WASTE MANAGEMENT PLAN

December 2024

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1. INTRODUCTION

The present Waste Management Plan (WMP) aims to provide actionable measures, procedures, and practices to be implemented towards waste management throughout the Luena-Saurimo Railway Construction. This railway construction is a vital component of Angola's Development Plan, prioritizing investment in transport infrastructure as a fundamental element for achieving sustainable development, enhancing regional connectivity, and stimulating local economic growth. Effective waste management is essential throughout the project lifecycle to mitigate environmental impacts, protect local natural ecosystems, and ensure adherence to both national and international environmental regulatory requirements. The implementation of waste management strategies is critical in preventing pollution and the degradation of natural habitats, thereby safeguarding the health and well-being of local communities.

Additionally, the waste management methodology presented in this document demonstrate compliance with relevant waste management regulations, namely the **Regulation on Waste Management** (Presidential Decree Nº. 190/12 of 24 August), **Executive Decree on Construction and Demolition Waste Management** (Executive Decree Nº. 17/13 of 22 January) and the **Strategic Plan for Urban Waste Management - PESGRU** (Presidential Decree No. 196/12 of 30 August). This comprehensive approach aligns with global best practices, demonstrating a commitment to responsible development that harmonizes economic growth with environmental stewardship.

2. OBJECTIVES OF THE MANAGEMENT PLAN

The overall objectives of the waste management plan are summarized below:

- Assessment, identification and quantification of waste to be generated and potential environmental impacts associated
- Ensure that waste handling and treatment/disposal procedures are compliant with Angolan legislation, with a priority on reuse and recycling
- Implement waste generation reduction and resource conservation measures
- Reduce or mitigate possible environmental and public health impacts resulting from waste generation

- Train all parties involved during the construction phase on sustainable waste management and environmental management practices.

3. SCOPE OF IMPLEMENTATION

The scope of implementation for the present Waste Management Plan encompasses all waste, both hazardous and non-hazardous, generated from activities during the construction phase of the Luena-Saurimo Railway Project, including waste from construction sites and all associated construction support facilities.

4. IDENTIFICATION OF THE INTERVENING ENTITIES

4.1. Project Owner

Details	Ministry of Transport – Luanda Railways (CFB)
Address	Avenida 4 de Fevereiro n.º 42, Luanda, Angola
Contacts	(+244) 222311303
E-mail	geral@mintrans.gov.ao
Representative	

4.2. Contractor

Details	OEC Engineering Consortium
Address	Condomínio Belas Business Park Torre Cabinda - 8º andar
Contacts	(+244) 222 67 8000
E-mail	antonio.lucas@oec-eng.com
Representative	António Lucas

4.3. Environmental Consultancy Entity

Details	Pantheroil, Oil and Gas Services
Address	Talatona Logistics Center, Office D07 Talatona – Luanda / Angola
Contacts	929 414 778
E-mail	geral@abp.co.ao
Representative	Kariana Gaspar – QHSA Manager kg@abp.co.ao

5. LEGAL FRAMEWORK

Angola's legislation on waste management reflects requirements and specifications designed to ensure effective waste management and protection of environmental and public health and are aligned with both national and international standards.

This Waste Management Plan has been meticulously prepared in accordance with the relevant legislation and includes:

- **Law Nº 111/2010 of January 30th – The Constitution of the Republic (CRA):** establishes the foundations for the structure and functioning of the country as a whole emphasizing respect for citizens' rights and freedoms. It defines the organization of the executive, legislative, and judicial powers, and promotes the protection of the environment and natural resources to ensure equitable and sustainable development
- **Law Nº. 5/98 of 19 June – Basic Law on the Environment (LBA):** fundamental guiding document that establishes the basic concepts and principles of protection, preservation and conservation of the environment, as well as the promotion of quality of life and the use of natural resources from a generational perspective
- **Presidential Decree Nº. 190/12 of August 24th – Waste Management Regulation:** establishes the general rules for management of hazardous and non-hazardous waste throughout the national territory indicating treatments and disposal methods accepted by the National Waste Agency and guidelines for waste operators licensing and operations
- **Executive Decree Nº. 17/13 of January 22nd – Management of Construction and Demolition Waste Regulation:** establishes the legal regime for managing waste resulting

from construction and demolition activities, emphasizing sustainable practices such as waste reduction and reuse as main alternatives

- **Presidential Decree Nº. 194/11 of July 7th – Regulation on Liability for Environmental Damage:** establishes liability for environmental risk and degradation by applying the polluter pays principle to prevent and remedy environmental damage caused by anthropogenic activities. This diploma states that the polluter is financially responsible, considering the extent and scope of their impact, and encompasses all costs associated with preventing, repairing, and mitigating environmental damage
- **Presidential Decree N. º 203/19 of July 7th – Landfill Legal Regime**: establishes the legal regime for landfills designated for waste disposal, aiming to reduce or mitigate the negative impacts associated with improper waste disposal, including soil and water pollution, greenhouse gas emissions, and the proliferation of diseases
- **Presidential Decree N. º 234/13 of July 18th – Legal Framework for the Elaboration of the Strategic Plan for Urban Waste Management (PESGRU):** establishes a framework aimed at enhancing the management of urban waste by mobilizing stakeholders including society, political leaders, and economic agents. It focuses on improving the efficiency of the waste management chain to achieve environmental sustainability in urban areas, addressing challenges such as waste reduction, recycling, and sustainable disposal practices
- **Presidential Decree Nº. 181/14 of July 28th – Organic Statute of the National Waste Agency (ANR):** It states that the ANR is a public body, endowed with legal personality, administrative, financial and patrimonial autonomy, created to ensure the implementation of the policy on Waste Management within the scope of the rules, regulations, as well as the supervision of the waste sector at national level
- **Presidential Decree 265/18 of November 15th – Waste Exportation Regulation:** establishes the rules and procedures for the operational and administrative control of waste shipments intended for reuse, recycling, and recovery outside the country, excluding hazardous waste from its applicability.

6. BASELINE

In Angola, the provincial government is usually responsible for assignment of urban cleaning services to waste operators. In provinces with high population density, the rapid growth in waste generation has significantly complicated waste management efforts, posing major challenges in

maintaining sanitation in Angola. According to estimates calculated by PESGRU, Angola generates roughly 4kg of waste per capita per day (inhab/day). In Luena the estimated waste generation is roughly 1kg/capita per day , which represents 40% of the nation's total waste production.

Moxico Province

In the Province of Moxico, the decentralization of fiscal management to Municipal Administrations has not resolved the inefficiencies in waste management. Contributing factors include the limited number of registered waste operators, insufficient collection equipment, and a lack of sustainable waste treatment/disposal alternatives. Based on information obtained from the municipal administration, waste treatment/disposal practices in the municipality currently involve the incineration of waste. This method has been adopted as a temporary measure due to the absence of a designated municipal landfill facility for waste disposal.

Projections from the Strategic Plan for Urban Waste Management (PESGRU) indicate a substantial increase in waste generation by 2025, with an anticipated per capita growth of approximately 76%. Consequently, per capita waste generation is expected to reach 0.44 kg/person in Moxico, leading to a significant rise in the total volume of waste produced (Source: MOSAIKO).

Locally, it is common to verify the collection of plastic waste such as PET bottles, which leads to economic opportunities for numerous families whether for resale or reuse (using bottles to resell juices or honey produced by local communities). In certain areas of the province, organic waste is utilized as a fertilizer, enhancing the fertility and overall production capacity of agricultural land. This practice is particularly beneficial for family farming, which represent a fundamental component of the region's economy.

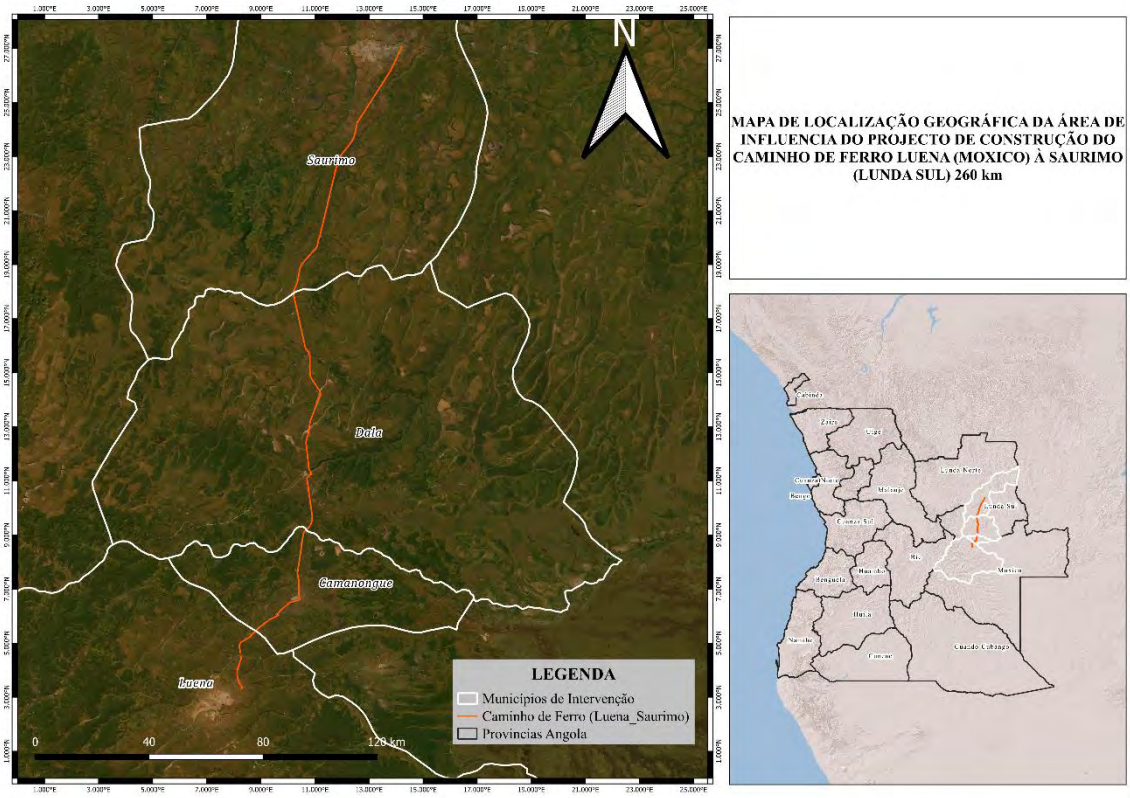
Lunda Sul Province

In Lunda Sul province, waste management is primarily conducted at the municipal level by the Municipal Basic Sanitation Department. Similar to the situation in Moxico, there is a limited number of authorized waste operators equipped with the necessary resources to effectively manage waste. Currently, waste is typically transported to an open-air dump site where it is incinerated. In Saurimo, there are environmental protection associations, including cooperatives and waste collectors, actively engaged in the collection of recyclable materials, particularly PET plastics. These collected recyclables are transported to Luanda for sale to recycling facilities.

7. PROJECT DESCRIPTION

The Luena-Saurimo railway construction project which will be over a distance of approximately 260 km, aims to establish a connection to the Benguela Railway (CFB). The project will adhere to both national and international engineering standards, with an anticipated service life of 100 years. The alignment will feature a single line with a 6.5 m wide platform and is designed to accommodate a maximum operational speed of 80 km/h for freight trains and 100 km/h for passenger trains. The railway will use a single-track platform constructed with 1,067 mm concrete sleepers. This significant infrastructure project is intended to enhance connectivity within the province of Moxico, traversing the municipalities of Moxico and Camanongue, and extending into the province of Lunda Sul through the municipalities of Dala and Saurimo.

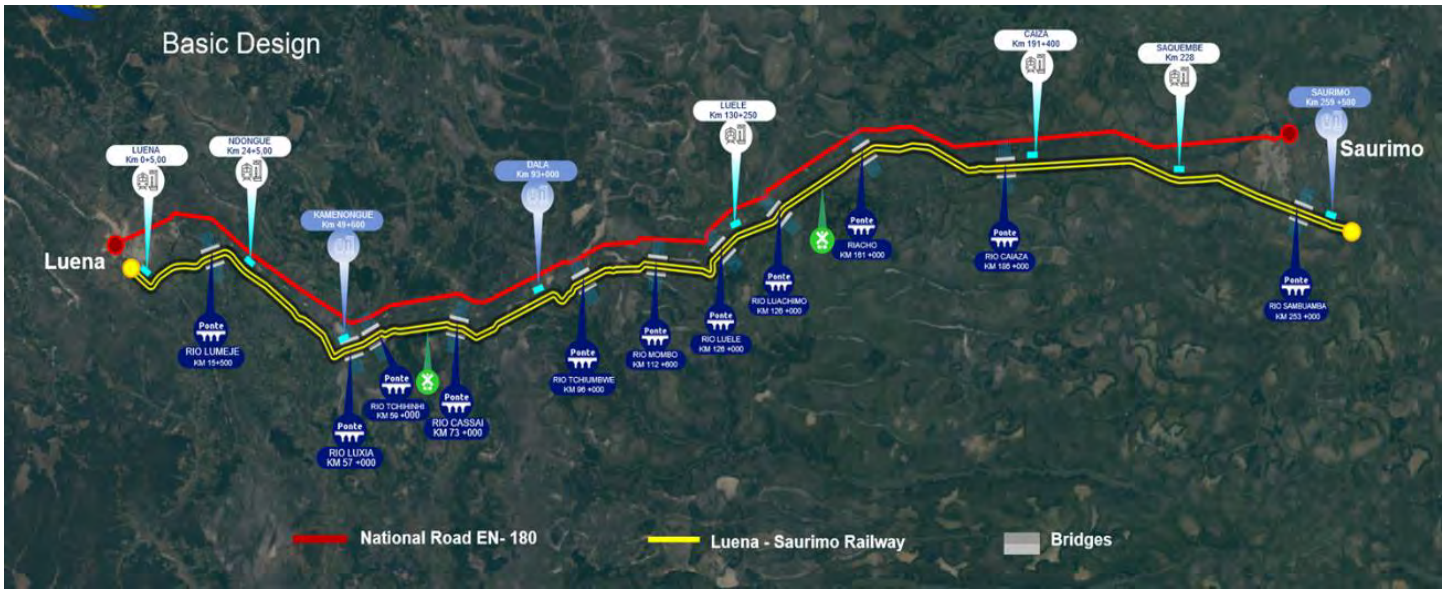
Figure 1. *Location of Project Area*



According to the Government of Angola, via the Ministry of Transport (MINTRANS), the Benguela Railway (CFB) serves as a critical railway corridor that facilitates connectivity between the coastal region and the interior of the country, extending from Benguela to Moxico. This railway enables the efficient transport of goods from the Port of Lobito inland. Consequently, extending the

railway network into the Lundas region is recognized as a strategic initiative to provide this area with a more dependable, safe, and competitive transportation system. This extension is intended to promote sustainable development in the region, enhance the transportation of mining resources, and support the objectives of PLANAGRÃO in the provinces of Moxico, Lunda Sul, and Cuando Cubango.

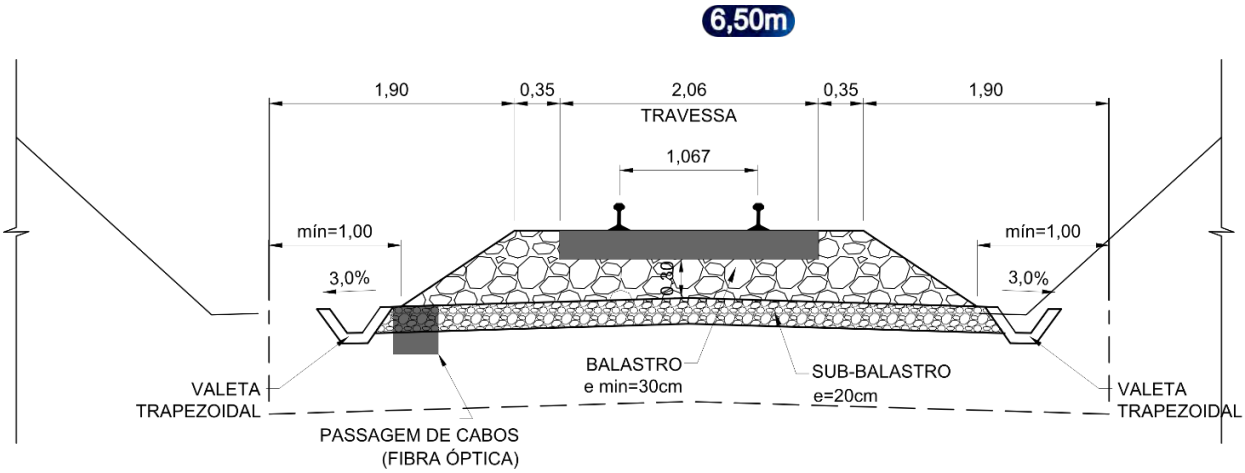
Figure 2. *Luena - Saurimo proposed Railway Design (Source OEC, 2024)*



The Luena-Saurimo railway line will be parallel to the existing EN250 route from Luena town until the alignment shifts northward across the Lumeje River. From this point, the alignment continues to run almost parallel to the existing EN180 road, before diverging in a northeasterly direction and concluding east of the Saurimo airport. The railway corridor will be divided into 11 sections whereby each section has its main facilities and infrastructure.

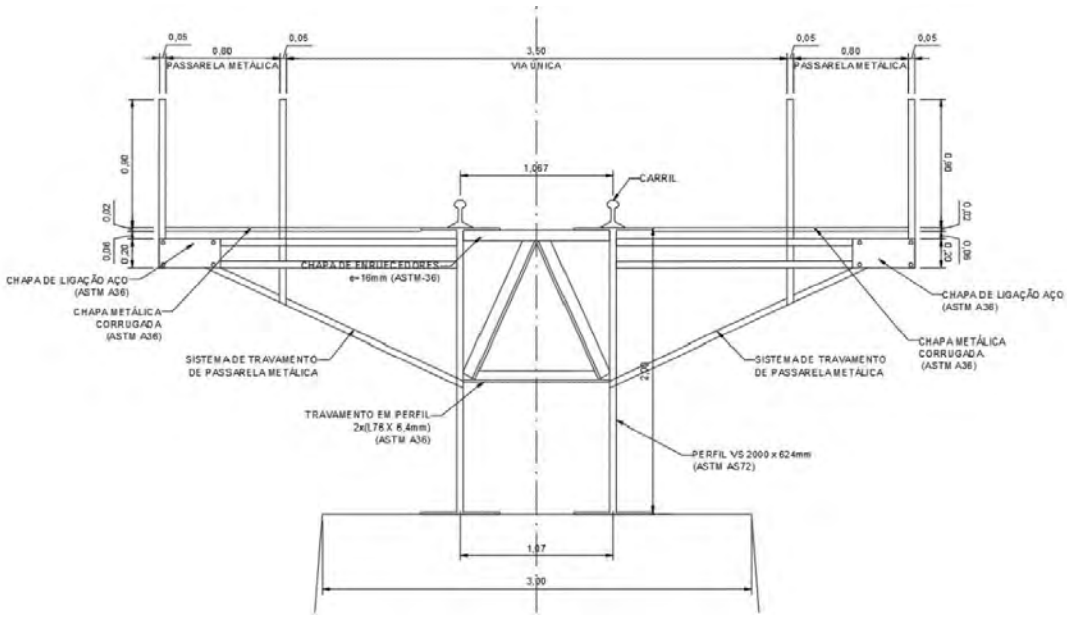
The Project foresees the construction of a total of 8 railway stations, namely: Station 1 – Surroundings of the City of Luena; Station 2 – Ndongue; Station 3 – Municipal Headquarters of Camanongue; Station 4 – Bíula community; Station 5 – Luele community; Station 6 – Caiaza community; Station 7 – Saquembue community and Station 8 –Saurimo City.

Figure 3. *General cross-section of the railway design (Source OEC, 2024)*



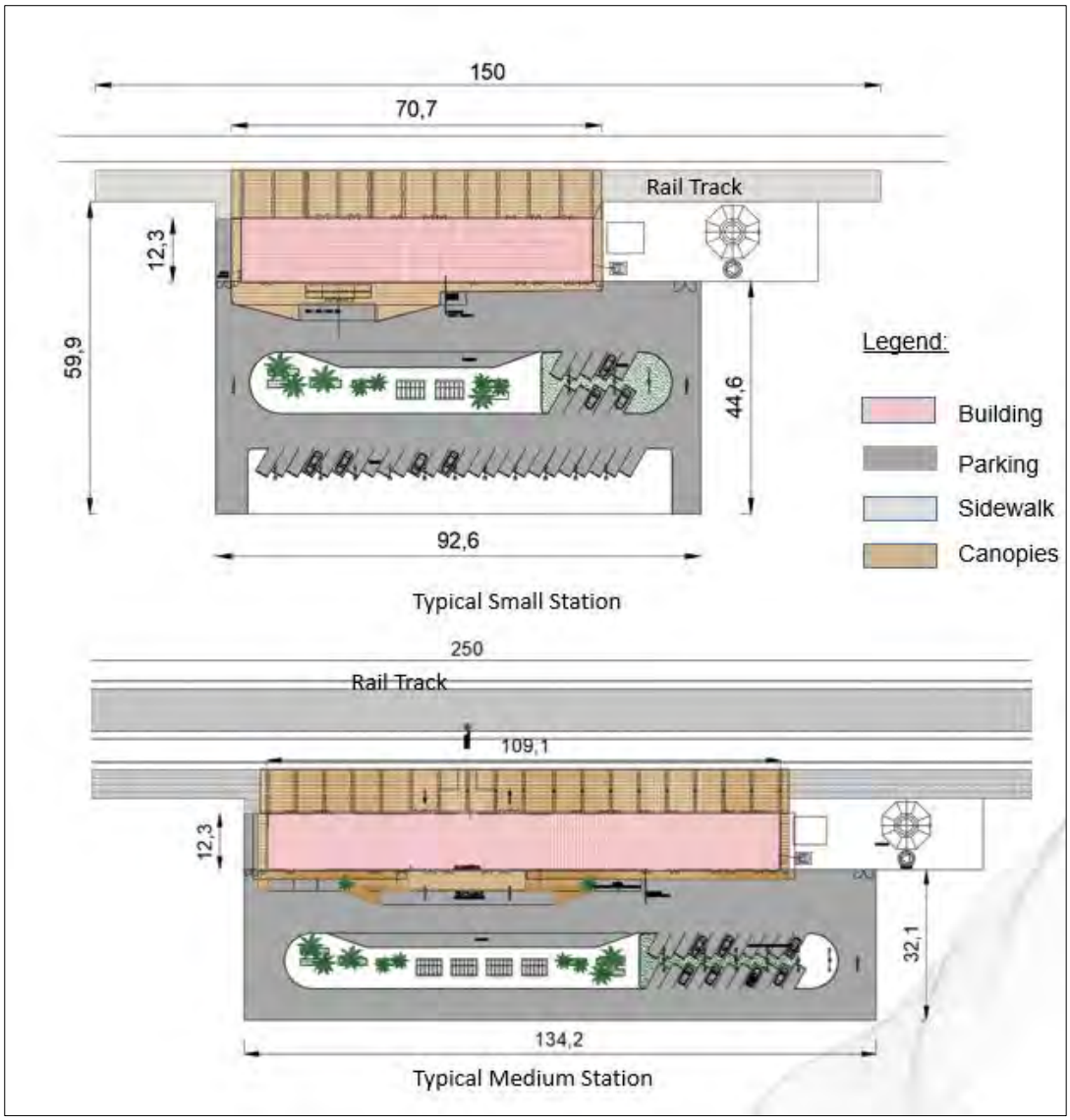
For the bridges, the load considered is maximum 26ton/shaft, total width at bridges is 5.10 m that includes 3.50 m finished single track and provision of 0.8m width side metal walkways for maintenance as illustrated below.

Figure 4. *General cross-section of bridge design (Source OEC, 2024)*



The general station layout includes a covered canopy between the railway track and platform to enter the station building. Smaller station layouts are considered for Ndongue, Camanongue, Luele, Caiaza and Saquembue. Dala and Saurimo stations will be bigger as seen in the medium size layout.

Figure 5. *Railway Station proposed Layout (Source*



The operational schedule for the Luena-Saurimo railway line includes the following:

- **Daily Operations:** Fuel transportation with return trips carrying various goods, with an estimated annual transport volume of 600,000 tons
- **Passenger Transport:** An anticipated 1,460 passenger trips annually, averaging four daily trips (two passenger and two cargo trains) between Luena and Saurimo. Worst-case daily train movement is yet to be confirmed
- **Cargo Transport:** Expected cargo includes aggregates, agricultural products, cement, and diesel, though specific volumes are currently undefined
- **Operating Hours:** The railway will operate during daytime only, with nighttime operations not yet confirmed.

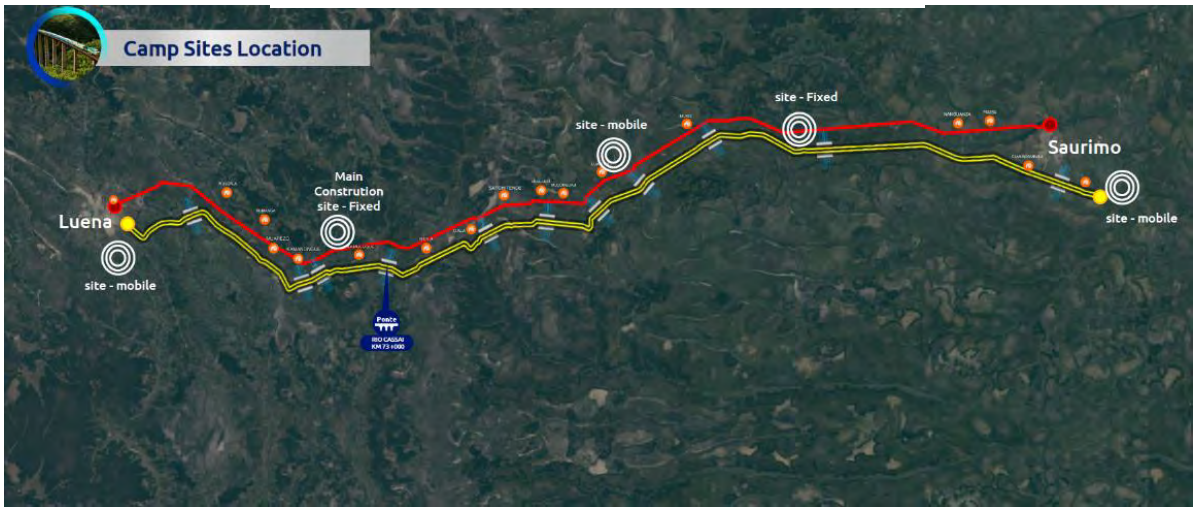
7.1. Construction Phase

The construction duration of the project is expected to take 60 months, and it is expected to have an operational lifespan of 100 years. The construction phase of the railway project will inevitably generate various types of waste due to activities such as vegetation removal, Implementation of fences and construction camp, earthworks (excavation, cut and fill, quarrying soils for embankments) , landscaping (crossing works, drainage works)Opening of new access roads, Soil compaction, Opening of septic tanks, Placement of signage, Electrical installations and communication systems, concrete production, Ballasting/gravel placement, Rail and sleeper assembly, Construction of stations (buildings), implementation of level crossings, Installation of sewage and drainage systems, construction of tanks for fuel and water storage, bridges over rivers and valleys, waste removal from the construction site.

7.2. Description of Construction Camp

The construction scope for the present project includes the establishment of a total of five construction camps. This comprises two main camps and three smaller, mobile, and temporary support sites. The main camps will be in Camanongue and Caiaza. The three small, temporary support sites will be situated in or near Luena, Luele, and Saurimo.

Figure 6. *Locations of camps along the Luena-Saurimo railway*



These construction camps will serve multiple purposes, including:

1. **Site Operations**: on-site construction activities, assembly and maintenance of equipment and machinery allocated to the project
2. **Material Storage**: storage of construction materials, tools, and other essential equipment
3. **Living Accommodations**: living bases for the accommodation of workers allocated to the project.

Table 1. *Locations and size of planned construction camps*

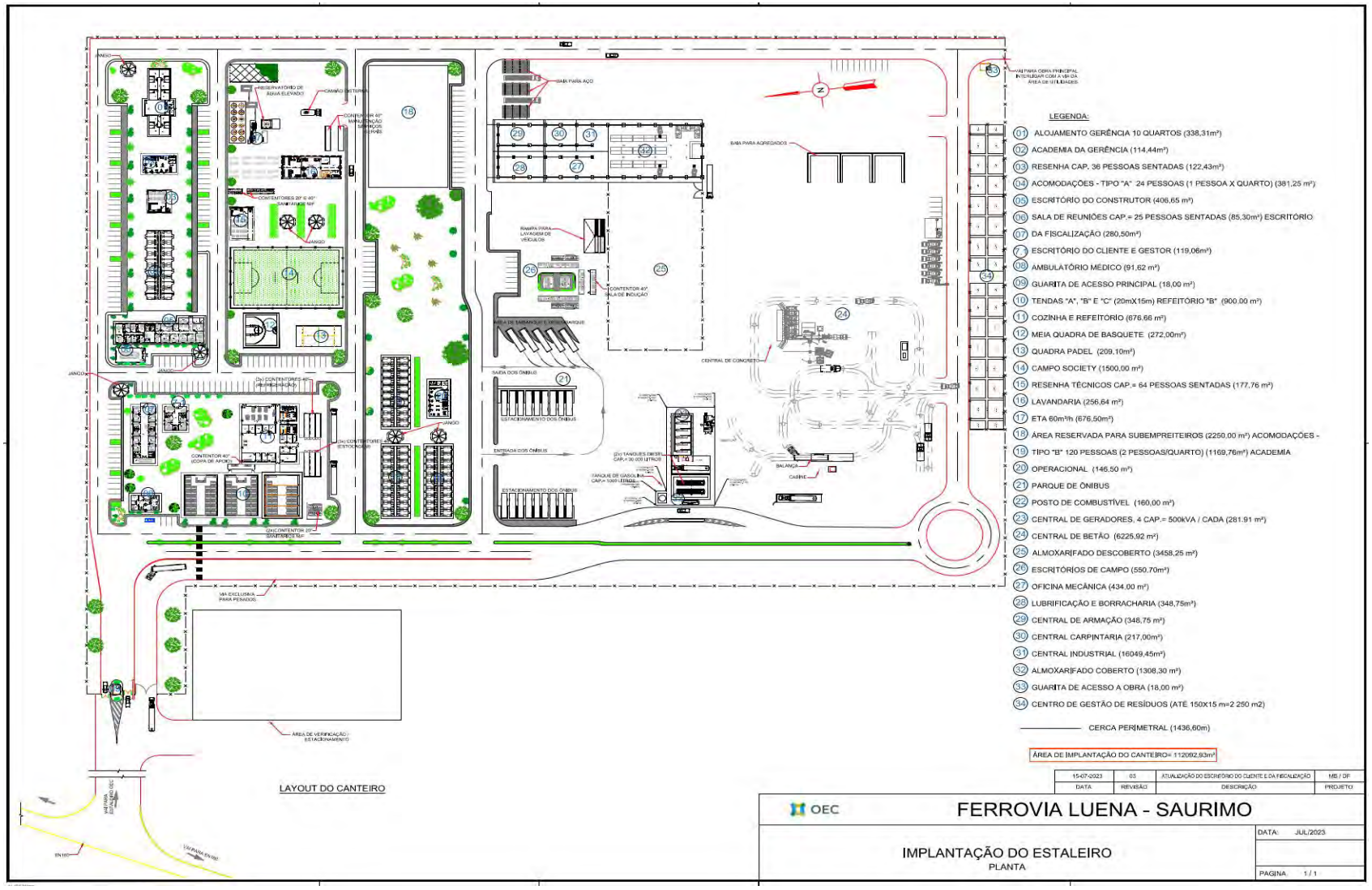
Chainage Location	Camp name	Description	Size (m^2)	No. staff on a typical day	Status of land – government/private
KM 0+500	Luena	Mobile	10,000	100	Government
KM 54+00	Camanongue	Main Camp – Fixed	60,000	750	Government
KM130+250	Luele	Mobile	10,000	150	Government
KM191+400	Caiaza	Main Camp – Fixed	30,000	300	Government
KM 259+500	Saurimo	Mobile	10,000	150	Government

All the construction camps will follow the same layout and will comprise of the following main areas:

- **Construction zone:** 2 Equipment and materials storage area; material loading and unloading area; generators area; fuel storage area (for supplying generators, vehicles and equipment); workshops (mechanical, carpentry, cutting, material assembly and welding work); heavy vehicle park; light vehicle park; bus park; Concrete plant; 4 administrative sections with offices (project owner section, project management team section, inspection team section and field team section); medical assistance area; waste management centre area; main access guardhouse and guardhouse for access to the work areas.

- **<u>Accommodations:</u>** 2 kitchens and cafeterias; laundry; 94 dormitories (34 single and 60 shared); 2 gyms; football field; paddle field and basketball field; 2 recreation areas (1 with 36-person capacity and 1 with 64-person capacity).

Figure 7. *Typical layout plan of the Main Camp*



All construction camps will be equipped to meet the necessary sanitary, safety, hygiene, and environmental standards, ensuring optimal conditions for operational activities. The construction camps will operate from 07:30 AM to 5:00 PM, Monday through Saturday, and the living bases will be designed to accommodate approximately 154 resident employees.

Safety measures will include the installation of fire-fighting equipment, such as CO_2 and chemical powder fire extinguishers, strategically positioned throughout the site. Additionally, safety signage and clearly marked emergency exits will be placed around the entire perimeter to enhance safety and facilitate efficient emergency response procedures.

The project will include the establishment of two new batching plants, each with a capacity of 90m³ per hour. Additionally, a sleeper production and storage facility are planned, with its location yet to be finalized. If installed, this facility will be situated in Dala, co-located with the quarry and a concrete batching plant. The facility will have the capacity to produce 20,000 units per month using the carousel methodology.

Table 2. *Locations and size of batching plants and sleeper production facilities*

Chainage Location	Plant/Facility	Description	Size (m²)	No. staff on a typical day	Status of land – government/private
KM54+000	Batching plant	Production of 90m3/hour	30,000	15	Government
KM 191+400	Batching Plant	Production 20,000m3/hour	30,000	15	Government
KM 994+00	Sleeper facilities with a Batching plant – Dala – to be defined further if it will be installed or not	20,000 units per month	30,000	20	Government

7.3. Resource Consumption

Water supply and use

It is critical, when considering the daily tasks that will be executed on construction sites, while ensuring the well-being of workers, to consider the water supply and use for this project. It is anticipated that during the construction phase the following water uses will be experienced:

- Human consumption
- Food preparation
- Sanitary use
- Material Mixture
- Washing equipment
- Dust suppression.

At least 36,300 m^3 of water will be needed during the construction phase (i.e. equivalent to 605m^3 per month over the 60-month planned construction period), and the water will be supplied from either existing boreholes or boreholes that will be drilled at the 5 camp sites. Water required at the quarries will be supplied from the existing boreholes. The water from the various boreholes will be filtered and distributed for the workforce in the field. For potable consumption, regular water quality analysis will be conducted to assure compliance with health and safety standards (national and international).

According to the World Health Organization (WHO, 2021), the recommended daily potable water consumption for sedentary adults under temperate environmental conditions is 2.2 liters for women and 2.9 liters for men. For physically active individuals and those exposed to high temperatures, the recommendation increases to 4.5 liters per day.

For the Luena-Saurimo Railway Construction Project, an estimated daily water consumption of 3 liters per person has been calculated, based on an average foreseen maximum workforce of 2000 employees. This projection results in a total estimated potable water consumption of 6,000 liters per day throughout the project execution phase.

Wastewater

During construction activities, wastewater is expected to be generated through daily activities, namely:

- Washing of Equipment, such as concrete mixers, trucks and others and vehicles
- Concrete mixture
- Sanitary facilities
- Wash basins
- Refectory.

To manage the generated wastewater, septic tanks with a capacity of 132,000 m^3 will be implemented. Furthermore, the project foresees wastewater collection and transport to a Wastewater Treatment Plant (WWTP) for additional treatment prior to its discharge into an authorized location. The authorization is to be provided by the Provincial government or municipalities.

Waste

During the construction phase, the primary sources of waste will include:

- **Construction waste:** This includes concrete, bricks, metal, wood, and other materials used in building the railway, stations and adjacent infrastructures essential to project implementation
- **Excavated soil:** Large volumes of soil will be excavated during the preparation of the railway route
- **Packaging materials:** Packaging of construction materials and equipment, such as plastics, cardboard, and wood pallets
- **Hazardous waste:** Potentially hazardous waste such as used oils, solvents, and chemical products (such as anticorrosive)
- **Urban Waste:** administrative activities and accommodations, such as paper/cardboard, plastic, and organic waste.

Operational Phase: Once operational, the railway line will generate waste through maintenance activities and day-to-day operations. Foreseen waste types include:

- **Routine maintenance waste:** This includes used components, used oils, and lubricants from machinery and equipment maintenance

- **Passenger and operational waste:** Waste generated from passenger services, such as food packaging, paper, and general urban waste
- **Track maintenance waste:** Materials resulting from track repairs and replacements, including metal, concrete, and ballast.

Electrical Energy

Energy consumption and efficiency in civil construction projects are significantly influenced by the scale and specificity of the project, as well as the equipment utilized during the construction phase. For the Luena-Saurimo Railway construction project, the energy supply for the construction sites will be sourced from the public electrical grid. Electricity for the construction phase will be provided from the National Grid for the stations and camps, including both fixed and mobile camps. The estimated electrical consumption for the construction phase of the project—encompassing the construction of tracks, stations, associated infrastructure, landscaping, earthworks, and drainage—is projected to be 137,200,350 kWh. Additionally, the total estimated amount of fuel required is 51,596,762 liters of diesel.

The design includes measures to ensure proper containment and to mitigate potential environmental spill risks associated with fuel storage, thereby adhering to environmental safety standards and promoting sustainability.

Atmospheric and Noise Emissions

Atmospheric emissions during the construction activities will result from the operation of light and heavy vehicles, machinery, and equipment, as well as the combustion of fossil fuels in generator sets and excavation activities. These operations are likely to release air pollutants, including carbon dioxide, nitrogen oxides, and particulate matter (PM2.5 and PM10). Additionally, noise emissions may arise from various on-site activities, including material loading and unloading, vehicle circulation and maneuvering, generator set operation, and the use of compaction machines. To reduce noise pollution, it is recommended to retain vegetation around the camps and where possible near communities to serve as a natural barrier on noise.

8. WASTE MANAGEMENT

Waste management can be understood as a set of techniques, actions and procedures that aim mainly to control the generation, storage, segregation, collection, transport, treatment and final destination of waste, in accordance with the best principles of preservation of public health and environmental resources.

8.1. Identification, Classification and Quantification of Waste

For this project, waste identification and classification will be limited to the following essential aspects:

- **Identification:** process of recognition of all waste generated during the construction of the railway and stations (hazardous or non-hazardous)
- **Classification:** categorization of identified waste types based on their physical and chemical characteristics, potential impacts, and regulatory requirements in order to allow proper separation, as well as handling and disposal in accordance with national and international environmental regulations
- **Quantification:** estimate of waste generation during the life cycle of the Project, assisting in decision-making for the different phases of the complete waste management chain.

The successful implementation of the aforementioned criteria is anticipated to be effective allowing a comprehensive assessment of the potential impacts associated with the waste generated from various activities of the Luena-Saurimo Railway Construction Project. In accordance with the Regulation of Waste Management in Angola, each waste category is assigned a specific codification, along with the respective treatment, disposal, or recovery alternatives as outlined in the Angolan Waste List (LAR) presented in Annexes II and III of Presidential Decree 190/12.

The table below provides an estimation of waste generation throughout the life cycle of the Project, along with the associated generation source:

Waste	LAR Code	Classification	Quantity (Kg)/month	Source Generation	Final Destination
Paint and varnish residues, containing organic solvents or other Hazardous substances	08 01 11 (*)	Hazardous	**To be estimated**	Conservation of wood and curbs, installation of signage and painting of metal structures	Incineration – D10
Paper and cardboard packaging	15 01 01	Non hazardous	**To be estimated**	Packaging of materials and administrative/office activities	Recycling – R5
Plastic Packaging	15 01 02	Non hazardous	**To be estimated**	Packaging of materials, foodstuffs, cleaning supplies and administrative work	Recycling – R5
Wooden packaging	15 01 03	Non hazardous	**To be estimated**	Packaging of materials; Railway Application & Sleeper Manufacturing	On-site re-use/ Landfill – D1
Packaging containing or contaminated with residues of hazardous substances	15 01 10 (*)	Hazardous	**To be estimated**	Application of chemicals for the conservation of curries and wood	Incineration – D10

Waste	LAR Code	Classification	Quantity (Kg)/month	Source Generation	Final Destination
Absorbents, filter materials, cleaning cloths and protective clothing, contaminated by hazardous substances	15 02 02 (*)	Hazardous	**To be estimated**	Maintenance of equipment and construction materials and Application of wall paintings	Incineration – D10
Mortar and Concrete	17 01 01	Non hazardous	**To be estimated**	Soil preparation, rail laying, foundation laying operations	Landfill – D1
Plastics	17 02 03	Non hazardous	**To be estimated**	Bottled water consumption, cable protection insulation and safety barriers, and office activities	Recycling – R5
Soils and rocks, containing hazardous substances	17 05 03 (*)	Hazardous	**To be estimated**	Spills during equipment/machinery refueling	Incineration – D10
Glass	17 02 02	Nno hazardous	**To be estimated**	Construction of structures, such as railway stations	Recycling - R5
Aluminium	17 04 02	Non hazardous	**To be estimated**	Laying of electrical and mechanical systems/cables	Incineration – D10
Iron and Steel	17 04 05	Non hazardous	**To be estimated**	Laying of Rails and Sleepers	Recycling – R5

Waste	LAR Code	Classification	Quantity (Kg)/month	Source Generation	Final Destination
Metal Mixture	17 04 07	Non hazardous	**To be estimated**	Laying the electrical cables	Recycling - R5
Tiles and Ceramic materials	17 01 03 (*)	Hazardous	**To be estimated**	Construction and equipping of planned railway stations	On-site re-use / Landfill – D1
Bituminous mixtures containing tar	17 03 01 (*)	Hazardous	**To be estimated**	Paving of the railway line	Incineration – D10
Septic tank sludge	20 03 04 (*)	Non hazardous	**To be estimated**	Sanitary facilities	Depuration - D2
Biodegradable waste	20 02 01	Non hazardous	**To be estimated**	Dining hall /kitchens	Landfill – D1
Ballast of railway lines containing hazardous substances	15 05 07 (*)	Hazardous	**To be estimated**	Laying of the Railway Line	Recovery

At this stage of the Project, the quantification of waste generation cannot be estimated as the necessary technical and operational details are not available. In order to develop reasonable estimative, detailed information is required on the project design and scope (including site layout and workforce numbers), the scale of construction activities (including volumes of earthworks, raw materials, and construction techniques), and the operational phase inputs and outputs (such as chemicals, fuels, lubricants, water, and energy), as well as planned maintenance activities and workforce accommodation arrangements.

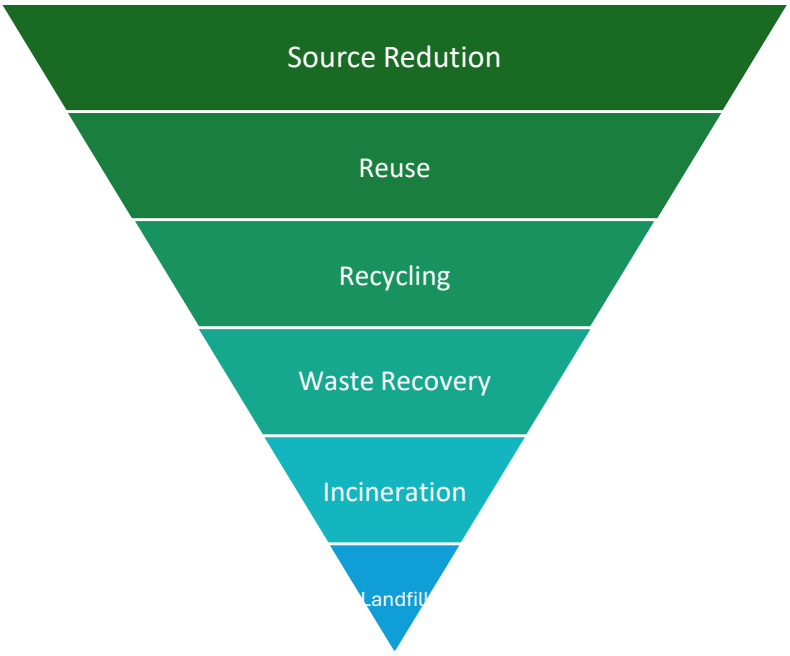
This plan assesses the range of waste management options considering project activities, infrastructure and national regulatory requirements. For each waste stream, it is indicated the most appropriate management method. Regarding hazardous waste, legislative indicated management option is mainly incineration by a licensed waste operator, ensuring treatment and/or disposal at approved facilities.

8.2. Waste Management Methodology

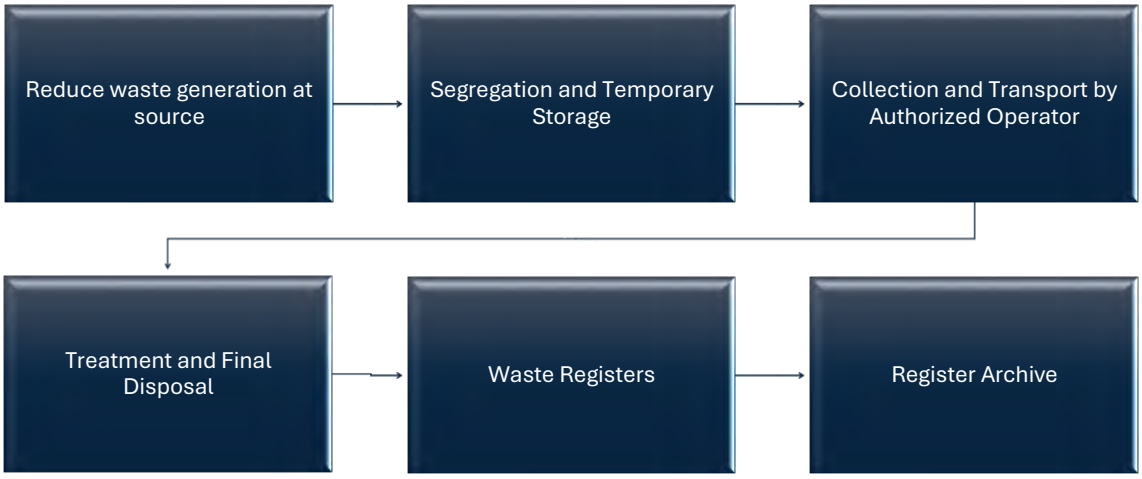
The establishment of clear references and targets is essential for guiding actions and policies in the pursuit of any objective. The UN 2030 Agenda for Sustainable Development serves as a comprehensive action plan aimed at promoting the welfare of people, the health of the planet, and the enhancement of global prosperity. Central to this agenda is the eradication of poverty in all its forms and dimensions, which is recognised as the foremost global challenge and a fundamental prerequisite for achieving sustainable development.

The methodology to be applied for this project is aligned to comply with both national and international legislation and is aligned with the 17 Sustainable Development Goals (SDGs) set forth by the United Nations. This will be achieved through the implementation of the waste hierarchy, which prioritizes waste prevention, reduction, reuse, recycling, and recovery, thereby ensuring the sustainable management of waste generated by the project. The integration of these principles will facilitate the promotion of environmentally sound practices and contribute to the overall sustainability objectives of the project.

Figure 8. *Waste management strategy*



In terms of methodology for Waste Management, it is expected that the following steps will be followed for the waste management chain or cycle:



a) Waste Generation at the source

Minimization and reduction of waste generation through accurate estimative strategies. This involves assessing and requesting only the necessary quantities of supplies while prioritizing the use of materials that can be recycled or reused to reduce packaging. By adopting such

practices, the project not only aims to reduce the environmental impact of waste but also promotes the principles of the circular economy through the implementation of the 7R´s policy:

1. Rethink: consider more sustainable alternatives, from the acquisition phase to the final disposal (use of returnable containers and packaging materials and avoid use of disposable materials)
2. Refuse: emphasizes the importance of refusing products that generate excessive or harmful waste (prioritize suppliers that use minimal packaging or provide sustainable materials)
3. Reduce: materials shall be ordered in bulk to reduce packaging
4. Repair: It involves the practice of repairing damaged products or items, rather than discarding them
5. Reuse: encourage the reuse of products and materials whenever possible, as a way to increase the useful life of waste (whenever possible metal, plastic, wood pallets, empty containers and concrete blocks will be reused for various site activities)
6. Recycle: It will consist of the selective collection of waste, separating recyclables for the subsequent transformation of these materials into new products
7. Reintegrate: refers to the process of reintroducing materials into the production chain.

b) Segregation and Temporary Storage

The segregation of waste must be conducted according to its origin, to ensure proper waste separation until collection by waste operator. However, for this waste management plan, segregation will be implemented in accordance with the provisions of the ISO 14001 Standard (Environmental Management System) based on the table below:

COLOR STANDARDS		Yellow	Metal		Brown	Organic waste
		Blue	Paper/cardboard (cardboard)		Black	Wood
		White	Ambulatory and Health Services Waste		Purple	Radioactive waste
		Grey	General Waste*		Green	Glass

		Orange	Plastic		Red	Dangerous

(*) not recyclable or mixed, or contaminated not separable.

c) Collection and Transport by Authorized Operator

The collection and transport of waste from temporary storage points to designated treatment facilities or final disposal sites must be conducted by operators duly authorized by the National Waste Agency (ANR). These operators are required to comply with regulatory guidelines, ensuring that all waste transport activities are documented, resulting in a detailed waste transport guides with information regarding the type, quantity, and characteristics of the collected waste, as well as the identities of both the generator and waste operator.

To ensure transparency and accountability, all waste documentation must be meticulously maintained and archived for a minimum period of five years by both parties.

During collection, the waste generator must ensure:

- Weighing of waste at the collection point
- Visual inspection to verify the compliance of the segregation process
- Mechanical or manual segregation whenever needed
- Supervision of the operation.

d) Waste Treatment

The treatment of waste generated from on-site activities must be sent to available treatment centers. At these facilities, the waste will undergo appropriate mechanical and biological processing, as necessary and feasible, to facilitate its reintegration into the production cycle and extend its useful life.

e) Waste Recovery and Disposal

The management of waste generated, including plastics, paint/chemical product cans, paper, and organics, involves forwarding materials to operators, companies, environmental protection associations, or individuals for proper treatment and recycling. Waste unsuitable for recovery will be sent to landfills or controlled dumps, ensuring environmentally correct disposal without compromising public health. The Project environmental management team is responsible for monitoring the entire waste management chain. This includes developing a supervision

procedure to oversee all activities and stakeholders involved in waste segregation, collection, treatment, and final disposal, in compliance with current legislation.

f) Waste Register

Waste transport operations to the treatment/disposal sites must be documented. A licensed waste operator holds the responsibility of the present waste transportation register and waste treatment/disposal certificate.

g) Waste Register Archive

Waste transport records must be archived for 5 years to allow waste cycle monitoring, internal and external audits, and the preparation of annual waste management reports for the Project. After treatment/disposal, the waste operator must present certificates to the waste generator.

This Waste Management Plan adopts a waste hierarchy consistent with IFC Performance Standard 3, prioritizing avoidance, reduction, recovery, reuse, and recycling prior to final disposal. Measures have been identified to minimize waste generation at the source and ensure compliance with the overall waste strategy. A licensed waste operator, authorized by the National Waste Agency, will be contacted to manage collection and to identify the most appropriate treatment or disposal methodology for each waste typology. In particular, the operator will be responsible for confirming the recyclability and reuse potential of materials and for ensuring that available treatment and recycling options are applied in line with the project's location and infrastructure. Final confirmation of recycling routes and treatment options will be provided upon formalization of the waste management services contract.

8.3. Temporary Waste storage sites

Temporary waste storage sites at the camps will be implemented to allow waste segregation, protection against rain, strong winds, and sun exposure. All waste generated by daily activities

at the construction sites will be sent to this site prior to being collected by waste operator and it will be waste generator responsibility to ensure waste segregation and proper storage.

Waste will be stored separately, according to their typology, for example:

- Recyclable or reusable waste, such as paper/cardboard, plastics, wood and metals
- Organic waste, such as food scraps
- Hazardous waste
- Construction and demolition waste.

The temporary waste storage must have all the technical features for proper storage of the waste, namely, retention basins, waterproof plastic bins, weather protection cover, waterproof pavement (concrete), spill emergency kits, as well as availability of firefighting equipment along the perimeter. The sites for temporary waste storage will comply with National and International Legislation, specifically Presidential Decree 190/12 of 24 August and ISO 14001 (SGA) for plastic bin color standardization and sustainable management. The preparation stages for the temporary waste storage sites are outlined below.

- **Setting the location:** It will consist of identifying a safe and easily accessible area for operators to collect waste. In addition, it should be a place with restrict access to authorized employees
- **Site preparation:** site preparation with paved floor, retention basins, coverage and ventilation
- **Placement of the waste bins:** the bins for waste segregation will be identified in accordance with national and international standards (Presidential Decree 190/12 of August 24th and ISO 14001 of the Environmental Management System): color and LAR codification, illustration/label of waste typology
- **Signage and Safety:** Identification of waste category/typology and national codification (LAR codes) on the bins, waste handling and PPE instructions, hazardous waste signs, restricted access and non-smoking signs placed within the perimeter, as well as firefighting signs and means.

9. RECOMMENDATIONS

Waste management is structured around an integrated policy comprising several key pillars: source generation reduction, waste reuse, recycling, waste recovery (including energy incineration and composting) and landfill (energy and waste). These measures aim to create a sustainable and effective waste management system of which the components can be summarized as:

Environmental Management

- Provide training for employees on environmental and waste management (highlight to waste segregation and handling)
- Conduct internal audits during the construction phase, to identify gaps on waste management chain
- Promote internal environmental campaigns to reinforce the implementation of the fulfillment of the Sustainable Development Goals and national waste legislation
- The client through a Corporate Social Responsibility (CSR) investment initiate and an engineered waste management facility or facilities to international standards that will be used during the project and be handed over to the local authorities for further operations once the operational phase of the project commences.

Urban Waste

- Integrate generated waste into the recycling/reuse system to reintroduce it back into the production chain
- Ensure the waste collection the Project Sustainability team supervises system.
- Avoid the use of unnecessary products and purchase only reusable or recyclable materials
- Due to the size and activity flow of the Project, collect generated waste daily to prevent the release of odors from organic waste decomposition
- Assess the possibility of providing recyclable or reusable solid waste to non-governmental organizations or factories dedicated to recycling and reuse
- Identify local cooperatives/farmers dedicated to the collection of waste for the composting process.

Construction Waste

- Significantly reduce the production of construction waste (resulting from stations construction activities) and whenever it is produced, it should always be reused in the containment of ravines or earthworks of access roads
- Cut trees only in necessary areas and pack leaves and bushes in recommended containers for reuse as sedimentation barriers on hillsides to control erosion and promote soil recovery
- Ferrous or metallic waste must be stored and packaged correctly and sent to recycling or reuse facilities.

Water Efficiency

- Implementation of efficient water consumption mechanisms and practices, such as timed taps in cafeteria and toilets, spray guns for hoses
- Provide awareness to employees on efficient water use
- Regularly inspect and repair leaks in water supply systems

Wastewater and Liquid Effluents

- Regular collection of wastewaters from construction site toilets. Ensure that these collections are stored in designated septic tank within the construction camp. This practice will prevent overflow and maintain sanitary conditions on site
- Regular inspections and monitor to septic tanks, toilets and cafeteria to identify leaks or overflow.

Waste Registers

Conducting waste registers verifications is an essential practice to understand the environmental performance of the project, quantity and origin of the waste generated, as a way to assist in decision-making and significantly reduce waste generation. This allows the project management team to develop effective waste management strategies.

It is recommended to assign a project team member responsible for a waste database for waste tracking, thus allowing better control of the waste management process and waste registers archive. This database should include primarily the following information:

- Types of waste generated
- Source and Quantity of waste
- Waste collection and site waste inspection dates
- Treatment/Final disposal quantity and respective certificates.

The waste operator is responsible for providing a waste management procedure (listing the available treatments/disposal alternatives to each waste typology) and additionally the following registers:

- **Waste Transport Register:** identification of the waste generator, identification of the transport waste operator, the number of the register, quantity of waste, the identification in accordance with Presidential Decree 190/12 of 24 August and both signatures of waste operator responsible for the waste collection and waste generator responsible for the collection supervision.
- **Waste treatment/disposal certificate:** identification of waste, treatment/disposal site, the number of the register, indication of treatment/disposal.

The database to be developed should be continuously updated and is limited to providing an efficient and up-to-date monthly and annual report.

9.1. Firefighting Equipment

Providing effective firefighting equipment is crucial for mitigating potential hazards and minimizing material and human damage. This comprehensive approach encompasses a range of resources, including trained personnel in emergency response and advanced equipment such as fire brigade teams, specialized brigades, tanker trucks, fire blankets, and fire extinguishers (CO_2 and ABC Chemical Powder). All project infrastructure and on-site facilities will be equipped with appropriate firefighting means. This includes the installation of fire extinguishers, fire blankets, emergency signaling and an emergency plan with clear signage. Regular and periodic training sessions conducted by certified Hygiene, Health, and Safety at Work specialists will ensure that all employees, both directly and indirectly involved in the project, are proficient in firefighting procedures.

A critical aspect of firefighting preparedness is the guaranteed accessibility of water for emergency response. To achieve this, the following measures will be implemented:

- Establish strategic water supply points throughout the construction site. These points will be connected to a reliable source of water, such as a municipal water supply or dedicated water storage tanks, ensuring immediate availability during emergencies

- Availability of water tanker trucks equipped with high-capacity pumps to provide a mobile and flexible water supply solution. These trucks will be stationed at key locations and will be readily available to support firefighting efforts in areas where water supply points are not accessible
- Conduct regular simulations to ensure that all personnel are familiar with the locations and operation of water supply points. These drills will help identify any potential issues and ensure that the water accessibility measures are effective.

9.2. Waste Monitoring Program

During the construction phase, the Project Management team or site supervision is responsible for ensuring compliance with waste management regulations. These recommendations will be integrated into project specifications and verified through:

- **Waste Identification and Quantification:**

  Identify types of waste and hazardous products prior to collection by licensed operators and quantify waste by type, origin, and activity.
- **Site Inspection and Monitoring:**

  Conduct regular inspections on all construction sites and construction camp to ensure adherence to waste reduction and segregation measures.
- **Training:**

  Provide training on waste management and environmental management.
- **Improvement Recommendations:**

  Suggest improvements for the collection, transport, and disposal of waste and wastewater. Monitor waste operators to ensure recovery and final disposal of waste.
- **Continuous Improvement:**

  Continuously evaluate activities, monitor waste production, ensure compliance with environmental legislation, and apply corrective and preventive measures to optimize waste management costs for ongoing improvement.

The Waste Management Process must define all the necessary requirements for the waste collection and transport process to comply with the environmental and health and safety recommendations of the technicians involved in the waste handling process.

PPE	Characteristics	Illustration
Boots	The boots must be made of leather with a steel toe cap for protection against the risk of falling materials, equipment, accessories or heavy objects on the feet, waterproof, resistant, preferably in black and non-slip soles.	
Gloves	Gloves made of cotton knit with latex rubber bath on the palm, resistant and non-slip. Protection of the user's hands against scraping, cutting and drilling.	
Helmet	Helmet to protect the head against sun rays and other objects, with a neck protector between 20 to 30 cm.	
Raincoat	Raincoat made of PVC-lined fabric, protection of employees on rainy days.	
Uniform	Based on the uniforms already used, the model must be long pants and a shirt with short sleeves, made of resistant fabric and of a specific color for the use of the service employee, in order to identify him according to his function. The uniform must also contain some reflective stripes, in the case of night collection.	

10. CONCLUSION

With the motivation and intention of contributing to socio-economic development, increasing production and fighting poverty in the local communities of the Project Intervention Provinces and in view of the current environmental challenges that are imposed in Waste Management, it is imperative that sustainable methods and mechanisms are defined so that waste management is done in a sustainable way.

According to Presidential Decree No. 194/12 of August 24, 2012, the activity in question is likely to generate waste for the planned activities, which makes it subject to the obligation to present a Waste Management Plan (PGR). Notwithstanding this issue, on the part of the financing entity, it also led to the need to prepare this Waste Management Plan.

Throughout this Waste Management Plan, clear strategies were outlined to reduce the amount of waste generated at the source, reuse and recycling measures, treatment and final disposal of waste, thus showing the importance of minimizing the impacts resulting from waste and the rationalization of available natural resources by integrating sustainable practices into the operational process, stimulating the circular economy and sustainable development.

However, at the end of the preparation and implementation, as well as the strict monitoring of this Waste Management Plan, it is expected that the parties involved during the different phases of the Project will be fulfilled. In addition, by applying continuous improvement, the Project's commitment to emerging environmental issues is demonstrated for a more sustainable future for present and future generations.

11. ANNEX

ANNEX I - Project Land Plot Authorization and Construction Camp Land Plot Authorization

ANNEX II - OEC company documents

ANNEX III – Firefighting Training Certificate

ANNEX IV – Environmental consultancy company documents

ANNEX V – Contract with authorized waste operator

SUSTAINABILITY
Policy

OEC

SUMMARY

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1. PURPOSE

This Policy has the purpose of establishing environmental, social and governance (ESG) references for us to act with sustainability. It defines the basic concepts that guide us, as well as our commitments, indicators, roles, and responsibilities in this area.

2. SUSTAINABILITY IN OEC

Sustainability is the term that summarizes the set of conditions and practices that lead to development capable of meeting the needs of the current generation, without compromising the ability to meet the needs of future generations. It is development that does not deplete resources for the future.

At OEC, the term sustainable applies to the services we provide and resources we use, from which should result goods that are durable and useful to society over time.

Acting for the benefit of society and promoting sustainable development are two of the fundamental values that guide **Our Culture**, serving and meeting the objectives of our clients and shareholders. Surviving, Growing, and Perpetuating presupposes that we are responsible for the right to life of future generations, assuring them better conditions than those we received from the generations that preceded us.

The management of environmental, social and governance issues is necessary for the long-term success of any business, as evidenced in the premises, goals and drivers of the **Novonor Group's ESG Positioning**, it affects our ability to contribute to sustainable development and it guides this Policy and the other guiding documentation that derives from it.

Thus, our practice must go beyond the duty to comply with the laws and determinations that regulate our activities, requiring an understanding of society's trends and priorities and attention to the conventions and commitments applicable in the locations where we operate, as well as requiring us to ensure that we adequately manage the **social and environmental risks** inherent in our operations.

Our Culture:
Our Culture reflects the principles, concepts and criteria that focused on education and work, underpin our actions at any time and place. It is perceived and practiced in the day-to-day operations, in the actions of each member, in the interactions between teams and with all related parties. Our Culture unites us, inspires us, and guides our future.
See more:
https://novonor.com/pt/a-novonor/nossa-cultura

Novonor Group's ESG Positioning
We are part of a global group, Brazilian in origin and inspired by the future, which conducts its business in a way that contributes to building a more sustainable world. Get to know the premises, goals and drivers of our ESG performance in:
https://novonor.com/pt/visao-de-futuro/posicionamento-esg

Socio-environmental Risk:
The effect of uncertainty in the achievement of objectives in which the occurrence of failures or accidents in operations or structures under our responsibility may result in impacts to the environment, people or communities in areas under our influence.

Acting with sustainability, therefore, means knowing and acting with priority in relation to our **material issues**, evaluating the results of the practice guided by this Policy - the effects of our actions that extend to our members, the supply chain, the communities around us, clients, users and beneficiaries of the products and services we deliver, and society in general.

Based on these considerations, and combining innovation as a driving factor for sustainable development, we expand the benefits we generate for the society we serve. In this way, we strengthen our competitiveness and facilitate the acquisition of new business, generating tangible and intangible results that sustain our recognition and create value for society and for the brand of OEC and its controlled companies.

Materiality:
Gathers the most relevant themes for sustainability management, on which we dedicate even more effort so that the identification of risks and opportunities leads to an efficient and safe action that favors the creation of value.
OEC material issues, defined from the vision and perspectives of the company and our stakeholders, relate directly or indirectly to our ability to create or preserve value, as well as, to the risk that our operations may cause negative impacts.
Learn about the OEC's material themes: *https://www.oec-eng.com/pt-br/sustentabilidade*

Stakeholders:
These are clients, shareholders, members, subcontracted workers, users, partners, creditors, suppliers, external partners, service providers, surrounding communities, authorities, the media, opinion formers, business leaders, class entities, third sector entities, governments, regulatory, and financial agents that can affect or be affected, directly or indirectly, by the activities of OEC and its controlled companies.

3. OUR COMMITMENTS

Our commitments with sustainability refer to the priorities and goals we have assumed in our **Action Programs** Programs and guide our way of acting and contributing to sustainable development.

The achievement of these results presupposes the adoption of objective conducts and a responsible and diligent performance, especially regarding risk management, aiming at generating positive impact and controlling or mitigating possible negative impacts on our operations.

Action Program:
At OEC, the work is planned, agreed, monitored and evaluated based on the Action Program (AP). In the AP, premises applied to all members make it easier for people and teams to build strategies to transform objectives and goals into results.

3.1. CONTRIBUTE TO THE DEVELOPMENT

Our contribution to sustainable development occurs from the services we provide, where our actions reinforce each other and provide a balance of positive results for our **stakeholders**, today and in the future.

At OEC, we operate committed to:

Ethics, integrity and transparency – For us, acting with ethics, integrity and transparency is an indispensable requirement for sustainability, as demonstrated by the alignment of this Policy with our **Integrity Policy and the Commitment to Acting Ethically with Integrity and Transparency** expressed in our **Code of Conduct.**

People – We promote sustainable development with an emphasis on people as they are the agents of transformation who can foster the most appropriate sustainable development model in each environment where we operate. People, their lives and physical integrity are our fundamental value. Thus, we assume the non-negotiable duty of creating safe, healthy, motivating work and living environments, promoting engagement and recognizing the results of our members, producing spaces that value diversity, free of discrimination, with respect for human rights and the differences between people, in line with our **Policies on People and on Diversity and Inclusion**, where safe and respectful relationships with those who live, work or attend the areas influenced by our activities are also guaranteed.

Economic development – We contribute to development by delivering useful products and services to society, generating tangible and intangible results for clients, shareholders, financiers, suppliers, members, subcontractors and communities, through the consequent collection of taxes and duties, through the technical qualification of our segments of activity and through respect for the competitive environment.

Social development – We extend benefits to the communities in our areas of influence, harmonizing the achievement of economic and social results by:

- Promoting local productive social inclusion by generating decent work and income opportunities for people in the communities where we operate, contributing to the reduction of vulnerabilities and facilitating better living conditions;
- Engaging, training, and developing the local and regional workforce, suppliers, and service providers;
- Promoting human development and citizen inclusion, especially through private social investments in education;
- Valuing, respecting and preserving the history, culture, customs and habits that distinguish the nations and communities in which we are inserted, and
- Conducting with respect and empathy the relationship with minority populations and ethnic, social, racial, and any other groups focus on diversity and inclusion agendas.

Environment – We make decisions about the services we provide considering the **life cycles** of our engineering solutions, the rational use of natural resources, the use of cleaner technologies, the need to combat climate change, the promotion of the circular economy with priority waste reduction and reuse, the improvement of environmental quality, and the protection of ecosystems and biodiversity.

Aware that the challenges of sustainability require partnerships and collective commitments, our actions are geared towards contributing to achieving the targets set by the United Nations Sustainable Development Goals (SDGs).

Life cycle of a solution, project or service:

Consists of the period during which we take stock of the potential aspects and impacts (positive and negative) related to our commitments to sustainability. This may range from the procurement of raw materials to the completion of the production process, or from the conception of a project or service to its full implementation, through use, reuse, and operation, to its final disposal or end of service life.

3.2. CONTROL AND MITIGATE RISKS AND IMPACTS

We identify, assess, prevent, mitigate and take responsibility for the consequences of risks and possible negative impacts generated in our operations, in compliance with applicable laws and in alignment with internationally recognized best practices.[1]

In all operations, we pursue the diligent practice of our Integrated Sustainability Program, which brings together the plans, procedures and controls that are aimed at the timely identification of hazards and the assessment of risks to people's health and safety, as well as the identification of aspects and assessment of impacts that may be imposed on the surrounding communities and on the environment.

We monitor the impacts on our operations, including those generated by our business partners, suppliers and service providers, influencing that our chain conducts its activities in alignment with the requirements of this Policy.

Thus, in keeping with our material themes, we pay special attention to:

- People health and safety risk management - As a topic of utmost materiality for OEC, it is the absolute obligation of all workers to look after their health and safety, and the health and safety of all people involved in or influenced by operations. At OEC, we preserve healthy and safe environments that apply engineering to prevent accidents, and we act with discipline so that any deviations, hazards, and risks are timely identified and corrected, and so that their communication is never omitted, allowing the adoption of all necessary measures to protect and preserve human life, in all situations.

[1] *The International Finance Corporation (IFC) Performance Standards, the basis of assessment adopted in the Equator Principles, are considered one of the main references for the practices to be adopted in OEC operations.*

- Human Rights Risk Management - We consider, but are not limited to:
  - Respecting and valuing diversity, in line with the **OEC's Diversity and Inclusion Policy**, promoting opportunities for all people, without distinction and based on strategies that favor equity;
  - Guaranteeing decent and dignified working conditions for all people, ensuring due diligence in combating illegal outsourcing, human trafficking, slave and child labor in all its forms, and the sexual exploitation of children and adolescents, combating any and all types of harassment and discrimination in relations, and ensuring the right to privacy.

- Risk management in the interface with the communities surrounding our operations - We observe the singularities of each local context, identifying and maintaining a transparent dialogue with stakeholders, through appropriate and accessible channels for consultation and communication. We guarantee the respect and protection of habits, culture, and historical heritage, with special attention to relationships with traditional populations.

- Environmental risk management - We guide our actions to avoid impacts and risks when possible, or mitigate them when unavoidable, adopting solutions that favor, in particular, the reduction or reuse of solid waste, the rational use of water, the preservation of biodiversity and environmental services, and the management of greenhouse gas emissions in line with decarbonization goals and commitments.

4. PERFORMANCE

We demonstrate the results of the practice of this Policy with timeliness and transparency, revealing the results related to the commitments we have undertaken in accordance with international sustainability reporting standards.

Thus, the targets and performance indicators defined and integrated into the cycle of the OEC Chief Executive Officer Action Program[2], seek to encourage the continuous improvement that we impose on our sustainability practice, taking into account the evolution of the risks and opportunities of the ESG agenda in our portfolio, the materiality of our themes, and the commitments made by the company.

[2] *At OEC, the Chief Executive Officer (CEO) is referred to as LN-OEC.*

5. ROLES AND RESPONSIBILITIES

It is up to the:

OEC Chief Executive Officer (LN-OEC):

- To ensure the implementation of this Policy within the scope of OEC and its controlled companies, and to monitor the evolution of sustainability performance practices and results in operations;
- To keep the OEC's Board of Directors (CA-OEC) informed about our sustainability performance and the evolution of the results measured by the operations indicators, disclosing this performance to the business stakeholders, and
- To propose to the CA-OEC changes to this Policy in order to keep it permanently updated as to commitments and the evolution of sustainability.

Chief Sustainability Officer (RAE[3] ESG):

- Support the LN-OEC and other leaders in updating and practicing this Policy;
- Propose specific strategies on sustainability performance in OEC;
- Support the LN-OEC and other leaders in the identification and management of socio-environmental and health and safety risks;
- Propose indicators and monitor their evolution to broaden and consolidate sustainability results within the OEC;
- Ensure transparent and consistent communication of these results in the Annual Reports, and
- Consolidate the OEC's influence of good sustainability practices in its segment.

OEC Members:

Act responsibly and in accordance with the commitments of this Policy, as agents of transformation for sustainable development, aware that understanding the meaning of sustainability in each environment and the results consolidated in this field contribute directly to the recognition of the company by society.

[3] *At OEC, the chief officers who are responsible for thematic areas (e.g., legal, finance, people and planning, communication and marketing, ESG, institutional relations) are referred to as RAE's.*

6. SCOPE

The OEC S.A. Sustainability Policy applies to all its members and its controlled companies, serving as a reference for its subcontracted companies.
Additionally, it serves as a guideline to its representatives in consortiums and other forms of association, so that the instructions set out here are adopted in these environments, while nevertheless promoting the necessary additions and guidelines to suit the interests of the other members.
Any activities or services shared by OEC and/or its controlled companies with other companies of the Novonor Group shall always comply with the Corporate Policies and other Guiding Documents of OEC, and limitations shall be established as to the responsibility of OEC and/or its controlled companies.

7. SCIENCE AND CERTIFICATION

This Sustainability Policy should be widely communicated and made available on the OEC Portal, and also published on the website for the free access of all publics.
Additionally, the managers appointed by OEC in non-controlled companies should be aware of this Policy for evaluation and possible application of similar orientation following the respective governance of these companies.

This Policy must be presented in the integration training sessions for new members, and periodically disclosed to ensure its full dissemination.

8. GENERAL PROVISIONS

If there are any questions about the content of this Policy, the member should seek clarification from his/her direct leader or, if necessary, from the OEC Sustainability Officer.

CONTROL INFORMATION

References: Novonor Group ESG Positioning, OEC Policy on People, OEC Diversity and Inclusion Policy, OEC Integrity Policy and OEC Code of Conduct.

Approval Date: 19/05/2023

Validity: This Policy will come into effect on the date of its publication and will remain in effect until expressly revised or revoked, and must be revalidated at most every 3 (three) years, and may be changed at any time.

Document Version: 3

Version	Date	Change
1	26/04/2018	Initial Issue.
2	10/06/2019	Corporate name change and format adaptation according to OEC's rebranding
3	19/05/2023	Periodic review and update and adjustments for consideration of Novonor Group's ESG Positioning

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EMERGENCY PREPAREDNESS & RESPONSE MANAGEMENT PLAN

DECEMBER 2024

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1. INTRODUCTION

The Emergency Preparedness and Response Plan for the "Luena-Saurimo" Railway Construction Project is a strategic document designed to identify, guide, and manage risks, ensuring the safety and well-being of employees and the proper functioning of project facilities. This plan outlines the necessary equipment, resources, procedures, and recommendations to be implemented in the event of serious accidents, catastrophes, or natural disasters during the project's execution.

The plan is designed according to the specific characteristics of the railway project, including its geographical location, access routes, and the nature of the construction activities, particularly the railway stations. It involves a risk assessment process and identification of potential accident scenarios at construction sites and high-risk areas. The document emphasizes the importance of efficient communication, legal compliance, and awareness of existing risks to minimize the impact of any emergencies.

2. PURPOSE

The purpose of this Emergency Preparedness and Response Management Plan is to establish the measures to address emergencies effectively. The general objectives include:

- Identify and list the possible emergency scenarios arising from the activities to be carried out during Project implementation and present effective responses
- Provide contact information for local emergency services, including emergency response management team contacts, Civil Protection and Fire Services, National Police and nearby medical facilities, in accessible locations
- Stablish an effective communication system whenever necessary (construction sites, construction camps and external entities)
- Provide training of employees in emergency preparedness and response and conduct emergency drills
- Establish procedures for the correct use of emergency response equipment, from firefighting equipment and first aid kits

- Describe the roles and/or responsibilities of emergency response teams;
- Comply with national and international legislation, as well as international agreements and other legal documents related to emergency response.

The Project management team and all involved parties must collaborate to achieve the Plan's objectives and mitigate potential risks associated with the project's activities.

3. LEGAL REQUIREMNTS

Compliance with national and international legislation, as well as adherence to International Standards for Safety and Hygiene at Work and within Communities, is critical to ensuring a healthy and safe work environment and sustaining the Project over time. The emergency procedures and measures outlined in this plan adhere to the following legal regulations:

OCCUPATIONAL HEALTH AND SAFETY LAWS		
Legal Document	**Applicable Legislation**	**Summary**
General Labor Law	Law Nº 12/23 of December 27th 2023	This regulation governs the conditions of safety, health, and hygiene in the workplace, stablishing the requirements and standards for the conduct of work activities and the obligations and responsibilities of both employees and employers to ensure a safe and healthy work environment.
General Regulation of Occupational Safety and Health Services	Executive Decree Nº 6/96 of February 2nd 1996	This regulation establishes the principles designed to promote safety, hygiene, and health in the workplace within companies, commercial and industrial establishments, and cooperatives.

Legal Regime of Occupational Accidents and Diseases	Decree Nº 53/05 of August 15th 2005	This regulation approves the legal framework for work-related accidents and occupational diseases. It defines these as incidents occurring during the course of employment within a company or institution that result in bodily injury to the worker, leading to partial or total, temporary or permanent incapacity to work, or resulting in death.
Regulation on the Legal Regime of Fire Safety in Buildings	Presidential Decree Nº 195/11 of June 8th 2011	Establishes the legal regime for fire safety in buildings/infrastructures.
National Health Policy	Presidential Decree Nº 262/10 of November 24th 2010	This regulation approves a series of programs aimed at enhancing health services nationwide, recognizing the right to health and well-being as a fundamental right for all Angolans.
Organic Regulation of the Civil Protection and Fire Service	Presidential Decree Nº 185/17 of August 11th	Establishes the competences of the Civil Protection and Fire Services in different sectors, specifically in emergency response
Regulation on the Procedure for Reporting the Occurrence of Spills	Executive Decree Nº. 11/05 of January 12th	Defines the standardization of the procedures for reporting the occurrence of spills to be provided

This Emergency Preparedness and Response Management Plan incorporates international standards and agreements on Health, Safety and Hygiene at Work and in the Communities, namely:

- **IFC Standards**:
  a) Performance Standard 1: assessment and management of socio-environmental risks and impacts related to the Project's activities

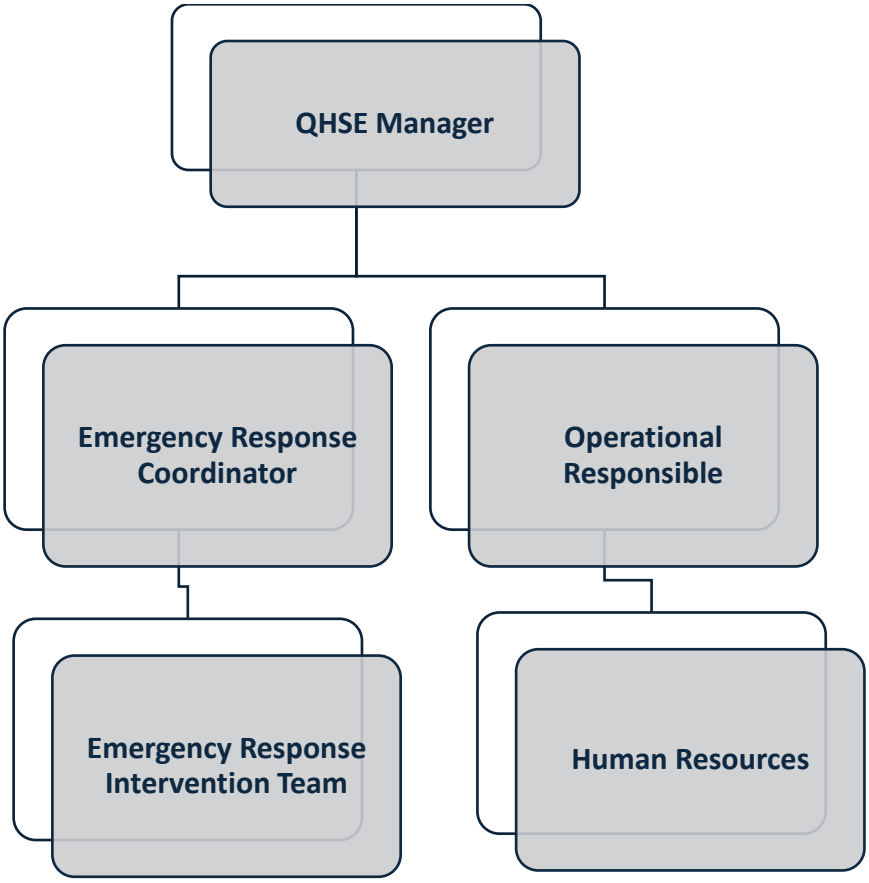
b) Performance Standard 2: addresses the employment and working conditions for the proper execution of the work inherent to the Project; and

c) Performance Standard 4: on the health and safety of communities near the Project's implementation area.

- **The Equator Principle (July 2020):** incorporates a set of voluntary guidelines for financial institutions seeking to integrate environmental and social considerations into their lending and financing processes, aligning with the UN Sustainable Development Goals (SDGs) and the Paris Agreement on climate change. This Plan supports the achievement of the SDGs through Project construction phase
- **Occupational Safety and Health Promotional Framework Convention, 2006**: considered as Convention Nº 187 of the International Labor Organization and held in Geneva, it stipulates the guidelines to be adopted by the signatory countries regarding the promotion of safety and health at work, promoting continuous improvement to prevent occupational injuries and diseases. This Plan adheres to these guidelines, aiming to reduce workplace risks and enhance safety for all.

4. ORGANIZATIONAL STRUCTURE FOR EMERGENCY PREPAREDNESS AND RESPONSE

The primary objective of the Project is to protect the health, safety, and well-being of all workers and surrounding communities. The Project Management team has the responsibility to oversee project execution, ensure compliance with health, safety, and environmental regulations, and maintain continuous supervision of employees, as a means of keeping them safe in matters of health, safety and well-being. Therefore, this plan foresees the following organizational structure for the Emergency Preparedness and Response team:



4.1 RESPONSIBILITIES OF THE INTERVENING PARTIES

This Emergency Preparedness and Response Plan (EPRP) was developed for the Luena – Saurimo Project specific project activities and must be communicated to all relevant parties. In addition to having employees with specific responsibilities for emergency preparedness and response, it is also essential that employees in general have risk-based awareness in order to avoid accidents and other emergency situations during the period of execution of the Project.

- **QHSE Manager:**

- **Emergency Response Coordinator:**

- **Emergency Response Intervention Team:**

- **Operational Responsible:**

- **Human Resources :**

5. EMERGENCY PREPAREDNESS AND RESPONSE MANAGEMENT PLAN

This Emergency Preparedness and Response Management Plan is designed to evaluate scenarios arising from the construction activities of the Luena-Saurimo Project that have the potential to cause physical harm or property damage. Additionally, it delineates the responsibilities of stakeholders, outlines emergency procedures, specifies the locations and plans for support sites, provides emergency contact information, and includes lists of trained rescuers, first-response resources, and planned drill exercises.

Based on this, the following specific measures will be implemented in this chapter to ensure efficient and prompt management in the event of an emergency during project activities:

- Creation of a multidisciplinary team for emergency response preparedness
- Continuously identify the risks inherent to the different construction activities, as well as in the Project's support facilities
- Apply preventive and corrective measures to address accidents and other emergencies
- Develop a training program for employees and other parties directly or indirectly affected on how to prevent and act in case of emergencies

- Establish partnerships with public and private bodies to act in case of emergencies, namely, the Provincial Civil Protection and Fire Services, National Police and nearby hospital units
- Develop and make felt in practice a set of operations and/or actions to respond to specific emergency situations in the Project
- Maintain in perfect operational conditions all the means and equipment necessary for use in case of emergencies.

The development and adherence to an emergency management plan offers significant benefits, including the optimization of time and costs associated with evacuation and victim assistance, as well as the creation of a safer working environment for all allocated workers.

5.1 IDENTIFICATION OF POTENTIAL EMERGENCY SCENARIOS

In general, the probability of emergencies occurrences in addition to the common risks typically associated with railway and infrastructure construction activities, indicate risks unique to projects of this scale and complexity. It is crucial to identify these specific risks and establish appropriate response methodologies in the event of an incident/accident.

The table below presents the identified risks associated with on-site construction work for the Luena-Saurimo Railway Project:

Risk	Location	Risk Exposure
Fire	Support facilities	Users of offices and project support facilities
	Build fronts	Workers allocated to construction sites
Running Over	Support facilities	Construction camp workers
	Build fronts	Workers allocated to the project and people who circulate nearby
Crush	Support facilities	Workers allocated to construction sites
	Build fronts	Workers allocated to construction sites
	Build t facilities	Construction camp workers

Rollover	Build fronts	Machine and vehicle operators
Falls from Heights	Support facilities	Workers who circulate on the construction sites
	Build fronts	Workers allocated to construction sites
Drops from top-level objects	Build Fronts	Workers allocated to construction sites
Collapse of structures	Build Fronts	Workers allocated to construction sites
Electrocution	Support facilities	Construction camp workers
	Build fronts	Workers allocated to construction sites
Explosion of flammable materials	Support facilities	Construction camp workers
	Build fronts	Workers allocated to construction sites
Burial	Build fronts	Workers allocated to construction sites
Release of toxic gases	Support facilities	Construction camp workers
Extreme weather conditions	Build fronts	Workers allocated to construction sites
Chemical Spills	Support facilities	Construction camp workers
	Build fronts	Workers allocated to construction sites

5.2 EMERGENCY PREPAREDNESS AND RESPONSE PROCEDURES

A brief description of the potential risks identified beforehand is essential to ensure workplace safety, comply with national and international safety regulations, and support adherence to the project's contractual deadlines. Consequently, the procedures for addressing each of the identified risks are detailed below:

Response Preparation Procedure in the Fire:

During the induction of new employees, fire response procedures must be presented to ensure that they understand and follow the correct protocols in the event of a fire. Additional information will be provided by their supervisor/ responsible or an Occupational Health and Safety Technician.

All employees, including subcontractors, as well as visitors, are required to adhere to the following procedures in the event of a fire:

- Remain calm
- If the infrastructure is equipped with a fire alarm, activate it immediately
- If trained, use firefighting equipment to prevent the spread of the fire
- If the fire cannot be extinguished within one minute despite your efforts, notify your manager or contact the emergency response team
- Keep doors and windows closed to contain the fire
- In the event of an evacuation, the intervention team should guide all personnel to the designated assembly point
- Remove combustible materials from the vicinity of the fire if necessary.

Response Preparation Procedure in the event of a hit-and-run and rollover

Accidents and collisions may involve vehicles or pedestrians during the transportation of materials to construction fronts or sites via public or project access roads. In accordance with the Traffic Management Plan, this document outlines safety measures for motor vehicles and provides protocols for addressing and mitigating damages in the event of accidents involving project vehicles.

In the event of a vehicle accident, collision, or pedestrian incident (whether related to the Project or not), the following procedures will be followed:

- Provide safety training for machine and vehicle operators
- Conduct safety training for all workers involved in the Project
- Offer safety training for the local communities near the Project area
- Conduct regular emergency drills to prepare both drivers and pedestrians
- After a collision, assess the situation for any injuries and determine the severity of those injuries
- Immediately shut off any machinery or vehicles involved in the collision
- Ensure all project-assigned vehicles and machinery are equipped with first aid kits and fire extinguishers

- Notify the site manager, transport manager, occupational safety team, or local health authorities
- Administer first aid to the injured until emergency responders arrive
- Move the injured person only if absolutely necessary to prevent imminent danger.

Response Preparation Procedure in Case of Crushing or Notching

The preparation and implementation of response procedures for crushing or entrapment incidents are essential during site activities for the Project. These procedures aim to ensure worker safety and minimize the impact of such incidents. The following actions outline the response protocols to be followed in the event of such situations:

- Personal Protective Equipment (PPE) must be worn by all personnel assigned to site and construction activities
- Notify supervisors (occupational safety officers and technicians) or public emergency services (fire services or national police) immediately
- Provide training for personnel working in high-risk areas
- Ensure rescue tools and equipment, such as hydraulic jacks and levers, are readily accessible
- Isolate the accident area using safety tape and traffic cones to prevent unauthorized access
- Conduct a thorough investigation of the incident to determine the root causes and implement corrective measures.

Response Preparation Procedure in case of falls from height/upper level

Work-at-height activities are common in civil construction projects and are a leading cause of serious accidents, including fatalities. Effective management of these activities is crucial to ensure the safety of all personnel on site. The following action guide provides protocols for preventing accidents and efficiently responding to potential incidents:

- Conduct proper inspections and ensure that a work permit is issued by the Occupational Health and Safety team

- Provide specialized training for operators that work at height, and ensure all employees receive first aid intervention training
- Enforce the mandatory and correct use of Personal Protective Equipment (PPE), specifically for work at height, including harnesses, lifelines, helmets, and safety boots
- Ensure the mandatory installation and use of Engineering Protective Controls (EPCs) such as safety nets, guardrails, and barriers in elevated areas
- Prior to approaching the victim in the event of an accident, confirm that the area is secure
- Assess the severity of the victim's injuries; provide first aid using first aid kits for minor injuries
- Notify relevant supervisory personnel, including the site manager and the Occupational Health and Safety team
- Suspend work activities in the affected area to prevent further incidents
- Investigate the accident to identify the underlying causes and implement corrective measures.

Response Preparation Procedure in case of collapse of structures

Collapses of structures, such as scaffolding, or incidents involving the discharge of materials like iron or metals during railway construction activities and at railway stations, are recurrent. Therefore, measures must be implemented to address and manage these incidents effectively:

- Enforce the mandatory use of Personal Protective Equipment (PPE), including helmets, safety boots, and high-visibility vests
- Ensure that rescue equipment is maintained in good condition and is readily accessible for use in emergencies
- Assess the severity of injuries sustained by the victim and administer first aid as appropriate
- Conduct ongoing training and emergency drills for all employees
- Employ appropriate techniques and tools to safely rescue workers trapped under debris, when feasible

- Notify relevant hierarchical managers, as well as civil protection and fire brigade services.

Response Preparation Procedure in case of Electrocution

Electrical accidents are prevalent in workplaces. For the construction of the Luena-Saurimo railway, it is anticipated that site activities will involve equipment that operates on electrical power. During the execution of the Project, certain practices may lead to incidents such as electrocution. In such cases, the response should be as follows:

- Safely disconnect the main power source or main switch of the electrical system
- Ensure the electrical current has been completely cut off before touching the victim
- If de-energizing the power source is not possible, use an insulated tool, such as a broom with a dry wooden handle, to move the victim away from the source of the electrical shock
- Notify the foreman, Occupational Health and Safety technicians, and public emergency response services immediately
- The first responder at the scene should assess the victim's responsiveness and administer first aid as appropriate
- Conduct an investigation into the incident, prepare a detailed report, and develop an action plan with corrective and preventive measures to prevent future occurrences.

Response Preparation Procedure the explosion of flammable products

For the construction of the Luena-Saurimo railway section, the use of flammable substances, including diesel, gasoline, and various gases, will be required. Small and medium quantities of fuel will be stored in tanks at construction sites and transported to construction fronts using tanker trucks. Fuel storage locations will be equipped with Fuel Spill Kits to manage any spills or leaks in compliance with legal requirements. In the event of a fuel spill, the following measures should be taken:

- Identify and clearly mark areas where flammable products are stored or used

- Provide training for personnel on preventive measures and response procedures for fuel spills
- Ensure that all spill containment facilities at fuel storage sites are properly maintained
- Install firefighting equipment, including fire extinguishers and fire blankets, at fuel storage locations
- Verify that no ignition sources are present near fuel storage areas
- Administer first aid to any injured individuals and, in the event of serious injuries, transport them to the nearest hospital
- Evacuate service areas immediately and proceed to the designated emergency assembly point, typically located outdoors
- Notify foremen, site managers, and the Occupational Health and Safety Department
- Once the fire is fully controlled, secure and mark the affected area until a thorough investigation is conducted by the responsible authorities.

Response procedure in case of burials

Burials are serious accidents and often occur on construction sites, particularly in excavations, earthworks or during the construction of tunnels and railway lines. The following are the measures to remedy the occurrences:

- Train all employees in safe excavation practices, including identifying signs of soil instability and emergency procedures
- Conduct drills of burial emergencies to prepare staff for a quick and effective response
- Provide Personal Protective Equipment (PPE) according to the specificity of the work to be carried out
- Keep rescue equipment such as shovels, rigs, excavators and first aid kits in easily accessible locations
- Carefully move the victim in case of extreme need
- Properly signal the danger at the site to prevent people from approaching

- Communicate to those responsible for construction and Health and safety at work
- Proceed with the investigation of the incident and prepare the report with the corrective measures.

Response procedure in case of release of toxic gases

Exposure to toxic gases in places such as construction camps and construction sites can result in serious risks to the health and lives of employees. Below is a set of measures to respond to possible emergencies in the event of the release of toxic gases:

- Identify all toxic gases that may be present in workplaces, including their potential sources
- Carry out risk assessment on construction sites and on construction sites
- Gas detection systems must be installed on construction sites and construction sites to continuously monitor the presence of toxic gases
- Use of Personal Protective Equipment, such as face masks and waterproof clothing
- Keep first aid and rescue kits, such as oxygen cylinders, readily available
- If possible, provide first aid to victims
- In case of evacuation, they should follow the instructions of the team in charge and go to the meeting point.

Response procedure in case of extreme weather conditions

Weather conditions, including torrential rains, strong winds, fog, intense heat, extreme cold, and other potential natural disasters, must be managed throughout the execution of the Project to ensure the safety of all personnel. Specific measures to prevent incidents and procedures to follow in the event of such conditions should be integrated into all Project activities:

- The weather conditions (daily) must be observed through the media, in order to alert employees, in particular the drivers assigned to the Project

- The Project Management Unit and the Occupational Health and Safety team will follow up on the meteorological services through the official website or credible pages
- Whenever occurrences of extreme weather conditions are verified and reported, they must be temporarily interrupted (until the work on site of the Project is exceeded)
- Where necessary, evacuation teams should evacuate personnel to safe areas
- All employees must remain in areas considered safe until further notice
- Employees will receive training on how to act in case of extreme weather conditions on the work fronts.

Response Procedure in Case of Chemical Spills

Prevention is the best way to avoid accidents involving chemicals and operating personnel. The storage of products in the appropriate places, the signaling or labeling of the hazardousness of the product are some of the prevention measures that can be implemented. However, in case of emergency involving chemical spills, it is necessary to:

- Avoid direct contact with the spilled chemical
- Communicate to the project manager responsible for the construction site, Occupational Health and Safety technician
- Identify the type of chemical spilled (see the technical sheet with the precautions to be taken)
- Demarcate the area with insulating tape and signposts
- If the risk of explosion or fire is verified, all ignition sources must be switched off
- If the situation cannot be controlled, contact competent bodies such as the fire department, for example.

6. COMMUNICATION SYSTEM

The development of a communication system that is efficient and functional, allowing the fluidity of information between the different departments and between employees assigned to the Project is extremely important for the proper execution of the Project's work, as well as to maintain a safe workplace without serious incidents.

Internal Communication

In the event of an accident or emergency case, the employee must notify the person in charge of the work, in case the event is on the construction front, in the case of one of the Project's support facilities, it must be communicated to the person in charge of the site or facilities and this in turn communicates to the Occupational Health and Safety department, using the means available on site (mobile phone or radio transmitter).

Then, only after the victim/employee has been referred to the nearest hospital unit, should the Occupational Health and Safety department prepare the work accident report to the Insurer within the stipulated period (X - hours), this record should be sent to the Project Management Unit, the Human Resources department, to those in charge of the construction sites and those responsible for the support sites.

In the event of an accident or emergency, the affected employee must immediately notify the supervisor QHSE technician if the incident occurs on the construction site. If the incident occurs at one of the Project's support facilities, it must be reported to the facility or site manager, who will then inform the Occupational Health and Safety Department using available communication methods (e.g., mobile phone or radio).

Subsequently, once the victim or employee has been transported to the nearest hospital, the Occupational Health and Safety Department is responsible for preparing the accident report and submitting it to the insurer within the specified timeframe. This report must also be forwarded to the Project Management Unit, the Human Resources Department, the construction site managers, and the managers of the support facilities.

External Communication

Mobile telephones will be available on-site at all times during Project activities. Each telephone will have a directory of emergency contacts for use in the event of an accident.

Throughout the Project, a communication system will be established using either radio or mobile phones to facilitate effective and efficient coordination among personnel responsible for different work fronts and construction sites. This system will ensure the prompt mobilization of necessary resources in case of an emergency.

In the event of significant incidents such as fires, floods, or explosions, the evacuation of all employees and other individuals present on-site must be authorized by the Construction Director. The evacuation will be conducted by the designated evacuation team, with support from the Fire Brigade, National Police, and health authorities.

6.1 EMERGENCY CONTACTS

The Project will partner with the following external emergency services in the vicinity of the construction camps and on the construction sites to ensure that the Emergency Preparedness and Response Plan can be fully implemented and that emergency responses are sufficiently fast, thus avoiding material damage and loss of human life:

- Civil Protection and Fire Services
- Health Facilities in the Project area (general hospitals and health posts)
- Medical emergencies for evacuations
- Public Security and Tranquility Institutions (National Police)
- National Demining Institute/Eastern Regional Directorate.

General Emergency Contacts	
Civil Protection and Fire Service	115
National Police	113
Project Representative	+ 244
OEC Representative, Engineering and Construction	+ 244
Representative of Bento Pedroso Construções	+ 244
Project Security	+ 244
Representation of the Inspection Company	+ 244
National Demining Institute (East Directorate)	+ 244

Emergency Medical Services	+ 244
Accident Insurance Bell	+ 244
Project Emergency Contacts	
Director of Works	+ 244
Shipyard Manager	+ 244
Occupational Health and Safety Manager	+ 244
Hygiene and Safety Technician	+ 244
1st Intervention Teams	+ 244
Evacuation Teams	+ 244
Surveillance Team	+ 244
Emergency Response Medical Care Facilities	
Moxico Province General Hospital	+ 244
Lunda-Sul Province General Hospital	+ 244
Luena Municipal Hospital	+ 244
Kamanongue Municipal Hospital	+ 244
Dala Municipal Hospital	+ 244
Saurimo Municipal Hospital	+ 244
Sagrada Esperança Clinic - Saurimo	+ 244
Sagrada Esperança Clinic – Luena	+ 244

6.2 COMMUNICATION BETWEEN THE PARTIES

Effective communication between the Responsible Teams and employees is crucial for the efficiency of the Emergency Response and Preparedness Plan, ensuring a comprehensive response to potential incidents involving operators. The Project Management team, along with the Health and Safety team, should continuously implement training programs and conduct briefing sessions to reinforce safety and emergency response procedures for all employees directly and indirectly involved in the Project.

It is recommended that work teams on construction sites be organized into pairs or small groups. This structure ensures that, in the event of an incident, first aid can be administered promptly and communication with responsible personnel and Health and Safety technicians is immediate.

6.3 COMMUNICATING WITH NEARBY COMMUNITIES

Ensuring the safety of nearby communities is a critical responsibility of the Project Management team, as the railway route passes through areas inhabited by these communities. While most incident scenarios outlined in this document do not directly involve community members, there may be situations where community engagement and cooperation are necessary to manage emergencies. Additionally, the involvement or support of local residents may be required for the safe operation of vehicles and machinery related to the Project.

It is essential to conduct training and informational sessions within the communities on safety measures for crossing access roads and the Project's emergency preparedness and response procedures. Engagement with traditional authorities, community leaders, and religious leaders during these training activities is recommended to ensure that safety information is disseminated effectively across all community levels.

7. MEANS OF RAPID INTERVENTION

All equipment or materials that can be used immediately to address possible emergency situations arising from any activity are considered means of first intervention. Based on the identification of potential emergency scenarios, the following equipment/materials can be observed as the available means of rapid intervention which, therefore, will be incorporated into the work fronts and shipyards:

- **Fire Extinguishers:** offices, means of transport (in particular fuel tanker trucks), generator areas, fuel and other chemical product storage areas, will be equipped with ABC Chemical Powder extinguishers and CO2 extinguishers and duly identified with reflective signs (allowing visibility in case of absence of

light). It is important to emphasize that these should always be checked for prompt use in case of fire and placed in easily accessible places

- **Fire hydrants:** It is planned that the shipyards will have hydrants, connected to the water supply system of the facilities, through the main storage tank as a way to ensure the uninterrupted supply of the hydrants.

- **First Kits:** The construction sites, the construction fronts and the light and heavy vehicles will be equipped with first aid kit boxes with all the materials, namely, adhesives of different sizes, scissors, tweezers, thermometer, gauze, antiseptic (hydrogen peroxide) or alcohol gel, latex gloves (disposable), compresses, betadine, ethyl alcohol, scissors, face masks and analgesic. Meanwhile, the first aid boxes will be placed in places that are easily accessible to those in need

8. EMERGENCY RESPONSE TEAMS

The main objectives of the emergency intervention teams are to respond quickly and efficiently to different situations, depending on the type of accident.

For the present Construction Project of the Luena-Saurimo Railway, three security teams will be set up, namely:

- 1st Intervention Team;
- Evacuation Team;
- Surveillance Team.

Below are the main functions of each of the teams to ensure that each of the teams performs their duties effectively, thus allowing greater safety of employees in the event of an emergency.

8.1 1ST INTERVENTION TEAMS

The functions of the 1st intervention team are the following:

- Conduct the actions to attack the accident with the most appropriate means at their disposal, namely, fire extinguishers, hydrants and first aid kits
- Whenever necessary, cut off the power supply

- Collaborate in the retention and evacuation of the victims from the place where the operations are carried out
- Whenever it is not possible to control the situation or there are imminent or greater dangers present on the site, close the doors and windows of the affected places and wait for the arrival of the fire brigade team
- Ensure that first aid equipment is always in good condition and functioning.

8.2 EVACUATION TEAMS

The roles/responsibilities of the evacuation teams are as follows:

- Lead/guide people to the exits, using the emergency exits, directing people to the Meeting Point
- Keep people calm, thus avoiding panic
- Prevent people from using unsafe paths
- Prove the complete evacuation, by counting the staff at the Meeting Point and, if any member is missing, immediately notify the HST coordinator/person in charge
- Ensure that no unauthorized staff member returns to the premises or incident area until deemed safe by the fire brigade team.

8.3 SURVEILLANCE TEAMS

Surveillance teams play a key role in the emergency response process, as site and personnel verification are a prerequisite for the closure of intervention operations after the emergency has occurred. However, the following are the responsibilities of the Surveillance teams:

- Control the movement of people and vehicles on site and keep access roads clear, facilitating the arrival of firefighters or outside help
- Provide information about the evacuation of the building, so as to know if all the people who were in the facility have been evacuated

- Provide various logistical support to evacuation and firefighting operations with the fire brigade team

It should be noted that, in addition to the responsibilities of the different intervention teams mentioned above, it is also the responsibility of all employees, subcontractors, visitors, among others, to carry out the tasks and activities of the Project in a safe way to prevent accidents and contribute to the response process for emergency cases. However, the responsibilities of the different parties are summarized below:

- Know the elements of the internal structure of safety and hygiene at work, as well as the procedures and safety policies of the Project
- Inform the Foreman, the Shipyard Manager or the Occupational Health and Safety Team, of any anomaly that it considers may cause any accident or difficulties in evacuation in the event of an emergency
- Know the location of the emergency exits, the fire extinguishers, hydrants and the meeting point
- Promptly receive and comply with the instructions given by the members of the different intervention teams mentioned above, without panicking
- Whenever you notice an accident, activate the alarm or report it to those responsible. If you have training to act, you should act until reinforcements arrive.

9. TRAINING AND DRILLS

9.1 TRAINING

In accordance with the National and International Legislation on Hygiene and Safety at Work, there must be a wide range of information and dissemination of the use of Personal Protective Equipment, as well as training of all employees in the area of Fire Safety, compliance with evacuation measures and procedures, basic instructions for the operation of fire extinguishers. It is extremely important to train employees in general and include those responsible for the Project.

Therefore, training actions should be limited to raising awareness among employees in relation to firefighting, compliance with alarm procedures and general procedures for

action in case of emergency, namely, evacuation and basic technical instructions for the use of rapid intervention means, such as fire extinguishers. The training should also be extensive with first aid kits and basic life support and the practical component of the use of fire extinguishers.

9.2 DRILLS

The drills serve to evaluate and test the measures presented in this Plan and, if necessary, to improve or even change behaviors and procedures.

The drills must be carried out every six months in order to achieve the objectives outlined in this document. These should be planned in advance as follows:

- Define the objectives to be achieved
- Determine the behaviors to observe during exercise
- Involve the entire internal (consortium) and external (firefighters) structure)

After the drills will be carried out:

- Compliance with the proposed objectives analysed
- The effectiveness of the performance of internal and external teams was analysed
- Análise minuciosa das falhas para a aplicação de medidas corretivas;
- Reports of Drills activities.

Exercise Report – Drill			
Date:	Hour:	No. of Participants:	Evacuation time:
Name of Safety Coordinator:			
Entities involved:			
Brief Description of the Simulation (location, type, dimension, etc.):			

ACTIONS	**YES**	**NO**	**OBSERVATIONS**
Planned exercise			
All employees listened and acted after the alarm signal			
The facilities were fully evacuated			

Someone went back without authorization			
All staff attended the meeting point			
At the meeting point, the count of all those present at the facilities was carried out			
The evacuation took place in a disciplined manner			
The evacuation was immediate after the alarm signal			
All safety instructions have been applied and followed			
The firefighting means (fire extinguishers, hydrants) were used and were in good operational condition			
Conclusions (referring to areas for improvement):			

10. RECOMMENDATIONS

This Emergency Preparedness and Response Plan was prepared as an essential element to ensure that the activities of the work on site run smoothly and the deadlines reflected in the Project's specifications are met, as well as its sustainability. However, it will serve as a guide and lead all those involved in the Project's activities, namely, the owner, inspectors, contractors and subcontractors, to respond to emergency situations throughout the Project's life cycle.

During the preparation of this Emergency Preparedness and Response Plan, the national and international legal requirements in force were taken into account, namely the General Labor Law (Law No. 12/33 of 27 December), the General Regulation of Occupational Safety and Health Services (Executive Decree 6/96 of 2 February), Regulation on the Legal Regime of Fire Safety in Buildings (Presidential Decree No. 195/11 of 8 June) and the Fire Safety Standards IFC Performance (Assessment and

Management of Social and Environmental Risks and Impacts, Employment and Working Conditions and Community Health and Safety).

During the assessment of the risks inherent to the Project works, several risks were identified that may incur accidents/incidents on the construction fronts and support sites, and to overcome these risks and avoid accidents, the following is recommended:

- For fuel storage locations, they must be places with easy air circulation and with adequate and sufficient means of 1st intervention
- Thorough completion of the training cycle and drill exercises for all Project staff
- Enforce the mandatory use of Personal Protective Equipment in work areas (construction sites and construction fronts)
- The Emergency Management Team, including the intervention teams, must be presented to all stakeholders in the Project
- The preparation of periodic reports and records to verify the operation of rapid intervention means and equipment
- Periodically (annually, for example) the fulfilment of the Plan and, if necessary, adjust it to the current context.

In short, it is expected that the Plan presented will be feasible and will be able to respond to possible emergencies that may arise throughout the entire life cycle of the Project.

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
Preconstruction and Construction				
S1.0	Social tension with foreign workforce	S1.1	Project recruitment policy includes effective local employment strategy, that includes training and capacity building and hiring metrics. The strategy must include gender targets	Contractor
	Social tension with foreign workforce	S1.2	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues.	Contractor
	Social tension with foreign workforce	S1.3	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances.	Contractor
	Social tension with foreign workforce	S1.4	A workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspects such as sexual exploitation, respect to religious and traditional matters, hunting, and fishing.	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
S2.0	Influx induced changes to social fabric	S2.1	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues.	Contractor
	Influx induced changes to social fabric	S2.2	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances.	Contractor
	Influx induced changes to social fabric	S2.3	Develop a workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspects such as sexual exploitation, respect to religious and traditional matters, hunting, and fishing.	Contractor
	Additional pressure on services for positive well-being	S3.1	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues.	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
S3.0	Additional pressure on services for positive well-being	S3.2	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances.	Contractor
	Additional pressure on services for positive well-being	S3.3	A workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspects such as use of public infrastructure, social services used by the community, respect for community religious and cultural practices, etc	Contractor
	Additional pressure on services for positive well-being	S3.4	Consider sport and recreational activities within camps for workers.	Contractor
	Additional pressure on services for positive well-being	S3.5	Establish work schedules that enable workers to participate in religious/spiritual gatherings and events.	Contractor
	Additional pressure on services for positive well-being	S3.6	Conduct cultural sensitivity training for both migrant workers and local community members to promote understanding and reduce potential conflicts	Contractor
S4.0	Accessibility and connectivity	S4.1	Identify and construct alternative pathways that connect villages and fields, ensuring that these new paths are safe, clearly marked, and easily accessible.	Contractor
	Accessibility and connectivity	S4.2	Identify additional level crossings that may be required during the detailed design phase.	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Accessibility and connectivity	S4.3	Engage with local communities to understand their specific connectivity needs and collaboratively plan the locations and design of new pathways or crossings, particularly connectivity needs to agricultural land, cultural heritage sites, places of worship as well as medicinal plant locations.	Contractor
Operations				
S5.0	Accessibility and connectivity	S5.1	Install clear signposts and wayfinding markers on both existing and new footpaths to help community members navigate the altered landscape. Consider building pedestrian walkways next to the railway bridges.	Operator
	Accessibility and connectivity	S5.2	All stations and trains must be accessible to people with restricted mobility through the use of ramps, handrails, accessible train carriages, wide entrances amongst others. Special rates for the elderly and people with special needs, travel cards or local discounts must be considered.	Operator
	Accessibility and connectivity	S5.3	Establish a regular maintenance program for the new and existing footpaths, overpasses, and underpasses to ensure they remain safe and usable.	Operator
	Accessibility and connectivity	S5.4	Conduct awareness campaigns to inform the community about the new pathways, crossings, and any changes to the existing footpath network.	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Accessibility and connectivity	S5.5	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues.	Operator
	Accessibility and connectivity	S5.6	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances. The community must assist with developing the grievance mechanism.	Operator
S 6.0	Social tension with foreign workforce	S6.1	Establish ongoing training and development programs for local community members to increase their skill levels and enhance employability for semi-skilled and skilled positions.	Operator
	Social tension with foreign workforce	S6.2	The railway operator should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets.	Operator
	Social tension with foreign workforce	S6.3	The operator shall evelop and implement recruitment policies that prioritise hiring from the local community and Angolan nationals, and promote gender equity and unbiased recruitment in the recruitment policies.	Operator
	Social tension with foreign workforce	S6.4	Provide support programs for female employees, such as mentorship, career advancement opportunities, and safe working conditions.	Operator
	Influx induced changes to social fabric	S7.1	The contractor should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets.	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
S7.0	Influx induced changes to social fabric	S7.2	Ensure that the hiring process prioritises local residents for available positions while also offering fair opportunities to qualified migrants.	Operator
	Influx induced changes to social fabric	S7.3	Develop and implement programs that facilitate the integration of migrants into the local community, such as cultural exchange events, sports activities, and social gatherings.	Operator
	Influx induced changes to social fabric	S7.4	Plan and develop adequate housing and infrastructure to accommodate the influx of workers, ensuring that it does not strain existing community resources	Operator
	Influx induced changes to social fabric	S7.5	Implement an influx management plan.	Operator
S8.0	Additional pressure on services for positive well-being	S8.1	The contractor should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets	Operator
	Additional pressure on services for positive well-being	S8.2	Collaborate with telecommunications providers to enhance mobile phone reception and internet connectivity in the project area and surrounding villages.	Operator
	Additional pressure on services for positive well-being	S8.3	Develop social and recreational facilities such as community centres, sports areas, and common spaces where migrant workers can socialize and engage in leisure activities.	Operator
	Additional pressure on services for positive well-being	S8.4	Conduct cultural sensitivity training for both migrant workers and local community members to promote understanding and reduce potential conflicts.	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
Preconstruction				
S 9.0	Economic and physical displacement and livelihoods disruptions	S9.1	Preliminary design of the railway line, stations locations and layouts have been revised on multiple occasions during ESIA stage to avoid displacement impacts and where avoidance is not feasible, impacts minimisation has been adopted. Refer Chapter 3 (Project Alternatives)	Contract
	Economic and physical displacement and livelihoods disruptions	S9.2	A Resettlement Policy Framework (RPF) has been developed to guide the management of land acquisition, resettlement, and livelihood restoration impacts associated with the Project, in accordance with Angolan legislations, IFC PS6 and other applicable international standards[1]	Contract
	Economic and physical displacement and livelihoods disruptions	S9.3	Following finalisation of the detailed design, site-specific Resettlement Action Plans (RAPs) and Livelihoods Restoration Plans (LRPs) will be prepared based on comprehensive socio-economic surveys, asset inventories, and stakeholder engagement. Compensation and assistance will be implemented prior to the commencement of construction in affected areas.	Contract
	Economic and physical displacement and livelihoods disruptions	S9.4	Replacement land is the preferred form of compensation for loss of land, particularly for customary land users, consistent with Angola's national practices. Cash compensation is provided for affected assets and improvements, including crops, trees, and structures, at replacement cost	Contract
	Economic and physical displacement and livelihoods disruptions	S9.5	Livelihood restoration measures will be implemented to address economic displacement and support the restoration of income and food security	Contract

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Economic and physical displacement and livelihoods disruptions	S9.6	RAPs and LRPs will be implemented on a phased basis, aligned with Project construction sequencing	Contract
	Economic and physical displacement and livelihoods disruptions	S9.7	Ongoing monitoring and adaptive management will be applied	Contract
	Economic and physical displacement and livelihoods disruptions	S9.8	A community Grievance Redress Mechanism will be implemented to allow community members to promptly raise any grievances related to land acquisition and resettlement with the project proponent	Contract
S 10.0	Inequality in compensation and livelihood restoration interventions	S10.1	Integration of the Gender Action Plan (GAP) in the entire resettlement planning and implementation	Contract
	Inequality in compensation and livelihood restoration interventions	S10.2	Implement a Grievance Mechanism to allow community members to promptly raise any grievances related to land acquisition with the project proponent	Contract

Sn	**Potential Impacts**	**SN**	**Mitigation measure**	**Responsibility**
	Inequality in compensation and livelihood restoration interventions	S10.3	Ongoing monitoring and adaptive management will be applied	Contract
S11.0	Value of land	S11.1	The project proponent must compile a relocation action plan (RAP) and livelihood restoration plan (LRP) according to international best practice inform the current value of land.	Contract
	Value of land	S11.2	Implement a clear, transparent, and well-communicated compensation process that ensures all stakeholders understand the criteria and procedures.	Contract
	Value of land	S11.3	Involve an independent third-party auditor to oversee the compensation distribution and resolve disputes impartially.	Contract
S12.0	Land as catalyst for tensions in communities	S12.1	Implement a clear, transparent, fair, and well-communicated compensation process that ensures all stakeholders understand the criteria and procedures	Contract
	Land as catalyst for tensions in communities	S12.2	Conduct regular and inclusive consultations with all affected community members to address concerns and explain the compensation process	Contract
	Land as catalyst for tensions in communities	S12.3	Establish a grievance redress mechanism where individuals can report and resolve issues related to perceived inequalities	Contract
	Land as catalyst for tensions in communities	S12.4	Use of community mediation committees to facilitate dialogue and mitigate tensions that arise between different groups regarding compensation	Contract

Sn	**Potential Impacts**	**SN**	**Mitigation measure**	**Responsibility**
	Land as catalyst for tensions in communities	S12.5	Provide social support services such as funding community-based projects that will benefit the wider community through various options to be considered during LRP implementation.	Contract
	Land as catalyst for tensions in communities	S12.6	Ongoing monitoring and adaptive management will be applied	Contract

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
S13.0	Misappropriation of funds	S13.1	Replacement land is the preferred form of compensation for loss of land, particularly for customary land users, consistent with Angola's national practices. Cash compensation is provided for affected assets and improvements, including crops, trees, and structures, at replacement cost	Contract
	Misappropriation of funds	S13.2	Livelihood restoration measures will be implemented to address economic displacement and support the restoration of income and food security	Contract
	Misappropriation of funds	S13.3	Implementation of the financial literacy and livelihood support programs for recipients of cash compensation to ensure they effectively use their funds to re-establish their livelihoods	Contract
	Misappropriation of funds	S13.4	Ongoing monitoring and adaptive management will be applied	Contract
Operations				

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
Preconstruction and Construction				
S 17.0	Direct local employment opportunities	S 17.1	Ensure fair and transparent recruitment processes that prioritise local hiring.	Contractor
	Direct local employment opportunities	S 17.2	Local content optimisation and integration in all project activities and supply chain	Contractor
	Direct local employment opportunities	S 17.3	Mainstreaming gender-related considerations including equal employment opportunities throughout Project activities and supply chain	Contractor
	Direct local employment opportunities	S 17.4	Consideration of vulnerable and marginalised groups in the employment opportunities implement training programs to upskill local workers, ensuring they qualify for various roles within the railway Project	Contractor
	Direct local employment opportunities	S 17.5	Communicate the availability of jobs to the community in a mutually agreed and accessible manner through advertisement of the available opportunities to the wider public and encouraging local communities to take up the opportunities. Ensure that communication include women	Contractor
	Direct local employment opportunities	S 17.6	Implement an accessible and transparent worker grievance mechanism to provide a platform for workers to submit complaints and comments regarding labour and working conditions	Contractor
S18.0	Skills development opportunities	S18.1	Skills development plans must be a contractual requirement. These plans must be focused on skills that the project needs, and that are also transferable. Support must be given to people after the training to ensure that their newly acquired skills can be implemented.	Contractor
	Skills development opportunities	S18.2	fostering on-the job training and collaboration with the existing vocational training centres or through OEC's internship/graduate recruitment and development scheme	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Skills development opportunities	S18.3	attaching non-skilled workers with the semi-skilled and/or skilled ones to facilitate skills and knowledge transfer on the job	Contractor
	Skills development opportunities	S18.4	priority to communities within the Project area in the employment and skills development	Contractor
	Skills development opportunities	S18.5	Establishing mentorship or apprenticeship programs wherein experienced professionals within the Project provide guidance and support to newly employed locals	Contractor
S19.0	Indirect Employment opportunities	S19.1	The project proponent should ensure a fair number of secondary economic opportunities are given to local contractors. Services and goods must be procured locally as far as reasonably possible. Aspects of this positive impact will occur by default when the construction force lives locally and they utilise local services and support local shops.	Contractor
S20.0	Risk of inequitable access to employment and income-generating opportunities	S20.1	The contractor should put measures in place to ensure the most effective local employment strategy is deployed. The strategy must include targets for gender equality targets.	Contractor
	Risk of inequitable access to employment and income-generating opportunities	S20.2	Establishing and enforcing policies and plans that promote diversity and inclusivity within the employment framework	Contractor
	Risk of inequitable access to employment and income-generating opportunities	S20.3	Equip women with the necessary skills to qualify for a broader range of employment opportunities within the project.	Contractor
	Risk of inequitable access to employment and income-generating opportunities	S20.4	Create a supportive and flexible work environment that accommodates the needs of women, including provisions for childcare, flexible working hours, and safe work conditions.	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
S21.0	Local inflation risks	S21.1	Project construction workers will be accommodated in the planned five construction camps to avoid/minimize housing over-demand within local communities and mitigate potential inflationary risks on the housing markets	Contractor
	Local inflation risks	S21.2	Arrange dedicated transport for workers living outside the Project camps, preventing the potential inflation impacts on local public transport	Contractor
	Local inflation risks	S21.3	Encourage local production of goods to increase supply and stabilise prices	Contractor
	Local inflation risks	S21.4	Continuous monitoring of the population influx and local infrastructure capabilities	Contractor
	Local inflation risks	S21.5	In the event that substantial project-induced inflation is **reported as a major (frequent) grievance,** the Project will consider alternative and duly qualified suppliers based outside of the project-affected communities.	Contractor
S22.0	Affordability of the railway transport for passengers and cargo	S22.1	Encourage local sourcing, contract local suppliers for goods and services required during the construction phase. This helps to stimulate the local economy and reduce the impact of increased demand.	Contractor
S23.0	Improved livelihoods, local economic and empowerment	S23.1	Encouraging the creation of local supply chains by facilitating connections between the Project construction activities and local businesses	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Improved livelihoods, local economic and empowerment	S23.2	The Project will actively support local businesses by procuring goods and services from nearby enterprises. This practice stimulates economic growth within the community, benefiting entrepreneurs and bolstering the local economy	Contractor
	Improved livelihoods, local economic and empowerment	S23.3	Include local procurement policies and commitments to sourcing produce from local farmers within project area and vicinity of the worker accommodation camps	Contractor
	Improved livelihoods, local economic and empowerment	S23.4	Implementation of livelihood restoration programs (LRP) such as capacity building, – provide training programs for local farmers to increase productivity and efficiency. This could include modern farming techniques, pest control, and sustainable practices.	Contractor
	Improved livelihoods, local economic and empowerment	S23.5	Implement Luena-Saurimo project LRP sub-programs as 'open-access' to provide the host community with the opportunity to upgrade skills within e.g., agriculture and small businesses	Contractor
S24.0	Community tensions from unfair or unaccepted governance systems	S24.1	Community and other stakeholders expectations management through continuous stakeholder engagement as per SEP, establishing transparent communication channels to manage community expectations effectively	Contractor
	Community tensions from unfair or unaccepted governance systems	S24.2	Engaging in continuous dialogue with the community, explaining the realistic scope of employment prospects and provide insights into the skills and qualifications necessary for various roles	Contractor
	Community tensions from unfair or unaccepted governance systems	S24.3	Broadening community participation in project-related benefits beyond direct employment	Contractor
	Community tensions from unfair or unaccepted governance systems	S24.4	Developing robust grievance redress mechanisms to address concerns and dissatisfaction within the community regarding employment opportunities, land access and resettlement issues	Contractor
	Community tensions from unfair or unaccepted governance systems	S24.5	Implement the Stakeholder Engagement Plan for construction. Create forums for regular dialogue between traditional and public authorities, youth and women's representatives, new arrivals, and other community members, as described in the Stakeholder Engagement Plan.	Contractor

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Community tensions from unfair or unaccepted governance systems	S24.6	Disseminate timely and accurate information regarding project progress to stakeholders at the local, provincial and national levels as described in the Stakeholder Engagement Plan.	Contractor
S25.0	Direct local employment opportunities	S25.1	Ensure fair and transparent recruitment processes that prioritise local hiring.	Operator
	Direct employment opportunities	S25.2	Implement training programs to upskill local workers, ensuring they qualify for various roles within the railway Project.	Operator
	Direct employment opportunities	S25.3	Advertisement of the available opportunities to the wider public and encouraging local communities to take up the opportunities	Operator
	Direct employment opportunities	S25.4	Mainstreaming gender-related considerations including equal employment opportunities throughout Project activities and supply chain	Operator
S26.0	Skills development opportunities	S26.1	The project needs to retain local labour where feasible for the operation and maintenance works of the railway Infrastructure and facilities.	Operator
	Skills development opportunities	S26.2	Developing structured training programs that align with the local needs	Operator
	Skills development opportunities	S26.3	Introducing initiatives aimed at capacity building within the local community, including collaborating with educational institutions or vocational training centres to offer specialized courses that cater to the skill demands of the Project	Operator
	Skills development opportunities	S26.4	Establishing mentorship or apprenticeship programs wherein experienced professionals within the Project provide guidance and support to newly employed locals.	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
S27.0	Indirect employment opportunities	S27.1	Encourage procurement of goods and services from local businesses to support the local economy.	Operator
	Indirect Employment opportunities	S27.2	Provide training and support for local businesses to help them meet the demands generated by the railway Project.	Operator
S28.0	Risk of inequitable access to employment and income-generating opportunities	S28.1	The operator should put measures in place to ensure the most effective local employment strategy is deployed. The strategy must include targets for gender equality target, particularly in both skilled and unskilled roles	Operator
	Risk of inequitable access to employment and income-generating opportunities	S28.2	Provide specialized training and skills development programs for women to equip them with the necessary skills to qualify for a broader range of employment opportunities within the project.	Operator
	Risk of inequitable access to employment and income-generating opportunities	S28.3	Create a supportive and flexible work environment that accommodates the needs of women, including provisions for childcare, flexible working hours, and safe work conditions.	Operator
S29.0	Local inflation risks	S29.1	Encourage local production of goods to increase supply and stabilise prices	Operator
	Local inflation risks	S29.2	Prioritise sourcing good and services from local suppliers and contractors	Operator
S30.0	Improved mobility, accessibility and Port connectivity	S30.1	implementing routine and periodic maintenance activities of the railway infrastructure for continuous and reliable service provision throughout the year	Operator
	Improved mobility, accessibility and Port connectivity	S30.2	Review of fares for both passengers and freight to a rate similar or cheaper with other available transport means	Operator
	Improved mobility, accessibility and Port connectivity	S30.3	Continuous key stakeholders engagement and communications including grievances redress mechanism	Operator
	Improved mobility, accessibility and Port connectivity	S30.4	Develop a partnership model with the operator and communities to establish a community-based feeder transportation service program to enhance access to the proposed stations. The program will utilise local	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Increased mobility and accessibility	S30.5	All stations and trains must be accessible to people with restricted mobility through the use of ramps, handrails, accessible train carriages, wide entrances amongst others. Special rates for the elderly and people with special needs, travel cards or local discounts must be considered.	Operator
S31.0	Affordability of the railway transport for passengers and cargo	S31.1	Operator to review ticket fairs and comparisons with other modalities along the railway corridor to optimise community/users' affordability of the ticket prices to being similar or less than alternative transport methods	Operator
	Affordability of the railway transport for passengers and cargo	S31.2	Continuous key stakeholders engagement and communications including grievances redress mechanism	Operator
S32.0	Improved livelihoods, local economic and empowerment	S32.1	Encouraging the creation of local supply chains by facilitating connections between the Project and local businesses	Operator
	Improved livelihoods, local economic and empowerment	S32.2	Promoting sustainability and economic resilience within the community	Operator
	Improved livelihoods, local economic and empowerment	S32.3	Incorporating social responsibility measures, such as community development funds or initiatives, to contribute to the overall well-being of the community	Operator
	Improved livelihoods, local economic and empowerment	S32.4	Skills development, training and capacity-building programs will be conducted as part of the implementation of the RAP and LRP to enhance the skills of the local workforce, making them more competitive and better prepared for employment opportunities within and beyond the Project	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
	Improved livelihoods, local economic and empowerment	S32.5	Conducting a comprehensive economic analysis to identify sectors that can support job creation beyond the Project's direct employment opportunities	Operator
S33.0	Community tensions from unfair or unaccepted governance systems	S33.1	Involve traditional authorities in the implementation of impact management tools.	Operator
	Community tensions from unfair or unaccepted governance systems	S33.2	Develop a Stakeholder Engagement Plan for construction. Create forums for regular dialogue between traditional and public authorities, youth and women’s representatives, new arrivals, and other community members, as described in the Stakeholder Engagement Plan.	Operator

Sn	Potential Impacts	SN	Mitigation measure	Responsibility
			Preconstruction	
S34.0	Exposure to diseases transmission	S34.1	Implementation of the Community Health and Safety Plan that will include measures to avoid or minimise exposure to diseases transmission to both workers and surrounding communities	Contract
	Exposure to diseases transmission	S34.2	Extend the workplace programme for HIV beyond the company's operations, and include all contractors, suppliers, transportation companies and local communities. Make it a contractual requirement. The spread of HIV along transportation routes (roads and railways) is well documented, so this component of the Project (transportation of all goods and services to and from the project site) needs special attention	Contract
	Exposure to diseases transmission	S34.3	Sensitise the community on communicable diseases through health education and awareness programs about disease transmission and encourage food vendors to uphold hygienic food handling practices and carry out periodic medical examinations	Contract
	Exposure to diseases transmission	S34.4	Free voluntary counselling sessions/programs for HIV/AIDS and STDs will be encouraged and provided to the community	Contract
	Exposure to diseases transmission	S34.5	Collaborate with existing programs at the municipalities or initiating and implementing targeted reproductive health education programs, specifically focusing on young girls, women and adolescents in schools	Contract

	Exposure to diseases transmission	S34.6	Toolbox talks should include talks about the impact of promiscuous behaviour	Contract
	Exposure to diseases transmission	S34.7	The project proponent should develop an in-house infectious diseases strategy applicable to all contractors and sub-contractors to address health issues within the workforce and align the strategy with a community HIV strategy implemented by a non-profit organisation. Local schools and communities living in traditional areas close to the project must be included in the strategy. The strategy should include voluntary counselling and testing and training of peer educators	Contract
	Exposure to diseases transmission	S34.8	A workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration	Contract
	Exposure to diseases transmission	S34.9	Provide clinics and medical services for construction staff that will: -provide surveillance and active screening and treatment for all workers -conduct immunization programs for workers in local communities to improve health, and guard against any infections and providing other services where they are not available regionally	Contract
	Exposure to diseases transmission	S34.10	Preventing illness amongst workers in local communities by undertaking further education initiatives training health workers in disease treatment	Contract
	Exposure to diseases transmission	S34.11	Develop a disease prevention strategy incorporated in the Community Health and Safety Plan for vector borne diseases (mosquito and other arthropod borne diseases) in close collaboration with the community health authorities that will include actions to: -control the sanitary conditions within camps and at mobile toilets placed near active construction zones	Contract
	Exposure to diseases transmission	S34.12	Monitor migrating workforce to prevent any further disease outbreaks	Contract

	Exposure to diseases transmission	S34.13	Collaborate with other control and treatment programs in the project area so that the maximum beneficial effects are in place for this project and its communities	Contract
	Exposure to diseases transmission	S34.14	Educate the project staff and personnel as well as the residents in surrounding communities on the risks and how to prevent them and also available treatment once they start feeling sick. This can include distribution of appropriate education materials at all levels of the community	Contract
	Exposure to diseases transmission	S34.15	Develop collaborative support with authorities to monitor the communities dealing with high-risk seasons to enhance capacity for early detection of the disease	Contract
	Exposure to diseases transmission	S34.16	Ctoilets placed near active construction zones.	Contract
S35.0	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.1	A construction Gender Action Plan (GAP) should be developed (or integrated in the Community Health and Safety Plan) and rolled-out for execution throughout the supply chain as a contractual requirement. This will include measures that ensure the safety and security of women in the communities along the railway corridor. These measures will include: -education and awareness campaigns for the communities	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.2	Review of specific Project components and activities that are known to heighten sexual abuse/harassment/abuse/GBV risks at the community level, e.g., employment opportunities, women food vendors, influx, operation of the construction camps/laydown areas	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.3	promote women involvement in all stages of Project activities and ensure that vulnerable people are involved in taking decisions on matters that affect them directly	Contract

	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.4	effective, on going and culturally appropriate dialogue and continuous engagement with the wider communities and different vulnerable groups such as women, girls and students through the SEP	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.5	Promote women involvement in all stages of Project activities and ensure that vulnerable people are involved in taking decisions on matters that affect them directly	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.6	implement comprehensive community and workers sensitisation programs in collaboration with local NGOs focusing on sexual health, consent, and substance abuse prevention, alongside providing accessible healthcare services, including counselling and support for vulnerable groups	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.7	The Contractor has existing Human Resource Policies and Codes of Conduct that establish strict monitoring and reporting mechanisms to prevent and address sexual harassment and substance abuse amongst employees of the Project within the Project area	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.8	Develop tailored BCC materials such as mirror hanger messages and bumper stickers to be displayed in camps and within the community centres	Contract
	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S35.9	Implement toolbox talks about the impact of promiscuous behaviour and vulnerabilities of the residents in surrounding communities and potential.	Contract
S36.0	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.1	Updating and implementation of existing OEC's Influx Management and Monitoring Plan (PI-PL-082-OECLS, 23 July 2023) for the Project	Contract

	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.2	Use of worker accommodation for non-local workers, avoid at-gate hiring practices	Contract
	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.3	Engagement and collaboration with the local government authorities and existing community members along the corridor inform them about the potential influx and collaborative mechanisms to address influx issues	Contract
	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.4	Prioritising the hiring of local villagers for construction jobs to reduce the influx of workers from outside the host sites area	Contract
	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.5	Implementation of resource-efficient practices (e.g. water and energy conservation at the camps and construction activities) to ensure that essential resources like water, energy and food are managed sustainably, reducing pressure on local resources	Contract
	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.6	Where feasible, through CSR activities during construction phase, support community/local government initiatives in the expansion and upgrading of public utility infrastructure e.g. water supply to meet increased demand,	Contract
	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.7	Designate a community liaison officer to monitor emerging resource and services pressures	Contract
	Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure	S36.8	Implement a grievance procedure to report specific resource and services concerns.	Contract
S37.0	Community safety risks and access during construction	S37.1	Implementation of construction Traffic Management Plan to ensure the safe flow of traffic	Contract

	Community safety risks and access during construction	S37.2	Implementation of the Community Health and Safety Plan	Contract
	Community safety risks and access during construction	S37.3	Maintain communities connectivity and accessibility by providing safe access routes/crossings/alternatives for all categories including vulnerable groups thorough assessment of the construction access routes including alternatives and high risk areas avoidance to ensure safety of the community groups at risk	Contract
	Community safety risks and access during construction	S37.4	Installing adequate safety barriers, signage and warning systems in construction zones and potential hazards	Contract
	Community safety risks and access during construction	S37.5	Enforcing safety protocols for construction transportation activities, such as speed limits and mandatory safety training for drivers and road users	Contract
	Community safety risks and access during construction	S37.6	Undertaking community safety awareness and sensitisation campaigns: maintaining open communication and actively engaging with the community, existing schools, health care centres, three-wheelers and other road users for awareness creation and addressing their concerns and issues	Contract
	Community safety risks and access during construction	S37.7	Providing mandatory training for construction workers and equipment operators to ensure they follow safety protocols and drive cautiously within construction zones	Contract
	Community safety risks and access during construction	S37.8	Maintaining a transparent and accessible community grievance redress mechanism	Contract

S38.0	Severance - accessibility and connectivity during operation phase	S38.1	There will be no fencing of the railway during operations as people and animals need to cross freely to ensure continued accessibility and connectivity. It would also be financially unfeasible and the fencing would be at risk of theft or vandalism. There may be a small number of exceptions where some fencing is necessary for safety, security and control purposes, e.g., Saurimo main station	Contract
	Severance - accessibility and connectivity during operation phase	S38.2	The preliminary design has integrated provisions for designated community crossings. The Project intends to develop at least one crossing point for vehicles in every community to allow access across the railway line. Pedestrians and livestock can also use these formal crossing points or cross anywhere along the railway line as it will not be fenced (apart from in the odd location by exception)	Contract
	Severance - accessibility and connectivity during operation phase	S38.3	Community engagements during detailed design process: the actual locations of the crossings in each community will be determined during detailed design. The Project will engage communities along the railway line and investigate where people currently cross in the area to help define suitable crossing point locations	Contract
	Severance - accessibility and connectivity during operation phase	S38.4	There will not be formal barriers at crossings due to the risk of damage and / or theft as has happened elsewhere in Angola. Most likely the community crossing points will be just levelled areas where cars, pedestrians, cyclists and motorbikes	Contract
S39.0	Safety risks from train movements during trains movements	S39.1	community safety awareness campaigns: conduct community education programs on railway safety, especially targeting children and parents as well enforcing the use of designated crossings. This endless campaign will be included in the operator’s ESMS and/or integrated in the Community Safety Sensitisation Plan to be implemented starting from a year in advance of start of train operations and then continuously during operations	Contract

	Safety risks from train movements during trains movements	S39.2	Distribute informational materials and hold workshops in villages to raise awareness about the dangers of playing near the railway	Contract
	Safety risks from train movements during trains movements	S39.3	The preliminary design has integrated provisions for designated community crossings. The Project intends to develop at least one crossing point for vehicles in every community to allow access across the railway line. Pedestrians and livestock can also use these formal crossing points or cross anywhere along the railway line as it will not be fenced (apart from in the odd location by exception)	Contract
	Safety risks from train movements during trains movements	S39.4	Community engagements during detailed design process: the actual locations of the crossings in each community will be determined during detailed design. The Project will engage communities along the railway line and investigate where people currently cross in the area to help define suitable crossing point locations	Contract
	Safety risks from train movements during trains movements	S39.5	Preliminary design has integrated railway safety considerations including telecommunication, signage, warning systems etc.	Contract
S40.0	Injury from physical hazards	S40.1	The Contractor has a H&S management system for Incidents and safety management,	Contract
S41.0	Deteriorated health from long term exposure to chemicals and emissions	S41.1	The Contractor has a H&S management system for Occupational health, Chemical handling and emissions	Contract
S42.0	Biological infections and bites	S42.1	PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN	Contract
	Biological infections and bites	S42.2	PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN	Contract
	Biological infections and bites	S42.3	OECLS-AF-PG-GER-002_TRAINING PLAN_EN	Contract
	Biological infections and bites	S42.4	PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN	Contract

S43.0	Deterioration of health due to poor ergonomic equipment and practices	S43.1	PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN	Contract
	Deterioration of health due to poor ergonomic equipment and practices	S43.2	PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN	Contract
	Deterioration of health due to poor ergonomic equipment and practices	S43.3	PI-PR-023-OECLS_ERGONOMIC PROGRAMME_EN	Contract
	Deterioration of health due to poor ergonomic equipment and practices	S43.4	PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN	Contract
Operations				
S44.0	Exposure to diseases transmission	S44.1	Encouraging and undertaking free voluntary counselling and testing sessions/programs for HIV/AIDS and STDs at health centres within project area of influence	Operator
	Exposure to diseases transmission	S44.2	Implement awareness and education programs about disease prevention and control	Operator
	Exposure to diseases transmission	S44.3	Operator is encouraged to initiate collaboration with local/government clinics/health care facilities along the railway corridor to offer extended support to communities where operator has worker health services. The operator may extend limited and/or specific preventative services, health screenings and check-up for communicable diseases. Where complex health cases are identified, patients requiring advance care will be referred to the nearest government hospital or public health facility	Operator

S45.0	Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence	S45.1	Coordinate with local authorities to enhance infrastructure and public services	Operator
S46.0	Injury from physical hazards	S46.1	The operator is responsible for the preparation of the following management plans: Operational Safety Management System -Mainline Operational Plan	Operator
	Injury from physical hazards	S46.2	All personnel are to have safety training during induction and participate in regular refresher trainings, webinars.	Operator
	Injury from physical hazards	S46.3	Operator is to conduct safety inspections as part of their internal monitoring to ensure measures are being implemented and are effectively avoiding risks	Operator
S47.0	Deteriorated health from long term exposure to chemicals and emissions	S47.1	Instituting regular health and safety inspections at stations and workshops	Operator
	Deteriorated health from long term exposure to chemicals and emissions	S47.2	Establishing a procedure for fit to work health checks for personnel	Operator
	Deteriorated health from long term exposure to chemicals and emissions	S47.3	Including health risks in all induction and refresher training	Operator
S48.0	Biological infections and bites	S48.1	Establish a memorandum of understanding with existing health/medical facilities in the four municipalities for the provision of medical services for project personnel	Operator
	Biological infections and bites	S48.2	Train First Aiders to be placed at each station	Operator
	Biological infections and bites	S48.3	Implement training for all workers during induction and refresher training	Operator

	Biological infections and bites	S48.4	Establish a health monitoring system as an early warning mechanism to identify increased incidences of infections/outbreaks among workers	Operator
	Biological infections and bites	S48.5	Include health outbreaks in the operational emergency response plan	Operator

Sn	Potential Impacts	SN	Mitigation measures	Responsibility
CIA 1	Air quality declining due to construction related dust dispersion	CIA 1.1	Record all dust and air quality complaints, identify causes, and take corrective measures.	Contractor
		CIA 1.2	Implement regular dust suppression (water spraying, covering stockpiles, speed limits).	
		CIA 1.3	Monitor PM10 and PM2.5 against WHO standards and report exceedances.	
		CIA 1.4	Maintain dialogue with communities on air quality concerns.	
CIA 2	Regional emissions rising from project related vehicle and machinery use	CIA 2.1	Conduct a GHG inventory for the project.	Operator
		CIA 2.2	Implement an energy efficiency and emissions reduction plan.	
		CIA 2.3	Use low-carbon technologies where feasible.	
		CIA 2.4	Report annually against Angola's NDC targets.	
CIA 3	Ambient noise levels increasing near construction and operational zones	CIA 3.1	minimising drop heights of materials i.e. lorry with lifting boom or dumper carefully depositing materials	Contractor
		CIA 3.2	maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)	
		CIA 3.3	all plant, equipment and noise control measures applied to plant and equipment should be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practicable. Any plant, equipment or items fitted with noise control equipment found to be defective will not be operated until repaired	
		CIA 3.4	machines in intermittent use will be shut down or throttled down to a minimum during periods between works	
		CIA 3.5	as far as is reasonably practicable, the location and orientation of semi-static equipment will be chosen to minimise the noise impact on sensitive receptors	
		CIA 3.6	where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements	
		CIA 3.7	where safe to do so, noise from reversing alarms will be controlled and limited as far as possible using physical barriers to restrict pedestrian and construction worker movements in zones with numerous turning/reversing construction vehicles, to minimise intrusive sound of tonal alarms	
		CIA 3.8	Where night works are required, as far as is practicable programme the work such that separation distances to noise sensitive receptors are maximised	
CIA 4	Water quality deteriorating due to sedimentation and potential contamination	CIA 4.1	Obtain the estimated flow of sewage water, per campsite, from the Water Consumption Study (Approximately 80% of Consumed Water turns into sewage water)	Contractor
		CIA 4.2	Design the Sewage Treatment System, to ensure that the resulting treated water to be discharged will respect the chemical and physical requirements of Angolan Regulations	
		CIA 4.3	Design the location of the Water Treatment System, at each campsite, ensure that the treated discharge is not near any existing surface or underground water body	
		CIA 4.4	Prepare a Technical Report on the Water Treatment System, for each campsite. Include this in the General Waste and Wastewater Management Plan	
		CIA 4.5	Send the General Waste and Wastewater Management Plan to Agência Nacional de Resíduos (ANR), to obtain approval; Pay the required legal fees	
		CIA 4.6	Send the Technical Report on the Water Treatment System, to the Secretaria do Ambiente do Governo Provincial, to obtain approval; Pay the required legal fees	
		CIA 4.7	Send the Technical Report on the Water Treatment System, to Instituto Nacional de Recursos Hídricos (INRH), to obtain approval; Pay the required legal fees	
		CIA 4.8	After obtaining approval, invest in and install the sewage water treatment system, at each location	

		CIA 4.9	Before operation, perform tests on the treated sewage water to ensure that the treatment system complies with Angolan discharge regulation limits; Collect a sample and send it to a certified Lab. Pay the required legal fees.	
		CIA 4.10	After tests approve and confirm the water treatment system's efficiency, the operation can start.	
CIA 5	Groundwater and surface water availability declining under project pressure	CIA 5.1	Follow abstraction volumes as prescribed in permits.	Operator
		CIA 5.2	Monitor groundwater levels in boreholes and wells.	
		CIA 5.3	Share monitoring results with communities.	
CIA 6	Natural vegetation declining due to clearance and land conversion.	CIA 6.1	Minimise clearance of natural vegetation and habitats at site fringes.	Contractor
		CIA 6.2	Maintain habitat connectivity corridors.	
		CIA 6.3	Monitor species of conservation importance.	
		CIA 6.4	Engage local authorities and communities in biodiversity monitoring.	
CIA 6	Local employment opportunities increasing, supporting economic empowerment	CIA 7.1	Implement a Local Employment and Procurement Plan (LPP) with transparent targets.	Operator
		CIA 7.2	Establish a Grievance Redress Mechanism (GRM).	
		CIA 7.3	Report annually on local employment and procurement outcomes.	
CIA 8	Land and Livelihoods	CIA 8.1	Develop and implement a Livelihood Restoration Plan (LRP).	Operator
		CIA 8.2	Prepare a Resettlement Action Plan (RAP) in line with IFC PS5.	
		CIA 8.3	Monitor livelihood restoration outcomes with affected households.	
CIA 9	Public services experiencing growing strain from project related population influx	CIA 9.1	Conduct a pre-construction infrastructure survey.	Operator & Municipalities
		CIA 9.2	Develop a Collaborative Service Delivery Plan with municipal authorities.	
		CIA 9.3	Co-invest in upgrading key infrastructure where necessary.	
CIA 10	Demography and Social Fabric	CIA 10.1	Implement zoning regulations and incentives for housing development.	Municipalities
		CIA 10.2	Monitor community welfare and social cohesion indicators.	
		CIA 10.3	Maintain dialogue with traditional authorities on social dynamics.	
CIA 11	Community health burden increasing with exposure to dust, emissions, and stressors.	CIA 11.1	Conduct regular health screenings and vaccinations for workers.	Contractor / Operator
		CIA 11.2	Implement traffic management and safe crossing measures.	
		CIA 11.3	Monitor accident statistics and health clinic records.	
		CIA 11.4	Maintain security arrangements that respect community welfare.	
CIA 12	Community access to heritage sites increasingly constrained by project footprint	CIA 12.1	Provide alternative paths if community access to heritage sites is disrupted.	Contractor
		CIA 12.2	Establish buffer zones around cemeteries and cultural sites.	
		CIA 12.3	Implement Chance Find Procedure.	
		CIA 12.4	Repair any damage to heritage structures in collaboration with communities.	
CIA 13	Intangible Cultural Heritage (ICH)	CIA 13.1	Maintain continuous dialogue with communities on traditions and practices.	Contractor
		CIA 13.2	Schedule construction to avoid interference with cultural/religious events.	

	CIA 13.3	Develop alternative arrangements if ICH is altered, with stakeholder agreement.	

sn	Potential Impact	Sn	MITIGATION MEASURES	Responsibility
Preconstruction				
GHG 1.0	Emissions associated with the use of on-site fuel for construction	GHG 1.1	Implement measures to decrease fuel use by maximising energy efficiencies, e.g. switch off all vehicles when stationary and maintain construction vehicles and conform to current emissions standards	Contractor
		GHG 1.2	Where possible, a proportion of imported energy to be sourced from renewable energy sources	Contractor
		GHG 1.3	Suitable training to operators to maximise the efficiency of using the equipment and reduce idling	Contractor
		GHG 1.4	Make sure that periodic inspections of vehicles are carried out	Contractor
		GHG 1.5	Make sure that the work planning is done properly. Make sure that no more than one work activity is performed for the same work	Contractor
		GHG 1.6	The use of solar light systems to reduce generator fuel consumption	Contractor
GHG 2.0	Embodied emissions associated with the materials used for construction	GHG 2.1	The use of locally sourced and/or produced materials. Where wood is to be integrated within the design, source from certified managed/sustainable forests. The use of recycled aggregates, where appropriate, for foundations, subbases, hard-standings and pavement materials. Maximise use of recycled steel and alternative cement replacements where feasible	Contractor
		GHG 2.2	Optimise transport logistics for efficient journeys of materials to site	Contractor
Operations				
GHG 3.0	Emissions associated with fuel consumption to power trains	GHG 3.1	prioritise the procurement of efficient locomotives	Operator
		GHG 3.2	minimise the idling times of locomotives	Operator
		GHG 3.3	promote fuel efficiency for operation of the locomotives, including efficient driving guidelines	Operator
GHG 4.0	Emissions associated with electricity consumption to power stations	GHG 4.1	the use of renewable energy sources (e.g. solar PV units) should be investigated.	Operator
		GHG 4.2	LED lighting can be used use at stations to increase energy efficiency	Operator
GHG 4.0	Embodied emissions associated with replacement of infrastructure	GHG 5.1	The use of locally sourced and/or produced materials	Operator
		GHG 5.2	Optimise transport logistics to ensure efficient journeys of materials to site.	Operator
Decommissioning				
GHG 6.0	Emissions associated with the use of on-site fuel for decommissioning	GHG 6.1	switch off all vehicles when stationary and maintain construction vehicles and	Decomission
		GHG 6.2	Where possible, a proportion of imported energy to be sourced from renewable energy sources	Decomission
		GHG 6.3	Suitable training to operators to maximise the efficiency of using the equipment and reduce idling	Decomission
		GHG 6.4	Promoting the use of sustainable fuels in construction vehicles, more fuel efficient and low carbon fuels can be used, where possible make use of electric vehicles to reduce fuel consumption	Decomission
		GHG 6.5	Make sure that periodic inspections of vehicles are carried out	Decomission
		GHG 6.6	Make sure that the work planning is done properly. Make sure that no more than one work activity is performed for the same work.	Decomission
GHG 7.0	Emissions associated with disposal	GHG 7.1	Optimise transport logistics for efficient journeys of materials to disposal facilities	Decomission
		GHG 7.2	Ensure maximum recycling and reuse rates	Decomission

sn	Potential Impact	Sn	MITIGATION MEASURES	Responsibility
			Preconstruction	
CCRA 1.0	Health and safety impacts for workforce	CCRA 1.1	Review of HSE plans, including development of heat-health action plans, and health and safety regulations such as:	Operations Manager / HSE Officer
		CCRA 1.2	provision of cool potable water	Operations Manager
		CCRA 1.3	provision of shaded areas during rest periods	Operations Manager
		CCRA 1.4	First Aid equipment to include treatment for dehydration e.g., electrolytes	HSE Officer
		CCRA 1.5	compulsory labour rest times on hot days	Site Supervisor
		CCRA 1.6	appropriate dress codes	HSE Officer
		CCRA 1.7	changes to working hours	Operations Manager
		CCRA 1.8	information and monitoring campaigns	HSE Officer
CCRA 2.0	Wildfire events caused by the project	CCRA 2.1	Ensure Fire Hazard Reduction Plan and the Fire Preparedness Plan are in place, including:	Fire Safety Officer
		CCRA 2.2	Requirement that official personnel be responsible for spotting and reporting fires or smoulderi	Fire Safety Officer
		CCRA 2.3	Ensure that any vegetation control measures are followed by removal of combustible materials	Operations Manager
CCRA 3.0	External wildfire causes damage to infrastructure	CCRA 3.1	Use of insurance mechanisms to cover risk, use of early warning mechanisms	Asset Manager
		CCRA 3.2	Review of maintenance regimes to include extreme temperatures and checks following extrem	Asset Manager
		CCRA 3.3	Update relevant policies, procedure, guideline, critical risk control standard	Asset Manager
CCRA 4.0	Heat-induced damage to steel structures	CCRA 4.1	Review of maintenance regimes to include extreme temperatures	Engineering Manager
		CCRA 4.2	Technical modification to facilities to allow operation during warmer average temperatures	Engineering Manager
		CCRA 4.3	Update relevant policies, procedure, guideline, critical risk control standard	Engineering Manager
CCRA 5.0	Heat stress to steel in bridges	CCRA 5.1	Review of maintenance regimes to include extreme temperatures	Bridge Engineer

CCRA 5.0	through thermal expansion	CCRA 5.2	Update relevant policies, procedure, guideline, critical risk control standard	Bridge Engineer
CCRA 6.0	Flood damage to asset	CCRA 6.1	Monitor sites where infrastructure damage may be of concern. Sites at particular risk of flood risk may need to be further identified in full flood risk report	Asset Manager
CCRA 7.0	River flooding affecting bridges	CCRA 7.1	Improve scour resilience during routine renewal of scour protection systems (design life c 20 years)	Bridge Engineer
		CCRA 7.2	Design future bridges to withstand climate change / consider flood models that account increase in flood event when assessing final designs	Engineering Manager
		CCRA 7.3	Consider planting rows of drought-resistant trees	Environmental Manager
CCRA 8.0	Drought creating potholes under track	CCRA 8.1	Monitor sites where potholes might be of concern and consider removing trees/vegetation that	Track Manager
		CCRA 8.2	Consider replating drought resistant trees at distance from railway	Environmental Manager
CCRA 9.0	Flooding leading to track-inundation	CCRA 9.1	Review of maintenance regimes to include checks following extreme events	Track Manager
CCRA 10.0	Supply chain and access	CCRA 10.1	Maintain strong relationships with multiple suppliers to secure priority services at pre-determine	Procurement Manager
		CCRA 10.2	Develop protocols for ensuring key staff on site in advance of potential flood event	Operations Manager
		CCRA 10.3	Ensure Emergency Preparedness and Response Plan includes measure for evacuation	HSE Officer
		CCRA 10.4	Ensure Fire Hazard Reduction Plan and the Fire Preparedness Plan are in place	Fire Safety Officer
CCRA 11.0	Landslides	CCRA 11.1	Optimise transport logistics for efficient journeys of materials to site	Geotechnical Lead
CCRA 12.0	pressure on existing services	CCRA 12.1	The ESIA recommends the following mitigation measures:	Social Manager
CCRA 13.0	Contamination of community water sources: Improperly treated and discharged wastewater (sewage or surface runoff from cleaning) at stations can also in advertently pollute water access points and rivers that	CCRA 13.1	implement robust water quality monitoring programs to regularly test water sources	Environmental Manager
		CCRA 13.2	Establish and enforce strict guidelines for the handling and disposal of hazardous materials within the ESMP as well as the EMS.	Environmental Manager
		CCRA 13.3	additional water quality testing takes place following a rainfall event	Environmental Manager
		CCRA 13.4	personnel do not carry out potentially polluting activities when rainfall events are anticipated	Operations Manager

CCRA 14.0	An influx of workers can lead to the spread of communicable diseases, such as respiratory infections, sexually transmitted infections (STIs), and vector-borne diseases, impacting both the workers and local communities.	CCRA 14.1	implement regular health screenings and vaccination programs for workers	HSE Officer
		CCRA 14.2	educate workers and local communities about disease prevention and hygiene practices.	HSE Officer
		CCRA 14.3	In addition to the measures outlined in the ESIA, the CCRA recommends:	HSE Officer
		CCRA 14.4	Implantation of additional screening following flooding and during dry spells	HSE Officer
CCRA 15.0	procurement of goods and services by the project may lead to inflation. This impact may extend beyond construction related industries and include food and supplies, leading to inflationary pressure on local households and businesses. Vulnerable	CCRA 15.1	The ESIA recommends the following mitigation measures: Monitor prices of essential goods and services and introduce price control measures if necessary	Social Manager
		CCRA 15.2	Enncourage local production of goods to increase supply and stabilise prices.	Procurement Manager
		CCRA 15.3	In addition to the measures outlined in the ESIA, the CCRA recommends:	Environmental Manager
		CCRA 15.4	climate risk to be incorporated into monitoring of changes in the AoI.	Environmental Manager
CCRA16	Project may impact the access and availability of botanical resources for healthcare leading to impacts for cultural heritage and medicinal practices.	CCRA 16.1	The ESIA recommends the following mitigation measures: where possible avoid removing or damaging any of these plants	Environmental Manager
		CCRA 16.2	if removal required, provide alternative replanting site (if possible, for replanting)	Environmental Manager
		CCRA 16.3	create local medicinal plant nursery sites towards replenishing lost stock of plants	Social Manager
		CCRA 16.4	frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage	Social Manager
		CCRA 16.5	frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.	Environmental Manager
		CCRA 16.6	conduct a comprehensive survey to identify and map areas where important medicinal plants used by the Tchokwe community are located. Engage local traditional healers and community members in the identification process.	Environmental Manager
		CCRA 16.7	No additional measures have been identified in this CCRA.	Environmental Manager
CCRA 17.0	Decreased water table levels from abstraction of ground water for stations	CCRA 17.1	The ESIA recommends the following mitigation measures: follow abstraction volumes as prescribed in authorisation permits and monitor usage.	Environmental Manager
		CCRA 17.2	install water flow meters on all water abstraction points (surface water, wells, and boreholes). Undertake hydraulic pump testing of all boreholes to be used as long-term water supply source to calculate sustainable yields.	Environmental Manager
		CCRA 17.3	In addition to the measures outlined in the ESIA, the CCRA recommends:	Environmental Manager
		CCRA 17.4	Future climate projections to be taken into account when calculating sustainable water use	Environmental Manager
CCRA 18.0	Reduced water quality from improper disposal of liquid and solid waste during operation of wastewater sites and dump grounds	CCRA 18.0	Establish and enforce strict guidelines for the handling and disposal of hazardous materials within the ESMP as well as the EMS.	Environmental Manager

sn	Potential Impact	Sn	MITIGATION MEASURES	Responsibility
Preconstruction				
HR 1.0	Equal opportunity and non-discrimination	HR 1.1	Implement a recruitment procedure that is transparent and open to all, regardless of race, political beliefs, colour, creed, sexuality, or gender ,includes a strategy for local recruitment, considers social and cultural sensitivities, outlines employment criteria for professional, semi-skilled, and unskilled labour and prohibits discrimination or harassment of job applicants	Contractor
		HR 1.2	The recruitment procedure should include specific non-specifications that include: applicants will not be questioned about their marital status, plans to have children, or number of dependents, as this can be used to discriminate against women due to concerns about their home responsibilities affecting their work commitment.	Contractor
		HR 1.3	A standardized job advertisement template, detailing the necessary skills, will be employed to announce openings. These job vacancies will be advertised in local languages within the Project area through suitable and accessible media, as well as on the project website	Contractor
		HR 1.4	A public awareness program will be developed and implemented to communicate employment and training opportunities	Contractor
		HR 1.5	Information will be disseminated publicly, including through media announcements at regional and national levels (as appropriate) and public meetings with communities in the Project area. Special attention will be given to reaching women and vulnerable groups, utilizing targeted meetings scheduled at times and locations designed to enhance women's participation	Contractor
		HR 1.6	Targets for local employment from communities will be established by the Project	Contractor
		HR 1.7	A whistle blower mechanism will be established to report discrimination cases anonymously without fear of repercussions	Contractor
		HR 1.8	Hiring managers from subcontractors will undergo training on the company's non-discrimination policies	Contractor
		HR 1.9	(Sub) contractors will need to meet quotas for the minimum number of women staff and staff with disabilities or from other vulnerable groups.	Contractor
HR 2.0	Just and favourable working conditions	HR 2.1	Pre-determined set of minimum salary requirement for each position to avoid salary exploitation by employers	Contractor
		HR 2.2	Implement strict monitoring and enforcement mechanisms to ensure timely payment of salaries, and ensure that salaries have been paid	Contractor
		HR 2.3	All employees will have a written contract that is clear, transparent and written in a language that is easy to understand that state the job aspects	Contractor
		HR 2.4	Contracts will be available in the workers' native languages and be explained, if needed, in a clear and understandable manner	Contractor
		HR 2.5	Workers' legal rights will be explained to them	Contractor
		HR 2.6	Develop a grievance redressal mechanism that allows workers to report issues and receive timely resolutions	Contractor
		HR 2.7	An independent system for monitoring and evaluating labour rights will be established	Contractor
		HR 2.8	Due diligence will be carried out to screen contractors and sub-contractors concerning their human rights records related to labour and working conditions	Contractor
		HR 2.9	The Code of Conduct that employees must sign will include a provision stating that any sexual relationship involving a power imbalance will result in the immediate dismissal of the senior individual	Contractor
		HR 2.10	The project will include a standard clause outlining provisions for health insurance, medical leave, and other aspects of medical care.	Contractor
		HR 2.11	For any construction camp that will be built, they must comply with international standards, align the IFC's requirement of the number of project personnel that can be accommodated, include social or entertainment areas, facilities for religious activities and medical facilities, include adequate water and sanitation facilities	Contractor
		HR 2.12	A system will be implemented to track the hours worked by all project employees, aiming to detect and address any practices resulting in excessively long working hours beyond project needs or national legal standards	Contractor
		HR 2.13	The Project will require that all workers in similar jobs receive the same or similar working conditions (such as salary, vacation, insurance, benefits, accommodation, and food	Contractor
		HR 2.14	Men and women will be treated the same and receive equal remuneration	Contractor
HR 3.0	Child labour	HR 3.1	Periodic audits will be carried out to ensure that the Project and Project workers to not engage in any activity that might encourage child labour.	Contractor
		HR 3.2	People working on the Project will be prohibited to engage in any activity that encourage child labour, such as buying goods and products from children working as street vendors.	Contractor
		HR 3.3	Every contract will contain a clause that strictly prohibits the employment of individuals under the age of 18, whether directly or indirectly. Contractors and subcontractors must ensure that their supply chains do not involve any minors. To enforce this clause, periodic inspections and audits will be carried out. If it is discovered that a contractor or subcontractor has employed someone under 18, it will be considered a contract violation, and the child will be removed from the workplace. The child's salary may continue to be paid for a designated period while an alternative solution is found.	Contractor

		HR 3.4	Through ongoing engagement with stakeholders, such as communities, teachers, local authorities and others that are concerned about how the project might impact child labour will be alerted and these stakeholders will be encouraged to use a grievance mechanism if they observe any project-related child labour incidents.	Contractor
HR 4.0	Freedom of association and collective bargaining	HR 4.1	Implement strong oversight mechanisms and ensure that there are clear, accessible channels for workers to report grievances without fear of retaliation.	Contractor
		HR 4.2	Establishing an independent body to oversee labour practices and provide support to workers.	Contractor
		HR 4.3	Fostering a culture of transparency and accountability within the Project.	Contractor
		HR 4.4	The Human Resources department will hold regular town hall-style meetings to share information and gather feedback on labour and working conditions.	Contractor
		HR 4.5	A labour and working conditions management plan will be created that acknowledge workers' right to organise, collectively bargaining and to form trade unions.	Contractor
HR 5.0	Safety and the Working Environment	HR 5.1	PPE equipment required for specific tasks will be provided to all workers.	Contractor
		HR 5.2	Inspections will be conducted to ensure that PPE equipment is used as appropriate.	Contractor
		HR 5.3	Training about cultural awareness and differences amongst workers will be provided.	Contractor
		HR 5.4	Plans for managing malaria and other vector-related conditions will be developed and implemented.	Contractor
		HR 5.5	A management plan for vaccine-preventable diseases will be developed and implemented to prevent the introduction and spread of such diseases by the incoming workforce to the local workforce. This plan will encompass all employees, contractors, and visitors to the project.	Contractor
		HR 5.6	An HIV/STD awareness campaign will be initiated to enhance the awareness and understanding of the risks related to HIV and STDs, detail the associated health implications, and explain the preventative measures available.	Contractor
		HR 5.7	A fatigue management plan will be developed. This will include provisions about driving hours and to avoid driving at night.	Contractor
		HR 5.8	Implement a road safety management plan that includes measures to monitor driver behaviour, hours of work and designated rest areas. This could includes measures such as installing speed measurement devices on all company cars to ensure that speeding limits are respected at all times.	Contractor
		HR 5.9	Work areas will be assessed to identify specific categories of hazards, including physical, chemical, biological, and radiological risks.	Contractor
		HR 5.10	An occupational health and safety training program, tailored to be culturally and linguistically appropriate, will be developed and implemented. This program will be updated regularly to reflect changes in project scope, incident statistics, and regulatory requirements.	Contractor
		HR 5.11	Daily meetings when commencing the workday will be held where health and safety issues are discussed	Contractor
HR 6.0	Access to information and freedom of opinion	HR 6.1	Develop and implement of a comprehensive stakeholder engagement plan	Contractor
		HR 6.2	The SEP should be accompanied by a communications plan and targeted information campaigns that use a variety of media tools with a focus on in-person verbal communication (but also considering print, telephone, internet and social media, where appropriate	Contractor
		HR 6.3	Develop and implement a public awareness program to communicate employment and training opportunities	Contractor
		HR 6.4	Information will be disseminated publicly, including through media announcements at regional and national levels (as appropriate) and public meetings with communities in the Project area. Special attention will be given to reaching women and vulnerable groups, utilizing targeted meetings scheduled at times and locations designed to enhance women's participation	Contractor
		HR 6.5	A formal structure, such as an Ethics Committee, will be established to address incidents of alleged harassment, discrimination, or any other human rights violations related to the work environment	Contractor
		HR 6.6	A whistle blower mechanism will be established to report discrimination cases anonymously without fear of repercussions	Contractor
		HR 6.7	Hiring managers from subcontractors will undergo training on the company's non-discrimination policies	Contractor
		HR 6.8	Develop a grievance mechanism	Contractor
HR 7.0	Gender Equality	HR 7.1	Ensure equal participation of women in all stages of project planning and implementation by setting quotas for women's representation in decision-making processes	Contractor
		HR 7.2	Provide targeted education and training programs for women, including adult education and vocational training, to enhance their skills and employment opportunities	Contractor
		HR 7.3	Implement strict anti-harassment policies and procedures within the project, with clear reporting mechanisms and consequences for violations	Contractor
		HR 7.4	Ensure that employment practices promote gender equality, including equal pay for equal work, and eliminate discriminatory job restrictions	Contractor
		HR 7.5	Provide gender sensitivity training for all workers, especially incoming male workers, to prevent gender-based violence and harassment	Contractor

		HR 7.6	Collaborate with local women's organizations and NGOs to monitor and address gender-based violence and exploitation in the project area	Contractor
		HR 7.7	Develop and enforce a code of conduct for workers that includes zero tolerance for sexual exploitation and abuse	Contractor
		HR 7.8	Establish safe spaces and support services for women, including counselling and legal assistance, to address incidents of violence or harassment	Contractor
		HR 7.9	Ensure fair compensation and relocation assistance for women affected by land acquisition, with specific provisions for widows, divorced, or abandoned women	Contractor
		HR 7.10	Additional human rights mitigation measures related to non-discrimination, land and relocation, health and security are included in those relevant sections of the report	Contractor
HR 8.0	Community health and safety	HR 8.1	Establish mobile health clinics to provide accessible medical care to communities and project workers	Contractor
		HR 8.2	Implement comprehensive malaria control programs, including distribution of insecticide-treated mosquito nets and regular mosquito spraying in affected areas	Contractor
		HR 8.3	Ensure proper waste management and drainage systems to prevent the creation of stagnant water bodies	Contractor
		HR 8.4	Provide clean water and sanitation facilities to reduce the risk of diarrheal diseases	Contractor
		HR 8.5	Implement dust and emission control measures to minimize respiratory issues.	Contractor
		HR 8.6	Conduct regular health screenings and provide vaccinations for tuberculosis and other prevalent diseases	Contractor
		HR 8.7	Offer sexual health education and distribute condoms to prevent the spread of STIs among workers and local populations	Contractor
		HR 8.8	Strengthen the capacity of the reference hospital and other local healthcare facilities through funding, equipment, and staffing support	Contractor
		HR 8.9	Collaborate with local health authorities to monitor health trends and respond promptly to outbreaks	Contractor
HR 9.0	Land, natural resources, and livelihoods	HR 9.1	Implement water management strategies that include regular monitoring of water quality and quantity	Contractor
		HR 9.2	Conduct frequent environmental assessments to monitor the impacts of construction activities on water sources and implement corrective measures as needed	Contractor
		HR 9.3	Ensure that temporary settlements for workers are equipped with sufficient water supply and sanitation facilities to prevent overuse and contamination of local water sources	Contractor
		HR 9.4	Consider investing in the construction and improvement of water supply systems and infrastructure in PACs to meet the increased demand	Contractor
		HR 9.5	Set up waste disposal and sanitation systems in worker camps to prevent contamination of water sources	Contractor
		HR 9.6	Work closely with local government officials to align project activities with ongoing water infrastructure projects and ensure a coordinated approach to water management	Contractor
		HR 9.7	Implement strict pollution control protocols to prevent construction-related contamination of water sources	Contractor
		HR 9.8	Collaborate closely with traditional leaders and municipal authorities to align land distribution practices with legal requirements, preventing conflicts over land ownership	Contractor
		HR 9.9	Ensure proper legal documentation for all land acquisitions and provide legal support to communities to understand their rights	Contractor
		HR 9.10	Develop and implement a fair and transparent relocation plan that includes adequate compensation, relocation assistance, and livelihood restoration programs	Contractor
		HR 9.11	Respect traditional rituals and cultural practices by involving traditional leaders in planning and decision-making processes, especially when relocating cultural sites	Contractor
		HR 9.12	Establish grievance mechanisms to address community concerns	Contractor
		HR 9.13	The land acquisition and compensation process will consider the farming season to ensure that no affected household loses crops without receiving compensation	Contractor
		HR 9.14	Livelihood restoration measures will be monitored after relocation, with additional measures developed and implemented as needed to ensure that livelihoods are restored to at least pre-project levels	Contractor
		HR 9.15	The project will engage directly with those holding customary rights to the land, with the compensation process being witnessed to minimize interference by intermediaries	Contractor
		HR 9.16	The project will assist the government in clarifying disputed land boundaries in the project area, particularly where customary land rights are involved	Contractor
		HR 9.17	Provide the same compensation to people that occupy their land from non-officially approved land documents	Contractor
HR 10.0	Environment	HR 10.1	Implement a Biodiversity Management Plan	Contractor
		HR 10.2	Conduct frequent environmental assessments to monitor the impacts of construction activities on water sources and implement corrective measures as needed	Contractor
		HR 10.3	Set up waste disposal and sanitation systems in worker camps to prevent contamination of water source	Contractor
		HR 10.4	Implement strict pollution control protocols to prevent construction-related contamination of soil and water sources	Contractor

		HR 10.5	Measure to preserve, mitigate and offset environmental impacts are communicated to stakeholders, including local communities	Contractor
HR 11.0	Security	HR 11.1	Provide cultural sensitivity and human rights training to security personnel to ensure they respect human rights and the cultural differences of people from different backgrounds	Contractor
		HR 11.2	Provide training to everyone employed in the Project that focus on respecting people from different backgrounds	Contractor
		HR 11.3	Ensure sufficient security guards the construction sites to reduce the chance of theft	Contractor
		HR 11.4	Implement community patrols during the evening to minimise night-time activity in the Project construction areas and to monitor any suspicious activity	Contractor
		HR 11.5	Develop a security management plan that is aligned with the Voluntary Principles on Security and Human Rights and additional international standards to mitigate any potential impacts that are related to interactions between public and private security forces	Contractor
HR 12.0	Access to remedy	HR 12.1	Establish accessible and transparent grievance mechanisms within the project area to address complaints and disputes efficiently	Contractor
		HR 12.2	The grievance procedure for workers will allow for grievances to be submitted anonymously	Contractor
		HR 12.3	Ensure the project's community grievance mechanism is well communicated among PACs and clearly communicated that it can accept complaints regarding interactions with both public and private security forces	Contractor
		HR 12.4	The grievance mechanism will be aligned in accordance with the UNGP	Contractor
		HR 12.5	All affected stakeholders (including contractor workers and community members) should have access to the Project's grievance mechanism	Contractor
Operations				
HR 1.0	Equal opportunity (Ops)	HR 13.1	Maintain transparent recruitment for operational staff.	Operator
HR 8.0	Community health (Ops)	HR 14.1	Establish mobile health clinics to provide accessible medical care to communities and project workers	Operator
HR 9.0	Livelihoods (Ops)	HR 15.1	Livelihood restoration measures will be monitored after relocation, with additional measures developed and implemented as needed to ensure that livelihoods are restored to at least pre-project levels	Operator
HR 10.0	Environment (Ops)	HR 16.1	Implement Biodiversity Management Plan.	Operator
HR 12.0	Access to remedy (Ops)	HR 17.1	Maintain accessible grievance mechanisms.	Operator

Sn	Potential Impacts	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring Sites	Responsibility	Project Management Plan/SOP
					Preconstruction and Construction					
S1.0	Social tension with foreign workforce	S1.1	Project recruitment policy includes effective local employment strategy, that includes training and capacity building and hiring metrics. The strategy must include gender targets	Recruitment policy should have a recruitment monitoring and evaluation framework	Approved recruitment policy.	No project activities/hiring processes undertaken without an approved recruitment policy.	Prior to project commencement, then quarterly.	Communities along railway corridor Aoi, Camps	Contractor	
				Trained community members and signed training register	Number of approved trainings and trained community members	Personnel involved in project activities should include be trained community members	Quarterly	Communities along railway corridor Aoi, Camps	Contractor	
				target of at least 50% of female and male local hires	Number of locals hired	No project activities undertaken without the inclusion of local hires	Quarterly	Communities along railway corridor Aoi, Camps	Contractor	
				Effectively implement support programs and ensuring females actively participate	Records and number of training/support programs received by women and number of participants	All female employees should undertake project	Quarterly	Communities along railway corridor Aoi, Camps	Contractor	
	Social tension with foreign workforce	S1.2	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues	Record of CLO engagements with communities, discussing project issues.	Number of community engagements and grievances raised.	No project activities undertaken without engaging and CLO appointment.	Prior to project commencement, once during pre-construction and monthly during construction	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Social tension with foreign workforce	S1.3	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances	Number of reported issues and grievances raised	Number of addressed and closed-out grievances	No project activities undertaken without an approved grievance mechanism	Prior to project commencement, once during pre-construction and monthly during construction	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Social tension with foreign workforce	S1.4	A workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspects such as sexual exploitation, respect to religious and traditional matters, hunting, and fishing.	Code of conduct should include community engagement programs	Approved workforce code of conduct	No project activities undertaken without an approved workforce code of conduct	Prior to project commencement, once during pre-construction and monthly during construction	Communities along railway corridor Aoi, Camps	Contractor	
S2.0	Influx induced changes to social fabric	S2.1	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues	Record of CLO engagements with communities, discussing project issues	Number of community engagements and grievances raised	No project activities undertaken without engaging and CLO appointment	Prior to project commencement	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Influx induced changes to social fabric	S2.2	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances.	Number of reported issues and grievances raised	Number of addressed and closed-out grievances	No project activities undertaken without an approved grievance mechanism	Prior to project commencement	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

	Influx induced changes to social fabric	S2.3	Develop a workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspects such as sexual exploitation, respect to religious and traditional matters, hunting, and fishing.	Code of conduct should include community engagement programs	Approved workforce code of conduct	No project activities undertaken without an approved workforce code of conduct	Prior to project commencement	Communities along railway corridor Aoi, Camps	Contractor	
S3.0	Additional pressure on services for positive well-being	S3.1	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues	Record of CLO engagements with communities and workers, discussing project issues	Number of engagements and grievances raised	No project activities undertaken without engaging and CLO appointment	Prior to project commencement	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Additional pressure on services for positive well-being	S3.2	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances	Number of reported issues and grievances raised	Number of addressed and closed-out grievances	No project activities undertaken without an approved grievance mechanism	Prior to project commencement	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Additional pressure on services for positive well-being	S3.3	A workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspects such as use of public infrastructure, social services used by the community, respect for community religious and cultural practices, etc	Code of conduct should include community engagement programs	Approved workforce code of conduct	No project activities undertaken without an approved workforce code of conduct	Prior to project commencement	Communities along railway corridor Aoi, Camps	Contractor	
				code of conduct monitoring report on the implementation of the code of conduct that includes list of distribution, training, disciplinary actions and corrective actions taken	number of code of conduct monitoring reports	No Annual report without at least two monitoring reports undertaken (i.e. every 6 months) incorporated	6 monthly	Communities along railway corridor Aoi, Camps	Contractor	
	Additional pressure on services for positive well-being	S3.4	Consider sport and recreational activities within camps for workers	Creation of recreational facilities (i.e. mini football fields, gym equipment). For other social services refer to S35	Number of facility and participatory records	All workers to participate in at least 1 recreational activity	Prior to project commencement, then quarterly	Project camp sites	Contractor	
	Additional pressure on services for positive well-being	S3.5	Establish work schedules that enable workers to participate in religious/spiritual gatherings and events	Development of surveys to assess whether work schedules are effectively accommodating workers needs	Number or percentage of workers who attend and participate in religious or spiritual gatherings and events from surveys	No workers shall undertaken project activities that conflict with their religious/spiritual events	Prior to project commencement	Project camp sites	Contractor	PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN
	Additional pressure on services for positive well-being	S3.6	Conduct cultural sensitivity training for both migrant workers and local community members to promote understanding and reduce potential conflicts	Prepare educational materials and raise public awareness on the relevance of maintaining local values and cultures	Number of education materials distributed and events attended by employees	Increased awareness of cultural heritage	Prior to project commencement, then quarterly	Project camp sites	Contractor	
	Accessibility and connectivity	S4.1	Identify and construct alternative pathways that connect villages and fields, ensuring that these new paths are safe, clearly marked, and easily accessible	Developed traffic management plan should include community engagements and information on alternative paths	Number of approved alternative paths	No project activities undertaken without traffic management plan and approved alternative paths from community leaders	Prior to project commencement, then quarterly	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN

S4.0	Accessibility and connectivity	S4.2	Identify additional level crossings that may be required during the detailed design phase	Include community members in design planning to identify required level crossings	Number of engagements	No project activities undertaken without including design plans from community leaders	Prior to project commencement, then quarterly	Communities along railway corridor Aoi, Camps	Contractor	
	Accessibility and connectivity	S4.3	Engage with local communities to understand their specific connectivity needs and collaboratively plan the locations and design of new pathways or crossings, particularly connectivity needs to agricultural land, cultural heritage sites, places of worship as well as medicinal plant locations	Engagements with communities to identify alternative paths suitable to them	Number of community engagements and recorded paths, cultural practices/event	No project activities undertaken without engaging and receiving approval from community leaders	Prior to project commencement, then quarterly	Communities along railway corridor Aoi, Camps	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
Operations										
S5.0	Accessibility and connectivity	S5.1	Install clear signposts and wayfinding markers on both existing and new footpaths to help community members navigate the altered landscape. Consider building pedestrian walkways next to the railway bridges	Developed traffic management plan should include community engagements and information on alternative paths	Number of approved alternative paths	No project activities undertaken without traffic management plan and approved alternative paths from community leaders	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Accessibility and connectivity	S5.2	All stations and trains must be accessible to people with restricted mobility through the use of ramps, handrails, accessible train carriages, wide entrances amongst others. Special rates for the elderly and people with special needs, travel cards or local discounts must be considered	Conducting regular audits of all stations to evaluate compliance with accessibility standards and effectiveness of elderly discount travel cards	Records of audits and findings	No station shall operate without implemented accessibility equipment	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Accessibility and connectivity	S5.3	Establish a regular maintenance program for the new and existing footpaths, overpasses, and underpasses to ensure they remain safe and usable	Develop program / education/ training provided to staff	Records of cleaning and maintenance schedules, methods and post-cleaning inspections	No project activities undertaken by untrained staff	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Accessibility and connectivity	S5.4	Conduct awareness campaigns to inform the community about the new pathways, crossings, and any changes to the existing footpath network	Program / education/ awareness campaigns provided to communities	Records of campaigns and community engagements	Increased awareness of alternative paths	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Accessibility and connectivity	S5.5	Appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues	Record of CLO engagements with communities and workers, discussing project issues	Number of engagements and grievances raised	No project activities undertaken without engaging and CLO appointment	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Accessibility and connectivity	S5.6	Develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances. The community must assist with developing the grievance mechanism	Number of reported issues and grievances raised	Number of addressed and closed-out grievances	No project activities undertaken without an approved grievance mechanism	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Social tension with foreign workforce	S6.1	Establish ongoing training and development programs for local community members to increase their skill levels and enhance employability for semi-skilled and skilled positions	Trained community members and signed training register	Number of approved trainings and trained community members	Personnel involved in project activities should include be trained community members	Quarterly	Communities along railway corridor Aoi	Operator	
	Social tension with foreign workforce	S6.2	The contractor should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets	Recruitment policy should include a required percentage of female and male local hires	Number of locals hired	No project activities undertaken without the inclusion of local hires	Quarterly	Communities along railway corridor Aoi	Operator	

S 6.0	Social tension with foreign workforce	S6.3	Develop and implement recruitment policies that prioritise hiring from the local community and Angolan nationals, with specific targets for female participation at least 10% of female in skilled and semi-skilled roles	Recruitment policy should have a recruitment monitoring and evaluation framework that includes training and capacity building and hiring metrics	Approved recruitment policy	No project activities/hiring processes undertaken without an approved recruitment policy	Quarterly	Communities along railway corridor Aoi	Operator	
	Social tension with foreign workforce	S6.4	Provide support programs for female employees, such as mentorship, career advancement opportunities, and safe working conditions	Effectively implement support programs and ensuring females actively participate	Records and number of training/support programs received by women and number of participants	All female employees should undertake project	Quarterly	Communities along railway corridor Aoi	Operator	
S7.0	Influx induced changes to social fabric	S7.1	The contractor should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets	Recruitment policy should include a required percentage of female and male local hires	Number of locals hired	No project activities undertaken without the inclusion of local hires	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Influx induced changes to social fabric	S7.2	Ensure that the hiring process prioritises local residents for available positions while also offering fair opportunities to qualified migrants	Records of local vs migrants hires	Number of qualified locals hired	No project activities undertaken without the inclusion of local hires	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Influx induced changes to social fabric	S7.3	Develop and implement programs that facilitate the integration of migrants into the local community, such as cultural exchange events, sports activities, and social gatherings	Prepare educational materials and raise public awareness on the relevance of maintaining local values and cultures	Number of education materials distributed and events attended by employees	Increased awareness of cultural heritage	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Influx induced changes to social fabric	S7.4	Plan and develop adequate housing and infrastructure to accommodate the influx of workers, ensuring that it does not strain existing community resources	Campsites should have housing units or space sufficient to accommodate from construction phase	Number of housing units provided to workers	All project employees shall only reside within the constructed camp facilities	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Influx induced changes to social fabric	S7.5	Implement an influx management plan	Influx management plan should include educational/awareness programs relating to the culture, resources, health and safety	Approved and implemented influx management plan	No project activities undertaken without approved influx management plan	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
S8.0	Additional pressure on services for positive well-being	S8.1	The contractor should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets	Recruitment policy should include a required percentage of female and male local hires	Number of locals hired	No project activities undertaken without the inclusion of local hires	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Additional pressure on services for positive well-being	S8.2	Collaborate with telecommunications providers to enhance mobile phone reception and internet connectivity in the project area and surrounding villages	Perform internet speed tests with various telecommunications providers and make use of signal boosters	Records of tests conducted including identified weak mobile and internet reception areas	In areas where reception is weak reception shall have signal boosters	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Additional pressure on services for positive well-being	S8.3	Develop social and recreational facilities such as community centres, sports areas, and common spaces where migrant workers can socialize and engage in leisure activities	Creation of recreational facilities (i.e. mini football fields, gym equipment)	Number of facility and participatory records	All workers to participate in at least 1 recreational activity	Quarterly	Communities along railway corridor Aoi, Camps	Operator	
	Additional pressure on services for positive well-being	S8.4	Conduct cultural sensitivity training for both migrant workers and local community members to promote understanding and reduce potential conflicts	Prepare educational materials and raise public awareness on the relevance of maintaining local values and cultures	Number of education materials distributed and events attended by employees	Increased awareness of cultural heritage	Quarterly	Communities along railway corridor Aoi, Camps	Operator	

Sn	Potential Impacts	SN	Mitigation measure	Parameter (to measure the implementation of the	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring Sites	Responsibility	Project Management Plan/SOP
					construction					
S 9.0	Economic and physical displacement and livelihoods disruptions	S9.1	Preliminary design of the railway line, stations locations and layouts have been revised on multiple occasions during ESIA stage to avoid displacement impacts and where avoidance is not feasible, impacts minimisation has been adopted. Refer Chapter 3 (Project Alternatives)							
	Economic and physical displacement and livelihoods disruptions	S9.2	A Resettlement Policy Framework (RPF) has been developed to guide the management of land acquisition, resettlement, and livelihood restoration impacts associated with the Project, in accordance with Angolan legislations, IFC PS6 and other applicable international standards[1]							

Economic and physical displacement and livelihoods disruptions	S9.3	Following finalisation of the detailed design, site-specific Resettlement Action Plans (RAPs) and Livelihoods Restoration Plans (LRPs) will be prepared based on comprehensive socio-economic surveys, asset inventories, and stakeholder engagement. Compensation and assistance will be implemented prior to the commencement of construction in affected areas.							
Economic and physical displacement and livelihoods disruptions	S9.4	Replacement land is the preferred form of compensation for loss of land, particularly for customary land users, consistent with Angola's national practices. Cash compensation is provided for affected assets and improvements, including crops, trees, and structures, at replacement cost							
Economic and physical displacement and livelihoods disruptions	S9.5	Livelihood restoration measures will be implemented to address economic displacement and support the restoration of income and food security							
Economic and physical displacement and livelihoods disruptions	S9.6	RAPs and LRPs will be implemented on a phased basis, aligned with Project construction sequencing							
Economic and physical displacement and livelihoods disruptions	S9.7	Ongoing monitoring and adaptive management will be applied							

	Economic and physical displacement and livelihoods disruptions	S9.8	A community Grievance Redress Mechanism will be implemented to allow community members to promptly raise any grievances related to land acquisition and resettlement with the project proponent							
	Inequality in compensation and livelihood restoration interventions	S10.1	Integration of the Gender Action Plan (GAP) in the entire resettlement planning and implementation	PAHs compensated according to the approved RAP	Number of PAHs compensated	No grievances or claims from PAHs	Quarterly	Project affected households and communities	Contrator	Note: the Project RAP and LRP shall be developed and implemented to address displacement
	Inequality in compensation and livelihood restoration interventions	S10.2	Ongoing monitoring and adaptive management will be applied						Contrator	
	Inequality in compensation and livelihood restoration interventions	S10.3	Implement a Grievance Mechanism to allow community members to promptly raise any grievances related to land acquisition with the project proponent	Number of grievances addressed within the prescribed redress timeframe	Number of grievances	No grievance left not addressed beyond 6 months	Reviewed every 6 months	Project affected households and communities	Contrator	
S10.0	Value of land	S11.1	The project proponent must compile a relocation action plan (RAP) and livelihood restoration plan (LRP) according to international best practice inform the current value of land	Approved RAP document that includes an LRP	Date update made and approval	Construction implemented with an approved RAP document that includes an LRP	Weekly during construction	Project affected households and communities	Contrator	

	Value of land	S11.2	Implement a clear, transparent, and well-communicated compensation process that ensures all stakeholders understand the criteria and procedures	Compensation entitlements matrix and register with both men and women of respective households	Date update made and approval	No compensation made that is not aligned with the approved compensation matrix	Reviewed every 6 month	Project affected households and communities	Contrator	
	Value of land	S11.3	Involve an independent third-party auditor to oversee the compensation distribution and resolve disputes impartially	Report from a Third Party auditor contracted	Number of audit reports	Construction implemented with annual monitoring report that includes input from the Auditor report	reviewed annually	Project affected households and communities	Contrator	
S12.0	Land as catalyst for tensions in communities	S12.1	Implement a clear, transparent, and well-communicated compensation process that ensures all stakeholders understand the criteria and procedures	Compensation entitlements matrix that reflects fair replacement value	Percentage of potentially impacted land rights holders who have received compensation entitlements and supplementary assistance as per	No affected individuals or households are left without compensation or adequate support	Quarterly	Project affected households and communities	Contrator	
	Land as catalyst for tensions in communities	S12.2	Conduct regular and inclusive consultations with all affected community members to address concerns and explain the compensation process	Stakeholder Engagement activities with landowners and business owners	Number of engagement activities with land/business owners	No construction without documented evidence	Quarterly	Project affected households and communities	Contrator	
	Land as catalyst for tensions in communities	S12.3	Establish a grievance redress mechanism where individuals can report and resolve issues related to perceived inequalities	Monitoring reports of SE&GRMP	Number of monitoring reports	Documented monitoring to Project's SE&GRMP	Reviewed annually	Project affected households and communities	Contrator	
	Land as catalyst for tensions in communities	S12.4	Use of community mediation committees to facilitate dialogue and mitigate tensions that arise between different groups regarding compensation	Organised mediation committees at municipalities	Number of community mediation committee sessions held	No grievances or claims from PAHs on insufficient mediation	Reviewed annually	Project affected households and communities	Contrator	
	Land as catalyst for tensions in communities	S12.5	Provide psychological and social support services to help affected individuals cope with the changes and potential conflicts	Stakeholder Engagement activities with community members	Number of community engagement activities	No construction without documented evidence	Quarterly	Project affected households and communities	Contrator	

	Land as catalyst for tensions in communities	S12.6	Ongoing monitoring and adaptive management will be applied	Developed monitoring and adaptive management document	Approved monitoring and adaptive management document	use of approved monitoring and adaptive managemet document	Quarterly	Project affected households and communities	Contrator	
S13.0	Misappropriation of funds	S13.1	Replacement land is the preferred form of compensation for loss of land, particularly for customary land users, consistent with Angola's national practices. Cash compensation is provided for affected assets and improvements, including crops, trees, and structures, at replacement cost	PAHs compensated according to the approved RAP	Number of PAHs compensated	No grievances or claims from PAHs	Quarterly	Project affected households	Contrator	
	Misappropriation of funds	S13.2	Livelihood restoration measures will be implemented to address economic displacement and support the restoration of income and food security	Approved RAP document that includes an LRP	Date update made and approval	No new construction areas without documented implementation of the RAP	Reviewed annually	Project affected households	Contrator	
		S13.3	Implement financial literacy and livelihood support programs for recipients of cash compensation to ensure they effectively use their funds to re-establish their livelihoods	Financial literacy engagement activities with land and business owners	Number of engagement activities with land/business owners	At least one engagement every 6 months	Reviewed every 6 month	Project affected households	Contrator	
	Misappropriation of funds	S13.4	Ongoing monitoring and adaptive management will be applied	Community Liaison Officers employed	Number of CLOs employed	At least one engagement every 6 months	Reviewed every 6 month	Project affected households	Contrator	

Sn	Potential Impacts	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring Sites	Responsibility	Project Management Plan/SOP
Preconstruction and Construction										
S 17.0	Direct local employment opportunities	S 17.1	Ensure fair and transparent recruitment processes that prioritise local hiring	Public advertising and awareness campaigns around recruitment processes and requirements for locals	Number of awareness campaigns and locals hires	Increased awareness of recruitment processes and requirements	Prior to project commencement, then as recruitments needs arise to be reported annually	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Contractor	
	Direct local employment opportunities	S 17.2	Local content optimisation and integration in all project activities and supply chain	Contracts awarded to local suppliers and service providers	Number of contracts awarded to local suppliers and service providers	≥30% of total procurement value	Quarterly	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Contractor	
	Direct local employment opportunities	S 17.3	Mainstreaming gender-related considerations including equal employment opportunities throughout Project activities and supply chain	Women employed across project roles	Number of women employed across project roles	≥25% of total workforce	Quarterly	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Contractor	
	Direct local employment opportunities	S 17.4	Consideration of vulnerable and marginalised groups in the employment opportunities implement training programs to upskill local workers, ensuring they qualify for various roles within the railway Project	Records and number of workers who received training and development and number of approved training programs	Number of workers who received training	All employees with a contract have undergone at least one training	6 monthly	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Contractor	
	Direct local employment opportunities	S 17.5	Communicate the availability of jobs to the community in a mutually agreed and accessible manner. Ensure that communication include women	Public advertising and awareness campaigns around recruitment processes and requirements for locals	Number of awareness campaigns and locals hires	Increased awareness of recruitment processes and requirements	Prior to project commencement, then as recruitments needs arise to be reported annually	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Contractor	
	Direct local employment opportunities	S 17.6	Implement an accessible and transparent worker grievance mechanism to provide a platform for workers to submit complaints and comments regarding labour and working conditions	Monitoring reports of SE&GRMP	Number of monitoring reports	Documented monitoring to Project's SE&GRMP	Reviewed annually	Project affected households and communities	Contrator	
S18.0	Skills development opportunities	S18.1	Skills development plans must be a contractual requirement. These plans must be focused on skills that the project needs, and that are also transferable. Support must be given to people after the training to ensure that their newly acquired skills can be implemented	Records and number of workers who received training and development and audit specific skills required for the project	Number of workers who received training	All employees with a contract that offers training opportunities	Prior to project commencement	Training centres along the corridor, communities, Camps	Contractor	

	Skills development opportunities	S18.2	fostering on-the job training and collaboration with the existing vocational training centres or through OEC's internship/graduate recruitment and development scheme	workers enrolled in OEC/vocational programs	Number workers enrolled in OEC/vocational programs	≥20% of workforce annually	Annual	Training centres, project sites	Contractor	
	Skills development opportunities	S18.3	attaching non-skilled workers with the semi-skilled and/or skilled ones to facilitate skills and knowledge transfer on the job	Initiating mentorship pairings	Number of mentorship	≥50 pairings per year	Quarterly	Camps, worksites	Contractor	
	Skills development opportunities	S18.4	priority to communities within the Project area in the employment and skills development	Hired people from local PACs	Number of hired people from local PACs	≥30%	Quarterly	HR records	Contractor	
	Skills development opportunities	S18.5	Establishing mentorship or apprenticeship programs wherein experienced professionals within the Project provide guidance and support to newly employed locals	Apprenticeships created	Number of apprenticeships created	≥10 apprenticeships per year	Annual	Camps, worksites	Contractor	
S19.0	Indirect Employment opportunities	S19.1	The project proponent should ensure a fair number of secondary economic opportunities are given to local contractors. Services and goods must be procured locally as far as reasonably possible. Aspects of this positive impact will occur by default when the construction force lives locally and they utilise local services and support local shops	Database of local suppliers and service providers and/or a local procurement policy with specified targets of goods and services that should be sourced locally	Number of local suppliers and service providers on the database	No construction without an approved procurement policy that includes local suppliers and service providers	Prior to project commencement, then every 6 months	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Contractor	
S20.0	Risk of inequitable access to employment and income-generating opportunities	S20.1	The contractor should put measures in place to ensure the most effective local employment strategy is deployed. The strategy must include targets for gender equality targets	Recruitment Policy and reporting with gender equality targets	percentage of female and male local hires	No project activities undertaken without a Recruitment Policy that has gender equality targets	Prior to project commencement, then annually	Communities along railway corridor Aoi, Camps, Materials sourcing areas, supply chain	Contractor	
	Risk of inequitable access to employment and income-generating opportunities	S20.2	Establishing and enforcing policies and plans that promote diversity and inclusivity within the employment framework	Existence of Diversity & Inclusion Policy and % of workforce from under-represented groups	Existence of approved Diversity & Inclusion Policy and % of workforce from	Policy in place; ≥20% of workforce from vulnerable groups	Annual	HR records, project sites, supply chain	Contractor	
	Risk of inequitable access to employment and income-generating opportunities	S20.3	Equip women with the necessary skills to qualify for a broader range of employment opportunities within the project	Records and number of female workers who received training and development and number of approved training programs	Number of female workers who received training	All female employees with a contract have undergone at least one training	6 monthly	Communities along railway corridor Aoi, Camps, Materials sourcing areas, supply chain	Contractor	

	Risk of inequitable access to employment and income-generating opportunities	S20.4	Create a supportive and flexible work environment that accommodates the needs of women, including provisions for childcare, flexible working hours, and safe work conditions	HR Policy and reporting with gender inclusive targets	Number of gender inclusive targets	No grievances from female employees on an non-conducive working environment	Prior to project commencement, then annually	Communities along railway corridor Aoi, Camps, Materials sourcing areas, supply chain	Contractor	
S21.0	Local inflation risks	S21.1	Project construction workers will be accommodated in the planned five construction camps to avoid/minimize housing over-demand within local communities and mitigate potential inflationary risks on the housing markets	Workers housed in camps	Number of workers housed in camps	≥80%	Quarterly	Worker camps	Contractor	
	Local inflation risks	S21.2	Arrange dedicated transport for workers living outside the Project camps, preventing the potential inflation impacts on local public transport	Dedicated transport services	Number of dedicated transport services	≥1 per camp	Quarterly	Transport depots	Contractor	
	Local inflation risks	S21.3	Encourage local production of goods to increase supply and stabilise prices	Local suppliers supported	Number of local suppliers supported	≥10 suppliers/year	Annual	Local markets	Contractor	
	Local inflation risks	S21.4	Continuous monitoring of the population influx and local infrastructure capabilities	Monitoring reports	Count	≥2/year	Biannual	PACs, towns	Contractor	
	Local inflation risks	S21.5	In the event that substantial project-induced inflation is **reported as a major (frequent) grievance,** the Project will consider alternative and duly qualified suppliers based outside of the project-affected communities	Grievances recorded regarding inflation of prices	Number of grievances	No grievances left not addressed for more than 6 months	6 monthly	Villages & towns along the railway corridor	Contractor	
S22.0	Affordability of the railway transport for passengers and cargo	S22.1	Encourage local sourcing, contract local suppliers for goods and services required during the construction phase. This helps to stimulate the local economy and reduce the impact of increased demand.	Develop a database of local suppliers and service providers and/or a local procurement policy with specified targets of goods and services that should be sourced locally	Number of local suppliers and service providers on the database	Annual reports with suppliers, sub-contractors and service providers	Annually	Villages & towns along the railway corridor	Contractor	
S23.0	Improved livelihoods, local economic and empowerment	S23.1	Encouraging the creation of local supply chains by facilitating connections between the Project construction activities and local businesses	Engagements with farmers to understand production capabilities and provide educational/awareness support programs	Number of engagements undertaken and programs developed	No project activities undertaken without developed programs for farmers	Every 6 months	Villages & towns along the railway corridor	Contractor	
	Improved livelihoods, local economic and empowerment	S23.2	The Project will actively support local businesses by procuring goods and services from nearby enterprises. This practice stimulates economic growth within the community, benefiting entrepreneurs and bolstering the local economy	Engage with local agricultural extension services, farmers and industry experts to ensure that farmers are the supported through programs, funding and low-interest loans	Number of farmers who received funds, loans, programs	Ensure project activities commence farmers CSR initiatives developed	Every 6 months	Villages & towns along the railway corridor	Contractor	

	Improved livelihoods, local economic and empowerment	S23.3	Include local procurement policies and commitments to sourcing produce from local farmers within project area and vicinity of the worker accommodation camps	Engage with local farmers and industry experts to ensure that farmers are the supported through programs,	Number of farmers who receive support from workers around accomodation camps	Every worker provide reciept of supporrt	Quarterly	Villages & towns along the railway corridor	Contractor	
	Improved livelihoods, local economic and empowerment	S23.4	Implementation of livelihood restoration programs (LRP) such as capacity building, – provide training programs for local farmers to increase productivity and efficiency. This could include modern farming techniques, pest control, and sustainable practices.	Assist with opening local markes	Number of markets opened	Ensure promotion of local markets	Quarterly	Villages & towns along the railway corridor	Contractor	
	Improved livelihoods, local economic and empowerment	S23.5	Implement Luena-Saurimo project LRP sub-programs as 'open-access' to provide the host community with the opportunity to upgrade skills within e.g., agriculture and small businesses	Engagements with local suppliers to understand production capabilities and provide educational/awareness support programs	Number of engagements undertaken	Ensure local suppliers receive the opportunity to supply goods and services through the project	Every 6 months	Villages & towns along the railway corridor	Contractor	
S24.0	Community tensions from unfair or unaccepted governance systems	S24.1	Community and other stakeholders expectations management through continuous stakeholder engagement as per SEP, establishing transparent communication channels to manage community expectations effectively	Engagements with the community/traditional leaders	Number of community engagements with traditional leaders	Annual reports with at least one engagement conducted per quarter	Quarterly	Communities along railway corridor Aoi, communities adjacent to the Camps & works areas	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Community tensions from unfair or unaccepted governance systems	S24.2	Engaging in continuous dialogue with the community, explaining the realistic scope of employment prospects and provide insights into the skills and qualifications necessary for various roles	Dialogues held	Number dialogues held	≥2/quarter	Quarterly	PACs	Contractor	
	Community tensions from unfair or unaccepted governance systems	S24.3	**Broadening community participation in project-related benefits beyond direct employment**	Community benefit initiatives	Number community benefit initiatives	≥3/year	Annual	PACs	Contractor	
	Community tensions from unfair or unaccepted governance systems	S24.4	Developing robust grievance redress mechanisms to address concerns and dissatisfaction within the community regarding employment opportunities, land access and resettlement issues	Grievances resolved within 30 days	Number rievances resolved within 30 days	≥80%	Quarterly	PACs	Contractor	
	Community tensions from unfair or unaccepted governance systems	S24.5	Implement the Stakeholder Engagement Plan for construction. Create forums for regular dialogue between traditional and public authorities, youth and women's representatives, new arrivals, and other community members, as described in the Stakeholder Engagement Plan	Number of dialogues between traditional and public authorities, youth and women's representatives, new arrivals, and other community members	Number of engagements with disaggregated data on age, gender and position/designation /occupation	Annual reports with at least one engagement conducted per quarter	Quarterly	Communities along railway corridor Aoi, communities adjacent to the Camps & works areas	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Community tensions from unfair or unaccepted governance systems	S24.6	Disseminate timely and accurate information regarding project progress to stakeholders at the local, provincial and national levels as described in the Stakeholder Engagement Plan	Dissemination activities and materials in form of print/radio/public announcements	Number of dissemination activities/ materials	Annual reports with at least one dissemination activity or material per quarter	Quarterly	Communities along railway corridor Aoi, communities adjacent to the Camps & works areas	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
				Operations						

S25.0	Direct employment opportunities	S25.1	Ensure fair and transparent recruitment processes that prioritise local hiring	Public advertising and awareness campaigns around recruitment processes and requirements for locals	Number of awareness campaigns and locals hires	increased awareness of recruitment processes and requirements	Prior to project commencement, then as recruitments needs arise to be reported annually	Communities along the corridor, Stations & maintenance yards	Operator	
	Direct employment opportunities	S25.2	Implement training programs to upskill local workers, ensuring they qualify for various roles within the railway Project	Records and number of workers who received training and development and number of approved training programs	Number of workers who received training	All employees with a contract have undergone at least one training	6 monthly	Communities along the corridor, Stations & maintenance yards	Operator	
	Direct employment opportunities	S25.3	Advertisement of the available opportunities to the wider public and encouraging local communities to take up the opportunities	Adverts published	Number of adverts published	≥5/year	Annual	Corridor communities	Operator	
	Direct employment opportunities	S25.4	Mainstreaming gender-related considerations including equal employment opportunities throughout Project activities and supply chain	Women in workforce	Women in workforce	More women found in workforce	Annual	HR records	Operator	
S26.0	Skills development opportunities	S26.1	The project needs to retain local labour where feasible for the operation and maintenance works of the railway Infrastructure and facilities.	Records of employees with contracts	Number of employees with contracts	No employee without a contract	6 monthly	Training centres along the corridor, Stations and railway workshops/yards	Operator	
	Skills development opportunities	S26.2	Developing structured training programs that align with the local needs	Organized training programs	Approved organized training programs	≥2/year	Annual	Training centres	Operator	
	Skills development opportunities	S26.3	Introducing initiatives aimed at capacity building within the local community, including collaborating with educational institutions or vocational training centres to offer specialized courses that cater to the skill demands of the Project	Partnerships with institutions	Number of partnerships with institutions	More partnerships	Annual	Corridor institutions	Operator	
	Skills development opportunities	S26.4	Establishing mentorship or apprenticeship programs wherein experienced professionals within the Project provide guidance and support to newly employed locals.	Apprenticeships created	Number of apprenticeships created	≥10/year	Annual	Workshops, stations	Operator	

S27.0	Indirect employment opportunities	S27.1	Encourage procurement of goods and services from local businesses to support the local economy	Database of local suppliers and service providers and/or a local procurement policy with specified targets of goods and services that should be sourced locally	Number of local suppliers and service providers on the database	No construction without an approved procurement policy that includes local suppliers and service providers	Prior to commencement of operations, then every 6 months	Communities along the corridor, Stations & maintenance yards	Operator	
	Indirect Employment opportunities	S27.2	Provide training and support for local businesses to help them meet the demands generated by the railway Project	Records and number of suppliers and service providers who received training and development and number of approved training programs	Number of suppliers and service providers who received training	All suppliers and service providers with a contract have undergone at least one training	Annually	Communities along the corridor, Stations & maintenance yards	Operator	
S28.0	Risk of inequitable access to employment and income-generating opportunities	S28.1	The operator should put measures in place to ensure the most effective local employment strategy is deployed. The strategy must include targets for gender equality target, particularly in both skilled and unskilled roles	Recruitment Policy and reporting with gender equality targets	Percentage of female and male local hires	No project activities undertaken without a Recruitment Policy that has gender equality targets	Prior to project commencement, then annually	Communities along the corridor, Stations & maintenance yards, railway employees, supply chain	Operator	
	Risk of inequitable access to employment and income-generating opportunities	S28.2	Provide specialized training and skills development programs for women to equip them with the necessary skills to qualify for a broader range of employment opportunities within the project	Records and number of female workers who received training and development and number of approved training programs	Number of female workers who received training	All female employees with a contract have undergone at least one training	6 monthly	Communities along the corridor, Stations & maintenance yards, railway employees, supply chain	Operator	
	Risk of inequitable access to employment and income-generating opportunities	S28.3	Create a supportive and flexible work environment that accommodates the needs of women, including provisions for childcare, flexible working hours, and safe work conditions	HR Policy and reporting with gender inclusive targets	Number of gender inclusive targets	No grievances from female employees on an non-conducive working environment	Prior to project commencement, then annually	Communities along the corridor, Stations & maintenance yards, railway employees, supply chain	Operator	
S29.0	Local inflation risks	S29.1	Encourage local production of goods to increase supply and stabilise prices	Engagements with local suppliers to understand production capabilities	Number of engagements undertaken	Annual report with evidence of engagement with local suppliers and opportunities available to supply goods and services through the project	Annually	Villages & towns along the railway corridor	Operator	
	Local inflation risks	S29.2	Prioritise sourcing good and services from local suppliers and contractors	Establish a monitoring and regulatory committee to make sure the local business is supported	Database of buyers goods and services	Annual reports including any findings/rends on local inflation	Annually	Villages & towns along the railway corridor	Operator	
S30.0	Improved mobility, accessibility and Port connectivity	S30.1	implementing routine and periodic maintenance activities of the railway infrastructure for continuous and reliable service provision throughout the year	Maintenance activities completed	Number of maintenance activities completed	≥4/year	Quarterly	Stations, tracks	Operator	
	Improved mobility, accessibility and Port connectivity	S30.2	Review of fares for both passengers and freight to a rate similar or cheaper with other available transport means	Fare reviews conducted	Number of fare reviews conducted	≥1/year	Annual	Operator HQ	Operator	
	Improved mobility, accessibility and Port connectivity	S30.3	Ensure equal opportunities remain active for all communities	Grievances recorded regarding accessibility	Number of grievances	No grievances left not addressed for more than 6 months	6 monthly	Villages & towns along the railway corridor	Operator	

	Improved mobility, accessibility and Port connectivity	S30.4	Develop a partnership model with the operator and communities to establish a community-based feeder transportation service program to enhance access to the proposed stations. The program will utilise local community vehicles (minivans, three-wheelers etc.,) to provide connections from community hubs directly to the train station at synchronised train timetables	Feeder services established	Number of vehicles provided	More than one per station	Annual	Stations	Operator	
	Improved mobility, accessibility and Port connectivity	S30.5	All stations and trains must be accessible to people with restricted mobility through the use of ramps, handrails, accessible train carriages, wide entrances amongst others. Special rates for the elderly and people with special needs, travel cards or local discounts must be considered	Conducting regular audits of all stations to evaluate compliance with accessibility standards and effectiveness of elderly discount travel cards	Records of audits and findings	No station shall operate without implemented accessibility equipment	Prior to project commencement, then quarterly	Villages & towns along the railway corridor	Operator	
S31.0	Affordability of the railway transport for passengers and cargo	S31.1	Operator to review ticket fairs and comparisons with other modalities along the railway corridor to optimise community/users' affordability of the ticket prices to being similar or less than alternative transport methods	Community engagements on price monitoring records and rates	Number of engagements	No station shall operate without implemented fare options specific to communities	Annually	Villages & towns along the railway corridor	Operator	
	Affordability of the railway transport for passengers and cargo	S31.2	Continuous key stakeholders engagement and communications including grievances redress mechanism	Grievances recorded of SE	Number of grievances	No grievances left not addressed for more than 6 months	6 monthly	Villages & towns along the railway corridor	Operator	
S32.0	Economic empowerment	S32.1	Encouraging the creation of local supply chains by facilitating connections between the Project and local businesses	Engage with local local supply chains to ensure that are supported through educational/awareness support programs	Number of engagements undertaken and programs developed	No project activities undertaken without developed programs for local supply chains	Annually	Villages & towns along the railway corridor	Operator	
	Economic empowerment	S32.2	Promoting sustainability and economic resilience within the community	Engage with local agricultural extension services, farmers and industry experts to ensure that farmers are the supported through programs, funding and low-interest loans	Number of farmers who received funds, loans, programs	Ensure project activities commence with farmers financial support initiatives developed	Annually	Villages & towns along the railway corridor	Operator	
	Economic empowerment	S32.3	Incorporating social responsibility measures, such as community development funds or initiatives, to contribute to the overall well-being of the community	CSR initiatives implemented and community development funds disbursed	Number of CSR initiatives implemented and of community development funds disbursed	≥2 CSR initiatives per year; ≥80% of allocated funds disbursed	Annual	Villages & towns along the railway corridor	Operator	
	Economic empowerment	S32.4	Skills development, training and capacity-building programs will be conducted as part of the implementation of the RAP and LRP to enhance the skills of the local workforce, making them more competitive and better prepared for employment opportunities within and beyond the Project	training programs delivered and of workers trained	Number training programs delivered and number of workers trained	≥3 training programs per year; ≥100 workers trained annually	Annual	Training centres, villages & towns along the railway corridor	Operator	

	Economic empowerment	S32.5	Conducting a comprehensive economic analysis to identify sectors that can support job creation beyond the Project's direct employment opportunities	Economic analysis report	Approved economic analysis report	Report completed	Every 2 years	Corridor communities	Operator	
S33.0	Community tensions from unfair or unaccepted governance systems	S33.1	Involve traditional authorities in the implementation of impact management tools	Engagements with the community/traditional leaders	Number of community engagements with traditional leaders	Annual reports with at least one engagement conducted per quarter	Monthly	Communities along railway corridor Aoi, communities adjacent to the railway stations & works areas	Operator	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
	Community tensions from unfair or unaccepted governance systems	S33.2	Develop a Stakeholder Engagement Plan for construction. Create forums for regular dialogue between traditional and public authorities, youth and women's representatives, new arrivals, and other community members, as described in the Stakeholder Engagement Plan	Number of dialogues between traditional and public authorities, youth and women's representatives, new arrivals, and other community members	Number of engagements with disaggregated data on age, gender and position/designation /occupation	Annual reports with at least one engagement conducted per quarter	Monthly	Communities along railway corridor Aoi, communities adjacent to the railway stations & works areas	Operator	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

Sn	Potential Impacts	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP
Preconstruction and Construction										
CH 1	Cultural misunderstanding (due to migration of labour during construction)	CH 1.1	Develop training materials to instruct key concepts, local context and foster local understanding among construction workers to avoid social conflicts with local communities	Trained personnel and signed training register	Number of approved trainings and trained personnel	No personnel involved in project activities without prior training	Annual training	Construction workers, sub-contractors, communities within project AoI	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN OECLS-AF-PG-GER-002_TRAINING PLAN_EN PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN
		CH 1.2	Maintain continuous dialogue with communities and their representatives throughout the project life cycle	Record of community engagements	Number of community engagements	No project activities undertaken without community engagement and approval	Quarterly	Communities within project AoI	Contractor	
		CH 1.3	Frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage	Record of involvement with local authorities	Number of engagements with authorities	No project activities undertaken without engagement and approval from authorities	Prior to project commencement, then quarterly	Communities within project AoI	Contractor	
		CH 1.4	Inform communities about grievance mechanism so they can report issues and concerns	Cultural heritage management plan and stakeholder engagement plan integrated with grievance procedure	Integration of grievance procedure into CHMP and SMP	No project activities undertaken without an approved cultural management plan and SMP	Prior to project commencement, then quarterly	Communities within project AoI	Contractor	
CH 2	Access to community heritage sites (disrupted during construction establishing camp sites, land delineation/zoning, enabling works, erection of railway RoW fencing and embankments, access roads and temporary closures of access routes during construction)	CH 2.1	If the community's usual access path to cultural heritage sites must be used for project implementation purposes, alternative paths that do not disrupt the community's routine must be indicated	Traffic management plan includes alternative paths; record of community engagements	Number of community engagements, number of approved alternative paths	No project activities undertaken without a traffic management plan and approved alternative paths	Prior to commencing construction and continuous as new construction zones open	Graveyards, ritual site, access tracks/crossings	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN Construction phase Chance Finds Procedure
		CH 2.2	Select suitable alternative paths that meet community needs, local authorities must be consulted	Traffic management plan includes approved alternative paths	Number of approved alternative paths	No project activities undertaken without a traffic management plan and approved alternative paths	Prior to commencing construction and continuous as new construction zones open	Graveyards, ritual site, access tracks/crossings	Contractor	
		CH 2.3	Local communities must be informed in advance about the approved alternative path	Record of community engagements	Number of community engagements	No project activities undertaken without community leader engagement and approval	Quarterly	Graveyards, ritual site, access tracks/crossings	Contractor	
		CH 2.4	Schedule project activities to avoid interference with normal flow of people and vehicles	Traffic management plan aligned with construction management plan	Information on project working hours	No project activities undertaken without an approved traffic and construction management plan or outside project working hours	Prior to commencing construction and continuous as new construction zones open	Communities within project AoI	Contractor	
		CH 2.5	Frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.	Record of community engagements	Number of community engagements	No project activities undertaken without community leader engagement and approval	Quarterly	Graveyards, ritual site, access tracks/crossings	Contractor	
CH 3	Destruction of native medicinal plants	CH 3.1	Frequently involve traditional local and administrative authorities in identifying and preserving medicinal plants	Record of community engagements related to medicinal plant identification	Number of community engagements	No project activities undertaken without engaging and approval from community leaders	Prior to project commencement, then quarterly	Community forests/medicinal plants, construction footprint	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
		CH 3.2	Maintain continuous dialogue with communities and their representatives throughout the project lifecycle to integrate a species inventory and avoid or rehabilitate the destruction of medicinal plants	Record of ongoing community engagements	Number of community engagements	No project activities undertaken without engaging and approval from community leaders	Prior to project commencement, then quarterly	Community forests/medicinal plants, construction footprint	Contractor	
		CH 3.3	Relocate medicinal plants	Integration of Cultural Heritage Management Plan (CHMP) to include medicinal plant relocation and restoration processes	Approved CHMP	No project activities without an approved CHMP	Prior to project commencement, then quarterly	Community forests/medicinal plants, construction footprint	Contractor	
		CH 3.4	Identify clearance routes/locations with medicinal plants and develop replanting/restoration plans	Integration of CHMP to include medicinal plant relocation and restoration processes	Approved CHMP	No project activities without an approved CHMP	Prior to project commencement, then quarterly	Community forests/medicinal plants, construction footprint	Contractor	
		CH 4.1	In case of damage, repair damage caused to local communities during construction with the parties involved	Integration of cultural heritage repair procedure in to CHMP	Approved CHMP	No project activities undertaken without an approved CHMP	Continuous throughout construction	Tangible cultural heritage sites within construction footprint/AoI	Contractor	PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		CH 4.2	Maintain continuous dialogue with local communities and representatives throughout the project life cycle	Record of community engagements	Number of community engagements	No project activities undertaken without engaging and receiving approval from community leaders	Continuous throughout construction	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		CH 4.3	Ensure that the demining is finalised, and the certificate has been issued	Integration of CHMP into construction management plan	Approved construction management plan	No project activities undertaken without an approved construction management plan	Once off during pre-construction	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
		CH 4.4	Evaluate the need to create a buffer zone on cultural heritage	Integration of buffer zones in to CHMP	Approved CHMP	No project activities undertaken without an approved CHMP	Prior to commencement of any new construction zones	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

CH 4	Destruction/deterioration of physical heritage structures	CH 4.5	Establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access path. This can help identify problems early and take corrective action	Monitoring programs integrated into the procedures for atmospheric emissions, noise, and vibration control	Number of approved monitoring programs	No project activities undertaken without approved monitoring programs and procedures	Quarterly	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-FR 10403 OECLS - NOISE MONITORING en PI-FR 10404 OECLS - VIBRATION MONITORING en (2) PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
		CH 4.6	Frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage	Record of engagements with traditional local and administrative authorities	Number of traditional local and administrative authorities engagements	No project activities undertaken without engaging and receiving approval from traditional local and administrative authorities	Quarterly	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		CH 4.7	In the event of grave relocation within the project area of influence, operations must immediately be interrupted, and traditional and municipal authorities must be notified to facilitate assistance and ensure compliance with cultural heritage legislation	Integration of grave relocation procedures into the CHMP	Approved CHMP	No project activities undertaken without an approved CHMP	Prior to project commencement, then quarterly	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
CH 5	Deterioration of heritage site visual character (including Sona sand drawings, due to generated dust)	CH 5.1	Regular dust suppression through water spraying or installing temporary barriers around construction zones to minimize dust accumulation.	Dust suppression methods integrated into the CHMP	Approved CHMP	No project activities undertaken without an approved CHMP	Prior to project commencement, then quarterly	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	PI-FR 10402 OECLS - AIR QUALITY MONITORING en PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN
		CH 5.2	Reduced vehicles speed limits to avoid increased dust emissions to protect visual character of the heritage site	Speed limits and dust control measures integrated into the procedure for controlling atmospheric emissions	Approved procedure	No project activities undertaken without an approved procedure	Prior to project commencement, then quarterly	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	
CH 6	Disrupted access to culturally touristic heritage sites	CH 6.1	Alternative paths that do not disrupt the community's routine must be indicated	Developed traffic management plan should include information on alternative paths	Number of approved alternative paths	No project activities undertaken without traffic management plan and approved alternative paths	Prior to commencing construction and continuous as new construction zones open	Community access routes	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		CH 6.2	Select suitable alternative paths that meet community needs, local authorities must be consulted	Developed traffic management plan should include information on alternative paths	Number of approved alternative paths	No project activities undertaken without traffic management plan and approved alternative paths	Prior to commencing construction and continuous as new construction zones open	Community access routes	Contractor	
		CH 6.3	Schedule project activities to avoid interference with the normal flow of people and vehicles	Developed traffic management plan should align with the construction management plan	Information related to project working hours	No project activities undertaken without approved traffic management plan and construction management plan	Daily	Community access routes	Contractor	
		CH 6.4	Maintain continuous dialogue with communities and their representatives throughout the project life cycle	Engagements with community	Number of community engagements	No project activities undertaken without engaging and receiving approval from community leaders	Prior to commencing construction and continuous as new construction zones open	Community access routes	Contractor	
		CH 6.5	Frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.	Engagements with community	Number of community engagements	No project activities undertaken without engaging and receiving approval from community leaders	Monthly	Community access routes	Contractor	
CH 7	Disruption of cultural, tradition and religious events (including sona drawings)	CH 7.1	Establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access paths. This can help identify problems early and take corrective action	Monitoring programs integrated into procedures for controlling atmospheric emissions, noise, and vibration	Number of approved monitoring programs in updated procedures	No project activities undertaken without approved monitoring programs and procedures	Prior to project commencement, then quarterly	Intangible cultural heritage events/calendar	Contractor	PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN OECLS-AF-PG-GER-002_TRAINING PLAN_EN PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN PI-FR 10402 OECLS - AIR QUALITY MONITORING en PI-FR 10403 OECLS - NOISE MONITORING en PI-FR 10404 OECLS - VIBRATION MONITORING en (2) PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
	Disruption of cultural, tradition and religious events	CH 7.2	Frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage	Engagements with the community to identify cultural practices and events	Number of community engagements and recorded cultural practices/event	No project activities undertaken without engaging and receiving approval from community leaders	Prior to project commencement, thereafter quarterly	Intangible cultural heritage events/calendar	Contractor	
	Disruption of cultural, tradition and religious events	CH 7.3	Maintain continuous continuous dialogue with communities and their representatives throughout the project life cycle	Engagements with the community to identify cultural practices and events	Number of community engagements and recorded cultural practices/events	No project activities undertaken without engaging and receiving approval from community leaders	Prior to project commencement, thereafter quarterly	Intangible cultural heritage events/calendar	Contractor	
	Disruption of cultural, tradition and religious events	CH 7.4	Implement dust suppression measures, such as water spraying on roads, install speed limits to avoid greater extent of emissions	Dust suppression methods integrated into the CHMP	Approved CHMP	No project activities undertaken without an approved CHMP	Prior to project commencement, then quarterly	Tangible cultural heritage sites/resources within construction footprint/AoI	Contractor	
Operations										

CH 8	Cultural misunderstanding (with operational personnels/staff)	CH 8.1	Develop training materials to personnel at stations and manning locomotives that provide key concepts, local context and foster local understanding among construction workers to avoid social conflicts with local communities.	Prepare educational materials and raise public awareness on the relevance of maintaining local values and cultures	Number of education materials distributed	Increased awareness of cultural heritage	Annual training	Communities within project AoI	Operator	To be developed
CH 10	Access to community heritage sites (new access roads and railway will enhance accessibility)	CH 9.1	Local communities must be informed in advance about the approved alternative paths	Access routes maintained during operations	Number of access routes maintained during operations	All public access routes marked	Monthly	Community access routes	Operator	To be developed
		CH 9.2	Schedule major project maintenance activities to avoid interference with the normal travel and transport of people and vehicles routes (tuktuk, motorcycles, cars and buses)	Number of maintenance activities scheduled outside peak traffic hours	Approved traffic management plan	No project activities undertaken without approved traffic management plan	Quarterly	Project operation and maintenance footprint	Operator	PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN
		CH 9.3	Frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage	Engagements with the community to identify cultural practices and events	Number of community engagements and recorded cultural practices/events	No project activities undertaken without engaging and receiving approval from community leaders	Prior to project commencement, thereafter quarterly	Intangible cultural heritage events/calendar	Operator	PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
CH 10	Deterioration of heritage site visual character due to dust emissions	CH 10.1	Initiate a community engagement programme that involves regular cleaning and maintenance, such as pressure washing to help manage dust accumulation.	Implementation of community engagment programmes for cleaning and maintenance activities	Number of engagement activities and cleaning activities conducted	No visible excessive dust	Prior to project commencement, thereafter monthly	Communities adjavent to railv	Operator	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN OECLS-AF-PG-GER-002_TRAINING PLAN_EN
CH 11	Destruction/deterioration of physical heritage structures	CH 11.1	Inform communities about grievance mechanism so they can report issues and concerns	Cultural heritage management plan and stakeholder engagement plan integrated with grievance procedure	Integration of grievance procedure into CHMP and SMP	No project activities undertaken without an approved cultural management plan and SMP	Prior to project commencement, then quarterly	Communities within project AoI	Operator	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		CH 11.2	Compensation in case of damage, repair damage caused to local communities during construction with the parties involved	Number of damage incidents identified and recorded	Number of compensated or repaired damages	All damages and repairs are resolved	Continuous and quartely reporting	Affected communities	Operator	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		CH 11.3	Establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access paths. This can help identify problems early and take corrective action	Monitoring programs integrated into procedures for controlling atmospheric emissions, noise, and vibration	Number of approved monitoring programs in updated procedures	No project activities undertaken without approved monitoring programs and procedures	Prior to project commencement, then quarterly	Intangible cultural heritage events/calendar	Operator	PI-FR 10403 OECLS - NOISE MONITORING en PI-FR 10404 OECLS - VIBRATION MONITORING en (2) PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
CH 12	Destruction of native medicinal plants/ reduced availability of medicinal plants (Invasive species maintenance of embankment sites can replant native medicinal plants used by the communities)	CH 12.1	Frequently involve traditional local and administrative authorities in the decision-making process regarding medicinal plants	Approved LRP	Established community gardens and rehabilitated areas	No project activities without an approved LRP	Annually	Community forests/medicinal plants, construction footprint	Operator	To be developed
		CH 12.2	Maintain continuous dialogue with communities and their representatives throughout the project life cycle	Approved LRP	Established community gardens and rehabilitated areas	No project activities without an approved LRP	Annually	Community forests/medicinal plants, construction footprint	Operator	To be developed
		CH 12.3	Remove invasive plants during regular maintenance/clearing of vegetation along the embankments and surrounding station locations	Medicinal plants inventory list	Increased knowledge of different medicinal plants	No project activities without an updated medicinal plant inventory	Quarterly	Community forests/medicinal plants, construction footprint	Operator	To be developed
CH 13	Disruption of cultural, tradition and religious events including sona drawings	CH 13.1	Establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access paths. This can help identify problems early and take corrective action	Monitoring programs integrated into procedures for controlling atmospheric emissions, noise, and vibration	Number of approved monitoring programs in updated procedures	No project activities undertaken without approved monitoring programs and procedures	Prior to project commencement, then quarterly	Intangible cultural heritage events/calendar	Operator	PI-FR 10403 OECLS - NOISE MONITORING en PI-FR 10404 OECLS - VIBRATION MONITORING en (2) PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN

Sn	Potential Impacts	Sn	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP
Pre-Construction and Construction phase										
AQ 1.0	Increased fugitive dust emissions from overall construction activities	AQ 1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site	Developed SEP template which includes records of community engagements	Number of community engagements	No project activities undertaken without community engagement and approval	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.2	Display the name and contact details of people accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager	Poster/notice boards containing contact details	Number of poster/notice placements	No project activities undertaken without designated personnel	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.3	Display the head or regional office contact information	Poster/notice boards containing contact details	Number of poster/notice placements	No project activities undertaken without designated personnel	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures. The desirable measures should be included as appropriate for the site. Visual monitoring is to be carried out and documented, with consideration to be given to quantitative monitoring in particularly sensitive locations only (e.g. high density residential areas very close to construction site, hospitals, school etc) or where complaints are received.	Dust mitigation measures aligned with all activities	Approved dust management plan	No project activities undertaken without a dust management plan	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.5	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken	Number of incidents reported and grievances raised	Number of addressed and closed-out grievances	No project activities to continue without grievances not addressed for more than 6 months	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.6	Make the complaints log available to the local authority when asked	Public available database with records of complain	Number of people with access to the database	No project activities undertaken without authorities access to the database	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.7	Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site or the action taken to resolve the situation in the logbook	Number of incidents reported and grievances raised	Number of addressed and closed-out grievances	No project activities to continue without grievances not addressed for more than 6 months	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.8	Where feasible, hold regular liaison meetings with other high risk construction sites within 250 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes	Construction programme meetings undertaken that includes plans/mitigation measures related to dust management	Number of plans/mitigation measures addressed and/or closed out during meetings	No project activities undertaken without measures addressing cumulative issues longer than 6 months	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.9	Undertake regular on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available on request. This should include regular dust accumulation checks of surfaces such as street furniture, cars, and windowsills within 100 m of site boundary. If dust accumulation from direct project activities is confirmed, appropriate with cleaning to be provided.	Records/number/ results of inspections and spot checks undertaken	Number of inspection actions closed	No project activities undertaken without regular inspections	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.10	Carry out regular site inspections to monitor compliance with any dust management plan, record inspection results, and make an inspection log available to the local authority when asked	Records/number/ results of inspections undertaken	Number of inspection actions closed	No project activities undertaken without regular inspections	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.11	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions	Designate and train a personnel to ensure all inspections are undertaken	Appointment of a trained personal	No project activities undertaken without a designated inspection personnel	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 1.12	Consider dust deposition, dust flux, or real-time PM_{10} continuous monitoring in particularly sensitive areas, or high 'dust risk' activities	Installation of dust monitoring equipment during project activities	Records/results of monitoring undertaken	Continuous monitoring in sensitive areas	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
AQ 2.0	Increased fugitive dust emissions during the preparation of construction sites/zones	AQ 2.1	Plan site layout so that machinery and dust causing activities are located away from receptors as far as possible	Design plans should include layout position of machinery at least 100m from receptors	Distance machinery is placed from receptors in metres	No machinery are placed near receptors	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 2.2	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site	Installation of mesh screens and designated closed storage areas	Number of designated and bunded storage areas developed	No project activities undertaken without implementation of measures	Quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 2.3	Fully enclose site specific operations where there is a high potential for dust production and the site is active for an extensive period	Enclose designated work areas	Number of designated areas enclosed	Dusty activities shall only be undertaken in designated areas	Quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 2.4	Avoid site runoff of water or mud	Installation of drainage systems	Designated drains	Runoff properly channelled as per design	Weekly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 2.5	Keep site fencing, barriers and scaffolding clean using wet methods	Records/number/ results of inspections undertaken	Number of inspection actions closed	No project activities undertaken without regular inspections	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 2.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	Bunded/enclosed areas to store fine powder materials	Number of enclosed material storage areas	No fine powder shall be stored at undesignated areas when not in use	Weekly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 2.7	Cover seed or fence stockpiles to prevent wind whipping	Installation of mesh covers over material stockpiles	Percentage of all material stock piles covered	No fine powder shall be stored at undesignated areas when not in use	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	

AQ 3.0	Increased fugitive dust emissions from waste	AQ 3.1	Avoid bonfires or burning of waste materials	Environmental inspections on waste management at camps and construction zones that record burning of waste	Number of incidences of burning waste recorded	No incidences of burning of waste recorded	Weekly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
AQ 4.0	Increased fugitive dust emissions from construction demolition	AQ 4.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust)	Inspection reports buildings demolished post construction that applied soft strip method	Number of buildings	Over 50% of planned buildings to be demolished after construction to apply the soft stripping method	Daily during demolition	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 4.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground	Inspection reports of method, location and frequency of dust suppression applied	Number of reported dust suppression activities applied	No demolition works without dust suppression applied	Daily during demolition	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 4.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives	Method statement of alternative manual or mechanical demolition	Approved demolition plans	No demolition works without approved demolition method statement	Monthly during demolition	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 4.4	Bag and remove any biological debris or damp down such material before demolition	Sealed bags of biological debris that are stored in bunded areas	Number of sealed and stored bags containing debris	No biological debris shall be stored anywhere aside sealed bags	Monthly during demolition	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
AQ 5.0	Increased fugitive dust emissions from earthworks	AQ 5.1	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable	Documentation of areas that have been re-vegetated	Area in m2	All exposed areas and stockpiles are re-vegetated	Quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 5.2	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable	Documentation of areas that have been treated using Hessian, mulches, or trackifiers	Area in m2	All exposed areas and stockpiles are treated	Quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 5.3	Only remove the cover in small areas during work and not all at once	Documentation of land cover removed at a construction zone	Area in m2	No clearance of vegetation beyond the designated construction zone and it's buffer	Prior to the commencement of a new construction area/zone	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
AQ 6.0	Increased fugitive dust emissions from construction activities	AQ 6.1	Avoid scabbling (roughening of concrete surfaces) if possible	Inspection reports of construction zones with recorded works that involved scabbing	Number of inspection reports with scabbing works reported	Less than 50% of planned works that applied scabbing	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 6.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place	Construction of designated and bunded storage areas	Number of designated and bunded storage areas developed	Sand shall not be stored anywhere aside designated areas	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 6.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery	Monitor delivery operations to confirm mitigation measures are in use	Records of deliveries, including vehicle conditions and reported incidents	No fine powdered materials shall be delivered without enclosed tankers	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 6.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	Monitor delivery operations and material handling to confirm mitigation measures are in use	Records of deliveries, including materials and number designated storage areas	No fine powdered materials shall be delivered without enclosed bags or stored anywhere aside designated areas	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
AQ7.0	Increased fugitive dust emissions from track out activities	AQ 7.1	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use	Sweeping schedules documenting the use of sweepers and/or additional sweeping requirements	Records of schedules and/or logs	No project activities undertaken without sweeping schedule	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.2	Avoid any dry sweeping of large areas	Sweeping schedule documenting the type of method to be used within a specifies area size	Developed sweeping schedule	No dry sweeping within specified area sizes	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport	Spot checks and vehicle inspections template that will be used at exit and entry points	Records/number/ results of inspections and spot checks undertaken	No vehicle will be allowed to exit or enter without undergoing an inspection or spot check	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable	Develop a route inspections template that will be used detailing conditions of routes and other relevant information	Approved route inspection template	Vehicles shall not make use of uninspected and unapproved routes	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.5	Record all inspections of haul routes and any subsequent action in a site log book	Designate and train a personnel to ensure all inspections are undertaken and repairs requirements	Appointment of a trained personal	No project activities undertaken without a designated inspection personnel	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned	Develop a schedule for routine cleaning and dampening	Records/number of cleaning and dampening undertaken	Vehicles shall only make use of hard surfaced roads that are cleaned and damped down	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable)	Installation and operation of a wheel washing system with rumble grids near exit and entry points	Records of the effectiveness of the system and vehicle usage	No vehicles shall exit or enter project area with undergoing a wheel wash	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.8	Ensure there is an adequate area of hard surface road between the wheel wash facility and the site exit, wherever site size and layout permits	Installation of at least 100m hard surface between the wheel wash facility and the site exit to allow any remaining moisture or debris to settle before vehicles leave the site.	100 m of area between wheel wash and facility exit	No vehicles shall exit with wheels fully dry	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	
		AQ 7.9	Access gates to be located at least 10 m from receptors where possible	Design plans should include position of access gates	10 m space	No access gates are placed near receptors	Prior to project commencement and quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor	

SN	Potential Impacts	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP
Preconstruction and Construction										
NV 1.0	Increased generation of noise from pre/construction activities	NV 1.1	Minimising drop heights of materials i.e. lorry with lifting boom or dumper carefully depositing materials	Training employees on handling procedures and drop height limits for the different types of materials and equipment used on site	Number and register of employees who received training	No untrained employees shall handle project equipment	Prior to project commencement and then quarterly toolbox talks	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.2	Maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)	Undertake routine inspections and repairs of roads	Number of road inspections and repairs undertaken throughout the project lifecycle	All project vehicles shall not make use of damaged roads	Prior to project commencement and then quarterly	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.3	All plant, equipment and noise control measures applied to plant and equipment should be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practicable. Any plant, equipment or items fitted with noise control equipment found to be defective will not be operated until repaired	Undertake routine inspections and repairs of equipment's	Number of equipment inspections and repairs undertaken throughout the project lifecycle	Any plant, equipment or items fitted with noise control equipment found to be defective will not be operated until repaired	Prior to project commencement and then quarterly toolbox talks	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.4	Machines in intermittent use will be shut down or throttled down to a minimum during periods between works	Develop a daily activity log, recording equipment usage/when machines are turned off or throttled down between tasks	Developed template of a daily activity log	No employees shall use equipment without an activity log at hand	Prior to project commencement and then daily	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.5	As far as is reasonably practicable, the location and orientation of semi-static equipment will be chosen to minimise the noise impact on sensitive receptors	Engage with communities to address any concerns and adjust equipment placement if necessary	Number of engagements	Equipment location shall be changed where communities experience negative impacts	Prior to project commencement and then quarterly	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.6	Where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements	Develop and integrate a noise and vibration management plan	Approved noise and vibration management plan	No project activities undertaken without approved noise and vibration management plan	Prior to project commencement	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.7	Where safe to do so, noise from reversing alarms will be controlled and limited as far as possible using physical barriers to restrict pedestrian and construction worker movements in zones with numerous turning/reversing construction vehicles, to minimise intrusive sound of tonal alarms.	Provide training to employees who be banksmen(spotters) ensuring they understand their responsibilities and safe operation procedures	Number of employees trained as spotters	Project activities should make use of spotters rather than alarms	Prior to project commencement and then quarterly toolbox talks	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.8	Where night works are required, as far as is practicable programme the work such that separation distances to noise sensitive receptors are maximised	Identifying the locations of noise-sensitive receptors and determining optimal work areas to maximize separation distances	Records/number of work areas identified	No night project activities shall be undertaken in areas beside the identified areas	Prior to project commencement	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV 1.9	A programme of community liaison should be carried out, including notification of works and details of the complaints process	Developed SEP should integrate community engagement and grievances mechanism	Approved SEP	No project activities undertaken without approved SEP	Prior to project commencement	Works areas/footprint and receptors within 100 m buffer	Contractor	
NV2.0	Increase in vibrations from pre/construction activities	NV2.1	Maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)	Undertake routine inspections and repairs of roads	Number of road inspections and repairs undertaken throughout the project lifecycle	All project vehicles shall not make use of damaged roads	weekly	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV2.2	Where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements	Develop and integrate a noise and vibration management plan	Approved noise and vibration management plan	No project activities undertaken without approved noise and vibration management plan	Prior to project commencement	Works areas/footprint and receptors within 100 m buffer	Contractor	
NV3.0	Generation of traffic noise	NV3.1	Maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)	Develop a daily activity log, recording equipment usage/when machines are turned off or throttled down between tasks	Developed template of a daily activity log	No employees shall use equipment without an activity log at hand	Prior to project commencement and then daily	Works areas/footprint and receptors within 100 m buffer	Contractor	
		NV3.2	A programme of community liaison should be carried out, including notification of works and details of the complaints process	Developed SEP should integrate community engagement and grievances mechanism	Approved SEP	No project activities undertaken without approved SEP	Prior to project commencement	Works areas/footprint and receptors within 100 m buffer	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
		NV3.3	Where safe to do so, noise from reversing alarms will be controlled and limited as far as possible using physical barriers and bright warning lights for pedestrians and construction workers in zones with numerous turning/reversing construction vehicles to minimise intrusive sound of tonal alarms	Provide training to employees who be banksmen(spotters) ensuring they understand their responsibilities and safe operation procedures	Number of employees trained as spotters	Project activities should make use of spotters rather than alarms	Prior to project commencement and then quarterly toolbox talks	Works areas/footprint and receptors within 100 m buffer	Contractor	
Operation										

N 4.0	Increased generation of noise from operation activities	NV4.1	Sympathetic site layout (i.e. use of structures as barriers, increase plant separation distance from receptors)	Maintain detailed site plans showing the placement of structures and equipment in relation to noise-sensitive areas, documenting adjustments made to minimise noise impacts	Approved and finalised design plans	All project activities shall be undertaken as per the approved design and works	Prior to commencement of operations	Works areas/footprint and receptors within 100 m buffer	Operator	
		NV4.2	Boundary barriers (consideration to the requirements of the height, density, and materials should be made at detailed design phase).	Conduct regular inspections of barriers to assess their condition and effectiveness throughout the project, making repairs or adjustments as needed to maintain noise control	Records and number of inspections undertaken	No project activities undertaken without boundary barriers in place	Monthly	Works areas/footprint and receptors within 100 m buffer	Operator	
		NV4.3	Low noise plant choice	Ensuring that all equipment selected during procurement meet predefined noise level standards	Procurement records of all equipment	All project activities shall make use of low noise plant/equipment as far as reasonable	During product/equipment procurement tendering	Works areas/footprint and receptors within 100 m buffer	Operator	
		NV4.4	Acoustic enclosures or locate plant internally	Maintain detailed site plans showing the placement of structures and equipment in relation to noise-sensitive areas, documenting adjustments made to minimise noise impacts	Approved and finalised design plans	All project activities shall be undertaken as per the approved design and works	Prior to commencement of operations	Works areas/footprint and receptors within 100 m buffer	Operator	
		NV4.5	Locate flues/exhausts on alternate side to receptors	Maintain detailed site plans showing the placement of structures and equipment in relation to noise-sensitive areas, documenting adjustments made to minimise noise impacts	Approved and finalised design plans	All project activities shall be undertaken as per the approved design and works	Prior to commencement of operations	Works areas/footprint and receptors within 100 m buffer	Operator	

SN	Potential Impact	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Indicative sampling locations	Responsibility	Project Management Plan/SOP
Pre construction and construction										
Soils 1.0	Soil contamination	Soils 1.1	Prepare readily available spill kits, absorbent materials, and containment booms to quickly address any spills	Spill kits within each area handling hazardous waste and number of personnel trained on spill response procedures	Number of spill kits	No spills left uncontained	6 monthly	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	PI-MP-010-OECLS Construction Stage - Waste Water and Drainage Management Plan •2024-07-28-OECL-OAL-OECLS-DC-086-2024 Descriptive Memory for Discharging Effluents into the Water Environment Temporary Shipyard for Construction Contract •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN •PI-PL-060-OECLS_Water Management Plan_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN
		Soils 1.2	Store hazardous materials and chemicals in designated, secure areas with secondary containment systems to prevent leaks	Site inspection reports that include containment infrastructure installed within areas handling hazardous materials, incidences, corrective actions, improvement actions	Number of inspection reports	No leakage of hazardous materials to the environment	Weekly inspection	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	PI-MP-010-OECLS Construction Stage - Waste Water and Drainage Management Plan •2024-07-28-OECL-OAL-OECLS-DC-086-2024 Descriptive Memory for Discharging Effluents into the Water Environment Temporary Shipyard for Construction Contract •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN •PI-PL-060-OECLS_Water Management Plan_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN
		Soils 1.3	Regular maintenance and inspections of construction equipment and vehicles to prevent leaks and spills.	Equipment and vehicle inspection reports	Number of inspection reports	No leakage of hazardous materials to the environment	Weekly inspection	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	PI-MP-010-OECLS Construction Stage - Waste Water and Drainage Management Plan •2024-07-28-OECL-OAL-OECLS-DC-086-2024 Descriptive Memory for Discharging Effluents into the Water Environment Temporary Shipyard for Construction Contract •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN •PI-PL-060-OECLS_Water Management Plan_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN
Soils 2.0	Deterioration of soil quality/structure	Soils 2.1	Limit the area of excavation at any given time to reduce the extent of soil disturbance. Use precise excavation techniques to minimise unnecessary soil disruption	Area of excavation land	Square meters (m^2)	No excavation beyond delineated and marked zones.	Quarterly	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
		Soils 2.2	Implement a phased construction approach to allow for gradual soil disturbance and recovery	Completed impact identification and assessment forms	Number of forms	No construction work without completed impact identification and assessment forms.	Before commencement of new construction zone	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
		Soils 2.3	Add organic matter, such as compost or manure, to the soil to replenish lost nutrients and improve soil structure	Land restoration implementation monitoring reports.	Number of reports	Comprehensive land restoration after construction considering the decrease in soil quality and providing appropriate measures	Annually	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
Soils 3.0	Soil erosion	Soils 3.1	Erosion protection measures that can be considered below culvert outlets to prevent scour erosion and new channel formation	Drainage, Erosion Control, and Maintenance designs	Number of erosion measures, inlet and outlet structures installed	All specified mitigation measures are installed and operational	Prior to construction demobilisation	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
		Soils 3.2	Unlined channels below culverts erode easily and should only be considered where rock outcrops are present, such as a rocky channel bed. Open channels should not be created in unchanneled valley bottoms wetlands, where flows need to be dispersed over a wide area.	Lined water channels below culverts	Number of lined channels below culverts	No unlined channels below culverts	Prior to construction demobilisation	All works areas, storage areas/yards, Camps, nearby water bodies	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
Operational phase										
Soils 4.0	Soil contamination	Soils 4.1	Regularly monitor soil quality to detect any signs of contamination or erosion	Environmental monitoring reports with visual observations of soil quality	Number of monitoring reports	No annual report without section on soil contamination and erosion	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 4.2	Ensure that wastewater and effluents are properly disposed of in designated areas or facilities designed to handle such waste	Onsite wastewater treatment, reuse of wastewater, if permitting	Presence of onsite wastewater treatment facilities per site, monitoring data and quantity of recycled wastewater, permit	100% operational onsite wastewater treatment facility	During construction of sites and throughout operation period	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 4.3	avoid discharging untreated wastewater into the soil or nearby water bodies.	Inspection reports with incidences of untreated water discharge to soil or water bodies	Number of incidences	Zero discharge of untreated wastewater to soil or water bodies	Monthly inspection	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 4.4	Use environmentally friendly and biodegradable cleaning agents that have minimal impact on soil quality	Tender for procurement to include clause on the preference of environmentally friendly and biodegradable products	Number of tenders	No tender issued without clauses related to environmental toxicity of the procured cleaning agents	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 4.5	Readily available spill kits, absorbent materials, and containment booms to quickly address any spills	Spill kits within each area handling hazardous waste and number of personnel trained on spill response procedures	Number of spill kits	No spills left uncontained	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	

		Soils 4.6	Store hazardous materials and chemicals in designated, secure areas with secondary containment systems to prevent leaks	Site inspection reports that include containment infrastructure installed within areas handling hazardous materials, incidences, corrective actions, improvement actions	Number of inspection reports	No leakage of hazardous materials to the environment	monthly inspection	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 4.7	Regular maintenance and inspections of construction equipment and vehicles to prevent leaks and spills.	Equipment and vehicle inspection reports	Number of inspection reports	No leakage of hazardous materials to the environment	monthly inspection	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
Soils 5.0	Deterioration of soil quality/structure	Soils 5.1	Clear culverts, pipes and stormwater outlets from blockages to prevent erosion. This is especially important during wet seasons.	Site inspection reports that include culvert clearance	Number of inspection reports	No annual report without section on culvert maintenance	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 5.2	Inspect cut and shaped surface for signs of erosion and sedimentation. Stabilise areas where erosion is observed using vegetation or other means or erosion control	Site inspection reports that include erosion control measures implemented	Number of inspection reports	No annual report without section on include erosion control measures implemented	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 5.3	Install silt fences along the RoW to capture sediment and prevent it from reaching nearby water bodies	Erosion control designs with silt fences	Number of silt fences installed	All specified mitigation measures are installed and operational	Prior to construction demobilisation	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
Soils 6.0	Soil erosion	Soils 6.1	clear culverts, pipes and stormwater outlets from blockages to prevent erosion. This is especially important during wet seasons	Site inspection reports that include culvert clearance	Number of inspection reports	No annual report without section on culvert maintenance	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	
		Soils 6.2	Inspect cut and shaped surface for signs of erosion and sedimentation. Stabilise areas where erosion is observed using vegetation or other means or erosion control.	Site inspection reports that include erosion control measures implemented	Number of inspection reports	No annual report without section on include erosion control measures implemented	6 monthly	All works areas, storage areas/yards, stations, workshops, nearby water bodies	Operator	

SN	Potential Impact	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP
Pre construction and construction										
LS 1.0	Increased changes in land use from migration	LS1.1	Establish buffer zones around agricultural and natural areas to protect them from development activities	Signage at buffer zones established around natural habitat and agricultural areas	Number of signs	No construction without signed buffer zones established	Quarterly	Excavated/disturbed areas	Contractor	
		LS1.2	Reforestation and afforestation programs to compensate for any loss of natural habitats	Afforestation/ reforestation projects	Percentage of vegetation cover restored	Compliance with IFC PS 6 and Environmental Management Act	Once-off post completion of construction	Excavated/disturbed areas	Contractor	
		LS1.3	Develop mitigation strategies that protect agricultural land and natural habitats with local farmers	Completed impact identification and assessment forms	Number of forms	No construction work without completed impact identification and assessment forms.	Before commencement of new construction zone	Excavated/disturbed areas	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
		LS1.4	Conduct awareness programs to educate the workforce and local communities about the importance of land conservation	Engagement activities on land conservation	Number of engagement activities	At least one activity every year	Annually	Excavated/disturbed areas	Contractor	
LS 2.0	Alteration of landscape	LS 2.1	Only clear vegetation that is absolutely necessary for construction and demining activities	Area of land cleared	Square meters (m²)	No clearance beyond delineated and marked zones.	Quarterly	Excavated/disturbed areas	Contractor	
		LS2.2	Preserve as much natural vegetation as possible	Area of natural vegetation surrounding construction zones maintained	Square meters (m²)	No clearance beyond delineated and marked zones.	Quarterly	Excavated/disturbed areas	Contractor	
		LS2.3	Replant cleared areas	Vegetation cover	Percentage of vegetation cover restored	At least 50% of vegetation cover restored during construction demobilisation	monthly during demobilisation	Excavated/disturbed areas	Contractor	
LS 3.0	Modification of scenic and aesthetic value	LS3.1	Prioritise the preservation of significant natural features and landscapes within the project area	Signage at buffer zones established around natural habitat and agricultural areas	Number of signs	No construction without signed buffer zones established	Quarterly	Excavated/disturbed areas	Contractor	
		LS3.2	Identify and protect areas of ecological or scenic value through zoning	Completed impact identification and assessment forms	Number of forms	No construction work without completed impact identification and assessment forms.	Before commencement of new construction zone	Excavated/disturbed areas	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
		LS3.3	Landscaping and vegetation plans that complement the natural surroundings	Completed land restoration plans that have considered the natural vegetation composition and their respective monitoring reports	number of land restoration reports	Comprehensive land restoration after construction considering the natural vegetation composition	Annually	Excavated/disturbed areas	Contractor	
		LS3.4	Engage with local communities to identify cultural significant areas that do not need to be disturbed	Engagement activities that assisted in confirming culturally significant areas	Number of engagement activities	Once during pre-construction and one activity every 6 months	Annually	Excavated/disturbed areas	Contractor	
LS 4.0	Impact on visual landscape from generation of waste	LS4.1	Prioritise reuse and recycling of construction materials and waste wherever possible	Waste collection and treatment service providers to be assessed, audited and chosen according to ability to handle waste in an environmentally responsible manner	Approved waste provider list	100% recyclable materials being diverted to approved recycling facilities	Upon completion of the ESIA report, annual audits	Excavated/disturbed areas	Contractor	PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
		LS4.2	Provide signage within camps and at construction zones along the railway RoW. Signage should be provided in applicable languages and can incorporate fines as a means of deterrence.	Waste Segregation for each waste stream incorporated into the Waste and Wastewater management plan in line with local regulations	Number and locations of waste collection areas	Suitable and labelled segregation bins at each waste collection area	Beginning of construction, daily / weekly inspection	Excavated/disturbed areas	Contractor	PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
		LS4.3	Implement the contractor's and the Project's Waste Management Plan prepared with the ESMP	Monitoring and inspection protocols to be included in Waste and Wastewater management plan design	Monitoring and inspection protocols followed	Adherence to Waste and Wastewater management plan	Monthly	Excavated/disturbed areas	Contractor	PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
Operation										
LS 5.0	Alteration of landscape	LS 5.1	Prioritize the restoration of cleared areas by replanting.	Vegetation cover around stations and railway RoW	Percentage of vegetation cover restored	At least 50% of vegetation cover restored maintained over the course of operations	6 monthly	Rehabilitated/landscaped areas	Operator	
		LS 5.2	Focus on preserving existing vegetation where possible and only remove vegetation that directly interferes with railway operations or poses safety risks	Site maintenance reports with indication of vegetation clearance within marked Stations and Railway RoW buffer	Number of incidents where marked vegetation is disturbed	Zero disturbance of vegetation beyond marked stations and railway RoW	Quarterly	Rehabilitated/landscaped areas	Operator	
LS 6.0	Impact on visual landscape from generation of waste	LS 6.1	Designated areas for temporary waste storage that are visually screened and properly managed	Site inspection reports that include waste collection infrastructure installed stations, incidences, corrective actions, improvement actions	Number of inspection reports	No incidence of un-controlled waste disposed to the environment	Weekly inspection	Rehabilitated/landscaped areas	Operator	
		LS 6.2	Use covered bins or containers to prevent littering and illegal dumping,	Site inspection reports that include waste collection infrastructure installed stations, incidences, corrective actions, improvement actions	Number of inspection reports	No incidence of un-controlled waste disposed to the environment	Weekly inspection	Rehabilitated/landscaped areas	Operator	
		LS 6.3	Provide signage within passenger wagons and at stations that discourages littering while in transit. Signage should be provided in applicable languages and can incorporate fines as a means of deterrence.	Signage on waste collection protocols within stations and wagon	Number and locations of signage placed	Singage visible across project area	6 monthly	Rehabilitated/landscaped areas	Operator	
		LS 6.4	Ensure that a waste management system is in place and operational at train stations	Audits of the developed and approved waste management plan for operations	Number of audited reports of the approved operational waste management plan	Annual review and approval of operational waste management plan	Annually	Rehabilitated/landscaped areas	Operator	

LS 7.0	Modification of scenic and aesthetic value	LS 7.1	Engage with local communities, stakeholders, and experts during the planning and design phases to understand concerns and preferences	Different types of stakeholder engagements (e.g consultations, meetings, F2F) conducted amd recorded	Number of recorded engagements	All recorded engagements with attendance register and meeting minutes	Quarterly	Project affected communities	Operator	
		LS 7.2	Consider integrating artistic elements along the railway corridor to enhance visual appeal and cultural significance	Evidence of incorporation of artistic or culturally relevant elements in railway corridor design planning	Approved design plans	Inclusion of elements in final detail design	Prior to construction	Railway corridor alignment	Operator/Design team	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN

Sn	Potential Impacts	Sn	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP
	Pre construction and construction									
B 1.0	Increased habitat fragmentation and Ecological disturbance	B1.1	Design of any fencing to allow for passage of small mammals and reptiles through the site where possible	Fencing design finalised	Final fencing design	Project sites, identified wildlife crossing points	Once during design phase	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Increased habitat fragmentation and Ecological disturbance	B1.2	Minimise clearance of natural vegetation and habitats at the fringe of the sites, to allow for greater connectivity of habitat	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Increased habitat fragmentation and Ecological disturbance	B1.3	use of native flora of local providence to replant any denuded areas which are not directly beneath the footprint of construction.	Area of land that has been replanted by native vegetation	Area replanted	Achievement of No Net Loss (NNL) and Net Gain (NG) in habitat quality	Annually	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
B 2.0	Reduced terrestrial vegetation cover	B2.1	Clearance to be conducted under supervision by a trained and qualified ecologist who can identify instances of breeding birds and enact protective measures to ensure breeding or nesting is not interrupted	Qualified ecologist contracted/employed	Number of ecologists employed	No construction commencing without an ecologist	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.2	Pre-clearance checks for any other non-mobile species to be conducted by a suitably trained ecologist, with capture and relocation of individuals to adjacent suitable habitats where feasible.	Site inspection reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.3	Sensitive and soft-start approach to vegetation clearance will be employed to enable fauna to disperse into surrounding habitats, starting at one end and working in a single direction	Incidences of fauna mortality during site clearance	Number of incidents	No incidence report of faunal mortality as a result of construction works	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.4	Avoid removal of large sections/patches, where feasible Avoid removal of and sections/patches which will not be directly replaced by project infrastructure, where feasible.	Incidences of land cleared	Number of incidents	Zero disturbance of marked vegetation/ zoned off sections of land	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.5	Identify, retain and/or relocate mature specimens of conservation importance	Incidences of unauthorised trees removed	Number of incidents	No incidence of unauthorised vegetation clearance	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.6	Identify and relocate young specimens of native trees during land clearance	Incidences of unauthorised trees removed	Number of incidents	No incidence of unauthorised vegetation clearance	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.7	Protected vegetation clearly marked (e.g. using flagging tape) and personnel and contractors must be instructed in the requirement to protect vegetation that has been marked	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.8	Avoid the use of herbicides and fire to clear vegetation	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.9	Replanting of native flora following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities	Area of land that has been replanted by native vegetation	Area replanted	Achievement of No Net Loss (NNL) and Net Gain (NG) in habitat quality	Annually	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.10	Areas to be cleared will be delineated and vegetation removal will be restricted to these designated areas only	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.11	Minimise access, disturbance to land and clearing of vegetation to prevent unnecessary ground disturbance	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Reduced terrestrial vegetation cover	B2.12	Limit access and disturbance to any additional natural areas outside of demarcated clearance zones	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
B 3.0	Removal of fertile topsoil to support vegetation recovery	B 3.1	Preservation and translocation of topsoil and seed bank as part of site rehabilitation / revegetation process. To be set aside for rehabilitation during post-construction landscaping	Area of top soil stripped and stock piled	Area	all stripped top soil stockpiled and maintained throughout construction	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
	Removal of fertile topsoil to support vegetation recovery	B 3.2	All scoured topsoil to be stockpiled and maintained for use in re-vegetation of undeveloped areas, fringes, embankments and surrounds	Area of top soil stripped and stock piled	Area	all stripped top soil stockpiled and maintained throughout construction	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN

B 4.0	Introduction of invasive species	B4.1	Implement an eradication programme to remove existing and new introduced and/or invasive species, particularly along roadsides and construction sites within the Project footprint area	Site maintenance reports with area of land cleared of invasives	Number of reports	No incidences of uncontrolled invasive plants and weeds around construction areas and camps	6 months	Habitats within AoI & construction footprint	Contractor	· PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN
	Introduction of invasive species	B4.2	Regular inspections within new and existing disturbed areas and newly disturbed areas for seedlings of AIS species	Site maintenance reports with area of land cleared of invasives	Number of reports	No incidences of uncontrolled invasive plants and weeds around construction areas and camps	6 months	Habitats within AoI & construction footprint	Contractor	· PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN
	Introduction of invasive species	B4.3	Control measures for weed management will include wash down facilities, controlled access to designated areas, ongoing monitoring and personnel training	Site maintenance reports with area of land cleared of invasives	Number of reports	No incidences of uncontrolled invasive plants and weeds around construction areas and camps	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN
	Introduction of invasive species	B4.4	Eradication programs will be considered with regards to pest fauna species	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
	Introduction of invasive species	B4.5	Where pest management has been identified as required (e.g. feral cats, rats, etc.), control measures will be considered including trapping, eradication, relocation and baiting. These programs will be supported by relevant training and awareness of employees and contractors	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
	Introduction of invasive species	B4.6	Wastes disposed of in the landfill shall be routinely covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
	Introduction of invasive species	B4.7	Depending on the chosen method of the selected waste site, the waste will be covered/removed regularly to limit the exposure to fauna and potential of diseases being spread	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
	Introduction of invasive species	B4.8	Waste should only be collected in receptacles in designated areas, which will be emptied regularly at the landfill	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
	Introduction of invasive species	B4.9	Continuous awareness raising, training and site inspections regarding introduction and invasion of alien fauna and spread of diseases	Number of staff who have undertaken training sessions that included invasive fauna and spread of diseases	Number of staff	No staff commences work without undertaking training that includes invasive fauna and spread of diseases	6 months	Habitats within AoI & construction footprint	Contractor	OECLS-AF-PG-GER-002_TRAINING PLAN_EN
B 5.0	Disturbance and emigration of fauna (and avifauna) species due to habitat degradation	B5.1	Induction training to include topic on prohibiting construction site staff and contractors from hunting, buying, or trading of wildlife as well as the collection of aquatic resources, timber and other resources to help conserve existing fauna and forestry resources	Number of staff who have undertaken training sessions that included restrictions on the extraction of natural resources	Number of staff	No staff commences work without undertaking training that includes restrictions on the extraction of natural resources	6 months	Habitats within AoI & construction footprint	Contractor	OECLS-AF-PG-GER-002_TRAINING PLAN_EN
	Disturbance and emigration of fauna (and avifauna) species due to habitat degradation	B5.2	Environmental education and awareness programs for all Project staff and contractors (e.g. through staff inductions). This will improve the understanding of the importance of native resources for local communities and ensure that the prohibitions and penalties regarding hunting, wildlife trade and the collection of other forestry resources are widely known	Number of education/awareness activities that included restrictions on the extraction of natural resources	Number of activities	No staff commences work without undertaking training that includes restrictions on the extraction of natural resources	6 months	Habitats within AoI & construction footprint	Contractor	OECLS-AF-PG-GER-002_TRAINING PLAN_EN
B 6.0	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.1	Avoid works during particularly windy conditions	Number of grievances on the death of vegetation covered with excessive dust	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.2	Confine vehicle movement to designated access routes and roads	Number of grievances on the death of vegetation covered with excessive dust	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.3	Minimise dust and pollution emissions using equipment with industry standard reduction systems and comply with applicable standards, where practicable	Site inspection reports with dust reduction measures used	Number of reports	No incidences of uncontrolled dust	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN

	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.4	Minimise dust through watering roads and cleared areas, especially during the dry season	Site inspection reports with dust reduction measures used	Number of reports	No incidences of uncontrolled dust	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.5	Use of native flora of local providence to provide a natural dust, light and noise barrier areas which are surrounding the footprint of construction zones like concrete batching plants and sleeper production site	Number of grievances on the excessive noise disturbance	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.6	Maintain all machinery to ensure both air and noise emissions are minimised and below applicable standard levels	Number of grievances on the excessive noise disturbance	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Contractor	PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.7	Where exceedance of the work site or environmental noise limits occurs, secondary noise barriers such as hoarding should be provided where feasible	Number of grievances on the excessive noise disturbance	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Contractor	PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 6.8	Install lights that illuminate towards and within delineated construction zones and avoid illuminating upwards or outwards towards natural vegetation cover.	Site maintenance reports with type of lighting around new construction zones	Number of reports	No incidences of lighting in unauthorised construction zones	6 months	Habitats within AoI & construction footprint	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
B 7.0	Direct mortality of fauna (and avifauna) from collision	B 7.1	Induction topic on road kill and incidence recording and reporting procedure	Number of staff who have undertaken training sessions that included restrictions on road kill and direct mortality of fauna	Number of staff	No staff commences work without undertaking training that includes restrictions on road kill and direct mortality of fauna	6 months	Habitats within AoI & construction footprint	Contractor	OECLS-AF-PG-GER-002_TRAINING PLAN_EN
	Direct mortality of fauna (and avifauna) from collision	B 7.2	Environmental education and awareness programs for all Project staff and contractors (e.g. through staff inductions). This will improve their understanding of the importance to avoid direct mortality of any fauna encountered either at the camps or along the construction sites	Number of education/awareness activities that included restrictions on road kill and direct mortality of fauna	Number of activities	No staff commences work without undertaking training that includes restrictions on road kill and direct mortality of fauna	6 months	Habitats within AoI & construction footprint	Contractor	OECLS-AF-PG-GER-002_TRAINING PLAN_EN
B 8.0	Waste and litter accumulation in nearby habitats	B 8.1	Disposable food and plastic waste should be temporarily stored in labelled, secure bins and skips before being disposed of in the appropriate landfill or recycling facility	Site maintenance reports with waste management measures used	Number of reports	No incidences of uncontrolled waste management around construction zones	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Waste and litter accumulation in nearby habitats	B 8.2	Packaging for both food, ingredients and construction materials should be segregated into appropriate bins / skips and disposed of in accordance with the Project waste management plan	Site maintenance reports with waste management measures used	Number of reports	No incidences of uncontrolled waste management around construction zones	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Waste and litter accumulation in nearby habitats	B 8.3	Bins and skips shall be covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species	Site maintenance reports with waste management measures used	Number of reports	No incidences of uncontrolled waste management around construction zones	6 months	Habitats within AoI & construction footprint	Contractor	PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
B 9.0	Reduced water quality in waterways due to increased siltation	B 9.1	Retention of natural sediment traps	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
	Reduced water quality in waterways due to increased siltation	B 9.2	Retention of wetlands and existing drainage channels	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
	Reduced water quality in waterways due to increased siltation	B 9.3	Stabilise landforms and implement erosion prevention measures during construction	Site maintenance reports with erosion management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
	Reduced water quality in waterways due to increased siltation	B 9.4	Any enabling / earthworks required in riverbeds will be conducted during the dry season and confined to the smallest area possible	Site clearance reports	Number of reports	No construction commencing without a site clearance report	weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
	Reduced water quality in waterways due to increased siltation	B 9.5	Maintain root systems (wherever practical) to maintain soil stability by cutting vegetation at ground level, thereby minimising soil erosion	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN

	Reduced water quality in waterways due to increased siltation	B 9.6	Install sediment traps to capture suspended sediments in drainage systems or channels susceptible to erosion	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
	Reduced water quality in waterways due to increased siltation	B 9.7	Areas to be cleared will be delineated and vegetation removal will be restricted to these designated areas only	Site clearance reports	Number of reports	No construction commencing without a site clearance report	Weekly inspections	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
B 10.0	Reduction in water quality in waterways due to waste and discharges	B 10.1	Waste materials from the construction process to be utilised as fill where feasible, with a zero-dumping policy for catchment areas and waterways	Site maintenance reports with waste management measures used around water bodies	Number of reports	No incidences of uncontrolled with waste management measures in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Reduction in water quality in waterways due to waste and discharges	B 10.2	All liquid pollutants and wastes stored within secondary containment and hard stand flooring, a minimum of 100m from open water bodies and surface water courses	Site maintenance reports with waste management measures used around water bodies	Number of reports	No incidences of uncontrolled with waste management measures in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Reduction in water quality in waterways due to waste and discharges	B 10.3	All solid and liquid fuel stores placed within secondary containment and hard stand flooring, a minimum of 100m from open water bodies and surface water courses	Site maintenance reports with waste management measures used around water bodies	Number of reports	No incidences of uncontrolled with waste management measures in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Reduction in water quality in waterways due to waste and discharges	B 10.4	All liquid material and waste storage facilities to be equipped with appropriate spill kits and containment instructions for unplanned spills	Site maintenance reports with waste management measures used around water bodies	Number of reports	No incidences of uncontrolled with waste management measures in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Reduction in water quality in waterways due to waste and discharges	B 10.5	The contractor will develop a fit-for-purpose spill response plan, including training for all on-site personnel, as part of the Project's ESMP	Site maintenance reports with waste management measures used around water bodies	Number of reports	No incidences of uncontrolled with waste management measures in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
	Reduction in water quality in waterways due to waste and discharges	B 10.6	All solid waste stores to have appropriate covers to prevent wind blown materials entering the environment	Site maintenance reports with waste management measures used around water bodies	Number of reports	No incidences of uncontrolled with waste management measures in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Contractor	•PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN •PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN

B 11.0	Disturbance and emigration of aquatic fauna (and avifauna) species due to habitat degradation	B11.1	Prohibit construction site staff and contractors from establishing instream aquaculture ponds, large scale fishing, as well as the collection of aquatic resources such as sand mining to help conserve existing habitats and aquatic resources that support aquatic fauna and avifauna	Number of staff who have undertaken training sessions that included restrictions on extraction of aquatic resources and other non-construction related activities	Number of reports	No staff commences work without undertaking training that includes restrictions on extraction of aquatic resources and other non-construction related activities	6 months	Habitats within AoI & construction footprint	Contractor	•OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Disturbance and emigration of aquatic fauna (and avifauna) species due to habitat degradation	B 11.2	Conduct environmental education and awareness programs for all Project staff and contractors (e.g. through staff inductions). This will improve the understanding of the importance of native resources for local communities and ensure that the prohibitions and penalties regarding hunting, wildlife trade and the collection of other forestry resources are widely known	Number of education/awareness activities that included restrictions on extraction of aquatic resources and other non-construction related activities	Number of activities	No staff commences work without undertaking training that includes restrictions on extraction of aquatic resources and other non-construction related activities	6 months	Habitats within AoI & construction footprint	Contractor	•OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Disturbance and emigration of aquatic fauna (and avifauna) species due to habitat degradation	B 11.3	Record all sightings during construction inlcuding abundance of Amur Falcon (and informing if adaptive management will be required) Conduct seasonal monitoring during construction and at least the first five years of operation on the seasonal occurrence and abundance of Amur Falcon and the Angolan Catfish – latter could be done by collecting eDNA samples during the wet and dry seasons, with emphasis on perennial rivers and wetlands	Construction observation records, seasonal monitoring records and re-evaluation of effectiveness of mitigation or the need for adaptive management	Number of reports	No impacts on the Amur Falcon and Angolan Catfish Confirmation of no Critical Habitat with additional information gathered. If CH is confirmed with additional information gathered, then biodiversity action plan for these species drafted and implemented.	6 months	Habitats within AoI & construction footprint	Contractor	•OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Disturbance and emigration of aquatic fauna (and avifauna) species due to habitat degradation	B 11.4	Replanting of native flora following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities	Area of land that has been replanted by native vegetation	Area replanted	Achievement of No Net Loss (NNL) and Net Gain (NG) in habitat quality	Annually	Habitats within AoI & construction footprint	Contractor	•OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN •PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN
	Operations									
B12.0	Increased habitat fragmentation and Ecological disturbance	B 12.1	Local education programs identifying biodiversity resources that are threatened and/or protected and discuss alternatives, such as conservation forestry	Educational events on biodiversity resources	Number of events	At least one annually	Annually	Habitats within AoI & construction footprint	Operator	To be developed
B13.0	Reduced terrestrial vegetation cover	B 13.1	Avoid the use of herbicides and fire to clear vegetation	Site maintenance reports with vegetation clearance measures used	Number of reports	No use of herbicides and fire control methods	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Reduced terrestrial vegetation cover	B 13.2	Replanting of native flora following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities	Area of land that has been replanted by native vegetation	Area replanted	Achievement of No Net Loss (NNL) and Net Gain (NG) in habitat quality	Annually	Habitats within AoI & construction footprint	Operator	To be developed
B 14.0	Removal of fertile topsoil to support vegetation recovery	B 14.1	Installation of surface water drains around the hard surfaces at stations to collect and direct effluent to the designated septic tanks	Site maintenance reports with waste water and erosion management measures used	Number of reports	No incidences of uncontrolled erosion/soil loss as a result of direct discharge of effluents	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Removal of fertile topsoil to support vegetation recovery	B 14.2	Regular emptying of station septic tanks to the municipal wastewater treatment plants	Site maintenance reports with waste water and erosion management measures used	Number of reports	No incidences of uncontrolled erosion/soil loss as a result of direct discharge of effluents	6 months	Habitats within AoI & construction footprint	Operator	To be developed
B 15.0	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 15.1	Confine maintenance vehicle movement to designated access routes along the railway RoW	Number of grievances on the death of vegetation covered with excessive dust	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 15.2	Use of native flora of local providence to provide a natural dust, light and noise barrier areas which are surrounding the footprint of construction zones like concrete batching plants and sleeper production site	Number of grievances on the excessive noise disturbance	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 15.3	Maintain locomotives to ensure both air and noise emissions are minimised and below applicable standard levels	Number of grievances on the excessive noise disturbance	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 15.4	where exceedance of the work site or environmental noise limits occurs, secondary noise barriers such as hoarding should be provided where feasible	Number of grievances on the excessive noise disturbance	Number of grievances	No grievances reported	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Impact from light, dust, noise and vibrations on terrestrial fauna (and avifauna)	B 15.5	Install lights that illuminate towards and within delineated station boundaries and avoid illuminating upwards or outwards towards natural vegetation cover	Handover reports from contractor with type of lighting around new stations, bridges and designated crossings	Number of reports	No incidences of lighting in unauthorised zones	Once off at end of construction	Habitats within AoI & construction footprint	Operator	To be developed
B 16.0	Direct mortality of fauna (and avifauna) from collision	B 16.1	Regular inspection of the railway alignment to re-locate nests and burrows that fauna are establishing within the immediate 50 m of the track	Number of staff who have undertaken training sessions that included restrictions on road kill and direct mortality of fauna	Number of staff	No staff commences work without undertaking training that includes restrictions on road kill and direct mortality of fauna	Annually	Habitats within AoI & construction footprint	Operator	To be developed
	Direct mortality of fauna (and avifauna) from collision	B 16.2	Clear vegetation near the tracks to remove attractive sites for foraging or shelter	Site clearance reports	Number of reports	No construction commencing without a site clearance report	weekly inspections	Habitats within AoI & construction footprint	Operator	To be developed

	Direct mortality of fauna (and avifauna) from collision	B 16.3	Maintain monitoring records of wildlife mortality due to collisions along the railway to inform whether there is a need to implement deterrent systems (olfactory repellents or acoustic devices) at locations where there is evidence of higher wildlife crossing and collisions	Site maintenance reports of wildlife mortality	Number of reports	No incidencesof wildlife mortality	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Direct mortality of fauna (and avifauna) from collision	B 16.4	Conduct environmental education and awareness programs for all Project staff at stations and operating the locomotives. This will improve their understanding of the importance to avoid direct mortality of any fauna	Number of education/awareness activities that included restrictions on road kill and direct mortality of fauna	Number of activities	No staff commences work without undertaking training that includes restrictions on road kill and direct mortality of fauna	Annually	Habitats within AoI & construction footprint	Operator	To be developed
B17.0	Waste and litter accumulation in nearby habitats	B 17.1	Disposable food and plastic waste at stations should be temporarily stored in labelled, secure bins and skips before being disposed of in the appropriate landfill or recycling facility	Site maintenance reports with waste management measures used around stations, wetlands and water bodies	Number of reports	No incidences of uncontrolled with waste management measures around stations, wetlands and water bodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Waste and litter accumulation in nearby habitats	B 17.2	Bins and skips at stations shall be covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species	Site maintenance reports with waste management measures used around stations, wetlands and water bodies	Number of reports	No incidences of uncontrolled with waste management measures around stations, wetlands and water bodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Waste and litter accumulation in nearby habitats	B 17.3	Waste disposal protocols at stations should be kept in line with the recommendations of the waste management practices	Site maintenance reports with waste management measures used around stations, wetlands and water bodies	Number of reports	No incidences of uncontrolled with waste management measures around stations, wetlands and water bodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
B 18.0	Reduced water quality in waterways due to increased siltation	B 18.1	Retention of natural sediment traps	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Reduced water quality in waterways due to increased siltation	B 18.2	Retention of wetlands and existing drainage channels.	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Reduced water quality in waterways due to increased siltation	B 18.3	Maintain root systems (wherever practical) to maintain soil stability by cutting vegetation at ground level, thereby minimising soil erosion	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Reduced water quality in waterways due to increased siltation	B 18.4	Install sediment traps to capture suspended sediments in drainage systems or channels susceptible to erosion	Site maintenance reports with sediment management measures used	Number of reports	No incidences of uncontrolled sediment in wetlands and waterbodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
B19.0	Reduction in water quality in waterways due to waste and discharges	B19.1	All liquid pollutants and wastes stored within secondary containment and hard stand flooring, a minimum of 100m from open water bodies and surface water courses	Site maintenance reports with waste management measures used around stations, wetlands and water bodies	Number of reports	No incidences of uncontrolled with waste management measures around stations, wetlands and water bodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Reduction in water quality in waterways due to waste and discharges	B19.2	All solid and liquid fuel stores placed within secondary containment and hard stand flooring, a minimum of 100m from open water bodies and surface water courses	Site maintenance reports with waste management measures used around stations, wetlands and water bodies	Number of reports	No incidences of uncontrolled with waste management measures around stations, wetlands and water bodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
	Reduction in water quality in waterways due to waste and discharges	B19.3	All liquid material and waste storage facilities to be equipped with appropriate spill kits and containment instructions for unplanned spills	Site maintenance reports with waste management measures used around stations, wetlands and water bodies	Number of reports	No incidences of uncontrolled with waste management measures around stations, wetlands and water bodies	6 months	Habitats within AoI & construction footprint	Operator	To be developed
B20.1	Introduction of invasive species	B20.1	Eradication programs will be considered with regards to pest fauna species	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Operator	
	Introduction of invasive species	B20.2	Where pest management has been identified as required (e.g. feral cats, rats, etc.), control measures will be considered including trapping, eradication, relocation and baiting. These programs will be supported by relevant training and awareness of PAPs	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Operator	
	Introduction of invasive species	B20.3	Wastes disposed of in the landfill shall be routinely covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Operator	
	Introduction of invasive species	B20.4	Depending on the chosen approach to waste management, the waste will be covered/removed regularly to limit the exposure to fauna and potential of diseases being spread	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Operator	
	Introduction of invasive species	B20.5	Waste should only be collected in receptacles in designated areas, which will be emptied regularly at the landfill	Site inspection reports with pest management/ eradication measures implemented	Number of reports	No incidences of uncontrolled pests around construction areas and camps	Weekly inspections	Habitats within AoI & construction footprint	Operator	

SN	Impact	SN	Mitigation measure	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP	
ES1	Displacement of wild animals and bees	ES 1.1	Monitor wildlife populations and relocate them to safer areas, if necessary, before construction begins	Incidence reports of killed wildlife or destroyed beehives	Number of incidents reported	No incidents of killed wildlife or destroyed beehives	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN to be updated with respect to road kill	
		ES 1.2	Assist residents in relocating beehives near construction zones to minimize noise disturbances to bees	Incidence reports of destroyed beehives	Number of hives relocated	No incidents of destroyed beehives	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN to be updated with respect to road kill	
		ES 1.3	Design fencing to allow passage for small mammals and reptiles through construction sites where feasible	Incidence reports of killed wildlife or destroyed beehives	Number of incidents reported	No incidents of killed wildlife	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN to be updated with respect to road kill	
		ES 1.4	Incorporate training on non-lethal methods for removing animals from camps and construction zones.	Staff training records	Number of staff trained	All project personnel trained	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN to be updated with respect to road kill	
		ES 1.5	Incorporate training for drivers on avoiding and reporting on roadkill	Staff training records	Number of staff trained	All project personnel trained	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN to be updated with respect to road kill	
ES 2	Modification of agricultural land	ES 2.1	Minimize clearance of agricultural land, natural vegetation, and habitats at the fringe of construction sites	Completed impact identification and assessment forms	Number of forms	No construction work without completed impact identification and assessment forms	Before commencement of new construction zone	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN	
				Area of land cleared	Square meters (m²)	No construction clearance beyond delineated and marked zones	Quarterly	Habitats & communities along the railway corridor	Contractor		
		ES2.2	Replant cleared areas post-construction, ensuring suitable conditions (sunlight, rainfall, etc.) to sustain original vegetative communities	Area of land cleared	Square meters (m²)	No construction zone left unrehabilitated	Monthly during the final year of construction	Habitats & communities along the railway corridor	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN	
		ES 2.3	Implement a separate Livelihood Restoration Plan (LRP) to assess and mitigate the long-term impacts on crop production in farming-dependent communities	LRP implementation monitoring reports	Number of reports	Comprehensive LRP considering the decrease in crop production and providing appropriate	Annually	Habitats & communities along the railway corridor	Operator	LRP to be developed	
ES 3	Reduced access to/availability of forest derived products	ES 3.1	Identify potential impacts on natural habitats and vegetation cover before construction	Completed impact identification and assessment forms	Number of forms	No construction without completed impact identification forms	Before commencement of each new construction zone.	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN	
		ES3.2	Minimize vegetation clearance footprint, avoiding removal of large sections or patches	Area of vegetation cleared	Square meters (m²)	No clearance beyond delineated and marked zones	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN	
		ES3.3	Restore cleared construction areas by replanting suitable vegetation based on sunlight and rainfall conditions	Area of land restored	Square meters (m²)	No construction zones left unrehabilitated	Monthly during the final year of construction.	Habitats & communities along the railway corridor	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN	
ES 4	Disruption in grazing patterns	ES 4.1	Identify risks of restricted access for livestock and ensure alternative access routes	Completed impact identification and assessment forms	Number of forms	No construction without completed impact identification forms	Before commencement of each new construction zone.	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN	
		ES 4.2	Minimize land clearance and disturbance beyond delineated construction areas	Area of land cleared	Square meters (m²)	No clearance beyond delineated and marked zones	Quarterly	Habitats & communities along the railway corridor	Contractor	PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN	
		ES4.3	Rehabilitate grazing areas after construction activities are completed	Area of land restored	Square meters (m²)	No construction zones left unrehabilitated.	Monthly during the final year of construction.	Habitats & communities along the railway corridor	Contractor	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN	

		ES 4.4	Conduct engagement sessions with communities on safe livestock crossing zones, restricted areas, and the grievance mechanism	Community engagement activities	Number of activities	No unresolved grievances related to livestock grazing after 6 months	Every 6 months	Habitats & communities along the railway corridor	Contractor	PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN	
	Depletion of groundwater	ES5.1	Conducting pump tests on all boreholes to be used, in order to determine the yield and aquifer recovery of each, which should relate into management measures that will ensure sustainable abstraction rates. This will help to ensure that rural community members reliant on groundwater resources are not negatively affected	Pump test reports	Number of reports	All boreholes used in the project have documented pump test reports	During drilling of borehole	Habitats & communities along the railway corridor	Contractor	PI-PL-061-OECLS_WATER MANAGEMENT PLAN_EN	
		ES5.2	Limit surface water abstraction within 500 m upstream of community settlements to prevent water quality deterioration	Distance of project borehole to nearest community/settlement	Meters (m)	No boreholes within 500 m of community settlements	During drilling of borehole	Habitats & communities along the railway corridor	Contractor	PI-PL-061-OECLS_WATER MANAGEMENT PLAN_EN	
		ES5.3	Ensure efficient use of water resources by monitoring extraction volumes at each borehole	Amount of water extracted	Volume (m³)	All boreholes fitted with functioning water meters	Monthly	Habitats & communities along the railway corridor	Contractor	PI-PL-031-OECLS_RESOURCE EFFICIENCY MANAGEMENT PLA – Cópia	
		ES5.4	Follow prescribed abstraction volumes as per authorization permits and monitor water usage	Amount of water extracted	Volume (m³)	All boreholes fitted with functioning water meters	Monthly	Habitats & communities along the railway corridor	Contractor	PI-PL-061-OECLS_WATER MANAGEMENT PLAN_EN	
ES5		ES5.5	Conduct refresher training on water conservation practices around construction zones and camps	Refresher training sessions	Number of personnel trained	All personnel receive annual refresher training on water conservation	Annually	Habitats & communities along the railway corridor	Contractor	PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN	
		ES5.6	Monitor water usage and ensure compliance with abstraction volumes as per authorization permits	Amount of water extracted	Volume (m³)	All boreholes fitted with functioning water meters	Monthly	Habitats & communities along the railway corridor	Contractor	To be developed	
		ES5.7	Install water flow meters at all water abstraction points (surface water, wells, and boreholes)	Amount of water extracted	Volume (m³)	All boreholes fitted with functioning water meters	Monthly	Habitats & farmlands along the railway corridor	Contractor	To be developed	
		ES5.8	Conduct hydraulic pump testing on all boreholes intended for long-term water supply to calculate sustainable yields	Pump test reports	Number of reports	All boreholes used in the project have documented pump test reports	During drilling of borehole	Habitats & communities along the railway corridor	Contractor	To be developed	
		ES5.9	Conduct annual training on water conservation practices for personnel at stations and workshops	Training sessions	Number of personnel trained	All personnel receive annual training on water conservation	Annually	Habitats & communities along the railway corridor	Contractor	To be developed	
	Destruction of medicinal plants	ES6.1	Conduct a comprehensive survey to identify and map areas where important medicinal plants used by the Tchokwe community are located. Engage local traditional healers and community members in the identification process	Impact identification forms filled by a trained ecologist during clearance activities	Number of forms	No clearance activity undertaken without supervision by a qualified ecologist	Weekly	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN	
		ES6.2	Clearance to be conducted under supervision by a trained and qualified ecologist who can identify medicinal plants used by the communities	Incidents of damaged or removed medicinal plants	Number of incidents	No grievances recorded related to damage or removal of medicinal plants	Annually	Habitats & communities along the railway corridor	Contractor	PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN	
		ES6.3	Where possible avoid removing or damaging medicinal plants	Incidents of damaged or removed medicinal plants	Number of incidents	No grievances recorded related to damage or removal of medicinal plants	Annually	Habitats & communities along the railway corridor	Contractor		
ES6		ES6.4	Create local nursery sites of native plants towards replenishing lost stock of medicinal plants	Number of nurseries developed	Number of nurseries	Two nurseries established by the project	Annually	Habitats & communities along the railway corridor	Contractor (during construction)	PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN	
Operation Phase											
	Displacement of wild animals and bees	ES 7.1	Monitor wildlife populations and relocate them to safer areas, if necessary, before operations begin.	Incidence reports of killed wildlife or destroyed	Number of incidents reported	No incidents of killed wildlife or destroyed	Quarterly	Habitats & communities	Operator		

ES7	Displacement of wild animals and bees	ES 7.2	Provide training on non-lethal methods for removing animals from station and workshop zones.	Staff training records	Number of staff trained	All project personnel trained	Quarterly	Habitats & communities along the railway	Operator		
	Displacement of wild animals and bees	ES 7.3	Train employees on how to avoid and report roadkill incidents..	Staff training records	Number of staff trained	All project personnel trained	Quarterly	Habitats & communities	Operator		
ES 8	Modification of agricultural land	ES 8.1	Implement a separate Livelihood Restoration Plan (LRP) to assess and mitigate the long-term impacts on crop production in farming-dependent communities.	LRP implementation monitoring reports	Number of reports	Comprehensive LRP considering the decrease in crop	Annually	Habitats & communities along the railway	Operator		
ES 9	Disruption in grazing patterns	ES 9.1	Hold engagement sessions with communities on safe crossing locations and the grievance mechanism during operations.	Community engagement activities	Number of activities	No unresolved grievances related to livestock grazing after 6 months	Every 6 months	Habitats & communities along the railway corridor	Operator		
ES 10	Destruction of medicinal plants	ES 10.1.	Maintain locations where rehabilitation and restoration of degraded areas were initiated during construction.	rehabilitated areas	area		Annually	Habitats & communities along the railway corridor	Operator		
		ES 10.2	Avoid removing or damaging medicinal plants during maintenance of the project locations	Incidents of damaged or removed medicinal plants	Number of incidents	No grievances recorded related to damage or removal of medicinal plants	Annually	Habitats & communities along the railway corridor	Operator		
		ES 10.3	Contribute to and maintain tree nurseries established during construction.	Number of nurseries developed	Number of nurseries	Two nurseries established by the project	Annually	Habitats & communities along the railway corridor	Operator		
ES11	Depletion of groundwater	ES 11.1	Follow abstraction volumes as prescribed in authorisation permits and monitor usage	Amount of water extracted	Volume (m^3)	All boreholes fitted with functioning water meters	Monthly	Habitats & communities along the railway corridor	Operator		
	Depletion of groundwater	ES 11.2	Install water flow meters on all water abstraction points (surface water, wells, and boreholes).	Amount of water extracted	Volume (m^3)	All boreholes fitted with functioning water meters	Monthly	Habitats & farmlands along the railway corridor	Operator		
	Depletion of groundwater	ES 11.3	Undertake hydraulic pump testing of all boreholes to be used as long-term water supply source to calculate sustainable yields	Pump test reports	Number of reports	All boreholes used in the project have documented pump test reports	During drilling of borehole	Habitats & communities along the railway corridor	Operator		
	Depletion of groundwater	ES 11.4	Ensure efficient use of water resources	Amount of water extracted	Volume (m^3)	All boreholes fitted with functioning water meters	Monthly	Habitats & communities along the railway corridor	Operator		

SN	Potential Impacts	SN	Mitigation measures	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Monitoring sites	Responsibility	Project Management Plan/SOP
Pre-Construction/Construction phase										
UE 1.0	Accidental leaks and spills. Activities that involve handling and storage of hydrocarbons or hazardous and dangerous chemicals pose a significant risk of accidental environmentalaquatic contamination. The proposed project activities include the transportation and handling of chemicals, materials and equipment sorted in containers that may leak or spill due to improper sealing or containers that may rapture or become damaged enroute to the project site.	UE 1.1	Follow good Industry Practices and Environmental Health and Safety (EHS) standards for the storage, handling and transportation of dangerous goods in line with international requirements and compliance with exisiting management plans	Monitoring reports of implemented management actions and procedures	number of reports	No annual report to lender without evidence of monitoring reports implemented	6 months	Project sites	Contractor	•PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN •PI-PR-041-CARGO HANDLING_EN •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
		UE 1.2	As reasonably practicable provide relevant training and refresher training to construction personnel.	Training records of procedures to control accidental leaks and spills	number of training records	No annual report to lender without evidence of training implemented	annually	Project sites	Contractor	•PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN •PI-PR-041-CARGO HANDLING_EN •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PR-002-HAZARD IDENTIFICATION AND OSH RISK ASSESSMENT_ENPI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •OECLS-AF-PG-GER-002_TRAINING PLAN_EN.
UE 2.0	Workers may demonstrate protests, as a result of the following: •poor and unsafe working conditions •issues with fair wages and working hours •inadequate worker benefits •poor leadership	UE 2.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Monitoring records demonstrating compliance with labour standards and workers' welfare requirements	Implementation status of preventive health measures	No evidence of unresolved labour grievances or persistent non-compliance with labour standards	3 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN •PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.
UE 3.0	The impact of health epidemics can cause widespread illness among workers, leading to severe labour shortages, reducing productivity and delaying project schedules. It could necessitate temporary closure, particularly if it is an infectious disease like COVID or other contagious illnesses that can infect workers and communities within the project area. Moreover, it can put a strains on the local healthcare facilities that are barely fully functional, unevenly distributed throughout the project areas and are not well equipped facilities in certain communities	UE 3.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Health monitoring and inspection reports confirming implementation of preventive health measures	Coverage and adequacy of disease prevention and awareness measures	No uncontrolled disease outbreaks attributable to project activities	6 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN •PI-PL-082_INFLUX MANAGEMENT PLAN_EN •OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN •PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN •PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN •PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN •PI-PR-052-OECLS_GUIDELINES FOR DRAWING UP THE RESPIRATORY PROTECTION PROGRAMME_EN.
UE 4.0	Increased risk of communicable diseases and health epidemics as a result of influx of workforce and entrepreneurs to the project area interacting communities. Particular concern is the current inadequate sanitation services within the communities and associated communicable diseases	UE 4.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Records of health surveillance, awareness activities, and sanitation inspections	Availability and functionality of project health support mechanisms	No sustained transmission of communicable diseases linked to the project workforce	3 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN •PI-PL-082_INFLUX MANAGEMENT PLAN_EN •OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN •PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN •PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN •PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN •PI-PR-052-OECLS_GUIDELINES FOR DRAWING UP THE RESPIRATORY PROTECTION PROGRAMME_EN.
UE 5.0	Health epidemics from inadequate facilities. Increase of people within project area from migration of labour and entrepreneurs can put a strain on the local healthcare facilities that are barely fully functional, unevenly distributed throughout the project areas and are not well equipped facilities in certain communities	UE 5.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Monitoring reports confirming availability and use of project-level health support measures	Effectiveness of stakeholder engagement and grievance management processes	No significant strain on local health facilities attributable to project activities	3 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN •PI-PL-082_INFLUX MANAGEMENT PLAN_EN •OECLS-AF-PG-GER-002_TRAINING PLAN_EN •PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN •PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN •PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN •PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN •PI-PR-052-OECLS_GUIDELINES FOR DRAWING UP THE RESPIRATORY PROTECTION PROGRAMME_EN.
UE 6.0	Social conflicts/ community unrest may arise when local communities are negatively impacted by the project •accidents that cause fatalities •when cultural norms and values are overlooked by either the project or migrant workers •damage to heritage sites •excluding communities in decision making processes •unequal benefits of from the project. •unfair recruitment processes and labour conditions •unsafe conditions around campsites and construction zones	UE 6.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Records of community engagement activities, grievances, and conflict resolution actions	Effectiveness of stakeholder engagement and grievance management processes	No unresolved community grievances escalating into conflict	3 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN •PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.
UE 7.0	Unanticipated floods can pose a health and safety risks to workers and communities, such as drowning, exposure to contamination of groundwater used for consumption.	UE 7.1	Implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual	Emergency preparedness, response, and incident records related to flooding events	Operational readiness and effectiveness of flood emergency response	Emergency procedures activated promptly and effectively when flooding occurs	annually	Project sites	Contractor	•PI-PL-001 Emergency Preparedness & Response Procedure with OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps) •PI-FR-003-PLN-0016-01 - PIAAIA water management •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN

UE 8.0	Health epidemic as a result of increased prevalence of communicable diseases and inadequate health facilities	UE 8.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Health inspection and sanitation monitoring reports	Adequacy and condition of sanitation and hygiene facilities	No prolonged health incidents linked to inadequate sanitation conditions	3 months	Project sites	Contractor	•PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN •PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN •PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN •Construction phase Communicable Diseases Management Plan
UE 9.0	Fires can be accidentally caused by careless human action, such as not properly disposing cigarettes, or disposing cigarettes that are still lit in areas where it can easily start a fire.	UE 9.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Fire safety inspection and monitoring reports	Compliance status with fire prevention requirements	No uncontrolled fire incidents caused by unsafe worker behaviour	3 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.
		UE 9.2	Implement the developed Emergency Response measures from the EPRP and Risk Management Procedure	Emergency drills, incident response, and evacuation records	Emergency response preparedness and response effectiveness	Emergency response systems functional and understood by workers	annually	Project sites	Contractor	
		UE 9.3	Review and update exisiting management plans to include: •ensuring that all workers are regularly trained on fire safety practices •placing signage to keep unauthorized personnel away from areas where open fires are likely to occur •Measures to prevent fires by eliminating risks, removing ignition sources near combustible materials and limiting fast fires and smoke development •the emergency response plan should include evacuation procedures, fire suppression systems, and first-aid provisions can help mitigate the impacts of a fire •evacuation procedures will take into consideration measures such as clear unimpeded escape routes, accessibility to the impaired or handicapped, marking and signing, and emergency lighting •ensure workers always wear appropriate PPE •detection and alarm system is required which includes communication methods •compartmentation measures to prevent or slow the spread of fire and smoke and include separation firewalls, floors, doors, dampers and smoke control systems •fire suppression control measures (example automatic sprinkler systems, manual portable extinguishers as well as firehouse reels).	Updated management plans, training records, and awareness materials	Currency and adequacy of fire management systems	Fire safety systems fully operational and communicated to workers	annually	Project sites	Contractor	
UE 10.0	Demining activities will be undertaken prior to the commencement of the proposed project activities. During demining activities, there is a slight chance that undetected UXO can be accidentally triggered, causing it to detonate. This will cause it to explode, resulting into injuries or fatalities. Moreover, one detonated UXO, can trigger a reaching of uncontrolled explosions if there are multiple UXO within the area.	UE 10.1	Use trained personnel equipped with appropriate protective gear and detection tools to remove UXOs	Training, certification, and deployment records	Personnel qualification and authorisation status	Only qualified and authorised personnel involved in UXO clearance	6 months	Project sites	Contractor	•PI-PL-001 Emergency Preparedness & Response Procedure with OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps) •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PR-008-INSPECTIONS_EN
		UE 10.2	Use low impact demining techniques to minimise soil destruction or damage	Demining method statements and supervision reports	Compliance with approved demining methodologies	Minimal disturbance beyond approved clearance areas	6 months	Project sites	Contractor	
		UE 10.3	Identified and remove UXOs safely before construction activities commence	UXO clearance certification records	UXO clearance certification status	No construction undertaken in areas not certified as cleared	once	Project sites	Contractor	
		UE 10.4	Monitor cleared areas for residual risks and ensure the area is safe	Post-clearance inspection and verification reports	Verification status of cleared areas	Cleared areas confirmed safe for unrestricted access	6 months	Project sites	Contractor	
		UE 10.5	Implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual	Emergency preparedness and response records	Emergency readiness for UXO incidents	Emergency response procedures understood and functional	annually	Project sites	Contractor	
		UE 10.6	Provide ongoing training for communities on response plan on potential undetected UXOs explosion discoveries by communities or workers	Community awareness and training records	Level of community awareness on UXO risks	Communities demonstrate awareness of UXO risks and app	annually	Project sites	Contractor	
		UE 10.7	Rehabilitate areas disturbed during demining activities	Rehabilitation completion and inspection reports	Condition and usability of rehabilitated land	Disturbed land restored to safe and usable condition	Post-demining	Project sites	Contractor	
		UE 10.8	Temporary erect fencing and warning signs around demining perimeter to prevent accidental entry	Inspection and maintenance records	Presence and integrity of fencing and warning signage	Demining areas clearly secured and signposted at all times	6 months	Project sites	Contractor	
		UE 10.9	Asses potential damage and benefits from recent demining activities during household survey for the development of the RAP to identify impacts from prior demining activities and that the LRP measures are accurately captured	RAP and livelihood restoration survey reports	Coverage of UXO-related impacts in RAP/LRP surveys	UXO-related impacts adequately captured and addressed in RAP and LRP	once			
UE 11.0	The process of clearing landmines and UXO offers positive impacts of which outweighs the negative impacts. This includes - Potentially saving lives and prevent unplanned human amputation injuries. - Land reclamation, as land will be returned to productive use for farming, animal grazing, building new homesteads or facilitating new developments. - Safer access to areas where potential natural resources (i.e firewood) can be collected.	UE 10.9	Asses potential damage and benefits from recent demining activities during household survey for the development of the RAP to identify impacts from prior demining activities and that the LRP measures are accurately captured	RAP and livelihood restoration survey reports	Coverage of UXO-related impacts in RAP/LRP surveys	UXO-related impacts adequately captured and addressed in RAP and LRP	once			•Resettlement Action Plan •Livelihood Restoration Plan •PI-PL-001 Emergency Preparedness & Response Procedure with OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps)
UE 12.0	Flooding. Drilling activities may pierce a ground water aquifer causing sudden overflow of groundwater above ground leading to localised flooding	UE 12.1	Implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual	Incident and response records related to groundwater flooding	Effectiveness of groundwater flooding response measures	Flooding incidents managed effectively without escalation	3 months	Project sites	Contractor	•PI-PL-001 Emergency Preparedness & Response Procedure with OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps) •PI-FR-003-PLN-0016-01 - PIAAIA water management •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
UE 13.0	Unanticipated localised pools of water or flooding from unexpected heavy and continuous rainfall in locations where cut and fill works are occurring	UE 13.1	Integration of drainage channels along the embankments, at bridges, culverts and at stations into the design to minimise localised pools and/or flooding from rainfall events.	Design documentation and drainage inspection records	Functionality of drainage infrastructure	Drainage systems functional and effective during rainfall events	annually	Project sites	Contractor	•PI-PL-001 Emergency Preparedness & Response Procedure with OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps) •PI-FR-003-PLN-0016-01 - PIAAIA water management •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
UE 14.0	Unexpected floods from overflowing riverbanks as a result of heavy and prolonged rainfalls can affect the construction activities, damaging equipment, and affecting the ability of works to commute and access the project site causing delays in works.	UE 14.1	Implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual	Emergency response and incident management records	Flood emergency response effectiveness	Flood events managed without major damage to works or facilities	3 months	Project sites	Contractor	•PI-PL-001 Emergency Preparedness & Response Procedure with OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps) •PI-FR-003-PLN-0016-01 - PIAAIA water management •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
UE 15.0	The increase in vehicle traffic as a result of the project transportation materials and equipment and workers could increase the risk of vehicle collision, especially along the EN180 which is also a public national road, resulting into the increase of accidents with other road users and pedestrians causing injuries or fatalities. Accidents can occur from speeding, not following road rules and because some portions of the roads that are not in good condition	UE 15.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Traffic monitoring, inspection, and incident records	Compliance with traffic management requirements	No repeated traffic incidents resulting from non-compliance	3 months	Project sites	Contractor	•PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PL-007 Stakeholder Engagement Plan
UE 16.0	Collision can occur when livestock and animals unexpectedly cross the road during the movements of the construction vehicles.	UE 16.1	Include the following in the transport/traffic management plans that will be developed as part of the detailed construction schedules •controls to ensure drivers are trained and have required licences to operate designated vehicle •identification of dangerous routes and measures to avoid them to reduce the risk of accidents •schedules that are monitored to control drivers' actions and that indicate vehicle maintenance •speed and night time travel restrictions on construction vehicles •an identified fleet monitoring system that will be applied for construction vehicles that includes telemetry to track vehicle locations, fuel usage, emissions and overall vehicle performance metrics.	Driver training, monitoring, and incident records	Driver compliance with traffic and safety controls	Drivers adhere to approved speed limits and designated routes	6 months	Project sites	Contractor	•PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PL-007 Stakeholder Engagement Plan

UE 17.0	Activities that involve movement of chemicals, materials and equipment in containers that may leak or spill due to improper sealing or container that may rapture or become damaged enroute to the project area from uneven/poorly structured roads along the EN 180. unexpected leaks and release of hydrocarbons or hazardous and dangerous chemicals pose a significant risk of accidental environmental contamination within the project area.	UE 17.1	Implement existing mangement controls in the following plans and procedures: •PI-PL- 100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN •PI-PR-041-CARGO HANDLING_EN •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PR-002-HAZARD IDENTIFICATION AND OSH RISK ASSESSMENT_ENPI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •OECLS-AF-PG-GER-002_TRAINING PLAN_EN.	Compliance monitoring and inspection records	Adherence to chemical transport and handling procedures	Transport and handling procedures followed consistently	3 months			•PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN •PI-PR-041-CARGO HANDLING_EN •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PR-002-HAZARD IDENTIFICATION AND OSH RISK ASSESSMENT_ENPI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN
UE 18.0	Accidental spills can result in the direct release of hydrocarbons or other hazardous and dangerous chemicals onto the roads, soils and into water bodies. In the event of an accidental leak/spill the fertility of the surrounding soil will decrease and natural/modified habitat and vegetation cover will die off. Moreover, it may lead to lead to long-term environmental degradation, affecting biodiversity and potentially harming local flora and fauna.	UE 18.1	Follow good Industry Practices and Environmental Health and Safety (EHS) standards for the storage, handling and transportation of dangerous goods in line with international requirements and compliance with exisiting management plans	Spill monitoring, inspection, and incident response reports	Effectiveness of spill prevention and response measures	Spill incidents promptly contained and managed to prevent contamination	3 months	Project sites	Contractor	•PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN •PI-PR-041-CARGO HANDLING_EN •PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN •PI-PR-002-HAZARD IDENTIFICATION AND OSH RISK ASSESSMENT_ENPI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •OECLS-AF-PG-GER-002_TRAINING PLAN_EN.
		UE 18.2	As reasonably practicable provide relevant training and refresher training to construction personnel.	Level of awareness and competency of construction personnel in spill prevention, handling of hazardous materials, and emergency response	Effectiveness of spill prevention and response measures	All relevant construction personnel are adequately trained and demonstrate clear understanding of spill prevention and response procedures	6 months	Project sites	Contractor	
		UE 18.3	Carry out regular monitoring to ensure compliance with exisiting management plans indicated in mitigation measure UE17.1	Effectiveness of monitoring and adherence to spill prevention and hazardous materials management procedures	Effectiveness of spill prevention and response measures	Regular monitoring confirms consistent implementation of spill prevention measures and compliance with approved management plans, with corrective actions taken promptly when gaps are identified	annually	Project sites	Contractor	
UE 19.0	In addition, the temporary closure of roads and unexpected detours/rerouting can cause confusion between pedestrians and drivers, in cases where the detours are not clearly marked or where pedestrians' pathways have been temporarily changed into access roads.	UE 19.1	Include the follwoing in the transport/traffic management plans that will be developed as part of the detailed construction schedules •controls to ensure drivers are trained and have required licences to operate designated vehicle •identification of dangerous routes and measures to avoid them to reduce the risk of accidents •schedules that are monitored to control drivers' actions and that indicate vehicle maintenance •speed and night time travel restrictions on construction vehicles •an identified fleet monitoring system that will be applied for construction vehicles that includes telemetry to track vehicle locations, fuel usage, emissions and overall vehicle performance metrics.	Road safety inspections and monitoring records	Clarity and safety condition of traffic detours	Detours clearly marked, communicated, and maintained	3 months	Project sites	Contractor	•PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PL-007 Stakeholder Engagement Plan
UE 20.0	Fires at disposal sites/dumpsites from flammable waste products, increased methane and heat exposure; when left unattended they can rapidly spread	UE 20.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Fire inspection and waste site monitoring records	Fire risk condition at waste disposal sites	Disposal sites managed without fire outbreaks	3 months	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.
		UE 20.2	Implement the developed Emergency Response measures from the EPRP and Risk Management Procedure	Electrical inspection, maintenance, and response records	Number of records	Electrical systems maintained in safe working condition	3 months	Project sites	Contractor	
		UE 20.3	Review and update exisiting management plans to include: •ensuring that all workers are regularly trained on fire safety practices •placing signage to keep unauthorized personnel away from areas where open fires are likely to occur •Measures to prevent fires by eliminating risks, removing ignition sources near combustible materials and limiting fast fires and smoke development •the emergency response plan should include evacuation procedures, fire suppression systems, and first-aid provisions can help mitigate the impacts of a fire •evacuation procedures will take into consideration measures such as clear unimpeded escape routes, accessibility to the impaired or handicapped, marking and signing, and emergency lighting •ensure workers always wear appropriate PPE •detection and alarm system is required which includes communication methods •compartmentation measures to prevent or slow the spread of fire and smoke and include separation firewalls, floors, doors, dampers and smoke control systems •fire suppression control measures (example automatic sprinkler systems, manual portable extinguishers as well as firehouse reels).	Updated fire management plans, training records, and inspection documentation	Management plan records	Fire prevention, detection, evacuation, and suppression measures are clearly defined, implemented, and understood by workers	annually	Project sites	Contractor	
UE 21.0	Activities that involve handling and storage of hydrocarbons or hazardous and dangerous chemicals pose a significant risk of accidental environmental contamination. The storage and handling of chemicals, materials and equipment sorted in containers that may leak or spill due to improper sealing or containers that may rapture or become damaged enroute to the project site. Improper storage and sealing can cause liquid chemicals to seep into the ground, leading to contamination of soil and waterbodies, potentially impacting the ecosystem and making groundwater unsafe to consume.	UE 21.1	Follow good Industry Practices and Environmental Health and Safety (EHS) standards for the storage, handling and transportation of dangerous goods in line with international requirements and compliance with exisiting management plans	Inspection and monitoring records confirming safe handling, storage, and transport of hazardous materials	Adherence to chemical transport and handling procedures	Hazardous materials are stored, handled, and transported in a manner that prevents leaks, spills, and environmental contamination	3 months	Project sites	Contractor	•Biodiversity Management Plan •PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN •PI-PL-037-OECLS_PESTICIDE MANAGEMENT PLAN_EN •PI-MP-007-OECL_WASTE AND HAZARDOUS MATERIALS MANAGEMENT PLAN •PI-PR-012-INCIDENT INVESTIGATION METHODOLGIES ANNEX I_EN •PI-PR-012- INCIDENT INVESTIGATION METHODOLGIES ANNEX II_EN •PI-FR-01201-OECLS_EN work accident statistics report •PI-FR-01202-OECLS_EN incident investigation report •PI-FR-01203-OECLS_EN incident alert form
		UE 21.2	As reasonably practicable provide relevant training and refresher training to construction personnel.	Training and awareness records for personnel handling hazardous substances	Adherence to chemical transport and handling procedures	Personnel handling hazardous materials demonstrate adequate knowledge and competence in spill prevention and response	annually	Project sites	Contractor	
		UE 21.3	Carry out regular monitoring to ensure compliance with exisiting management plans	Compliance monitoring and inspection records	Adherence to chemical transport and handling procedures	Hazardous materials management procedures are consistently implemented and adhered to	3 months	Project sites	Contractor	
		UE 22.1	Carry out regular monitoring to ensure compliance with exisiting management plans	Electrical safety inspection and fire prevention monitoring records	Safety condition of electrical systems	Electrical systems and equipment are maintained in a safe condition that minimizes fire risk	3 months	Project sites	Contractor	
		UE 22.2	Implement the developed Emergency Response measures from the EPRP and Risk Management Procedure	Emergency preparedness, fire drill, and incident response records	Safety condition of electrical systems	Fire incidents are managed effectively through timely and coordinated emergency response actions	annually	Project sites	Contractor	

UE 22.0	Fires can be caused by electric faults, as a result of machine malfunctions and poor wiring that can overheat, igniting sparks that cause fires onsite. Moreover, in the event of a fire on site, the potential risk of the fire spreading is great because it can come into contact with highly flammable chemicals stored onsite such as paints and fuels.	UE 22.3	Review and update exisiting management plans to include: •ensuring that all workers are regularly trained on fire safety practices •placing signage to keep unauthorized personnel away from areas where open fires are likely to occur •Measures to prevent fires by eliminating risks, removing ignition sources near combustible materials and limiting fast fires and smoke development •the emergency response plan should include evacuation procedures, fire suppression systems, and first-aid provisions can help mitigate the impacts of a fire •evacuation procedures will take into consideration measures such as clear unimpeded escape routes, accessibility to the impaired or handicapped, marking and signing, and emergency lighting •ensure workers always wear appropriate PPE •detection and alarm system is required which includes communication methods •compartmentation measures to prevent or slow the spread of fire and smoke and include separation firewalls, floors, doors, dampers and smoke control systems •fire suppression control measures (example automatic sprinkler systems, manual portable extinguishers as well as firehouse reels).	Updated fire safety management plans, training records, and inspection reports	Management plans	Fire safety systems, procedures, and worker awareness measures are fully operational and effective	annually	Project sites	Contractor	•PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN •PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN •PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN •PI-PR-048-PRELIMINARY RISK ANALYSIS_EN •PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.
					Operations phase					
UE 1.0	Accidental spills of transported f fuels and other liquid cargo. This is the greatest risk to environmental degradation due to their ability to disperse rapidly and impact a larger area. Accidental spills can directly release fuel and dangerous chemicals into nearby water bodies and groundwater used for consumption, potentially affecting the health of communities along the ROW.	UE 1.1	Implement IFC Guidelines, namely: -Implement systems for the proper screening, acceptance and transportation of dangerous goods -rail tank cars to meet international standards -preparation of spill prevention and control, and emergency preparedness and response plans, based on an analysis of hazards, including the nature, consequence, and probability of accidents. Based on result of the hazard analysis, implementation of prevention and control measures which may include: -routing and timing of hazardous materials transport to minimize risk to the community (e.g. restricting transport of hazardous materials on some routes) -limiting train speed in developed areas -dissemination of emergency preparedness and response information to the potentially affected communities (e.g. emergency notification systems and evacuation procedures)	Implementation status of IFC-compliant procedures for transport, handling, routing, and emergency preparedness for dangerous goods	Level of compliance with IFC dangerous goods transport requirements	Fuel and hazardous materials transport is managed in a manner that prevents uncontrolled spills and protects communities and water resources - Procedures approved and implemented	3 months	Operation facilities	Operator	•Operational ESMP •Operation Emergency Preparedness & Response Procedure •Operations Fire Prevention and Protection Procedure
		UE 1.2	Develop an emergency response plan to cater for large scale spills or leaks from rail tankers and/or wagons. Identify suitably trained professionals and equipment to limit and rehabilitate spills to minimise impact to the environment. As reasonably practicable conduct regular inspections of wagons/tankers to identify loss of containment scenarios	Existence, adequacy, and operational readiness of emergency response plans for large-scale rail spill scenarios	Emergency spill response preparedness and capability	Emergency response arrangements are in place and capable of effectively managing large-scale spill scenarios	3 months	Operation facilities	Operator	
		UE 1.3	Ensure that cleaning and contamination equipment to deal with smaller accidental events are located at storage and refuelling sites, and that they are discarded at acceptable waste disposal facilities once used	Availability, condition, and proper disposal arrangements for minor spill response and contamination clean-up equipment	Availability and condition of minor spill response equipment	Spill response equipment is readily available, functional, and safely disposed of after use	3 months	Operation facilities	Operator	
		UE 1.4	Keep stocks of materials needed to clean and contain spill events	Adequacy and continuous availability of spill containment and clean-up materials at operational facilities	Adequacy of spill containment and clean-up materials	Spill containment materials are consistently available and sufficient for foreseeable spill scenarios	3 months	Operation facilities	Operator	
		UE 1.5	Provide relevant training to operational personnel.	Level of training and demonstrated competency of operational personnel in spill prevention and response	Personnel competency in spill prevention and response	Operational staff demonstrate adequate competence in spill prevention and emergency response	annually	Operation facilities	Operator	
UE 2.0	social unrest can be caused by external structural changes in society that may impact the project operations as well as project infrastructure. Workers may demonstrate protests, as a result of the following: •poor and unsafe working conditions •issues with fair wages and working hours •inadequate worker benefits •poor management leadership	UE 2.1	Develop and implement an operational Stakeholder Engagement Plan to ensure continuous community engagements	Implementation effectiveness of the operational Stakeholder Engagement Plan during operations	Effectiveness of stakeholder engagement processes	Communities remain informed and engaged, with no escalation of unresolved concerns	3 months	Operation facilities	Operator	•Operational ESMP •Project's Workers Grievance Mechanism •Policies and procedures related to (Non-Discrimination and equal opportunity/Worker's right to Privacy/Worker's freedom of movement or of association/Restriction on Child Labour/Restrictions on Forced Labour) •Human Resource Policy
		UE 2.2	Establish a network of community/stakeholder liaison officers that will actively involve community leaders in project decision making process	Functionality and activity level of community and stakeholder liaison arrangements	Functionality of community liaison arrangements	Community leaders are actively engaged in project-related discussions	3 months	Operation facilities	Operator	
		UE 2.3	Develop and inform both locals and workers of the grievance mechanism process for operation phase	Accessibility, use, and resolution effectiveness of grievance mechanisms for workers and communities	Accessibility and effectiveness of grievance resolution mechanisms	Grievances are addressed in a timely and transparent manner without escalation	3 months	Operation facilities	Operator	
		UE 2.4	Ensure adequate working conditions and fair compensation	Compliance of working conditions, wages, and benefits with applicable labour standards	Compliance with labour standards and employment conditions	Working conditions and compensation meet applicable labour standards	6 months	Operation facilities	Operator	
		UE 2.5	Develop effective management plans	Operational implementation and effectiveness of approved management plans	Operational effectiveness of management systems	Management systems are operational and effectively implemented	annually	Operation facilities	Operator	
		UE 2.6	Implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual.	Operational readiness and effectiveness of emergency response procedures under the EPRP and ESMS	Emergency response readiness and effectiveness	Emergency procedures are functional and understood by workers	annually	Operation facilities	Operator	
UE 3.0	Community conflicts/unrest may arise when local communities are negatively impacted by the project, as a result of the following factors: • frequent accidents that cause fatalities •Rude or bad language used towards passengers and communities •unsafe conditions at stations and when boarding/offloading locomotives	UE 3.1	Develop and implement an operational Stakeholder Engagement Plan to ensure continuous community engagements	Effectiveness of stakeholder engagement activities in addressing community concerns during operations	Proactive engagement and conflict prevention performance	Community concerns are addressed proactively, preventing escalation into conflict	3 months	Operation facilities	Operator	•Operational ESMP •Project Stakeholder Engagement Plan and Grievance Redress Mechanism •Operations Community Safety Management Plan and associated sub-procedures •Influx Management Strategy for Operations
		UE 3.2	Establish a network of community/stakeholder liaison officers that will actively involve community leaders in project decision making process	Continuity and effectiveness of communication between the operator and affected communities	Continuity and effectiveness of community liaison functions	Effective communication channels exist between communities and the operator	3 months	Operation facilities	Operator	
		UE 3.3	Develop and inform both locals and workers of the grievance mechanism process for operation phase	Performance of grievance management system in resolving operational-phase complaints	Effectiveness of grievance handling during operation	Grievance mechanisms are accessible and trusted by communities	6 months	Operation facilities	Operator	
		UE 3.4	Ensure adequate working conditions and fair compensation	Extent to which labour practices contribute to or reduce community dissatisfaction	Labour practice compliance and workforce satisfaction	Labour practices do not contribute to community dissatisfaction	annually	Operation facilities	Operator	
		UE 3.5	Develop effective management plans	Effectiveness of management controls in preventing conflict-related operational risks	Operational control of conflict-related risks	Management controls reduce operational conflict risks	annually	Operation facilities	Operator	
		UE 3.6	Implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual.	Effectiveness of emergency response actions in preventing escalation to community unrest	Effectiveness of emergency response in preventing unrest	Emergency incidents are managed without escalation to community unrest	annually	Operation facilities	Operator	
UE 4.0	Health epidemic as a result of increased prevalence of communicable diseases and inadequate health facilities	UE 4.0	Awareness campaigns will be implemented on health and communicable diseases	Coverage and effectiveness of health and communicable disease awareness activities	Coverage and effectiveness of health awareness campaigns	Communities and workers demonstrate increased awareness of health risks	6 months	Operation facilities	Operator	•Operations Communicable Diseases Management Plan •Influx Management Strategy for Operations
		UE 4.1	Develop and implement a training program for operational staff on health and hygiene management	Staff knowledge and application of health, hygiene, and dis	Staff competency in health and hygiene practices	Staff apply appropriate hygiene and disease prevention practices	annually	Operation facilities	Operator	
		UE 4.2	Develop and implement a community health and safety plan for operational phase	Implementation effectiveness of the Community Health and Safety Plan during operations	Effectiveness of community health risk management	Community health risks associated with operations are effectively managed	annually	Operation facilities	Operator	
		UE 4.3	Develop and implement an emergency response plan for operations.	Operational readiness and effectiveness of emergency health response arrangements	Health emergency response capability	Health emergencies are managed promptly and effectively	annually	Operation facilities	Operator	
UE 5.0	Deteriorated health of workers. In addition, maintenance of stations, equipment and project infrastructure, such as cleaning of fuel tanks, refuelling, vehicle servicing, can inadvertently result in spills that release oils, lubricants, or other chemicals into the environment. Depending on the amount and the type of substance that was spilled, it may cause health concerns, particularly on workers due to exposure of toxic substances or by contaminating drinking water sources.	UE 5.0	Awareness campaigns will be implemented on health and communicable diseases	Worker awareness of occupational health risks related to spills, chemicals, and contaminated water	Worker awareness of occupational health risks	Workers demonstrate awareness of occupational health risks	6 months	Operation facilities	Operator	•Human Resource Policy •Operations Pollution Prevention Plan •Operations Pesticide use and management Plan •Operations Waste and Wastewater Management Plan
		UE 5.1	Develop and implement a training program for operational staff on health and hygiene management	Competency of workers in applying health and hygiene practices during operational activities	Worker competency in health and hygiene practices	Workers apply safe health and hygiene practices	annually	Operation facilities	Operator	
		UE 5.2	Develop and implement a community health and safety plan for operational phase	Effectiveness of health risk management measures for workers and surrounding communities	Control of health risks to workers and communities	Health risks to workers and communities are minimized	annually	Operation facilities	Operator	
		UE 5.3	Develop and implement an emergency response plan for operations.	Effectiveness of emergency response measures for occupational health incidents	Effectiveness of occupational health incident response	Occupational health incidents are managed effectively	annually	Operation facilities	Operator	

UE 6.0	Poor housekeeping at the stations and its surrounding areas can increase the risk of a fire by creating an environment where combustible materials/debris and waste materials accumulate. The accumulation of materials and debris can act as a fuel for fire and obstruct emergency exit ways, making it difficult to evacuate or access fire extinguishers in an emergency. Overall, poor housekeeping not only increases the likelihood of a fire starting but also exacerbates its spread and the potential for severe damage.	UE 6.1	Develop and implement an operational Emergency Response measure from the EPRP and a Risk Management Procedure And Life and Safety Master Plan for operation phase	Level of preparedness and effectiveness of fire emergency and life safety measures	Fire risk preparedness and response capacity	Fire risks from poor housekeeping are effectively controlled	3 months	Operation facilities	Operator	•Operations Hazardous Materials Management and Safety Plan •Operations Pollution Prevention Plan •Operations Pesticide use and management Plan •Operations Waste and Wastewater Management Plan •Operation Emergency Preparedness & Response Procedure •Operations Fire Prevention and Protection Procedur
		UE 6.2	The EPRP should include trainings for workers at stations and communities on how they should respond to a fire outbreak	Knowledge and preparedness of workers and communities in fire response procedures	Fire response knowledge and preparedness of workers and communities	Workers and communities understand fire response procedures	annually	Operation facilities	Operator	
		UE 6.3	Ensure that stations and maintenance workshops have fire abatement equipment	Availability and operational condition of fire detection and firefighting equipment	Availability and functionality of firefighting equipment	Firefighting equipment is available and functional	3 months	Operation facilities	Operator	
		UE 6.4	All new buildings or upgrades to train stations accessible to the public will be designed and constructed in full compliance with local building codes and fire regulations. and fire safety standards	Compliance status of station design and construction with fire and building safety codes	Compliance status with fire and building safety standards	Facilities comply with applicable fire safety standards	annually	Operation facilities	Operator	
		UE 6.5	Implement mandatory regular maintenance and testing of systems is required to ensure that all mechanical, electrical, and civil structures and systems conform with operational requirements.	Condition and operational integrity of mechanical, electrical, and civil systems	Operational condition of mechanical, electrical, and civil systems	Infrastructure systems remain safe and operational	6 months	Operation facilities	Operator	
UE 7.0	Fires caused by slash and burn activities to clear land for farming or from cigarettes thrown out from locomotives can burn along the embankments can potentially damage the rail infrastructure.	UE 7.1	Develop and implement an operational Emergency Response measure from the EPRP and a Risk Management Procedure And Life and Safety Master Plan for operation phase	Approved and operational fire emergency and life safety plans	EPRP procedures in place and functional	Emergency response, risk management, and life safety plans are approved, disclosed, and actively implemented	annually	Operation facilities	Operator	•Operation Emergency Preparedness & Response Procedure •Operations Fire Prevention and Protection Procedure
		UE 7.2	The EPRP should include trainings for workers at stations and communities on how they should respond to a fire outbreak	Fire response training conducted for workers and communities	Training records and attendance documentation	Relevant workers and nearby communities have received fire response training and refresher awareness	annually	Operation facilities	Operator	
		UE 7.3	Ensure that stations and maintenance workshops have fire abatement equipment	Availability and functionality of fire-fighting equipment	Equipment inventory and inspection records	Fire-fighting equipment is present, functional, and accessible at all stations and workshops	3 months	Operation facilities	Operator	
		UE 7.4	All new buildings or upgrades to train stations accessible to the public will be designed and constructed in full compliance with local building codes and fire regulations. and fire safety standards	Compliance of station infrastructure with fire and building codes	Compliance certificates and inspection reports	All applicable stations comply with national building and fire safety regulations	During upgrades and audits	Operation facilities	Operator	
		UE 7.5	Implement mandatory regular maintenance and testing of systems is required to ensure that all mechanical, electrical, and civil structures and systems conform with operational requirements.	Condition and operational integrity of mechanical, electrical, and civil systems	Maintenance schedules and inspection logs	Maintenance and testing conducted as per approved operational schedules	3 months	Operation facilities	Operator	
UE 8.0	Fires at disposal sites/dumpsites from flammable waste products, increased methane and heat exposure; when left unattended they can rapidly spread	UE 8.1	Develop and implement an operational Emergency Response measure from the EPRP and a Risk Management Procedure And Life and Safety Master Plan for operation phase	Approved emergency response and fire management procedures for waste sites	Site-specific emergency response procedures	Emergency response and fire management measures are in place and implemented at disposal sites	annually	Operation facilities	Operator	•Operations Pollution Prevention Plan •Operations Contaminated Land Management Procedure •Operations Hazardous Materials Management and Safety Plan
		UE 8.2	The EPRP should include trainings for workers at stations and communities on how they should respond to a fire outbreak	Fire response training activities at disposal sites	Training materials and participation records	Workers and surrounding communities are aware of fire risks and response procedures	annually	Operation facilities	Operator	
		UE 8.3	Ensure that stations and maintenance workshops have fire abatement equipment	Availability and condition of fire abatement equipment	Equipment inspection and maintenance records	Fire abatement equipment is available and maintained in working condition	3 months	Operation facilities	Operator	
		UE 8.4	All new buildings or upgrades to train stations accessible to the public will be designed and constructed in full compliance with local building codes and fire regulations. and fire safety standards	Compliance status of waste-related facilities	Regulatory approval and compliance documentation	Facilities meet applicable building and fire safety requirements	During upgrades and audits	Operation facilities	Operator	
		UE 8.5	Implement mandatory regular maintenance and testing of systems is required to ensure that all mechanical, electrical, and civil structures and systems conform with operational requirements.	Maintenance and inspection records for waste management infrastructure	Maintenance and inspection records	Routine maintenance and inspections conducted in line with operational procedures	3 months	Operation facilities	Operator	

Sn	Potential Impacts	SN	Mitigation measures	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Threshold Value	Measuring Frequency	Indicative sampling location	Responsibility
Pre-Construction and Construction phase									
CIA 1	Air quality declining due to construction related dust dispersion	CIA 1.1	OEC will follow good industry practices to minimise impacts on air quality and apply the mitigation measures included for air quality as a result of activities directly related to the construction of Luena Saurimo	Number of dust complaints received and resolved	Number of dust complaints resolved	100% resolution within 7 working days	Weekly	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor
		CIA 1.2	Implement regular dust suppression (water spraying, covering stockpiles, speed limits).	Compliance rate with dust suppression plan	Percent	95% compliance rate	Daily	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 1.3	Monitor PM10 and PM2.5 against WHO standards and report exceedances.	PM10, PM2.5, NOx, SO_2 levels	µg/m³	WHO 24-hour mean: PM10 ≤ 45 µg/m³, PM2.5 ≤ 15 µg/m³	Quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 1.4	publish public notices of the location and duration of construction informing the community of periods of increased activity that will generate dust.	Dust complaints logged.	Number of complaints received and adressed	Zero unresolved community complaints on dust	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	
CIA 2	Regional emissions rising from project related vehicle and machinery use	CIA 2.1	Conduct a GHG inventory for the project.	Total GHG emissions (Scope 1 & 2)	tCO2e/year	Baseline established, annual reduction target of 2%	Annually	All works areas, Camps, laydown areas, adjacent sensitive receptors	Operator
		CIA 2.2	Implement an energy efficiency and emissions reduction plan.	Progress against emissions reduction pla	Percent	100% implementation of planned actions	Quarterly	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 2.3	Use low-carbon technologies where feasible.	Percentage of fleet/plant using low-carbon technology	Percent	20% of fleet/plant by project year 3	Annually	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 2.4	Report annually against Angola's NDC targets.	Alignment of project emissions with sectoral NDC targets	Percent alignment	100% reporting compliance, emissions within NDC pathway	Annually	All works areas, Camps, laydown areas, adjacent sensitive receptors	
CIA 3	Ambient noise levels increasing near construction and operational zones	CIA 3.1	minimising drop heights of materials i.e. lorry with lifting boom or dumper carefully depositing materials	Compliance with drop height limits	Meters, Percent compliance	Max drop height 1.5m; 100% compliance	Daily spot checks	All works areas, Camps, laydown areas, adjacent sensitive receptors	Contractor
		CIA 3.2	maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)	Condition of haul road surfaces	Rating (Good/Fair/Poor)	Maintain 'Good' condition rating	Weekly	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 3.3	all plant, equipment and noise control measures applied to plant and equipment should be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practicable. Any plant, equipment or items fitted with noise control equipment found to be defective will not be operated until repaired	Percentage of plant with valid noise inspection certificate	Percent	100% of operational plant	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 3.4	machines in intermittent use will be shut down or throttled down to a minimum during periods between works	Number of idling machines recorded	Count	Zero unnecessary idling (>5 mins)	Daily spot checks	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 3.5	as far as is reasonably practicable, the location and orientation of semi-static equipment will be chosen to minimise the noise impact on sensitive receptors	Distance from semi-static plant to nearest sensitive receptor	Meters	Minimum 100m separation where practicable	During setup of equipment	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 3.6	where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements	Inclusion of noise/vibration controls in method statements	Percent of relevant statements	100% inclusion	During work package review	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 3.7	where safe to do so, noise from reversing alarms will be controlled and limited as far as possible using physical barriers to restrict pedestrian and construction worker movements in zones with numerous turning/reversing construction vehicles, to minimise intrusive sound of tonal alarms	Use of non-tonal/white sound alarms or physical barriers	Percent of fleet/zoned areas	100% in high-risk zones	Monthly	All works areas, Camps, laydown areas, adjacent sensitive receptors	
		CIA 3.8	Where night works are required, as far as is practicable programme the work such that separation distances to noise sensitive receptors are maximised	Noise levels (LAeq) at nearest sensitive receptor during night works	dB(A)	≤55 dB(A) LAeq (night) at nearest receptor	During night works	Nearest residential/sensitive receptor to night work site	
CIA 4		CIA 4.1	Obtain the estimated flow of sewage water, per campsite, from the Water Consumption Study (Approximately 80% of Consumed Water turns into sewage water)	Sewage water generation rate	m³/day	As per design specification	During design phase	Groundwater sources - boreholes & wells	Contractor
		CIA 4.2	Design the Sewage Treatment System, to ensure that the resulting treated water to be discharged will respect the chemical and physical requirements of Angolan Regulations	Compliance of design with Angolan discharge standards	Approved design document	100% compliance with all parame	During design review	Groundwater sources - boreholes & wells	

	Water quality deteriorating due to sedimentation and potential contamination	CIA 4.3	Design the location of the Water Treatment System, at each campsite, ensure that the treated discharge is not near any existing surface or underground water body	Distance from discharge point to nearest water body	Approved design document	Minimum 5 km buffer	During design review	Groundwater sources - boreholes & wells	
		CIA 4.4	Prepare a Technical Report on the Water Treatment System, for each campsite. Include this in the General Waste and Wastewater Management Plan	Completion and submission of Technical Report	Approved report	Report completed and integrated	Prior to permit application	Groundwater sources - boreholes & wells	
		CIA 4.5	Send the General Waste and Wastewater Management Plan to Agência Nacional de Resíduos (ANR), to obtain approval; Pay the required legal fees	Receipt of approval from ANR	Approval letter received	Formal approval obtained	Prior to construction	Groundwater sources - boreholes & wells	
		CIA 4.6	Send the Technical Report on the Water Treatment System, to the Secretaria do Ambiente do Governo Provincial, to obtain approval; Pay the required legal fees	Receipt of provincial environmental approval	Approval letter received	Formal approval obtained	Prior to construction	Groundwater sources - boreholes & wells	
		CIA 4.7	Send the Technical Report on the Water Treatment System, to Instituto Nacional de Recursos Hídricos (INRH), to obtain approval; Pay the required legal fees	Receipt of water resources approval	Approval letter received	Formal approval obtained	Prior to construction	Groundwater sources - boreholes & wells	
		CIA 4.8	After obtaining approval, invest in and install the sewage water treatment system, at each location	Installation completion status	Percent complete	100% installation before camp occupation	During construction	Groundwater sources - boreholes & wells	
		CIA 4.9	Before operation, perform tests on the treated sewage water to ensure that the treatment system complies with Angolan discharge regulation limits	Laboratory test results for key parameters (BOD, COD, TSS, etc.)	Number of monitoring lab tests	Meet Angolan effluent discharge standards (e.g., BOD ≤ 30 mg/L, TSS ≤ 100 mg/L)	Prior to system operation	Groundwater sources - boreholes & wells	
		CIA 4.10	After tests approve and confirm the water treatment system's efficiency, the operation can start.	Operational readiness certificate	Approved lab tests	Certificate issued	Prior to operation	Groundwater sources - boreholes & wells	
CIA 5	Groundwater and surface water availability declining under project pressure	CIA 5.1	Follow abstraction volumes as prescribed in permits.	Volume of water abstracted	m³/month	No water abstraction below the volumes prescribed in authorisation permits	Monthly	Groundwater sources - boreholes & wells	Contractor
		CIA 5.2	Monitor groundwater levels in boreholes and wells.	Water meters installed on all boreholes to be used	Percentage of boreholes with meters	No water abstraction below the volumes prescribed in authorisation permits	Quarterly	Groundwater sources - boreholes & wells	
		CIA 5.3	Share monitoring results with communities.	Number of community meetings where water data is shared	Number of meeting held	Biannual sharing at minimum	Biannually	Groundwater sources - boreholes & wells	
CIA 6	Natural vegetation declining due to clearance and land conversion.	CIA 6.1	Minimise clearance of natural vegetation and habitats at site fringes.	Area of natural vegetation cleared beyond permitted footprint	Square meters (m²)	Zero unauthorized clearance	Monthly	Excavated/disturbed areas	Contractor
		CIA 6.2	Maintain habitat connectivity corridors.	Width and condition of maintained corridors	Square meters (m²)	Minimum 50m width, 'Good' condition	Quarterly	Excavated/disturbed areas	
		CIA 6.3	Monitor species of conservation importance.	Presence/absence and abundance of key indicator species	Count Presence/Absence	No local extinction; populations stable or increasing	Annually	Excavated/disturbed areas	
		CIA 6.4	Engage local authorities and communities in biodiversity monitoring.	Number of community members participating in monitoring	Number of community members attended the meeting	Minimum 5 community members trained and engaged per year	Annually	Excavated/disturbed areas	
CIA 6	Local employment opportunities increasing, supporting economic empowerment	CIA 7.1	Implement a Local Employment and Procurement Plan (LPP) with transparent targets.	Public advertising and awareness campaigns around recruitment processes and requirements for locals	Number of awareness campaigns and locals hires	Increased awareness of recruitment processes and requirements	Prior to project commencement, then as recruitments needs arise to be reported annually	Communities along railway corridor Aoi, Camps, Materials sourcing areas	Operator
		CIA 7.2	Establish a Grievance Redress Mechanism (GRM).	Number of employment/procurement related grievances received and resolved	Number of addressed and closed-out grievances	No project activities undertaken without an approved grievance mechanism	Prior to project commencement, once during pre-construction and monthly during construction	GRM office, project site	
		CIA 7.3	Report annually on local employment and procurement outcomes.	Annual report completeness and disclosure	Number of reports of completeness and disclosures	Report published and shared with communities annually	Annually	Company website, community noticeboards	
CIA 8	Land and Livelihoods	CIA 8.1	Develop and implement a Livelihood Restoration Plan (LRP).	Number of affected households with restored/enhanced livelihoods	Number of restored household	100% of eligible households achieve pre-project or improved standard of living within 2 years of displacement	Annually	Affected households	Operator
		CIA 8.2	Prepare a Resettlement Action Plan (RAP) in line with IFC PS5.	RAP completion and approval	Date of Approval status	Full RAP approval before any displacement	Prior to displacement	Project office, lender's portal	
		CIA 8.3	Monitor livelihood restoration outcomes with affected households.	Household income levels compared to baseline	Percent of baseline	≥100% of pre-displacement income	Annually for 3 years	Resettled households	
CIA 9	Public services experiencing growing strain from project related population influx	CIA 9.1	Conduct a pre-construction infrastructure survey.	Survey report completed identifying capacity gaps	Number of gaps	Report completed 6 months before major workforce influx	Once, pre-construction	Municipal service facilities (clinics, schools, water points)	Operator & Municipalities
		CIA 9.2	Develop a Collaborative Service Delivery Plan with municipal authorities.	Formal agreement/MoU signed with municipalities	Signed formal agreement	MoU signed before workforce camp establishment	Prior to camp occupation	Municipal offices	
		CIA 9.3	Co-invest in upgrading key infrastructure where necessary.	Value of co-investment in infrastructure	The budget set aside	As agreed in MoU; minimum 1% of project labor cost	Prior to project commencement	Upgraded infrastructure sites	
CIA 10	Demography and Social Fabric	CIA 10.1	Implement zoning regulations and incentives for housing development.	Number of new housing units built with project support/incentives	Number of new housing unit build	Meet agreed target in Municipal Plan	Annually	Municipal planning office	Municipalities
		CIA 10.2	Monitor community welfare and social cohesion indicators.	Results of community perception surveys	Number of addressed and closed-out grievances	No decline in social cohesion index	Biannually	Sample households in project area	
		CIA 10.3	Maintain dialogue with traditional authorities on social dynamics.	Number of structured dialogues held with traditional authorities	Number of community engagements and grievances raised	Quarterly meetings	Quarterly	Traditional authority offices	

CIA 11	Community health burden increasing with exposure to dust, emissions, and stressors.	CIA 11.1	Conduct regular health screenings and vaccinations for workers.	Percentage of workers with up-to-date health screenings/vaccinations	Number of recorded screening or vaccinanted workers	100% of direct workers	Every 6 months	Site clinic, worker records	Contractor / Operator
		CIA 11.2	Implement traffic management and safe crossing measures.	Number of traffic incidents involving community members	Number of traffic incident recorded	Zero incidents	Monthly	Project road intersections, community areas	
		CIA 11.3	Monitor accident statistics and health clinic records.	Rate of reportable accidents and clinic visits for respiratory/issues	Rate per 200,000 work hours	Industry average or below	Monthly	Site clinic, incident reports	
		CIA 11.4	Maintain security arrangements that respect community welfare.	Number of community complaints related to project security	Number of complaints received and adressed	Zero substantiated complaints of security misconduct	Quarterly	Community Liaison Office, GRM logs	
CIA 12	Community access to heritage sites increasingly constrained by project footprint	CIA 12.1	Provide alternative paths if community access to heritage sites is disrupted.	Functionality and community satisfaction with alternative access	number of satisfied community members	≥80% community satisfaction	After path establishment	Alternative path locations	Contractor
		CIA 12.2	Establish buffer zones around cemeteries and cultural sites.	Integrity of buffer zones (no encroachment)	Yes/No	No encroachment or damage	Monthly	Buffer zone perimeters	
		CIA 12.3	Implement Chance Find Procedure.	Number of chance finds reported and handled per procedure	Approved reports and procedure	100% reported and handled appropriately	As occurs	Any work location	
		CIA 12.4	Repair any damage to heritage structures in collaboration with communities.	Damage incidents and satisfactory repair completion	Number of reported damaged structures	Zero incidents; any damage repaired to community satisfaction	As required	Affected heritage site	
CIA 13	Intangible Cultural Heritage (ICH)	CIA 13.1	Maintain continuous dialogue with communities on traditions and practices.	Number of community consultations on ICH	Number of consultation reported	Biannual consultations	Biannually	Community meeting points	Approved d+E1:J57
		CIA 13.2	Schedule construction to avoid interference with cultural/religious events.	Number of work schedule adjustments for cultural events	Scheduled adjusments	100% of major community-identified events accommodated	As required	Project work schedule	
		CIA 13.3	Develop alternative arrangements if ICH is altered, with stakeholder agreement.	Existence and community acceptance of alternative arrangements	Approved developed alternatives	Formal agreement documented	Prior to any alteration	Affected community area	

sn	Potential Impact	Sn	MITIGATION MEASURES	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Likely frequencey	Monitoring Sites	Threshold Level	Responsibility
				Preconstruction					
GHG 1.0	Emissions associated with the use of on-site fuel for construction	GHG 1.1	Implement measures to decrease fuel use by maximising energy efficiencies, e.g. switch off all vehicles when stationary and maintain construction vehicles and conform to current emissions standards	GHG reduction and Climate Response Plan	Emmissions reduction targets	Annual	Project area of influence	As set	Contractor
		GHG 1.2	Where possible, a proportion of imported energy to be sourced from renewable energy sources	GHG emission	MtCO2e of GHG emissions	Annual	Project area of influence	Exceeding 25,000 tCO2e annually	Contractor
		GHG 1.3	Suitable training to operators to maximise the efficiency of using the equipment and reduce idling	Training operators	Number of operators trained	Before and during construction phase	Construction sites	Increased efficiency over time	Contractor
		GHG 1.4	Make sure that periodic inspections of vehicles are carried out	Vehicle inspection for optimum performance	Number of inspections	Regularly	Construction sites	Compliance with inspection checklist	Contractor
		GHG 1.5	Make sure that the work planning is done properly. Make sure that no more than one work activity is performed for the same work	Proper work planning	Approved work plan	Quarterly	Construction sites	No work is repeated	Contractor
		GHG 1.6	The use of solar light systems to reduce generator fuel consumption	GHG Reduction Targets	Reduction in tCO2e	Annually	Construction and operational phases	Project specific targets	Contractor
GHG 2.0	Embodied emissions associated with the materials used for construction	GHG 2.1	The use of locally sourced and/or produced materials. Where wood is to be integrated within the design, source from certified managed/sustainable forests. The use of recycled aggregates, where appropriate, for foundations, subbases, hard-standings and pavement materials. Maximise use of recycled steel and alternative cement replacements where feasible	The use of locally and/or produced materials.	MtCO2e of GHG emissions	Quarterly	All works sites/footprint	At least 90% of locally sourced and/or produced materials to be used should be from certified managed/ sustainable forests.	Contractor
		GHG 2.2	Optimise transport logistics for efficient journeys of materials to site	Minimized transportation distances for materials to the site	MtCO2e of GHG emissions	Quarterly	All works sites/footprint	At least 90% of locally sourced an/or produced materials to be used should be from nearby suppliers	Contractor
				Operations					
GHG 3.0	Emissions associated with fuel consumption to power trains	GHG 3.1	prioritise the procurement of efficient locomotives	Use of energy-efficient equipment	Adoption of energy-efficient traction systems and locomotives	Continous	Operation sites	Energy efficiency target	Operator
		GHG 3.2	minimise the idling times of locomotives	MtCO2e of GHG emissions	MtCO2e of GHG emissions	Quarterly	Surrounding communities	GHG emission reduction in line with agreed limits & decarbonization	Operator
		GHG 3.3	promote fuel efficiency for operation of the locomotives, including efficient driving guidelines	MtCO2e of GHG emissions	MtCO2e of GHG emissions	Quarterly	Surrounding communities	GHG emission reduction in line with agreed limits & decarbonization	Operator
GHG 4.0	Emissions associated with electricity consumption to power stations	GHG 4.1	the use of renewable energy sources (e.g. solar PV units) should be investigated.	Investigation of renewable energy sources for station use	Feasibility study conducted for integrating renewable energy	Once during project design	stations	GHG emmissions reduction	Operator
		GHG 4.2	LED lighting can be used use at stations to increase energy efficiency	Reliance on electricity from the identified National grid for electrical overhead lines	Percentage of electricity sourced from the National grid for overhead lines	Monthly	project site	Smooth operations	Operator
GHG 4.0	Embodied emissions associated with replacement of infrastructure	GHG 5.1	The use of locally sourced and/or produced materials	The use of locally and/or produced materials.	MtCO2e of GHG emissions	Quarterly	All works sites/footprint	At least 90% of locally sourced and/or produced materials to be used should be from certified managed/ sustainable forests.	Operator
		GHG 5.2	Optimise transport logistics to ensure efficient journeys of materials to site.	MtCO2e of GHG emissions	MtCO2e of GHG emissions	Quarterly	Project area of influence/Surrounding community	GHG emission reduction in line with agreed limits & decarbonization	Operator
				Decomposition					
GHG 6.0	Emissions associated with the use of on-site fuel for decommissioning	GHG 6.1	Implement measures to decrease fuel use by maximising energy efficiencies, e.g. switch off all vehicles when stationary and maintain construction vehicles and conform to current emissions standards	Fuel consumption reduction	Litres of fuel saved / MtCO2e	Monthly	Decommissioning sites	Compliance with emissions standards	Operator
		GHG 6.2	Where possible, a proportion of imported energy to be sourced from renewable energy sources	Share of renewable energy used	Total energy used	Quarterly	Decommissioning sites	≥20% renewable share	Operator
		GHG 6.3	Suitable training to operators to maximise the efficiency of using the equipment and reduce idling	Operator training	Number of operators trained	Before and during decommissioning	Decommissioning sites	All operators trained	Operator
		GHG 6.4	Promoting the use of sustainable fuels in construction vehicles, more fuel efficient and low carbon fuels can be used, where possible make use of electric vehicles to reduce fuel consumption	Fuel type used	Number of fleet using sustainable fuels	Quarterly	Decommissioning sites	≥30% fleet using low-carbon/electric	Operator
		GHG 6.5	Make sure that periodic inspections of vehicles are carried out	Vehicle inspection	Number of inspections	Regularly	Decommissioning sites	Compliance with inspection checklist	Operator
		GHG 6.6	Make sure that the work planning is done properly. Make sure that no more than one work activity is performed for the same work.	Work plan approval	Approved work plan	Quarterly	Decommissioning sites	No repeated work activities	Operator
GHG 7.0	Emissions associated with disposal	GHG 7.1	Optimise transport logistics for efficient journeys of materials to disposal facilities	Transport efficiency	MtCO2e of GHG emissions	Quarterly	Disposal facilities / transport routes	Emissions reduction in line with agreed limits	Operator
		GHG 7.2	Ensure maximum recycling and reuse rates	Recycling/reuse rate	Number of materials recycled/reused	Quarterly	Disposal facilities	≥80% recycling/reuse rate	Operator

sn	Potential Impact	Sn	MITIGATION MEASURES	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Likely frequencey	Monitoring Sites	Threshold Level	Responsibility
				Operations					
CCRA 1.0	Health and safety impacts for workforce	CCRA 1.1	Review of HSE plans, including development of heat-health action plans, and health and safety regulations such as:	HSE plan approved and implemented	implemented HSE plan	Annual review	All operational sites	Approved plan in place	Operations Manager / HSE Officer
		CCRA 1.2	Provision of cool potable water	Availability of potable water	Available of potable water to all workforce	Daily	All operational sites	Water available at all times	Operations Manager
		CCRA 1.3	Provision of shaded areas during rest periods	Shaded rest areas provided	Shaded rest areas provided to every workforce	Daily	All operational sites	Shade available	Operations Manager
		CCRA 1.4	First Aid equipment to include treatment for dehydration e.g., electrolytes	First aid kit contents compliant	First aid kit contents compliant resolved	Monthly	All operational sites	Fully stocked kits	HSE Officer
		CCRA 1.5	Compulsory labour rest times on hot days	Compliance with rest schedules	Following compliance with rest schedules	During heatwaves	All operational sites	≥95% compliance	Site Supervisor
		CCRA 1.6	Appropriate dress codes	PPE compliance rate	Number of PPE compliance rate	Monthly	All operational sites	≥95% compliance	HSE Officer
		CCRA 1.7	Changes to working hours	Records of adjusted schedules	Approved working schedules	During heatwaves	All operational sites	Adjustments implemented	Operations Manager
		CCRA 1.8	Information and monitoring campaigns	Training attendance records	Number of of workforce that attended training	Quarterly	All operational sites	≥90% attendance	HSE Officer
CCRA 2.0	Wildfire events caused by the project	CCRA 2.1	Ensure Fire Hazard Reduction Plan and the Fire Preparedness Plan are in place, including:	Approved plans available	Approved plans available on files	Annual	Operational areas	Plans approved	Fire Safety Officer
		CCRA 2.2	Requirement that official personnel be responsible for spotting and reporting fires or smouldering areas	Fire watch records	Fire watch records on files	Daily (dry season)	Right-of-way & yards	Continuous monitoring	Fire Safety Officer
		CCRA 2.3	Ensure that any vegetation control measures are followed by removal of combustible materials	Volume of combustible waste removed	Amount fo the waste removed	After vegetation works	Operational areas	No residual fuel load	Operations Manager
CCRA 3.0	External wildfire causes damage to infrastructure	CCRA 3.1	Use of insurance mechanisms to cover risk, use of early warning mechanisms	Insurance valid; alerts received	Resolved risks	Annual	Exposed assets	Active coverage	Asset Manager
		CCRA 3.2	Review of maintenance regimes to include extreme temperatures and checks following extreme events	Inspection completion time	Number of hours used	Event-based	Exposed assets	≤24 hours	Asset Manager
		CCRA 3.3	Update relevant policies, procedure, guideline, critical risk control standard	Policies reviewed and updated	Policies reviewed and updated	Annual	Organisation-wide	Updated documents	Asset Manager
CCRA 4.0	Heat-induced damage to steel structures	CCRA 4.1	Review of maintenance regimes to include extreme temperatures	Maintenance inspections completed	Number of maintenance inspections completed	Quarterly	Steel structures	Inspections completed	Engineering Manager
		CCRA 4.2	Technical modification to facilities to allow operation during warmer average temperatures	Modifications completed	Modifications approved	As required	Steel structures	Design limits met	Engineering Manager
		CCRA 4.3	Update relevant policies, procedure, guideline, critical risk control standard	Standards updated	All standards updated	Annual	Organisation-wide	Updated standards	Engineering Manager
CCRA 5.0	Heat stress to steel in bridges through thermal expansion	CCRA 5.1	Review of maintenance regimes to include extreme temperatures	Expansion joint condition	Expansion joint condition approved	Quarterly	Bridges	≥98% joints OK	Bridge Engineer
		CCRA 5.2	Update relevant policies, procedure, guideline, critical risk control standard	Policies updated	Yes/No	Annual	Bridges	Updated documents	Bridge Engineer
CCRA 6.0	Flood damage to asset	CCRA 6.1	Monitor sites where infrastructure damage may be of concern. Sites at particular risk of flood risk may need to be further identified in full flood risk report	Flood depth exceedance; asset downtime	Meters and hours	Event-based	Low-lying assets	No structural damage	Asset Manager
CCRA 7.0	River flooding affecting bridges	CCRA 7.1	Improve scour resilience during routine renewal of scour protection systems (design life c 20 years)	Condition of scour protection	Approved condition of scour protection	Bi-annual; post-flood	River crossings	≥95% protection intact	Bridge Engineer
		CCRA 7.2	Design future bridges to withstand climate change / consider flood models that account increase in flood event when assessing final designs	Design compliance with flood models	Approved design compliance with flood models	At design / upgrade	Bridges	Climate factors included	Engineering Manager
		CCRA 7.3	Consider planting rows of drought-resistant trees	Survival rate of planted trees	Number survival rate of planted trees	Annual	Riverbanks near bridges	≥80% survival	Environmental Manager
CCRA 8.0	Drought creating potholes under track	CCRA 8.1	Monitor sites where potholes might be of concern and consider removing trees/vegetation that are absorbing water and drying out embankments	Number of defects recorded	No./km	Quarterly	Embankments	Below intervention level	Track Manager
		CCRA 8.2	Consider replating drought resistant trees at distance from railway	Vegetation establishment success	Number of trees planted	Annual	Along railway corridor	≥80% survival	Environmental Manager
CCRA 9.0	Flooding leading to track-inundation	CCRA 9.1	Review of maintenance regimes to include checks following extreme events	Post-event inspections; drainage maintenance	Inundation duration; drainage capacity	24 hrs	Event-based	Track sections	Track Manager
CCRA 10.0	Supply chain and access	CCRA 10.1	Maintain strong relationships with multiple suppliers to secure priority services at pre-determined prices following extreme event	Approved suppliers	Number of approved suppliers	Annual review	Supply chain	≥2 suppliers per service	Procurement Manager
		CCRA 10.2	Develop protocols for ensuring key staff on site in advance of potential flood event	Staff availability records	Yes/No	Event-based	Operational sites	Key staff available	Operations Manager
		CCRA 10.3	Ensure Emergency Preparedness and Response Plan includes measure for evacuation	Emergency drills conducted	Number of emergency drills conducted	Annual	All sites	≥1 drill/year	HSE Officer
		CCRA 10.4	Ensure Fire Hazard Reduction Plan and the Fire Preparedness Plan are in place	Plans approved and reviewed	Plans approved and reviewed	Annual	All sites	Approved plans	Fire Safety Officer
CCRA 11.0	Landslides	CCRA 11.1	Optimise transport logistics for efficient journeys of materials to site	Movement indicators; incidents	Number of journeys	Monthly; after rain	Cuttings & slopes	No unsafe movement	Geotechnical Lead

CCRA 12.0	Population influx increases pressure on existing services e.g. housing, water and sanitation, waste management and public health facilities and increase community tensions.	CCRA 12.1	The ESIA recommends the following mitigation measures: In addition to the measures outlined in the ESIA, the CCRA recommends:The potential impacts of climate-related migration included in any future influx management study	Influx management measures implemented	Yes/No	Annual	Project-affected communities	Measures implemented	Social Manager
CCRA 13.0	Contamination of community water sources: Improperly treated and discharged wastewater (sewage or surface runoff from cleaning) at stations can also in advertently pollute water access points and rivers that communities use (both human and livestock), indirectly causing	CCRA 13.1	implement robust water quality monitoring programs to regularly test water sources	Water quality monitoring results	mg/L; pH; E. coli	Quarterly	Community water sources	Within regulatory limits	Environmental Manager
		CCRA 13.2	Establish and enforce strict guidelines for the handling and disposal of hazardous materials within the ESMP as well as the EMS.	Compliance with hazardous materials procedures	Compliance rate	Monthly	Operational sites	≥95% compliance	Environmental Manager
		CCRA 13.3	additional water quality testing takes place following a rainfall event	Post-rainfall test records	Records filed	Post-rainfall	Community water sources	No exceedances	Environmental Manager
		CCRA 13.4	personnel do not carry out potentially polluting activities when rainfall events are anticipated	Records of work stoppages	Records filed	As required	Operational sites	No pollution incidents	Operations Manager
CCRA 14.0	An influx of workers can lead to the spread of communicable diseases, such as respiratory infections, sexually transmitted infections (STIs), and vector-borne diseases, impacting both the workers and local communities.	CCRA 14.1	implement regular health screenings and vaccination programs for workers	Screening and vaccination records	Number of vaccinate workers	Annual	Workforce & communities	≥90% coverage	HSE Officer
		CCRA 14.2	educate workers and local communities about disease prevention and hygiene practices.	Awareness sessions conducted	No./year	Annual	Communities & sites	≥2 sessions/year	HSE Officer
		CCRA 14.3	In addition to the measures outlined in the ESIA, the CCRA recommends:	Additional Measures	Number of measure	Event-based	Affected areas	Measures implemented	HSE Officer
		CCRA 14.4	Implantation of additional screening following flooding and during dry spells	Additional screening records	Number of records	Event-based	Affected areas	Screening conducted	HSE Officer
CCRA 15.0	The increased procurement of goods and services by the project may lead to inflation. This impact may extend beyond construction related industries and include food and supplies, leading to inflationary pressure on local	CCRA 15.1	The ESIA recommends the following mitigation measures: Monitor prices of essential goods and services and introduce price control measures if necessary	Price monitoring reports	Yes/No	Quarterly	Local markets	No abnormal inflation	Social Manager
		CCRA 15.2	Enncourage local production of goods to increase supply and stabilise prices.	Percentage of local procurement	Number of local procuremnt	Annual	Project supply chain	≥40% local sourcing	Procurement Manager
		CCRA 15.3	In addition to the measures outlined in the ESIA, the CCRA recommends:	Additional Measures	Number of measure	Event-based	Affected areas	Measures implemented	Environmental Manager
		CCRA 15.4	climate risk to be incorporated into monitoring of changes in the AoI.	Records of reported risks	Number of risks reports	Event-based	Project footprint	All risks attended to	Environmental Manager
CCRA16	Project may impact the access and availability of botanical resources for healthcare leading to impacts for cultural heritage and medicinal practices.	CCRA 16.1	The ESIA recommends the following mitigation measures: where possible avoid removing or damaging any of these plants	Incidents of plant removal	Number of incidents	Continuous	Project footprint	Zero avoidable loss	Environmental Manager
		CCRA 16.2	if removal required, provide alternative replanting site (if possible, for replanting)	Replanting completed	Number of trees planted	As required	Approved sites	Successful replanting	Environmental Manager
		CCRA 16.3	create local medicinal plant nursery sites towards replenishing lost stock of plants	Nursery established	Number of trees planted	Once	Local communities	Nursery operational	Social Manager
		CCRA 16.4	frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage	Engagement records	Number of Engagement	Annual	Communities	≥2 engagements/year	Social Manager
		CCRA 16.5	frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.	Survey reports completed	Yes/No	Once	Project area	Survey completed	Environmental Manager
		CCRA 16.6	conduct a comprehensive survey to identify and map areas where important medicinal plants used by the Tchokwe community are located. Engage local traditional healers and community members in the identification process.	Survey reports completed	Number of survey reports	Once	Project area	Survey completed	Environmental Manager
		CCRA 16.7	No additional measures have been identified in this CCRA.	Additional Measures	Number of measure	Event-based	Affected areas	Measures implemented	Environmental Manager
CCRA 17.0	Decreased water table levels from abstraction of ground water for stations	CCRA 17.1	The ESIA recommends the following mitigation measures: follow abstraction volumes as prescribed in authorisation permits and monitor usage.	Abstraction volumes vs permit	m³	Monthly	Abstraction points	Within permitted limits	Environmental Manager
		CCRA 17.2	install water flow meters on all water abstraction points (surface water, wells, and boreholes). Undertake hydraulic pump testing of all boreholes to be used as long-term water supply source to calculate sustainable yields.	Flow meters installed and operational	Number of flow meters	Annual	Water abstraction points	All meters functional	Environmental Manager
		CCRA 17.3	In addition to the measures outlined in the ESIA, the CCRA recommends:	Water balance updated	Measurements	Review cycle	Water supply systems	Climate included	Environmental Manager
		CCRA 17.4	Future climate projections to be taken into account when calculating sustainable water use	Flow meters installed and operational	Number of flow meters	Annual	Water abstraction points	All meters functional	Environmental Manager
CCRA 18.0	Reduced water quality from improper disposal of liquid and solid waste during operation of wastewater sites and dump grounds	CCRA 18.0	Establish and enforce strict guidelines for the handling and disposal of hazardous materials within the ESMP as well as the EMS.	Compliance with hazardous materials procedures	Number hazardous materials	Monthly	Operational sites	≥95% compliance	Environmental Manager

sn	Potential Impact	Sn	MITIGATION MEASURES	Parameter (to measure the implementation of the mitigation measure)	Unit of the parameter	Likely frequencey	Monitoring Sites	Threshold Level	Responsibility
Preconstruction									
HR 1.0	Equal opportunity and non-discrimination	HR 1.1	Implement a recruitment procedure that is transparent and open to all, regardless of race, political beliefs, colour, creed, sexuality, or gender ,includes a strategy for local recruitment, considers social and cultural sensitivities, outlines employment criteria for professional, semi-skilled, and unskilled labour and prohibits discrimination or harassment of job applicants	Local recruitment plan	Description of the Local Recruitment Plan aimed at boosting recruitment of PAPs and IPs (Project Affected Persons and Indigenous Peoples)	annually	Project site(s)	Increased recruitment of PAPs and IPs, adherence to local hiring regulations and policies	Contractor
		HR 1.2	The recruitment procedure should include specific non-specifications that include: applicants will not be questioned about their marital status, plans to have children, or number of dependents, as this can be used to discriminate against women due to concerns about their home responsibilities affecting their work commitment	Job applications free from prohibited questions	Documentation confirming the development Job applications free from prohibited questions	6 monthly	Project site(s), Contractor/Subcontractor premises	Compliance with recruitment procedure	Contractor
		HR 1.3	A standardized job advertisement template, detailing the necessary skills, will be employed to announce openings. These job vacancies will be advertised in local languages within the Project area through suitable and accessible media, as well as on the project website	Adverts published in local langua standardized job advertisement template document	Approved standardized job advertisement template	6 monthly	Project site(s), Contractor/Subcontractor premises	communities received a standardized job advertisement	Contractor
		HR 1.4	A public awareness program will be developed and implemented to communicate employment and training opportunities	Organized of awareness sessions conducted	Number of employees attending organsed sessions	6 monthly	Contractor HQ and camps	No personnel working on the project without induction and refresher training on workers compensation	Contractor
		HR 1.5	Information will be disseminated publicly, including through media announcements at regional and national levels (as appropriate) and public meetings with communities in the Project area. Special attention will be given to reaching women and vulnerable groups, utilizing targeted meetings scheduled at times and locations designed to	women/vulnerable groups received information	Documented evidence of informing of women/vulnerable groups who received information	Monthly	Project site(s), Contractor/Subcontractor premises	women/vulnerable groups participating	Contractor
		HR 1.6	Targets for local employment from communities will be established by the Project	Hired workforce from local communities	Number of hired workforce from local communities	annually	Project site(s)	Increased recruitment of PAPs and IPs, adherence to local hiring regulations and policies	Contractor
		HR 1.7	A whistle blower mechanism will be established to report discrimination cases anonymously without fear of repercussions	Create anonymous reporting channel	Functioning anonymous reporting channel	Monthly	Project site(s)	Personnel sending anonymous	Contractor
		HR 1.8	Hiring managers from subcontractors will undergo training on the company's non-discrimination policies	Managers trained on non-discrimination policies	Number of trainings provided	6 monthly	Contractor HQ and camps	No manager working on the project without induction and refresher training on communicable diseases	Contractor
		HR 1.9	(Sub) contractors will need to meet quotas for the minimum number of women staff and staff with disabilities or from other vulnerable groups.	Compliance to the recruitment policy and principles of the training center and technical assessments	Percentage (%) of staff and subcontractors where the policy is implemented; Monitor the induction programme fo all	Annually	Camp Sites, Project's Subcontractors	100% policy adoption and implementation across the project	Contractor
HR 2.0	Just and favourable working conditions	HR 2.1	Pre-determined set of minimum salary requirement for each position to avoid salary exploitation by employers	Document for Salary scale	Salary scale document approved	Annual	HR camp sites	Policy in place	Contractor
		HR 2.2	Implement strict monitoring and enforcement mechanisms to ensure timely payment of salaries, and ensure that salaries have been paid	Prepared payroll date document	Approved payroll date	Annual	HR camp sites	Workers receiving payments in time.	Contractor
		HR 2.3	All employees will have a written contract that is clear, transparent and written in a language that is easy to understand that state the job aspects	Contract issuance rate; Contract comprehension; Adherence to the conditions of employment;	Percentatge (%) of employees provided with contracts upon employment or contract renewal;	Annually or during contract renewal	Workplace, Camp Sites	Target 100% contract issuance rate to all eligible employees; Target >85%	Contractor
		HR 2.4	Contracts will be available in the workers' native languages and be explained, if needed, in a clear and understandable manner	Contract issuance rate; Contract comprehension; Adherence to the conditions of employment;	Percentatge (%) of employees provided with contracts upon employment or contract renewal;	Annually or during contract renewal	Workplace, Camp Sites	Target 100% contract issuance rate to all eligible employees; Target >85%	Contractor
		HR 2.5	Workers' legal rights will be explained to them	Employee satisfaction	Average statisfaction score on a scale (1-5 0r 1-10) based on employee feedback	Annually or during contract renewal	Workplace, Camp Sites	Target an average score of >8 out of 10 on employee satisfaction	Contractor
		HR 2.6	Develop a grievance redressal mechanism that allows workers to report issues and receive timely resolutions	Accessibility of grievance mechanisms	Tracker or register showing the number of grievances received over a specified period	Monthly	Various Operational Workplaces	Wide accessibility of the grievance mechanism	Contractor
		HR 2.7	An independent system for monitoring and evaluating labour rights will be established						Contractor
		HR 2.8	Due diligence will be carried out to screen contractors and sub-contractors concerning their human rights records related to labour and working conditions	Adherence to IFC Performance Standards (PS) 1 and 2, and Labour Principles	Assessment and Management of Environmental and Social Risks and Impacts and PS 2	Annually	Stations and other operational offices	Target >75 % recruitment of PAPs and Ips;	Contractor
		HR 2.9	The Code of Conduct that employees must sign will include a provision stating that any sexual relationship involving a power imbalance will result in the immediate dismissal of the senior individual	Level of awareness and understanding of the policies among employees; Incidence rate (GBV, harassment, sexual	Compliance with updated disciplinary procedure and rules	Quartely or Annually	Workplace, Camp Sites, project accomodation and other	Full compliance	Contractor
		HR 2.10	The project will include a standard clause outlining provisions for health insurance, medical leave, and other aspects of medical care.						Contractor
		HR 2.11	standards, align the IFC's requirement of the number of project personnel that can be accommodated, include social or entertainment areas, facilities for religious activities and medical facilities, include adequate water and sanitation facilities	Establishment and functionality of Camp Residents Committee; Utilisation of GRM; Overall resident Satisfaction with	Number of committee meetings held; number of grievances filed and	Mothly or Quaterly	Camp site	Camp Residents Committee established within the first month of	Contractor
		HR 2.12	A system will be implemented to track the hours worked by all project employees, aiming to detect and address any practices resulting in excessively long working hours beyond project needs or national legal standards						Contractor
		HR 2.13	The Project will require that all workers in similar jobs receive the same or similar working conditions (such as salary, vacation, insurance, benefits, accommodation, and food	Adherence to the conditions of employment	Percentage (%) of employees who demostrate an understanding of their contract	Annually or during contract renewal	Workplace, Camp Sites	Target >85% of employees understand their contract terms and conditions;	Contractor
		HR 2.14	Men and women will be treated the same and receive equal remuneration	Functioning grievance mechanism	Number of grievances	Quarterly	HR department		Contractor
HR 3.0	Child labour	HR 3.1	Periodic audits will be carried out to ensure that the Project and Project workers to not engage in any activity that might encourage child labour.	Develop audits plan	number of audits conducted	Annual	Contractor records	≥1 audit/year	Contractor
		HR 3.2	People working on the Project will be prohibited to engage in any activity that encourage child labour, such as buying goods and products from children working as street vendors.	Audit findings	Number of Audit findings	Quarterly audits	Project site	Zero findings	Contractor
		HR 3.3	Every contract will contain a clause that strictly prohibits the employment of individuals under the age of 18, whether directly or indirectly. Contractors and subcontractors must ensure that their supply chains do not involve any minors. To enforce this clause, periodic inspections and audits will be carried out. If it is discovered that a contractor or subcontractor has employed someone under 18, it will be considered a contract violation, and the child will be removed from the workplace. The child's salary may continue to be paid for a designated period while an alternative solution is found.	Adherence to child protection policies and guidelines	The percentage of the extent to which project personnel and contractors comply with established child protection policies, including provisions prohibiting child labor, exploitation, and abuse.	Monthly	Stations and other operational offices	Full compliance with child protection policies and guidelines, with zero tolerance for any instances of child labor or abuse	Contractor

		HR 3.4	Through ongoing engagement with stakeholders, such as communities, teachers, local authorities and others that are concerned about how the project might impact child labour will be alerted and these stakeholders will be encouraged to use a grievance mechanism if they observe any project-related child labour incidents.	Age verification records	Number of child labour incidents	Quarterly audits	Project site	Zero child labour (zero tolerance)	Contractor
HR 4.0	Freedom of association and collective bargaining	HR 4.1	Implement strong oversight mechanisms and ensure that there are clear, accessible channels for workers to report grievances without fear of retaliation.	Independent oversight mechanism plan	Independent oversight mechanism accessible by workers	once-off	Project sites	Functional oversight mechanism	Contractor
		HR 4.2	Establishing an independent body to oversee labour practices and provide support to workers.	Personnel trained on on supporting workers during induction	Number of personnel	determined by recruitment demands	Contractor HQ	No personnel working on the project without induction	Contractor
		HR 4.3	Fostering a culture of transparency and accountability within the Project.	Transparency culture trainings	Number of training held	Quarterly	Project site	Transparent culture and adopted accountabilty	Contractor
		HR 4.4	The Human Resources department will hold regular town hall-style meetings to share information and gather feedback on labour and working conditions.	Organise workers meetings	Number of workers meetings held	Quarterly	Project site	100% working conditions	Contractor
		HR 4.5	A labour and working conditions management plan will be created that acknowledge workers' right to organise, collectively bargaining and to form trade unions.	Labour management plan	Labour management plan approved	Quarterly	HR offices	100% respect for labour rights	Contractor
HR 5.0	Safety and the Working Environment	HR 5.1	PPE equipment required for specific tasks will be provided to all workers.	Provided PPE to employees	Number of employees received PPE	Quarterly	Constructions and camp sites	All employees have appropriate ppe	Contractor
		HR 5.2	Inspections will be conducted to ensure that PPE equipment is used as appropriate.	PPE equipment inspections	Number of inspections conducted	Monthly	Constructions and camp sites	All PPE equipment are used properly	Contractor
		HR 5.3	Training about cultural awareness and differences amongst workers will be provided.	Cultural awareness training sessions organized	Number of trainig sessions	Quarterly	Constructions and camp sites	All workers are aware of cultural differences	Contractor
		HR 5.4	Plans for managing malaria and other vector-related conditions will be developed and implemented.	Malaria management plan document	Approved malaria management plan	Annual	Health office at construction site	Implemented plan	Contractor
		HR 5.5	A management plan for vaccine-preventable diseases will be developed and implemented to prevent the introduction and spread of such diseases by the incoming workforce to the local workforce. This plan will encompass all employees, contractors, and visitors to the project.	Developed management plan for vaccine-preventable diseases	Approved document	Annual	Health office at construction site	All employees received vaccine	Contractor
		HR 5.6	An HIV/STD awareness campaign will be initiated to enhance the awareness and understanding of the risks related to HIV and STDs, detail the associated health implications, and explain the preventative measures available.	Organized HIV/STD awareness campaigns	Number of awareness sessions	Quarterly	Project site and camps	All workers are aware and understanding of the risks related to HIV and STD	Contractor
		HR 5.7	A fatigue management plan will be developed. This will include provisions about driving hours and to avoid driving at night.	Fatigue management plan on avarage driving hours	Number of driving hours	Hours	Transport logs at project sites	Driving less than 8 hours//day	Contractor
		HR 5.8	Implement a road safety management plan that includes measures to monitor driver behaviour, hours of work and designated rest areas. This could includes measures such as installing speed measurement devices on all company cars to ensure that speeding limits are respected at all times.	safety management plan and using vehicles with speed limit devices	Number of speed limit devices provided to workers	Annual	Fleet records at project sites	100% follow safety management plan	Contractor
		HR 5.9	Work areas will be assessed to identify specific categories of hazards, including physical, chemical, biological, and radiological risks.	Hazard assessment	Number of hazard categories identified	Annual	HR offices	All categories covered	Contractor
		HR 5.10	An occupational health and safety training program, tailored to be culturally and linguistically appropriate, will be developed and implemented. This program will be updated regularly to reflect changes in project scope, incident statistics, and regulatory requirements.	Organized occupational health and safety training sessions	Number of training provided	Monthly (inspections)	HR records	All workers are trained	Contractor
		HR 5.11	Daily meetings when commencing the workday will be held where health and safety issues are discussed	Daily safety meetings	Number of meetings held	daily	project site	All workers are complying	Contractor
HR 6.0	Access to information and freedom of opinion	HR 6.1	Develop and implement of a comprehensive stakeholder engagement plan	Prepare stakeholder engagement plan document	Approved SEP document	Annual	Project site and camps	SEP in place	Contractor
		HR 6.2	The SEP should be accompanied by a communications plan and targeted information campaigns that use a variety of media tools with a focus on in-person verbal communication (but also considering print, telephone, internet and social media, where appropriate	communications planned and campaigns conducted	Number of people who attended campaign	Quartely	Communities around project area	campaigns delivered	Contractor
		HR 6.3	Develop and implement a public awareness program to communicate employment and training opportunities	The level of awereness in the community regarding the project's recruitment procedures and opportunities; community outreach; Application rates; Diversity of applicants	Percentate (%) of the community reporting awereness of recruitment procedures; Diversity metrics (e.g., gender ratio, percentage of minority groups, people with disability etc) of applicants	Continously during active recruitment phases	Community, national wide compaign	Target > 75% awereness in the target community; Aim to reach >80% of the target demographic within the community; Target an engagement rate of >50% among those reached; Set specific targets based on community demographics (e.g., gender parity, representation of minority groups etc)	Contractor
		HR 6.4	Information will be disseminated publicly, including through media announcements at regional and national levels (as appropriate) and public meetings with communities in the Project area. Special attention will be given to reaching women and vulnerable groups, utilizing targeted meetings scheduled at times and locations designed to enhance women's participation	Information accessible to vulnerable groups	Number of individuals reached through various channels (e.g., social medis, community meetings, flyers); Percentage (%) of engaged individuals out of those reached; Number of	Continously during active recruitment phases	Community, national wide compaign	Aim to reach >80% of the target demographic within the community; Target an engagement rate of >50% among those reached; Set specific targets based on	Contractor
		HR 6.5	A formal structure, such as an Ethics Committee, will be established to address incidents of alleged harassment, discrimination, or any other human rights violations related to the work environment	Implementation of Policy for Prevention and Response to Gender-based Violence	Implementation and documentation of the (Prevention and Response to Gender-based Violence) Policy, along with the development of a project-specific implementation and monitoring plan or checklist	quarterly	Project site(s), Employee areas	Compliance with the policy, effectiveness of implementation, integration into ESMS	Contractor
		HR 6.6	A whistle blower mechanism will be established to report discrimination cases anonymously without fear of repercussions	Create anonymous reporting channel	Functioning anonymous reporting channel	Monthly	Project site(s)	Personnel sending anonymous	Contractor

		HR 6.7	Hiring managers from subcontractors will undergo training on the company's non-discrimination policies	Managers trained on non-discrimination policies	Number of trainings provided	6 monthly	Contractor HQ and camps	No manager working on the project without induction and refresher training on communicable diseases	Contractor
		HR 6.8	Develop a grievance mechanism	Employees awareness of the grievance procedure;	Percentage of employees who are aware of the grievance	Annually or bi-annually	Workplace, Camp Sites	Target >90% awareness among all employees	Contractor
HR 7.0	Gender Equality	HR 7.1	Ensure equal participation of women in all stages of project planning and implementation by setting quotas for women's representation in decision-making processes	Compliance to the recruitment policy and principles of the training center and technical assessments	Percentage of staff and subcontractors where the policy is implemented; Monitor the induction programme fo all employees	Annually	Camp Sites, Project's Subcontractors	100% policy adoption and implementation across the project	Contractor
		HR 7.2	Provide targeted education and training programs for women, including adult education and vocational training, to enhance their skills and employment opportunities	Skills advancement, Career progression, Local employment retention; Training satisfaction, Training program participation	Percentage (%) of women enrolled in each training program; Qualitative assessment (pre- and post-training evaluation and quantitative measures (certification completion rates); Percentages (5) of local employees retained; Average satisfaction score on a scale (1-5 0r 1-10)	Annually or bi-annually	Workplace, Camp Sites	Target >80% training participation rate among eligible employees; >75% of training participants demonstrate improved skills; Percentage (%) of internal promotions or role advancements annully; Target >905 retention rate; Target and average score of >8 on a scle 1-10 on training satisfaction	Contractor
		HR 7.3	Implement strict anti-harassment policies and procedures within the project, with clear reporting mechanisms and consequences for violations	Adherence to the policy; planand procedures of preventing harassments and implementation of policies and	Number of audits and assessments to evaluate the	Monthly	Various Operational Workplaces	100% compliance with established policies and plans, with minimal	Contractor
		HR 7.4	Ensure that employment practices promote gender equality, including equal pay for equal work, and eliminate discriminatory job restrictions	Personnel trained on gender equality protection and discriminations during induction and refresher training	Number of personnel trained	6 monthly	Contractor HQ and camps	No personnel working on the project without induction and refresher training on gender equality protection and discriminations	Contractor
		HR 7.5	Provide gender sensitivity training for all workers, especially incoming male workers, to prevent gender-based violence and harassment	Personnel trained on GBV and SEA during induction and refresher sessions	Number of personnel trained	6 monthly	Contractor HQ and camps	No personnel working on the project without induction and refresher training on GBV ans SEA	Contractor
		HR 7.6	Collaborate with local women's organizations and NGOs to monitor and address gender based violence and exploitation in the project area	Reporting Protocols, and Remedial Action for GBV and SEA	Reporting protocols, and remedial action procedures to address Gender-Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) for operational staff and passengers	quarterly	Project site(s), Operational areas, Passenger facilities	Compliance with established protocols, effectiveness of reporting mechanisms, implementation of remedial actions	Contractor
		HR 7.7	Develop and enforce a code of conduct for workers that includes zero tolerance for sexual exploitation and abuse	Developed Codes of Conduct	Establishment and documentation of codes of conduct,	quarterly	Project site(s), Operational areas, Passenger facilities	Compliance with established protocols	Contractor
		HR 7.8	Establish safe spaces and support services for women, including counselling and legal assistance, to address incidents of violence or harassment	Training in related prevention measures; availability and accessibility of victim support	Time taken to respond to and resolve reported cases; percentage (%) of employees and relevant stakeholders who have completed the training; Number of victims accessing support services	Quartely or Annually	Workplace, Camp Sites, project accomodation and other work areas	Target zero incidents; >90% of employees and stakeholders showing comprehensive understanding of GBV, sexal harrassment and exploitation, gender discrimination; Target response within 24 hours and resolution within the defined timeframe; Target >95% participation rate in training; 100% of reported victims receive support they need	Contractor
		HR 7.9	Ensure fair compensation and relocation assistance for women affected by land acquisition, with specific provisions for widows, divorced, or abandoned women	Monitoring reports reflecting the completion of RAP and livelihood restoration activities	Percentage completion of RAP and livelihood restoration activities	quarterly	PACs along the RoW	Timely completion of RAP activities according to the established schedule in the approved RAP and LRP, with periodic assessments to ensure adherence to timelines and milestones.	Contractor
		HR 7.10	Additional human rights mitigation measures related to non-discrimination, land and relocation, health and security are included in those relevant sections of the report	Existence and compliance Community Health, Safety and Security Plan and Disciplinary Procedure	Number of reported incidents related to community health, safety and security	Monthly	Various Operational Workplaces and local communities	No non- compliances related to Community Health, Safety and Security Plan and Disciplinary Procedure	Contractor
		HR 8.1	Establish mobile health clinics to provide accessible medical care to communities and project workers	Health facilities available for residents in community along the RoW who are employed on the Project	Number of health facilities	annually	Construction camps	Each camp to have one facility	Contractor
		HR 8.2	Implement comprehensive malaria control programs, including distribution of insecticide-treated mosquito nets and regular mosquito spraying in affected areas	Malaria prevention measures implemented	Number of individual received malaria control measures	Quarterly	Project area	Measures in place	Contractor
		HR 8.3	Ensure proper waste management and drainage systems to prevent the creation of stagnant water bodies	Identified waste disposal points	Number of disposal points	Monthly	Worker camps	100% camps covered	Contractor
		HR 8.4	Provide clean water and sanitation facilities to reduce the risk of diarrheal diseases	Access to clean water and sanitation	Number of indivuduals having access to clean water	Quartely	Project areas and surrounding communities	Adequate access	Contractor

HR 8.0	Community health and safety	HR 8.5	Implement dust and emission control measures to minimize respiratory issues.	Dust/emission control Measures	PM10 concentration	Monthly	Site boundary	≤WHO limits	Contractor
		HR 8.6	Conduct regular health screenings and provide vaccinations for tuberculosis and other prevalent diseases	Health screenings conducted	Number of indivuduals screened and received vaccines	Quartely	Project areas and surrounding communities	Individuals free from TB and other diseases	Contractor
		HR 8.7	Offer sexual health education and distribute condoms to prevent the spread of STIs among workers and local populations	Health eduction sessions	Number of sessions conducted and workers attended	Quartely	Project areas and surrounding communities	Workders are well educated	Contractor
		HR 8.8	Strengthen the capacity of the reference hospital and other local healthcare facilities through funding, equipment, and staffing support	Existence and compliance Community Health, Safety and Security Plan and Disciplinary	Number of reported incidents related to community health, safety and security	Monthly	Various Operational Workplaces and local communities	No non- compliances related to Community Health, Safety and Security Plan and	Contractor
		HR 8.9	Collaborate with local health authorities to monitor health trends and respond promptly to outbreaks	Disease outbreaks linked to project	Number of diseases cases reported	Continously	Project areas and surrounding communities	All cases are adressed	Contractor
HR 9.0	Land, natural resources, and livelihoods	HR 9.1	Implement water management strategies that include regular monitoring of water quality and quantity	Water quality tests	Number of tests taken	Monthly	Local water Sources and project sites	All water souces are managed	Contractor
		HR 9.2	Conduct frequent environmental assessments to monitor the impacts of construction activities on water sources and implement corrective measures as needed	Environmental assessments conducted	Number of environmental assessments	Qutertly	Project site	Minor impacts	Contractor
		HR 9.3	Ensure that temporary settlements for workers are equipped with sufficient water supply and sanitation facilities to prevent overuse and contamination of local water sources	Provided water supply and sanitation facilities	Number of facilities provided	Quarterly	Worker camps	Workers have proper water supply and sanitation facilities	Contractor
		HR 9.4	Consider investing in the construction and improvement of water supply systems and infrastructure in PACs to meet the increased demand	Compensation payments completed	Number of people who received payments	Per relocation phase	PACs	100% paid	Contractor
		HR 9.5	Set up waste disposal and sanitation systems in worker camps to prevent contamination of water sources	Waste disposal systems installed	Number of systems	Quarterly	Project area	Fully functional systems	Contractor
		HR 9.6	Work closely with local government officials to align project activities with ongoing water infrastructure projects and ensure a coordinated approach to water management	Meetings help with the local government officials	Number of meeting hel	Annual	Local Govt offices	Proper water infrustractures	Contractor
		HR 9.7	Implement strict pollution control protocols to prevent construction-related contamination of water sources	Protocols violations detected	Number of violations reported	Monthly	Site	Zero tolerance	Contractor
		HR 9.8	Collaborate closely with traditional leaders and municipal authorities to align land distribution practices with legal requirements, preventing conflicts over land ownership	Traditional leaders and municipal hold meetings	Number of meetings held	Annual	Community	≥2/year	Contractor
		HR 9.9	Ensure proper legal documentation for all land acquisitions and provide legal support to communities to understand their rights	Legal land documentation verified	Approved document	Continuous	Project records	100% verified	Contractor
		HR 9.10	Develop and implement a fair and transparent relocation plan that includes adequate compensation, relocation assistance, and livelihood restoration programs	Relocation plan implemented	Relocation plan approved	Per phase	Resettlement sites	Fully implemented	Contractor
		HR 9.11	Respect traditional rituals and cultural practices by involving traditional leaders in planning and decision-making processes, especially when relocating cultural sites	Monitoring reports reflecting the completion of RAP and livelihood restoration activities	Percentage completion of RAP and livelihood restoration activities	quarterly	PACs along the RoW	Timely completion of RAP activities according to the established schedule in the approved RAP and LRP, with periodic assessments to ensure adherence to timelines and milestones.	Contractor
		HR 9.12	Establish grievance mechanisms to address community concerns	Land-related grievances resolved	Number of resolved concerns	Quarterly	Community offices	≥90% resolved	Contractor
		HR 9.13	The land acquisition and compensation process will consider the farming season to ensure that no affected household loses crops without receiving compensation						Contractor
		HR 9.14	Livelihood restoration measures will be monitored after relocation, with additional measures developed and implemented as needed to ensure that livelihoods are restored to at least pre-project levels	Livelihood restoration success rate	Number of restored livellihood	Annually	Resettled households	≥ pre-project levels	Contractor
		HR 9.15	The project will engage directly with those holding customary rights to the land, with the compensation process being witnessed to minimize interference by intermediaries	Monitoring reports reflecting the completion of RAP	Percentage completion of RAP	quarterly	PACs along the RoW	Timely completion of RAP activities according to the established schedule in the approved RAP and LRP, with periodic assessments to ensure adherence to timelines and milestones.	Contractor
		HR 9.16	The project will assist the government in clarifying disputed land boundaries in the project area, particularly where customary land rights are involved	disputes resolved	Number of resolved disputes	Annual	Govt records	≥80% disoutes have been resollved	Contractor
		HR 9.17	Provide the same compensation to people that occupy their land from non-officially approved land documents	Legal land documentation verified	Approved document	Continuous	Project records	100% verified	Contractor
HR 10.0	Environment	HR 10.1	Implement a Biodiversity Management Plan	Biodiversity Management Plan implemented	practiced biodiversity management plan	Quarterly	Project area	Fully implemented	Contractor
		HR 10.2	Conduct frequent environmental assessments to monitor the impacts of construction activities on water sources and implement corrective measures as needed	Environmental monitoring conducted	Niumber of environmental monitoring conducted	Quarterly	Project area	No major impacts	Contractor
		HR 10.3	Set up waste disposal and sanitation systems in worker camps to prevent contamination of water source	Waste disposal systems installed	Number of systems	Quarterly	Project area	Fully functional systems	Contractor
		HR 10.4	Implement strict pollution control protocols to prevent construction-related contamination of soil and water sources	Pollution incidents recorded	Number of incidents recorded	Continuous	Project area	Zero major incidents	Contractor
		HR 10.5	Measure to preserve, mitigate and offset environmental impacts are communicated to stakeholders, including local communities	Organized stakeholder meetings	Number of individual attended and number meetings held	Annual	Community	Community is aware of environmental impacts	Contractor

HR 11.0	Security	HR 11.1	Provide cultural sensitivity and human rights training to security personnel to ensure they respect human rights and the cultural differences of people from different backgrounds	Security personnel trained on cultural sensitivity and human rights during induction	Number of training offered	Annual	HR office and project area	Security personnel aware of cultural sensitivity and human rights	Contractor
		HR 11.2	Provide training to everyone employed in the Project that focus on respecting people from different backgrounds	Provided trainings	Number of training provided	Annual	HR office and project area	All employees follow rules	Contractor
		HR 11.3	Ensure sufficient security guards the construction sites to reduce the chance of theft	Frequency of security-related incidents affecting project personnel, contractors and	Time taken to respond to an incident; community feedback (score)	Daily	Community, Work office(s)	aim for 0%/low threshold incidents; <30 minutes for urgent security responses	Contractor
		HR 11.4	Implement community patrols during the evening to minimise night-time activity in the Project construction areas and to monitor any suspicious activity	Community level of satisfation with security measures	number of incidents per month	Monthly	Community, Work office(s)	Target an average of >4 (on a 1-5 scale) from community feedback	Contractor
		HR 11.5	Develop a security management plan that is aligned with the Voluntary Principles on Security and Human Rights and additional international standards to mitigate any potential impacts that are related to interactions between public and private security forces	Compliance rate (adherence to IFC PS4 requirements in the SMP); Compliance to Disciplinary Action Procedure and Disciplinary Rules and the Code of Conduct Procedure	Number of compliance rate of IFC PS4 requirements implemented	Quarterly	Community, Work office(s)	Taget >95% adherence to IFC PS4 compliance rate;	Contractor
HR 12.0	Access to remedy	HR 12.1	Establish accessible and transparent grievance mechanisms within the project area to address complaints and disputes efficiently	Accessibility of grievance mechanisms	Tracker or register showing the number of grievances received over a specified period, categorized by type, source, and severity	Monthly	Various Operational Workplaces	Wide accessibility of the grievance mechanism	Contractor
		HR 12.2	The grievance procedure for workers will allow for grievances to be submitted anonymously	Create anonymous reporting channel	Functioning anonymous reporting channel	Monthly	Project site(s)	Personnel sending anonymous	Contractor
		HR 12.3	Ensure the project's community grievance mechanism is well communicated among PACs and clearly communicated that it can accept complaints regarding interactions with both public and private security forces	SEP conducted for both public and private security forces	Number of recruited stakeholders specialized in securirty forces	quarterly	PACs along the RoW and neighbouring areas	Compliance with security forces	Contractor
		HR 12.4	The grievance mechanism will be aligned in accordance with the UNGP	Grievance mechanism document aligned with UNGP	Approved document	Annnually	Project records	Fully aligned	Contractor
		HR 12.5	All affected stakeholders (including contractor workers and community members) should have access to the Project's grievance mechanism	Accessibility of grievance mechanisms	Tracker or register showing the number of grievances received over a specified period, categorized by type, source, and severity	Monthly	Various Operational Workplaces	Wide accessibility of the grievance mechanism	Contractor
Operations									
HR 13.0	Equal opportunity	HR 13.1	Maintain transparent recruitment for operational staff.	advertised, competitive process	Percentage	Per hiring cycle	Company HR Dept.		Operator
HR 14.0	Community health	HR 14.1	Establish mobile health clinics to provide accessible medical care to communities and project workers	Clinic utilization rate; patients served	Number of patiets received vaccine	Monthly	Mobile clinic locations	Meet target coverage	Operator
HR 15.0	Livelihoods	HR 15.1	Livelihood restoration measures will be monitored after relocation, with additional measures developed and implemented as needed to ensure that livelihoods are restored to at least pre-project levels	Livelihood restoration success rate	Number of restored livellihood	Annually	Relocated households	≥100% of pre-project income	Operator
HR 16.0	Environment	HR 16.1	Implement Biodiversity Management Plan.	BMP implementation status report	Report completed	Quarterly	Project area, offset sites	completed as per schedule	Operator
HR 17.0	Access to remedy	HR 17.1	Maintain accessible grievance mechanisms.	grievances received/resolved; resolution time	Number; Days	Monthly	GRM offices, online portal	<30 days avg. resolution	Operator

Chainage	Location	Sensitive Area	Distance from the Alignment / Work Site (m)	Latitude	Longitude	*Air Quality*	*Noise Pollution*	*Surface Water Quality*	*Potable Water Quality (in Situ)*	*Potable Water Quality (Laboratory)*	*Wastewater Quality (in Situ)*	*Wastewater Quality (Laboratory)*	*Column1*	*Column2*
						Monthly	Monthly	Monthly	Monthly	Quarterly	Monthly	Quarterly		

Angolan local standards for underground and surface water (Regulation on Water Quality Presidential Decree 261/11 of October 6th 2011)								International Standards			Potable Water Analysis		Project Standards									Measuring Frequency	Responsibility	Project Management Plan/SOP
		A1		A2		A3		Lower Limi	Upper Limi	Regulation					A1		A2		A3					
Parameters	Expression of Results	VMR	VMR	VMA	VMR	VMA	VMR						Parameters	Expression of Results (Measuring Unit)	VMR	VMR	VMA	VMR	VMA	VMR				
PH 25°C	Sorensen scale	6,5-8,5		5,5-9,0		5,5-9,0		0	0	WHO, Guideline for Drinking Water Quality 2011	Fecal Coliform	CFU/100ml	PH 25°C	Sorensen scale	6,5-8,5		5,5-9,0		5,5-9,0					
Colour (after simple filtration)	mg/l Pt-Co Scale	10	(O)20	50	(O)100	50	(O)200	0	0	WHO, Guideline for Drinking Water Quality 2011	*Escherichia coli*	CFU/100ml	Colour (after simple filtration)	mg/l Pt-Co Scale	10	(O)20	50	(O)100	50	(O)200				
Total suspended solids	mg/l	25						0	0	WHO, Guideline for Drinking Water Quality 2011	Temperature	°C	Total suspended solids	mg/l	25									
Temperature	°C	22									Turbidity	NTU	Temperature	°C	22									
Contractivity	uS/cm, 20°C	1000		1000		1000			5	WHO, Guideline for Drinking Water Quality 2011	Colour	TCU	Contractivity	uS/cm, 20°C	1000		1000		1000					
Odour	Dilution factor at 25°	3		10		20			15	WHO, Guideline for Drinking Water Quality 2011	Carbonate Alkalinity	mg/l	Odour	Dilution factor at 25°	3		10		20					
Nitrates (*)	mg/l NO3	25	(O)50		(O)50		(O)50				pH		Nitrates (*)	mg/l NO3	25	(O)50		(O)50		(O)50				
Flow (l)	mg/l Fe	0,7-1,7	1,5	0,7-1,7		0,7-1,7		6,5	8,5	WHO, Guideline for Drinking Water Quality 2011	Electrical Conductivity	µs/cm	Flow (l)	mg/l Fe	0,7 1,7	1,5	0,7 1,7		0,7 1,7					
Total extra level organic chlorine	mg/l Cl								2500	EPA, Parameters of Water Quality 2001	Total Dissolved Solids	mg/l	Total extra level organic chlorine	mg/l Cl										
Dissolved Iron (*)	mg/l Fe	0,1	0,3	1,0	2,0	1,0			1000	WHO, Guideline for Drinking Water Quality 2011	Phenolphthalein Alkalinity	mg/l	Dissolved Iron (*)	mg/l Fe	0,1	0,3	1,0	2,0	1,0					
Manganes (*)	mg/l Mn	0,05		0,01		1,00					Total Alkalinity	mg/l	Manganes (*)	mg/l Mn	0,05		0,01		1,00					
Copper	Mg/l Cu	0,02	(O)0,05	0,05		1,00			600	Bureau of Indian Standards, 2012	Carbonates	mg/l	Copper	Mg/l Cu	0,02	(O)0,05	0,05		1,00					
Zinc	mg/l Zn	0,5	3,0	1,0	5,0	1,0	5,0				Non Carbonates	mg/l	Zinc	mg/l Zn	0,5	3,0	1,0	5,0	1,0	5,0				
Boro	mg/l B	1,00		1,00		1,00					Total Hardness	mg/l	Boro	mg/l B	1,00		1,00		1,00					
Beryllium	mg/l Be								500	WHO, Guideline for Drinking Water Quality 2011	Calcium	mg/l	Beryllium	mg/l Be										
Cobalt	mg/l Co										Magnesium	mg/l	Cobalt	mg/l Co										
Nickel	mg/l Ni										Sulphate	mg/l	Nickel	mg/l Ni										
Vanadium	mg/l V								250	WHO, Guideline for Drinking Water Quality 2011	Phosphate	mg/l	Vanadium	mg/l V										
Arsen	mg/l As	0,01	0,05		0,05	0,05	0,10		5	American Journal of Chemistry 2016, 6(1): 12-17	Iron	mg/l	Arsen	mg/l As	0,01	0,05		0,05	0,05	0,10				
Cadmium	mg/l Cd	0,001	0,005	0,001	0,005	0,001	0,005		0,3	WHO, Guideline for Drinking Water Quality 2011	Manganese	mg/l	Cadmium	mg/l Cd	0,001	0,005	0,001	0,005	0,001	0,005				
Total Chromium	mg/l Cr		0,05		0,05		0,05		0,1	WHO, Guideline for Drinking Water Quality 2011	Nitrate	mg/l	Total Chromium	mg/l Cr		0,05		0,05		0,05				
Lead	mg/l Pb		0,05		0,05		0,05		50	WHO, Guideline for Drinking Water Quality 2011	Nitrite	mg/l	Lead	mg/l Pb		0,05		0,05		0,05				
Selenium	mg/l Se		0,01		0,05		0,01		0,5	EPA, Parameters of Water Quality 2001	Chloride	mg/l	Selenium	mg/l Se		0,01		0,05		0,01				
Mercury	mg/l Hg	0,0005	0,0010	0,0005	0,0010	0,0005	0,0010	200	300	WHO, Guideline for Drinking Water Quality 2011	Fluoride	mg/l	Mercury	mg/l Hg	0,0005	0,0010	0,0005	0,0010	0,0005	0,0010				
Barium	mg/l Ba		0,1		1,0		1,0		1,5	WHO, Guideline for Drinking Water Quality 2011	Sodium	mg/l	Barium	mg/l Ba		0,1		1,0		1,0				
Cranets	mg/l CN		0,05		0,05		0,05		200	EPA, Parameters of Water Quality 2001	Potassium	mg/l	Cranets	mg/l CN		0,05		0,05		0,05				
Sulfates	mg/l SO4	150	250	150	(O)250	150	(O)250		12	American Journal of Chemistry 2016, 6(1): 12-17	Salinity	ppt	Sulfates	mg/l SO4	150	250	150	(O)250	150	(O)250				
Chlorides	mg/l Cl	200		200		200			0,9	Australian Drinking Water Guidelines 6, 2011	Ammonia Nitrogen (NH3)	mg/l	Chlorides	mg/l Cl	200		200		200					
Surface-active substances (which react with methylene blue)	mg/l P2 O3 sodium lauryl sulfate	0,2		0,02		0,5			0,5	EPA, Parameters of Water Quality 2001	Bicorbonate Alkalinity	mg/l	Surface-active substances (which react with methylene blue)	mg/l P2 O3 sodium lauryl sulfate	0,2		0,02		0,5					
Phosphates (*) (2)	mg/l P2 O3	0,4		0,7		0,7					Lead	mg/l	Phosphates (*) (2)	mg/l P2 O3	0,4		0,7		0,7					
Phenols	mg/l C6 H5 OH		0,001	0,001	0,005	0,010	0,100		0,01	WHO, Guideline for Drinking Water Quality 2011	Copper	mg/l	Phenols	mg/l C6 H5 OH		0,001	0,001	0,005	0,010	0,100				
Dissolved or emulsified hydrocarbons	mg/l		0,05		0,20		1,00		2	WHO, Guideline for Drinking Water Quality 2011	Zinc	mg/l	Dissolved or emulsified hydrocarbons	mg/l		0,05		0,20		1,00				
Polynuclear aromatic hydrocarbons	ug/l		0,2		0,2		1,0	3	5	WHO, Guideline for Drinking Water Quality 2011	Nickel	mg/l	Polynuclear aromatic hydrocarbons	ug/l		0,2		0,2		1,0				
Total paradise pesticides hexachlorocyclohexane, dieldrin and others	ug/l		1,00		2,5		5,0		0,02	WHO, Guideline for Drinking Water Quality 2011	Cobalt	mg/l	Total paradise pesticides hexachlorocyclohexane, dieldrin and others	ug/l		1,00		2,5		5,0				
Dissolved Oxygen (*)	mg/l O2					30			0,1	USEPA, 2008	Aluminium	mg/l	Dissolved Oxygen (*)	mg/l O2					30					
Biochemical Oxygen demand (CBO520°) (*)	mg/l O2	3		5		7			0,2	EPA, Parameters of Water Quality 2001	Total Suspended matter	mg/l	Biochemical Oxygen demand (CBO520°) (*)	mg/l O2	3		5		7					
Biochemical Oxygen Demand at (C	mg/l N	1		2		3			0,04	WHO, Guideline for Drinking Water Quality 2011	Selenium (Se)	mg/l	Biochemical Oxygen Demand at (CBO520°) (*)	mg/l N	1		2		3					
Kjeldahl nitrogen (excluding nitrogen from NO2 and NO3)	mg/lNH4	0,05		1,00	1,50	2,00	(O) 4,00		0,17	WHO, Guideline for Drinking Water Quality 2011	Cyanide (CN)	mg/l	Kjeldahl nitrogen (excluding nitrogen from NO2 and NO3)	mg/lNH4	0,05		1,00	1,50	2,00	(O) 4,00				
Ammonia Nitrogen	mg/l	0,1		0,2		0,5			0,7	WHO, Guideline for Drinking Water Quality 2011	Barium (Ba)	mg/l	Ammonia Nitrogen	mg/l	0,1		0,2		0,5					
Extractable substances with chloroform	mg/l C								0,01	WHO, Guideline for Drinking Water Quality 2011	Bromate (BrO3)	mg/l	Extractable substances with chloroform	mg/l C										
Total Organic Carbon (COT)	mg/l C								0,07	WHO, Guideline for Drinking Water Quality 2011	Molybdenum (Mo)	mg/l	Total Organic Carbon (COT)	mg/l C										
Residual organic carbon after flocculation and membrane filtration (5um)	/100 ml	50		5000		50000		0,2	0,5	WHO, Guideline for Drinking Water Quality 1997	Free Residual Chlorine	mg/l	Residual organic carbon after flocculation and membrane filtration (5um)	/100 ml	50		5000		50000					
Total Coliforms	/100 ml	20		2000		20000			0,03	WHO, Guideline for Drinking Water Quality 2011	Uranium	mg/l	Total Coliforms	/100 ml	20		2000		20000					
Fecal streptococci	/100 ml	20		1000		10000			0,01	WHO, Guideline for Drinking Water Quality 2011	Arsenic	mg/l	Fecal streptococci	/100 ml	20		1000		10000					
Salmonella		Absence in 5000ml		Absence in 1000ml					0,003	WHO, Guideline for Drinking Water Quality 2011	Cadmium	mg/l	Salmonella		Absence in 5000ml		Absence in 1000ml							
Total germs at 22°C/72h	U.F.C./1 ml	100							0,05	WHO, Guideline for Drinking Water Quality 2011	Chromium	mg/l	Total germs at 22°C/72h	U.F.C./1 ml	100									
Total germs at 37°C/48h	U.F.C./1 ml	10											Total germs at 37°C/48h	U.F.C./1 ml	10									
Fecal streptococci	U.F.C./100 ml												Fecal streptococci	U.F.C./100 ml										
Sulphite reducing Clostridia	U.F.C./20 ml			<1									Sulphite reducing Clostridia	U.F.C./20 ml			<1							
Choleric vibrio	U.F.C./100 ml												Choleric vibrio	U.F.C./100 ml										
Escherichia coli	U.F.C./250 ml												Escherichia coli	U.F.C./250 ml										
Pseudomas aeruginosa	U.F.C./250 ml												Pseudomas aeruginosa	U.F.C./250 ml										

** not applicable SADC standards

(O)	The limits may be exceeded in case of geographical or meteorological
(*)	Limits may be exceeded for parameters marked with * in lakes with shallow depth
(1)	The indicated values constitute the lower and upper limits of the concentrations.
(2)	This parameter is included to satisfy the ecological requirements of certain
(3)	Refers to a VMR

VMR	Recommended Maximum Value
VMA	Maximum Admissable Value
UFC	Colony forming units

Standards for wastewater
(Regulation on Water Quality Presidential Decree
261/11 of October 6th 2011)

Parameters	Expression of Results (Measuring Unit)	VLE (1)	International Standards			Project Standards			Measuring Frequency	Responsibility	Project Management Plan/SOP
			Lower Limit	Upper Limit	Standard	Parameters	Expression of Results (Measuring Unit)	VLE1 (Threshold Value)			
pH at 25°C	Sorensen scale	6,0-9,0 (2)	6	9	WBG EHS Genernal Guidelines, 30 Apr 2007	PH.25°C	Sorensen scale	6,0-9,0 (2)			
Temperature	°C	Increase of 3°C (3)		Increase of 3°C (3)	WBG EHS Genernal Guidelines, 30 Apr 2007	Temperature	°C	Increase of 3°C (3)			
CBO 20°C (20) (O)	mg/l O2	40		30	EPA - January 22, 2014	CBO 20°C (20) (O)	mg/l O2	40			
CQO (0)	mg/l O2	150		100	EPA - January 22, 2014	CQO (0)	mg/l O2	150			
sst (0)	mg/l	60				sst (0)	mg/l	60			
Aluminium	mg/l Al	10		100	EPA - January 22, 2014	Aluminium	mg/l Al	10			
Total Iron	mg/l Fe	2,0				Total Iron	mg/l Fe	2,0			
Total Manganes	mg/l Mn	2,0		50	EPA - January 22, 2014	Total Manganes	mg/l Mn	2,0			
Smell		Not detectable in dilution 1:20		2	EPA - January 22, 2014	Smell		Not detectable in dilution 1:20			
Colour (O)		Not detectable in dilution 1:20		10	EPA - January 22, 2014	Colour (O)		Not detectable in dilution 1:20			
Residual Chlorine available				2	EPA - January 22, 2014	Residual Chlorine available					
Free	mg/l Cl2	0,5		1	EPA - January 22, 2014	Free	mg/l Cl2	0,5			
Total	mg/l Cl2	1,00				Total	mg/l Cl2	1,00			
Phenols	mg/l C6 H5 OH	0,5				Phenols	mg/l C6 H5 OH	0,5			
Oil and fat	mg/l	15				Oil and fat	mg/l	15			
Sulfides	mg/l S	1,00				Sulfides	mg/l S	1,00			
Sulphites	mg/l SO3	1,00				Sulphites	mg/l SO3	1,00			
Sulfates	mg/l SO4	2000				Sulfates	mg/l SO4	2000			
Total Phosphor	mg/l P	3 (in waters that feed lagoons or reservoirs) 0,5 (in lagoons or reservoirs)				Total Phosphor	mg/l P	3 (in waters that feed lagoons or reservoirs) 0,5 (in lagoons or reservoirs)			
Ammonia Nitrogen	mg/l NH4	10				Ammonia Nitrogen	mg/l NH4	10			
Total Nitrogen	mg/l NH4	15				Total Nitrogen	mg/l NH4	15			
Nitrates	mg/l NO3	50				Nitrates	mg/l NO3	50			
Aldehydes	mg/l	1,0				Aldehydes	mg/l	1,0			
Total Arsenic	mg/l A	1,0				Total Arsenic	mg/l A	1,0			
Total Lead	mg/l P	1,0				Total Lead	mg/l P	1,0			
Total Cadmium	mg/l Cd	2,0				Total Cadmium	mg/l Cd	2,0			
Total Chromium	mg/l Cr	2,0				Total Chromium	mg/l Cr	2,0			
Hexavalent Chromium	mg/l Cr (VI)	0,1				Hexavalent Chromium	mg/l Cr (VI)	0,1			
Copper	Mg/l Cu	1,0				Copper	Mg/l Cu	1,0			
Nickel	mg/l Ni	2,0				Nickel	mg/l Ni	2,0			
Mercury	mg/l Hg	0,05				Mercury	mg/l Hg	0,05			
Total Cyanides	mg/l CN	0,5				Total Cyanides	mg/l CN	0,5			
Sulphides	mg/l S	1,0				Sulphides	mg/l S	1,0			
Mineral oils	mg/l	15				Mineral oils	mg/l	15			
Detergents (sodium lauryl sulfate)	mg/l	2,0 (4) (5)				Detergents (sodium lauryl sulfate)	mg/l	2,0 (4) (5)			

Waste Water

(1)	VLE - Emission limit value, understood as a monthly average, defined as the arithmetic average of the averages of the daily averages referring to the working days of a month that must not be exceeded. The daily value determined on the basis of a representative sample of waste water discharged over a period of twenty-four hours, cannot exceed twice the monthly average value (the sample over a period of twenty-four hours must be composed taking into account the discharge regime of wastewater produced)
(2)	The average value may, at most, be included in the interval 5,0 - 10,0
(3)	Temperature of the receiving medium after discharge of waste water, average of 30m downstream of the discharge point, the average value being able to exceed the monthly average value of 2°C
(4)	The daily average value cannot exceed twice the monthly average value.
(5)	Value related to the discharge of the industrial unit for the production of HCH from lindane extraction or simultaneously, production of HCH and extraction of lindane

OEC Engineering and Construction

Environmental and Social Impact Assessment for the Proposed Luena-Saurimo Railway Line (260km) Project, Angola

Environmental and Social Management Plan (ESMP) Report

2720234-R03-04

JANUARY 2026

GENERAL NOTES

Project No.: 2720234-R03-04

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Client: OEC Engineering and Construction

Date: January 2026

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RGM Environment (Pty) Ltd.

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ABBREVIATIONS AND ACRONYMS

Abbreviations & Acronym	Full Definition
AoI	Area of Influence
AU	African Union
AZE	Alliance for Zero Extinction
CRB	Contractors Board
CRO	Community Relations Officer
CTC	Control
DRC	Democratic Republic of Congo
EAC	East African Community
EHS	Environmental, Health and Safety
EHS	Environmental, Health, and Safety
ERB	Engineering Registration Board
ESG	environmental, social and governance
ESIA	Environmental and Social Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESMS	Environment and Social Management System
GIIP	Good International Industry Practice
IFC	International Finance Corporation
IPs	Indigenous Peoples
LAS	lender appraisal standards
MAPTSS	Ministry of Public Administration, Labor and Social Security
MINAGRIF	Ministry of Agriculture and Forests
MINAMB	Ministry of Environment
MINEA	Ministry of Energy and Water
MINOPOT	Ministry of Public Works and Spatial Planning
MINTRANS	Ministry of Transport
OECD	Organisation for Economic Co-operation and Development
PACs	project affected communities
PAHs	project affected households
PESGRU	Provincial Urban Waste Management Plans Strategic Plan for Urban Waste Management

1 INTRODUCTION

1.1 Purpose of the ESMP

An Environmental and Social Management Plan (ESMP) is a management tool used to prescribe measures that need to be implemented to avoid, minimise, restore, or, if needed, to offset any negative impacts of the project on the receiving environmental and host communities – with the main aim being to prevent residual impacts (i.e., negative impacts that cannot be mitigated to an acceptably low level). Mitigation measures are often in-built or embedded within existing Environment and Social Management System (ESMS), procedures, or plans, and commitment to these is reinforced in an ESMP.

The ESMP establishes a mechanism for management of change to, or continuous improvement of, the ESMP (Section 4.7) to allow for flexibility around the way in which the project achieves its main aim of preventing residual impacts, as it gathers experience and data on Environmental and Social (E&S) performance through the Project's lifecycle. This enables the project to be responsive to stakeholder grievances through improving management measures or gathering and verification of environmental data.

Most importantly, the ESMP describes the scope and legal standing of the plan Chapter 3 and assigns responsibility of the implementation of the plan to the relevant Party Chapter 5 and requires sign-off at the appropriate level. The ESMP also describes the mechanism for delegation of responsibility for project activities, as well as the implementation of and adherence to the ESMP, to other parties.

This ESMP has been developed for the Luena Saurimo Railway Project in Angola that integrates the findings of the Environmental and Social Impact Assessment (ESIA) conducted for the Project by RSK in 2024.

1.2 Objectives of the ESMP

The objectives of this ESMP are to provide:

- measures to avoid and minimize significant impacts during pre-construction phase (site selection, routing, alignments and locations, design etc)
- environmental and social procedures that effectively control Project impacts and that monitor compliance with the requirements set out in the Procedures
- a framework for setting out environmental and social performance indicators, monitoring requirements and review procedures for activities associated with the Project
- government authorities, stakeholders, and the Proponent with assurance that mitigation measures will be addressed, are achievable, and a common basis for measuring compliance with specific mitigation requirements
- stakeholders with assurance that identified mitigation measures to address impacts are documented, and that the environmental and social management of the Project can reduce negative impacts and optimize or enhance positive impacts.

1.3 Scope and legal standing of the ESMP

This ESMP applies to all phases of the Project as described in Chapter 2. It applies to the project's direct footprint and activities, as well the projects influence/impact on the receiving environment and host communities, collectively referred to as the Project Area of Influence (AoI), which is further defined in Section 2.4.

The Proponent and owner of the Luena Saurimo Project is MINTRANS (Ministério dos Transportes de Angola) on behalf of the Government of Angola. MINTRANS will have ultimate responsibility for ensuring compliance with the ESMP (as part of the Lenders loan agreement, as well as the environmental license). The person responsible for approving the ESMP and with a legal/fiduciary mandate for ensuring MINTRAN's compliance with the ESMP is to be confirmed.

Further,

- the Consortium OECI, S.A – Sucursal em Angola and Bento Pedroso Construções S.A will be the Contractor
- MINFIM (Ministério das Finanças) as the Borrower
- the foreseen Operator is Caminhos de Ferro de Benguela (CFB).

2 PROJECT OVERVIEW

2.1 Project location

The Luena-Saurimo railway line will connect Benguela´s Railway which it is the only railway connection from Central Africa to the Atlantic. Its construction, originated by a law from August 1899, construction began in 1903 and was finished on February 2nd, 1929 in the city of Luena (Moxico Province) to the future connection to Luanda´s Railway in Saurimo (Lunda Sul Province) as detailed in Figure 2-1 and **Error! Reference source not found.**.

The Project traverses through two Provinces and four municipalities

- Moxico Province: Municipalities of Moxico Camanongue
- Lunda – Sul Province: Municipality of Saurimo

Detailed project description is provided in the ESIA Report (Volume 1) – Chapter 2.

Table 2-1:Towns and villages traversed by the proposed Luena-Saurimo railway line

Province	Municipality	Towns/Villages traversed by proposed railway line
Moxico Province	Luena	Tchiteno, Canda I, Samauzo (including Catembo Nova)
	Camanongue	Ndongue, Mumanga (including Saissazo and Caiza), Muapezo, Tchilonga, Mazemba, Samalengue, Camuleque, Cassai Ponte, São João, Musseringinge (including Samucanda and Malasa)
Lunda Sul Province	Saurimo (currently known as Cassengo)	Muamucalanganza, Saquembue, Muanguigi, Caiza, Muicaimbo, Mwatximbia, Sagungu, Luari, Sambuamba, Nanguanza, Cassamba I, Cassamba II, Maurilo-Sachula, Muxie
	Dala	Luele, Luachimo, Mukunguaji, Satxitende, Nacatoco, Biula

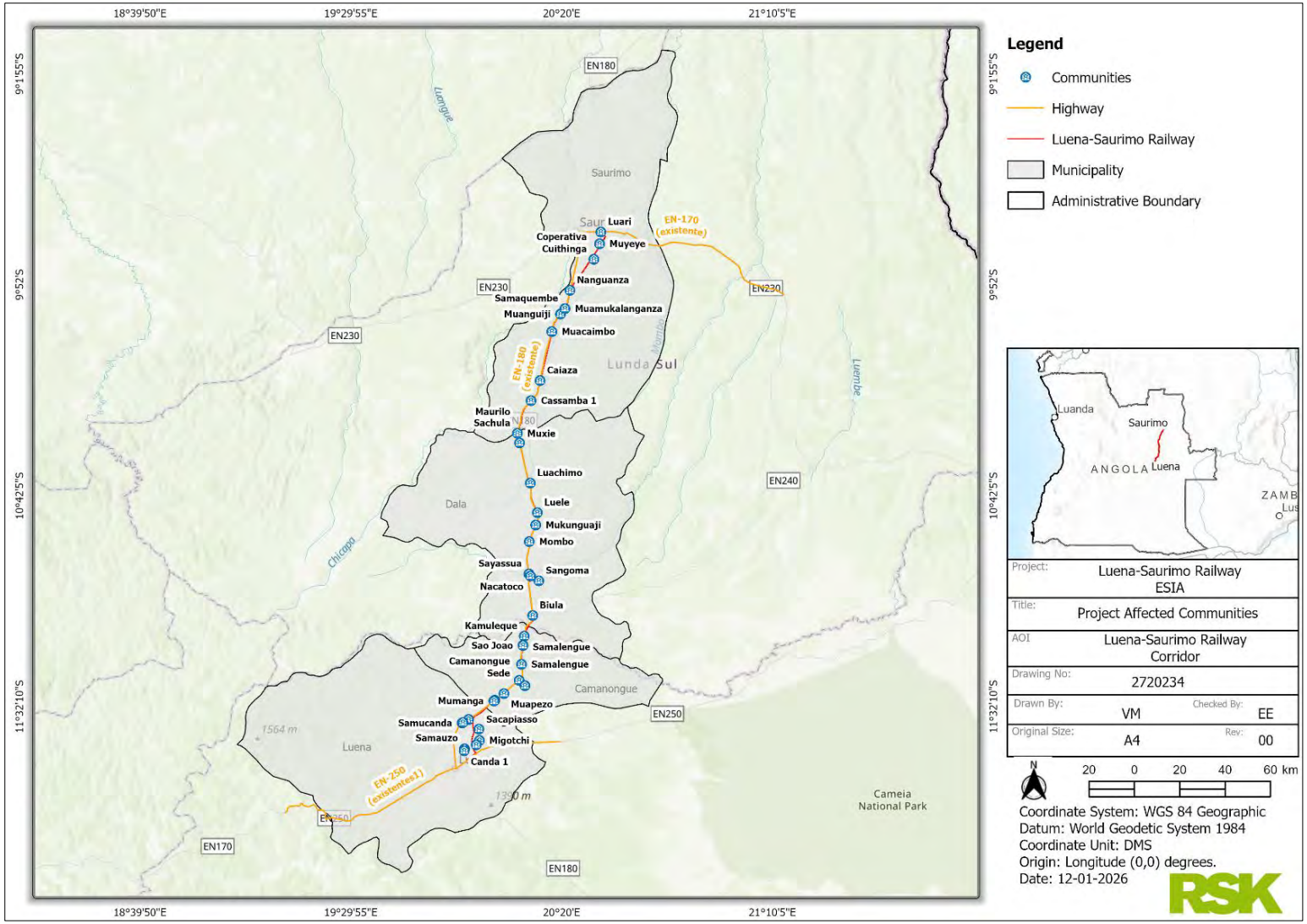


Figure 2-1: The proposed Luena-Saurimo railway line route

2.2 Project activities and infrastructure (aspects)

The line is divided into 11 sections with the following main facilities and infrastructure as follows (see Table 2-2):

- construction camp sites: two main and three support camp sites
- concrete works/batching plants: two plants
- track works and other railway infrastructure e.g. signalling and barriers
- borrow pits: none
- rock quarries and rock crushers: four existing
- sleeper production and storage facilities: the current plan is to have a sleeper plant near Dala. OEC are also analysing an option to bring the sleepers from abroad
- marshalling yard: none
- tunnels: none
- sidings: two locations
- passenger stations: eight stations/locations
- river crossings: 11 bridges
- abstraction of water: five boreholes, one at each camp
- spoil dumpsites: 11 locations i.e. one in each section
- culverts: 45 locations (main culverts) (identified by preliminary design and remains subject to refinement during detailed design)
- potential livestock, pedestrian, and road crossings: nature, type, design and specific locations of the crossings to be determined during detailed design. At least 100 crossings of different types (e.g. pedestrians, gravel roads, earth roads, livestock, community access) exists across the proposed railway line
- waste management facilities: one collection point/centre at each camp
- waste water management facilities: one at each camp.
- perimeter fencing: the whole alignment will not be fenced to allow continued community access. Fence at the major station only (Saurimo).

Table 2-2 below provides the locations of the main facilities and infrastructure along the Project route. The detailed high resolution A3 maps of each alignment section with main infrastructure and community labels is provided in the Volume 2 of ESIA Report Appendix 01.

Table 2-2: Key Infrastructure along the Luena -Saurimo Railway route

Section ID	Start - end km points	Approx. distance (km)	Name	Stations	Bridges	Culverts	Sidings / passing loops	Campsites KM point	Quarries and KM point	Production/batch plants KM point
1	0-17	17	Luena - Lumeje	1	1	1		1 (Support)		
2	17-58	41	Ndongue-Luxia	2	1	1		1 Main camp at Ndongue KM22+900		1 concrete batching plant at Ndongue camp KM22+00
3	58 – 86	28	Tchihinhi-Cassai		2	1	1		Biula access at KM 79+000	1 sleeper production plant near Biula near KM79+000
4	86-100	14	Dala - Tchiumbwe	1	1	1			Tchiumbwe river access at KM 98+000	
5	100-120	20	Tchiumbwe - Mombo			1				
6	120-130	10	Luele							
7	130-149	19	Luele-Luachimo	1	1			1 support camp Luele/Luachimo KM 130+200	Jazida at KM 140+000	
8	149-170	21	Luachimo - Riacho			2	1		Griner – access near KM 1656+500	
9	170-190	20	Riacho - Caiaza			1				
10	190-225	35	Caiaza - Saquembue	1	1	2		1 main - Caiaza KM 191+000		1 concrete batching plant at Caiaza camp (KM191+400)

Section ID	Start - end km points	Approx. distance (km)	Name	Stations	Bridges	Culverts	Sidings / passing loops	Campsites KM point	Quarries and KM point	Production/batch plants KM point
11	225-260	35	Saquembue - Saurimo	2	2	2		1 Support KM 259+500	Catoca – 45 km north of Saurimo	

2.2.1 Stations

Apart from the existing main Luena Station, the project will construct a total of 8 new stations listed in Table 2-3 below.

Table 2-3 Locations of proposed new stations

Km chainage	Name	Station	Buffer	Passing loops (sidings)
-6.200	Luena (City)	Existing station		
0+550	Luena	Station 1	700 m	
26+500	Ndongue	Station 2	700 m	
49+600	Camanongue	Station 3	700 m	
93+000	Dala	Station 4	700 m	
71+600				Loop 1
130+250	Luele	Station 5	700 m	
162+200				Loop 2
191+400	Caiaza	Station 6	700 m	
228+000	Saquembue	Station 7	700 m	
259+500	Saurimo	Station 8	700 m	

Figure 2-2 Proposed stations along the railway line

2.2.2 Camps

The Luena- Saurimo railway Project will have 5 camp sites whereby two will be main camps (Ndongue KM 22+900 and Caiaza KM191+400), , while the remaining three camps will be small, support camps (Luena KM 0+500, Luele KM130+250 and Saurimo KM 259+500). The typical layout for the main camps is attached in the Volume 2 of the ESIA Report Appendix 02.

The camps will accommodate workers building the railway as well as serve as safe storage areas for materials and goods. At the two main camp locations, the maximum number of workers will be 1,000 people. **Error! Reference source not found.** and Figure 2-3**Error! Reference source not found.** provides an overview of the proposed camps.

Figure 2-3: Locations of camps along the Luena-Saurimo railway

2.2.3 Passing loops

There are two planned passing loops along the Luena-Saurimo Railway; one at KM71+600 and one at KM162+200. The passing loops will be 700 m long and the railway corridor at these loops will be 30 m wide.

2.2.4 Production facilities

The Project will establish two new batching plants with a capacity of 90 m3 / hour. One sleeper production and storage facility is yet to be defined. If installed, it will be located at Dala in the same location as the quarry and a concrete batching plant will be also installed. The facility will have a capacity to produce 20,000 units per month with the carousel methodology.

2.2.5 Bridges and culverts

The proposed project will have 11 bridges and 45 main culverts. All 11 bridges will have a total length of 4.55 km and piles totalling 40 km. The longest bridge will be 1,250 m. Composite deck bridges will be constructed.

2.2.6 Crossings

The Project also provides specific signage for intersections between the main line and rural roads and pedestrian access routes, especially in locations close to large population centres, with level crossings being provided for these cases. Vertical and horizontal signs will be placed before the level crossings to guide the railway operator. Protective equipment for level crossings will include a physical barrier operated by its independent mechanism and vertical signalling.

2.2.7 Signalling and telecommunications

The signalling and telecommunications will include Semi-automatic signalling; centralised Circulation Control: Semi-automatic interlocking and management and on-board signalling.

The railway signalling envisaged in the implementation of the project is a “passive” signalling system that is not dependent on external power sources and will use a metronet network. The network will be compatible with the existing Benguela railway line, however, will not be connected to with other networks used for other railway operators in Angola.

2.2.8 Access roads for construction and maintenance activities

The construction traffic movements will use both a 5 m length strip on each side of the railway alignment. In alternative, the EN 180 road will be also used. The Contractor will preferentially use two 5 m length access road strips for daily movement of trucks and road vehicles.

2.3 Associated facilities

For the purposes of this ESIA, project activities and infrastructure will collectively be referred to as project ‘aspects’. However, as per above definition, there are no associated facilities currently linked to the proposed Luena-Saurimo Railway Project for the following reasons:

- the trains will be diesel run locomotives which does not require an exclusive high voltage electric transmission line
- the construction and maintenance access road along the railway line is part of the Project components
- no marshalling yards and separate/third part workshops/camps/yards are required
- existing quarries along the project route have been identified for potential use during construction activities (refer Section 2.4.2 and 2.7.1.4 above). The identified sites are used for other projects within Lunda Sul and Moxico Provinces; hence no new quarry site will be established solemnly for the railway project purposes
- demining works: demining along the proposed railway route was undertaken by National Demining Centre (Centro Nacional De Desminagem - CND) from February 2025 and completed in September 2025 and certificate of clearance was issued for the Project.While demining could, in principle, be considered an enabling activity under IFC PS1 and OECD Common Approaches, in this case it is the responsibility of the CND as part of nationwide campaign to clear the whole country with focus on infrastructure development and safety priorities.

2.4 Project phases and activities

Pre-construction activities

The following activities are anticipated to take place once the necessary environmental authorisations, permits and/or licenses are in place:

- detailed site investigations e.g. geotechnical, topographical, hydrological etc.
- preliminary and detailed engineering designs
- demining of servitude area (search and removal of unexploded ordinances)
- permits: relevant permits for intrusive investigations, water abstraction, import or material and equipment. The un-anticipated incidence of unexploded ordinances is addressed under Unplanned Events in this ESIA
- procurement will consider all the import/export of materials/equipment that comes abroad. In this regard, the rail, the slippers, and metallic beams, as well as rail assembly equipment will be dealt in advance, to avoid delays to the construction phase and obtain the necessary permits for the importation of such materials
- establishment and demarcation of land for all project infrastructure i.e. campsites, stations, batching plants, sleeper production and storage facilities
- land access: Land Access is Owner's responsibility. The quarries planned are existing however necessary procedures to access for extraction purposes needs to be competed. In addition, confirmation that all land at the proposed locations for stations and camps is acquired and demarcated for the project
- site clearance (brush cutting and grubbing), stockpiling.

Construction phase and activities

The construction phase is expected to take 60 months, depending on selected alternative and weather conditions at the time of construction and due to agreed milestones. Key activities includes:

- mobilisation of workers, machinery, construction equipment
- transportation of all required materials, equipment, and components to the camps sites
- establishment of access roads
- railway track superstructure and track works (track assembly, alignment)
- earthworks (excavation, cut and fill, quarrying soils for embankments)
- landscaping (crossing works, drainage work)
- establishment of work fronts and construction phases
- construction of railway bridges and culverts
- construction of passenger stations
- execution of passing loops
- signalling and communication systems installation
- concrete works (batching plants, sleeper production and storage)
- waste production management and treatment
- abstraction of water
- demobilisation of construction work sites and rehabilitation of construction work areas.

Operation and maintenance

Activities during operation includes:

- asset management
- resource management
- operating and maintenance (workshops, control centre)
- fuel supply, storage and management
- materials management
- regular clearance (brush cutting) of the railway servitude and track
- operation and maintenance of waste of waste facilities.

Decommissioning

The design and operational lifespan of the Luena-Saurimo railway is estimated to be 100 years. Decommissioning of the infrastructure is not envisaged in the near future. Periodic maintenance and rehabilitation works are expected to be undertaken. In the longer run, the railway line could be upgraded depending on prevailing conditions.

2.5 Potential environmental and social Impacts

Potential Environmental and Social Impacts are indicated for ease of reference in the mitigation tables in Chapter 7 of this ESMP.

3 GOVERNANCE FRAMEWORK

This Section outlines the legislative and international best practice of the environmental and social requirements for the Luena-Saurimo Railway Project. It presents relevant Angolan laws necessary for the successful implementation of the Projects environmental and social components and discusses the applicable standards from international lending organisations.

The Angolan regulatory framework may be subject to change to both regulatory instruments and authorities during the Projects lifecycle. Therefore, periodic reviews and assessments of the regulatory framework is recommended. The overarching governance of environmental and social matters for the construction and operational phases of the project is detailed in a separate E&S Governance Framework document.

3.1 Institutional framework

OEC will have overall authority and responsibility for implementing the environmental and social commitments of the Project. During the construction phase, the third-party contractors will carry out these commitments under the supervision of OEC and will be bound to the ESMP and ESMS.

The ESMS associated with the Project is described in section 4. The ESMS will provide the mechanism to facilitate documenting legal obligations in a register, which will be periodically reviewed and updated.

Section 5 provides a summary of organisations, other than OEC, that are relevant for setting policies and enforcing laws related to the Project.

3.2 National regulatory framework

Angolan laws which establish legal requirements for the Project are outlined in Table 3-1 and

Table **3-2**. These tables provide a structures outline of the relevant legal obligations that the Project shall adhere to under specific Angolan legislations.

3.3 Applicable permits, licences and authorizations

Different statutory permits, licences, approvals or authorizations will be required during the course of Project development and implementation. A tentative permitting register is provided in Table 3-3. The Register shall be updated at least monthly to guide the Project and forecast required permits and timelines.

The permits and licences required during the construction phase is the responsibility of the Contractor's compliance team. The Contractor shall establish and maintain a compliance register that incorporates the permits and adds on deadlines to obtain permits, deadlines when permits expire and department(s) that is responsible for obtaining/renewing the permit.

During operations, Caminhos de Ferro de Benguela (CFB) will review and update the Contractor's compliance register and their legal and other requirements register.

Table 3-1: Institutional framework

Organisation	Responsibilities/ Relevance
Ministry of Environment (MINAMB)	The Ministry of Environment (MINAMB) is responsible for the development, management, implementation, and monitoring of environmental policies related to environmental quality, pollution control, conservation areas, and the rational use of natural resources. MINAMB is responsible for issuing environmental licenses for activities with significant environmental and social impacts, promoting the implementation of measures and programs for the protection of the environment and quality of life and to conduct training and awareness campaigns on environmental technologies.
Ministry of Transport (MINTRANS)	The Ministry of Transportation (MINTRANS) is responsible for formulating, managing, executing, evaluating, and controlling transportation and logistics policies. This includes promoting service development and optimisation in road, rail, civil aviation, maritime, and port areas; regulating and overseeing economic activities in the transport sector; and ensuring transportation safety. MINTRANS supervises the National Land Transport Agency (ANTT) and its affiliations (i.e., The National Directorate of Infrastructure and Supervision and The National Directorate of Rolling Stock Management, Rail and Road Equipment Approval) responsible for the modernisation and regulations of railways and road infrastructure.
Benguela Railway Company (CFB - EP)	The Benguela Railway Company (CFB - EP) is responsible for the administration of rail transport services for passengers, cargo and mail and directly or indirectly engage in activities related to railway operations as long as these activities comply with relevant investment laws and regulations. Additionally, the railway operated by CFB - EP extends beyond the provinces of Angola and reaches the Democratic Republic of Congo (DRC).
Ministry of Public Works and Spatial Planning (MINOPOT)	MINOPOT is the executive body of the government responsible for proposing policies, executing, and overseeing the programs and projects for the overall development and rehabilitation of all infrastructure. MINOPOT supervises the National Directorate of Engineering Works, the National Directorate of Land Management and Housing, the National Directorate of Spatial Planning and Urbanism, and the Regulatory Institute for Construction and Public Works.
National Institute for Biodiversity and Conservation (INBC)	The INBC is responsible for developing and implementing policies and strategies for sustainable biodiversity management and the National Environmental Conservation System. Their duty includes ensuring compliance with national and internal laws, conventions and regulations related to biodiversity and environmental conservation areas.
National Waste Agency (ANR)	The ANR is a single collective public entity created to implement the national-level waste management policies, within the framework of normative regulation, supervision, and other applicable legislation.
Ministry of Agriculture and Forests (MINAGRIF)	The MINAGRIF is responsible for formulating, implementing and monitoring policies in the field of agriculture, livestock, forests, food security and safety, management and organization of aquatic biological resources, fishing activities and sustainable aquaculture throughout Angola. MINAGRIF supervises the National Forestry Directorate and the Forest Development Institute, responsible for policies concerned with forests and wildlife.
National Demining Institute (INAD)	The INAD is a legally autonomous entity tasked with mine clearance activities, mine hazard awareness, research, tagging, innovation, and stock destruction to enable socio-economic development and unrestricted movement within the country.

Organisation	Responsibilities/ Relevance
National Commission for Civil Protection and Firefighters	The National Commission for Civil Protection and Firefighters is the specialised body for technical advice and operational coordination of the activities of civil protection organizations and structures.
National Operational Coordination Centres (CCON)	CCON coordinates the participation of all entities and institutions in civil protection, emergency, serious accidents, catastrophes or calamities. Its duties include monitoring and evaluating operational activities, liaising with civil protection agents, disseminating strategic information, issuing alerts to populations and institutions, and proposing international assistance on behalf of the government.
Ministry of Public Administration, Labor and Social Security (MAPTSS)	MAPTSS is responsible for policies and programs related to Public Administration, Labor and Social Security. MAPTSS supervises the General Labour Inspectorate with its function of developing and monitoring labour policies in all aspects. It also supervises the National Directorate of Human Rights, ensuring social security and advocating for Human Rights with the affiliation of the Minister of Justice and Huaman Rights.
Ministry of Energy and Water (MINEA)	MINEA is responsible for developing, planning, implementing, and monitoring of energy and water policies, laws and strategies to promote, coordinate and collaborate with local administrations to ensure sustainable water and energy programmes. The MINEA supervises the National Electricity Transport Network Public Company and the National Institute of Water Resources.
National Directorate of Local State Administration	The National Directorate of Local State Administration is a state body under the supervision of the Ministry of Territorial Administration. Its mission is to implement measures and tasks related to organizing and operating the bodies and services of the Local State Administration at the provincial, municipal, and communal levels.
Ministry of Culture and Tourism	This Ministry is responsible for formulating, implementing and overseeing policies in the field of culture and tourism development in Angola. Its duties include defining development policies, ensuring legal and international treaty compliance, managing cultural heritage, developing regional tourism strategies, and promoting entrepreneurship in the sector. The Ministry supervises the National Institute of Cultural Heritage in terms of implementing cultural heritage policies.
Government of the Moxico and Lunda Sul Provinces	The Government of the Provinces of Moxico and Lunda Sul is responsible for ensuring compliance of the State with the interest of citizens, legal framework, public investment programs and budgets and promote the performance of local administrations. The Government within the Provinces supervises the Provincial Office of Infrastructure and Technical Services, the Provincial Office of Transport, Traffic and Urban Mobility, and the Provincial Office of Environment, Waste Management and Community Services.
Municipal Administrations of Moxico, Camanongue, Dala and Saurimo Municipalities	The Municipal Administrations ensures executive functions within the Municipality, promotes harmonious development, environmental progress and the quality of life through improved public services and social assistance.

Table 3-2: Angolan policy provisions, legal requirements, and applicability thereof

Angolan Legislations / Policy	Applicability
National Policies	
National Development Plan (2023 – 2027)	The National Development Plan includes policies, programmes, objectives and priorities that are aligned with the Angolan 2050 long-term strategy with the focus on development of human capital, the modernisation and expansion of infrastructure and the diversification of the economy.
Angola 2050: Long-Term Strategy (2023)	Is strategy on where the country wants to be in future. The strategy indicates short-term initiatives to achieve the long-term strategies.
National Environmental Management Programme	Emphasises on the need for an environmental management strategy to protect the environment, its natural resources and pollution from governmental activities and private individuals. The programme contains strategic subcategories that focuses on inter-sectoral coordination, environmental education and the protection, management and rehabilitation of the environment.
National Master Plan for the Transport Sector	Provides an assessment and prioritisation of road infrastructure, railways, ports and maritime transport, aviation and road passenger transport projects.
Trans-African Corridor	An infrastructure development corridor for the development of a new greenfield African railway line expansion in a coordinated manner between SADC member states Zambia, Angola and DRC.
Legislations/Regulations	
Environmental Framework Law (Law Nº 5/98 of June 19th, 1998)	The EFL is the overarching law governing environmental legislation in Angola. Under the EFL, MINAMB has developed several policies and regulations to ensure sustainable development of all projects.
Environmental Impact Assessment Regulations (Law Nº 8/20 of April 16th, 2020)	The decree regulates the environmental licensing process of projects of which by their nature, location or scale can cause significant environmental and social impacts. The decree establishes environmental licenses for installation, operation and decommissioning for projects.
General Regulation of Environmental Impact Assessment and Environmental Licensing Procedure (Presidential Decree Nº 117/20 of April 22nd, 2020)	This decree establishes rules and procedures for the environmental impact assessment of public and private projects and the environmental licensing procedure for activities that are likely to cause significant environmental and social impact, as well as applicable fees and fines for noncompliance.

Angolan Legislations / Policy	Applicability
Environmental Auditing (Decree Nº 1/10 of January 13th, 2010)	Establishes procedures for undertaking environmental audits to understand project compliance for activities that are subject to an environmental impact assessment (EIA).
Terms of Reference for the Development of Environmental Impact Studies (Executive Decree Nº 92/12 of March 1st, 2012)	Establishes guidelines for the preparation of the Environmental Impact Studies necessary for environmental feasibility analysis of a Project subject to an EIA. The EIA shall strictly comply with the ToR approved by the Ministry of the Environment.
Liability for Environmental Damage (Presidential Decree Nº 194/11 of July 7th, 2011)	The Decree aims to establish the responsibility for the risk or degradation of the environment from any activity that may cause or threaten to cause damage to the environment. The decree states that any party causing environmental damage is required to repair the damages and/or compensation to the affected parties.
Waste Management Guidelines (Presidential decree Nº 190/12 August 24th ,2012)	Provides detailed requirements for segregation, storage and containment for waste and categorization for hazardous and non-hazardous waste. The decree further establishes guidelines for collecting, transporting, treatment, recycling and disposal of waste The decree is mainly limited to promoting environmental protection and public health, as well as encouraging sustainable waste management practices throughout the country.
Biodiversity National Action Plan (Presidential Decree No. 26/20 of February 6th, 2012)	Are guidelines that will guide the actions of conservation, preservation and protection of Biodiversity in Angola in the next seven years (2019-2025).
Biodiversity and Resources	
Law of Forests and Wild Fauna (Law Nº 6/17 of January 24th, 2017)	Establishes the rules to ensure the conservation, rational and sustainable use of forests and wild fauna in Angola as well as the general bases applicable to the performance of related activities.
Biological and Aquatic Resources Law (Law Nº 6-A/04 of October 8th, 2004)	The Law No. 6-A/04 of 8 October, Law on Aquatic Biological Resources, establishes the rules to ensure the conservation and sustainable use of aquatic biological resources existing in waters under the sovereignty of the Angolan State, as well as the general bases for the exercise of activities related to them, in particular fishing and aquaculture activities.

Angolan Legislations / Policy	Applicability
National Strategy and the Biodiversity Action Plan 2019-2025 (Law Nº 26/20 of February 6th, 2020)	The National Strategy and Action Plan for Biodiversity (NBSAP) of the Republic of Angola serves as an integrated strategic framework, within which the conservation and sustainable use of Biodiversity in Angola can be organised and coordinated for the fulfilment of an Action Plan over a period of seven years (2019-2025).
Environmental Conservation Areas Law (Law Nº 12/21 of May 21st, 2021)	The purpose of Law No. 12/21 of 21 May is to define the National System of Environmental Conservation Areas to establish the criteria and rules for its creation, classification and management through principles that safeguard its preservation, conservation and sustainable use.
Labour	
General Labour Law (Law Nº 12/23 of December 27th, 2023)	The law is aimed at creating employment and promoting economic and social development of Angola.
Health and safety	
Angolan Health Regulations (Law Nº 05/87 of February 23rd ,1987)	The purpose of the Law is to supervise the sanitary order integrated in the public health activities, with a view of promoting the health of the population, as well as regulating the mortuary sanitary activity and the handling of corpses or remains in cemeteries.
General Regulation of Occupational Safety and Hygiene Services in Organizations (Executive Decree Nº 6/96 of February 2nd, 1996)	This decree establishes the principles that aim to promote occupational safety, hygiene and health. It outlines safety and service organisation conditions, ensuring safe and hygienic conditions that protect workers' health through occupational medical exams regulations, safety protection equipment provision, safety workplace conditions.
Occupational Hygiene and Safety System (Decree Nº 31/94 of August 5th, 1994)	Establishes principles aimed at the employer promoting safety, hygiene and health and providing training for compliance at the workplace, under the terms of Article 46(2) of Law No. 23/92-Constitutional Law.
Legal Regime of Occupational accidents and Occupational Illnesses (Decree Nº 53/05 of August 5th, 2005)	Establishes the Legal Regime of Accidents at Work and Occupational Diseases. This states the right to compensation for the damage resulting from accidents at work and occupational diseases for employees and their family members protected by the compulsory social protection system.

Angolan Legislations / Policy	Applicability
General Regulation of Occupational Safety and Health Signs (Decree Nº 128/04 of November 23rd ,2004)	Establishes the minimum requirements and rules for the placement and use of safety and health signs in the workplace, being applicable to all public, mixed, private and cooperative companies and signalling devices. Where signalling devices are used, these required to be regularly cleaned, maintained, checked and, if necessary, repaired or replaced.
Energy	
Electricity General Law (Law Nº 14-A/96 of May 31st, 1996)	Establishes the general principles of the legal provisions applicable to activities of production, transport, distribution and use of electric energy.
Environmental Protection Regulations for Petroleum Activities (Decree Nº 39/00 of October 10th, 2000)	Aims to guarantee the preservation of the environment in relation to health, water, soil, subsoil, air, flora and fauna, ecosystems, landscape, atmosphere, cultural values. Archaeological and aesthetic aspects and defines environmental protection areas subject to onshore and offshore petroleum activities.
Water	
Water Law (Law Nº 6/02 of June 21st, 2002)	Establishes the general principles of the legal regime inherent to the use of national water resources, both surface and groundwater for private use.
Regulation on General Rules of Use of Water (Presidential Decree Nº 82/14 of April 12th, 2014)	Define the modalities that need to be implemented during the project on the regime of general use of water resources, including suggestions for the elaboration of a plan for the use and management of surface and groundwater, with the aim of maintaining water despite use with its initial value and quality, and protected from any type of impact.
Regulation on Water Quality (Presidential Decree Nº 261/11 of October 6th, 2011)	Approves the Regulations that establishes the standards and criteria for measuring the quality of water, according to its main uses, from the perspective of protecting public health, the integrated management of water resources and the preservation of the environment.
National Water Plan (Presidential Decree Nº 126/17 June 13th, 2017)	The plan provides characterisation the biophysical, economic and social, environmental, legal and institutional characterization of the Water Sector in Angola, and also gives an overview, although not recent, of the conditions of supply, water resources, quantity and quality, and the area of influence of the Project.

Angolan Legislations / Policy	Applicability
Regulation on Public Water Supply and Wastewater Sanitation (Presidential Decree Nº 83/14 of April 22nd, 2014)	For this Project, the works activities must comply with the effluent management and treatment criteria provided for by law, to demonstrate that the water from these activities is properly disposed of, without causing damage to human health and water bodies.
Regulation for the Prevention and Control of Pollution of National Waters (Presidential Decree Nº 141/12 of June 21st, 2012)	This Regulation establishes the regime for the prevention, surveillance and control of the pollution of national waters by pollutants from various human activities, namely ships, vessels, construction and industries.
Land use and resettlement	
Land Law (Law Nº 9/04 of November 09th, 2004)	Establishes the general bases of the legal regime of lands integrated in the original property of the State, the land rights that may fall on them and the general regime of transmission, constitution, exercise and extinction of these rights. In paragraph 7 of Article 27, it classifies land occupied by railway lines and their stations of public interest as partial reserves, considering a safety strip on each axis of the track.
Law on Territorial and Urban Planning (Law Nº 3/04 of July 25th, 2004)	This law establishes the instruments for urban and rural territorial space management and establishes a system for urban and territorial planning and related policies. It regulates the territorial planning system general framework in coordination with other instruments such as the general regime of defence, occupation, and use of land. It establishes that the land must comply with municipal and special territorial plans.
General Regulation of Territorial Plans (Decree Nº 2/06 of January 23rd, 2007)	Aims at the regulatory development of the general phases of spatial planning and urbanism, enshrined in the Spatial Planning Law, in the aspect of the respective instruments of management of urban and rural territorial space, regulating the general framework of the territorial planning system in an integrated and coordinated manner with other dimensions of the territory, namely, the general regime for the defence, occupation and use of land and other instruments of spatial planning.
General Regulation Land Concession (Decree Nº 58/07 of July 27th, 2007)	This decree establishes the legal framework for the concession of free lands within Angola and does not apply to private property lands. This law also establishes the procedure for the occupation of urban and rural land intended for public purposes.
Regulation for Resettlement Operations (Presidential Decree Nº 117/16 of May 30th, 2016)	Defines the rules, procedures and criteria that must comply with the actions of the Public and Autonomous State Administration Bodies, in the process of rehousing a group of people in areas subject to urban requalification and reconversion or construction and public works. In essence, it establishes the relocation rights and guarantees and defines the procedure for relocation and financial compensation operations

Angolan Legislations / Policy	Applicability
Law of Expropriation for Public Utility (Law Nº 1/21 of January 7th, 2005)	Establishes the principles and rules to be observed in Expropriation for public utility by the competent bodies of the State Administration. Based on this law, cases of public utilities are considered when the intervention of the competent body of the Public Administration is underlying, namely the operation of the means of public transport (rail or road).
Cultural heritage	
Cultural Heritage Law (Law Nº 14/05 of October 7th, 2005)	Establishes standards and guidelines for the protection, conservation, enhancement and promotion of the country's cultural heritage. Its purpose is to safeguard and preserve the existing cultural heritage tangible and intangible assets.
Regulation of Immovable Cultural Heritage (Presidential Decree Nº 53/13 of October 7th, 2013)	This Decree regulates the rules and procedures for the protection, preservation and enhancement of the Immovable Cultural Heritage and applies to all assets classified or in the process of being classified such as monuments, ensembles or architectural sites, public or private, located in the national territory, whose interest and cultural relevance determine their legal protection.
Approves the General Statute of Museums (Presidential Decree Nº 44/11 of March 7th, 2013)	Establishes that museums are responsible for the custody and dissemination of historical and cultural collections at national level.
Recognizes Semba as National Intangible Cultural Heritage, in the field of Forms of Cultural Expression and the same Presidential Decree Classifies the so-called Kwanza Corridor as a National Cultural Itinerary (Presidential Decree Nº 54/55/23 of May 2nd, 2023, Series I - No. 77)	The Decree recognizes the generic music and dance of Semba as national intangible cultural heritage and classifies the so-called Kwanza Corridor as national cultural itinerary. This contributes establishment of patriotism and ensures social cohesion. In this same Decree, the Corredor do Cuanza is classified as a National Cultural Initiative, as it preserves the memory and history of Angola linked to the colonial period.
Elevates the category of Cultural Heritage Church of the Holy Family (Presidential Decree Nº	Aims to recognize that the influence and strengthening of Christianity in Luanda is elevated to National Historical-Cultural Heritage object of protection by the local authorities of the state. It elevates the category of the Church of the Holy Family as the cultural heritage.

Angolan Legislations / Policy	Applicability
52/23 of April 28th, 2023, Series I)	
Approves the Organic Statute of the National Institute of Cultural Heritage (Presidential Decree Nº 16/21 of January 14th, 2021)	The National Institute of Cultural Heritage (INPC), is mandated to implement public policies in the field of research, documentation, conservation, preservation, management and promotion of cultural, historical-cultural and national heritage, as well as to develop and execute the national museological policy.
Organic Statute of the Ministry of Culture and Tourism (Presidential Decree Nº 280/22)	States the attributions that the Ministry of Culture and Tourism has in terms of the implementation of the policies and programs defined for the respective body within the ministerial sector and take the necessary decisions for this purpose, under the terms of the Constitution of the Republic of Angola and other legislation in force.
Regulations on the Procedures Relating to the Protection, Export, Import and Transfer of Cultural Goods (Decree Nº 87/20 of April 6th,2020)	Sets out the conditions for the introduction of cultural goods, and the conditions and procedures for the import of cultural goods, in order to safeguard Angolan cultural heritage and prevent the illicit trade in cultural goods, in particular where such trade could contribute to terrorist financing.
Transport	
Basic Land Transport Law (Presidential Decree Nº 20/03 of August 19th, 2003)	Establishes a land transport system comprising its infrastructures, construction, upgrade and the productive factors related to the travel by land, of people and goods, within the scope of the national territory or that have part of the route in it.
General Regulation of Rail Carriage of Passengers, Baggage and Fares (Presidential Decree Nº 209/13 of December 12th, 2013)	Establishes the general regulation of rail freight transport and the tariff regime, establishing the minimum of public intervention to safeguard the essential contractual relationship between the public and the railway transport operating companies, considering the general interest of these services.
General Regulation of Railway Traffic Safety (Executive Decree Nº	Establishes the mandatory application of the Railways, as well as all other specific regulations that are part of the operating network by the Angolan railways. It establishes general traffic safety.

Angolan Legislations / Policy	Applicability
170/10 of December 13th, 2010)	
Regulation on the Conditions for the Provision of Railway Transport Services and Railway Infrastructure Management (Presidential Decree Nº 203/13 of December 3rd, 2013)	Defines the Conditions for the Provision of Rail Transport Services and the Management of Railway Infrastructure and the promotion of safety, promotion and protection.
License for the Provision of Railway Transport Services and Application for the Issuance of a License for Access to the Activity of Railway Transport Services Provision (Executive Decree Nº 188/15 of April 21st, 2015)	Establishes the application model for railway undertakings applying for Licenses for the Exercise of the Activity of Provision of Railway Transport Services, their renewal or amendment/updating. The railway undertaking must complete all the fields of the application and provide the relevant information in accordance with the guidelines stipulated by law.
Regulation of Public Railway Transport Services (Presidential Decree Nº 131/10 of July 8th, 2010)	Defines how, within the framework of a legislation in force, the competent authorities may intervene in the field of public rail passenger and freight transport in order to ensure the provision of services considered to be of general economic interest.
Bases of the Railway Services Concession and Support Logistics of the Lobito Corridor (Presidential Decree Nº 205/21 of August 30th, 2021)	Establishes the Bases for the Concession of Railway Services and Support Logistics of the Lobito Corridor, which have a special nature in relation to the general regimes established for the services covered. In Chapter II, Article 4, it states that the Concession covers the operation and maintenance, by the Concessionaire, of the infrastructure of the Lobito/Luau Railway Line assigned to the Benguela Railways.

Angolan Legislations / Policy	Applicability
General Bases of Concessions for the operation of rail passenger and freight transport services (Presidential Decree Nº 194/13 of November 20th, 2013)	Establishes the concepts for the general operation of passenger and freight rail transport services on the Luanda/Malanje, Lobito/Benguela/Luau and Namibe/Menongue railway lines. The concession is expanded to commercial areas in stations, cargo terminals and goods warehouses, as long as they are included in the aforementioned contracts.

Table 3-3: Tentative permits/licences required

Permit	Requirements	Issuing Entity	Issuance Process Duration	Permit Validity	Issuing Fee	Supporting Legislation
Environmental Installation and operation License	Accordingly, to Chapter III in Article 21, Project Owner or Company must submit the following via digital platform SIA - Integrated Environmental System: • EIA • Non-technical summary • Description of the activity • Description and justification of the activity • Legal framework of the activity • Brief biophysical and socio-economic information on the area • Information on the current use of the land in the area of activity • Commercial Registry Certificate of the Company • Value of the project investment • Nominal List of machinery and equipment • Public deed of the Company • Proposed distribution of onus and social benefits • Waste Management Plan submission protocol to Waste Agency (Appendix 17.1) • Hiring a company specialized in environmental consulting to carry out the EIA	Environmental Ministry	30 Business days	3 Years	0, 04% for investments above 249.000.000,00 AOA	Presidential Decree 117/20 of April 22nd, 2020 - Environmental Licensing Presidential Decree 83/222 of April 12th - Environmental Licensing Fees and Emoluments
Waste Management Plan Compliance Certificates	Accordingly, to Chapter I in Article 7, Project Owner or Company must submit the following: • Project descriptive memory and Justification • Generated waste Description • Waste Management Procedure • Waste Operator contract • Waste Operator documentation • Project Layout	National Waste Agency (ANR)	60 Business Days	4 years	Above 20.000,00 m2 - 806.552,74 AOA	Executive decree nº 527/21 of October 15th - Waste Management Presidential Decree 190/12 of August 24th
Construction Licence	• Application for a license to the issuing authority • Documentation of ownership/use of the plot • 3 signed copies of the architectural project • ESIA	Municipal Administration	30 Business Days	1 year	Usually, fees are charged according to Project dimension	No Supporting Legislation Available

Permit	Requirements	Issuing Entity	Issuance Process Duration	Permit Validity	Issuing Fee	Supporting Legislation
					and construction activities to be executed	
Construction on locations considered sacred or used for rituals	Prior to carrying out construction activities, a survey should be carried out within the Project Area of Influence to identify potential sacred sites. After this verification, the Municipal Directorate of Cultural Heritage should be contacted and a visit to the identified places should be scheduled for confirmation. The confirmation visit must be carried out in the presence of a municipal cultural heritage technician and traditional authorities. The traditional authorities will guide which cultural procedures (rituals) must be fulfilled for permission to use the site. The Sobas will make a list of things to buy for the ritual (usually wine, milk, cheese, rice, pasta, goats, chickens). This whole process is intermediated by the municipal administration.	Traditional authorities of the community	N/A	N/A	N/A	Local Customs
Vegetation mapping before and during deforestation activities	During deforestation activities, the slaughter of baobabs must be registered in a database (indication of the date of the slaughter, municipality, commune and geographical coordinates). This database must generate a map using GIS software. They must be sent to the IDF, as the baobabs are on the endangered species list.	Report to IDF - Forest Development Institute	N/A	N/A	N/A	N/A
Declaration of Public Utility	All information relating to the acquisition attempt by way of private law; Indication of the budget appropriation that supports the expenses with the Expropriation and the respective captivation or corresponding guarantee	Planning and Economy Ministry or Holder of executive power	N/A	3-5 years	N/A	Law No. 1/21 of January 7, 2021 - Expropriation for public utility
Survey of all existing water resources along the track	Before starting work on the site, a mapping (through GIS) of all existing water courses along the line, such as rivers, lakes, ponds and others, must be carried out	Report to the National Institute of Water Resources (INRH)	N/A	N/A	N/A	N/A
Land Legalization	Land ownership documents, location sketches and terms of delivery of land or areas to be occupied or acquired within the scope of the project)	Municipal Administrations	N/A	N/A	N/A	law nº 9/04 of November 9; land law

Permit	Requirements	Issuing Entity	Issuance Process Duration	Permit Validity	Issuing Fee	Supporting Legislation
Collection of surface or underground water for supply	• Design and Calculate the Estimated Water Consumption per Temporary Campsite (Human consumption, Works Consumption) • Plan the location of each Water Borehole at each Temporary Campsite • Hire a Local Water Borehole Specialist to execute a Pilot Borehole at the planned location. Obtain data on water parameters at the location (Quantity, Yield, Deepness, Capacity, etc.) • Obtain a Water Sample from the Borehole and send it to a Licensed local Laboratory for chemical and physical analyses of the water quality • After obtaining all borehole data, decide on the requirement for a Water Treatment Plant, as per local regulation. Decide on the Number of Boreholes to be installed at each location • Design the decisions made and prepare a documental report • Send the documental report to the E&S Consultant to consider in the ESIA Report • Send the ESIA Report to MINAMB, to obtain the Environmental Installation License for the Construction • Send the report for approval and requesting authorization to proceed to the local Secretaria do Ambiente, do Governo Provincial, responsible for the Area; Pay the requested legal fees, for the process • With the Approval of the above entity, prepare a process and send it to INRH (Instituto Nacional de Recursos Hídricos). Pay the requested legal fees, for the process • With the approval of the 3 entities above, proceed with the completion of the pilot borehole, and the remaining infrastructure related to the Water Use Permit. Ensure to consider water meters at each water borehole.	National Institute of Water Resources			To be provided by National Institute of Water Resources	

3.4 Lender appraisal standards

The Project intends to apply for international finance and will, therefore, need to not only meet national standards, but also international lender appraisal standards (LAS). The following LAS are applicable:

- World Bank Group Environmental and Social Framework, 2018, including, inter alia
- OECD Common Approaches on environment and officially supported export credits
- International Finance Corporation (IFC) Performance Standards (PS`s) 1-8, Environmental and Social Sustainability (2012), including relevant Guidance Notes (GN's)
- World Bank Group (WBG) General Environmental, Health, and Safety (EHS) Guidelines, and relevant WBG sector specific EHS guidelines, 2007
- EHS Industrial Sector Guidelines for Railways, 2007
- Equator Principles IV (EP4, 2020) as well as Equator Principles guidance and requirements on greenhouse gas emissions and climate change risk
- United Nations Guiding Principles on Business and Human Rights ("UNGPs")
- International Law, including conventions, treaties and protocols assented to by the Angolan Government.

3.4.1 IFC performance standards

The applicability of each of the eight IFC PSs to the Project, are presented in Table 3-4.

Table 3-4: IFC Performance Standards requirements

Performance Standards	Relevance to the Project
IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts	PS1 underscores the importance of managing social and environmental performance throughout the life of a project by using a dynamic social and environmental management system. The Project has committed to abiding by PS1, including undertaking environmental and social assessments and full consultation with local communities and setting up mechanisms for working with Affected Communities. Development of Project Environmental and Social Management System (ESMS).
IFC PS2: Labour and Working Conditions	The Project will ensure that it upholds labour rights, protect workforce by addressing forced, migrant and child labour, human rights and provide safe working conditions during both construction and operation.
IFC PS 3: Resource Efficiency and Pollution Preventions	Pollution prevention and abatement in line with international available technologies and practices; energy and resource efficient approaches during construction and operation phases of the Project. These considerations have been made during Project design.
IFC PS 4: Community, Health, Safety and Security	Project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase risks arising from accidents, releases of

Performance Standards	Relevance to the Project
	hazardous materials, exposure to diseases, and the use of security personnel. Community health and safety plans will be included in the Project.
IFC PS5: Land Acquisition and Involuntary Resettlement	Project will trigger involuntary displacement especially economic along the railway line. Some existing smallholder farms in the corridor. Commitment to develop and implement a Resettlement Action Plan (RAP) and Livelihoods Restoration Plan (LRP).
IFC PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (updated GN6, 2019)	The Project shall undertake dry and wet season baseline surveys, including critical habitat assessments and development of required management/action plan addressing pertinent biodiversity issues along the corridor.
IFC PS7: Indigenous Peoples	There are no known Indigenous Peoples within the Project AoI. Refer IPs Screening in the Baseline chapter.
IFC PS8: Cultural Heritage	The Project will protect irreplaceable cultural heritage resources identified within Project AoI including application of Chance Find Procedure.

4 PROJECT ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

Aligned with IFC PS1, as the Project owner is responsible for the development of an ESMS. Key aspects/principles required for an effective ESMS are:

4.1 Policy statement

4.1.1 Proponent's Policy Statement

At the time of the preparation of this ESMP, the Proponent's E&S Policy was not yet finalised. This is to be updated as part of the Operational ESMP.

4.1.2 Contractor Policy statement

As indicated in the 0.PI-PR-001-OECLS-R02- INTEGRATED SUSTAINABILITY PROGRAM MANUAL, The Luena-Saurimo Railway Project is based on OEC's Sustainability Policy and Guidelines. From this document, the Luena-Saurimo Railway Project established its Sustainability Commitments, providing a framework for the creation of the Integrated Sustainability Program in line with sustainable development, based on the following principles:

- compliance with legal frameworks and other applicable requirements
- adequate management of environmental aspects and hazards and risks to safety and health, with Objectives and Goals
- continuous improvement of results with emphasis on preventive action in Occupational Health, Safety at Work, Environment and Social Responsibility
- socio-environmentally responsible business performance.

The OEC Sustainability Policy establishes environmental, social and governance (ESG) references for the organisation to act with sustainability. It defines the basic concepts that guide the Company, as well as commitments, indicators, roles, and responsibilities in this area (the full policy is attached at Appendix 17.2 of this ESMP Report). The Sustainability Commitment for the Luena-Saurimo Railway Project is extracted below.

SUSTAINABILITY
INTEGRATED PROGRAMME

SUSTAINABILITY COMMITMENTS

OECI S/A, Angola Branch for the construction of the Luena-Saurimo Railway (Engineering, Supply and Construction), considering OEC's Sustainability Policy and the Sustainability Guidelines in Angola, undertakes to develop its processes and activities in line with sustainable development, based on the following principles:

- Compliance with legal frameworks and other applicable requirements;
- Proper management of environmental aspects and safety and health hazards and risks, with Objectives s and Targets;
- Continuous improvement of results with an emphasis on preventive action in Occupational Health, Safety at Work and the Environment;
- Socially and environmentally responsible business performance .

Those responsible for implementing the Integrated SUSTAINABILITY Programme, through planned delegation and raising people's awareness, are:

- Corporate Responsibility - of the Director of Contract, the other Managers, the PRs and the other Leaders;
- Operational Responsibility - of each Member directly carrying out the tasks in all work areas or sectors.

Luanda, 23rd August 2023

Manuel António Kai
Contract Director

Sustainability Commitment - Rev.A

4.2 Process for risk/impact identification

4.2.1 Preconstruction and construction phase

In addition to the ESIA conducted for the Luena Saurimo Project, the Contractor has a procedure for the identification of environmental and social impacts that is applied throughout the construction phase (PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN).

The procedure has eight stages recorded on form PI-FR 0301 OECLS - Identification of Aspects and Assessment of Environmental Impacts to identify aspects and assess environmental impacts in routine, non-routine and emergency situations. These stages are summarised as follows:

- stage 1 - Knowledge of the environmental and neighbourhood impact studies, where they exist, and of the environmental licenses issued, as well as a survey of the risks and opportunities of the Work or Office
- stage 2 - Identifying processes and activities
- stage 3 - Identification of environmental aspects
- stage 4 - Assessment of environmental impacts
- stage 5 - Identifying an emergency situation

- stage 6 - Technical analysis of the environmental impacts identified
- step 7 - Management guidelines and definition of controls
- stage 8 - Re-evaluation of the technical analysis.

The Sustainability Manager for Luena Saurimo Project is responsible as the process owner to identify risks and opportunities throughout the Project's lifecycle (design, preconstruction, construction, operations) and maintaining a Risks, Opportunities & Aspects Register. The outcome recorded in PI-FR 0301 OECLS is communicated to the Sustainability Manager for the Contractor and coordination with the Construction Manager through monthly meetings.

The *PI-PR-048-PRELIMINARY RISK ANALYSIS_EN* Procedure establishes guidelines for the preparation of Preliminary Risk Analyses (PRAs) associated with the project's processes and activities, in order to ensure:

- the identification of occupational health and safety hazards and risks and any environmental impacts not covered in the application of procedures *PI-PR-002-OECLS - Identification of Occupational Health and Safety Hazards and Risk Assessment* and *PI-PR-003- OECLS - Identification of Environmental Aspects and Impact Assessment*
- that elements for the planning and execution of activities on site, in addition to operational controls, procedures and work instructions, take into account the significant environmental aspects and the hazards and risks identified, respectively, in procedures *PI-PR-002- OECLS - Identification of Occupational Safety and Health Hazards and Risk Assessment* and *PI-PR-003- OECLS - Identification of Environmental Aspects and Assessment of Environmental Impacts*
- the engagement of workers and middle management in awareness-raising mechanisms related to occupational health and safety hazards and risks and environmental impacts, as well as the respective prevention and mitigation measures
- compliance with the concept of continuous improvement of operational controls, procedures and work instructions.

The methodology for preparing the Preliminary Risk Analysis (PRA) has four main stages that is recorded in form in *PI-FR 048 - Preliminary Risk Analysis*.

4.2.2 Operation and maintenance phase

At the time this ESMP was developed, the MINTRANS E&S policies and procedures were not fully developed. It is recommended that a E&S Risk Identification and Management Procedure is developed that includes the following main sections:

- screening procedure (types of activities that require different levels of E&S assessments)
- Environment and Social Assessment Process (steps)
- Decision-Making, Institutional Responsibilities and Organisation Capacity
- tools (for recording and reporting)
- Monitoring and Reporting
- Implementation Plan.

4.3 Organizational capacity/competency

Overall, the project owner (MINTRANS) is responsible for securing competent personnel for the design, construction, supervision and operation of the Luena Saurimo railway.

4.3.1 Preconstruction and construction phase

The Macrostructure of the Luena-Saurimo Railway Project is defined by the Director of the Contract (reference to the *0.PI-PR-001-OECLS-R02- INTEGRATED SUSTAINABILITY PROGRAM MANUAL*).

The Contractor's sustainability team for the project comprises of the following team members under the supervision of the Sustainability Manager:

- occupational health and safety coordinator with two technicians
- environmental coordinator with two technicians
- social coordinator with two officers
- medical coordinator with a nurse, laboratory technician, administration support staff and paramedic driver.

The Contractor will develop job descriptions with personnel qualifications during pre-construction and determine whether external recruitment will be needed or not while mobilising. The OECLS-AF-PG-GER-002_TRAINING PLAN_EN enables the sustainability manager to propose training activities as necessary for the Luena Saurimo Project. As a minimum, all personnel enrolled in the construction will undertake an induction course that will include all human resource related policies, procedures and workers grievance mechanism. The Sustainability manager will develop induction training and briefing materials on the ESMP and its sub plans for all personnel (managers, coordinators, technicians, support staff and sub-contractors).

4.3.2 Operation and maintenance phase

The personnel overseeing the implementation of the ESMP and Lender compliance requirements during operations is defined by MINTRANS and the railway operator, CFB. The team is to comprise of

- occupational health and safety manager with two technicians/officers
- environmental manager with two environmental officers
- social manager with community liaison officers in each municipal
- medical coordinator with a nurse, laboratory technician, administration support staff and paramedic driver.

As a minimum, all personnel employed for the operation and maintenance of the Luena Saurimo railway are required to undertake an induction course that will include all human resource related policies, procedures and workers grievance mechanism for the project. In addition, the Environmental Manager will develop induction training and briefing materials on the Operational ESMP and its sub plans for all personnel (managers, coordinators, technicians, support staff and sub-contractors).

4.4 Emergency preparedness and response

4.4.1 Preconstruction and construction phase

OECL has developed an Emergency Response Plan (ERP) PI-PL-100-OECLS as well as

- PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN,

- PI-MP-007-OECL_WASTE AND HAZARDOUS MATERIALS MANAGEMENT PLAN,
- PI-PL-105-OECLS_CHEMICALS MANAGEMENT PLAN_EN and
- PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN

The following are examples of emergence situation for which the contractor has considered and established programs and practices for response:

- fire / explosions at camps, generators and at construction sites
- hazardous materials spills e.g. fuel, oil, chemicals, untreated wastewater etc leading to contamination of land and surface water
- accidents involving construction vehicles and equipment.
- construction/security incidents leading to serious injuries or ill health.
- natural disasters e.g. landslides during construction, flooding, etc.
- outbreak of communicable diseases.
- Security threats/risk, protests and theft.

4.4.2 Operation and maintenance phase

It is important to develop procedures and practices during the operational phase for the handling of hazardous materials that allow for quick, fast, and effective responses to any accidents that may result in injury or environmental damage. The CFB will prepare an emergency preparedness and response plan for this project that as a minimum should include the following steps that can be divided into more details:

- administration (policy procedures standards and guidelines distribution and definitions)
- organization of emergency areas this includes the command centres and medical stations etc.
- roles and responsibilities
- communication systems
- emergency response procedures
- emergency resources including equipment required and highlight how and where they will be stored, maintained, and retrieved
- training and drills for employees
- reporting, checklists and documentation
- business continuity and contingency
- reviewing and updating the emergency response plan to reflect changes that may be required in any way.

The CFB's ESMS is to include their operational Environmental Emergency Preparedness & Response Procedure that will cover the following:

- fire / smoke at stations and on locomotives
- fuel spills, fires and explosion at storage depots and during transportation
- hazardous materials spills e.g. lubricants, oil, chemicals, etc at workshops and during transportation of related cargo
- landslides during rail operation and maintenance
- accidents and incidents leading to serious injuries or ill health
- natural disaster e.g. flooding

- outbreak of communicable diseases
- deliberate attacks or damage to project facilities.

A draft ERP plan is provided in Appendix 17.3.

4.5 Audit and inspections

4.5.1 Environmental inspection

The purpose of the environmental inspections is to verify that good environmental practices are applied by the company and that environmental and social requirements included in the contract are being met.

The environmental inspection will include but not limited to the following activities:

- systematic/periodical inspection of all site activities and the project offsite facilities by the including borrow pits and quarry sites areas. To ensure that the contract requirements relating to environmental matters are being complied with, and that no impact foreseen and unforeseen are occurring
- review/adjustment/modification of the Project plans, methods statement and works design and arrangements to ensure that environmental protection measures specified in the contract documents are adopted and company proposals provide acceptable levels of impact control. The ESMP shall be modified, as necessary, if required by the authority
- the results of ongoing compliance monitoring to be communicated to affected people and their government representatives. Ongoing public consultations to be held throughout the project life cycle to continue receiving community input and enable community concerns to be documented and incorporated into the environmental management process.

4.5.2 Audit program

The CFB will develop an Audit program for the project for both construction and operation phase. This program is to include regulatory, lender and voluntary environmental, social, health and safety commitments, who is responsible for conducting them, frequency, locations and reporting timeframes. Audits will also assess compliance with agreed objectives and targets as well as the effectiveness of the Luena Saurimo Project ESMP and associated Procedures and their implementation. The audits will be based on appropriate protocols prepared by CFB environmental, social and health and safety managers.

4.5.3 Self-auditing and compliance/annual audits

OECL's PI-PR-010 Audit Procedure prescribes that annual internal audit programs are established by the Sustainability Manager. The developed program will include OEC's environmental and social performance against the ESMS, the construction ESMP and lender requirements as well as OEC's permits/licences/certificates. The dates and responsibilities will be recorded in the prescribed form in the procedure.

4.5.4 Control audits

Presidential Decree No. 1/10, of 13 January, establishes the procedure for carrying out environmental audits whose purpose is limited to assessing the actual or potential levels of pollution or environmental degradation. In addition, it also allows you to verify that the auditee is complying with environmental standards and environmental quality standards.

Article 8 emphasizes the obligation to carry out environmental audits of activities subject to Environmental Impact Assessment. The Ministry of Supervision is responsible for carrying out an environmental audit, and the entity being audited must collaborate with the auditors, making all documentation available to them and granting access to all facilities and equipment.

In its Article 7, it assigns the responsibility to the Ministry of the Environment to determine, when necessary, the carrying out of occasional environmental audits, establishing specific guidelines and deadlines, after being submitted to the Environmental Impact Assessment of the Project.

4.6 Reporting

The Project will require a system of internal reporting that allows for appropriate assessment of the effectiveness of the ESMS. The table below summarises the main reporting requirements for the Project.

Table 4-1: List of main reporting requirements

Type of Report	Preparer	Topic	Primary Receiver	Frequency
Control Audits	Regulators in Angola e.g. Ministry of Environment	Regulatory compliance	CFB	Whenever regulator deems necessary
Compliance Audits	MINTRANS	Project's performance and compliance to ESMP	Ministry of Environment/Lender	Annual
	MINTRANS	Contractor's performance and compliance to ESMP	-**Contractor**	Annual
Inspections	MINTRANS, CFB, Supervising engineer	Compliance to ESMP	**Contractor**	Quarterly
	CFB, MINTRANS Supervising engineer	Compliance to ESMP	Sub-contractors	Quarterly
	Contractor	Compliance to ESMP	Subcontractors	Prescribed in specific operational procedures
Monitoring Reports	Contractor	Progress implementation of the ESMP	CFB Supervising engineer	Quarterly

Type of Report	Preparer	Topic	Primary Receiver	Frequency
	Contractor	Progress on the implementation on the ESMP and in relation to Lender requirements	MINTRANS	Quarterly
	MINTRANS & CFB	Progress on the implementation on the ESMP and in relation to Lender requirements	Lender representative	6 monthly – Annually
Public reports	Contractor during construction	Progress on the construction	Stakeholders including provincial and municipal leaders Community leaders	Determined by the Stakeholder Engagement Plan
	CFB during operations	Information about operations schedules, changes, ESMS performance results	Stakeholders including provincial and municipal leaders Community leaders	Determined by the Stakeholder Engagement Plan

4.7 Management of change

4.7.1 Preconstruction and construction phase

OECL manages changes in the documented management plans and procedures through their PI-PR-013-OECLS_DOCUMENTED INFORMATION CONTROL_EN Procedure. The procedure provides a framework of the types of documents developed as part of the OECL ESMS. These are categorised as either a Corporate Procedure, Procedure of the Work/Offices, Plans and Programs, Projects, Work Instructions and Forms. The procedure also provides the coding for the respective documents. Any change to the documents can be proposed by any employee, submitted to the person responsible for the management plan/procedure that is indicated in each respective document. Before effecting any change, the respective personnel indicated responsible for the document is to inform and consult other personnel who may be affected by the change and assess potential unwanted impacts that may arise from the proposed change. The changes to be included in the management plans/procedures can arise from corrective actions from internal/external audits, good practice lessons from inspections, stakeholder relations changes in legislative/contractual requirements and/or agreed changes with Lender representatives to improve the environmental performance of the project. All approved changes to the documents are to be incorporated to the document control master list that is part of the PI-PR-013-OECLS_DOCUMENTED INFORMATION CONTROL_EN Procedure that indicates the revision number, authorisers and issue dates. This master list and changed document are to be presented at Project Staff meetings to ensure that all departments have recent information.

4.7.2 Operation and maintenance phase

The Project owner will develop a procedure to keep record of changes throughout the construction and operations of the project. These changes include:

- personnel changes
- permit and approvals
- schedule changes (regarding procurement, construction or operational)
- policies, procedures and management plans
- corrective actions from inspection and audits.

The Change Management Procedure should include relevant forms for documenting changes and outline responsibilities across the project's organisational structure. Changes are to be communicated in both written form and during regular project management meetings.

4.8 Management programs and procedures

The plans, procedures and policies for the proposed Luena- Saurimo Project are detailed in Table 4-2 below. These will need to be reviewed and where necessary as part of the Construction ESMP, updated with the most recent findings and mitigation measures from the ESIA in line with updates from detailed design.

The Operator, that is, CFB and MINTRANS are to develop the list of management plans and procedures presented below for the operations phase.

Table 4-2: List of Project-specific policies, plans and procedures developed and adopted for Luena - Saurimo

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
1	PS1	Policy	0.PI-PR-001-OECLS-R02- INTEGRATED SUSTAINABILITY PROGRAM MANUAL	Contractor
			PI-PR-004-OECLS-OBJECTIVES AND ACTION PLANNING_EN	Contractor
			Operations E&S Policy	Caminhos de Ferro de Benguela (CFB)
		Identification of risks and impacts	PI-PR-048-PRELIMINARY RISK ANALYSIS_EN PI-PR-002-HAZARD IDENTIFICATION AND OHS RISK ASSESSMENT_EN PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN • PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en • PI-FR-003-PLN-0016-01 - PIAAIA cargo handling and lifting en • PI-FR-003-PLN-0016-01 - PIAAIA Ellectrical Assembly en • PI-FR-003-PLN-0016-01 - PIAAIA Excavation en • PI-FR-003-PLN-0016-01 - PIAAIA General Services en • PI-FR-003-PLN-0016-01 - PIAAIA grounding mesh for the final structures en • PI-FR-003-PLN-0016-01 - PIAAIA Health en • PI-FR-003-PLN-0016-01 - PIAAIA housekeeping service en • PI-FR-003-PLN-0016-01 - PIAAIA Industrial plants, Framing and carpentry en • PI-FR-003-PLN-0016-01 - PIAAIA Landfill_ en • PI-FR-003-PLN-0016-01 - PIAAIA Mettalic assembly en • PI-FR-003-PLN-0016-01 - PIAAIA Paint works en	Contractor

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
			• PI-FR-003-PLN-0016-01 - PIAAIA Paving_ en • PI-FR-003-PLN-0016-01 - PIAAIA pouring concrete en • PI-FR-003-PLN-0016-01 - PIAAIA Repairs en • PI-FR-003-PLN-0016-01 - PIAAIA Storage and supply of hydrocarbon derivatives en • PI-FR-003-PLN-0016-01 - PIAAIA supplies and warehouse en PI-FR-003-PLN-0016-01 - PIAAIA water management	
		Management Programmes	PI-PR-013-OECLS_DOCUMENTED INFORMATION CONTROL_EN	
			Environmental and Social Management Plan (this document) prepared as part of the bankable ESIA	Consultant - RSK
			Construction ESMP Includes: • Environmental and Social Training Procedure • Environmental Incident Response Procedure • Environmental Incident Reporting Form	Contractor
			Operational ESMP • Environmental and Social Training Procedure • Environmental Incident Response Procedure • Environmental Incident Reporting Form	CFB
		Monitoring and Review	Environmental and Social Monitoring Plan prepared as part of the bankable ESIA (updated during construction and operation)	Consultant-RSK
			PI-PR-010-OECLS-AUDIT CONFORMITIES_EN	Contractor
			PI-PR-011-OECLS_HANDLING NON-CONFORMITIES AND CORRECTIVE ACTIONS_EN	Contractor
		Organisational capacity and competency	E&S Governance Framework	CFB
			Human Resource Policy	CFB

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
		Legal Compliance	PI-PR-014-OECLS_LEGAL REQUIREMENTS_EN	Contractor
			Permit Legal Compliance Monitoring tracker/Register	Contractor
			Operations legal compliance Register	CFB
		Emergency Preparedness & Response	PI-PL-001 Emergency Preparedness & Response Procedure with • OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency lay-out plan for camps)	Contractor
			• Operation Emergency Preparedness & Response Procedure (to include mainline and stations) (A draft plan is provided in Appendix 17.3)	CFB
			Fire Prevention and Protection Procedure -included in the PI-PL-001 Emergency Preparedness & Response Procedure	Contractor
			Operations Fire Prevention and Protection Procedure	CFB
	PS 1 and PS 4	Stakeholder Engagement	Project Stakeholder Engagement Plan and Grievance Redress Mechanism	MINTRANS & CFB (construction and operations phases)
			PI-PL-007 Stakeholder Engagement Plan	Contractor
2	PS 2	Labour and working Conditions	Human Resource Policy with • Recruitment Procedure • Retrenchment and severance procedure • Working conditions and Terms of Employment • Workers' organisations	Contractor
			Code of Conduct Procedure with Disciplinary Rules Disciplinary Action Procedure	Contractor
			OECLS-AF-PG-GER-001_ACCOMMODATION PLAN_EN	Contractor
			Camp Management Plan	Contractor
			OECLS-AF-PG-GER-002_TRAINING PLAN_EN	Contractor

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
			PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN	
			Construction Workers Grievance Mechanism	Contractor
			Project's Workers Grievance mechanism	CFB
		Suppliers and sub-contractors	PI-PR-005-OECLS-MANAGEMENT OF SUPPLIERS AND SUBCONTRACTORS_EN	Contractor
			Operations Management of suppliers and subcontractors	CFB
		Worker Influx	PI-PL-082_INFLUX MANAGEMENT PLAN_EN	Contractor
			Influx Management Strategy for Operations	CFB
		Human Rights	Policies and procedures related to • Non-Discrimination and equal opportunity • Worker's right to Privacy • Worker's freedom of movement or of association • Restriction on Child labour • Restrictions on Forced Labour	Contractor CFB
		Occupational Health	• PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN • PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN • PI-PR-022-OECLS_HEARING CONSERVATION PROGRAM_EN • PI-PR-023-OECLS_ERGONOMIC PROGRAMME_EN • PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN • PI-PR-025-OECLS_SICK LEAVE MONITORING PROGRAMME-SLMP_EN • PI-PR-052-OECLS-GUIDELINES FOR DRAWING UP THE RESPIRATORY PROTECTION	Contractor

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
		Incidents	PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN • PI-PR-012-INCIDENT INVESTIGATION METHODOLGIES ANNEX I_EN • PI-PR-012- INCIDENT INVESTIGATION METHODOLGIES ANNEX II_EN • PI-FR-01201-OECLS_EN work accident statistics report • PI-FR-01202-OECLS_EN incident investigation report • PI-FR-01203-OECLS_EN incident alert form	Contractor
		Safety Management	PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN PI-PR-008-INSPECTIONS_EN PI-PR-009-QUALIMETRY_EN PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN PI-PR-041-CARGO HANDLING_EN PI-PR-042-ELECTRICAL INSTALLATIONS AND ELECTRICAL SERVICES_EN PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN PI-PR-045-HOT WORKS_EN PI-PR-046_SIGNALLING AND ISOLATION_EN PI-PR-049-OECLS -HAZARDOUS WORK PERMIT_EN PI-PR-103-WORK AT HEIGHT_EN PI-PR-102-OECLS_CONFINED ENVIRONMENT SERVICES_EN • PI-FR 10201 OECLS_EN - Confined Space Registration • PI-FR 10202-OECLS_EN - letter of agreement • PI-FR 10203 OECLS _EN registration and scope for authorisation confined space work • PI-FR 10204 OECLS_EN confined space permit	Contractor
			Operational Safety Management System	CFB

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
			Mainline Operational Plan	CFB
3	PS 3	Resource Efficiency	PI-PL-031-OECLS_RESOURCE EFFICIENCY MANAGEMENT PLAN - Cópia	Contractor
			Operations Resource Efficiency Management Plan	CFB
			Soil Management Plan	Contractor
			PI-MP-009-OECL_WATER MANAGEMENT PLAN PI-PL-061-OECLS_WATER MANAGEMENT PLAN_EN Water Abstraction Procedure (groundwater and/or surface water)	Contractor
		Pollution Prevention	PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN	Contractor
			PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN PI-MP-007-OECL_WASTE AND HAZARDOUS MATERIALS MANAGEMENT PLAN PI-MP-010-OECL_WASTE WATER AND DRAINAGE MANAGEMENT PLAN PI-PL-092-OECLS_WASTE WATER MANAGEMENT PLAN_EN PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN	Contractor
			PI-PL-106-OECLS_AIR QUALITY MANAGEMENT PLAN_EN PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN • PI-FR 10402 OECLS - AIR QUALITY MONITORING_EN • PI-FR 10403 OECLS - NOISE MONITORING en • PI-FR 10404 OECLS - VIBRATION MONITORING en (2)	Contractor
			Operations Pollution Prevention Plan	CFB
			Operations Waste and Wastewater Management Plan	CFB
			PI-PL-105-OECLS_CHEMICALS MANAGEMENT PLAN_EN	Contractor

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
			PI-PL-001 Emergency Preparedness & Response Procedure with • OECLS-ENG-DE-EST-006-00 LAYOUT PLANO DE EMERGÊNCIA (Emergency layout plan for camps)	
			• Operations Spill Prevention and Emergency Response Plan (A draft plan is provided in Appendix 17.3) • Operations Contaminated Land Management Procedure	CFB
4	PS 4 and PS 7	Community health	PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN	Contractor
			Construction phase Communicable Diseases Management Plan	Contractor
			Operations Communicable Diseases Management Plan	CFB
		Community Safety	PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN	Contractor
			Operations Community Safety Management Plan and associated sub-procedures	CFB
			Operations Hazardous Materials Management and Safety Plan	CFB
5	PS 5	Land	Resettlement Action Plan (RAP). The RAP and LRP will be undertaken during pre-construction phase after demining and detailed design	MINTRANS & CFB
		Livelihoods	Livelihood Restoration Plan (LRP). The RAP and LRP will be undertaken during pre-construction phase after demining and detailed design	MINTRANS & CFB
6	PS 6	Biodiversity	PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN	Contractor (during construction)
			Vegetation and Topsoil Removal Procedure Biodiversity Management Plan (including ongoing habitat inventory of losses to Natural Habitat/Modified Habitat of conservation/ecosystem service value to reduce losses through feasible alternatives)	Contractor (during construction)

Sn	Performance Standard Reference	Topic	Management Plans and Procedures	Responsible
			PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN	Contractor (during construction)
			Biodiversity Management Plan and Operations Invasive species management plan	CFB
7	PS 7	Indigenous Peoples	Indigenous Peoples Plan Free, Prior, and Informed Consent (FPIC) Procedure	n/a
8	PS 8 and PS 1	Archaeological and cultural Heritage	PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN • PI-FR 108 01 OECLS NAIC CHANCE FINDS FORM	Contractor

4.9 Training

One of the most important mechanisms for the enhancement of the project's environmental and social performance will be the continued implementation of a training programme for all project personnel including all subcontractors and third parties.

A procedure for training has been developed for the construction phase by the Contractor. It provides a framework for responsibilities with respect to training; assigns the respective sustainability manager to identify (at a high-level) environmental and social training needs; and the process of maintaining a record of training.

The existing training procedure will be updated to incorporate the following main environmental and social training components:

- environmental and social policy of the project
- environmental and social requirements of the project and how these will be implemented and monitored on site
- contents and relevant requirements of the project actions contained within the ESMP and applicable environmental and social procedures
- environmental and social sensitivities of the project footprint and surroundings
- procedures to be followed in the event of non-compliance with the environmental and social requirements
- process for addressing unforeseen environmental and social incidents; and
- responsibilities with respect to environmental and social issues applicable to their roles.

Accordingly, training should be provided at each stage of the project, from preconstruction through to construction and (to a lesser degree) operation, and should include:

- induction training for all staff including modules on health and safety, environmental awareness, accommodation rules, worker code of conduct, stakeholder engagement, grievance mechanisms and cultural heritage awareness
- training on the EHS legal requirements and EHS compliance commitments of the Luena-Saurimo project. It is critical that all staff on the Luena-Saurimo project understand the laws and regulations and rules the Luena-Saurimo project has committed to, and that staff understand the consequences of breaking these rules
- toolbox training for specific topics and tasks
- training for individuals involved in tasks with specific responsibilities.
- Refresher training programmes will also need to be implemented to ensure continual improvement and awareness for all project personnel.

4.10 Continued stakeholder engagement

The project has a Stakeholder Engagement Plan that was developed as part of the ESIA up to disclosure of the ESIA findings (refer Appendix 06 of the ESIA Report – Volume 2). In addition, the Contractor has their Stakeholder Engagement Plan (PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN) that will be updated as necessary during the construction phase. The operator (CFB) MINTRANS is to develop their own Stakeholder Engagement Plan for operations.

The objectives of ongoing stakeholder engagement include to:

- ensure understanding and awareness by facilitating an open, culturally appropriate, and inclusive approach to engagement that provides timely and accurate information in an accessible and transparent way to all stakeholders, regardless of their status
- manage expectations and concerns by providing a mechanism, which not only provides stakeholders an opportunity to freely provide comment and feedback but also allows the project to respond to this feedback, thereby addressing concerns
- manage risks through building sustainable relationships. Stakeholder risks are widely recognised to be one of the key challenges facing large-scale development projects such as the Luena-Saurimo project. Communities expect more open and transparent dialogue and longer-term social commitments from companies. Engagement will allow the Luena-Saurimo project to understand stakeholder interests and issues and work with stakeholders to find mutually acceptable ways to achieve or address these
- create value where engagement allows for partnerships to be developed for the mutual benefit of the project and the stakeholders. This includes but is not restricted to corporate social investment activities. This relates also to seeking mutual benefit through design and operations by considering stakeholders and seeking their benefit in all the Luena-Saurimo project activities.

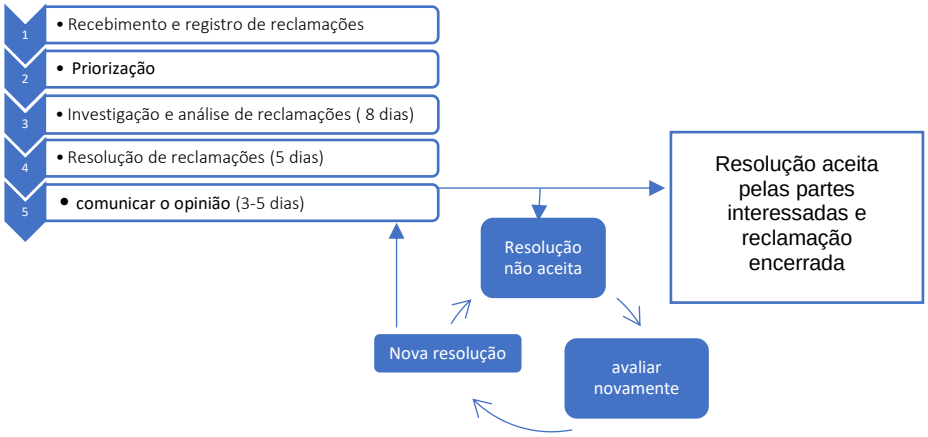
4.11 Grievance management

The main objective of establishing a Grievance Redress Mechanism (GRM) is to implement a systematized process (identification, tracking and redress) to manage grievances from stakeholders that could potentially arise from the Project in an efficient, methodical and transparent manner.

GRM intends to provide benefits to both the Project and stakeholders by following specific objectives:

- to create effective communication between the project and affected parties
- to build up productive relationship among all stakeholders including affected parties
- provide access to affected parties to provide comments and suggestions on the Project decisions that might be adversely affected to them
- mitigates or prevents adverse impacts of the project on communities and produces appropriate corrective or preventive action
- to ensure and promote trust in stakeholder engagement activities and procedures
- to support the efficient identification of arising issues as well as facilitating corrective actions and pre-emptive engagement.

The mechanisms for grievance management and redressed mechanisms are to be “transparent and accessible,” therefore, Stakeholders should be available at the appropriate moment in the process. The grievance procedure will be simple, administered in the first instance at the local level to facilitate access, flexibility and open to evidence, considering the need for accelerated, and fair resolution of their grievances. A schematic process for dealing with grievances and complaints is following presented:



Further details of the GRM are available as part of the Stakeholder Engagement Plan in the ESIA Appendix 06 of the ESIA Report (Volume 2).

5 ROLES AND RESPONSIBILITIES

5.1 Proponent and infrastructure owner: MINTRANS

MINTRANS will have ultimate responsibility for ensuring compliance with the ESMP (as part of the Lenders' loan agreement, as well as the environmental licence). The proponent is to appoint a person responsible for approving the ESMP and with a legal/fiduciary mandate for ensuring compliance with the ESMP.

When the MINTRANS's ESMS is finalised, the ESMP is to be updated with the operator's organogram. The organogram is to demonstrate functions/positions that will manage E&S aspects of the project, human resources and supply chain management.

5.2 Supervising Engineer

The Supervising Engineer is MINTRANS's representative in the Project location during construction. They are responsible for ensuring the ESMP is being implemented and reported against. They are to monitor the performance of the Contractor in meeting the agreed standards and thresholds and communicate on any adaptive/corrective measures to maintain performance.

The supervising engineer shall have functions/positions responsible for E&S aspects and oversee the management procedures and management plans indicated in Section 4.8 above.

5.3 Contractor

The 0.PI-PR-001-OECLS-R02- INTEGRATED SUSTAINABILITY PROGRAM MANUAL defines the responsibilities of the Director of the Contract as follows:

- assuming responsibility for the effectiveness of this System, considering its predicted, verified and characterized results in the Critical Analysis of the Sustainability Management System
- assuming overall responsibility and accountability for the prevention of work-related injuries and health problems, as well as for the provision of safe and healthy workplaces and activities
- the establishment of Sustainability Commitments, considering their compatibility with the strategic guidelines and their context
- ensuring the Integrated Sustainability Program so that they are communicated, understood, and applied to the Luena-Saurimo Railway Project
- promoting awareness with a Process-based approach and risk mindset
- ensuring the integration of the requirements of this System in the Business Processes
- promoting the resources necessary for the practice of this System
- communicating the importance of a simple and effective sustainability management and according to the requirements of this System
- engaging, directing, and supporting the people involved, to contribute to the effectiveness of this System
- the communication to these persons, of the importance of meeting the requirements of the Stakeholders and the applicable legal requirements
- promoting continuous improvement
- applying other relevant management functions, to demonstrate their leadership, since it applies to their areas of responsibility
- developing, leading and promoting a culture in the Luena-Saurimo Railway Project that supports the intended results in the Integrated Sustainability Program
- protecting workers from reprisals when reporting incidents, hazards, risks, and opportunities
- ensuring that the Luena-Saurimo Railway Project establishes and implements a process of consultation and participation of work
- supporting the establishment and functioning of the Sustainability committees and
- promote the continuous improvement of this system.

Contractor Senior Management will appoint specific management staff (Engineering, Administration, Commercial, Production, Sustainability and Equipment) who, irrespective of other responsibilities, will have defined roles, responsibilities, and authority for:

- ensuring the operationalization of the Integrated Sustainability Program, demonstrating the ESMS is established, implemented, and maintained
- reporting to the Director of Contracts on the performance of the ESMS for review including recommendations for improvement
- ensuring the allocation of essential resources (financial, material and human) for the implementation and maintenance of the Integrated Sustainability Program
- ensuring the implementation, application, maintenance, and critical analysis of the results of the Integrated Sustainability Program

- ensures that the Program achieves the intended results
- approves the Responsibility Matrix of the Integrated Sustainability Program
- promotes continuous improvement
- the Sustainability in the Luena-Saurimo Railway Project.

5.3.1 Construction team

The organogram below presents the contractor's team for the construction phase of the Luena Saurimo Railway. The Sustainability Manager will oversee the medical, social and environmental requirements for the project. The Manager will attend Project Staff Meetings to brief the staff on E&S issues to enable the Engineering, Production and Equipment Managers to implement the requirements of the Construction ESMP and it's subplans. The Contractor's Sustainability Manager will be primary link between the Sustainability team and the engineering, production and equipment teams in conducting risk assessments for planned works and new construction zones. Further roles and responsibilities of the E&S team is included in Section 5.4 below.

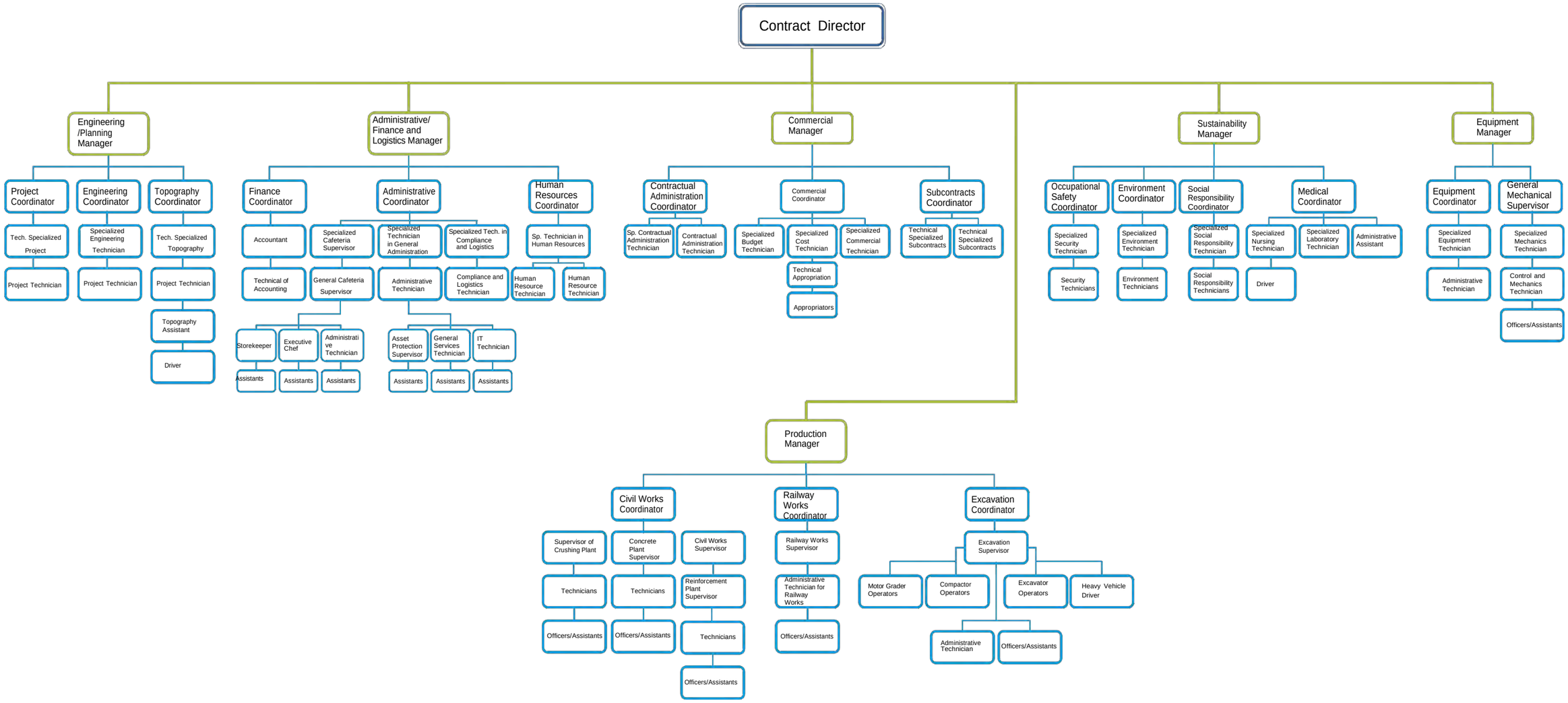


Figure 5-1: OEC Organogram

5.4 Health, Safety, Security, Social and Environmental team

5.4.1 Environmental and Social/Sustainability Manager

The project is to employ an Environmental and Social (E&S)/Sustainability Manager for construction and operation phases who will have the responsibility to:

- developing and executing E&S plans in the workplace according to legal and Lender guidelines
- ensuring that the E&S plan and procedures in the project's ESMS are updated
- establish the grievance categorisation matrix (that describes the nature, magnitude/severity of grievance) and actions to be taken for each grievance category
- evaluating practices, procedures and facilities to assess risk and adherence to the law
- develop and agree environmental and social workplans, timelines and budgets with the construction manager
- ensure robust processes are in place to measure and report performance against E&S plans
- ensure that all E&S accidents and incidents are investigated appropriately and reported and actions are taken to prevent recurrence
- ensure effective consultation and communication on E&S matters between the H&S teams and construction foreman (foremen)
- ensure E&S policies, procedures, safe systems of work, method statements and risk assessments are communicated and implemented
- communicate E&S performance versus plan, monitoring reports and audit reports with construction manager, Project owner and Lender representative as applicable
- attend all initial meetings with the Project Staff and Subcontractor representatives to clearly define their role within the confines of the Project E&S Program
- establish and conduct regular (weekly) meetings with E&S teams and monthly/quarterly meetings with subcontractor representatives and issue minutes of meeting and interface with Project Staff and each Subcontractor Safety Representatives relating to E&S to ensure proper compliance
- attend Project Staff Meetings to brief the staff on E&S issues on the project
- record, notify and prepare written report of any violations or unsafe practices to Subcontractors for immediate correction actions.

5.4.2 Health and Safety Manager/coordinator

The project is to employ a Health and Safety (H&S) Manager/coordinator for construction and operation phases who will have the responsibility to:

- developing and executing health and safety plans in the workplace according to legal and Lender guidelines
- preparing and enforcing policies to establish a culture of health and safety

- evaluating practices, procedures and facilities to assess risk and adherence to the law
- develop and agree on H&S workplans, timelines and budgets.
- ensure robust processes are in place to measure and report performance against H&S plans
- ensure that all H&S accidents and incidents are investigated appropriately and reported and actions are taken to prevent recurrence
- ensure effective consultation and communication on H&S matters
- ensure H&S policies, procedures, safe systems of work, method statements and risk assessments are communicated and implemented
- communicate H&S performance, accident rates, KPI's
- attend all initial meetings with the Project Staff and Subcontractor representatives to clearly define their role within the confines of the Project E&S Program
- establish and conduct regular (weekly) meetings with E&S teams and monthly/quarterly meetings with subcontractor representatives and issue minutes of meeting and interface with Project Staff and each Subcontractor Safety Representatives relating to H&S to ensure proper compliance
- ensure regular (daily) jobsite and work area inspections and safety checklist are conducted and weekly jobsite inspection reporting noting safety violations and corrective actions
- record, notify and prepare written report of any violations or unsafe practices to Subcontractors for immediate correction actions
- attend Project Staff Meetings to brief the staff on safety issues on the project and coming from the company and to keep informed of the progress of the job.

5.4.3 Environmental Officers

The project is to employ Environmental Officers for construction and operation phases who will have the responsibility to:

- support the E&S Manager in preparing environmental plans and procedures and keeping them updated
- ensure the E&S management plans and procedures are implemented by both direct employees and sub-contractors
- ensure environmental monitoring is implemented and maintaining respective monitoring reports
- plan for the collection of respective samples and measurements at registered laboratories
- supervise the operation of the waste segregation and storage areas, the water treatment plant(s) and waste treatment plant(s)
- provide data to E&S Manager for monthly environmental reporting
- implement necessary interventions on site by conducting field inspections, reporting deficiencies, monitoring the implementation of corrective actions in the field
- conduct E&S risk assessments, making suggestions about the measures to be taken, and monitoring agreed actions for implementation
- ensure that necessary environmental permits are obtained
- support the E&S Manager planning and managing environmental audits

- implementing various organizations E&S awareness and training sessions.

5.4.4 Social Officer(s)

The project is to employ Social Officers for construction and operation phases who will have the responsibility to:

- support the E&S Manager in preparing E&S plans and procedures and keeping them updated
- ensure the E&S management plans and procedures are implemented by both direct employees and sub-contractors
- ensure monitoring aspects of community health safety and security is implemented and maintaining respective monitoring reports
- ensure that the project's grievance mechanism is implemented and grievances are recorded, communicated and closed in accordance with the procedure
- supervise the implementation of the Project's Stakeholder Engagement Plan with the Community Liaison Officers
- participate in E&S risk assessments, making suggestions about the measures to be taken, and monitoring agreed actions for implementation
- support in obtaining information on changing socio-economic information on the communities within the project AOI and providing information to the E&S manager in reviewing and updating the E&S management plans
- provide data to E&S Manager for monthly environmental reporting
- support the Compliance officer in liaising with respective community leaders and municipal authorities in obtaining necessary permissions/permits
- support the E&S Manager planning and managing environmental audits
- implementing various organisations E&S awareness and training sessions.

5.4.5 H&S officer(s)

The Health and Safety officer(s) will oversee all health and safety aspects of the project to ensure continuing compliance with the ESMS. Responsibilities include:

- providing overall co-ordination of the ESMS on site
- ensuring the Risk Register is up to date
- ensure that significant Health and Safety risks are identified, correctly managed, and communicated to all staff
- ensuring the promotion of Health and safety awareness of all who work for and on behalf of the contractor
- ensuring that all who work for and on behalf of the project are aware of the relevant legal obligations and other requirements the site is required to comply with for all activities and operations conducted
- assisting with the implementation of programs required to meet objectives and targets
- ensuring that all relevant registers, records, and other documentation are kept up to date
- ensuring that all who work for and on behalf of the Project are aware of all procedures
- liaising with the E&S Manager and H&S Manager
- ensuring incidents and complaints are suitably addressed

- identifying applicable environmental training requirements for all staff and ensuring that training is undertaken
- review monthly stakeholder engagement reports to assess issues related to the environment, health, and safety performance
- inform the E&S manager of any activity or change that will impact stakeholders.

5.4.6 Community/Stakeholder Liaison Officer(s)

The Community Liaison Officer will be responsible for Community and Local government engagement activities. Responsibilities include to:

- proactively maintain regular contact with affected communities through regular community visits (at least monthly)
- produce daily and monthly stakeholder engagement reports
- ensure communication with vulnerable groups by meeting women, youth and as well as community, and community leaders
- conduct courtesy visits to project stakeholders (at least monthly) to monitor opinions and provide updates on Project activities
- report grievances to the Social Officer(s).

5.4.7 Inspectors – Environmental and H&S

The project will employ inspectors who will be responsible to:

- inspect equipment, tools, and working conditions to ensure safety of workers engaged in construction, operations and maintenance works
- observe crews at work and report incidences and non-conformities
- examine conditions of construction zones and recommend any additional safety measures for workers
- instruct workers in use of safety equipment and safe work methods as necessary
- investigate accidents to determine causes and devises preventive measures.

5.4.8 Environmental and Social compliance officer

The Project owner (MINTRANS) is ultimately responsible for overseeing compliance of the project to both national legislation and Lender requirements. The proponent and contractor are to designate compliance monitoring to designated personnel who will be responsible for:

- identifying any amendments to the national laws and preparing briefs of new or amended law in relation to the project
- monitoring the Project's Permit Register to ensure the renewal of relevant permits are submitted to the correct authority in a timely manner
- collaborate with the social and environmental officers to ensure that permits are obtained
- work with the E&S manager and H&S Manager on Lender compliance.

5.5 Administration and Commercial Departments

The Project owner and the Contractor are to ensure that their Human Resources, Commercial and Administration teams have access to and understand the Construction and Operational

ESMP requirements and all the respective sub-plans developed for the project. The HR team is responsible for:

- developing the HR and Recruitment Policies in line with IFC, ILO and GIIP practices on Human Rights
- developing the Project's code of conduct and disciplinary procedures
- conducting induction training and refresher training on all E&S and H&S aspects in collaboration with the E&S Manager
- developing and implement a workers grievance mechanism ensuring that recorded grievances are closed within the indicated timeframe.

The Commercial and Administration team is responsible for:

- ensuring that all subcontractors have received the respective construction and operational ESMP and its sub-plans
- ensuring that subcontractors have participated in the respective induction and refresher trainings organised by HR
- regularly meeting with the E&S manager (monthly/quarterly) to share progress on their implementation of the respective E&S requirements
- camp management including accommodation
- conducting inspections/internal audits of the camps with the environmental and H&S officers
- security personnel receive induction and refresher training that includes (not limited to) the HR policies, code of conduct, the Community Health Safety and Security Plan and any other E&S management plan as agreed with the E&S manager.

5.5.1 Subcontractors

If the Project will engage sub-contractors, each subcontracted entity are responsible for environmental and social matters as included in their contracts and each subcontractor shall appoint a designated employee from his organization to act on his behalf regarding environmental and social subjects. Throughout the duration of the contract, the subcontractor shall:

- attend required induction and refresher trainings in relation to the HR policies and the Construction and Operational ESMP
- follow the requirements of this ESMP, the Construction and Operational ESMP and its subsequent operating procedures
- report any potential environmental incidents or complaints to the site representative including spilt oil, excess waste, excessive dust generation etc.

6 ENVIRONMENTAL AND SOCIAL MITIGATION MEASURES

6.1 Mitigation measures for construction and operation phase

6.1.1 Socio-economic mitigation measures

Mitigation measures for socio-economic impacts are presented in Appendix 17.4.1

6.1.2 Occupational health and Community health and safety

Mitigation measures for Occupational and community health and safety impacts are presented in Appendix 17.4.2

6.1.3 Cultural Heritage mitigation measures

Mitigation measures for cultural heritage are presented in Appendix 17.4.3

6.1.4 Air Quality mitigations measures

Mitigation measures for air quality are presented in Appendix 17.4.4

6.1.5 Noise and Vibration mitigation measures

Mitigation measures for noise and vibration are presented in Appendix 17.4.5

6.1.6 Soils and Landscape mitigation measures

Mitigation measures for soils and landscape are presented in Appendix 17.4.6

6.1.7 Hydrology and geohydrology mitigation measures

Mitigation measures for hydrology and geohydrology are presented in Appendix 17.4.7

6.1.8 Biodiversity mitigation measures

Mitigation measures for biodiversity are presented in Appendix 17.4.8

6.1.9 Ecosystem services mitigation measures

Mitigation measures for ecosystem services are presented in Appendix 17.4.9

6.1.10 Unplanned Events mitigation measures

Mitigation measures for unplanned events are presented in Appendix 17.4.10

6.1.11 Cumulative Impacts mitigation measures

Mitigation measures for Cumulative Impacts are presented in Appendix 17.4.11

6.1.12 GHG and CCRA mitigation measures

Mitigation measures for GHG and CCRA are presented in Appendix 17.4.12

6.1.13 Human right risks mitigation measures

Mitigation measures for human rights risks are presented in Appendix 17.4.13

7 ENVIRONMENTAL AND SOCIAL MONITORING COMMITMENTS

An environmental and social monitoring plan describes the monitoring activities to ensure that adverse environmental and social impacts are minimised while the positive impacts are enhanced during the project implementation. The plan describes how, when and where the monitoring activities will be undertaken and who will carry them out. It entails compliance for carrying out the plan, and outlines mechanisms for checking environmental performance during the operation life of the project.

7.1 Purpose of the monitoring plan

The purpose of environmental and social monitoring is to measure the environmental effects of the project (quantitatively) whenever possible. The environmental and social monitoring program will operate through the preconstruction, construction, and operation phases. It will consist of several activities, each with a specific purpose, key indicators, and significant criteria.

Also, the purpose is to ensure that management measures, identified and described in the environmental and social procedures, are implemented and are effective at achieving an acceptable level of compliance with the Luena-Saurimo project ESMP and ESMS. The monitoring program shall include the entities identified as having the primary responsibility for the relevant measures; the timing and frequency that the monitoring measure will need to be undertaken; and the performance indicator(s) (the performance measurement used to measure / bench the level of success for a particular monitoring measure) of that particular monitoring measure.

There are four types of monitoring that are also relevant to this ESIA:

- baseline monitoring: the measurement of environmental parameters during a pre project period and operation period to determine the nature and ranges of natural variations and where possible establish the process of change
- impact/effect monitoring: involves the measurement of parameters (performance indicators) during construction and operation Phase in order to detect and quantify environmental and social change, which may have occurred as a result of the project. This monitoring provides experience for future projects and lessons that can be used to improve methods and techniques
- compliance monitoring: takes the form of periodic sampling and continuous measurement of levels of compliance with standards and thresholds e.g. for waste discharge, air pollution; and
- mitigation monitoring: aims to determine the suitability and effectiveness of mitigation programs designed to diminish or compensate for adverse effects of the project.

To ensure that mitigation measures are properly done, monitoring is essential. The proposed monitoring commitment register for Luena-Saurimo Railway is presented in the ESIA Report Volume 2 - Appendix 17. The Monitoring Commitment Registers are provided in the ESMP Report as well as Appendix 17.5. The spreadsheet details the

parameters to be monitored, frequency, monitoring sites/sampling area, measurement unit/method, target level/standard and responsibility for monitoring.

The following key aspects to be monitored are included in the commitment register:

- biodiversity and ecosystem services
- social aspects
- cultural heritage
- occupational and community health and safety
- surface water and hydrology
- groundwater
- air quality
- noise and vibrations
- landscape and soils
- potable water
- groundwater quality.

Contractor work sites will be monitored during construction and provide the project proponent and lenders monitoring reports on agreed reporting timeframes (recommended timeframes indicated in section 4.6 above). The Ministry for Transport and/or Environment may undertake independent monitoring of selected parameters to verify the results of the contractor and to audit the implementation of environmental mitigation measures contained in the ESMP and associated procedures for the project. A Draft Monitoring register has been prepared as Appendix 17.6. This is to be adapted by the Contractor in the C-ESMP and by CFB for operations.

8 APPENDICES

The detailed appendices supporting this ESMP are included in the appendices section of the ESIA report. The appendices are organised as follows:

8.1 Appendix 17.1: Waste Management Plan

8.2 Appendix 17.2: OEC Sustainability Policy & Commitment

8.3 Appendix 17.3: Emergency Response Plan

8.4 Appendix 17.4: Impact Mitigation Tables

8.5 Appendix 17.5 Monitoring Commitments

8.6 Appendix 17.6: Monitoring Register

Please refer to the respective sections in the ESIA appendices for the full content of these documents.

For the Luena-Saurimo Railway Construction Project, an estimated daily water consumption of 3 liters per person has been calculated, based on an average foreseen maximum workforce of 2000 employees. This projection results in a total estimated potable water consumption of 6,000 liters per day throughout the project execution phase.

Wastewater

During construction activities, wastewater is expected to be generated through daily activities, namely:

- Washing of Equipment, such as concrete mixers, trucks and others and vehicles
- Concrete mixture
- Sanitary facilities
- Wash basins
- Refectory.

To manage the generated wastewater, septic tanks with a capacity of 132,000 m^3 will be implemented. Furthermore, the project foresees wastewater collection and transport to a Wastewater Treatment Plant (WWTP) for additional treatment prior to its discharge into an authorized location. The authorization is to be provided by the Provincial government or municipalities.

Waste

During the construction phase, the primary sources of waste will include:

- **Construction waste:** This includes concrete, bricks, metal, wood, and other materials used in building the railway, stations and adjacent infrastructures essential to project implementation
- **Excavated soil:** Large volumes of soil will be excavated during the preparation of the railway route

- **Packaging materials:** Packaging of construction materials and equipment, such as plastics, cardboard, and wood pallets
- **Hazardous waste:** Potentially hazardous waste such as used oils, solvents, and chemical products (such as anticorrosive)
- **Urban Waste:** administrative activities and accommodations, such as paper/cardboard, plastic, and organic waste.

Operational Phase: Once operational, the railway line will generate waste through maintenance activities and day-to-day operations. Foreseen waste types include:

- **Routine maintenance waste:** This includes used components, used oils, and lubricants from machinery and equipment maintenance
- **Passenger and operational waste:** Waste generated from passenger services, such as food packaging, paper, and general urban waste
- **Track maintenance waste:** Materials resulting from track repairs and replacements, including metal, concrete, and ballast.

Electrical Energy

Energy consumption and efficiency in civil construction projects are significantly influenced by the scale and specificity of the project, as well as the equipment utilized during the construction phase. For the Luena-Saurimo Railway construction project, the energy supply for the construction sites will be sourced from the public electrical grid. Electricity for the construction phase will be provided from the National Grid for the stations and camps, including both fixed and mobile camps. The estimated electrical consumption for the construction phase of the project—encompassing the construction of tracks, stations, associated infrastructure, landscaping, earthworks, and drainage—is projected to be 137,200,350 kWh. Additionally, the total estimated amount of fuel required is 51,596,762 liters of diesel.

The design includes measures to ensure proper containment and to mitigate potential environmental spill risks associated with fuel storage, thereby adhering to environmental safety standards and promoting sustainability.

Atmospheric and Noise Emissions

Atmospheric emissions during the construction activities will result from the operation of light and heavy vehicles, machinery, and equipment, as well as the combustion of fossil fuels in generator sets and excavation activities. These operations are likely to release air pollutants, including carbon dioxide, nitrogen oxides, and particulate matter (PM2.5 and PM10). Additionally, noise emissions may arise from various on-site activities, including material loading and unloading, vehicle circulation and maneuvering, generator set operation, and the use of compaction machines. To reduce noise pollution, it is recommended to retain vegetation around the camps and where possible near communities to serve as a natural barrier on noise.

overcome these risks and avoid accidents, the following is recommended:

- For fuel storage locations, they must be places with easy air circulation and with adequate and sufficient means of 1st intervention
- Thorough completion of the training cycle and drill exercises for all Project staff
- Enforce the mandatory use of Personal Protective Equipment in work areas (construction sites and construction fronts)
- The Emergency Management Team, including the intervention teams, must be presented to all stakeholders in the Project
- The preparation of periodic reports and records to verify the operation of rapid intervention means and equipment
- Periodically (annually, for example) the fulfilment of the Plan and, if necessary, adjust it to the current context.

In short, it is expected that the Plan presented will be feasible and will be able to respond to possible emergencies that may arise throughout the entire life cycle of the Project.

OEC Engineering and Construction

Environmental and Social Impact Assessment for the Proposed Luena-Saurimo Railway Line (260 km), Angola

ESIA Report – Volume 1 (Main Report)

2720234-R02-04

JANUARY 2026

RSK GENERAL NOTES

Project No.: 2720234-R02-04

Title: ESIA for proposed development of Luena-Saurimo Railway Line (260km), Angola

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Date:	31 January 2026	Date:	

RGM Environmental (Pty) Ltd (RGM) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RGM. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RGM for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RGM (Pty) Ltd.

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
AAQS	Ambient Air Quality Standards
ABP	Angola Black Panther Group
ACHPR	African Charter on Human and Peoples' Rights
ADESCA	Associação for the Development of Angolan Civil Society
AERMOD	Atmospheric Dispersion Modelling
AHWT	Angolan Highlands Water Tower
AIQM	Institute of Air Quality Management
ANAM	National Mine Action Agency
ANR	National Waste Agency
ANTT	National Land Transport Agency
AOI	Area of Influence
AQIA	Air Quality Impact Assessments
AQMS	Air Quality Monitoring System
AZE	Alliance for Zero Extinction
BAP	Biodiversity Action Plan
BCC	Behaviour Change Communication
BID	Background Information Document
BOD	Biological Oxygen Demand
CAPDC	Community Development Support and Promotion Canter
CAT	Cruel, Inhuman or Degrading Treatment of Punishment
CB	Congo Basin
CBD	Convention on Biological Diversity
CCKP	Climate Change Knowledge Portal
CCON	Coordination Centres
CCRA	Climate Change Risk Assessment
CDW	Construction and Demolition Waste
CFB	Caminho de Ferro de Benguela E.P (Benguela´s Railway)
CFL	Caminho de Ferro de Luanda E.P (Luanda Railway line)
CFM	Moçâmedes Railway (Moçâmedes -Menongue.)

Abbreviation	Definition
CH	Critical Habitat
CHA	Critical Habitat Assessment
CHSS	Community, Health, Safety and Security
CIA	Cumulative Impact Assessment
CICA	Council Of Christian Churches of Angola
CITES	Convention On International Trade in Endangered Species of Wild Fauna and Flora
CLO	Community Liaison Officer
CMS	Convention of Migratory Species
CND	Centro Nacional De Desminagem
CO	Carbon Monoxide
CR	Critically Endangered
CRC	Convention on the Rights of The Child
CRPD	Convention on the Rights of Persons with Disabilities
CTC	Traffic Control
DMP	Dust Management Plan
DO	Dissolved Oxygen
DRC	Democratic Republic of The Congo
EBA	Endemic Bird Areas
EBRD	European Bank for Reconstruction and Development
EFL	Environmental Framework Law
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMP	Environmental Monitoring Plan
EN	Endangered
ENIA	Environmental Noise Impact Assessment
EOO	Extent Of Occurrence
EP4	Equator Principle IV
EPDA	Environmental Protection and Development Authority
EPRP	Emergency Preparedness and Response Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan

Abbreviation	Definition
ESMS	Environmental and Social Management System
ESOMAR	World Association for Market, Social and Opinion Researchers
FEED	Front-End Engineering Design
FGDs	Focus Group Discussions
FPIC	Free, Prior, and Informed Consent
GBVH	Gender Based Violence and Harassment
GDI	Gender Development Index
GE	General Eléctric
GHG	Greenhouse Gases
GII	Gender Inequality Index
GIIP	Good International Industry Practice
GIS	Geographic Information System
GNI	Gross National Income
GoA	Government of Angola
GPH	Good Practice Handbook
GPS	Global Positioning System
GRM	Grievance Redress Mechanism
GSM	Gravel Sand & Mud
H&S	Health and Safety
HDI	Human Development Index
HRIA	Human Rights Impact Assessment
HRRA	Human Rights Risk Assessment
HSS	Health, Safety and Security
I&APs	Interested and Affected Parties
IAQM	Air Quality Management
IBA	Important Birds Areas
IBAT	Integrated Biodiversity Assessment Tool
ICCPR	International Covenant on Civil and Political Rights
ICESCR	International Covenant on Economic Social and Cultural Rights
IDF	Institute for Forest Development
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation

Abbreviation	Definition
IHAS	Integrated Habitat Assessment System
IHDI	Inequality-Adjusted Human Development Index
IHIA	Intermediate Habitat Integrity Assessment
IIAG	Ibrahim Index of African Governance
ILO	International Labour Organization's
INAD	National Demining Institute
INBC	National Institute for Biodiversity and Conservation
INPC	National Institute of Cultural Heritage
INRH	The National Institute of Water Resources
IPs	Indigenous Peoples
IRCOP	Regulatory Institute for Construction and Public Works
ITCZ	Inter-Tropical Convergence Zone
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
KBAs	Key Biodiversity Areas
KIIs	Key Informant Interviews
km	Kilometres
LAS	Lender Appraisal Standards
LCTTFA	Lobito Corridor Transit Transport Facilitation Agency
LOO	Likelihood of Occurrence
LRP	Livelihood Restoration Plan
MAPTSS	Ministry of Public Administration, Labor and Social Security
MAS	Maintenance Assistance System
MAT	Ministry of Territorial Administration and State Reform
MINAGRIF	Ministry of Agriculture and Forestry
MINAMB	Ministry of Environment
MINCULTUR	Ministry of Culture and Tourism
MINDENACVP	Ministry of National Defense, Former Combatants and Veterans of The Homeland
MINEA	Ministry of Energy and Water
MINOPOT	Ministry of Public Works and Spatial Planning
MINTRANS	Ministry of Transport
MPI	Multidimensional Poverty Index

Abbreviation	Definition
MPI	Multidimensional Poverty Index
NAPA	National Adaptation Programme of Action
NASA	National Aeronautics and Space Administration
NBSAP	National Strategy and Action Plan for Biodiversity
NCC	National Climate Commitments
NDC	National Determined Contribution
NDVI	Normalized Difference Vegetation Index
NGLL	Multidimensional Poverty Index
NGLL	New General Labor Law
NGOs	Non-Government Organisations
NIR	Near-Infrared
NOx	Nitrogen Oxides
OADEC	Community Development Relief Organization
OECD	Organization For Economic Co-Operation and Development
OHS	Occupational Health and Safety
OMA	Angolan Women's Organisation
ORP	Oxidation Reduction Potential
PACs	Project Affected Communities
PAHs	Project Affected Households
PAOI	Project Area Of Interest
PDNSTIR	National Master Plan for The Transport and Road Infrastructure Sector
PESGRU	Strategic Plan for Urban Waste Management
PID	Project Information Document
PIMM	Integrated Municipality Intervention Plan
PLANAGRÃO	National Promotion Plan for Grain Production
PLANCs	Permits, Licences, Authorisations/Approvals, Notifications and Consents
PM	Particulate Matter
PNGA	Programa Nacional De Gestão Ambiental
POPs	Persistent Organic Pollutants
PPV	Peak Particle Velocity
PS	Performance Standard

Abbreviation	Definition
RAMS	Reliability, Availability, Maintainability, And Safety
RAP	Resettlement Action Plan
RICS	Royal Institute of Chartered Surveyors
RNT	National Electricity Transport Network Public Company (–E.P)
RoW	Right of Way
RPF	Resettlement Policy Framework
RSGs	Reference Soil Groups
SADC	Southern African Development Community
SAMRA	Southern African Marketing Research Association
SASS	South African Scoring System
SCC	Species of Conservation Concern
SCP	Signalling Concentration Post
SCS	Signalling Concentration Station
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SIA	Social Impact Assessment
SIC	Stones-In-Current
SMEs	Small And Medium Enterprises
SO_2	Sulphur dioxide
SOPs	Standard Operating Procedures
SPCB	Service and Civil Protection and Fire Service
SR	Scoping Report
SRTM DEM	Shuttle Radar Topography Mission Digital Elevation Model
STIs	Sexually Transmitted Infections
SWIR	Short-Wave Infrared
TCFD	Taskforce For Climate Related Financial Disclosure
tCO2e	Tonnes Carbon Dioxide Equivalent
TDS	Total Dissolved Solids
TMU	Terrain Morphological Unit
ToR	Terms of Reference
TWQR	Target Water Quality Range

Abbreviation	Definition
UNCCD	United Nations Convention on Combatting Drought and Desertification
UNDP	United Nations Development Programme
UNEP-WCMC	United Nations Environment World Conservation Monitoring Centre
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded Ordnance
VC	Valued Components
VECs	Valuable Environmental Components
VG	Vegetation
VU	Vulnerable
WBG	World Bank Group
WHO	World Health Organisation
WTP	Water Treatment Plant
ZB	Zambezi Basin

EXECUTIVE SUMMARY

This Executive Summary provides a high-level overview of the project and highlights the key findings, potential impacts and management measures.

Background and rationale of the Project

Angola's Ministry of Transport plans to modernise national transport by building a 260 km railway between Luena and Saurimo, linking the Benguela Railway with the future Luanda Railway and improving passenger and goods movement across Moxico and Lunda Sul Provinces (see Figure 1-1). As the railway the Project seeks international funding, it follows Angolan regulations and international standards mainly the IFC Performance Standards Equator Principles and World Bank EHS Guidelines. This Project represents a significant infrastructure investment to support Angola's National Transport and Road Infrastructure Master Plan, aligning with the government's goals for sustainable development and economic diversification, as we as benefit that include job creation, skills development, economic growth, and improved access between towns for local communities.

The Ministry of Transport (MINTRANS) is the Project proponent, with OECI S.A./Bento Pedroso Construções S.A. as design-build contractors. Key government bodies, lenders, and regulators will oversee compliance with all applicable requirements.

Governance framework and Lenders' standards

The Luena–Saurimo railway project's ESIA complies with Angolan regulatory requirements, including all necessary environmental and social permits, licences, and authorisations. The Project ESIA approach also aligns with key Lender Appraisal Standards, including the IFC Performance Standards (1–8), World Bank EHS Guidelines, Equator Principles IV, and OECD Common Approaches. The ESIA further integrates guidance on greenhouse gas emissions, climate change risk, the UN Guiding Principles on Business and Human Rights, relevant international treaties, and corporate governance practices, including OEC's Standard Operating Procedures. It also outlines the institutional framework and the roles of the key implementing agencies.

Based on list of activities in Annex II of the Angola's Presidential Decree No. 117/20 of 22 April 2020 that guides ESIA and permitting process, the proposed Project is classified as Category B and the relevant activity identified is activity (l) Railway lines with a length equal to or greater than 5 km. However, as per IFC and OECD (Legal Instruments - OECD/LEGAL/0393, 2025) categorisation, the proposed Project is classified as Category A based on the nature, scale and potential environmental and social risks and impacts of Project. Regardless of project category assigned, the proposed Project is committed to implementing highest standards of environmental and social sustainability throughout all phases of the Project.

Project infrastructure and facilities

The Project is located within two Provinces of Moxico and Lunda Sul; and traverses four municipalities (Moxico, Camanongue, Dala and Saurimo) and approximately 33 Project-Affected Communities (PACs) along the proposed railway line. The 260 km Luena-Saurimo railway line will have a 30 m right of way both ways from centre line; it will be a single line track platform narrow metric gauge (1,067 mm) using concrete sleepers and maximum speed of 100 km/h and 80 km/h for passenger and freight trains respectively. The trains will be diesel-powered locomotive and

operates during day time only at the moment. The railway line runs almost parallel to the existing EN250 from Luena town to chainage KM4+500 where the alignment curves north across Lumeje river. The alignment continues almost parallel to the existing EN 180 road from KM21+500 to KM233+00 where it diverts north-easterly and ends east of the Saurimo airport. The railway corridor is divided into 11 sections whereby each section has its main facilities and infrastructure.

Construction is scheduled to commence in 2026 lasting for approximately 60 months, with a 100-year operational design lifespan. The Project facilities and infrastructure are summarised below:

- construction camp sites: two main camps (Ndongue and Caiaza) and three support camp sites (Luena, Luele and Saurimo)
- concrete works/batching plants: two plants
- passenger stations: eight stations (Luena, Ndongue, Camanongue, Dala, Luele, Caiaza, Saquembue and Saurimo). Saurimo will be the only major station
- bridges and culverts: 11 composite deck bridges across 11 rivers; and 45 main culverts
- sidings: two locations with passing loops
- crossings: potential livestock, pedestrian, and road crossings: nature, type, design and specific locations of the crossings to be determined during detailed design. At least 100 crossings of different types (e.g. pedestrians, gravel roads, earth roads, livestock, community access) exists across the proposed railway line
- signalling and telecommunications (vertical signage 260km, control centres, fibre optic and access chambers)
- sleeper production and storage facilities: the current plan is to have a sleeper plant near Dala. OEC are also analysing an option of importing sleepers from South Africa
- abstraction of water: five boreholes, one at each camp
- spoil dumpsites: 11 locations i.e. one in each section
- waste management facilities: one collection point/centre at each camp
- waste water management facilities: one at each camp
- perimeter fencing: the whole alignment will not be fenced to allow continued community access. Fence at the major station only (Saurimo)
- rock quarries and rock crushers: four existing quarries along the corridor have been identified for potential use
- access roads: construction and operation/maintenance traffic movements will use both a 5 m length strip on each side of the railway alignment. In alternative, the EN 180 road will be also used
- workers accommodation: to be provided at the Camps, and in line with EBRD Guidance
- borrow pits: none will be required for the Project
- tunnels: none will be required/constructed for the Project
- marshalling yard: none will be required/constructed for the Project.

Further, demining of the entire corridor has been completed successfully. As per IFC and OEC standards, there are no Associated Facilities connected to the Project.

The Project construction and operation and maintenance activities will require different materials and resources at different quantities such as land (1,560 ha permanent acquisition), water (252,000 m³), energy (137,200,350 kWh and 51,596,762 litres of diesel for construction), track materials (15,000 tons of steel, 532 km rails, 396,000 sleepers, concrete 120,000 m3, and aggregate 850,000 m3), workforce (1,000 employees at peak), and subsequent waste generation. However, the Project's preliminary design endeavoured to embed various resource efficiency measures and principles to optimise the use of natural resources involved in the Project process. The resource use efficiency is an ongoing process which will be further incorporated during detailed design iterative process whereby the Project shall adopt best practices in sustainability, energy efficiency, and occupational health, consistent with the OEC policies and procedures, Angolan legislative requirements and international standards.

The Project's primary supply chain encompasses a range of specialized materials, equipment, engineering systems, and high-value components sourced both internationally (UK, Poland, South Africa and Netherlands) and within Angola. The Project will promote responsible sourcing practices through established supply chain sustainability commitments.

Alternatives considered

The Luena–Saurimo railway Project considered several technically, sustainability and financially feasible alternatives during planning and preliminary design stage through to detailed design phases to ensure a balanced and cost-effective options with minimal environmental and social impacts. Key alternatives assessed included:

- no-go alternative: not viable, as it would prevent the needed linkage between Angola's railway networks
- design and alignment alternatives: several options and iterative adjustments were made to avoid involuntary resettlement especially physical displacement, large wetlands and settlements
- drainage infrastructure including river crossings, bridge and culvert basic designs were adapted to maintain natural drainage
- stations and camps design and reconfiguration alternatives to minimise resettlement, environmental impacts and maintain community convenient access to stations
- road/community crossings alternatives for continued community access throughout Project phases
- energy source alternatives including combination of various renewable sources
- water source alternatives: considerations of new boreholes at each camp, supplying water for camps and stations
- waste management alternatives based on waste hierarchy
- resource and materials alternatives: Use of existing quarries and licensed suppliers
- locomotive options considerations (diesel powered, electrical, hydrogen fuel-cell, hybrid.

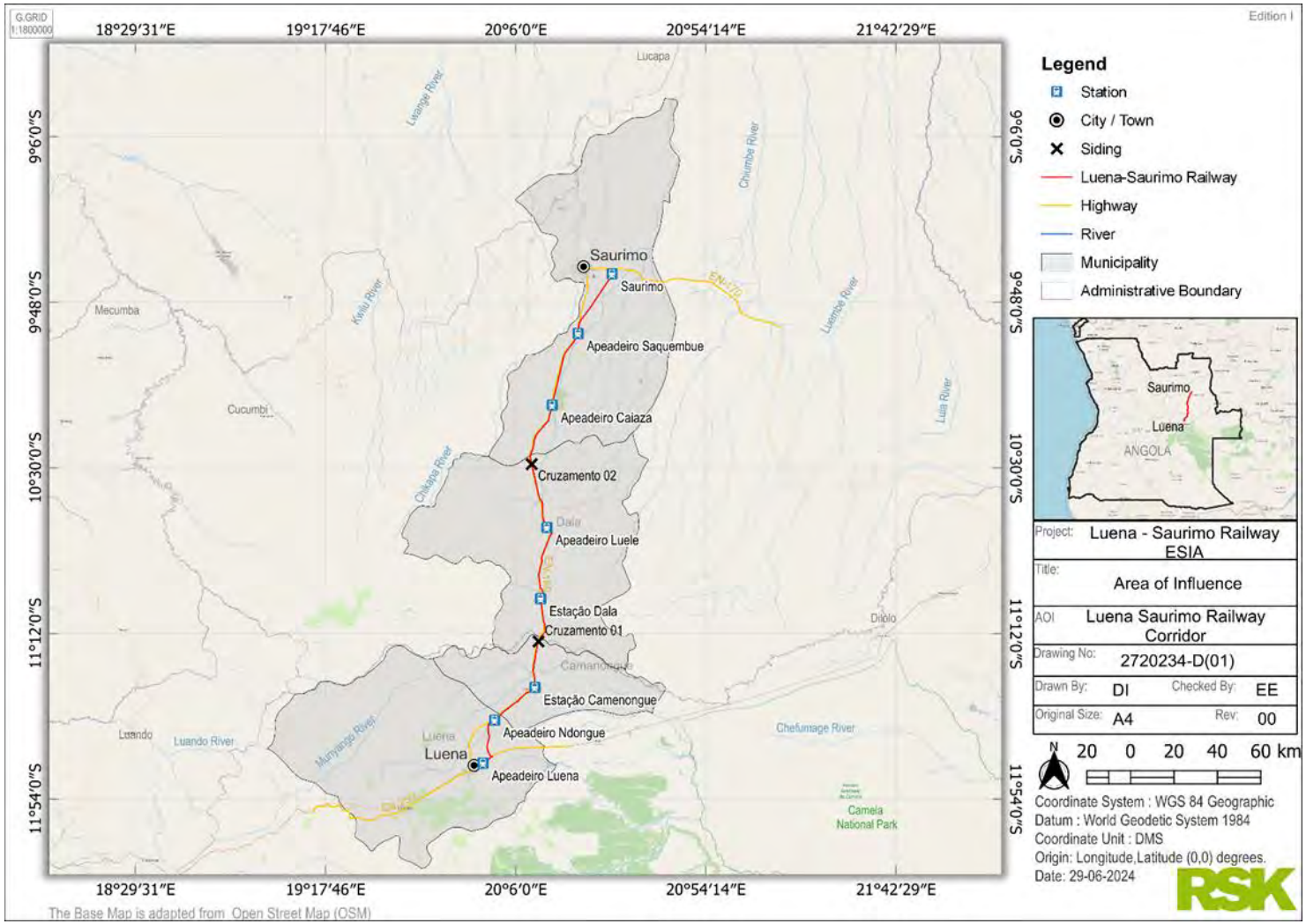


Figure 1-1: The proposed Luena-Saurimo railway line route

Stakeholder engagements and disclosure

Extensive, inclusive, transparent and culturally-appropriate engagement activities have been undertaken along the railway corridor covering all PACs at varying levels in compliance with IFC, EP4 and Angolan legislative requirements. A Stakeholder Engagement Plan (SEP) including a Grievance Redress Mechanism was prepared. Stakeholder engagement rounds/phases are highlighted below:

- first phase during Scoping Stage (September 2023 and March – April 2024)), the team held public meetings with 29 communities/settlements/neighbourhoods at 18 locations along the proposed railway corridor
- second phase during detailed baseline assessments for ESIA (May – June 2024), the team held focus group discussions with six communities at six locations (Table 5-7 and Table 5-8)
- third phase - Resettlement Policy Framework (RPF) fieldwork engagements undertaken in Dec.2025 with Provincial Governments (Moxico and Lunda Sul), Municipal Authorities, and Traditional Authorities (local leaders – Sobas) in all 33 PACs along the railway line. These engagements focused solely on resettlement issues. The RPF engagements are dealt with separately in a separate RPF Report
- fourth phase engagement will be undertaken as public disclosure of the ESIA Report package in compliance with IFC PS1 and EP4 requirements
- further, additional consultations at each PAC will be conducted during development of the Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) along with detailed design stage before commencement of construction works. Consultations shall continue throughout all phases of the Project.

Key stakeholders concerns and issues raised includes:

- community is ready and willingly accepts development of the railway because of anticipated positive socio-economic impacts
- improved mobility of goods and services between the two Provinces
- improved livelihoods and reliable means of transport
- opportunities for local economy development and expanded investments in the two Provinces
- expectation on reduced prices of goods and services especially in Lunda Sul after connectivity to Benguela railway
- generation of local employment opportunities during construction
- community crossings and access to the farms and water sources mainly rivers after railway construction
- potential involuntary physical displacement and impacts on crops/farms to be compensated as a result of Project
- impacts on graves and associated relocation if railway line will cross graveyards
- potential impact on local medicinal trees (*Mussivi)* if cleared for construction
- biodiversity impacts on local flora and fauna
- proposed stations locations closer to the communities

- regular updates on details on project design especially project schedule, timing, exact alignment of the railway track and station's locations
- continued stakeholder engagements at all levels and feedback mechanism throughout the Project to enhance sustainability

Baseline context

The Luena – Saurimo railway project area is characterised by a distinct socio-economic, cultural, and environmental landscape. The project Area of Influence (AoI) has been defined for various disciplines to guide the baseline and ESIA assessment process.

The proposed railway line traverses 33 project affected communities. Most communities centres are located nearby rivers that will be crossed by the railway line. These communities along the railway corridor largely rely on subsistence farming, livestock keeping and informal economies, with significant disparities in literacy and access to education and healthcare. Traditional leadership structures, such as Sobas, play a critical role in decision-making and land allocation. The study also highlighted human rights and gender dynamics, emphasising the need for inclusive community engagement. Human Rights Risk Assessment identifies salient human rights risks and opportunities, aligned with the Universal Declaration of Human Rights (UDHR). Further, there are no indigenous peoples or communities identified or exist within the project corridor and its area of influence at present.

The baseline cultural heritage for the Luena-Saurimo railway project identified both tangible and intangible cultural assets within the Project AoI. Key findings highlight the cultural richness of the region, such as traditional dances, rituals, medicinal plant usage, and significant historical artifacts like masks, monuments, cemeteries, and sacred sites. The Project's design has prioritised the avoidance of graves and cemeteries to prevent relocation and associated community concerns.

The project area lies within the Eastern Plateau, characterised by wet and dry seasons, annual rainfall of about 1,070 mm, and temperatures between 11°C and 34°C. The landscape includes flat-topped hills and plateaus with significant hydrological features like wetlands, rivers, and seep zones.

The baseline noise environment reflects a typical rural soundscape, with natural sounds (wind, insects, birds), livestock, human activities, and vehicle noise, especially near access roads and the EN180 highway, as well as farming and school-related noise.

Air quality is mainly influenced by outdoor fossil-fuel cooking and waste burning. PM10 and PM2.5 levels vary, with some locations exceeding WHO guidelines, though monitoring durations were short. Ozone (O_3) exceeded WHO peak-season guidelines, typical for remote dry areas, while CO remained within acceptable limits.

Soil types range from well-drained to poorly drained, and apart from eroded soils in limited parts of the Project area, there is no evidence of geological hazards within 50km of the Project corridor. Hydrological studies highlighted sensitive areas such as wetlands and floodplains within the Congo and Zambezi basins. The railway line crosses 11 major rivers. The project area contains multiple floodplain wetlands and rivers, generally maintaining water quality suitable for aquatic life, though some parameters may affect sensitive species. Floodplain wetlands and rivers supporting community activities such as fishing and agriculture are classified as high-sensitivity zones.

Ecologically, the railway corridor traverses Angolan Miombo woodlands and the Kasai and Zambezian Headwaters freshwater ecoregions, areas of high biodiversity value that provide key

ecosystem services such as water regulation, soil stability, carbon sequestration and cultural benefits. The corridor includes natural, agricultural and modified habitats, with IHAS results indicating adequate to good habitat conditions supporting diverse macroinvertebrates. Six vegetation/habitat units were identified, including woodlands, forests and aquatic areas, all important for ecosystem services and biodiversity support. There are no critical habitats identified within the Project area. The nearest protected area, Cameia National Park, lies over 50 km away, outside the project's direct AoI, with no overlap with Endemic Bird Areas. The wider region maintains significant ecological value.

Key impacts of concern and assessment

The overall negative impacts identified for the construction and operational phase were found to have a pre-mitigation impact risk rating of Major and Moderate. During these phases, several major positive socio-economic impacts were also identified. For all negative potential impacts, corresponding mitigation and monitoring measures have been developed. These measures are designed to manage the impacts satisfactorily, reducing their risk rating to Minor, Negligible, or No Effect and ensuring no residual significant impacts remain. These potential impacts are broadly grouped into positives and negatives.

Key benefits from the Project includes:

- direct local employment opportunities during construction and operation phases
- indirect employment opportunities
- technology transfer and skills development
- income generation and benefits to local suppliers
- improved community mobility and accessibility, flow of goods and services
- local economy and livelihoods improvement

Key negative impacts of concern includes:

- involuntary resettlement related impacts from land acquisition
- severance and community accessibility to farms, rivers and connectivity
- potential for localised flooding/inundation and sedimentation in some parts of the alignment
- local drainage alteration
- community health and safety during construction and operation phases
- population influx and associated impacts
- occupational health and safety risks during constriction and operation
- habitats fragmentation/loss and ecological disturbances
- potential for waste generation and associated contaminations
- deterioration/disturbance of cultural heritage aspects and social fabric
- short term elevated noise and air emissions during construction

Cumulative impacts

Cumulative impacts from the Luena–Saurimo railway were assessed in relation to existing and planned developments in the area, including the 220 kV transmission corridor, EN180 road rehabilitation, Saurimo Ring Road, a clay mine, the Sonangol fuel depot, University Lueji a'Nkonde, the Saurimo Industrial Complex, and water treatment plants in Saurimo and Dala. These combined activities contribute to overlapping environmental, social, and cultural pressures during both construction and operation.

The assessment identified cumulative effects on the physical environment (higher dust and exhaust emissions, noise, reduced water levels and quality, and increased runoff), the biological environment (vegetation loss, invasive species, wildlife mortality), and the socio-economic environment (employment benefits but also inflation, strain on services, disease burden, social tensions, and road accidents). Cultural heritage may experience restricted access, noise interference during events, and loss of native medicinal plants.

Management measures and plans

The Luena–Saurimo Project incorporates comprehensive environmental and social management through topic-specific recommended mitigation measures and sub-plans aligned with national and international requirements. These are consolidated into a stand-alone Environmental and Social Management Plan (ESMP), which details measures to avoid, minimise, or mitigate all identified risks and impacts. The Project is committed to the development and executing of a site-specific Construction ESMP along with the proposed sub-plans throughout all phases. For the operational phase, an Environmental and Social Management System (ESMS) will be established to integrate all measures, define roles, and ensure long-term monitoring, reporting, and compliance.

Conclusion

The ESIA concludes that the proposed project preliminary design has already prioritised avoiding and minimising adverse impacts and integrated safety measures into the design plans. The Project will follow strict adherence to construction and operational management plans and mitigation measures to enable the reduction and offsets of the identified potential impacts and will therefore have no anticipated significant residual impacts. The mitigation measures will enable the long-term sustainability of ecological systems and enhance the socio-economic benefits while addressing community vulnerabilities.

In summary, the nature and the physical footprint of the project, as well as the scale will potentially give rise to negative impacts in both the construction and operational phases. However, through mitigating the majority of impacts can be mitigated to Minor, No effect or Negligible.

1 INTRODUCTION

1.1 Background and rationale of the Project

The Angolan Government intends to modernize and expand the country's transportation infrastructure. Angola has three railways with a network of over 2,700 km:

- the Luanda Railway connects Luanda to Malanje and has a length of 500 km
- the Benguela Railway has the longest network in the country with 1,344 km
- the Moçamedes Railway with 856 km.

The Angolan Executive, recognizing the imperative need for strategic investments and the execution of the National Master Plan for the Transport and Road Infrastructure Sector (PDNSTIR), alongside the directives outlined in the National Railway Network Expansion Plan, has embarked upon a transformative endeavor. Under Presidential Order Nº 55/23 dated March 27th, 2023, the Executive has authorized the award of the Luena-Saurimo railway construction Project to the consortium comprising OEC S.A - Sucursal and Bento Pedroso Construções. This endeavor represents a strategic measure aimed at bolstering sustainable development within the region, with a particular focus on enhancing railway transportation infrastructure. This project not only envisages streamlining the movement of goods and individuals between Luena and Saurimo but also seeks to broaden the reach of rail transport benefits to neighboring areas, notably the Lundas regions.

The new railway line Luena-Saurimo railway line (260 km) ('the Project') will connect Benguela´s Railway (CFB) in the city of Luena (Moxico Province) to the future connection to Luanda´s Railway (CFL) in Saurimo (Lunda Sul Province). There are no railway lines connecting the existing main lines and the only transport option within the Angolan territory between the lines is multimodal, with road transport replacing traffic between the lines. This situation represents a strategic constraint on Angolan territories and economic development.

In tandem with this initiative, the extension of the Benguela Railway (CFB) network to the Lundas emerge as a pivotal undertaking, poised to facilitate access to a safe, reliable, and competitive mode of transportation.

It is well established that the rail links connections, expansion of the national network and the improvement of railway circulation are particularly important for the National Master Plan for the Transport and Road Infrastructure Sector (PDNSTIR).

Based on PDNSTIR, the proposed Luena-Saurimo railway line is expected to bring significant economic benefits to Angola, by improving transportation links between the cities of Luena and Saurimo, expanding the commercial activities, facilitating better flow of goods and products between the two Provinces, as well as connecting them to other parts of Angola.

The Lundas region, distinguished for its robust mining activities, stands to benefit immensely from the establishment of an efficient railway system, which will serve as a critical conduit for transporting minerals and associated resources. Furthermore, the proposed railway infrastructure holds the potential to catalyze ancillary initiatives within the region, notably the the development of cereal production (rice, wheat, corn, soy) in

the region within the scope of the National Promotion Plan for Grain Production (PLANAGRÃO) Project of the Angolan government aimed at fostering industrial growth and diversification across the provinces of Lunda-Norte, Lunda-Sul, Moxico, and Cuando - Cubango.

Building the Luena-Saurimo railway will not only create jobs and stimulate economic growth in the region of the works, but it will also promote and connect the towns of Luena and Saurimo and the communities in between. The railway line will enable people to have alternative means of transport in person and for their goods to markets they previously did not have access to. The expanded reliable means of transport and freedom of movement will most likely allow for further economic growth for the smaller areas that will also be frequented by tourists and business people searching to expand their businesses in the interior of Angola.

Being connected to the Benguela railway and port connection will further allow movement to other regions of Angola as well with access to new goods and experiences previously to far or expensive to experience and engage with.

The construction phase of the Project will create several part time jobs with further skills transfer to the workers allowing them to have trades that can be applied even after the railway has been built. During the construction phase several local businesses including farmers will have the opportunity to provide services and goods to the construction company and their workers.

1.2 Environmental regulatory requirements and governance

To manage the project sustainably, the process to determine whether a programme, activity, or project will have adverse impacts on the environment is through conducting an Environmental and Social Impact Assessment (ESIA). This is embedded in the Angolan Presidential (Decree No. 117/20 of 22 April 2020) which describes the General Regulations for Assessment of Environmental Impact and Environmental Licensing Procedure. The Decree necessitates undertaking of the full ESIA for the proposed construction of the Luena-Saurimo railway line.

Therefore, this ESIA has been prepared in accordance with the requirements of the Angolan EIA Regulations (Presidential Decree 117/20 of 20 April) and the regulations on stakeholder engagement (Executive Decree 87/12 of 24 February), as well as various Lender Appraisal Standards (LAS) as detailed in the preceding section.

1.3 Lender Appraisal Standards (LAS)

The Project intends to apply for international finance and will, therefore, need to not only meet national standards, but also international Lender Appraisal Standards (LAS. The following LAS are applicable:

- World Bank Group Environmental and Social Framework, 2018, including, inter alia:
    - World Bank Group (WBG) General Environmental, Health, and Safety (EHS) Guidelines, and relevant WBG sector specific EHS guidelines, 2007
    - EHS Industrial Sector Guidelines for Railways, 2007

- OECD Common Approaches on environment and officially supported export credits
- Equator Principles IV (EP4, 2020) and other associated applicable guidance notes and best practices, including, inter alia:
  - Guidance Note on Climate Change Risk Assessment, Equator Principles Association, September 2020
  - Guidance Note on Implementation of Human Rights Assessments under the Equator Principles, Equator Principles Association, September 2020
  - Best Practice Note on Biodiversity Baseline - Surveys, Equator Principles Association, March 2022
  - Guidance Note on Evaluating Projects with Affected Indigenous Peoples, equator Principles Association, September 2020
- United Nations Guiding Principles on Business and Human Rights ("UNGPs")
- UN Voluntary Principles on Security and Human Rights, 2000
- International Finance Corporation (IFC) Performance Standards (PS`s) 1-8, Environmental and Social Sustainability (2012), including relevant Guidance Notes (GN's) inter alia:
  - The IFC Environmental, Health, and Safety Guidelines for Construction Materials Extraction, April 2007
  - Workers' accommodation: processes and standards A guidance note by IFC and the EBRD, August 2009
- International conventions, treaties and protocols assented to by the Angolan Government.

1.4 Objectives of the ESIA

The objectives of the ESIA process is to identify and investigate potentially significant biophysical and socio-economic impacts, and to highlight any environmental dependencies and opportunities for adding environmental value, associated with the proposed project. Furthermore, and very importantly, the ESIA offers an opportunity for the public and key stakeholders to provide input and to participate in the process. This is to enable the end-design being grounded in sustainable development principles, demonstrate the application of global good practice standards in promoting a sustainable economy across a region and promote a sustainable and socially responsible development that is responsive to global, regional, and local pressures.

This ESIA study has been undertaken in accordance with the requirements of the Angolan Presidential Decree No. 117/20, applicable LAS and outcomes of the Scoping exercise. Consequently, the specific objectives of undertaking this ESIA are to:

- describe the proposed Luena-Saurimo railway Project, its design to date, components, any associated facilities and activities throughout all project phases

- identify and map stakeholders and undertaking public consultations with communities along the proposed corridor, authorities and any other interested party that may be affected and/or interested by the proposed railway line Project
- assemble, evaluate, and present baseline conditions on the relevant biophysical and socio-economic and cultural conditions within the Project area of influence
- identification and characterization of potential impacts on the biophysical and socio-economic and cultural environment that may arise from railway Project implementation in different phases
- propose mitigation and management options to avoid, minimize, compensate or offset any adverse significant biophysical and socio-economic impacts and enhancement strategies for positive impacts to realize more Project benefits
- develop an Environmental and Social Management Plan (ESMP) and an Environmental Monitoring Plan (EMP) with a mechanism to be used throughout the project cycle.

1.5 Project categorisation

Based on list of activities in Annex II of the Angola's Presidential Decree No. 117/20 of 22 April 2020 that guides ESIA and permitting process, the proposed Project is classified as Category B and the relevant activity identified is activity (l) Railway lines with a length equal to or greater than 5 km. Category B projects requires Scoping and detailed ESIA studies to be undertaken. At the date of writing the ESIA, the project had been registered on the Angola Ministry of Environment (MINAMBs) SIA-DP portal and assigned Category B Project in terms of Angolan legislations.

However, the OECD Common Approaches, Equator Principles and IFC Standards require the categorisation of projects for which an application for funding is being made according to the categorised listed in the OECD 'Common Approaches' (OECD 2022) in order to establish the level of risk associated with the project as all as to prescribe the level of assessment needed to support a funding application.

As per IFC and OECD (Legal Instruments - OECD/LEGAL/0393, 2025) categorization, the proposed Project is classified as Category A based on the nature, scale and potential environmental and social risks and impacts of Project. These impacts may affect an area broader than the sites or facilities subject to physical works. Based on the potential impact of the Project and, particularly, the level of economic resettlement involved, the project has been categorized as Category A. This categorisation is also in line with the illustrative lists of Category A projects provided by the OCED Common Approaches, Equator Principles 4 (EP4) and the IFC.

However, regardless of project category assigned, the proposed Project is committed to implementing highest standards of environmental and social sustainability throughout all phases of the Project.

1.6 Structure of the ESIA report

This ESIA report is structured according to the Angolan legislative requirements and the LAS applicable to the Project. It includes the following chapters as detailed in Table 1-1.

Table 1-1: Structure of the ESIA report

Name	Description
Chapter 1	Introduction
Chapter 2	Project Description
Chapter 3	Project Alternatives
Chapter 4	Governance Framework
Chapter 5	Stakeholder Engagement
Chapter 6	Socio-economic Baseline Conditions
Chapter 7	Cultural Heritage Baseline Conditions
Chapter 8	Physical Environment Baseline Conditions
Chapter 9	Biodiversity Baseline Conditions
Chapter 10	Impacts Identification and Assessment
Chapter 11	Cumulative Impacts Assessment
Chapter 12	Environmental and Social Management Plan
Chapter 13	Environmental and Social Monitoring Commitment
Chapter 14	Conclusion and Impact Statement
Chapter 15	References
Appendices	Appendices. Presented separately as Volume 2 of this report

1.7 Project team

This section provides an overview of the project's team involved in the ESIA process.

1.7.1 Proponent information

Table 1-2 Details of client and contact person

Name	OEC Engineering
Contact person	Antonio Lucas
Email address	antonio.lucas@oec-eng.com

1.7.2 Key project role players

Table 1-3 Key delivery parties and third-party advisory

Organisation	Role/Responsibility
Key delivery parties	
Ministry of Transport, Angola - MINTRANS (Ministério dos Transportes de Angola)	Owner/Employer
Consortium OECI, S.A – Sucursal em Angola and Bento Pedroso Construções S.A	Appointed Principal Contractor
Caminhos de Ferro de Benguela (CFB)	Railway operator responsible for operations including technical and maintenance support
Leading Financing Bank – HSBC UK	Lenders
Ministry of Finance, Angola - MINFIM (Ministério das Finanças)	Borrower
Third party advisory	
RSK	Commissioned by OECI – Sucursal Angola and Bento Pedroso Construções (BPC) - BPC for environment and social consultancy services
Panther Oil – Oil and Gas Services lda	RSK Partner in Angola and overseeing Angola legislative requirements

1.7.3 Environmental and social assessment team

RSK included a comprehensive technical team with Angolan and railways experience across Africa and Europe. Table 1-4 includes the key environmental and social team members that worked on this Project.

Table 1-4: Environmental and social team

Role/Specialist	Consultant name	Qualification	Company
Project Director/ IFC Compliance	Edward Ezekiel	MA.(Distinction) Urban Development BA. (Hons) Geography and Environmental Studies	RSK
Project Manager/ IFC specialist	Navonaeli Kaniki	Mphil Environmental Management BSc. Environmental Science	RSK
ESIA Consultant	Noluyolo Xorile	BA.(Hons) Geography Bachelor of Arts	RSK
ESIA Consultant	Anzani Tambani	Bachelor of Environmental Sciences	RSK

Role/Specialist	Consultant name	Qualification	Company
ESIA Consultant	Catherine Ndzungu	BSc (Honours) Geography and GIS & Remote Sensing BA. Geography and Environmental Studies	RSK
Socio-economic & livelihoods	Ilse Carin Aucamp	PhD Social Work	Independent
Socio-economic & livelihoods	San-Marie Aucamp	MA. Research Psychology	Independent
Stakeholder Engagement Lead , Cultural Heritage and Legislative Framework	Kariana Janice Guimarães Gaspar	BSc. Environmental and Sanitary Engineering	Pantheroil
Stakeholder Engagement	José Armando Pereira	MA. Economics, Spatial Planning and Regional Development	Pantheroil
Labour and human rights	Hilde van Vlaenderen	PhD Social Psychology MA. Psychological and Pedagogical Sciences	RSK
Land Use, Public Infrastructure Services	Nivaldo Tati	BSc. Environmental Engineering	Pantheroil
Biodiversity	Andrew Husted	MSc. Aquatic Health BSc. (Hons) Aquatic Health BSc. Natural Science	Independent
Biodiversity (Terrestrial & Aquatic Habitats)	Gareth Walker	PhD Zoology MSc. Botany Invasion Ecology BSc. (Hons) Conservation Ecology	Independent
Biodiversity – Ornithology	Ryno Kemp	PhD Zoology (Candidate) BSc. Honours Zoology BSc. Zoology	Independent
Hydropedology	Mathew Mamera	PhD Soil Science MSc. Soil Science (Hydropedology, Wetland Delineation and Rehabilitation) BSc. Agricultural Science	Independent
Hydrology & Geohydrology	Johan Kriek	MSc. Geohydrology BSc. (Hons) Engineering & Environmental Geology	Independent
Hydrogeology & Soil	Retief Grobler	MSc. Plant Sciences	Independent

Role/Specialist	Consultant name	Qualification	Company
Noise and vibration	Dan Clare	BSc.(Hons) Environnemental Science, PTS IOA Diploma, Acoustics and Noise Control	RSK
	Ceri Jones	MSc. Acoustics PGDIP, Acoustic & Noise Control BSc. Music Technology	RSK
Air quality	William Franklin	MSc. Environmental Quality Management BSc. Biological Sciences	RSK
	Charles Kwok	MSc. Water and Environmental Management Beng. Environmental Engineering and Management	RSK
Climate change risk assessment	Natalie Sokol	PhD Climate and Development MA. Sustainable Development BSc. (Hons) Environmental Management	RSK
GHG assessment	Libby Robinson	PhD Paleoclimate BSc. (Hons) Earth and Environmental Science	RSK
Environmental Expert	Grace Kassimoto	MSc. Climate change & Sustainable Development BSc. Environmental Management	RSK
GIS & Mapping	David Israel Mbwiga	BSc. Geoinformatics	RSK

1.8 Limitations and opportunities

During development of this ESIA, the following considerations were made:

- Project design stage: the preliminary basic design has been used for the purpose of ESIA development. During ESIA stage, FEED and detailed design investigations were under the process. Therefore, modelling and/or detailed quantitative analyses of some thematic disciplines such as noise and vibrations, air quality, hydrological simulations etc. could not be undertaken. The additional specialised studies will be undertaken during detailed design process and additional findings will be incorporated into the specific management and monitoring plans to developed as part of C-ESMPs before commencement of civil works. In addition, this ESIA has considered all worst case scenarios.

- Secondary data limitations: historically, the project area was affected by civil unrest and conflicts. Limited studies and/or scientific research exists specifically for along the railway corridor. The ESIA team gathered and corroborated existing data sources to the extent possible to supplement primary data collection. Further primary data collection will be undertaken during resettlement planning and the upcoming detailed design stage especially at this stage when demining works have been completed.
- Demining works: during ESIA fieldwork in 2023 and 2024, demining of the corridor was not undertaken. Due to health and safety concerns, transect walks, sampling and other field observations/activities were limited within communities, existing access tracks/routes/footpaths that are used by communities along/across the proposed corridor. Demining works were initiated in February 2025 and completed by September 2025; hence the corridor is deemed safer for further detailed engineering investigations and other studies. See section 2.5.1 for further details on demining works.

2 PROJECT DESCRIPTION

The Project Description considers each project phase, for example design, planning, preconstruction, construction, operation and handover/ decommissioning (as applicable). Sequential consideration allows for logical consideration of the differing nature of project requirements – in the earlier phases baselines, impact assessments and E&S Permits, Licences, Authorisations/Approvals, Notifications and Consents (PLANCs) dominate, while in the later phases, establishing good practices, monitoring and managing performance become key requirements. Further, this chapter presents the preliminary basic design of the Project developed as of 22nd June 2024 and subsequent updates provided up to 28th August 2025 were used for the purpose of the ESIA. The detailed design and other supporting site investigations were on the pipeline during ESIA stage.

2.1 Project location

The Luena-Saurimo railway line will connect Benguela´s Railway which it is the only railway connection from Central Africa to the Atlantic. Its construction, originated by a law from August 1899, construction began in 1903 and was finished on February 2nd , 1929 in the city of Luena (Moxico Province) to the future connection to Luanda´s Railway in Saurimo (Lunda Sul Province) as detailed in Figure 2-1 and Table 2-1.

The Project traverses through two Provinces and four municipalities

- Moxico Province: Municipalities of Moxico and Camanongue
- Lunda – Sul Province: Municipalities of Saurimo and Dala.

Moxico Province, located in the southeast of Angola, encompasses the largest territorial expanse, occupying approximately 17% of the nation's total land area with 223.023 km^2. Administratively, the Province is subdivided into nine municipalities: Alto Zambezi, Bundas, Camanongue, Léua, Luacano, Luau, Luchazes, Cameia, and Moxico. The Provincial capital, Luena, formerly known as Vila Luso, serves as the administrative center, housing over 40% of the Province population among its total of 935,649 inhabitants (INE 2014). Luena is situated 1,314 km from the national capital Luanda, 265 km from Lunda - Sul Province, and 7 km from the proposed railway line.

The Moxico municipality is situated in the Provincial capital of Luena covering an area of 38, 999 km^2 and it is inhabited by approximately 440,850 residents. Geographically, the municipality is delimited to the north by the municipalities of Camanongue, Cacolo, and Dala (Lunda-Sul Province); to the east, with the municipalities of Léua and Alto Zambeze; to the south, with the municipalities of Bundas and Luchazes; and to the west, with Camacupa and Cuemba in the Bié Province.

Camanongue municipality is distinguished by its high road traffic, attributed to the presence of a fully paved National Road crossing the municipal seat. Occupying an area of 2,783 km^2, it sustains an estimated population of 42,145 inhabitants. Geographically, the municipality shares its borders to the north with Dala municipality (Lunda-Sul province), to the east with the Cameia municipality, Léua municipality to the south and Moxico municipality to the west.

Lunda-Sul Province is located in the northeast of Angola, located between the geographical coordinates 10°15'33"S and 20°37'30"E, with an estimated population of 537,587 inhabitants, covering an area of 77,636 km² distributed in four municipalities (Dala, Cacolo, Muconda and Saurimo). Saurimo, the capital of the Province, is situated about 937 km from the national capital, Luanda, 259 km from Moxico Province, and 12 km from the town centre to the proposed Saurimo railway station where the rail terminates. The climate of the province is predominantly tropical-humid, with temperatures ranging between 34°C maximum and 22°C minimum in two different seasons (dry season called *cacimbo* and rainy season).

Saurimo municipality, the capital of the Province, is located in the northeast of Angola between the geographical coordinates 9.65893° S; 20.39811 E (UTM). Administratively Saurimo is divided into three major communes: the Sombo commune, and the commune of Mona-Quimbundo.

Dala municipality, with an estimated population of 101,000 inhabitants, shares border to the north with the Saurimo municipality, to the east with Muconda municipality, to the south with the municipalities of Cameia, Camanongue and Moxico; and Cacolo municipality to the west. This delineation of borders defines the area of influence for the municipality, illustrating its spatial relations and neighboring jurisdictions within the Province.

Based on resettlement policy framework fieldwork, approximately 33 Project-Affected Communities (PACs) have been identified (see Table 2-1). The PACs will be further verified during development of the detailed Resettlement Action Plan (RAP).

Table 2-1: Project affected communities traversed by the proposed Luena-Saurimo railway line

Province	Municipality	PACs
Moxico	Luena	Tchiteno, Canda I, Samauzo (including Catembo Nova)
	Camanongue	Ndongue, Mumanga (including Saissazo and Caiza), Muapezo, Tchilonga, Mazemba, Samalengue, Camuleque, Cassai Ponte, São João, Musseringinge (including Samucanda and Malasa)
Lunda Sul	Saurimo (currently known as Cassengo)	Muamucalanganza, Saquembue, Muanguigi, Caiza, Muicaimbo, Mwatximbia, Sagungu, Luari, Sambuamba, Nanguanza, Cassamba I, Cassamba II, Maurilo-Sachula, Muxie
	Dala	Luele, Luachimo, Mukunguaji, Satxitende, Nacatoco, Biula

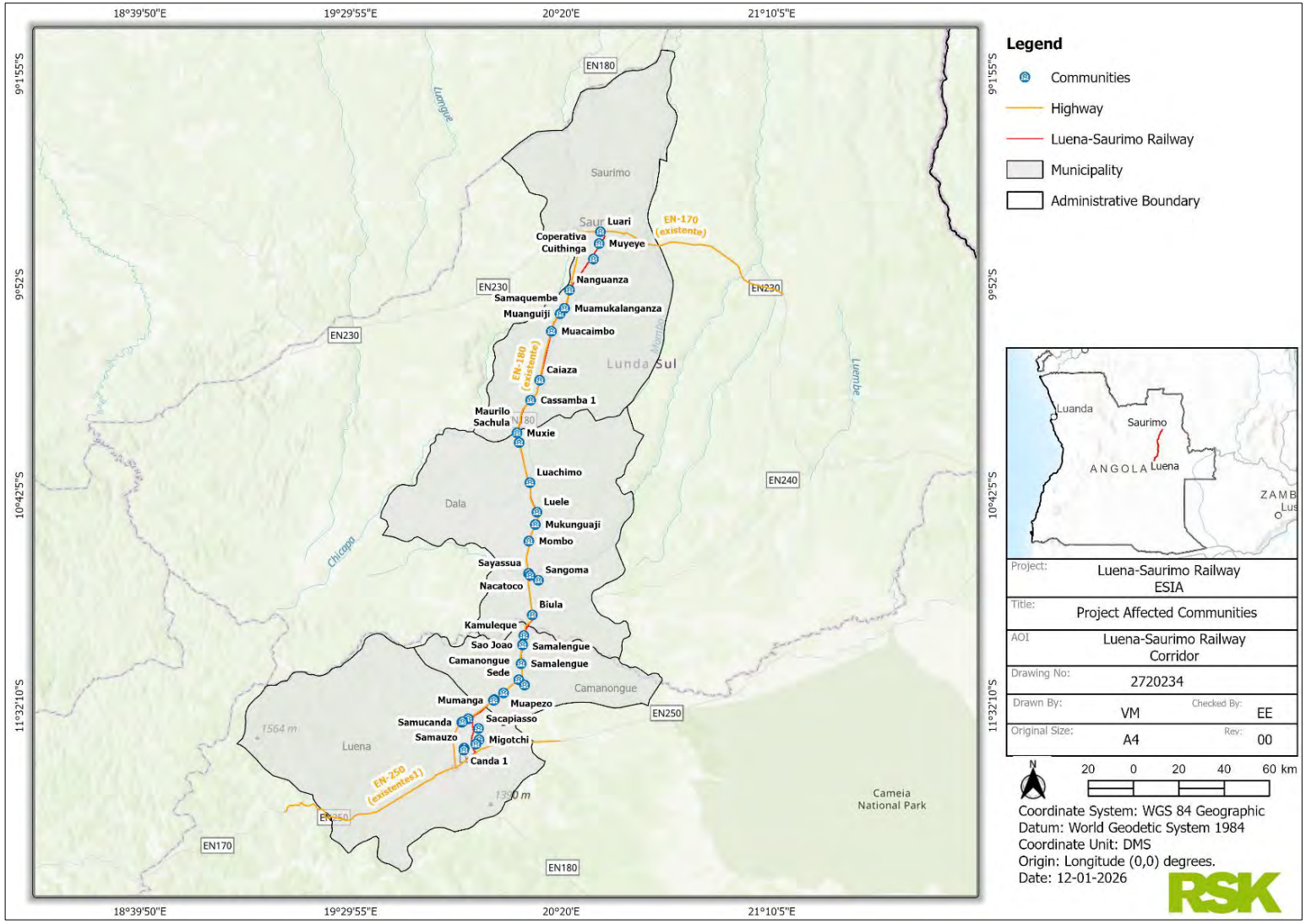


Figure 2-1: The proposed Luena-Saurimo railway line route

2.2 Route description

The 260 km Luena-Saurimo railway line runs almost parallel to the existing EN250 from Luena town to chainage KM4+500 where the alignment curves north across Lumeje river. The alignment continues almost parallel to the existing EN 180 road from KM21+500 to KM233+00 where it diverts north-easterly and ends east of the Saurimo airport. The railway corridor is divided into 11 sections (see Table 2-2 overleaf) whereby each section has its main facilities and infrastructure. The detailed high resolution A3 maps of each alignment section with main infrastructure and community labels is provided in Appendix 01.

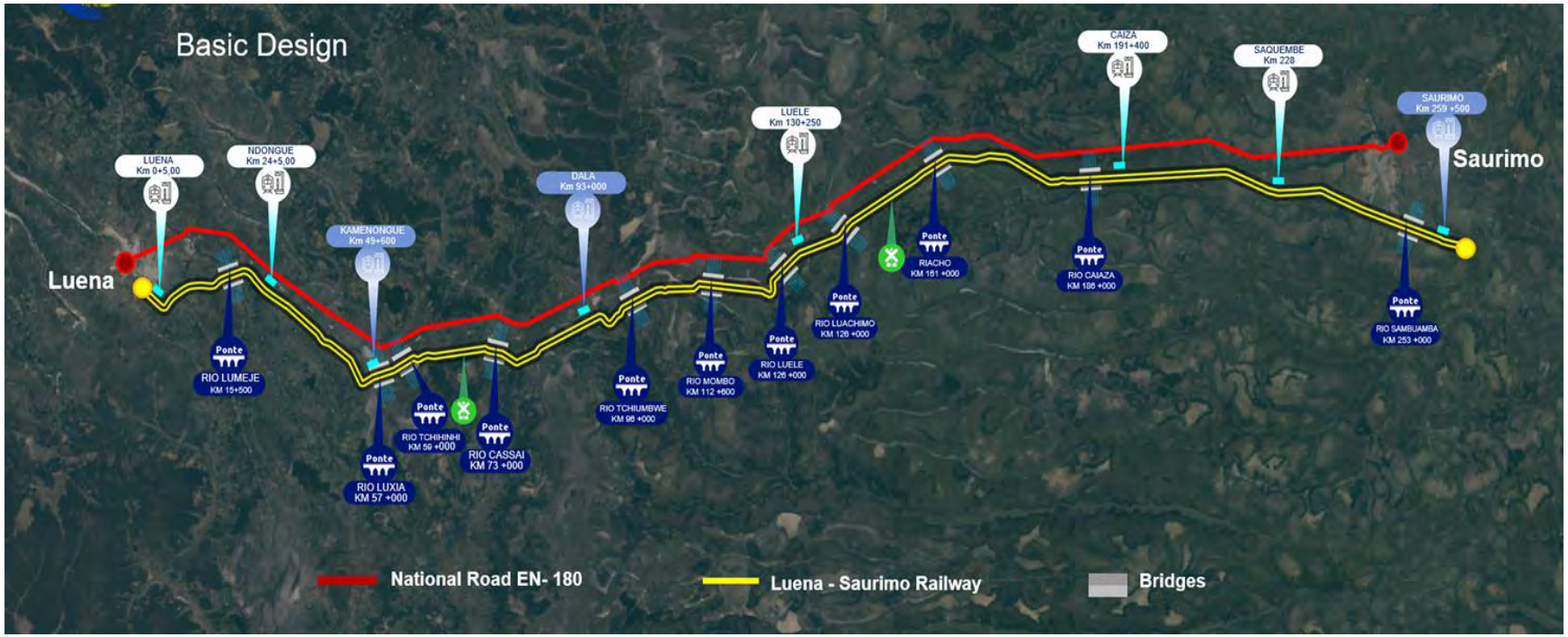


Figure 2-2: General key layout illustration of Luena-Saurimo route showing EN180 road and chainage of stations and key infrastructure

Source: OEC, March 2024

2.3 Design basis and criteria

The Luena-Saurimo railway line will be approximately 260 km long and will be built according to international standards for the single track layout and structural elements such as composite deck bridges, steel structures, culverts and drainage elements. The track will be a single line with a 6.60 m wide platform. The Luena-Saurimo railway line has a maximum design speed of 80 km/h for freight trains 100 km/h for passenger trains, single railway track platform with concrete sleepers and with 1,067 mm gauge. The **Error! Reference source not found.** below illustrates the general cross section of the railway

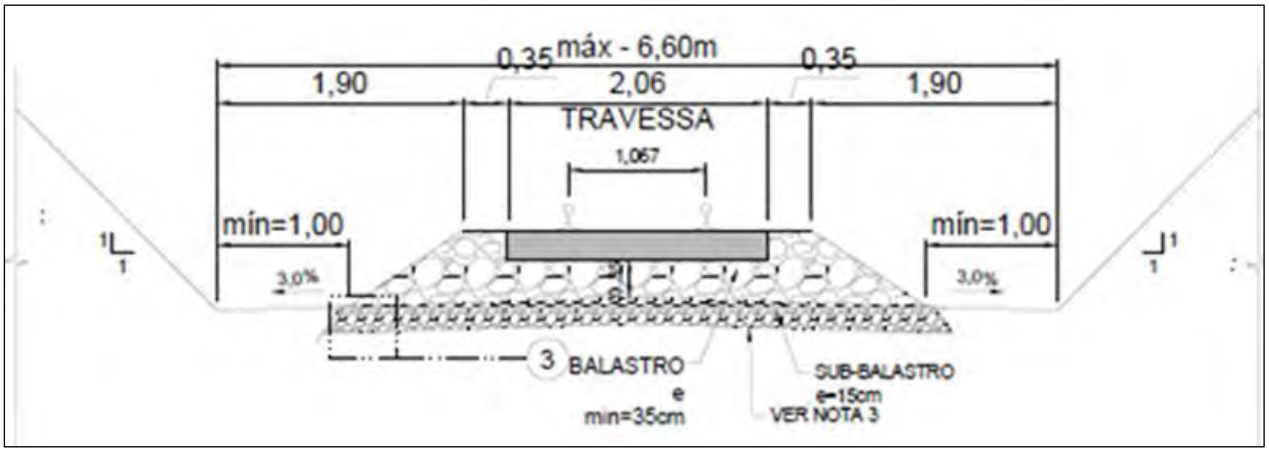


Figure 2-3: General cross -section of the railway design
design.

For the bridges, the load considered is maximum 22 ton/shaft, total width at bridges is 6.70 m that includes 3.50 m finished single track and provision of 1.0 m width side metal walkways for possible maintenance (see Figure **2-4**).

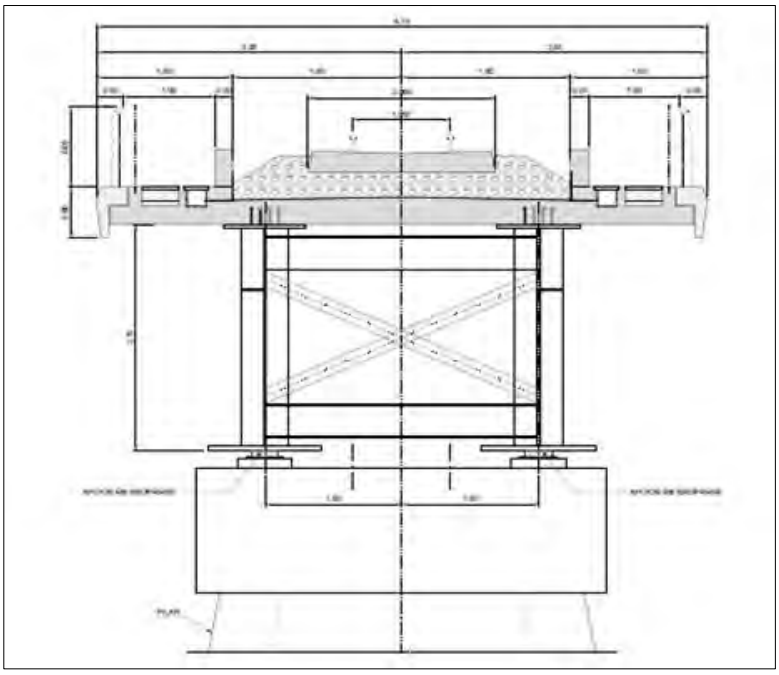


Figure 2-4: General cross -section of bridge design

Further, the railway line has been divided into 11 sections between each bridge/rivers crossing. The design assumption is based on the cut and fill quantities to attain a balance between both in each section hence a global balance of earthworks and in some cases, e.g. Sections 1 and 2 in which Section 1 requires 7,200 m^3 of fill material and Section 2 has 7,400 m^3 in deposit, OEC will transport the excess material from Section 2 to Section 1. Based on this, it turns out that it is not necessary to have borrow pits outside the planned earthworks areas.

Generally, design criteria for railway Right of Way (RoW) and superstructure includes:

- right of way comprises 30 m both ways from centreline, i.e. 60 m RoW including construction and maintenance access road
- railway single track platform = 6.60 m in cuts and embankment, with a transverse slope of 3% from the axis, minimum bending radius 600 m, maximum gradient 1.5%
- cuts: slopes, with a slope of 1(V): 1(H), with benches 3.00 m wide every 7.00 m of unevenness, from the platform, for 1st and 2nd category materials and 4(V): 1(H) in 3rd category material
- embankments: slopes of slopes of 1(V) :1.5(H), with benches 3.00 m wide for every 7.0 m difference in level from the platform and 1(V): 2(H) for the slopes below the 2nd bench
- 260 km divided into 11 'Sections' for construction purposes (11 bridges crossings along the route)
- narrow metric gauge = 1,067 mm
- monoblock pre-stressed concrete sleepers, spaced 0.66 m apart (11,667 units/km)
- two passing loops locations
- no marshalling yards, tunnels or viaducts are included as part of the Project
- total of 8 stations (one major station in Saurimo), 5 construction camps (2 major camps and 3 smaller support camps). No third party workshops/camps/yards will be required
- 11 composite deck bridges across 11 river crossings/sections
- demining works have been completed in Oct.2025 covering RoW, stations, camps, passing loops, access roads and immediate surroundings
- existing quarries along the corridor will be used to source materials (no new quarries will be opened)
- maximum passenger train speed is 100 km/h and 80 km/h for freight trains
- day-time trains operations only at the moment, 4 trains/day (2 passenger and 2 freight), each with 20 carriages and 40 wagons per service respectively
- diesel-powered trains like existing Benguela line, hence no need for an exclusive high voltage electric transmission line for railway

- all refuelling activities to be undertaken at the existing Luena station facility on Benguela line.

At the time of writing, it is understood that the following train types will be utilised across the Luena - Saurimo railway route:

- main Stock: GE C30ACi (General Eléctric - USA) + 20 carriages (passengers)
- main Stock: 2 GE C30ACi (General Eléctric - USA) locomotives + 40 wagons (freight).

At the time of the ESIA, the preliminary technical studies that were undertaken for the basic design that includes the railway track definition after several layout studies to make sure that the final line layout will minimize the land acquisition and resettlement impacts through bypassing urban areas, locating construction Camps within station areas and:

- to minimize structural works (bridges, culverts and special structures) avoiding complicated topography
- plan/profile and sections layout forecasted to compensate as much as possible the balance between excavations and embankment works.

Technical studies that were performed are:

- preliminary hydrology studies (InterTechne Report, 23DD-LS-3-GE-G00-00-G-RT-001, Rev.02 09 Oct.2025)
- preliminary analysis of geological existing conditions
- basic structures design calculations – special bridges, culverts, buildings
- drainage preliminary studies.

2.4 Project facilities and infrastructure

The line is divided into 11 sections with the following main facilities and infrastructure as follows (see Table 2-1):

- construction camp sites: two main camps and three support camp sites
- concrete works/batching plants: two plants
- track works and other railway infrastructure
- signalling and telecommunications (vertical signage 260km, control centres, fibre optic and access chambers)
- borrow pits: none will be required for the Project
- rock quarries and rock crushers: four existing quarries along the corridor have been identified for potential use
- sleeper production and storage facilities: the current plan is to have a sleeper plant near Dala. OEC are also analysing an option of importing sleepers from South Africa
- marshalling yard: none will be required/constructed for the Project
- tunnels: none will be required/constructed for the project
- sidings: two locations with passing loops
- passenger stations: eight stations/locations
- river crossings: 11 bridges
- abstraction of water: five boreholes, one at each camp

- spoil dumpsites: 11 locations i.e. one in each section
- culverts: 45 locations (identified by preliminary design and remains subject to refinement during detailed design)
- potential livestock, pedestrian, and road crossings: nature, type, design and specific locations of the crossings to be determined during detailed design. At least 100 crossings of different types (e.g. pedestrians, gravel roads, earth roads, livestock, community access) exists across the proposed railway line
- waste management facilities: one collection point/centre at each camp
- waste water management facilities: one at each camp
- perimeter fencing: the whole alignment will not be fenced to allow continued community access. Fence at the major station only (Saurimo).

Table 2-2 below provides the locations of the main facilities and infrastructure along the Project route. The detailed high resolution A3 maps of each alignment section (11 Sections) with main infrastructure and community labels is provided in the Volume 2 of this ESIA Report - Appendix 01.

Table 2-2: Key Infrastructure along the Luena -Saurimo Railway route

Section ID	Start - end km points	Approx. distance (km)	Section name	Stations	Bridges	Culvert	Sidings/ passing loops	Campsites KM point	Quarries and KM point	Production/Batch plants KM point
1	0-17	17	Luena - Lumeje	1	1 (15+927 - 17+940)	1		1 Support camp KM 0+500		
2	17-58	41	Ndongue-Luxia	2	1 (57+100 - 57+360)	1		1 Main at Ndongue KM22+900		1 concrete batching plant at Ndongue camp KM22+900
3	58 – 86	28	Tchihinhi-Cassai		2 (58+270 - 58+390) and (73+500 - 74+100)	3	1		Biula access at KM 79+000	1 sleeper production plant near Biula near KM79+000
4	86-100	14	Dala - Tchiumbwe	1	1 (96+700 - 97+300)	1			Tchiumbwe river access at KM 98+000	
5	100-120	20	Tchiumbwe - Mombo		1 (113+102 - 113+137)	2				
6	120-130	10	Luele		1 (127+500 - 127+600)	5		1 support camp Luele/Luachimo KM 128+800		

Section ID	Start - end km points	Approx. distance (km)	Section name	Stations	Bridges	Culvert	Sidings/ passing loops	Campsites KM point	Quarries and KM point	Production/Batch plants KM point
7	130-149	19	Luele-Luachimo	1	1 (142+193 - 142+298)				Quarry at KM 140+000	
8	149-170	21	Luachimo - Riacho		1 (163+160 - 163+320)	3	1		Griner – access near KM 156+500	
9	170-190	20	Riacho - Caiaza		1 (188+810 - 189+150)	4				
10	190-225	35	Caiaza - Saquembue	1		17		1 Main - Caiaza KM 192+415		1 concrete batching plant at Caiaza camp (KM192+415)
11	225-260	35	Saquembue - Saurimo	2	1 (255+820 - 255+930)	8		1 Support camp at Saurimo station area KM 259+500	Catoca – 45km north of Saurimo	

2.4.1 Stations

Apart from the existing main Luena Station, the Project will construct a total of 8 new stations listed in **Error! Reference source not found.** below and **Error! Reference source not found.** overleaf. Summary of planned services and utilities at the stations are presented in Table 2-4: and Table 2-5 below. The detailed design phase will further define detailed specifications, layout, and other requirements based on the level of operational requirements, access, security, safety reasons, aesthetics and functionality requirements.

Table 2-3: Locations of proposed new stations

Km chainage	Name	Station	Buffer	Passing loops (sidings)
-6.200	Luena (City)	Existing Luena station	N/A	N/A
0+550	Luena	Station 1	700 m	
22+900	Ndongue	Station 2	700 m	
49+600	Camanongue	Station 3	700 m	
93+000	Dala	Station 4	700 m	
78+900				Loop 1
130+250	Luele	Station 5	700 m	
165+200				Loop 2
191+400	Caiaza	Station 6	700 m	
226+900	Saquembue	Station 7	700 m	
259+500	Saurimo	Station 8	700 m	

Table 2-4: Passenger and freight services at proposed new stations

Station		Ticketing offices	Passenger waiting room	Passenger disembarking platforms and approx. dimensions	Freight sorting and storage and area	Parking area	Personnel (Estimated number)
1	Luena	3 booths	100 pax	10 m x 250 m	none	4.500	To be confirmed
2	Ndongue	none	50 pax	10 m x 150 m	none	3.000	To be confirmed
3	Camanongue	none	50 pax	10 m x 150 m	none	3.000	To be confirmed
4	Dala	3 booths	100 pax	10 m x 250 m	none	4.500	To be confirmed
5	Luele	none	50 pax	10 m x 150 m	none	3.000	To be confirmed
6	Caiaza	none	50 pax	10 m x 150 m	none	3.000	To be confirmed
7	Saquembue	none	50 pax	10 m x 150 m	none	3.000	To be confirmed
8	Saurimo	3 booths	100 pax	10 m x 250 m	none	4.500	To be confirmed

Figure 2-5 Stations and some of the major crossings

Table 2-5: Utilities at proposed new stations

Station		# of Toilets	Solid waste collection point	Source of water supply	Source of power	Waste water onsite/ or pipe to third party location
1	Luena	2	Portable waste bins	New borehole	Generator	Onsite facility
2	Ndongue	2	Portable waste bins	New borehole	Generator	Onsite facility
3	Camanongue	2	Portable waste bins	New borehole	National grid	Onsite facility
4	Dala	2	Portable waste bins	New borehole	National grid	Onsite facility
5	Luele	2	Portable waste bins	New borehole	Generator	Onsite facility
6	Caiaza	2	Portable waste bins	New borehole	Generator	Onsite facility
7	Saquembue	2	Portable waste bins	New borehole	Generator	Onsite facility
8	Saurimo	2	Portable waste bins	New borehole	Generator	Onsite facility

The general station layout includes a covered canopy between the railway track and platform to enter the station building. Smaller station layouts are considered for Ndongue, Camanongue, Luele, Caiaza and Saquembue. Luena, Dala and Saurimo stations will be bigger as seen in the medium size layout shown in Figure 2-6 below.

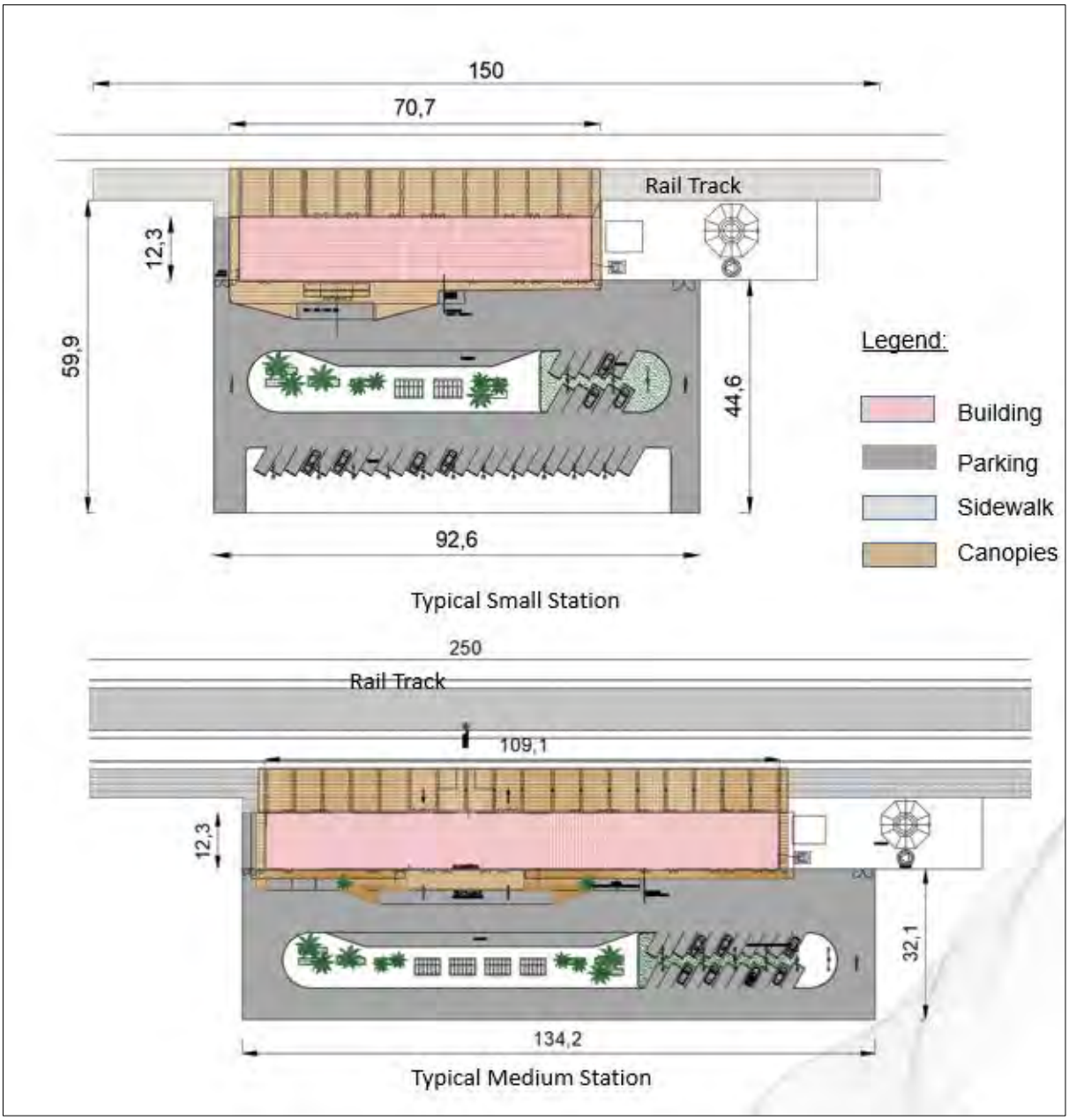


Figure 2-6: General layout of planned stations for the Luena-Saurimo Railway line

2.4.2 Camps

The Luena- Saurimo railway Project will have 5 camp sites whereby two will be Main/Major Camp sites (Ndongue and Caiaza), while the remaining three camps will be small, Support Camps (Luena, Luele and Saurimo). The camps will accommodate all construction workers who are temporarily relocated from the homes or who have to commute a long distance to get to the project site. The Ndongue and Caiaza main camps will accommodate the railway construction workforce and will also be used as secure storage sites for construction materials, equipment and supplies. (see Figure 2-7). The three small support camps will be located in or near Luena, Luele and Saurimo. The typical layout for the main camps is provided in overleaf and detailed view is attached as Appendix 02.

The camps will accommodate workers building the railway as well as serve as safe storage areas for materials and goods. At the two main camp locations, the maximum number of workers will be 1,000 people. In exceptional cases, when additional accommodation is required, the Contractor will use nearby facilities such as the IU Hotel Luena or IU Hotel Saurimo, as well as other commercial hotels in the cities of Luena and Saurimo that have already been identified for this purpose.

All camps will have their own kitchen/canteen, water treatment plants, septic tanks and storage facilities. However, the three support camp sites will follow a standardised layout, sharing common facilities. Table 2-6 and Table 2-7 provides an overview of the proposed camps.

To minimise environmental and resettlement impacts, the locations of all five camps have been selected to coincide with the future station sites, allowing the project to make use of the same infrastructure to be developed there — including power supply, water provision (boreholes) and sanitation systems. The camps strategically located adjacent to and partially coinciding with the site of the future railway stations to optimise land take for the project.

In summary, Ndongue construction camp will have the following characteristics:

- total number of rooms – 500
- total number of bathrooms – 525
- total number of kitchens – 1 industrial kitchen;
- accommodation capacity – the camp is designed to accommodate 900 people
- septic tanks – septic tanks will be installed in the industrial area (in locations distant from the planned WWTP). The tanks will be regularly managed to be collected, treated, and to be disposed of in an approved area
- water treatment plant
- underground conduits – electrical ducts, water supply pipes, sewer pipes, and stormwater drainage lines
- storage deposits – 1 covered warehouse, 1 uncovered warehouse, and aggregate silos
- concrete batching plant.

Caiza main camp will have the following characteristics:

- total number of rooms – 50
- total number of bathrooms – 50
- total number of kitchens – 1 general canteen
- accommodation capacity – the camp is designed to accommodate 100 people
- septic tanks – septic tanks will be installed in the industrial area (in locations distant from the planned WWTP). The tanks will be regularly managed to be collected, treated, and to be disposed of in an approved area
- water treatment plant

- underground conduits – electrical ducts, water supply pipes, sewer pipes, and stormwater
- drainage lines
- storage deposits – 1x uncovered warehouse;
- concrete batching plant.

The three supporting construction camps will share the following layout and characteristics:

- total number of kitchens – 1 canteen;
- workers dormitories if necessary
- septic tanks – septic tanks will be installed in the industrial area (in locations distant from
- the planned WWTP). The tanks will be regularly managed to be collected, treated, and to be disposed of in an approved area;
- water treatment plant
- underground conduits – electrical ducts, water supply pipes, sewer pipes, and stormwater
- drainage lines;
- storage deposits – 1 uncovered warehouse.

Table 2-6: Locations and size of planned construction camps

Chainage Location	Camp name	Description	Size (m^2)	No. staff on a typical day	Status of land – government/private
KM 0+500	Luena	Support camp	10,000	100	Government
KM 22+900	Ndongue	Main Camp with 500 rooms, 1 industrial kitchen and 525 bathrooms	60,000	900	Government
KM128+800	Luele	Support camp	10,000	150	Government
KM192+150	Caiaza	Main Camp with 50 rooms, 1 kitchen canteen and 50 bathrooms	30,000	100	Government
KM 259+500	Saurimo	Support camp	10,000	150	Government

Table 2-7: Utilities and facilities at planned construction camps

Chainage Location	Camp name	Source of water	Source of power	Health	Storage	Number of people accommodated
KM 0+500	Luena	New borehole	Generator	To be determined	1 uncovered Warehouse;	To be confirmed
KM 22+900	Ndongue	New borehole with own WTP	Generator	Medical assistance	1 covered warehouse, 1 uncovered warehouse, aggregate silos; Concrete batching plant	900
KM 128+800	Luele	New borehole	Generator	To be determined	1 uncovered Warehouse;	To be confirmed
KM 191+400	Caiaza	New borehole with own WTP	Generator	Medical assistance	1 uncovered Warehouse; Concrete batching plant	100
KM 259+500	Saurimo	New borehole	Generator	To be determined	1 uncovered Warehouse;	To be confirmed

Figure 2-7: Locations of proposed camps, river crossings and existing quarries along the Luena-Saurimo railway

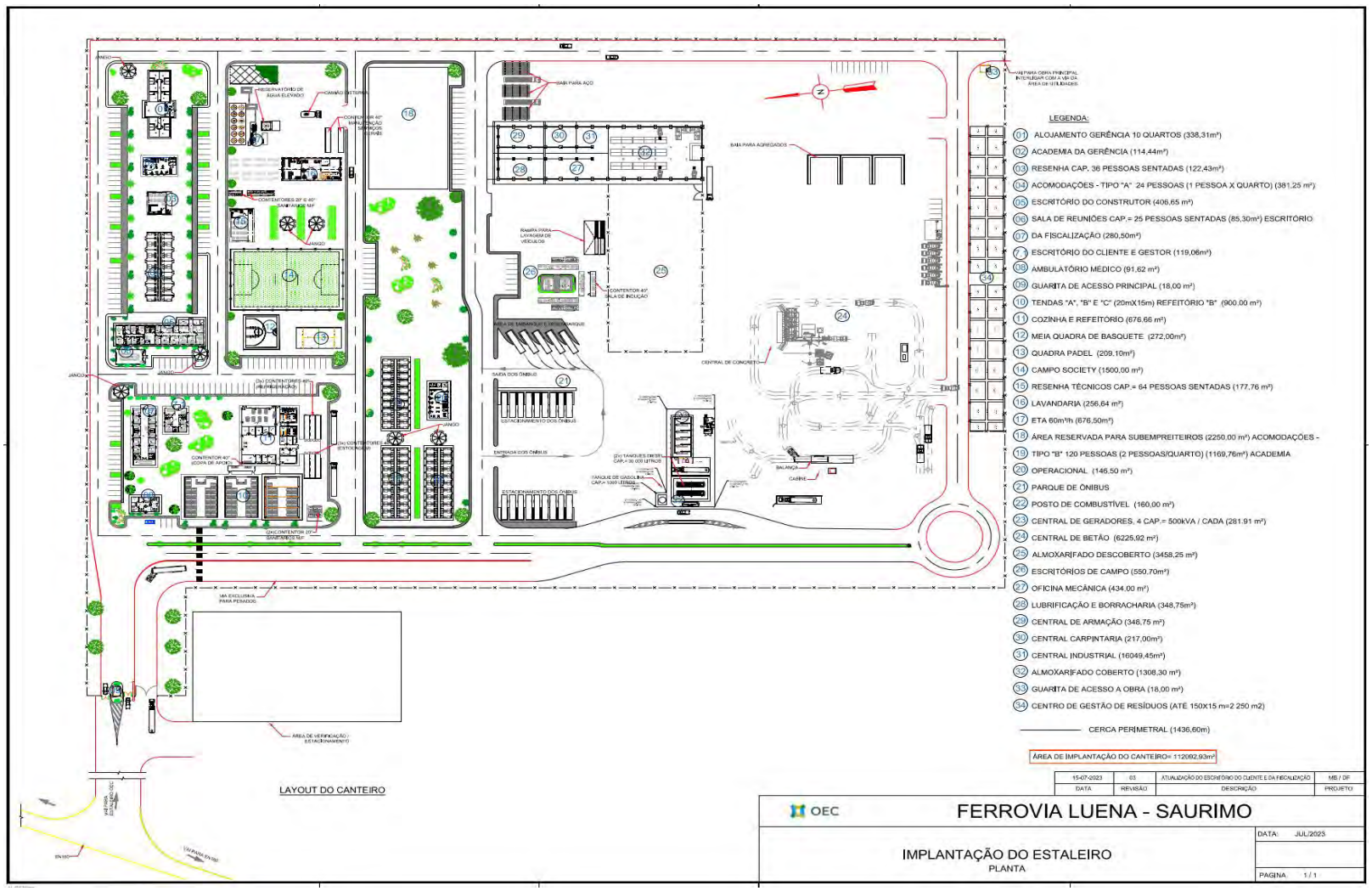


Figure 2-8: Typical layout plan of the Ndongue Main Camp

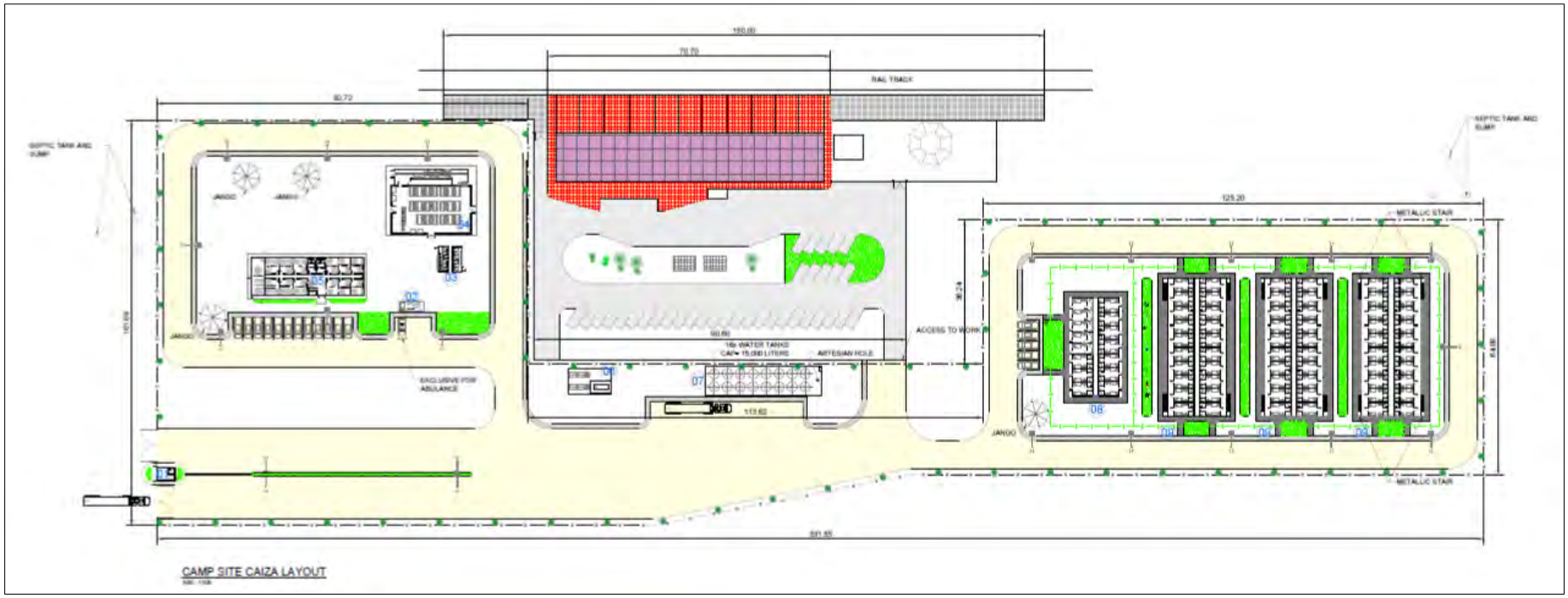


Figure 2-9: Typical layout plan of the Caiza Main Camp

2.4.3 Passing loops

There are two planned passing loops along the Luena-Saurimo Railway; one at KM71+600 and one at KM165+200. The passing loops will be 700 m long and the railway corridor at these loops will be 30 m wide.

2.4.4 Production facilities

The Project will establish two new batching plants with a capacity of 90m^3 / hour. One sleeper production and storage facility are yet to be defined. If installed, it will be located at Dala in the same location as the quarry and a concrete batching plant will be also installed. The facility will have a capacity to produce 20,000 units per month with the carousel methodology (see Table 2-8).

Table 2-8: Locations and size of batching plants and sleeper production facilities

Chainage location	Plant/Facility	Description	Size (m^2)	No. staff on a typical day	Status of land – government/private
KM22+900	Batching plant	Production of 90m^3/hour	30,000	15	Government
KM 191+400	Batching Plant	Production 20,000m^3/hour	30,000	15	Government
KM 79+000	Sleeper facilities with a Batching plant – Dala – to be defined further if it will be installed or not	20,000 units per month	30,000	20	Government

2.4.5 Bridges and culverts

The proposed project will have 11 bridges and 45 culverts. Their locations are indicated in Table 2-9 below for the culvert locations, Figure 2-10 for bridges locations and Figure 2-11 for the typical cross-section design of the bridges. All 11 bridges will have a total length of 4.55 km and piles totalling 40 km. The longest bridge will be 1,250 m. Composite deck bridges will be constructed.

Table 2-9 : Culverts along the railway corridor

Culver number	Chainage	
1	8	+ 564
2	38	+ 221
3	64	+ 098
4	70	+ 700
5	79	+ 880
6	86	+ 400
7	106	+ 968
8	109	+ 850
9	120	+ 300
10	120	+ 662
11	122	+ 090
12	123	+ 550
13	125	+ 250
14	158	+ 729
15	165	+ 300
16	167	+150
17	170	+800
18	176	+679
19	178	+700
20	181	+ 400
21	192	+ 995
22	197	+ 300
23	198	+ 590
24	201	+ 221
25	203	+ 500
26	203	+ 679
27	204	+ 426
28	204	+ 869
29	209	+ 165
30	210	+ 500
31	212	+ 150
32	212	+ 241
33	214	+ 577
34	217	+ 727

Culver number	Chainage	
35	219	+ 700
36	221	+ 631
37	224	+ 784
38	228	+600
39	231	+ 700
40	233	+ 100
41	237	+800
42	243	+ 556
43	245	+ 100
44	248	+ 222
45	258	+ 300

Source: OEC, August, 2025

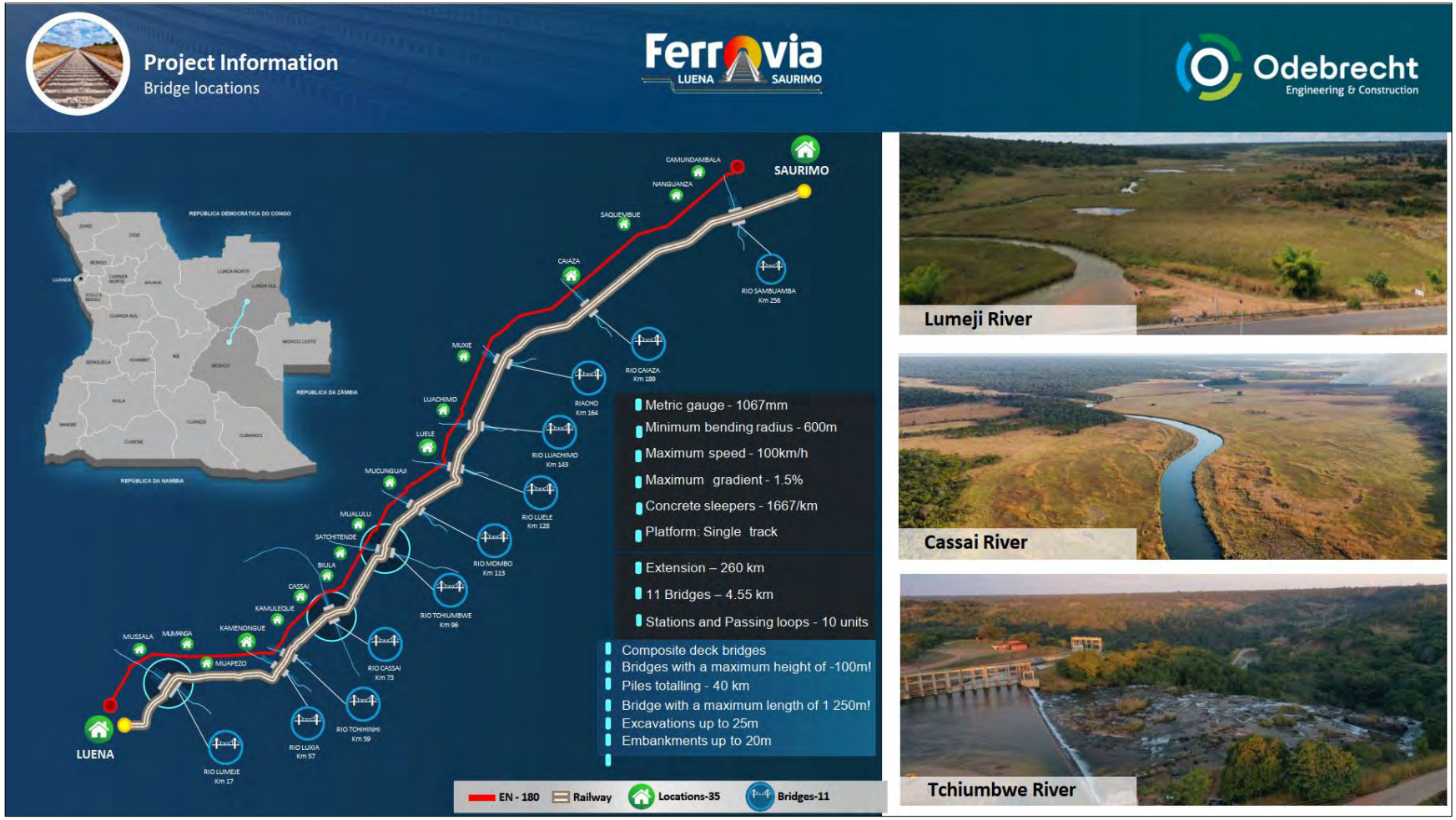


Figure 2-10 Bridges locations across the railway line

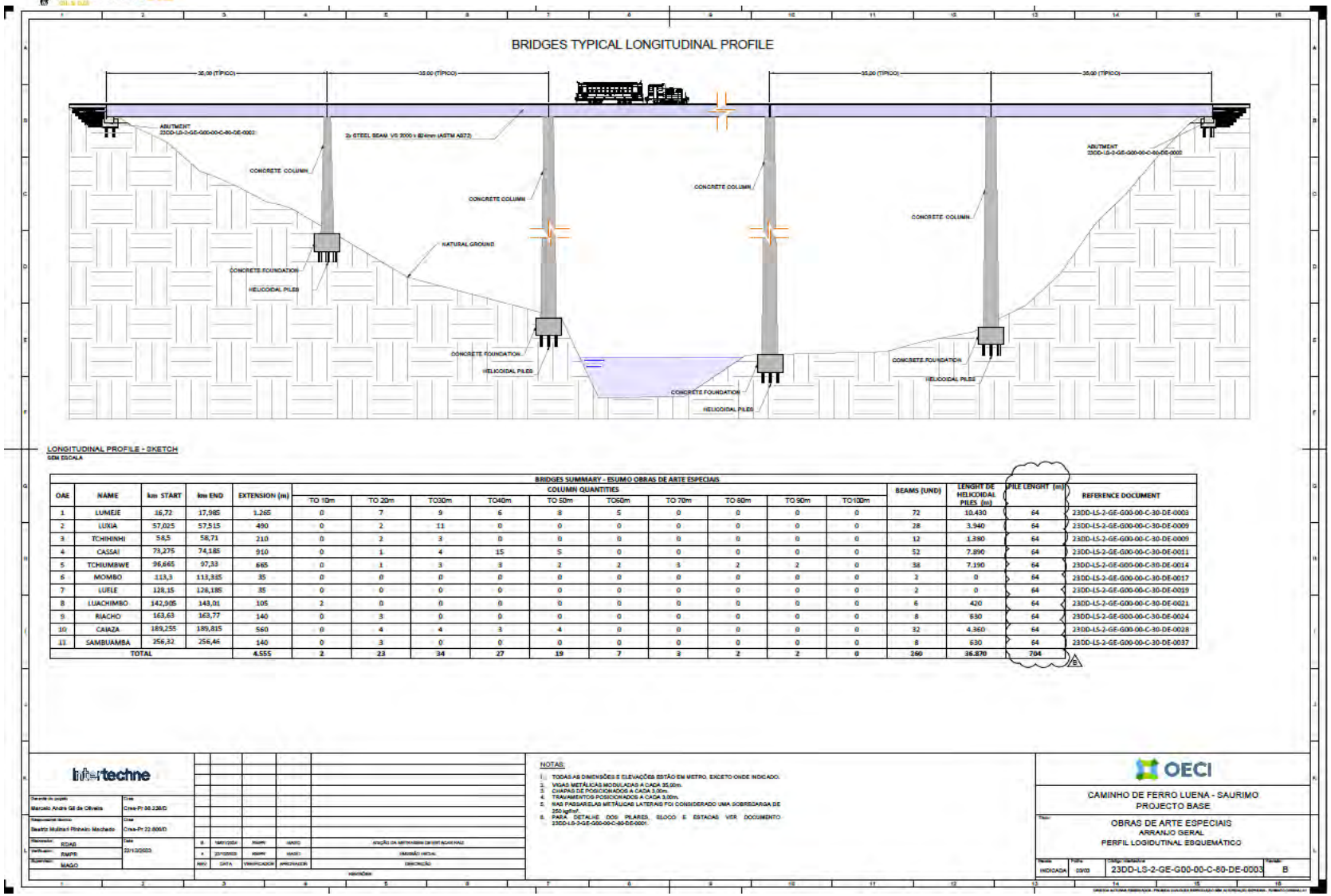
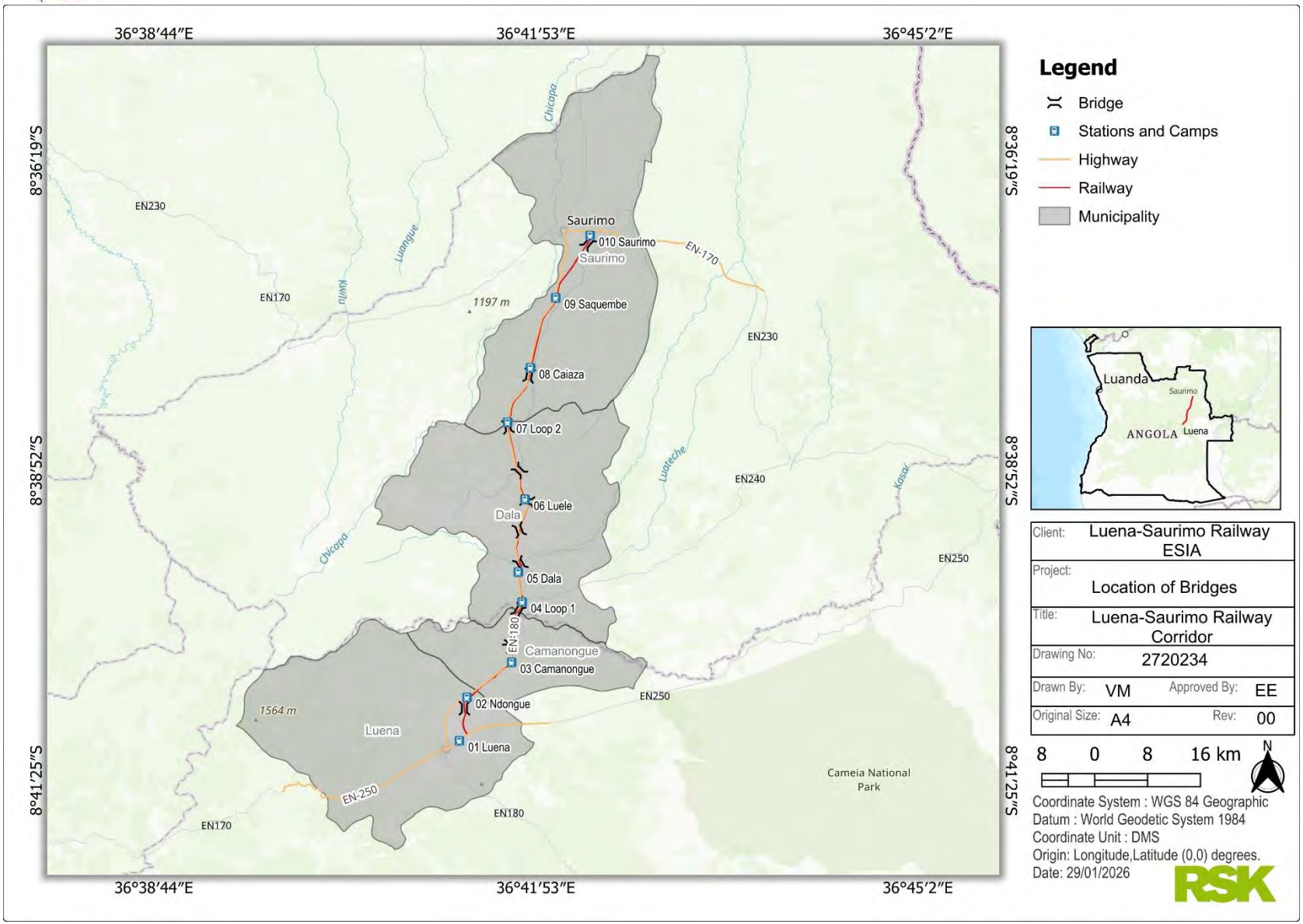
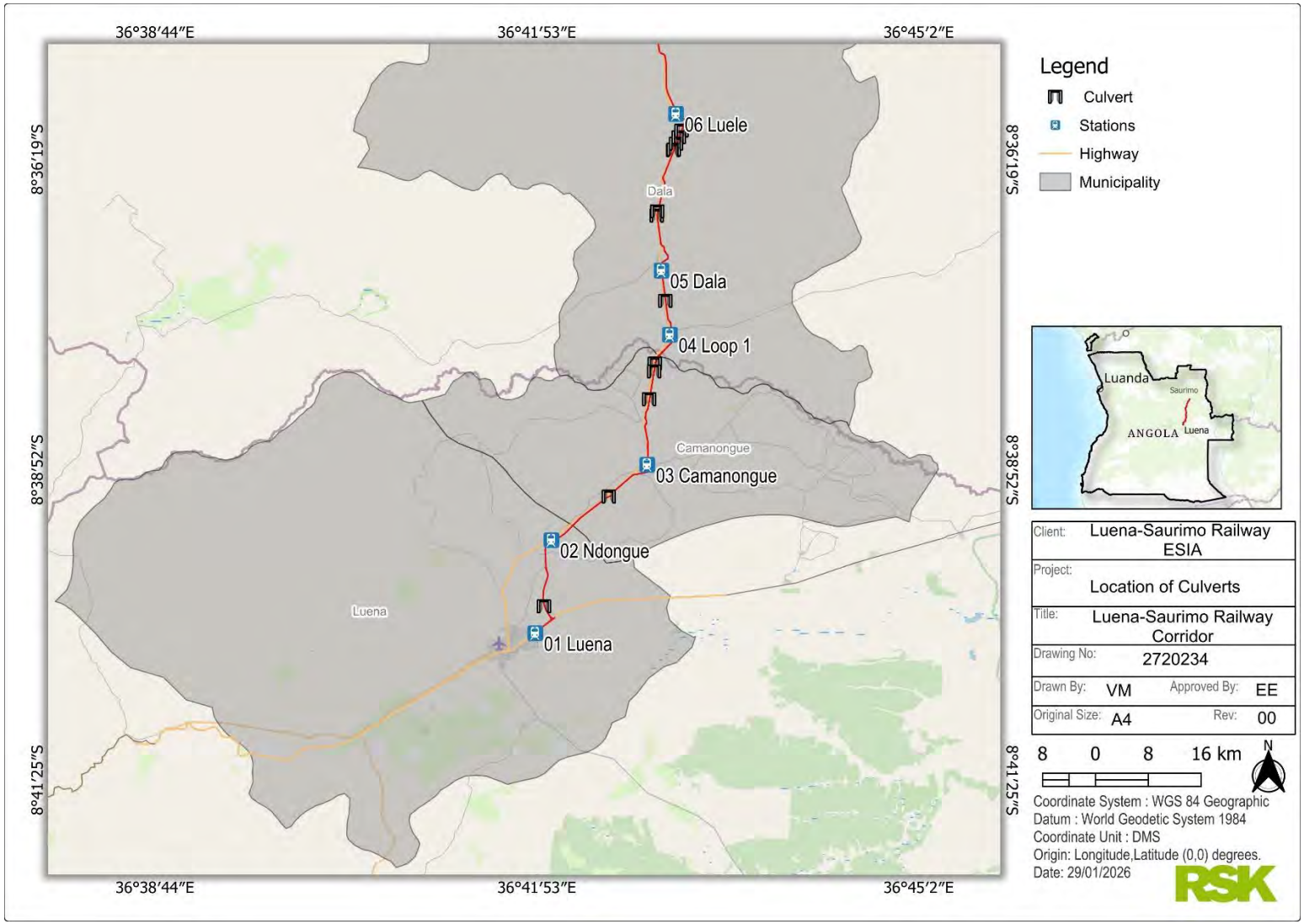


Figure 2-11: Typical longitudinal section of the planned bridges

Source: OEC, June 2024


36°38′44″E
36°41′53″E
36°45′2″E
8°36′19″S
8°38′52″S
8°41′25″S
Legend
Bridge
Stations and Camps
Highway
Railway
Municipality
Saurimo
010 Saurimo
09 Saquembe
08 Caiaza
07 Loop 2
06 Luele
Dala
05 Dala
04 Loop 1
Camanongue
03 Camanongue
02 Ndongue
01 Luena
Luena
1197 m
1564 m
EN230
EN170
EN-170
EN240
EN250
EN-250
EN180
EN-180
Chicapa
Luangue
Kwilu
Luateche
Kasai
Cameia National Park
Luanda
ANGOLA
Client: Luena-Saurimo Railway ESIA
Project: Location of Bridges
Title: Luena-Saurimo Railway Corridor
Drawing No: 2720234
Drawn By: VM
Approved By: EE
Original Size: A4
Rev: 00
8 0 8 16 km
N
Coordinate System : WGS 84 Geographic
Datum : World Geodetic System 1984
Coordinate Unit : DMS
Origin: Longitude,Latitude (0,0) degrees.
Date: 29/01/2026
RSK


36°38′44″E
36°41′53″E
36°45′2″E
8°36′19″S
8°38′52″S
8°41′25″S
06 Luele
Dala
05 Dala
04 Loop 1
Camanongue
03 Camanongue
02 Ndongue
Luena
01 Luena
Legend
Culvert
Stations
Highway
Municipality
Luanda
Saurimo
ANGOLA
Luena
Client: Luena-Saurimo Railway ESIA
Project: Location of Culverts
Title: Luena-Saurimo Railway Corridor
Drawing No: 2720234
Drawn By: VM
Approved By: EE
Original Size: A4
Rev: 00
8 0 8 16 km
N
Coordinate System : WGS 84 Geographic
Datum : World Geodetic System 1984
Coordinate Unit : DMS
Origin: Longitude,Latitude (0,0) degrees.
Date: 29/01/2026
RSK

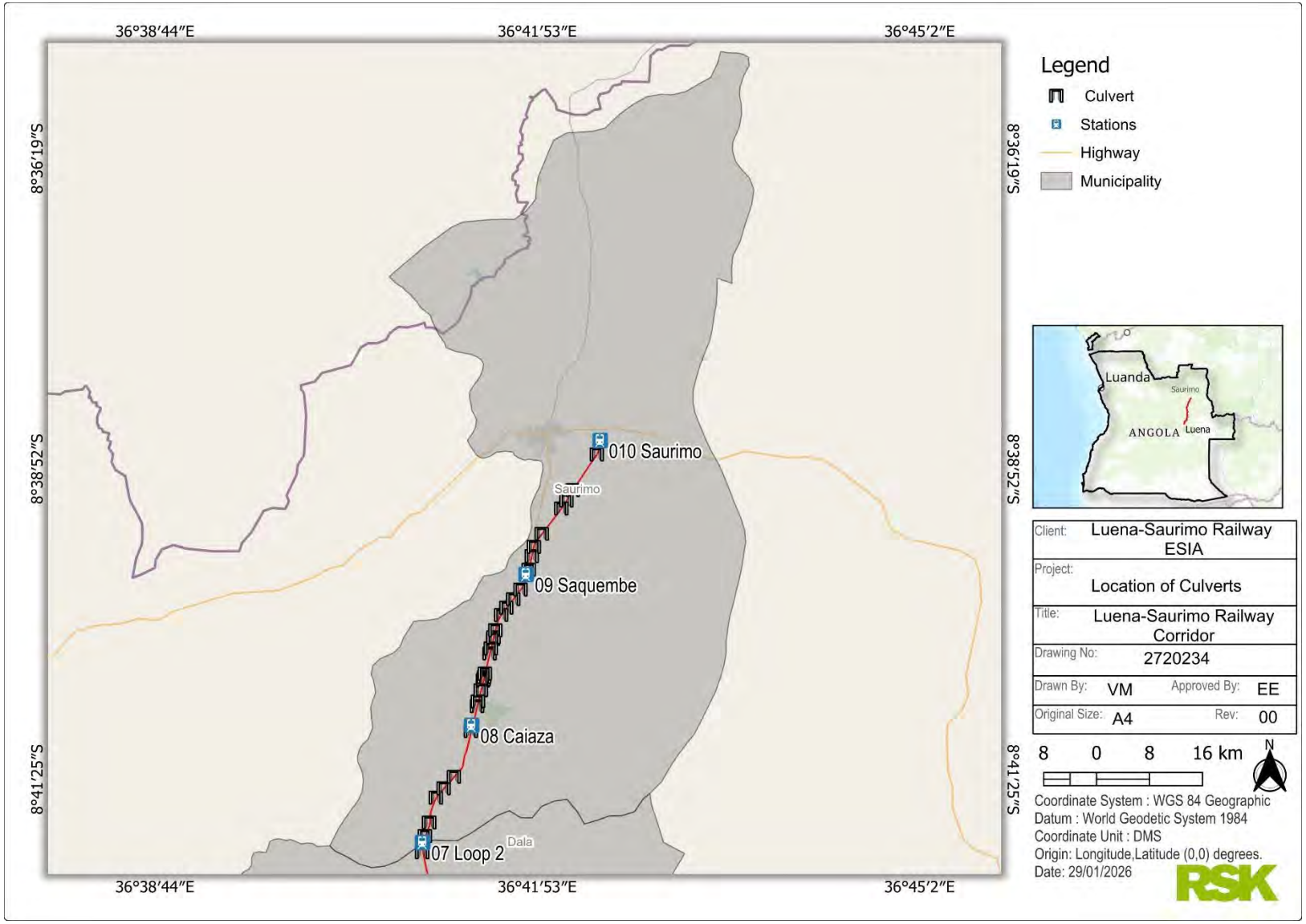


Figure 2-12 Proposed bridge and culvert locations along railway line

2.4.6 Crossings

The Project also provides specific signage for intersections between the main line and rural roads and pedestrian access routes, especially in locations close to large population centres, with level crossings being provided for these cases. Vertical and horizontal signs will be placed before the level crossings to guide the railway operator. Protective equipment for level crossings will include a physical barrier operated by its independent mechanism and vertical signalling.

More than 100 potential crossing points of different types have been identified during site visit; however, the locations and their specific designs/specifications will be refined and confirmed during the detailed design phase in accordance with international railway safety standards and best practice, to ensure continued community access, connectivity, safe crossing and avoiding severance impacts. The selection of the crossings will be informed by existing paths, access routes, technical and safety considerations, functionality as well as further engagements with affected communities to identify preferred crossing locations and local authorities obtained through the iterative detailed design processes.

2.4.7 Signalling and telecommunications

The signalling and telecommunications will include Semi-automatic signalling; centralized Circulation Control: Semi-automatic interlocking and management and on-board signalling.

The railway signalling envisaged in the implementation of the project is a “passive” signalling system that is not dependent on external power sources and will use a metronet network. The network will be compatible with the existing Benguela railway line, however, will not be connected to with other networks used for other railway operators in Angola.

A provision of ducts for the implementation of fibre optics and a programmed telephone system will be installed following the alignment of the main and railway access road. Each station will have 1 technical connection room to control/regulate the Metronet.

Signage on the main line will include vertical posts that guide railway operators about the existence of level crossings, bridges, stations and intermediate yards ahead. In addition, specific signage aims to guide the operation of the line and warn about aspects related to operational safety. The signs will be installed on the right side of the direction of railway traffic, positioned outside the safety area, in places where the railway operator can visibly see and read. The signage supports will be made of 1010 galvanized steel, have a 2” section, 4 fins (100 x 50 x 2.75 mm) with anti-rotation function, buffer plastic to prevent water from entering the post.

Signage categories includes:

- regulatory signs that indicate maximum allowed speed, Differentiated Maximum Authorized Speed, Stop and Honk
- warning signs that indicate to the railway operator to be alert and pay more attention ahead including Level crossing ahead 500m, Bridge, Men working, Stop, Full Stop, Reduce Speed, End of Safety/Precaution zone, Resume speed and restricted/Barred line

- indicative/guidance signals that support the railway operator in preparing changes in movements that include manoeuvre limits, the line number, start and end of Traffic Control (CTC), station 1 km ahead, kilometer distance markers.

2.4.8 Access roads for construction and maintenance activities

The construction traffic movements will use both a 5 m length strip on each side of the railway alignment. In alternative, the EN 180 road will be also used. The Contractor will preferentially use two 5 m length access road strips for daily movement of trucks and road vehicles.

The transport of large loads will reach Lobito Seaport and from there to Luena, the transport will be by train.

After demining, the traffic and logistic plans will be issued according to the Work Plan phases. The safety signals will move along the advance of works. The signals will be placed in panels located in the entrance of the work areas, and within the work areas to sensitize the community of our presence and safety risks to avoid accidents.

2.5 Associated facilities

In terms of the recommendation of the Council on Common Approaches for officially supported export credits and environmental and social due diligence (The “Common Approaches”, established by the Organisation for Economic Co-operation and Development (OECD), 2022), project activities and infrastructure include:

“Those components that the project sponsor (including contractors) directly owns, operates or manages and that are physically and technically integrated with the undertaking”.

In terms of IFC PS 1 (2012), this could include: “Aspects from the early developmental stages through the entire life cycle (design, construction, commissioning, operation, decommissioning, closure or, where applicable, post-closure) of a physical asset”.

The OECD and IFC both include the requirement to assess “associated facilities” as part of an ESIA. Associated facilities are, according to IFC (2012) and OECD (2022):

“Those facilities that are not a component of the project but that would not be constructed or expanded if the project did not exist and on whose existence the viability of the project depends; such facilities may be funded, owned, managed, constructed and operated by the buyer and/or project sponsor or separately from the project”.

For the purposes of this ESIA, project activities and infrastructure will collectively be referred to as project ‘aspects. However, as per above definition, there are no associated facilities currently linked to the proposed Luena-Saurimo Railway Project for the following reasons:

- the trains will be diesel run locomotives which does not require an exclusive high voltage electric transmission line
- the construction and maintenance access road along the railway line is part of the Project components
- no marshalling yards and separate/third part workshops/camps/yards are required

- existing quarries along the project route have been identified for potential use during construction activities (refer Section 2.4.2 and 2.7.1.4 above). The identified sites are used for other projects within Lunda Sul and Moxico Provinces; hence no new quarry site will be established solemnly for the railway project purposes

2.5.1 Consideration of demining works

Angola is one of the signatories of the United Nations Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction (1997)[1]. The National Mine Action Agency (ANAM) is the overall national focal point regarding the Convention and yearly reporting as per Article 7 requirements. This treaty addresses the humanitarian impacts of landmines, aiming to protect civilians, livestock, and wildlife and to support post-conflict recovery. Under the Convention, the Angolan government is obligated to demine the entire country, document and destroy all known landmines and report progress annually.

Demining activities throughout Angola are fully controlled and undertaken by specialised Demining Brigades within National Demining Centre (Centro Nacional De Desminagem - CND), under the Ministry of National Defence, Former Combatants and Veterans of the Homeland. Like the rest of other projects in Angola and nation-wide clearance as per UN Convention, the proposed Luena-Saurimo Project is not in charge or in control of the demining works.

Demining along the proposed railway route was undertaken by CND from February 2025 and completed in September 2025 and certificate of clearance was issued for the Project. Overall, 27 mines, 2,000 munitions, over 9,500 metallic fragments and 33 projectiles were cleared along the 260 km corridor. The works covered the railway line 60 m RoW (30 m on each side of the centreline), stations and camp footprints and extended further in areas where high concentration of unexploded ordinances were detected.

While demining could, in principle, be considered an enabling activity under IFC PS1 and OECD Common Approaches, in this case it is the responsibility of the CND as part of nationwide campaign to clear the whole country with focus on infrastructure development and safety priorities. Demining along the EN180 highway corridor, a main transport route had already been initiated for other development initiatives most notably the EN180 highway and high voltage overhead transmission line established within the same corridor; and is not exclusively required for, nor dependent on the Luena–Saurimo Railway Project. Consequently, demining does not meet IFC's definition of an Associated Facility. Further, demining typically is associated with side effects such as vegetation clearance, crops and community and workers health and safety risks due to the nature of the works. However, during additional site visit conducted in September and October 2025 after demining works, sampled community engagements and site verification undertaken along the railway corridor (e.g. KM37 Muapezo, KM79 Biula, KM107 Satxitende, KM121 Mucunguaji, KM129 Luele, KM191 Caiaza and KM227 Saquembue) local leaders and communities confirmed that demining team conducted engagements with the community members ahead of works, and crops/farmlands were not destroyed. Non-intrusive methods were applied in the farms since crop areas were deemed safe at first place.

[1] https://legal.un.org/avl/ha/cpusptam/cpusptam.html

In addition, any other uncaptured demining related impacts on crops/farmlands or assets (if any) along the project footprint will be verified during detailed stakeholder engagement at each Project Affected Community for the RAP and associated asset survey.

In terms of biodiversity, insignificant vegetation clearance occurred in some spots were high concentration of ordinances were detected. However, none of the cleared vegetation are of conservation concern under IUCN and Angolan guidelines. See Figure 2-13 as sample at Saurimo proposed station area.

Further, the un-anticipated incidence of unexploded ordinances is addressed under Unplanned Events in this ESIA (Chapter 10.7).

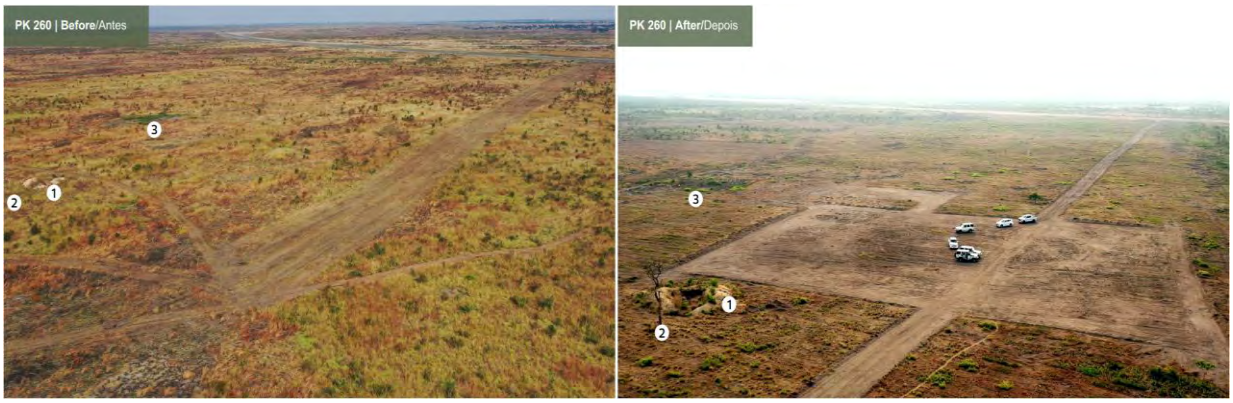


Figure 2-13 Sample vegetation clearance before and after demining works at Saurimo station area (KM260)

2.6 Project phases and activities

This section provides an overview of the proposed Luena Saurimo Railway key activities during the pre-construction, construction and operational phases posing potential environmental or social risk/impact.

2.6.1 Pre-construction activities

The following activities are anticipated to take place once the necessary environmental authorisations, permits and/or licenses are in place:

- detailed site investigations e.g. geotechnical, topographical, hydrological etc.
- preliminary and detailed engineering designs
- demining of servitude area (search and removal of unexploded ordinances)
- permits: relevant permits for intrusive investigations, water abstraction, import or material and equipment. The un-anticipated incidence of unexploded ordinances is addressed under Unplanned Events in this ESIA
- procurement will consider all the import/export of materials/equipment that comes abroad. In this regard, the rail, the slippers, and metallic beams, as well as rail assembly equipment will be dealt in advance, to avoid delays to the construction phase and obtain the necessary permits for the importation of such materials
- establishment and demarcation of land for all project infrastructure i.e. campsites, stations, batching plants, sleeper production and storage facilities
- land access: Land Access is Owner's responsibility. The quarries planned are existing however necessary procedures to access for extraction purposes needs

to be competed. In addition, confirmation that all land at the proposed locations for stations and camps is acquired and demarcated for the project

- site clearance (brush cutting and grubbing), stockpiling and re-use/ disposal
- topsoil removal and stockpiling for reuse, stripping.

Table 2-10: Pre-construction aspects and sub-aspects

Aspect	Sub-aspect
Pre-Construction phase	
Establishment of workforce and equipment's	• permits • procurement of imported materials and equipment • recruitment and induction of workforce • establishment of camps facilities and workers accommodation
Enabling works (the activities associated with the large-scale transformation of the direct project footprint)	• site investigations (geotechnical and geophysical) • land access • demolitions, removal and relocations of pre-existing structures and utilities (where applicable) • vegetation clearance (brush cutting and grubbing), stockpiling and re-use/ disposal • topsoil removal and stockpiling for reuse • stripping and stockpiling subsoils for reuse or spoil • spoil stockpiling and spreading

2.6.2 Construction phase activities

The construction phase is expected to take 60 months, depending on selected alternative and weather conditions at the time of construction and due to agreed milestones. In summary, this phase will entail the following (not necessarily in the order described):

- mobilisation of workers, machinery, construction equipment
- transportation of all required materials, equipment, and components to the camps sites
- establishment of access roads
- railway track superstructure and track works (track assembly, alignment)
- earthworks (excavation, cut and fill, quarrying soils for embankments)
- landscaping (crossing works, drainage work)
- establishment of work fronts and construction phases
- construction of railway bridges and culverts
- construction of passenger stations
- execution of passing loops
- signalling and communication systems installation
- concrete works (batching plants, sleeper production and storage)
- waste production management and treatment
- abstraction of water

- demobilisation of construction work sites and rehabilitation of construction work areas.

Table 2-11: **Construction phase aspects and sub-aspects**

Aspect	Sub-aspect
Construction phase	
Cut and fill, quarries, dumpsites, sleeper production and concrete works	• cut and fill, borrow pits and stockpiling • blasting and rock breaking • excavation / extraction • crushing • concrete works/batching plants • sleeper production or importation and storage
Construction (building) activities	• construction of access roads • construction of campsites • development of drainage/ stormwater management systems and culverts • construction of embankments and foundations • composite deck bridges construction • establishment of underpasses, over passes, level crossings and other specialised crossings for pedestrians, livestock, mammals, vehicles, railways and services (as applicable) • establishment of railway line and laying of rail infrastructure • construction of stations (including ancillary structures, services, and utilities) • resource usage • spill containment and management • service/maintenance and emergency repairs of heavy equipment/plant and light vehicles • metal works, coating and painting • laydown/storage of materials, storage of dangerous and hazardous materials
Movement of vehicles and plant	• transportation of workers • transportation of construction materials • movement of abnormal loads • temporary obstruction of roads, accesses, livestock routes and footpaths
Generation and disposal of waste	• waste management hierarchy: avoidance/prevention, reduction, re-use, recycle and recovery new dumpsites (domestic waste and sewage sludge) • use of existing waste facilities • liquid wastes/effluents (other than sewage)
Wastewater management/ treatment (sewage and domestic wastewater)	• wastewater treatment plants • septic tank systems

Aspect	Sub-aspect
	• sludge management/handling
Large scale procurement	• goods and services through primary supply chain • sustainable sourcing and supply chain management
Water use	• abstraction of water (ground water) • municipal water
Demobilisation	• removal of redundant/temporary structures/features, closures, and stockpiles • rehabilitation and restoration

2.6.3 Construction scheduling

The construction duration of the project will be 60 months. Starting date foreseen in 2026 with definitive date yet to be defined. and it is expected to have an operational lifespan of a 100 years.

In consultation with the Contractor, the ESIA team has applied the following work programme (Table 2-12) during the 60 months construction period as the basis for respective noise and air quality assessments.

Table 2-12: Indicative work program of the main construction activities

Main Activities	Start	Finish	Total Months
1. Early Works (Geotechnical and Mobilization Works)	2	15	14
a. Site Clearance and Grubbing	2	13	12
b. Site and Temporary Camps Establishment	2	15	14
2. Earthworks and Civils	6	42	37
3. Track Works	26	58	33
a. Ballast and Track Laying	26	57	32
b. Ballast Distribution	26	57	32
c. Ballast Tamping	26	58	33
4. Signalling & Telecommunication Works	35	60	26
5. Passenger Station, Freight Facilities, Permanent Camp Establishment	34	57	24

2.6.4 Operation and maintenance activities

Activities during operation include:

- asset management
- resource management
- operating and maintenance (workshops, control centre)
- fuel supply, storage and management
- materials management

- regular clearance (brush cutting) of the railway servitude and track
- operation and maintenance of waste of waste facilities.

The planned locomotive type during operation is the GE C30ACi (General Eléctric - USA) diesel engine with a Gross Max Power of 3,300 GHP. The foreseen longest train is with 40 wagons and 2 locomotives i.e. 560 m for cargo trains. Passenger trains will be up to a maximum of 20 carriages. The average travel lengths are determined and published in the five-year Extra-Strategic and Business Plans developed by CFB.

The planned railway service operations will include:

- daily transportation of fuel and the return trip will carry various goods. Expected tons of goods to be transported to the proposed development is 600,000 tons
- expected annual number of passenger trips to the proposed development: 1,460 trips/trains. This is on average four daily trips/trains between Luena and Saurimo: 2 passengers and 2 cargo trains per day. Therefore, maximum number of daily movement of trains envisaged is four (4) trains
- nature of cargo that will likely be transported on the completed line includes aggregates, agricultural products, cement, diesel. The volumes are not yet defined
- locomotives will park at the respective stations between schedules. There is no yard for locomotives anticipated between Luena and Saurimo
- trains during the night are currently not envisaged.

Table 2-13: Operation phase aspects and sub-aspects

Aspect	Sub-aspect
Operational phase	
Operational – general	• operation and maintenance of railway equipment and infrastructure
Railway service operation	• control / operation of rolling stock, maintaining services and safety management • fuel supply • energy resource usage and management
Maintenance of RoW and stations	• maintenance and improvements

Marshalling yard, workshops	• operation and maintenance of facilities and equipped infrastructure (i.e. specialised infrastructure, tools, machinery and equipment used for operation and maintenance of fleet/rolling stock)
Quarries and borrow pits	• operation of remaining open/active borrow pits • maintenance and rehabilitation of closed sites
Waste and wastewater	• operation and maintenance of waste separation/storage facilities • project dumpsites • wastewater treatment plants and septic tanks
Fuel supply	• delivery of fuel for operational purposes • emergencies related top accidents and spillage incidents

2.6.5 Decommissioning

The design and operational lifespan of the Luena-Saurimo railway is estimated to be 100 years. Decommissioning of the infrastructure is not envisaged in the near future. Periodic maintenance and rehabilitation works are expected to be undertaken. In the longer run, the railway line could be upgraded depending on prevailing conditions.

2.7 Resources requirements and embedded resource efficiency measures

This section presents the preliminary design estimates of resources and utilities that will be refined during the FEED phase and design considerations of the resource efficiency. The resource use efficiency is an ongoing process which will be further considered in detail during detailed design phase.

2.7.1 Construction phase

2.7.1.1 Workforce

A peak of 1,000 employees is expected whereby the labour force will constitute 15% skilled, 60% semi-skilled and the remain will be unskilled. Regarding female participation in this Project, it is important to note that in the skilled and semi-skilled spectres, the collaboration of female will be significantly higher than in the site works, an estimate 30% of female to fulfil the Engineer, Planning, Design, Canteen and Cleanings categories.

It is currently estimated that 80% of the workforce will be from the Project area with 93% being Angolan nationals for the entire Project (construction and operation).

2.7.1.2 Workers' accommodation

Construction workers recruited from other places in Angola/outside local communities and internationally will be accommodate at the camps as presented in Section 2.4.2 above. The design, planning, construction, operation and maintenance of the workers' facilities will be based on Angola's national requirements, OEC SOPs, IFC Performance

Standard 2 (Labour and Working Conditions) and IFC & EBRD Guidance Note on Workers' Accommodation: Processes and Standards, 2009. The Project's Worker Accommodation Plan (OECLS-AF-PG-GER-001-OECLS, 29 August 2023) includes appropriate key standards for worker accommodation, which are broadly in line with the IFC/EBRD guidance note for key aspects.

Overall principles considered includes but not limited to health and safety considerations e.g. structures, light, ventilation, hygiene, water supply etc.; workers' wellbeing; living space – beds and number of occupants; gender and privacy considerations; support facilities; management and maintenance; and compliance requirements. Welfare areas will be configured to meet international standards on worker wellbeing and comfort, with provisions for potable water, shaded rest zones, and hygienic sanitary facilities.

OEC will provide accommodation to all workers who are temporarily relocated from their usual place of residence, including Angolan nationals coming from other provinces or residing too far from the construction sites to commute daily. Workers who do not have access to adequate transport, whether public or organised by OEC, will therefore be entitled to accommodation at the construction camps.

OEC will ensure that all worker accommodation facilities are regularly inspected to maintain compliance with national health, safety, and environmental standards. These inspections will cover hygiene and sanitation conditions, water quality, waste management, safety measures such as fire protection and emergency exits, structural integrity, and overall living conditions.

Internal inspections will be conducted weekly by the OEC's on-site Sustainability Team (Environment, Safety, Health and Social Responsibility), ensuring that potential issues are promptly identified and corrective actions implemented when necessary.

The management of worker accommodation facilities will be coordinated by the Administrative Director and the Sustainability Director, together with their respective teams, who will oversee the overall operation of the camps. Their responsibilities include ensuring that accommodation management aligns with established regulations and promoting periodic inspections to maintain quality, safety, and environmental performance.

Day-to-day management will be handled by the Construction Site Manager, supported by staff responsible for maintenance, catering, security, and hygiene. The Sustainability Director will conduct regular inspections and audits, while the Construction Site Manager will ensure the proper functioning of infrastructure and utilities. Housekeeping and cleaning staff will maintain hygiene standards, and the security team will oversee the safety of workers and property. This integrated management structure ensures that living conditions remain safe, clean, and compliant throughout the construction period.

2.7.1.3 Materials and equipment/plant

Procurement will take into account all the import/export of materials/equipment that comes abroad. In this regard, the rail, the sleepers and metallic beams, as well as rail assembly equipment should be dealt in advance, to avoid delays to the construction phase. Based on the project's procurement plan and to meet technical specifications and ensure quality of the development, key project materials and equipment will be sources from countries including Netherlands, Poland, Republic of South Africa and United

Kingdom. While this international procurement is necessary, the project is committed to the utilisation to local material and equipment where feasible.

The estimated amount of materials for the track will be:

- steel 15,000 tons
- rails 531 Km
- sleepers 396,000.

The construction phase will have the following equipment. However, the equipment and plant inventory will be updated at later stages during detailed design.

- 200 trucks
- 40 cylinders
- 14 CAT D6
- 20 backhoes
- 4 mobile crushing plants
- 1 stationary crushing plant
- 3 mobile concrete plants, including one concrete plant to be at the sleeper plant.

The following equipment list was developed in consultation with the Contractor and has been adopted for the purpose of this ESIA (Table 2-14):

Table 2-14: Adopted equipment list used for the ESIA assessment

T1.1 Site Clearance and Grubbing	T1.2 Site and Camp Establishment	T1.3 Earthworks and Civils	T1.4 Signalling and Telecommunication Works	T1.5 Ballast and Track Laying
Tracked excavator	Lorry with lifting boom	Dump truck (tipping fill)	Tracked excavator	Tracked excavator
Dozer	Lifting platform	Dozer	Dump truck (tipping fill)	Hand-held welder (welding piles)
Wheeled backhoe loader	Tracked excavator	Tracked excavator	Diesel generator	Diesel generator
Hand Tools	Wheeled backhoe loader	Wheeled backhoe loader	Lorry with lifting boom	Impact Driver
Dump truck (tipping fill)	Hand Tools	Hand Tools	Hand-held welder (welding piles)	Hydraulic breaker power pack
	Dump truck (tipping fill)	Grader	Hand-held circular saw	Wheeled backhoe loader
		Water Tanker	Hand Tools	Hand Tools
		Vibratory roller	Lifting platform	
T1.6 Track Works	**T1.7 Ballast**	**T1.9 Rock breaking**		
Track Grinding Machine	Ballast Equaliser	Tracked excavator		
Angle grinder (grinding steel)	Ballast Tamping	Breaker mounted on excavator		
Road Rail Vehicle (RRV)		Dump truck (tipping fill)		
Hydraulic breaker power pack		Hydraulic breaker power pack		
Hand Tools		Hand Tools		
Area Specific				
T2.1 Culvert and Bridge Works	**T2.2 Ballast production**	**T2.3 Foundations (piling)**	**T2.4 Foundations (concreting)**	**T2.5 Steel and Framework**
Tracked excavator	Diesel generator	Tracked excavator	Dump truck (tipping fill)	Wheeled mobile telescopic crane

Dump truck (tipping fill)	Tracked excavator	Dump truck (tipping fill)	Concrete pump	Concrete pump
Tracked mobile crane	Atlas Copco FlexiROC T35 Drilling Rig	Vibratory piling rig	Diesel generator	Diesel generator
Wheeled backhoe loader	Tracked crusher	Diesel generator	Tracked excavator	Lorry with lifting boom
Diesel generator	Roller	Hand-held circular saw (cutting paving slabs)	Vibratory Poker	Concrete mixer truck
Vibratory roller	Hydraulic breaker power pack	Hydraulic breaker power pack		
	Vibratory roller			
	Wheeled backhoe loader			

2.7.1.4 *Energy and resource-use efficiency considerations*

The project development requires energy for construction and operation phases, typically in the form of electricity and fuel. The electricity for the construction phase will be provided from generators for the stations and camps (both main camps and support camps). The estimated electrical consumption for the construction phase of the project (including construction of track/stations/associated infrastructure, landscaping, earth works, and drainage) is 137,200,350 kWh and the total estimate amount of fuel required is estimated at 51,596,762 litres of diesel. The primary source of fuel will be from an existing depot in Luena. The respective camp sites are planned with a designated fuel storage area and refuelling station for construction vehicles.

Energy efficiency strategies incorporated in the design for the Luena–Saurimo Railway Project include optimized design, renewable energy integration, and operational audits. These measures aim to reduce the carbon footprint and enhance sustainability across all phases of the project. The overall Energy Efficiency Strategy is based on the best international practices and technical modules detailed below:

- design and construction – temporary and permanent facilities
  - use of energy-efficient materials and construction methods e.g., optimized earthworks, low-loss track design
  - stations and facilities designed for natural lighting, ventilation, and insulation.
  - installation of LED lighting, high-efficiency HVAC, and variable frequency drives for pumps
- renewable energy sources integration
  - solar photovoltaic (PV) systems will be used to supply power to station facilities and auxiliary systems.
  - solar energy is also being considered for lighting the internal circulation routes of the construction site and its access roads
  - assessment of hybrid or renewable energy solutions for remote facilities will be carried out
- electrical installations and equipment
  - four generator units of 500 kVA each and four units of 60 kVA distributed across the work fronts will be used for power supply at the Camps
  - all lamps purchased for buildings (accommodation, offices, laundry, kitchen, etc.) will be LED
  - all household appliances used in the accommodation (air conditioners), kitchen (industrial equipment, refrigerators, etc.), and offices (computers, monitors, printers, etc.) will be new and compliant with energy efficiency standards
- monitoring and continous improvement
  - energy audits and benchmarking will be performed (energy use per ton-km per facility)
  - Key Performance Indicators (KPIs) will be defined for energy consumption and greenhouse gas (GHG) emissions
  - annual reporting and reviews of energy performance will ensure continuous improvement and compliance with sustainability objectives.

2.7.1.5 Quarries

The total main construction materials expected for the entire project will be:

- concrete 120,000 m^3
- aggregates 850,000 m^3

The supply of aggregate will be from existing quarries along the project corridor to avoid a new quarry for this Project. The four quarries identified are (Figure 2-14):

- Dala – access route near Km 98+000
- Cóxi – Biula – access route near Km70+000
- Pola/Griner – access route near Km165+000 currently being used by the Griner Construction Company
- Catoca Mine – 45 km north from Saurimo.

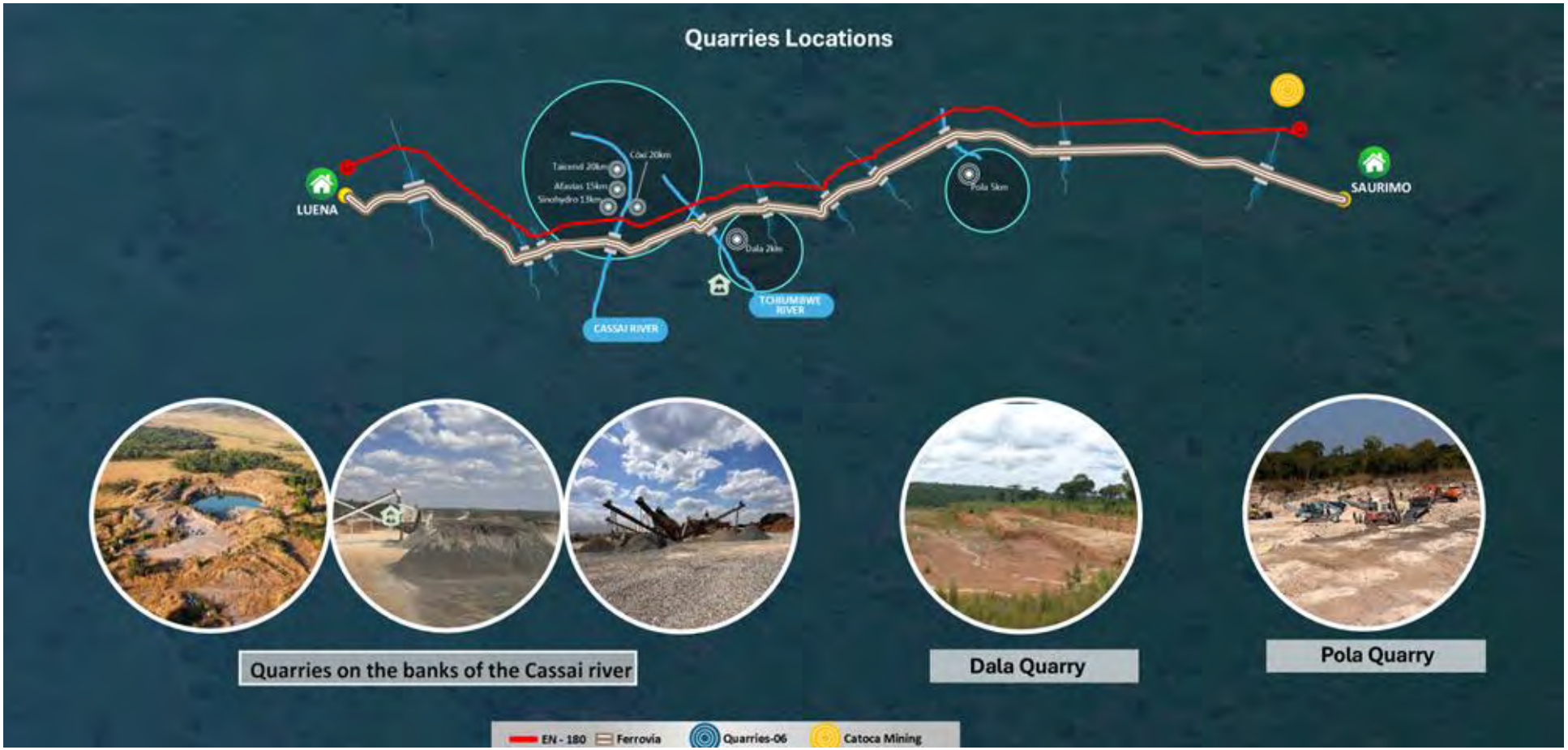


Figure 2-14: Locations of existing quarries to be used for the Project

Source: OEC, March 2024

2.7.1.6 *Soil materials*

There are no new burrow pits planned for the construction of the Luena-Saurimo Railway. The contractor studied the rail corridor to achieve an objective of practically activating topsoil which will be reused in slope coating and in the access roads. The construction plan during the railway corridor shall:

- obtain partial balance of volumes and reduce volumes handled between sections
- restrict construction traffic to defined areas and stay between physical barriers: i.e. rivers
- minimise the “average transport distance”
- reduce in the amount of equipment, especially trucks (diesel, oil, maintenance, etc).

The design assumption, based on the cut and fill quantities, is to have a balance between both in each section (the sections are divided between each bridge - rivers) so, there is global balance of earthworks. In some cases, the contractor will transport the excess material between sections e.g., if section 1 requires 7,200 m^2 of fill material and Section 2 has 7,400 m^2 in excavated from earthworks, the excess will be transported to Section 1. Based on this design assumption, the contractor does not find it necessary to have borrow pits outside the planned earthworks areas and the transportation distance has been reduced.

2.7.1.7 *Water sources, abstraction and resource use efficiency*

Water use during the construction phase will serve as several purposes, including (but not limited to):

- suppressing dust generated by construction activities
- compacting soil to achieve soil stability and load-bearing capacity
- concrete mixing
- masonry works
- equipment cooling
- human consumption.

During the 60-month construction phase, total water consumption is estimated at approximately 252,000 m^3, corresponding to about 4,200 m^3 per month for general construction works and an additional 50,000 m^3 for specific earthworks and concrete preparation.

Given the scale of railway construction activities, two primary water sources are foreseen:

- groundwater abstraction – via boreholes to be drilled at each camp (5 camps) equipped with submersible pumps, located inside the administrative yards within the designated Water Technical Areas at each camp
- surface water abstraction – where available, rivers near the construction sites (notably at Ndongue and Caiaza) may serve as supplementary water sources.

As of September 2025, after completion of demining works, detailed hydrogeological assessments are now possible. The Project is planning to execute a Pilot-hole drilling and lithology logging at each planned borehole location to obtain data on water parameters such as yield, depth, and capacity. A hydrogeological study will also be

conducted to determine safe abstraction limits and prevent de-watering the aquifers or limiting the access of water for neighbouring communities. Water samples from the test-boreholes will be analysed in a licensed local laboratory to assess chemical and physical quality parameters.

To minimise consumption, the Contractor will reuse water (grey water) for non-potable purposes, including soil wetting, dust control, washing of vehicles, equipment and plants, cleaning of workshops and loading areas, and irrigation of vegetation.

To minimise water system leaks during construction, the Contractor implements maintenance inspections to detect leaks and execute repairs and/or replacements.

Water treatment and distribution

The water treatment will be based on Consortium's practices, national and international standards and best practices to be fully defined after the execution of detailed hydrogeological assessments. Two main treatment methods will be applied: conventional and simplified treatment.

Conventional treatment:

- process steps: coagulation (e.g., PAC), flocculation (hydraulic chicanes, Gfloc ≈ 40 s^{-1}), sedimentation (high-rate settlers), rapid filtration (anthracite/sand/gravel), and disinfection with sodium hypochlorite (5 mg/L, 30-min contact time).
- design parameters: ground reservoirs sized for ⅓ of daily maximum flow and elevated tanks for 1/30. PVC-PBA distribution network (minimum diameter 50 mm, maximum velocity 2 m/s)
- chemical dosing: Automated dosing pumps with regular calibration; residual chlorine and continuously monitored pH.

Simplified Treatment (for smaller support camps):

- process steps: slow sand filtration (1 m sand, 0.25–0.35 mm, two filters in parallel), followed by disinfection and pH correction (soda ash or caustic soda)
- design: suitable for smaller or lower-risk sources; manual or semi-automated operation.

Treated water will be stored in surface tanks and distributed through HDPE piping network to accommodation, kitchens, workshops and other facilities. A total of 13 interconnected PVC tanks (each 15,000 L, total capacity 195,000 L) will be installed to store raw, treated, and reuse water**.**

Water consumption and re-use measures

The activities requiring the largest water volumes include earthworks – embankments and compaction of soil layers, concrete production, food preparation for the workforce, and dust suppression on access roads and construction areas.

To minimise consumption, the Consortium consider water reuse for dust suppression and irrigation. Reuse water will be allocated for non-potable purposes, including soil wetting, dust control, washing of vehicles, equipment and plants, cleaning of workshops and loading areas, and irrigation of vegetation. These measures aim to close the water use cycle, ensuring efficient and sustainable management in accordance with Angolan environmental legislation.

2.7.1.8 *Waste generation and management hierarchy*

The Project will generate various types and quantities of construction-based waste, hazardous wastes, domestic waste, wastewater and effluents form construction activities, camps and other facilities. A maximum area of 2,500 m^2 is foreseen within the main construction camps to serve as the Waste Management Centre (WMC). Overall, all types of wastes will be managed as per construction Stage - Waste and Hazardous Materials Management Plan PI-MP-007-OECLS. Recycling, reuse and recovering practices will be promoted throughout the supply chain.

As part of efforts to achieve zero waste to landfills, the project's overall waste management strategy and decisions are ground on the principles of waste management hierarchy (see Figure 2-15) whereby detailed specific approaches at each hierarchy level are provided in the updated construction Waste Management Plan (PI-MP-007-OECLS). As per the hierarchy, waste prevention is the most preferred priority, followed by waste reduction, waste reuse, waste recycling, waste recovery and disposal at the landfills as the least preferred option.

- waste prevention – decisions on reducing or preventing waste generation at first place as much as possible, e.g. concrete remains, optimising inventory at the Camps and works areas etc.
- waste reduction – e.g. through design process, manufacturing and selection of materials
- waste reuse – reuse of certain construction by-products such timber, hardwood etc.
- waste recycle – e.g. treated wastewater for irrigation, dust suppression, recycled scrap metals, plastics, papers etc.
- waste recovering - processes that result into energy and materials e.g. gasification
- waste disposal – use of established landfills at each Camp, however in combination with above four options.

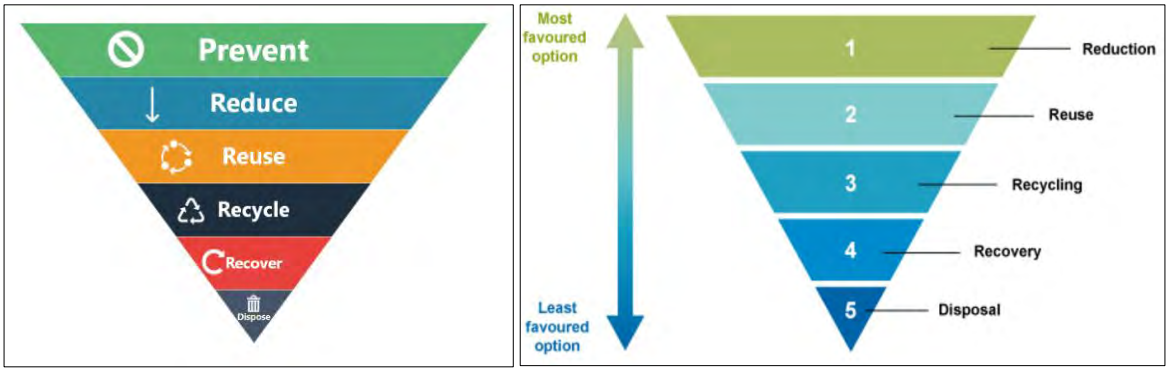


Figure 2-15 Waste management hierarchy adapted by the project

All solid waste generated at the various work fronts and construction sites (Table 2-15) will be sorted at source, collected by the Cleaning and Environment Teams of the Contractor and transported to the WMC. At the WMC, waste will be temporarily stored and, depending on its type, either treated on site or sent to its final destination.

Waste is segregated at source, stored in color-coded, labeled containers (e.g., blue for paper, red for plastics, yellow for metals, brown for organics, orange for hazardous).

Table 2-15 Average monthly estimate of solid waste production during construction

Residue type	Unit	Average amount
General waste	Kg/month	1,100
Organic	Kg/month	1,400
Wood	Kg/month	1,000
Cardboard/paper	Kg/month	600
Scrap	Kg/month	900
Glass	Kg/month	130
Plastic	Kg/month	1,200
Oil	Kg/month	100
Tires	Kg/month	250
Health waste	Kg/month	150

The Contractor foresees establishment of a landfill to collect waste if there is no available facilities around the project area. The landfill will consist of a ditch made of two cells, each having a capacity of about 1,050 m^3. The ditch will be covered by an HDPE geomembrane (to avoid leaks) and will reach a depth of 3 m below the ground level. Recycling measures planned for the construction phase include:

- organic waste will be composted; the final composted product may be used to recover areas degraded by construction. OEC's HSE Department will be responsible for these activities
- metal scrap may be collected by local steel mills
- toners and ink cartridges may be reused.

Confirmation on whether landfill(s) will be constructed is subject to detailed design. If a landfill is required then it will be developed in accordance with Angolan regulatory and permitting processes, and the IFC EHS Guidelines for Waste Management Facilities.

The Consortium will subcontract a specialised and duly licensed company to collect all non-recyclable or non-reusable waste and transport it to approved/licensed dumped areas if it exists.

Non-hazardous solid waste

Non-hazardous solid waste that will not have a recycling destination, will be managed onsite through a proper onsite solid waste landfill, licensed for operating and provided with a leachate pit. The landfill will consist of a ditch made of two cells, each having a capacity of about 1050 m3. The ditch will be covered by a HDPE geomembrane (to avoid leaks) and will reach a depth of 3 m below the ground level. The ditch will only receive non-hazardous waste generated during the Project construction phase. Once the ditch will be filled in, over it, will be placed a geomembrane sheet covered with topsoil to restore the area to its original condition. The collected leachate will be sent to the temporary

campsite's sewage treatment plant for treatment. Details of the onsite waste landfill are included in the Contractor's Waste and Hazardous Materials Management Plan PI-MP-007-OECLS. Temporary waste storage/accumulation areas will be provided at camps and construction zones along the alignment. The accumulation areas will be roofed (protection from weathering), concrete-paved or waterproofed or equipped with containment trays to prevent spills and leakages and avoid the exposure to weathering (especially the special hazardous waste temporary storages/accumulation areas).

Hazardous solid and liquid wastes will be collected onsite and sent to a licensed incineration facility in the Province through the licenced waste management company ANGOLA ENVIRONMENTAL SERVIÇOS, LDA. The Hazardous materials shall be kept in properly locked up, fenced or anyhow protected locations, properly ventilated, roofed, paved and accessible exclusively from trained and authorized personnel. The Contractor's Construction Stage - Waste and Hazardous Materials Management Plan PI-MP-007-OECLS outlines measures used in the documentation, transportation and disposal of hazardous materials.

Non-hazardous liquid waste (wastewater and effluent)

An estimated 37,500 litres per day of wastewater generation is expected during construction and will be treated through septic tanks and a WTP at the camps. Both systems will treat wastewater within the limits stipulated by Angolan law. The WTP and septic tanks will store the sewage sludge resulting from treatment. Water quality from treatment plant will be monitored weekly. Treated effluent will be reused for irrigation and dust suppression where feasible. The typical wastewater treatment design at the camps is provided in Figure 2-16 below.

Mobile toilets will be placed along the RoW for construction workers and transported back to the nearest camp for cleaning and disposal. Effluent will be treated in the onsite sewage treatment plant, sorted in surface tanks and distributed through a pipe network and then will be either reused onsite for dust control operations or in the kitchens, workshops and other facilities.

Regarding oil and grease management, the kitchen, mechanical shop, generator area, pump station, and other areas within the construction camp that are in frequent contact with oil and grease will have oil/grease traps installed to separate such substances from the sewage network. Oils and fats will be managed by the Environment Teams, and they will be collected/treated weekly.

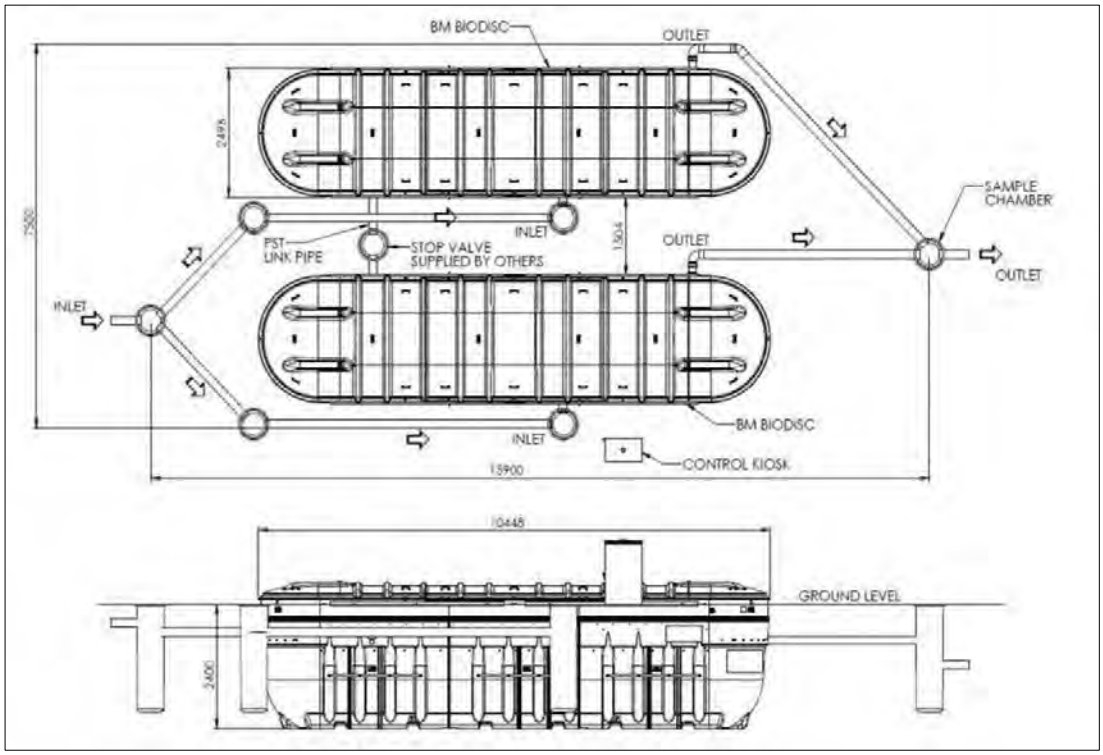


Figure 2-16 Typical wastewater treatment plan design for the construction phase

Storm management for substance affected runoff/effluents

At the construction camp, each camp has a stormwater and drainage system (refer to Appendix 02 Camp Layout). A surface rainwater drainage system, consisting of ditches, will direct runoff toward natural courses. The ditches are designed to prevent stormwater falling outside the camp area from entering and infiltrating the site. This external stormwater will not be filtered. Stormwater falling within the camp area, especially near zones frequently exposed to oils and greases (such as the kitchen, mechanical shop, pump station, and generator area), will pass through oil/grease separators before being discharged into the drainage ditch and natural courses.

The stormwater will be collected and captured through a functional surface drainage system and discharged to ponds after applying a proper filtration or treatment (for reusing it onsite, where possible) and/or to seasonal natural water channels/streams. In case heavy rains leads to the generation of pits and ponds, they will be removed by pumping the water by means of vacuum truck and disposing it of as per the Project specifications and requirements. Additional information on Stormwater and Drainage Management is included in the Contractor's Wastewater and Drainage Management Plan PI-MP-010-OECLS.

At the construction works areas, temporary drainage systems will be constructed to mitigate soil erosion, prevent ravines, and manage surface runoff. These systems will direct water to natural flood attenuation ponds identified in the project design, with the aim of reusing rainwater. Where feasible, rainwater may also be discharged into natural watercourses, based on technical and economic considerations.

Effluent treatment

The Effluent Treatment will be based as per the Contractor's Waste Management Plan and local and international standards and best practices as highlighted below:

- preliminary treatment: screening (bars 10–13 mm, velocity 0.4–0.75 m/s), grit removal (V = 0.3 m/s), oil and grease traps, and flow measurement (Parshall flume)
- Biological Treatment: Activated sludge (conventional or extended aeration), with design parameters: θc = 4–10 days (conventional), 18–30 days (extended), A/M = 0.25–0.5 or 0.07–0.15 kgDBO/kgSSVTA.dia, HRT = 6–24 h, DO = 1.5–4 mg/L
- reuse: consider water reuse for dust suppression, irrigation, or process water, following quality standards.
- thickening and dewatering: use of geo-bags, centrifuges, filter presses, or drying
- beds
- disposal: compliant with environmental regulations; options include landfill, composting, or use as soil amendment (if safe)
- monitoring: regular testing for pathogens, heavy metals, and compliance with disposal standards
- use of modular treatment systems for construction camps and operational facilities
- compliance with discharge standards for effluents.

2.7.1.9 Pesticides use

The Project does not anticipate using any pesticides throughout construction and operation phases, therefore further reference to activities and assessment related to pesticides is not included in the ESIA.

2.7.1.10 Indicative land requirements

The project will require acquisition of both permanent and temporary land for various activities during construction and operation phases. Land requirement estimates have been developed to support early resettlement planning and will be refined during detailed design and preparation of RAP. Permanent land acquisition is primarily associated with the establishment of the railway RoW and other permanent Project infrastructure. In addition to the RoW, permanent land acquisition may be required for station sites, sidings, and other permanent railway facilities. The exact extent of permanent land take at these locations will be confirmed during detailed design and site-specific surveys including affected asset inventories. Temporary land occupation will occur during the construction phase to support construction activities and logistics including construction camps, batching plants, spoil disposal sites and other temporary work areas. Land within the temporary construction buffer and ancillary sites will be occupied for the duration of construction and is expected to be reinstated and returned to prior use following completion of works, where feasible. See further details in a separate Luena-Saurimo Resettlement Policy Framework (RPF) report. Table 2-16 provides an initial overview of land take requirements. This will be refined during detailed design process and development of the Resettlement Action Plan (RAP) for the project.

Table 2-16 Indicative breakdown of project land requirements

Project component	Description / assumption	Estimated affected area (Ha)	Land tenure status	Type of land acquisition
Railway corridor (permanent RoW)	260 km corridor with a 60 m RoW (30 m either side of centreline)	~ 1,560	State land – predominantly subject to legally recognised customary land use rights (rural community land)[2]	Permanent
Railway construction and safety buffer	Temporary land use restrictions of up to 50 m from either side of the railway centreline	TBC	State land – predominantly subject to legally recognised customary land use rights (rural community land)	Temporary
Stations (8), station access roads, sidings and passing loops	Confined within the 60 m RoW corridor	Stations, sidings, and passing loops form an integral part of the railway infrastructure and are generally accommodated within the railway RoW	Predominantly state land subject to customary land use rights; in peri-urban areas, State land of the private domain (urban land)	Permanent
Main construction camps (2) and laydown areas	Two main camps with a combined footprint of approx. 90,000 m²	~ 9	State land of the private domain (predominantly unallocated / unoccupied)	Temporary
Small support construction camps (3)	Three mobile camps with a combined footprint of approx. 30,000 m²	~ 3	State land of the private domain (predominantly unallocated / unoccupied)	Temporary
Batching plants (3)	Temporary concrete batching plants with a combined footprint of approx. 90,000 m²	9	Government	Temporary
Bridges and culverts	Construction of 11 bridges and 45 major culverts along the corridor to cross rivers,	Included in railway corridor estimates[3]	State land of the public domain (watercourses), with adjacent rural	Permanent (assumed within corridor)

[2] Land allocated to individuals or households by traditional authorities (Sobas) under customary tenure arrangements, with certain allocations documented through written confirmations and, in some cases, registered at municipal level. Once the railway is established the land would become State land of the public domain.

[3] Permanent bridge and culvert structures are assumed to be located within the permanent railway RoW. Temporary construction areas required for bridge and culvert works are assumed to be accommodated within the temporary construction buffer included in the Project's indicative land requirements. These assumptions will be confirmed during detailed design and RAP preparation.

Project component	Description / assumption	Estimated affected area (Ha)	Land tenure status	Type of land acquisition
	streams, and drainage channels		community land during construction.	
Stations (8 new stations)	Permanent land take for new stations typically located near towns or settlements. Three medium-sized and five small stations	4.7ha[4]	Government	Permanent
Access roads	Temporary access within or adjacent to the RoW; existing roads (including EN180) used where feasible	Included in railway corridor estimates.	State land of the public domain (existing roads) and predominantly rural community land where new access is required	Temporary
Crossings	Level crossings will be installed where the railway intersects rural roads and pedestrian paths near populated areas	Included in corridor estimates.	State land of the public domain (roads and paths).	Permanent (assumed within corridor)
Quarries	Aggregates to be sourced from existing licensed quarries; no new quarry development planned	No additional land take.	n/a	n/a

2.7.2 Operational phase

2.7.2.1 General operations

- locomotives will park at the respective stations between schedules. There is no yard for locomotives anticipated between Luena and Saurimo
- schedules will be displayed visually around the station for passengers
- as there is currently no night time trains envisaged, the stations will be physically closed after operating hours

[4] Based on typical station layout in Table 2-4 above, three medium stations each typically 134.2m x 44.4m (5,958.5m^2) totaling 17,875.5m^2 equivalent to 1.9ha. Five small stations each typically 92.6m x 59.9m (5,546.7m^2) totaling 27,733.7m^2 equivalent to 2.8ha.

- vendors for food and drinks will be located outside of the station compound.

In the absence of confirmed operational phase resource quantities at this stage, the upcoming detailed design phase will incorporate an assessment of the resource demands, risks, and opportunities for efficiency including:

- evaluating potential water, energy, emissions, and optimization locally-compatible technologies or mechanisms
- assessing diesel dependency and associated greenhouse gas emissions to define efficiency measures.
- identifying opportunities for renewable energy integration at the stations, material reuse, and waste avoidance or minimisation.

This assessment will be undertaken in line with Good International Industry Practice (GIIP), with the World Bank Group Environmental, Health and Safety (EHS) Guidelines used as a technical reference to inform the identification of feasible resource efficiency measures.

2.7.2.2 Water use and efficiency

During the operation of Luena, Camanongue, Dala and Saurimo Stations, municipal networks may be used. In the remaining stations, the water supply will be provided through Artesian Boreholes and respective equipment will be installed, including a Photovoltaic (PV) System to operate the boreholes to improve energy efficiency and reduce emissions (through reduced fossil fuel dependency) consistent with GIIP principles.

2.7.2.3 Energy supply

During operations Luena, Camanongue, Dala and Saurimo Stations will be connected to and powered by the national grid. The remaining stations will be through electric generators. These will be placed on the side of the main station buildings, covered but with ventilation and access gate for refuelling.

Information regarding all fuel used/consumption during operation i.e. litres diesel per year for operation of locomotives and litres diesel for operational generators at stations will be determined at detailed design stage. The locomotives will be refuelled at the existing facility within Luena major station which is currently operation and servicing the Benguela line. The fuel capacity of the expected locomotives to be used will be capable of travelling approximately 1,500 km without refuelling hence an additional refuelling facility is not needed between Luena and Saurimo. Later extension of the railway line from Saurimo to Lunda Norte Province will necessitate establishment of the additional refuelling facility.

Stations will have controlled entry access and parking spaces. The detailed design will consider provisions for universal access (including people with disabilities), gender considerations, fire abatement and fencing.

The onsite wastewater infrastructure (septic tanks) will be located on the sides of the station buildings with access from the parking area for easy access for maintenance.

2.7.2.4 *Maintenance workshop*

During operations, the Project will have the following indicative Track Mechanized Brigade:

- heavy-duty track: 1
- ballast regulator, leveller and stabilizer:1
- special/small carriages for people and equipment transportation: 1
- bulldozer: 1
- motor grader: 1
- loader: 1
- backhoe loader: 1
- roller: 1
- dump truck: 3

These will be stored at designated maintenance workshops located at the sidings/passing loops and if necessary, at the stations.

The maintenance workshop will also store spare equipment, lubricants, solvents and any other liquid containers that may be required for cleaning or servicing the stations and locomotives. The detailed design phase will provide specifications for the construction of the hard surface flooring at workshops, stormwater and effluent collection drains and locations for spill containment equipment.

2.7.2.5 *Ballast/aggregate materials*

It is envisaged that the same quarries used during construction will be used for maintenance of embankments and access roads. No provision of new quarries and/or borrow pits has been included in the operational plans and in this ESIA.

2.7.2.6 *Labour force*

On average, a total of 89 workers are planned during operations; on average 39 workers at stations during operations per day is currently estimated. Labour will be sourced from Luena, Camanongue, Dala and Saurimo municipalities as a priority.

Although studies have not yet been carried out on the use of local labour for operation phase, the Benguela Railway Company (CFB) has in its recruitment policy of local technicians for specialized professional training and their insertion in the various areas of the Company's specialty, in line of what happened in other Provinces.

In addition, the general labour laws provide the basis for all recruitment, working procedures and grievance management. The Human Resources Department of the CFB will be in charge of all recruitment and training of all staff to be employed during operation. The CFB has Internal Regulations and a Code of Ethics that serve as guideline for good conduct procedures and policies.

It is not confirmed whether recruitment will be conducted jointly with third-party companies or not. Outsourced employment could be for non-specialized seasonal work at the stations (approximately 200 in number taking into account the planned number of Stations), and along the railway track (housekeeping, cleaning and unblocking culverts, etc.).

The CFB seeks to establish

- Annual development and Training Plans for various training courses for their employees
- Gender policy that commits to provide a fair, inclusive and diverse work environment
- Influx management plans/ policies/ procedures
- Workspace management procedures: including standards and accommodation to ensure the work environment is safe, healthy and productive for all employees.
- CFB health centres that will benefit from various social programs run by the Ministry of Health, including Sexually Transmitted Diseases. The programs include medical consultation and medication.

2.7.2.7 Waste management

In Saurimo and Luena the municipal solid waste management system is in place and functioning accordingly. It is anticipated that waste in the stations will be collected onsite and sent to a licensed incineration facility in the Province through the licenced waste management company ANGOLA ENVIRONMENTAL SERVIÇOS, LDA

Waste produced during each trip is to be collected at main stations at the end of the route i.e. Saurimo or Luena. A maximum area of 2,500 m^2 is foreseen within the construction camp to serve as the Waste Management Centre (WMC). Thereafter, waste will be collected using trucks or suction equipment and sent to municipal collection centre's. Estimated quantity and nature of general waste, hazardous waste, wastewater during operation is not yet determined.

Where feasible the stations will be incorporated into municipal sewer systems where available. Otherwise, septic tank systems large enough to deal with the anticipated use will be installed. These systems will have to be carefully planned so that it does not pollute the fresh water drinking sources including ground and surface water.

2.7.3 Additional resource use efficiency embedded in the design

In addition to the above described resource use efficiency, the Project detailed design shall endeavour to optimize the use of natural resources involved in the Project process. The project will adopt best practices in sustainability, energy efficiency, and occupational health, consistent with the OEC policies and procedures, Angolan legislative requirements and international standards as highlighted below:

- Greenhouse gas emission reduction through integration of the renewable energy sources (solar energy)
- temporary buildings/facilities such as site offices will incorporate passive design principles to improve energy performance, including natural ventilation and daylighting
- high-efficiency materials (insulated walls, roofs) will be prioritized to reduce reliance on mechanical heating or cooling systems
- construction, operation and maintenance equipment will be selected based on suitability, energy efficiency, emission levels, minimum occupational and health risks exposure to workers and nearby communities or sensitive receptors

- power usage during construction: all generators are switched off when not in use; air conditions and lights in the offices are switched off when not in use and at the end of the working day during construction phase; and solar lights are used for all perimeter and security lighting
- energy saving: using energy-saving LED lighting, avoiding the operation of non-essential equipment outside working hours
- water conservation measures will be applied throughout construction and operation phases through various means such as installation of water metres to monitor consumption, installation of water-saving fixtures, leaks prevention, raising awareness among workers through targeted training
- rainwater harvesting: all buildings will be fitted with rainwater collection systems that feed into water storage tanks. This water can be used for toilets in the buildings and for dust suppression
- water abstraction limits: OEC will comply with abstraction limits to prevent overuse of the borehole, which could lead to depletion or negative impacts on the local water table
- integration of the resource use efficiency measures/requirements in the C-ESMPs and contractual obligations.

2.8 Primary supply chain and sustainability commitments

The Project's primary supply chain encompasses a range of specialized materials, equipment, engineering systems, and high-value components sourced both internationally and nationally within Angola. Key suppliers are based in UK, Poland, South Africa and Netherlands will be assessed and selected for their proven track record in delivering high-quality, durable, and efficient railway components infrastructure. The foreseen major supply chain as of September 2025 is provided in Table 2-17 below.

Large volumes of construction materials such as cement, aggregates, water and other prefabricated elements will be procured from licensed suppliers in Angola in accordance with national regulations and contractual quality standards.

Table 2-17 Foreseen major supply chain outside Angola

Country	Suppliers	Package
Poland	Voestalpine or Siemens or Kombud + Monat + KZA	Signaling/Telecommunications
	Cogifer Polska + KZN Bierzanów	Turnouts
	Consortium of WPS + Strunbet + Tracktec (+ Riw group)	Sleepers (including fastnings)
	Vossloh	Sleepers, turnout´s and fastenings
	Torhamer	Aggregator
UK	British Steel	Rails / Steel
	Terex / Powerscreen / Aimix Group	Crushers / Concrete Plant / Parts
	JCB / Terex / Komatsu UK/ Caterpillar UK	Construction Equipment / Parts
	Tenenge UK (Odebrecht Group)	Miscellaneous
South Africa	Colossal	Sleepers
	Maziya Group	Railway assembly
	Voestalpine	Turnouts
	OGS ((Odebrecht Global Sourcing)	Miscellaneous
Netherlands	Ballast Nedam	Bridge structrures

In compliance with IFC PS 1 and PS 3 as part of the primary supply chain, the Project will update and implement Supply Chain Management Plan (PI-PR-005-OECLS-MANAGEMENT OF SUPPLIERS AND SUBCONTRACTORS_EN) to promote responsible sourcing practices and ensure that suppliers meet relevant health, safety, human rights, labour, environmental and social sustainability requirements.

In line with IFC Performance Standards 1 and 3, supplier selection prioritizes the following Supply Chain Sustainability commitments:

- Sustainability and Green Procurement: Preference is given to suppliers capable of providing materials and equipment with certified low carbon footprints and energy-efficient performance
- Regulatory Compliance: All suppliers must comply with EU Directives on product safety, emissions, and materials sustainability, as well as Angolan import, health, and licensing requirements
- Labor Practices: Core suppliers are screened to ensure no involvement in child labour, forced labour, or other labour rights violations, in line with IFC PS2.
- Climate and Efficiency Objectives: Equipment will be selected for high durability and energy efficiency, often complying with EU eco-labelling standards.

In terms of supply chain risk management, although no high-risk suppliers (e.g. based in conflict-affected areas or with known labour violations) have been identified, the Project will implement a supply chain monitoring system to ensure:

- traceability of critical equipment and material inputs
- verification of environmental and labour compliance where risks are identified
- integration of supply chain due diligence into procurement documentation.

2.9 Corporate social responsibility and investment considerations

Like in other mega projects executed by OEC, the contractor will consider feasible social investments within the communities along the railway line during construction period. This will be aligned with the project's Livelihood Restoration Plan (LRP) to be developed and implemented.

Initial broad considerations include:

- direct local employment: prioritize hiring and training of local labor from within communities
- skills transfer and capacity building: offer training in construction, health, and safety
- social infrastructure: support for water supply, and sanitation in affected communities.

During entire constriction period, continuous community engagement will be undertaken through the Social Communication Program within Construction Stakeholder Engagement Plan as a vital tool for supporting relationships between project implementers, environmental program managers, and all affected/interested social segments. It will guide negotiation procedures throughout the project, from planning to construction, and establishes effective communication channels for information and dissemination of environmental and social programs.

2.10 Project Area of Influence (AoI)

As per IFC PS1, where the Project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, environmental and social risks and impacts will be identified in the context of project's area of influence. Therefore, the AoI must be delimited and should be considered to encompass, as appropriate:

- the primary project site(s) and related facilities that the client (including its contractors) develops or controls, such as power transmission corridors, pipelines, canals, tunnels, relocation, and access roads, borrow and disposal areas, construction camps
- associated facilities that are not funded as part of the project (funding may be provided separately by the client or by third parties including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project
- areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken

- areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project
- cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

The Project Area of Influence (AoI) was considered for the primary project footprint and key environmental and social topics/themes and is presented in Table 2-18. It is recommended that this is updated once the results of any additional studies are conducted and an AoI register is maintained and communicated to any employees and government officials through relevant plans and procedures. This is important as the scope/boundary of potential project impacts and needs to be considered within the scope of any management or mitigation measures.

The detailed high resolution maps of the AoI are provided in Appendix 03.

Table 2-18: Project Area of Influence for the Luena-Saurimo railway

AoI per environmental and social theme/ topic	Description of AoI[5]
Direct footprint	• Luena-Saurimo direct RoW. The railway corridor footprint will be 30m both ways from the centreline making a corridor of 60m RoW. Based on current basic design, it is assumed that the railway track embankment and construction/maintenance access roads on both sides of the embankment will be about 17.5 m wide, approximately 8 m on either side of the centreline of the railway alignment) • railway RoW exceptions where the RoW widens further at approaches either side of stations especially main stations, and a few other limited cases where widening is needed • footprint of all project Aspects (infrastructure and facilities as presented in Section 2.3 above including quarry sites, camp sites) • additional 100 m buffer (50 m on either side of the centreline of the railway alignment). This is to accommodate any additional space for safety considerations, required for spoil soil storage piles, temporary lay-down/storage areas along parts of the railway alignment as well as the locations for the campsites and stations.
Thematic AoI's identified, in addition to the direct footprint	
Social, Labour, Health, Safety and Security, Human Rights	• primary level – project affected communities (PACs) direct project footprint (described above) and area within a 5 km zone around the direct footprint. It Includes settlements, communities' villages and centres/towns within a geographical boundary defined by project land take requirements, construction, and operation activities. These communities will be directly (e.g., through economic displacement and loss of livelihoods, community health and safety, noise, and other

[5] Note: within each AoI different impact/risks have been identified with differing levels of impact significance, which is described in this ESIA report

AoI per environmental and social theme/ topic	Description of AoI[5]
	related impacts) and indirectly (e.g., through in-migration or indirect economic impacts) impacted • secondary level (indirect) – municipalities (Luena, Camanongue, Dala and Saurimo) through which the railway passes, in which project facilities are located or which could be associated with other project activities such as transportation • tertiary level – Provinces traversed by the railway line (Moxico and Lunda Sul) and the nation, which stands to benefit from the improvement in rail infrastructure and revenue generation and which provide a general context for the Project • the extent of the AoI for potential impacts on the livelihoods, health, safety, and security of project-affected communities is subject to review pending the completion of detailed design for the Project
Indigenous Peoples (IPs)	• **not applicable** as per IP screening outcome whereby IPs (as per IFC PS 8, World Bank ESS 8 and IWGIA) could not be identified within the Project area (at least 5km both ways from the centre line) during ESIA study hence deemed absent.
Resettlement[6]	• the resettlement AoI encompasses all areas where Project-related land use may affect people, assets, or livelihoods. This includes areas of permanent land acquisition for the railway and associated infrastructure, as well as areas of temporary land occupation during construction that will be reinstated following completion of works • permanent project footprint: 260 km railway corridor within the permanent 60 m RoW, representing the primary area of permanent land acquisition for railway construction, operation, and maintenance • ancillary and support infrastructure footprint: land required for stations, access roads, construction camps, batching plants, sidings, passing loops, crossings, and other Project facilities, largely within the RoW; any localised deviations • temporary construction and safety buffer: precautionary area extending up to approximately 50 m on each side of the railway centreline, where temporary, location-specific access or land-use restrictions may occur during construction for safety reasons • indirect livelihood impact zone: areas beyond direct land take where predictable indirect livelihood impacts may occur
Cultural Heritage	• for tangible and intangible cultural heritage, the AoI includes a 5 km buffer zone around the direct project footprint. Therefore, the AoI for tangible cultural heritage will need to be applied during construction and operation but would need to be extended based on the findings of the detailed socio-economic and household surveys that shall be undertaken as part of the Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) studies • potential additional tangible or intangible cultural heritage sites may be identified during the pre-construction clearance activities. The AoI may need to be re-defined at this stage
Noise and Vibration	• the AoI for construction noise was set at a 300 m radius on either side of the railway alignment and around fixed points (e.g. stations,

[6] See further details in a separate report: Resettlement Policy Framework for Luena-Saurimo, Jan.2026

AoI per environmental and social theme/ topic	Description of AoI[5]
	quarries, camps), based on review of aerial mapping, and the closest receptors identified during the baseline survey exercise, noting where the receptors are taking into consideration noise emission levels that would be likely to reach the areas • the AoI for construction vibration has been set to 50 m on either side of construction areas • the planned stations, sidings, and the alignment are permanent and will remain operational over the lifetime of the project, so the temporal AoI will be approximately 100 years • for the temporary construction access roads and quarries, the temporal AoI is for the period of construction • the AoI during operational phase will be defined after the detailed design is finalised
Air Quality	• emissions from marshalling yard and diesel locomotives will fall within the RoW of 17.5 m on either side of the centreline of the alignment. Thus, the AoI for air quality is considered included in the direct project footprint • The Project Area of Influence (AoI) for earthworks, construction and demobilisation demolition activities is defined as up to 250 m from the Project site boundary. • For trackout activities, up to 250 m from the road connecting to each station will be considered and its AoI is defined as up to 50 m from the edge of those roads, as per the IAQM guidance
Hydropedology	• the assessment includes a footprint of all project aspects comprising the direct AoI. For the indirect impacts a 20 km AoI has been utilised. The assessment zone was considered to enable identification of sensitive receptors and potential direct and indirect impacts of the Project • the assessment includes a footprint of all project aspects. Any habitat located beyond the 20 km AoI from the proposed railway track is unlikely to be impacted by the development. As such, the 20 km AoI is considered sufficient for this assessment
Hydrology	• in terms of hydrology, the AoI refers to the geographic region that is likely to be affected by a Project's water-related impacts, such as changes in water flow, water quality, and aquatic ecosystems • the project footprint at the location where the railway crosses a watercourse or waterbody • surface waterbodies downstream of any project infrastructure and construction facilities • the AoI varies from 2 to 5 km downstream of route crossing points, access road crossing points, infrastructure or construction facilities, depending on the extant quantity of water and its quality, including sediment concentrations and turbidity, in the watercourse and the quantity and quality of any water discharged • the AoI also includes surface waterbodies that will be used to supply water to the Project • the temporal AoI for construction is the period that includes abstraction and discharge and a short recovery period of less than one year

AoI per environmental and social theme/ topic	Description of AoI[5]
	• the spatial AoI for operation is 2 to 5 km downstream of watercourses and waterbodies and the temporal AoI for operations stage is the life of the Project
Geohydrology	• the groundwater AoI during the Project construction phase will encompass aquifers crossed by the right-of-way, aquifers affected by Project groundwater abstraction for the infrastructure, and other construction activities that may be affected by planned discharges, spills and leaks of fuels and chemicals by the Project • during the operational phase, the AoI will include aquifers crossed by the railway as well as aquifers utilised for longer term water supply to the project, for example at stations that will rely on groundwater sources • although the project corridor will cross large aquifer systems its direct and indirect impacts are considered to be limited to no more than 1 km from the railway • as groundwater is primarily influenced by geological formations the expected AoI for geology and aquifers are considered to be similar
Landscape and visual	• the AoI for the landscape and visual baseline include the corridor along the full length of the railway line and extends to areas where the railway line can be seen from and where it alters the existing landscape character. This includes an immediate corridor on of 30 m on either side of the alignment and viewpoints from where the railway line, stations, camps and quarries are visible varying from 1 to 5 km to also capture longer distance visibility of Project associated permanent infrastructure.
Biodiversity	• for this Project the direct area of influence is a 1km buffer, either side of the planned railway track as an area of assessment • the AoI for habitat loss and direct mortality impacts is inclusive of the full Project construction and operation footprint (RoW), and including associated facilities (if any), camps, quarries and any existing or new roads utilized for incoming and outbound traffic • indirect impacts typically extend across a wider area and often relate to the socioeconomic sphere of influence of the project. A development project can indirectly affect various ecosystem services including water purification, climate regulation, soil fertility, and pollination. It can disrupt wildlife migration routes, assemblages, and breeding grounds, potentially leading to population declines. The extraction of timber, non-timber forest products, and aggregates can result in habitat degradation, reduced biodiversity, and increased erosion. Additionally, cultural and recreational services provided by natural landscapes may be diminished, impacting local communities and their traditional practices • for the indirect impacts a 20 km indirect AoI has been utilized. The assessment zone was considered to enable identification of sensitive receptors and potential direct and indirect impacts of the project. The assessment includes a footprint of all project aspects. Any habitat located beyond the 20 km AoI from the proposed railway track is unlikely to be impacted by the development • as such, the 20 km AoI is considered sufficient for this assessment and is referred to as the AoI from hereon • there are no designated protected areas and wildlife corridors found within the railway corridor AoI

AoI per environmental and social theme/ topic	Description of AoI[5]
Cumulative impacts	• The cumulative AoI of 20 km has been applied that incorporates other direct AoI for the receptors indicated above and that includes the Provincial landscape and locations where all project Aspects (infrastructure and facilities as presented in Section 2, including quarry sites and camp sites). The furthest quarry (Biula access at KM 79+000) that may be used by the Project is approximately 15km from the planned railway line, therefore the cumulative impacts AoI encompasses this quarry. • Development projects within the primary or secondary level social AoI above and the biodiversity wider AoI indicated above were considered in Chapter 11 on the Cumulative Impacts.

3 PROJECT ALTERNATIVES

This chapter examines the technically and financially feasible alternatives considered during the feasibility, planning and design phases to achieve the Project objectives. The aim is to outline how the proposed Luena-Saurimo railway project represents an optimised design consideration that is technically and financially feasible whilst minimising overall environmental and social impacts. The assessment of potential impacts that will arise as the result of the Project, along with the identification of appropriate mitigation and management measures contained in Chapter 7 of this ESIA report are based on preferred alternatives. Considering alternatives in the design of the Project is an important aspect because it provides developers and decision-makers with a broader base upon which choices on the most socially, environmentally, and economically acceptable option can be made.

However, this chapter is informed and developed based on the preliminary basic design only that was available during ESIA stage. The Front-End Engineering Design (FEED) and detailed design investigations are in the pipeline. Therefore, detailed rationale and decision making process in adoption of certain alternatives will be further assessed in the detailed design. The Project is initiating a Management of Change (MoC) procedure as an update to existing Project SOPs (see PIFR-003-PLN-0016-01-PIAAIA - Project Adjustments/Design Updates) to document and analyse design changes and motives behind during detailed design process.

3.1 No-go project alternatives

The project “No-Go” alternative assumes that the proposed project or part of its activities will not be undertaken. This alternative provides a baseline condition against which the impacts of the other alternatives are compared, and it remains the default option that can be used in the analysis to provide the baseline for assessment and to illustrate the implications of not implementing the project. The implications of the no-go alternative are provided below. *Transport*

The EN180 highway is the main gateway between Lunda Sul and Moxico connecting to Benguela railway line at Luena. The continued over-reliance on the existing road network for freight and passenger movement will remain and travel times as well as operating costs will remain high, with continued road maintenance burdens. The ongoing wear and tear on roads will increase public expenditure on maintenance.

Safety and infrastructure

The accident rates will remain unchanged or increase with traffic growth on the road network, while the long term capacity of the existing rail network is likely to gradually diminish due to the escalating demand for transporting goods, materials and passengers.

Socio-economic impacts

No new direct or indirect jobs from the railway construction or operation will be created, leaving local communities with limited market access, stagnant mobility and fewer opportunities for socio-economic development.

Environmental and climate impacts

Relying heavily on road freight elevates GHG emissions, increasing fuel consumption which, worsening air pollution and potentially generate more surface runoff, durst and noise from the road traffic.

Strategic and regional impacts

With a railway network capable of boosting national development, Angola's strategic plan envisages railway projects with high socio-economic value, including the reduction of regional asymmetries, improved product flow, and expanded passenger transport. The proposed routes also pass through regions with high agricultural, mineral, agro-industrial, and manufactured production potential, which could be further enhanced by proper transport infrastructure.

The No-Go alternative would limit Angola`s opportunity to transform its logistics landscape, weaken its competitiveness in regional and international trade which may in turn hinder long term socio-economic development.

Policy and strategic planning misalignment

The Luena–Saurimo Railway Project is part of Angola's broader strategy to expand its rail network by over 1,200 kilometres, reinforcing the northern, southern, and eastern corridors to enhance economic diversification, improve freight and passenger connectivity, reduce transport costs, and support regional trade. This expansion aligns with the National Transport Master Plan, which prioritises the development of key corridors to facilitate economic growth and regional integration.

Moreover, Angola is a partner in the Lobito Corridor initiative, a key regional trade and infrastructure route connecting Angola, the Democratic Republic of Congo, and Zambia to the Atlantic coast. This corridor has been formalised in the Lobito Corridor Transit Transport Facilitation Agency Agreement, which aims to harmonise corridor development, reduce transit times, increase modal shift to rail, and improve logistics efficiency in line with SADC and national infrastructure plans.

The Luena–Saurimo link has been prioritized under the National Railway Network Expansion Plan and authorized for construction through Presidential Order Nº 55/23. The Ministry of Transport aims to improve the speed, volume, and safety of goods and passenger movement along the railway.

Within this strategic framework, the "No-Go" alternative serves as a baseline for evaluating design, alignment, station locations, materials, and technology. Assessment considers environmental and social impacts, as well as alignment with national transport policy, regional integration, cost-effectiveness, and long-term sustainability. Selecting the "No-Go" alternative would conflict with the objectives of the proposed project and undermine the Ministry of Transport's vision for enhanced connectivity, efficiency, and reduced bottlenecks.

3.2 Design and alignment alternatives

The OECI and BPC has great appreciation for the natural conditions in Angola. They have therefore committed to cause minimal impact as far as possible on both the natural and human environment while constructing the railway line.

Based on this commitment the OECI and BPC has identified a route that has the smallest possible footprint for impacts on wetland, rivers and other sensitive areas. It is placed in close proximity to infrastructure that has already had major impacts on the environment such as roads and electricity supply lines so as to not unnecessarily disturb the natural environment. The current proposed alignment has also focused strongly on limiting the displacement of people or their livelihoods.

The Front-End Engineering Design (FEED) will take into consideration the following alternatives that are further described in the sections below:

- river crossing/bridge alternatives considered. Some bridges can be slightly re-oriented, extended etc. Column sizes and dimensions at the following locations
    - Changed PH Km 70+700, please see revised alignment Appendix 1-2.3
    - Mombo Bridge, please see revised alignment Appendix 1-2.4
    - Luele Bridge, please see revised alignment Appendix 1-2.5
    - Luachimbo corridor, please see revised alignment Appendix 1-2.6
    - Sambuamba Bridge, please see revised alignment Appendix 1-2.10
- re-alignment considerations for sensitive areas like large wetlands for example close to Luena
- stations alternatives considered. Current locations *vs.* proposed new locations e.g. Saquembue station has been moved to KM227+500 to avoid resettlement impacts and community issues (revised alignment Appendix 1-2.11)
- road crossings/access tracks alternatives considered near Muapeso (revised alignment Appendix 1-2.1) and in Camanongue (revised alignment Appendix 1-2.2).
- sleeper production alternatives considered: OEC is studying two options: the importation of sleepers or to install a site plant. The methodology of the site plant, if it will be the chosen, is to work with a carousel fabrication method.

3.2.1 Alignment towards Saurimo town

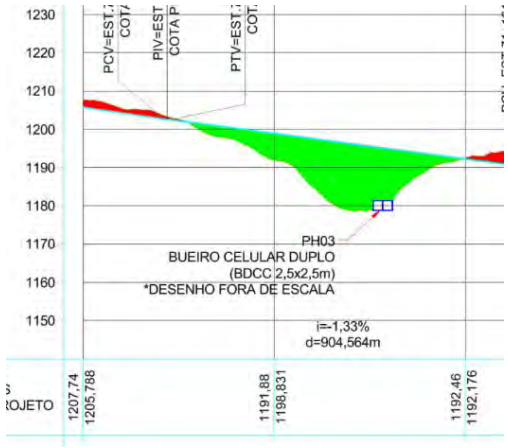
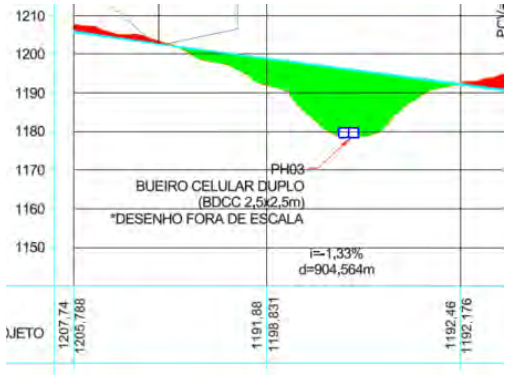
The railway line diverts north-easterly from the EN180 highway and ends east of the Saurimo airport. This was selected as the preferred alternative compared to approaching Saurimo on the west side of the urban centre or maintaining a parallel alignment to the EN180. The other two alternatives had disadvantages in terms of space as they would be restricted by the current construction of the EN180, growing urban density towards the west of the town and the Saurimo Airport. In addition, there was concern that the alignment towards the west of the town would act ac as a significant drainage barrier. The current alignment towards the east of the town is the preferred route included in the ESIA that avoids impact to existing structures and was indicated that future plans is to implement a more industrial zone in the municipality east of the current urban centre.

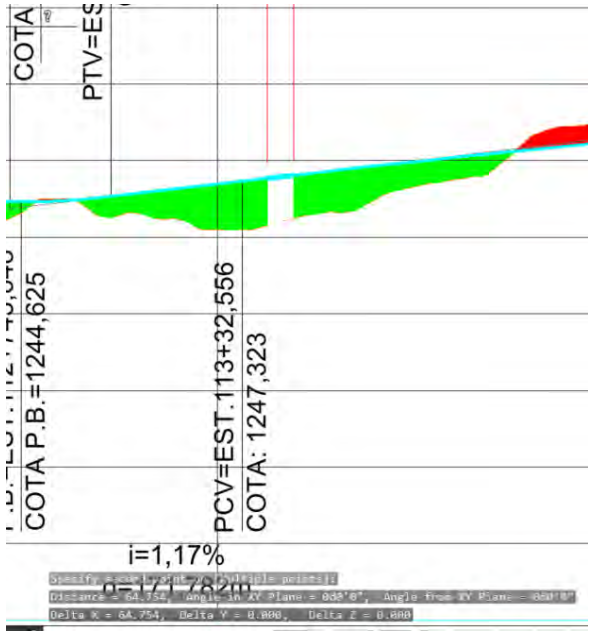
3.2.2 Drainage infrastructure alignment and sizes

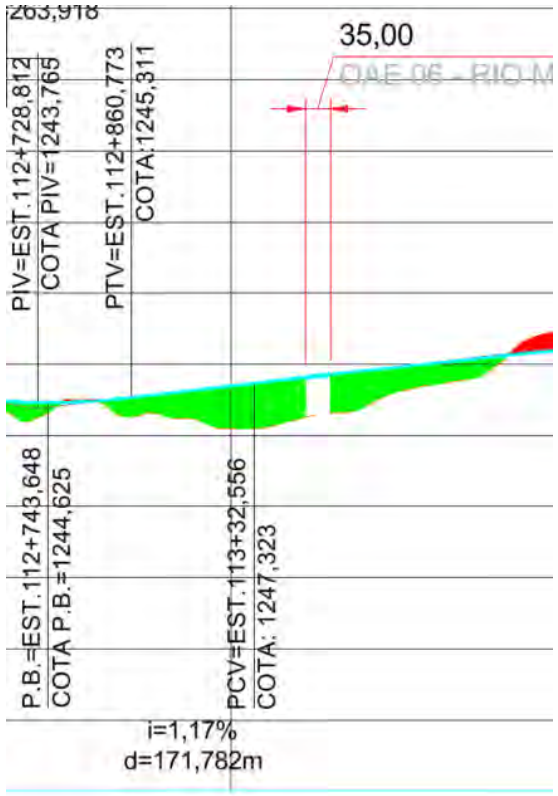
Some bridges were slightly re-oriented and extended to consider sensitive areas like large wetlands. Alternative culvert placements and sizes were also considered. Detailed description is provided in Table 3-1 overleaf.

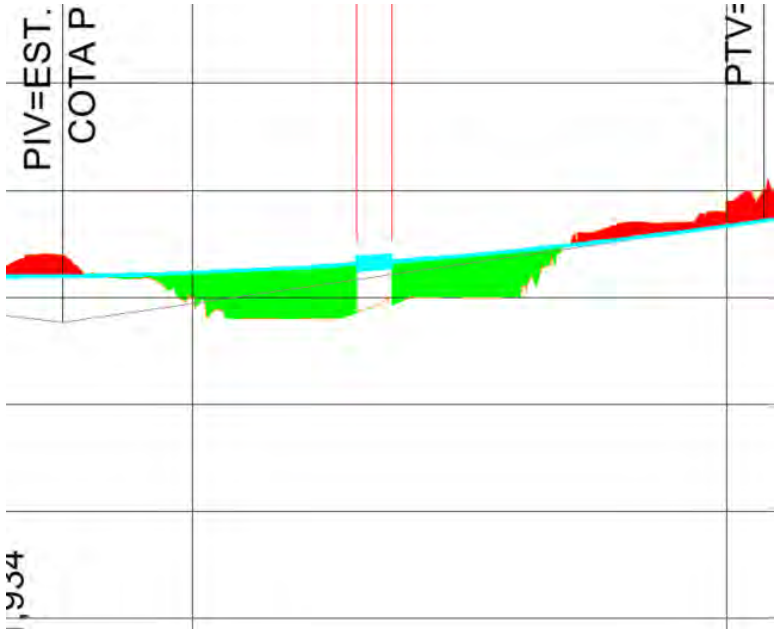
Table 3-1: Summary of watercourse features and locations where alternative design considerations at proposed culvert and bridge positions

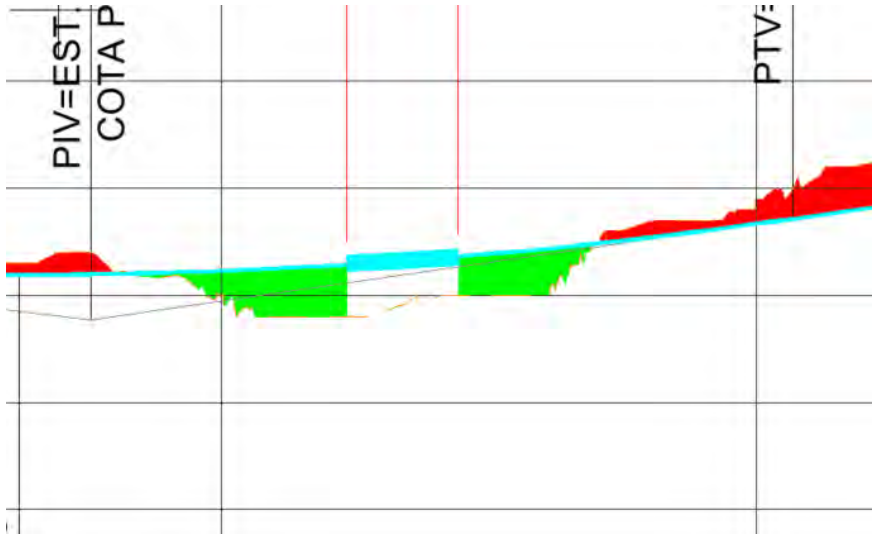
Chainage (km)	Watercourse name	Watercourse type	Notes
8+500	Unknown	None expected	Currently two culverts of 2.5 m x 2.5 m each are proposed
17+500	Rio Lumeje	River channel with floodplain	Wide floodplain system next to a small local community (unnamed). The proposed bridge has a span of 1250 m, which transects the river channel and adjacent wetland entirely
45+500	Unnamed (close to Camanongue Village)	Seep connected to a channelled valley bottom wetland	A seep wetland system that changes into a channelled valley bottom wetland is located south of the railway corridor near the Camanongue Village. The preliminary engineering design has been updated to provide access to water and cultivated lands for people and livestock. The hydrological engineering design parameters to make provision for lateral flow hydrological connectivity
57+400	Rio Luxia	River channel with floodplain	Wide floodplain with suspected groundwater inputs. The proposed bridge has a span of 490 m, which transects the river channel and adjacent wetland entirely
58+600	Rio Tchihinhi	Channelled valley bottom (channel is distinct, but discontinuous)	Wetland system driven by groundwater seepage. The proposed bridge has a span of 210 m, which transects the wetland entirely
70+700	Unknown	Unchanneled valley bottom (narrow discontinuous channel present)	Wetland system driven by groundwater seepage with an incised narrow channel at the proposed railway transect. The proposed two culverts of 2.5 m x 2.5 m each has been revised and shifted to the north to align with the indistinct wetland channel (located at coordinates 11°14'25.74"S 20°11'35.70"E along the railway corridor – refer to revised alignment Appendix 1-2.3

Chainage (km)	Watercourse name	Watercourse type	Notes
			22DD-LS-2-GE-G00-00-C-30-DE-0011 
			22DD-LS-2-GE-G00-00-C-30-DE-0011_0 
73+900	Rio Cassai	River channel with floodplain	River channel with cultivation along right hand channel bank. Furrows are present in sandy soils and with observed isolated peat soils. The proposed bridge has a span of 910 m, which transects the river channel and adjacent wetland habitat

Chainage (km)	Watercourse name	Watercourse type	Notes
86+250	Unknown	None expected	Currently one culvert of 2.5 m x 2.5 m is proposed. The purpose of the culvert is to allow runoff to pass through the railway corridor in an area where convergent contour lines are present to prevent damming
97+000	Rio Tchiumbwe	River in steep valley with rapids in reach	The proposed bridge is located in a narrower portion of the river valley with steeper slopes compared to the wider valley. The proposed bridge has a span of 665 m, which transects river and riparian habitat
106+800	Unknown	None expected	Currently one culvert of 2.5 m x 2.5 m is proposed. The purpose of the culvert is to allow runoff to pass through the railway corridor in an area where convergent contour lines are present to prevent damming
113+300	Rio Mombo	Channelled valley bottom with a seep zone to the south	Water flow is the width of swamp forest vegetation and can be reasonably well accommodated by the proposed 35 m bridge. System expected across is hydrologically well intact with peat soils present. The design has been revised so that bridge location shifts to the north – refer to Appendix 1-2 22DD-LS-2-GE-G00-00-C-30-DE-0017 

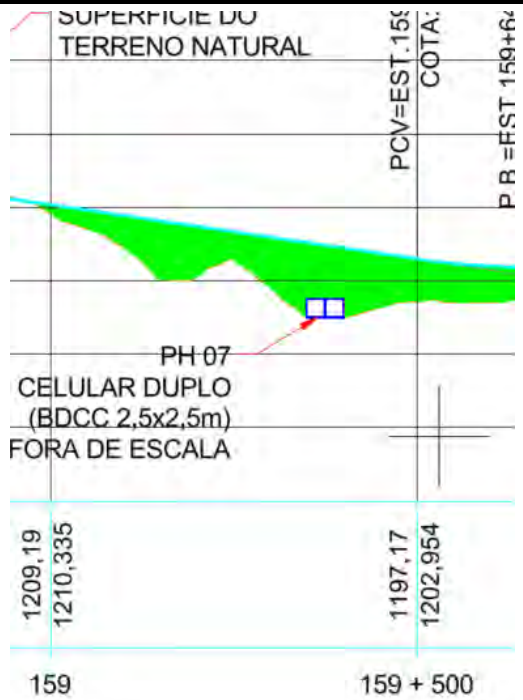
Chainage (km)	Watercourse name	Watercourse type	Notes	
			Measured horizontally from Chainage 113	Specify second point or [Multiple points]: Distance = 64.754, Angle in XY Plane = 0d0'0", Angle from XY Plane = 0d0'0" Delta X = 64.754, Delta Y = 0.000, Delta Z = 0.000
			22DD-LS-2-GE-G00-00-C-30-DE-0017_0	
			Measured horizontally	Specify second point or [Multiple points]: Distance = 105.000, Angle in XY Plane = 0d0'0", Angle from XY Plane = 0d0'0" Delta X = 105.000, Delta Y = 0.000, Delta Z = 0.000

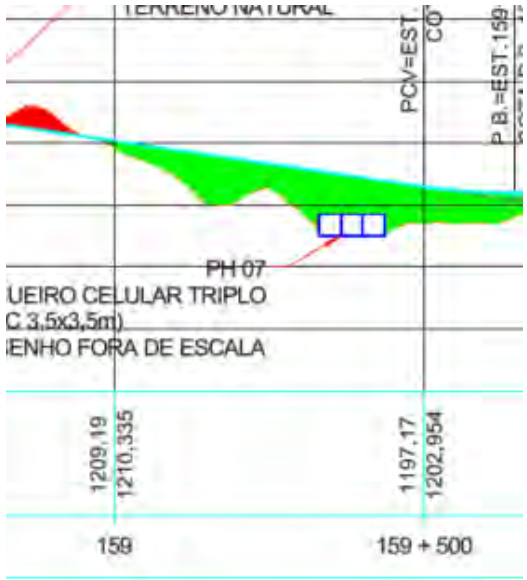
Chainage (km)	Watercourse name	Watercourse type	Notes	
			from Chainage 113	
128+150	Rio Luele	Channelled valley bottom with broad seep zones	Water flow is present across the width of valley floor, which include swamp forest vegetation, but also extends beyond it, in a flow path of approximately 75 m wide where base flow regularly occurs System is hydrologically well intact with peat soils present. Initial proposed crossing of a small bridge with pillars and a span of only 35 m has been changed to abridge of 105 m, overpassing the valley to accommodate a wider flow zone across the width of the valley floor as described above – refer to revised alignment Appendix 1-2	
			22DD-LS-2-GE-G00-00-C-30-DE-0019	
				Specify second point or [Multiple points]: Distance = 33.834, Angle in XY Plane = 3d34'58", Angle from XY Plane = 0d0'0" Delta X = 33.767, Delta Y = 2.114, Delta Z = 0.000

Chainage (km)	Watercourse name	Watercourse type	Notes
			22DD-LS-2-GE-G00-00-C-30-DE-0019_0 
			Specify second point or [Multiple points]: Distance = 105.170, Angle in XY Plane = 3d15'16", Angle from XY Plane = 0d0'0" Delta X = 105.000, Delta Y = 5.970, Delta Z = 0.000
143+000	Rio Luachimo and Rio Luele	River channel with floodplain and seepage inputs	Exact bridge location not surveyed due to access constrains, but surroundings areas were visited. River reach with rapids (near road crossing) will be transects by a bridge with a span of 105 m. The railway corridor south of the bridge is located in a seep connected to the Luachimo River. The railway track alignment between Km 140+500 and Km 145+500 m was changed and is now closer and parallel to the EN180 to make provision for lateral flow hydrological connectivity – refer to revised alignment Appendix 1-2

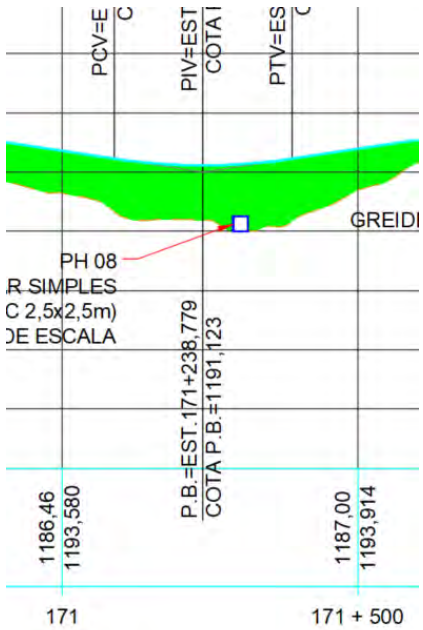
Chainage (km)	Watercourse name	Watercourse type	Notes	
			22DD-LS-2-GE-G00-00-C-30-DE-0021	

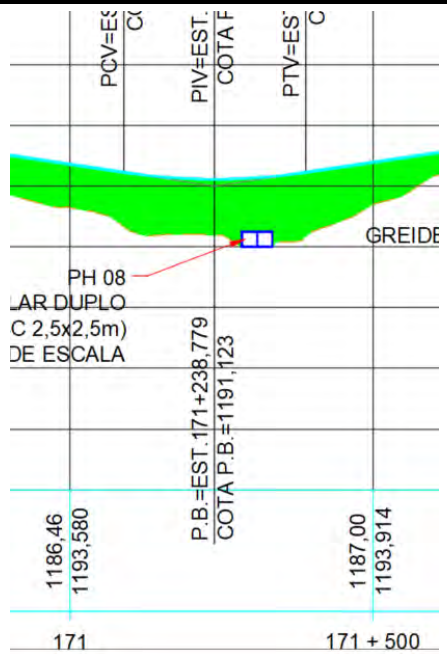
Chainage (km)	Watercourse name	Watercourse type	Notes
			22DD-LS-2-GE-G00-00-C-30-DE-0021_0
149+000	Unknown	None expected	Currently one culvert of 2.5 m x 2.5 m is proposed. The purpose of the culvert is to allow runoff to pass through the railway corridor in an area where convergent contour lines are present to prevent damming
159+400	Rio Muxie	Channelled valley bottom with broad seep zone to the north	Channel confirmed within swamp forest vegetation in the centre of the valley bottom with a width of approximately 15 m and depth of approximately 1.5 m to 1.75 m. The flow path can increase across the width of the swamp forest. System is hydrologically well intact with peat soils present. Only two culverts of 2.5 m x 2.5 m each are currently proposed at a position outside of the channel and main area of flow. The reviewed designs have been updated with 3 culverts with larger dimensions (3.5 m X 3.5 m), at a location more central to the observed channel to allow for flow across a wider width within the swamp forest. Refer to revised alignment Appendix 1-2

Chainage (km)	Watercourse name	Watercourse type	Notes	
			22DD-LS-2-GE-G00-00-C-30-DE-0023	

Chainage (km)	Watercourse name	Watercourse type	Notes
			22DD-LS-2-GE-G00-00-C-30-DE-0023_0 
163+800	Rio Maurilio	Unchanneled valley bottom with broad seep zones (a discontinuous channel present in areas)	Water flow expected across the width of the swamp forest of approximately 70 m wide. System is hydrologically well intact with peat soils present, but no distinct channel. Proposed crossing is a bridge with pillars with a span of approximately 142 m. The revised drawings have shifted the bridge marginally to the north to accommodate swamp forest vegetation. Refer to revised alignment Appendix 1-2

Chainage (km)	Watercourse name	Watercourse type	Notes	
			22DD-LS-2-GE-G00-00-C-30-DE-0024	
			Locate Point on bridge	'_id Specify point: X = 325.162 Y = 507.815 Z = 0.000
			22DD-LS-2-GE-G00-00-C-30-DE-0024_0	
			Locate Point on bridge	'_id Specify point: X = 330.138 Y = 508.479 Z = 0.000
171+400	Unknown	Channelled valley bottom with broad	Channel confirmed within swamp forest vegetation in the centre of the valley bottom with a width of 5-8 m and depth of approximately 1.5 m. System is hydrologically well intact with peat soils present. The revised design	

Chainage (km)	Watercourse name	Watercourse type	Notes
		seep zones (channel discontinuous)	has changed from a single culvert of 2.5 m x 2.5 m to a double of the same dimension. This is to allow for flow across a wider width in this peat wetland adapted to low energy flows. Refer to revised alignment Appendix 1-2.9
			22DD-LS-2-GE-G00-00-C-30-DE-0025 

Chainage (km)	Watercourse name	Watercourse type	Notes
			22DD-LS-2-GE-G00-00-C-30-DE-0025_0 
189+500	Rio Luachimo	Channelled valley bottom with broad seep zones	Significant sedimentation impacts observed from ill-designed road culverts and poorly vegetated embankments located upstream of the proposed railway crossing. Road culverts were observed to be silted (blocked) more than half their height. Once completely block this will result in severe damming and possible road failure. The latter will result in the release of massive amounts of sediment towards the proposed railway line and possible channel incision within the watercourse. Proposed crossing is a bridge with pillars with a span of approximately 560 m
197+850	Unknown	No distinct watercourse observed	No samples collected as no surface water was observed. Currently two culverts of 2.5 m x 2.5 m each are proposed
222+100	Unknown	No distinct watercourse observed	Currently two culverts of 2.5 m x 2.5 m each are proposed. The purpose of the culvert is to allow runoff to pass through the railway corridor in an area where convergent contour lines are present to prevent damming

Chainage (km)	Watercourse name	Watercourse type	Notes
238+400	Unknown	No distinct watercourse observed	No samples collected as no surface water was observed. Currently one culvert of 2.5 m x 2.5 m is proposed. The purpose of the culvert is to allow runoff to pass through the railway corridor in an area where convergent contour lines are present to prevent damming
248+500	Unknown	No distinct watercourse observed	No watercourse expected at location. Currently one culvert of 2.5 m x 2.5 m is proposed. The purpose of the culvert is to allow runoff to pass through the railway corridor in an area where convergent contour lines are present to prevent damming
256+300	Rio Sambuamba	Channelled valley bottom with broad seep zones	Agricultural activities dependent on watercourse and within seepage area with created furrows. Proposed crossing is a bridge with pillars with a span of approximately 140 m. The revised alignment has shifted the bridge marginally to the north – see revised alignment Appendix 1-2 22DD-LS-2-GE-G00-00-C-30-DE-0037

Chainage (km)	Watercourse name	Watercourse type	Notes	
			22DD-LS-2-GE-G00-00-C-30-DE-0037_0	

3.2.3 Road crossings/access tracks alternatives considered

Types of crossings typically considered along railway lines include overpasses, underpasses and level crossings. Level crossings have been selected as the preferred choice from a technical perspective. The alternative factored in the number of trains are maximum 2 passenger and 2 freight trains along a single track, there are no night time trains planned, and the relatively few settlements along the RoW that have a number of existing dirt roads/footpaths that traverse the alignment.

Table 3-2: Road crossings/access tracks alternatives considered

Chainage (km)	Location	Notes	Drawing Ref Number
38+200	KM 38+200 close to Muapeso Commune	Concern raised that residents will be cut-off from a water resource and cultivated lands by the proposed railway corridor. The engineering design has been revised to make provision for four level crossings to enable access to water and cultivated lands for people and livestock. Refer to revised alignment Appendix 1-2	22DD-LS-2-GE-G0-00-C-30-DE-0006_0

Chainage (km)	Location	Notes	Drawing Ref Number
45+500	KM45 close to Camanongue	The community will be cut-off from a water resource by the proposed railway corridor. The revised design has considered 6 level crossings (locations in purple below) for people and animals to access agricultural lands and water crossings refer to revised alignment drawing Appendix 1-2.2	22DD-LS-2-GE-G0-00-C-30-DE-0007_0

3.2.4 Alignment and stations/camps reconfiguration/amendments in 2025

As part of the preliminary studies to inform the detailed design, the contractor conducted aerial surveys along the alignment route between December 2024 and July 2025. The resulting orthophotos contributed to some amendments in the alignment and drainage structures. These changes are presented in the Table 3-3 below. further information on the design drawings and the Project's identification of aspects and assessment of environmental impacts by applying their PI-FR-003-PLN-0016-01 procedure is attached in Appendix 04 OEC SOPs_Plans - 3.

Table 3-3 Alignment and stations reconfiguration in 2025

Sn	Design changes	Justifications
i.	Relocation of the central construction yard (camp site) from KM 54 to KM 22 at Ndongue hence combining the Camp and station within the same area	• Reduction in agricultural land occupation and requirements hence avoiding and minimizing involuntary resettlement impacts • Significant avoidance of crossing through the communities of Camanongue, Muapeso, and Ndongue • Reduced interference with local communities and lower risk of traffic accidents and pedestrian collisions • The new location at KM 22+900 reduces transport distance by 60 km per trip to Luena station, where all materials arrive via the Lobito Corridor • Reduced construction traffic, minimized disruption to local circulation, and less damage to existing roads • Consolidation of the batching plant, equipment, and workshops in a single location
ii.	Relocation of Ndongue Station from KM 24+500 to KM 22+900	• Improved accessibility for Musserinjinje and Ndongue communities • Minimal farmland occupation at KM 22+900 • Avoidance of recently developed agricultural zones • The new station location at KM 22+900 coincides with the main construction site access, avoiding new land occupation and new access roads
iii.	Slight realignment towards EN180 KM 38	• High-definition surveys allowed alignment adjustments to minimize farmland occupation • Improved community crossing paths and access to farmland • limits distance traversed across the wetlands to reduce disturbance
iv.	Slight realignment towards EN180, km 45+500	• same as above

Sn	Design changes	Justifications
v.	Change in the crossing of the Tchihinhi valley	• Orthophoto surveys identified a better and shorter crossing with minimized wetland impact • Reduced farmland occupation and impact on houses • New crossing avoids bridge construction; PH culverts used instead with better earthworks balance • Replacement of bridge with PH culverts, avoids excavations required for bridge construction.
vi.	Alignment adjustment KM 72 & Cassai River crossing	• Reduced alignment over wetlands and improved Cassai River crossing • Loop 1 brought closer to EN180, facilitating rail access • Improved earthwork volume balance and avoidance of new dumpsites • Alignment follows existing high-voltage power line corridor • Minimized farmland impacts
vii.	Minor shift of the northern abutment of the Tchiumbwe bridge 60 m westward, towards EN180	• LiDAR survey revealed elevation differences vs. Google Earth base. The shift improves accuracy of alignment, reducing unexpected earthwork and environmental disruption • Chiumbwe bridge maintained in the same location to preserve the best crossing identified and confirmed by the LiDAR system
viii.	Slight realignment towards EN180 at KM 126	• Adjustment of railway curve radii for improved efficiency and railway safety • Minimization of land occupation and potential impacts • LiDAR and photogrammetry surveys improved alignment accuracy reducing unnecessary earthworks • Prevent earthworks in untouched areas and reduction in earth movement
ix.	Replacement of "Riacho" Bridge with Multiple Culverts at KM 163 as alternative to the previous solution at this point.	• LiDAR survey enabled elevation corrections and improved valley crossing enhances alignment accuracy and reduces earthwork in sensitive valley areas • Revised drainage design with shorter lengths and reduced upstream flow minimizes erosion and flooding risks • Improved volume balance and avoidance of new deposit areas • Replacement of bridge with PH culverts avoids excavations required for bridge construction.

3.3 Materials and resource alternatives

Sleeper production: OEC is studying two options: the importation of sleepers or to install a site plant. The methodology of the site plant, if it will be the chosen, is to work with a carousel fabrication method.

Aggregate: Considerations in sourcing construction fill material included establishing new burrow pits and quarries in comparison to using existing locations. The preferred alternative was to use existing quarries described in section 2.4.6 above. This avoids impacts associated with additional land take, clearance of natural habitat and creating a number of access routes

3.4 Station alternatives

Initial station at Luena was to be situated in the northeast of the city, among a densely populated part of the city and closer to the existing station for the Benguela Railway. After review on possible availability of land, a second alternative was suggested approximately 10km from the Luena Central Station. The second alternative is the preferred alternative included in the preliminary designs and ESIA because it avoids potential impacts related to demolition/ removal of existing structures, and the topography of the second alternative is also friendly. In addition, the second alternative minimizes disruptions to existing public infrastructure and avoids potential displacement impacts.

Further, Saquembue station has been moved to KM227+500 (revised alignment Appendix 1-2.11) as shown in Figure 3-1 overleaf.

3.5 Technology alternatives

During the FEED phase, a technology selection process will be undertaken that will address the following core project components:

- power generation systems e.g. use of solar at mobile facilities versus diesel powered generators. The design has considered generators as the alternative to connecting to the municipal system. Factors considered include availability of mechanics and technicians who are knowledgeable to repair and maintain generators, the availability of generators in the country, the cost compared to other renewable energy sources like solar panels and the availability of fuel along the project corridor
- wastewater treatment systems e.g. use of biodigesters, septic tanks, natural wetland systems. The design has considered the use of septic tanks because of the low cost, simple technology. Biodigesters are currently expensive to procure and install in the region and natural wetlands were not considered to avoid any indirect conflicts with residents whose livestock may wander through
- storm management for substance affected runoff/effluents. Each camp has a stormwater and drainage system (refer to Appendix 02 Camp Layout). The stormwater will be collected and captured through a functional surface temporary drainage system and discharged to ponds after applying a proper filtration or treatment (for reusing it onsite, where possible) and/or to seasonal natural water channels/streams. In case heavy rains leads to the generation of pits and ponds, they will be removed by pumping the water by means of vacuum truck and disposing it of as per the Project specifications and requirements. Additional

information on Stormwater and Drainage Management is included in the Contractor's Waste Water and Drainage Management Plan PI-MP-010-OECLS

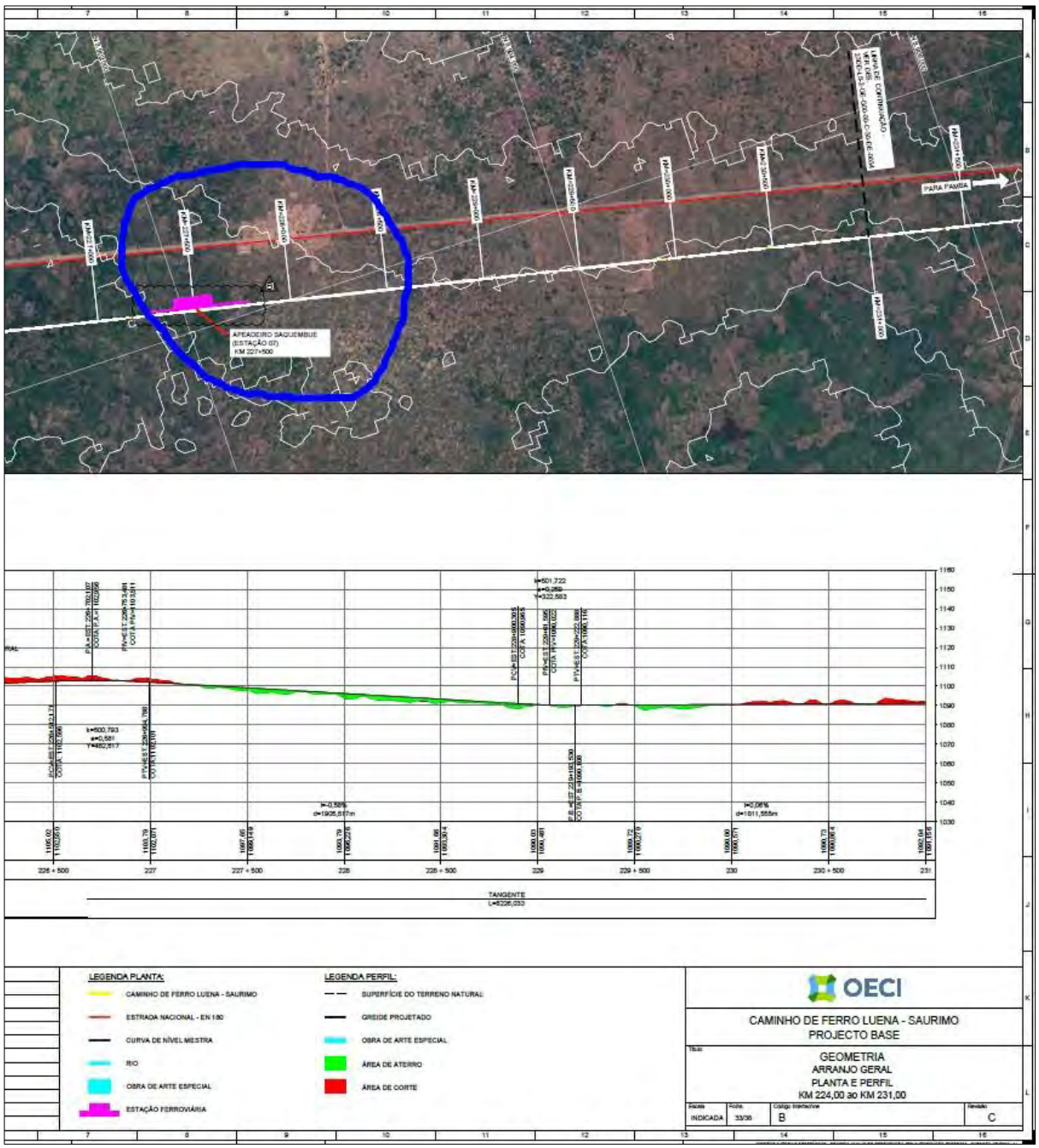


Figure 3-1: Saquembue station new location (KM227+500)

3.5.1 Locomotive options

Table 3-4 below presents a comparison of the advantages and disadvantages between different locomotive engine options. The Project has chosen to use a diesel engine (General Eléctric C30ACi) as the preferred alternative for the following reasons:

1. Although hybrid, electrical and hydrogen engines have lower emissions, the investment costs were considered too high for the government at the present moment.
2. The Project area has limited supporting infrastructure and supply to enable to run the alternative locomotives (e.g. established electrical lines, LNG or hydrogen refilling stations and high capacity batteries). This would require the Project to construct associated facilities to minimise disruption, adding onto the high investment cost
3. The current demand forecast for freight requires locomotives that can travel long distances and can easily be linked to the existing Benguela railway line that connects from central Africa to the Atlantic ocean. The Benguela line currently does not have supporting infrastructure for full electrical, hybrid or hydrogen locomotives.

Table 3-4 Comparison of locomotive alternatives for the Luena Saurimo railway

Option	Advantages	Disadvantages
Diesel-electric locomotives (conventional)	• Operational Flexibility: Diesel locomotives can operate on any line, unlike electric trains, which require expensive electrified infrastructure like overhead wires. • High Fuel Efficiency & Power: Diesel engines are highly fuel-efficient and produce high power and torque, making them ideal for pulling heavy loads. • Durability: Diesel engines are known for their durability and long service life. • Reduced Infrastructure Needs: They do not require the regular replenishment of water and coal that steam locomotives needed, and they eliminate the need for trackside electrical systems.	• **Air pollution:** diesel engines produce emissions, including soot and nitrous oxides, contributing to air pollution. • **Noise and vibration:** diesel engines generate significant noise and vibrations for both the passengers and the public • **Fuel costs:** due to changes in the market prices, diesel fuel is now often comparably priced or more expensive than petrol, impacting operating costs. • **Maintenance:** diesel engines are more complex than steam engines, with more moving parts that require regular maintenance, increasing running and maintenance costs. • **Efficiency *vs.* electric:** diesel-electric systems have lower overall energy efficiency compared to straight electric trains due to energy conversion losses in the diesel-electric transmission.

Option	Advantages	Disadvantages
	• Lower Initial Cost: cost of investing in a diesel-electric locomotive is lower compared to the significant investment required for electrification. • Power and Traction: Diesel locomotives can provide high power output, making them suitable for heavy freight and long-distance travel.	
Hybrid / dual-fuel locomotives (diesel + LNG or battery assist)	• **Environmental benefits:** hybrid locomotives significantly reduce fuel consumption and pollutant emissions, particularly in comparison to pure diesel locomotives. • **Operational flexibility:** the dual-mode locomotives can switch between electric and diesel power, allowing them to operate on both electrified and non-electrified lines, giving operators greater flexibility. • **Improved efficiency:** by recovering energy through regenerative braking, hybrid locomotives can improve overall efficiency and reduce the peak demand on their prime movers. • **Quieter operation:** in electric mode, locomotives can operate with zero noise and exhaust emissions, which is beneficial in urban areas or clean air zones. • **Faster acceleration:** Hybrid powerplants can enhance transient power and tractive effort, resulting in faster acceleration.	• **High initial costs:** the complex powertrain and dual energy sources of hybrid and dual-mode locomotives make them more expensive to build and acquire. • **System complexity increases maintenance:** the combination of multiple power systems leads to greater mechanical complexity, which can increase maintenance requirements and costs. • **Energy storage efficiency:** energy is lost in both the charging and discharging process, which can reduce net efficiency. • **Freight and speed limitations:** due to factors like wheel adhesion, the effectiveness of hybrid systems can have high-speed rail and heavy freight limitations. • **Weight:** the additional components of a hybrid system, like batteries or fuel cells, can increase the overall weight and volume of the locomotive
Full electrification (electric traction)	• **No exhaust gases:** electric locomotives produce no exhaust gases where they operate, improving local air quality and reducing the overall carbon footprint of rail transport.	• **High infrastructure costs:** substantial upfront investment needed to install and maintain the necessary infrastructure, such as overhead wires or third rails, substations, and control systems. • **Pow**er supply dependence: the electric traction system relies on a continuous and stable electricity

Option	Advantages	Disadvantages
	• **Higher efficiency:** convert a higher percentage of energy into motion than diesel trains. • **Lower long-term running costs:** electric locomotives have lower maintenance costs and fuel expenses compared to diesel engines • Faster speeds and quicker travel times**:** electric locomotives have high acceleration and can achieve greater power output for their size. • **Quieter operation:** Electric trains run more quietly for both the passenger and the public. • **Reduced maintenance:** they require less frequent and less extensive maintenance due to fewer moving engine parts	supply to operate without stoppages. • **Limited route options**: The range of electric trains is limited to routes with overhead electrification. • **Electromagnetic interference**: The overhead power distribution networks can cause interference with nearby communication and signalling lines.
Hydrogen fuel-cell locomotives	• **Environmental benefits**: hydrogen fuel cells produce only water and heat as byproducts at the point of use, resulting in zero harmful emissions and significantly lower the carbon footprint of rail transportation. • **Quiet and vibration-free operation**: The lack of engine noise and vibration makes them a more pleasant for passengers • **Fast refueling**: hydrogen locomotives can be refueled quickly, reducing downtime. • **Energy efficiency**: Hydrogen fuel cells are highly efficient in converting chemical energy into electricity • **Versatility**: Hydrogen trains can operate in remote locations and can potentially even run on existing or electrified lines.	• **High cost**: The significant investments needed for the technology, fuel production, and infrastructure make them expensive to implement. • **Infrastructure limitations**: There is a limited network of hydrogen refueling stations, requiring significant expansion to support widespread use. • **Production challenges:** Producing "green" hydrogen from renewable sources is energy-intensive, and most current production relies on non-renewable fossil fuels, negating some environmental benefits. • **Storage and safety:** Hydrogen requires high-pressure storage, which poses safety concerns due to its high flammability and potential for leakage. • **Developmental stage:** The technology and the associated hydrogen economy are still in their early stages of development, requiring substantial funding and research to become viable. • **Energy intensive production:** The process of extracting hydrogen from water using

Option	Advantages	Disadvantages
		electrolysis can be energy-intensive with minimal recovery.

4 GOVERNANCE FRAMEWORK

This Chapter provides a description of the governance framework encompassing Angolan legislative and lender requirements applicable for Luena-Saurimo railway Project execution and successful assessment of environmental and social aspects of the Project.

Governance requirements presented entails the following:

- Angolan regulatory requirements: the national regulatory requirements form part of the identification, assessment, and proposed mitigation of potential project impacts. This will include identification of E&S Permits required for the project
- Lender Appraisal Standards (LAS): this includes an assessment of requirements in terms of IFC Performance Standards (1-8), World Bank Group EHS Guidelines, Equator Principles IV (EP4, 2020) and OECD Common Approaches
- corporate governance: OEC Standard Operating Procedures (SOPs) and other Plans pertinent to Luena-Saurimo Project
- institutional framework and key implementing agencies.

4.1 Constitution of the Republic of Angola

Article 39 of the Angolan Constitution defines environmental rights, stating that every citizen has the right to live in a healthy and unpolluted environment, and has the responsibility to defend and preserve it. It is the State's responsibility to design and implement adequate measures to protect the environment in all its aspects to maintain ecological equilibrium, economic viability, rational use, and exploration of natural resources, while ensuring sustainable development.

4.2 Policy and strategic plans

4.2.1 National Development Plan (2023 – 2027)

The Plan is structured based on three principles, namely alignment of the governance program with the Angolan 2050 long-term strategy, impact orientation and programmatic interdependence. The orientation of impact brings together three main pillars, namely the development of human capital, the modernization and expansion of infrastructure and the diversification of the economy. The plan includes nine major elements with seven axis, 20 policies, 79 programmes, 151 objectives and 315 priorities.

4.2.2 Angola 2050: Long-Term Strategy

The Angola 2050 Strategy was approved in July 2023. The plan is bifocal with a clear vision of where the country wants to be in the future yet clearly indicating the short-term initiatives to take the right direction.

4.2.3 National Environmental Management Programme

The National Environmental Management Programme (Programa Nacional de Gestão Ambiental – (PNGA)), is an important instrument for achieving sustainable development. Finalised in 2009, with assistance from the United Nations Development Programme (UNDP), the PNGA emphasises the need for an environmental management strategy to protect the environment. Importantly, the Environment Framework Law recognises that the implementation of the PNGA should be the responsibility of all sectors of government whose activities may have an influence on the environment, all private individuals and organisations that make use of natural resources, as well as those individuals who may use resources unsustainably and cause pollution. The PNGA has five strategic sub-programmes including Promotion of inter-sectoral coordination; protection of biodiversity, flora, and terrestrial and marine fauna; ecosystem rehabilitation and protection; environmental management; and environmental education, information, and awareness.

4.2.4 National Master Plan for the Transport Sector

The National Master Plan for the Transport Sector undertaken by MINTRANS provides an assessment and prioritization of road infrastructure, railways, ports and maritime transport, aviation and road passenger transport. the National Master Plan for the Transport and Road Infrastructure Sector (PDNSTIR), alongside the directives outlined in the National Railway Network Expansion Plan, has embarked upon a transformative endeavor whereby a total of 13 new projects have been identified and prioritised. The proposed Luena-Saurimo railway is one of the proposed sub-projects under the Master Plan.

4.2.5 Trans-African Corridor

The European Union and the United States committed at the G20 Summit in India in 2023 to support the development of a new greenfield African railway line expansion between Zambia and Angola by launching feasibility studies. The new railway line is part of developing the Trans-African Corridor connecting southern Democratic Republic of the Congo (DRC) and northwestern Zambia to regional and global trade markets via the Port of Lobito in Angola. The corridor governance instrument titled the “Lobito Corridor Transit Transport Facilitation Agency (LCTTFA) Agreement” was signed in January 2023. This creates a framework for the three Southern African Development Community (SADC) Member States to jointly develop harmonised corridor laws, policies, regulations, and systems including infrastructure development in a coordinated manner. It should accelerate growth in domestic and cross-border trade along the Corridor through the implementation of harmonised trade facilitation instruments, strengthening coordination of joint corridor development activities, and fostering effective participation of small and medium enterprises (SMEs) in value chains. The Lobito Corridor presents an alternative strategic route to export markets for Zambia and DRC and offers the shortest route linking key mining regions in these two countries to the sea. The EU-U.S. partnership will upgrade critical infrastructure across sub-Saharan Africa to unlock the economic potential of the region. The partnership will combine financial resources and technical know-how to accelerate the Trans-African Corridor development, including investments in digital access and agricultural value chains that will increase regional competitiveness (Railtech, 2023).

4.2.6 Nationally Determined Contribution of Angola

The Nationally Determined Contribution of Angola demonstrates Angola's commitment to the Paris Agreement by responding to Decision 1/CP.21 of COP21 through reviewing and updating its NDC's. Angola's NDC's include both unconditional and conditional measures to support the reduction of GHG emissions as well as adaptation to the adverse impacts of climate change.

4.3 Legal framework

Table 4-1 provides a list of relevant Angolan legislations, the most pertinent of which are described in the subsequent sub-sections.

Table 4-1: Selected Angolan legislations that are relevant to the Project

Title	Number
General	
Constitution of the Republic of Angola	Law Nº 111/2010 of January 30th, 2020
Environmental legislations	
Environmental Framework Law	Law Nº 5/98 of June 19th, 1998
Environmental Impact Assessment Regulations	Law Nº 8/20 of April 16th, 2020
General Regulation of Environmental Impact Assessment and Environmental Licensing Procedure	Presidential Decree Nº 117/20 of April 22nd, 2020
Environmental Auditing	Decree Nº 1/10 of January 13th, 2010
Terms of Reference for the Development of Environmental Impact Studies	Executive Decree Nº 92/12 of March 1st, 2012
Liability for Environmental Damage	Presidential Decree Nº 194/11 of July 7th, 2011
Guidelines for Provincial Urban Waste Management Plans	Executive Decree Nº 234/13 of July 18th, 2013
Strategic Plan for Urban Waste Management (PESGRU)	Presidential Decree Nº 196/12 of August 30th, 2012
Waste Management Guidelines	Presidential decree Nº 190/12 August 24th ,2012
Biodiversity National Action Plan	Presidential Decree No. 26/20 of February 6th, 2012
Biodiversity and resources	
Law of Forests and Wild Fauna	Law Nº 6/17 of January 24th, 2017
Biological and Aquatic Resources Law	Law Nº 6-A/04 of October 8th, 2004
National Strategy and the Biodiversity Action Plan 2019-2025	Law Nº 26/20 of February 6th, 2020

Environmental Conservation Areas Law	Law Nº 12/21 of May 21st, 2021
Labour	
General Labour Law	Law Nº 12/23 of June 27th, 2023
Health and safety	
Angolan Health Regulations	Law Nº 05/87 of February 23rd ,1987
General Regulation of Occupational Safety and Hygiene Services in Organizations	Executive Decree Nº 6/96 of February 2nd, 1996
Occupational Hygiene and Safety System	Decree Nº 31/94 of August 5th, 1994
Legal Regime of Occupational accidents and Occupational Illnesses	Decree Nº 53/05 of August 5th, 2005
General Regulation of Occupational Safety and Health Signs	Decree Nº 128/04 of November 23rd, 2004
Energy	
Electricity General Law	Law Nº 14-A/96 of May 31st, 1996
Environmental Protection Regulations for Petroleum Activities	Decree Nº 39/00 of October 10th, 2000
Water	
Water Law	Law Nº 6/02 of June 21st, 2002
Regulation on General Rules of Use of Water	Presidential Decree Nº 82/14 of April 12th, 2014
Regulation on Water Quality	Presidential Decree Nº 261/11 of October 6th, 2011
National Water Plan	Presidential Decree Nº 126/17 June 13th, 2017
Regulation on Public Water Supply and Wastewater Sanitation	Presidential Decree Nº 83/14 of April 22nd, 2014
Regulation for the Prevention and Control of Pollution of National Waters	Presidential Decree Nº 141/12 of June 21st, 2012
Land use and resettlement	
Land Law	Law Nº 9/04 of November 09th, 2004
Law on Territorial and Urban Planning	Law Nº 3/04 of July 25th, 2004
General Regulation of Territorial Plans	Decree Nº 2/06 of January 23rd, 2007
General Regulation Land Concession	Decree Nº 58/07 of July 27th, 2007
Regulation for Resettlement Operations	Presidential Decree Nº 117/16 of May 30th, 2016
Law of Expropriation for Public Utility	Law Nº 1/21 of January 7th, 2005
Cultural heritage	

Cultural Heritage Law	Law Nº 14/05 of October 7th, 2005
Regulation of Immovable Cultural Heritage	Presidential Decree Nº 53/13 of October 7th, 2013
Approves the General Statute of Museums	Presidential Decree Nº 44/11 of March 7th, 2013
Recognizes Semba as National Intangible Cultural Heritage, in the field of Forms of Cultural Expression and the same Presidential Decree Classifies the so-called Kwanza Corridor as a National Cultural Itinerary	Presidential Decree Nº 54/55/23 of May 2nd, 2023, Series I - No. 77
Elevates the category of Cultural Heritage Church of the Holy Family	Presidential Decree Nº 52/23 of April 28th, 2023, Series I
Approves the Organic Statute of the National Institute of Cultural Heritage	Presidential Decree Nº 16/21 of January 14th, 2021
Organic Statute of the Ministry of Culture and Tourism	Presidential Decree Nº 280/22
Regulations on the Procedures Relating to the Protection, Export, Import and Transfer of Cultural Goods	Decree Nº 87/20 of April 6th,2020
International conventions ratified by Angola in the context of the protection of its historical and cultural heritage	Resolution 21/90 of 21/11/1990
	Resolution 26-B/91 of 31/12/1991
	Resolution 22/11 of 23/11/2011
	Resolution 25/11 of 25/11/2011
	Resolution 20/15 of 30/12/2015
Transport	
Basic Land Transport Law	Presidential Decree Nº 20/03 of August 19th, 2003
General Regulation of Rail Carriage of Passengers, Baggage and Fares	Presidential Decree Nº 209/13 of December 12th, 2013
General Regulation of Railway Traffic Safety	Executive Decree Nº 170/10 of December 13th, 2010
Regulation on the Conditions for the Provision of Railway Transport Services and Railway Infrastructure Management	Presidential Decree Nº 203/13 of December 3rd, 2013
License for the Provision of Railway Transport Services and Application for the Issuance of a License for Access to the Activity of Railway Transport Services Provision	Executive Decree Nº 188/15 of April 21st, 2015
Regulation of Public Railway Transport Services	Presidential Decree Nº 131/10 of July 8th, 2010

Bases of the Railway Services Concession and Support Logistics of the Lobito Corridor	Presidential Decree Nº 205/21 of August 30th, 2021
General Bases of Concessions for the operation of rail passenger and freight transport services	Presidential Decree Nº 194/13 of November 20th, 2013

4.3.1 Environmental Framework Law of 1998

The Environmental Framework Law No. 5/98 (EFL) was promulgated in accordance with Articles 12 and 24 of the 1992 Angolan Constitution (reformed in 2010). The EFL is the overarching law governing environmental legislation in Angola. Under the EFL, MINAMB has developed several policies and regulations to ensure sustainable development. Key articles include:

- Article 3 – defines Environmental Impact Assessment (EIA), Environmental Impact Study (EIS), and public consultation
- Article 10 – requires that all Projects affecting communities, ecological balance, and use of natural resources shall be subject to environmental impact assessment
- Article 11 – the National Government is responsible to develop regulations necessary to implement the National Environment Management Plan (Nacional de Gestão Ambiental)
- Article 12 – (Environmental Heritage) "The Government must ensure that the environmental heritage, and in particular natural, historical and cultural, is the subject of permanent measures and defence appreciation, through environmental protection associations"
- Article 17 – licensing of activities that are liable to cause significant environmental impacts is required as determined by the EIA.

4.3.2 Presidential Decree No. 117/20 of 22nd April - Environmental Impact Assessment Regulations and Environmental Licencing Procedures

The Decree on Environmental Impact Assessment 117/20 is established in accordance with Article 16 of the EFL.

This Decree regulates the environmental licensing process of projects which, by their nature, location or scale are susceptible of causing significant environmental and social impacts. three types of licenses are concerned: the environmental installation license, environmental operation license and environmental decommissioning license.

- environmental installation license – issued as an authorization of project facilities layout implementation, according to the specifications contained in the project design, valid for 3 years
- environmental operation license – issued as an authorization to start operations, compliant with all requirements and measures of environmental impact assessment, valid for 5 years
- environmental decommissioning license – issued as an authorization to end operations, compliant with all requirements of MINAMB.

The licensing process takes 30 business days counted from the date of ESIA report submission to Environmental Ministry on the Integrated Environmental System digital

portal (SIA-DP). Project´s proponent must hire an Environmental consultancy company registered on Environmental Ministry to execute and submit ESIA. The request for environmental licensing must include the following documents:

- facility description, dimension, complexity, and activities description
- land ownership documents
- non-technical summary of environmental impact assessment
- technical summary of environmental impact assessment
- approval of the entity that regulates the respective activity.

Information about organization (business schedule, company register documents, list of equipment, environmental consultancy company documents). A license renewal request must be submitted on the SIA-DP 90 days before its expiration.

This Decree also establishes guidelines and procedures to be followed during the development of EIS. The minimal content of an ESIA is described below:

- identification of project´s proponent, consultancy company and technical team identification
- project description
    - objective and scope
    - location description
    - project specifications
- description of the alternatives under study
- characterization of project´s area of influence
- environmental diagnosis of the area of influence:
    - physical environment
    - biotic environment
    - socioeconomic environment
- analysis of Project´s environmental impacts
- description of compensatory and mitigation measures
- environmental monitoring plan
- conclusion.

According to Chapter III in Article 21, the Project Owner or Company must submit the following via the SIA-DP as part of the ESIA:

- non-technical summary
- description of the activity and justification of the activity, legal framework of the activity
- brief biophysical and socio-economic information on the area
- information on the current land use within the project area
- Commercial Registry Certificate of the Company, Value of the project

investment

- nominal List of machinery and equipment, public deed of the Company
- proposed distribution of onus and social benefits
- waste management plan submission protocol to Waste Agency
- hire an environmental company to conduct EIA and submit to SIA-DP.

For those aspects without local technical specification, international legislation standards were consulted and considered (specifically IFC PS's and WBG EHS Guidelines) for compliance and monitoring purposes.

The environmental licencing process is provided in Figure 4-1 overleaf.

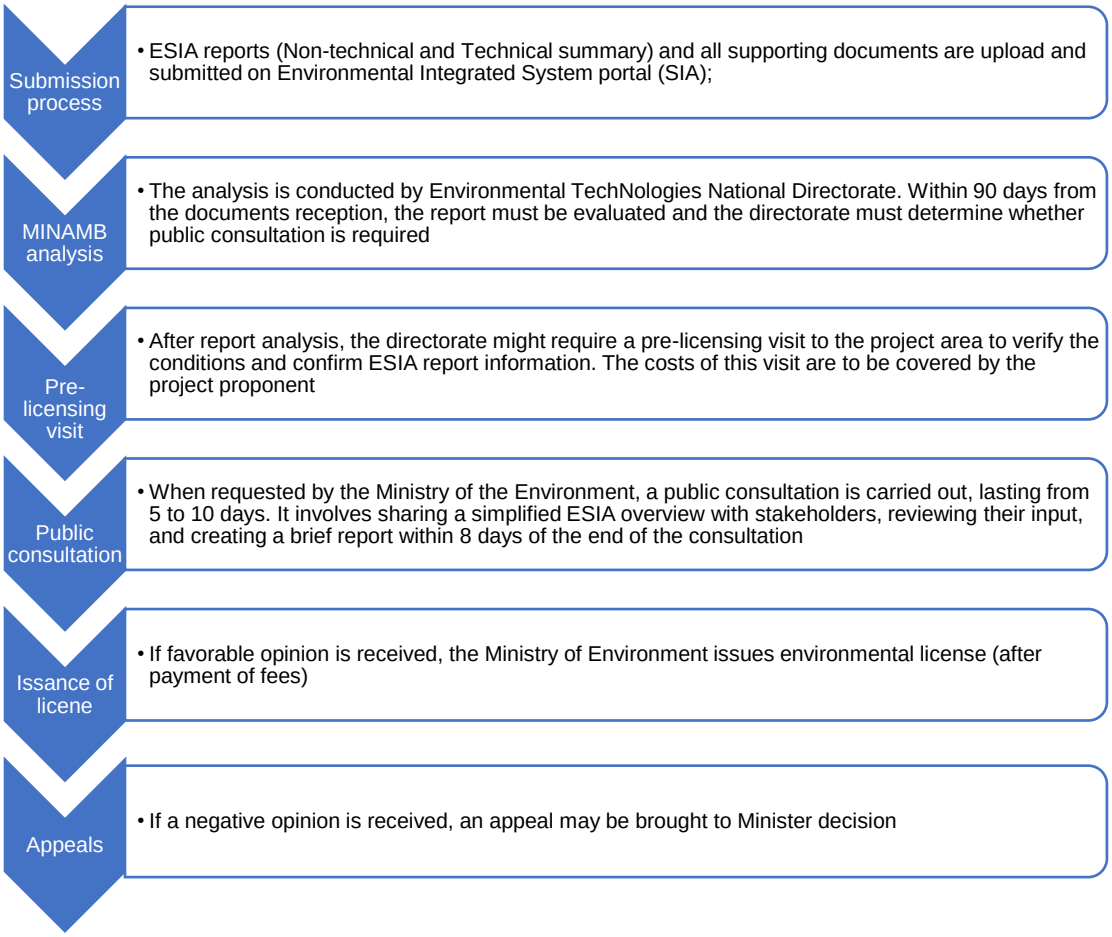


Figure 4-1 Angolan environmental licencing process

4.3.2.1 Integrated Environment System (SIA)

SIA is an online platform that aims to make the process of Environmental Licensing (Operation and Installation) simple and more effective. It is managed by the Ministry of the Environment, through its National Directorate of Environmental Technologies, comprises 5 stages, namely:

1. Identification Registration (contact and operational of the company) of the

person who needs the licensing, i.e., the proponent of the project

2. Project:
    a) Identification (Name of the project, Investment Amount and currency, single-scenario zones)
    b) Address (Province, Municipality, District or Commune and Neighborhood)
    c) Installation Data (soil conditions, unit of measurement, total land area, occupied area, free area, area characteristics, geographic coordinates in Degrees, Minutes and Seconds)
    d) Responsible (NIF, Taxpayer Name and Type of Person)
    e) Responsible contact (Email and telephone contacts).
3. Accessories:
    - Address (Province, Municipality, District or Commune and Neighborhood)
    - Water Use (type of catchment, name of the watercourse, potable or not, quantity in m^3, description of water use)
    - Products and By-Products (Product and/or by-products denomination, unit of measurement, average daily quantity)
    - Machinery and Equipment (Denomination of the Machine and/or equipment, quantity, brand, model and training)
    - Stock (Raw material, unit of measure, average daily quantity).
4. Files:
    - Client's Legal Documentation (Business License, Commercial Registration Certificate, Location Sketches, Investment Statement, Physical Arrangement of Equipment)
    - Submission of the Environmental Impact Study.
5. Summary of the information requested prior to the submission of the license.

4.3.3 Presidential Decree Nº 83/22 April 12th, 2022- Fees to be Charged for the Issuance and Renewal of Environmental Licenses

The Presidential Executive Decree establishes the fees and fees for granting an Environmental License for Installation, Operation and Deactivation, as well as the renewals of the respective licenses, the endorsement of transmissions, the costs of Environmental Impact Assessment, Environmental Audits and records of environmental consultancy entities. The proposed Luena-Saurimo Project will likely be subjected to the fees as prescribed in the Decree.

4.3.4 Decree Nº 1/10 of January 13th, 2010 - Conducting Environmental Audits of Public or Private Activities Likely to Cause Significant Damage to the Environment

Presidential Decree No. 1/10, of 13 January 2010, establishes the procedure for carrying out environmental audits whose purpose is limited to assessing the actual or potential levels of pollution or environmental degradation. In addition, it also allows for the verification that the auditee is complying with environmental standards and environmental quality standards.

Article 8 of this Decree emphasises the obligation to carry out environmental audits of activities subject to Environmental Impact Assessment (EIA). The Ministry of Supervision is responsible for carrying out an environmental audit, and the entity being audited must collaborate with the auditors, making all documentation available to them and granting access to all facilities and equipment.

In its article 7, it assigns the responsibility to the Ministry of the Environment to determine, when necessary to carry out occasional environmental audits, establishing specific guidelines and deadlines, after being submitted to the Environmental Impact Assessment of the project.

4.3.5 Executive Decree Nº 92/12 of March 01st, 2012- Terms of Reference for the Development of Environmental Impact Studies

Executive Decree 92/12 of March 1st establishes the guidelines for the preparation of the Environmental Impact Studies necessary for the environmental feasibility analysis of the Project subject to an Environmental Impact Assessment. However, the Environmental Impact Assessment must be prepared in accordance with the legislation on Environmental Impact Assessment and strictly comply with the Terms of Reference approved by the Ministry of the Environment, which guides the preparation of the same according to the specificity of each Project.

4.3.6 Presidential Decree Nº 194/11 of July 07th, 2011- Liability for Environmental Damage

The Decree on Liability for Environmental Damage 194/11 applies to any activity that may cause or threaten to cause damage to the environment. The Decree aims to establish the responsibility for the risk or degradation of the environment. Any party causing environmental damage is required to repair damages and/or provide compensation to affected parties because of damage caused.

4.3.7 Presidential Decree Nº 190/12 of August 24th, 2012 - Waste Management Guidelines

Waste Management Guideline Presidential Decree 190/12 provides detailed requirements for segregation, storage and containment for waste and categorization for hazardous and non-hazardous waste. These specific waste requirements are required to be included in operational procedures for waste generation.

Waste transportation should be executed by authorized service providers (licensed by National Waste Agency), with appropriately adapted equipment to enable safe waste transportation. The drivers must receive safety driving and basic emergency response training. The vehicles must have a waste manifest form that has been completed with information related to the nature of material being transported.

Presidential Decree Nº. 190/12, of 24 August 2012, deals with the Regulation on Waste Management, establishes comprehensive guidelines for the proper management of waste, addressing issues related to the collection, transportation, treatment, recycling, and safe disposal of waste, including solid, liquid, and gaseous waste. The decree is mainly limited to promoting environmental protection and public health, as well as encouraging sustainable waste management practices throughout the country. Article 7 of this regulation states that "All public or private entities that produce waste or carry out activities related to waste management must draw up a Waste Management Plan..." and "The Waste Management Plan is valid for a period of 4 years, counted from the date of its approval"

Executive Decree Nº. 17/13, of 22 January 2021, deals specifically with the management of Construction and Demolition Waste (CDW). It establishes the guidelines and

procedures necessary for the correct management of this waste, including its collection, transportation, recycling, reuse, and environmentally appropriate disposal. The main objective of this decree is to ensure that the generation and handling of construction and demolition waste is done in a sustainable manner, with the least possible environmental impact. In addition, it seeks to promote the practice of the circular economy, encouraging the reuse of construction materials and the reduction of waste.

Presidential Decree Nº. 181/14, of 28 July 2014, approves the Organic Statute of the ANR, being a body under the MINAMB with the attributions of regulating, executing, studying and developing Waste Management policies at national and provincial level, as well as analysing and issuing opinions on the Waste Management Plans of operators and companies that due to their activities are likely to generate waste.

Presidential Decree Nº. 203/19, of 25 June 2019, approves the Legal Regime of Landfills and fundamentally aims to avoid or reduce the negative effects on the environment resulting from the disposal of waste in landfills, both on a local scale, in particular the pollution of surface and groundwater, soil and atmosphere, and on a global scale, that is, the emission of greenhouse gases through the decomposition of organic waste, as well as any risks to public health.

Presidential Decree Nº. 194/11 of 07 July 2011, approving the Regulation on Liability for Environmental Damage, whose fundamental objective is to establish liability for the risk and degradation of the environment, applying the polluter pays principle, to prevent and remedy environmental damage.

Executive Decree Nº. 234/13, of 18 July 2013, approves the Regulation on Strategic Plans for Urban Solid Waste Management (PESGRU), with the aim of mobilizing society in general, political decision-makers and different economic agents on the Urban Solid Waste Management model.

Law Nº. 5/98, of 19 June 1990, "Basic Law on the Environment", serves as one of the main legal instruments that establishes the fundamental principles and guidelines for the protection and management of the environment in the country. It plays a crucial role in promoting practices that encourage sustainable development, biodiversity conservation, pollution prevention, and proper management of natural resources in Angola. In addition, this legislation provides the framework for the implementation of programs and projects that have a direct or indirect impact on the environment.

4.3.8 Law Nº 6/17 of January 24th, 2017- Basic Law on Forests and Wild Fauna

Law No. 6/17 of 24 January establishes the rules that aim to ensure the conservation, rational and sustainable use of forests and wild fauna in Angola as well as the general bases applicable to the performance of related activities.

Based on Article 3 of this Basic Law, it is limited to establishing measures for the conservation of forest ecosystems, as a habitat for the diversity of species of terrestrial fauna and flora, recognizing the importance of existing natural areas in the country, namely the Miombo Forest and the Mayombe Forest, which host a diversity of wildlife species, in particular terrestrial ones. Meanwhile, the establishment of general principles and criteria for access to forest and wildlife resources and their sustainable management is essentially aimed at harmonising ecological and environmental aspects with technological and socio-economic development.

4.3.9 Law Nº 6-A/04 of October 8th, 2004 - Aquatic Biological Resources Act

The Law No. 6-A/04 of 8 October, Law on Aquatic Biological Resources, establishes the rules to ensure the conservation and sustainable use of aquatic biological resources existing in waters under the sovereignty of the Angolan State, as well as the general bases for the exercise of activities related to them, in particular fishing and aquaculture activities.

Section V, Article 92, prohibits the introduction of dangerous substances into exclusive economic zones, the territorial sea, the coastline and riparian areas. In addition, it establishes that all legal entities who carry out activities likely to cause pollution of the aquatic environment have the obligation to apply measures to prevent and minimize pollution.

4.3.10 Law Nº 26/20 of February 6th, 2020 - National Strategy and the Biodiversity Action Plan 2019-2025

The National Strategy and Action Plan for Biodiversity (NBSAP) of the Republic of Angola was formulated to serve as an integrated strategic framework, within which the conservation and sustainable use of Biodiversity in Angola can be organised and coordinated for the fulfilment of an Action Plan over a period of seven years (2019-2025).

The NBSAP was developed in accordance with the requirements of the Convention on Biological Diversity, which provides details on the designed and implemented. It presents a more comprehensive, futuristic, and ideal vision that is intended to be lived at the end of its implementation, striving for respect for present and future generations.

In general terms, the use of land and biodiversity resources outside the conservation areas includes activities such as Agriculture, Logging, Exploitation of marine and aquatic resources, Mining, Oil Exploration, Industrial Activity, Tourism activity, and Civil construction.

Furthermore, it highlights the importance and obligation for all projects in the country to carry out Environmental Impact Studies and to be monitored through periodic Environmental Audits in accordance with the legislation in force, to mitigate the impacts on the biodiversity of fauna and flora.

4.3.11 Law Nº 12/21 of May 21st, 2021 - Environmental Conservation Areas Law

The purpose of Law No. 12/21 of 21 May is to define the National System of Environmental Conservation Areas to establish the criteria and rules for its creation, classification and management through principles that safeguard its preservation, conservation and sustainable use.

4.3.12 General Labour Law (Law 12/23 of December 2023)

This law came into effect in March 2024 and repeals Law 7/15 of 2015 which aimed to create employment and enable the economic and social development of Angola. The12/23 law enacts the various changes from Law 7/15 including:

- fixed-term employment contracts are only allowed in very exceptional situations provided for and typified by law, thus the employment contract for an indefinite period has become the rule

- new disciplinary measures were introduced, namely (i) temporary category demotion, and (ii) suspension of work with loss of remuneration
- elimination of the categorization of companies as micro, medium, small and large companies for the purposes of calculating compensation and indemnities
- flexible working hours were introduced for employees with family responsibilities
- complementary maternity leave was introduced (granted for a period of four weeks and non-remunerated)
- paternity leave was introduced (granted for seven business days, consecutive or interpolated, non-remunerated)
- a new chapter on personality rights was also introduced.

The International Labour Organisation's (ILO) Minimum Age Convention of 1973 states that National laws or regulations may permit the employment or work of persons aged 13 to 15 years on light work that is not likely to harm their health or development or prejudice their attendance of school, participation on vocational orientation or training programmes approved by the competent authority or their capacity to benefit from instruction received. The minimum age for any type of employment or work which by its nature or the circumstances or the circumstances in which it is carried out is likely to jeopardise the health, safety or morals of young people shall not be less than 18 years. It must also be noted a Draft General Labour Law was approved in May 2023.

4.3.13 Law Nº 05/87 of February 23rd, 1987 - Angolan Health Regulations

The purpose of the above-mentioned Law is to supervise the sanitary order integrated in the public health activities, with a view to promoting the health of the population, as well as regulating the mortuary sanitary activity and the handling of corpses or remains in cemeteries.

4.3.14 Law Nº 12/23 December 27th, 2023 - General Regulation of Occupational Safety and Hygiene Services in Organizations

This decree establishes the principles that aim to promote occupational safety, hygiene and health.

Article 17 of this decree outlines safety and service organisation conditions, ensuring that every worker has the right to work in safe and hygienic conditions that protect their health (occupational medical exams regulations, safety protection equipment provision, safety workplace conditions). The employer must ensure the country's economic development and promote the harmonization of work under optimal safety, hygiene, and health conditions.

4.3.15 Decree Nº 31/94 of August 5th, 1994 - Occupational Hygiene and Safety System

Decree No. 31/94 of 5 August establishes the principles aimed at promoting safety, hygiene and health at the workplace, under the terms of Article 46(2) of Law No. 23/92-Constitutional Law.

The employer is responsible for promoting a healthy work environment with conditions of occupational health, hygiene and safety, in addition to training and awareness actions for compliance with the stipulated measures.

4.3.16 Decree Nº 53/05 of August 5th, 2005 - Legal Regime of Occupational accidents and Occupational Illnesses

Decree No. 53/05 of 15 August establishes the Legal Regime of Accidents at Work and Occupational Diseases. The scope is limited to guaranteeing the right to compensation for the damage resulting from accidents at work and occupational diseases for employees and their family members protected by the compulsory social protection system.

Article 7 of this law emphasizes the obligation of insurance against risks resulting from accidents at work and occupational diseases, extended to all workers, apprentices and trainees, after the execution of the respective employment contract to be signed between the two parties (the employer and the insurer).

4.3.17 Executive Decree Nº 128/04 of November 23rd, 2004- General Regulation of Occupational Safety and Health Signs

Executive Decree No. 128/04 of 23 November "General Regulation of Safety and Health Signs at Work" establishes the minimum requirements for the placement and use of safety and health signs in the workplace, being applicable to all public, mixed, private and cooperative companies.

Article 5 mentions Rules for the use of signalling means and devices, where signalling means and devices must be regularly cleaned, maintained, checked and, if necessary, repaired or replaced, as well as ensuring that employees understand the signs.

4.3.18 Electricity General Law - Law Nº 14-A/96 of May 31st, 1996

Establishes the general principles of the legal provisions applicable to activities of production, transport, distribution and use of electric energy.

4.3.19 Environmental Protection Regulations for Petroleum Activities - Decree Nº 39/00 of October 10th, 2000

It aims to guarantee the preservation of the environment in relation to health, water, soil, subsoil, air, flora and fauna, ecosystems, landscape, atmosphere, cultural values. Archaeological and aesthetic aspects and defines environmental protection areas subject to onshore and offshore petroleum activities.

4.3.20 Law Nº 6/02 of June 21st, 2002 - Water Law

Decree-Law No. 6/02, of 21st June, approves the Water Law, applied to inland waters, both surface and groundwater, and establishes the general principles of the legal regime inherent to the use of national water resources.

Article 22 mentions the classification of water, as to common use and private use, with common use being that which results from the law and which takes place under natural conditions, without contractual or administrative formalities, and private use being that which requires a license or concession, except for the provisions of Article 26. of this law.

4.3.21 Presidential Decree Nº 261/11 of October 6th, 2011 - Regulation on Water Quality

The Presidential Decree 261/2011 of 6 October approves the Regulations that establishes the standards and criteria for measuring the quality of water, according to its main uses, from the perspective of protecting public health, the integrated management of water resources and the preservation of the environment.

4.3.22 Presidential Decree Nº 82/14 of April 12th, 2014 - Regulation on General Rules of Use of Water

This Diploma defines modalities to be implemented during the project on the regime of general use of water resources, including suggestions for the elaboration of a plan for the use and management of surface and groundwater, with the aim of maintaining water despite use with its initial value and quality, and protected from any type of impact.

4.3.23 Presidential Decree Nº 83/14 of April 22nd, 2014 - Regulation on Public Water Supply and Wastewater Sanitation

For this Project, the works activities must comply with the effluent management and treatment criteria provided for by law, to demonstrate that the water from these activities is properly disposed of, without causing damage to human health and water bodies.

4.3.24 Presidential Decree Nº 141/12 of June 21st, 2012 – Regulation for the Prevention and Control of Pollution of National Waters

This Regulation establishes the regime for the prevention, surveillance and control of the pollution of national waters by pollutants from various human activities, namely ships, vessels, construction and industries.

4.3.25 Presidential Decree Nº 126/17 of June 13th, 2017 - National Water Plan

The National Water Plan, in addition to including the biophysical, economic and social, environmental, legal and institutional characterization of the Water Sector in Angola, also gives an overview, although not recent, of the conditions of supply, water resources, quantity and quality at the level of Angola, and the area of influence of the Project.

4.3.26 Law Nº 9/04 of November 09th, 2004 – Land law

Law No. 9/04 of 9 November "Land Law" establishes the general bases of the legal regime of lands integrated in the original property of the State, the land rights that may fall on them and the general regime of transmission, constitution, exercise and extinction of these rights. Being applicable to rural and urban land on which the State establishes any of the land rights provided for therein for the benefit of natural persons or legal persons governed by public or private law, for the purposes of agricultural, livestock, forestry, mining, industrial, commercial, housing, urban or rural construction, spatial planning, environmental protection and combating soil erosion.

Article 27 of this law refers to reserved land, classifying it as total or partial. For the total land, no form of occupation or use is allowed, apart from being used for its own management or conservation. Partial land, on the other hand, is allowed for all forms of occupation or use, as long as they do not conflict with purposes provided for by law. In

paragraph 7 of article 27, it classifies land occupied by railway lines and their stations of public interest as partial reserves, considering a safety strip on each axis of the track.

4.3.27 Law Nº 3/04 of July 25th, 2004 - Law on Territorial and Urban Planning

This law adopts a concept of integrated planning that not only includes socio-economic aspects but also attempts to create synergies in the relationship between urban and rural areas (DBSA, 2021). It calls for the establishment of a decentralised system to coordinate land use planning. The law establishes the instruments for urban and rural territorial space management and establishes a system for urban and territorial planning and related policies. It regulates the territorial planning system general framework in coordination with other instruments such as the general regime of defence, occupation, and use of land. It establishes that the land must comply with municipal and special territorial plans.

4.3.28 Decree Nº. 2/06 of January 23rd, 2006 - General Regulation of Territorial Plans

Decree No. 2/06 of 23 January, "General Regulation of Territorial Plans" aims at the regulatory development of the general phases of spatial planning and urbanism, enshrined in the Spatial Planning Law, in the aspect of the respective instruments of management of urban and rural territorial space, regulating the general framework of the territorial planning system in an integrated and coordinated manner with other dimensions of the territory, namely, the general regime for the defence, occupation and use of land and other instruments of spatial planning.

4.3.29 Decree Nº. 58/07 of July 27th, 2007 - General Regulation Land Concession

This decree establishes the legal framework for the concession of free lands within Angola and does not apply to private property lands. This defines the legal discipline of the concessions of free land, but the lands that constitute private or private property are under the discipline of the Civil Law.

This law also establishes the procedure for the occupation of urban and rural land intended for public purposes. However, land occupied or to be occupied for purposes of public interest shall be reserved for the State and may, by determination of the Local Government, be handed over to the public services concerned, including those endowed with legal personality, so that they may use it in accordance with their specific destination.

4.3.30 Presidential Decree Nº. 117/16 of May 30th, 2016 - Regulation for Resettlement Operations

Presidential Decree No. 117/16 of 30 May "Regulation of Rehousing Operations", Defines the rules, procedures and criteria that must comply with the actions of the Public and Autonomous State Administration Bodies, in the process of rehousing a group of people living in a given territory, households, residents in areas subject to urban requalification and reconversion or construction and public works, in accordance with the principles governing Public Administration, safeguarding the pursuit of the public interest and the protection of citizens' rights and interests.

The Decree also establishes the admissibility of rehousing, establishing that the admissibility of resettlement is the responsibility of the Provincial Government, and the implementation is the responsibility of the Municipal Administration. Finally, it establishes

the relocation rights and guarantees and defines the procedure for relocation and financial compensation operations.

4.3.31 Law Nº 1/21 of January 7th, 2021 - Law of Expropriation for Public Utility

Law no. 1/21 of 7 January "Expropriation for Public Utility", establishes the principles and rules to be observed in Expropriation for public utility by the competent bodies of the State Administration. Based on this law, cases of public utilities are considered when the intervention of the competent body of the Public Administration is underlying, namely the operation of the means of public transport (rail or road).

4.3.32 Law Nº 14/05 of October 7th, 2005- Cultural Heritage Law

Establishes standards and guidelines for the protection, conservation, enhancement and promotion of the country's cultural heritage. Its purpose is to safeguard and preserve the existing cultural heritage, including tangible and intangible assets, monuments, archaeological sites, cultural manifestations and other elements of historical, artistic, archaeological, ethnographic and scientific significance. Furthermore, defines the responsibilities and obligations of government entities and civil society regarding the protection and management of cultural heritage.

4.3.33 Presidential Decree Nº. 53/13 of October 7th, 2013 - Regulation of Immovable Cultural Heritage

The purpose of the above-mentioned Decree is to regulate the rules and procedures for the protection, preservation and enhancement of the Immovable Cultural Heritage, provided for by Law No. 14/05, of 7 October and applies to all assets classified or in the

process of being classified such as monuments, ensembles or architectural sites, public or private, located in the national territory, whose interest and cultural relevance determine their legal protection.

4.3.34 Presidential Decree Nº 44/11, of March 7th, 2013 - Approves the General Statute of Museums

Establishes that museums are responsible for the custody and dissemination of historical and cultural collections at national level.

4.3.35 Presidential Decree Nº 54/55/23, of May 2nd, 2023, Series I - No. 77

The Decree recognizes Semba as national intangible cultural heritage and classifies the so-called Kwanza Corridor as national cultural itinerary. The Semba is a genre of music and dance that contributes to the establishment of patriotism and ensures social cohesion. In this same Decree, the Corredor do Cuanza is classified as a National Cultural Initiative, as it preserves the memory and history of Angola linked to the colonial period.

4.3.36 Presidential Decree, Nº 52/23 of April 28th, 2023- Series I - no. 76

The above-mentioned Decree aims to recognize that the influence and strengthening of Christianity in Luanda is elevated to National Historical-Cultural Heritage object of

protection by the local authorities of the state. It elevates the category of the Church of the Holy Family as the cultural heritage.

4.3.37 Presidential Decree Nº 16/21, of January 14th, 2021

The National Institute of Cultural Heritage (INPC) is mandated to implement public policies in the field of research, documentation, conservation, preservation, management and promotion of cultural, historical-cultural and national heritage, as well as to develop and execute the national museological policy.

4.3.38 Presidential Decree Nº 280/22 - Organic Statute of the Ministry of Culture and Tourism

According to the above-mentioned Decree, the Ministry of Culture and Tourism has the following attributions:

Article 5

Ensure the implementation of the policies and programs defined for the respective body and take the necessary decisions for this purpose, under the terms of the Constitution of the Republic of Angola and other legislation in force

b) To guide, coordinate, direct and control all the action of the Ministry

c) To guide and coordinate the activity of the Secretaries of State, the Directorates and the Heads of the other Organs of the Ministry.

In this way, this important ministerial sector has the following bodies and services:

a) Minister

b) Secretaries of State.

Advisory Support Bodies:

a) Advisory Board

b) Board of Directors.

Direct Executive Services:

a) National Directorate of Cultural Action

b) National Directorate of Communities and Institutions of Traditional Power

c) National Directorate of Tourism Development

d) National Directorate of Tourism Qualification and Licensing

e) National Directorate of Art and Tourism Training.

4.3.39 Decree Nº 87/20 of April 6th, 2020 - Establishes the Regulation on the procedures relating to the Protection, Export, Import and Transfer of Cultural Goods

According to the above-mentioned Decree, all pre-inventoried and catalogued national cultural assets defined in the regulation apply to protection.

Notwithstanding the existing legal instruments in Angola whose objective is to protect and conserve the Angolan historical heritage, there is a set of international legislation ratified

by Angola in the field of tangible and intangible cultural heritage that are briefly highlighted below:

- Resolution 21/90 of 21/11/1990: approves the accession of the People's Republic of Angola to the International Centre for Studies for the Conservation and Restoration of Cultural Heritage.
- Resolution 26-B/91 of 31/12/1991: approves the accession of the People's Republic of Angola to the International Covenant on Economic, Social and Cultural Rights, the International Covenant on Civil and Political Rights and the respective Optional Protocol where the Covenant.
- Resolution 22/11 of 23/11/2011: approves the accession of the Republic of Angola to the UNESCO Convention for the Protection of Cultural Property in the Event of Armed Conflict.
- Resolution 24/11 of 24/11/2011: approves the accession of the Republic of Angola to the Convention on the Protection and Promotion of the Diversity of Cultural Expressions.
- Resolution 25/11 of 25/11/2011: approves the accession of the Republic of Angola to the Convention for the Safeguarding of the Intangible Cultural Heritage.
- Resolution 20/15 of 30/12/2015: approves the ratification of the Convention on the Charter of the African Cultural Renaissance.

4.3.40 Presidential Decree Nº 20/03 of August 19th, 2003 - Basic Land Transport Law

The Basic Law on Land Transport, considered the main normative instrument, establishes a land transport system comprising its infrastructures and the productive factors related to the travel by land, of people and goods, within the scope of the national territory or that have part of the route in it.

The Chapter III, Article 21, states that the national railway network and its infrastructures are in the public domain of the State and consist of a Core Network, which includes lines, sections of lines or branches basically intended for the transport of large volumes of traffic and passengers, by lines dedicated to the provision of national and international passenger and freight transport services, long-haul, high-speed and quality. And by a complementary network, which is composed of the lines, sections of line and sidings of the national rail network, which are not included in the core network.

The Article 21, refers to the continuous updating of the railway network within the framework of the general transport policy, considering the current demand and the potential that rail transport presents, because of technical and technological progress, as well as the interests of the geographical areas served, thus stimulating the construction of new lines, sections, sidings and variants to the existing routes.

Article 22, in its paragraphs 1, 2 and 3 deals with the construction, conservation and supervision of new railway lines and support infrastructures, which may be carried out by the State or by other entities through concession, delegation or provision of services.

4.3.41 Presidential Decree Nº 209/13 of December 12th, 2013 - General Regulation of Rail Carriage of Passengers, Baggage and Fares

Presidential Decree No. 202/13 of 12 December, "General Regulation of Rail Freight Transport and Tariffs" establishes the general bases of rail freight transport and the tariff regime, establishing the minimum of public intervention to safeguard the essential contractual relationship between the public and the railway transport operating companies, considering the general interest of these services.

4.3.42 Executive Decree Nº 170/10 of December 13th, 2010 - General Regulation of Railway Traffic Safety

Executive Decree No. 170/10 of 13 December "General Regulation on the Safety of Railway Circulation" establishes the mandatory application of the Railways, as well as all other specific regulations that are part of the operating network by the Angolan railways.

This diploma announces that the responsibility for the management, supervision and compliance with the General Traffic Safety Regulation is the responsibility of the National Land Transport Agency, which is responsible for its distribution and each of the stations, depot or station and other dependencies must have at least one copy of this document for consultation.

4.3.43 Presidential Decree Nº 203/13 of December 3rd, 2013 - Regulation on the Conditions for the Provision of Railway Transport Services and Railway Infrastructure Management

Presidential Decree No. 203/13 of 3 December, "Regulation on the Conditions for the Provision of Rail Transport Services and Railway Infrastructure Management", defines the Conditions for the Provision of Rail Transport Services and the Management of Railway Infrastructure on which they are provided, providing, in particular: Liberalized and concessioned services, Access to rail transport activity, Access to and transit on the national network, Powers of the regulatory body, Tasks and financing of the infrastructure manager, Allocation of railway infrastructure capacity, Charging for the use of railway infrastructure, Safety and Promotion and protection of competition.

4.3.44 Executive Decree Nº 188/15 of April 21st ,2015 - License for the Provision of Railway Transport Services and Application for the Issuance of a License for Access to the Activity of Railway Transport Services Provision

Executive Decree No. 188/15 of 21 April, establishes the application model for railway undertakings applying for Licenses for the Exercise of the Activity of Provision of Railway Transport Services, their renewal or amendment/updating. The railway undertaking must complete all the fields of the application and provide the relevant information in accordance with the guidelines stipulated by law.

4.3.45 Presidential Decree Nº 131/10 of July 8th, 2010 - Regulation of Public Railway Transport Services

Presidential Decree No. 131/10 of 8 July "Regulation on Rail Transport Services", defines how, within the framework of the legislation in force, the competent authorities may intervene in the field of public rail passenger and freight transport in order to ensure the provision of services considered to be of general economic interest, which are adequately sufficient to meet the needs of the population, of the required quality and at a lower public

price than would be available to them if they were offered in accordance with market rules.

4.3.46 Presidential Decree Nº 205/21 of August 30th, 2021- Bases of the Railway Services Concession and Support Logistics of the Lobito Corridor

The Presidential Decree No. 205/21 of 30 August "Bases for the Concession of Railway Services and Support Logistics of the Lobito Corridor", establishes the Bases for the Concession of Railway Services and Support Logistics of the Lobito Corridor, which have a special nature in relation to the general regimes established for the services covered.

In Chapter II, Article 4, it states that the Concession covers the operation, operation and maintenance, by the Concessionaire, of the infrastructure of the Lobito/Luau Railway Line assigned to the Benguela Railways. The operation and operation by the Concessionaire of the railway freight service on the Lobito/Luau Railway Line, the construction, operation and operation by the Concessionaire of two Freight Transit Terminals to support the railway freight transport service on the Lobito/Luau Railway Line.

4.3.47 Presidential Decree Nº 194/13 November of 20th, 2013 - General Bases of Concessions for the Operation of Passenger and Freight Rail Transport Services

Presidential Decree No. 194/13 of 20 November establishes the concepts for the general operation of passenger and freight rail transport services on the Luanda/Malanje, Lobito/Benguela/Luau and Namibe/Menongue railway lines. The concession is expanded to commercial areas in stations, cargo terminals and goods warehouses, as long as they are included in the aforementioned contracts.

4.4 Angola´s administrative divisions

4.4.1 Political and Administrative Division of Angola

According to Law No. 18/16 of 17 October 2016– Political-Administrative Division Law, the political-administrative division of Angola is distributed amongst 18 provinces, 164 municipalities and 518 communes. Provinces are headed Governors, municipalities by Municipal Administrators, and communes by Communal Administrators. Cultural authorities (Sobas) or local leaders (chairman of the resident'' committee) are also present at the communal level.

4.4.1.1 Provincial administration

The Provincial government is responsible for assisting and developing plans and strategies relevant to the socioeconomic progress of its province. As it is the focal point in the implementation of many projects and actions that require the mobilisation of society in general, the provincial government collaborates with the private sector, local authorities, civil society representatives, religious institutions, and non-governmental organisations.

4.4.1.2 *Municipal administration*

The Municipal Administrator oversees the fulfilling the Stat`s obligations at the local level and promotes social and economic development and ensures the delivery of public services within the municipality.

4.4.1.3 *Communal administration*

The Communal administration is headed by a Communal Administrator, a singular and decentralised executive body of the central administration that is responsible for the execution of the functions of the State at the communal level and with competences and powers stipulated by law.

4.5 Institutional framework and implementing agencies

4.5.1 Ministry of Environment (MINAMB)

Established under Presidential Decree No. 278/22 of 7th December, the MINAMB is responsible for development, management, implementation, and monitoring of environmental policies (protection and preservation of environmental quality, pollution control, conservation areas, etc.) and rational use of natural resources. The primary responsibilities of the MINAMB are to coordinate sustainable management strategies and policies of natural resources through:

- issuing environmental licenses for activities likely to cause significant environmental and social impacts
- promoting implementation of measures to protect biosafety and biodiversity of the environment and quality of life
- conducting training and awareness campaigns for consumers and companies in environmental technologies
- implementing programs in protected areas and landscapes including nature conservation areas, natural parks, and biosphere zones.

These duties are performed by direct executive bodies and services, namely: the National Directorates of Environment, Environmental Education, Climate Action and Sustainable Development and Environmental Technologies.

4.5.2 Ministry of Transport (MINTRANS)

The MINTRANS is responsible for proposing the formulation, management, execution, evaluation, and control of policy in the field of transportation and logistics including:

- promoting the development and optimization of the provision of services in the road, rail, civil aviation, maritime and port areas, logistics and related activities enabling, organising, and supervising competition and competitiveness among different means of transportation
- regulating, licensing, overseeing, and inspecting the economic activities of entities in the transport sector
- promoting road, railway, and maritime safety, as well as the safety of the civil aviation system.

National Land Transport Agency (ANTT)

The ANTT was established to merge laws governed by the National Institute of Road Transport and the National Institute of Angolan Railways with the following mandate in railway transportation:

- participate in the definition and regulation of the public railway's domain
- promote the updating and modernization of the technical regulations of the railway system
- promote the implementation of technical enhancements to railway transportation and its respective components, equipment, and materials, in accordance with applicable legal standards and technological evolution
- exercise other attributions established by law or determined by superiors.

National Directorate of Infrastructure and Supervision

An entity affiliated with the ANTT responsible for overseeing and controlling all infrastructure in the field of land transportation throughout the national territory, responsible for:

- monitoring compliance with regulations applicable to land transportation activities
- enabling compliance with regulations applicable to auxiliary and complementary land transportation activities according to prevailing legislation
- collaborating in joint inspection actions with other services and inspection agencies
- licensing railway infrastructures and road terminals
- promoting safety in railway and road infrastructures.

National Directorate of Rolling Stock Management, Rail and of Road Equipment Approval

The Directorate of Rolling Stock and Approval of Road and Railway Equipment is a department assigned to the National Land Transport Agency, which has the following responsibilities:

- promoting safety in road and rail rolling stock
- approval and certification of systems, components and equipment of rolling stock relevant to traffic safety, organising and keeping records of all acts
- analyse and instruct the approval process and prepare the declaration and non-objection for the type of vehicle and equipment to be used in the road and rail sector
- conduct vehicular forensics and exercise other powers stipulated by law or determined by higher.

4.5.3 Benguela Railway Company (CFB - EP)

CFB - EP is a public company that specialises in legal, administrative, financial, and patrimonial autonomy. The CFB-EP's corporate responsibilities include the following:

- the operation of rail transport of passengers, cargo, and mail
- directly or indirectly carry out complementary or ancillary activities to railway operation, with the restrictions of the legislation applicable to the investment process and the regime of public companies.

It is important to note that in addition to crossing the provinces of Angola, it reaches the Democratic Republic of Congo (DRC).

4.5.4 Ministry of Public Works and Spatial Planning (MINOPOT)

MINOPOT is the executive body of the government responsible for proposing policies, executing, and overseeing the programs and projects including:

- proposing the formulation of policies, programs, and projects for the development and achievement of sector goals
- promoting, in coordination with other agencies, the rehabilitation, expansion, modernization, and creation of conditions for the maintenance and integrated operation of all public infrastructure
- promoting and implementing construction and rehabilitation programs and projects in the field of terrestrial infrastructure
- encouraging the application of international best practices in the construction, conservation, and management of public infrastructure.

National Directorate of Engineering Construction Works

The National Directorate of Engineering Works oversees planning, coordination, and technical control of construction project and is responsible for:

- drafting annual and multi-year investment and activity plans, coordinating engineering studies and projects, ensuring quality and compliance
- managing public procurement processes and overseeing execution
- developing regulations for engineering projects
- addressing soil erosion and coastal protection through studies and projects
- providing opinions on engineering studies by other entities
- ensuring safety plans and compliance during construction
- assessing national engineering needs and promoting construction efforts
- maintaining technical records and promoting innovative solutions
- fulfilling other legal or mandated duties.

National Directorate of Land Management and Housing

The National Directorate of Land Management and Housing is an entity affiliated with MINOPOT, oversees the national land policy, land management, and housing coordination and is responsible for:

- developing annual and multi-year investment plans and managing public procurement processes
- proposing policy measure and guidelines for land tenure, registration, and housing including national land policy applications
- proposing national guidelines for land management and regulation as well as obtaining land surplus value through urban planning
- establishing norms and methodologies for land registration using GIS
- collaborating on scientific research in land management
- contributing to standards for the country's political and administrative division
- guiding housing construction programs and supervision

- stimulating private sector housing production and self-construction methods
- managing the State's real estate registry.

National Directorate of Spatial Planning and Urbanism

The National Directorate of Spatial Planning and Urbanism, within the MINOPOT, oversees the National Policy on Spatial Planning and Urbanism and responsible for:

- proposing policy measures for spatial planning and urbanism and developing methodological guidelines for their implementation
- managing public procurement processes
- proposing and revising legal frameworks
- establishing standards and methodologies for planning plans, guiding the elaboration of Spatial Planning Options, and preparing the State of National Spatial Planning Report
- developing monitoring systems for urban indicators
- collaborating on scientific research in the field
- encouraging citizen and institutional participation
- maintaining the Central Archive of Planning
- conducting technical evaluations of studies and plans
- coordinating sectoral policies with spatial planning.

Regulatory Institute of Civil Construction and Public Works

The Regulatory Institute for Construction and Public Works (IRCOP), is a legal entity governed by public law, classified as a public establishment, endowed with legal and administrative, financial and patrimonial autonomy, integrating the Indirect Administration of the State. In general, IRCOP intends to regulate and supervise the exercise of construction activity at a national level, as well as the quality and criteria of the preparation of Projects, the techniques of execution of construction that are embodied in the design and preparation of projects and supervision of Public Administration projects, allowing greater safety, efficiency, rigor and quality in its execution.

In general terms, IRCOP has the following attributions:

- regulate and supervise the Construction and Public Works Sector, drafting the necessary standards for these purposes
- to grant Enabling Titles for the exercise of Construction and Public Works activities whose registration or registration is legally incumbent upon it. as well as verifying their conditions of stay and evaluating their performance
- propose rules and regulations for the exercise of construction and public works activities
- produce statistical information in construction and public works that are of reference for the Sector
- promote the dissemination of legislation applicable to construction and public works activities among companies, public entities, and collaborate with other entities in this field

- supervise the supervision of the construction of buildings, monuments and social facilities of the Public Administration.

4.5.5 National Institute for Biodiversity and Conservation (INBC)

Responsible for the development and execution of a policy for sustainable biodiversity management and the National Environmental Conservation System. The INBC is also responsible for:

- developing and coordinating the execution of policies and strategies in the field of biodiversity conservation and management of environmental conservation areas
- develop programs and plans for the organization of national and transboundary environmental conservation areas
- implementing international conventions and protocols related to nature conservation and the management of biological diversity resources in collaboration with relevant institutions
- enabling policy and means to demonstrate compliance with laws and regulations in the field of conservation and sustainable management of biodiversity and environmental conservation areas.

4.5.6 National Waste Agency (ANR)

The ANR is a single collective public entity created to implement the national-level waste management policies, within the framework of normative regulation, supervision, and other applicable legislation.

4.5.7 Ministry of Agriculture and Forests (MINAGRIF)

The MINAGRIF is the central administrative body of the State responsible for formulating, proposing, conducting, evaluating, controlling, as well as overseeing policies in the field of agriculture, livestock, forests, food security and safety, management and organization of aquatic biological resources, fishing activities and sustainable aquaculture throughout Angola.

National Directorate of Forestry

The National Forestry Directorate is responsible for formulating, promoting, and overseeing the implementation of policies, strategies, plans, programs, and actions in forests throughout the national territory.

Forest Development Institute (IDF)

The IDF is responsible for the promotion, coordination, and implementation of forest, wildlife, rural, and technology transfer policies.

4.5.8 National Demining Institute (INAD)

The INAD is a legally autonomous entity tasked with mine clearance activities, mine hazard awareness, research, tagging, innovation, and stock destruction to enable socio-economic development and unrestricted movement within the country.

4.5.9 National Commission for Civil Protection and Firefighters

The National Commission for Civil Protection and Firefighters is the specialised body for technical advice and operational coordination of the activities of civil protection organizations and structures.

4.5.10 National Operational Coordination Centres (CCON)

CCON is responsible for coordinating the participation of all entities and institutions in civil protection, emergency and assistance operations during serious accidents, catastrophes or calamities.

Additionally, CCON responsibilities include monitoring and evaluating operational activities, liaising with civil protection agents, disseminating strategic information, issuing alerts to populations and institutions, and proposing international assistance on behalf of the government.

4.5.11 Ministry of Public Administration, Labor and Social Security (MAPTSS)

MAPTSS is responsible for policies and programs related to Public Administration, Labor and Social Security. In the area of Labor, its functions include proposing labour policies, coordinating the national training system and employment services, ensuring compliance with labour legislation and promoting the ratification of international labour instruments. In Social Security, MAPTSS proposes mandatory social protection policies, supervises social security management entities and promotes measures to guarantee the sustainability of the system.

General Labour Inspectorate

The General Laboure Inspection, abbreviated as IGT, was created in the light of Presidential Decree No. 90/22 of April 18th, is a public institution, endowed with legal personality, administrative, financial and patrimonial autonomy and its purpose is to ensure the application and observance of labour legislation, inform, guide, regulate and supervise the action of the organizations of the legal-labour relationship. Regarding Occupational Hygiene and Safety, the IGT's responsibilities are to guarantee safety, hygiene and health at work, including promoting compliance with technical standards, supervising working conditions and analyse accidents and occupational diseases.

National Directorate of Human Rights

The mission of the National Directorate of Human Rights is to ensure the defence and observance of Human Rights, in accordance with the principles established in the Constitution, the Universal Declaration of Human Rights, the African Charter on Human and Peoples' Rights and other international legal instruments relating to Human Rights, to which Angola is a party. The National Directorate of Human Rights has the following powers:

- to support the Minister of Justice and Human Rights in the formulation and implementation of policies relating to the preservation of Human Rights and to monitor implementation

- promote cooperation with other institutions in the field of human rights
- ensure the collection, processing and analysis of statistical information on Human Rights, within the framework of the National Statistical System.

4.5.12 Ministry of Energy and Water (MINEA)

MINEA is responsible for planning, implementing, and monitoring of energy and water policies and laws as well as:

- developing and promoting energy and water sector policies
- designing strategies to promote and coordinate profits, and rational consumption of energy and water resources ensuring sustainable development
- the license, supervision and inspection of hydraulic and water and sanitation systems
- collaborating with local administrations in the expansion and implementation of electrification programmes, water supply and support the development of rural and urban zones.

National Electricity Transport Network Public Company (RNT – EP)

RNT– EP is a public company specialized in transmission of electric energy in Angola. RNT is responsible for management of very high-tension systems (110 kV to 400 kV transmission lines), the interconnection network, national installations, and market regulation.

National Institute of Water Resources (INRH)

The INRH mission is to ensure the implementation of the national water resources policy, in matters related to the planning and integrated management of these resources, their use, preservation, protection, supervision and control. The duties of the Water Resources Institute are limited to the preparation and implementation of the National Water Resources Policy, efficient and sustainable planning of water resources, promotion and implementation of national plans and programs for the development and protection of water resources. It also includes the coordination of river basin management plans and monitoring of water quality.

4.5.13 National Directorate of Local State Administration

The National Directorate of Local State Administration is a state body supervised by the Ministry of Territorial Administration whose mission is to carry out measures and tasks related to the organization and functioning of the bodies and services of the Local State Administration (at Provincial, Municipal and Communal level).

4.5.14 Ministry of Culture and Tourism

This Ministry is responsible for formulating, conducting, supervising, evaluating and implementing an executive policy in the field of culture and tourism in Angola including defining policies for cultural and tourism development, ensuring compliance with legislation and international treaties, coordinating areas such as cultural heritage, developing tourism regionalization strategies and promoting entrepreneurship in the sector.

National Institute of Cultural Heritage

This body under administration supervised by of Ministry of Culture and Tourism is responsible for implementing public policies in the field of research, documentation, conservation, preservation, management, and promotion of cultural heritage, historical-cultural and national, as well as integrating museums and defining national museological policy.

4.5.15 Government of the Moxico and Lunda Sul Provinces

The Government of the Provinces of Moxico and Lunda Sul, as a decentralized body of the central administration, works to ensure compliance with the duties of the State administration and the interests of citizens at the local level. It is responsible for ensuring compliance with legal frameworks, overseeing public investment programs and budgets and promote the performance of local administrations.

The Provincial governments are expected to promote economic development, and the guarantee of the provision of public services within its administrative jurisdiction, while respecting the autonomy of local government. Led by the Provincial Governor, it is responsible for developing governance policies, managing budgets and public investment plans.

Provincial Office of Infrastructure and Technical Services

The Provincial Office of Infrastructure and Technical Services, under the Provincial Governor, oversees urban infrastructure, public works, urban management, and real estate and is responsible for urban and spatial planning, licensing urban operations, coordinating energy and water tasks, proposing housing development measures, maintaining real estate data, proposing investment projects, and fulfilling other legal or mandated duties.

Provincial Office of Transport, Traffic and Urban Mobility

The Provincial Office of Transport, Traffic, and Urban Mobility, under the Provincial Governor, coordinates transport-related matters. Its powers include promoting projects, coordinating municipal initiatives, managing transportation systems, developing integrated transport networks, decentralising parking systems, managing private and public transport articulation, supporting traffic regulatory authorities, and fulfilling other legal or mandated duties.

Provincial Office of Environment, Waste Management and Community Services

The Provincial Office of the Environment, Waste Management and Community Services, operating under the authority of the Provincial Governor, is responsible for implementing policies, programs and projects related to the environment, waste management and community services. It is responsible for promoting and monitoring operations such as sanitation and waste collection, maintenance of cemeteries, establish partnerships for the mitigation of environmental impacts, propose conservation measures for historical heritage and cultural sites.

4.5.16 Municipal Administrations of Moxico, Camanongue, Dala and Saurimo Municipalities

The Municipal Administrations, as a decentralised body of the State, ensures executive functions within the Municipality. It promotes harmonious development, provides public services, and enhances citizens' quality of life by improving education, healthcare,

sanitation, utilities, transportation, infrastructure, and social assistance. It guides harmonious development, provides public services, and promotes economic, social, and environmental progress within respective geographical areas.

4.6 Benguela Railway Company (CFB)

The Benguela Railway Company (CFB – Caminhos de Ferros de Benguela), the expected Luena-Saurimo railway operator, was restructured under Presidential Decree No. 233/20 of July 21st. Its corporate purpose is to operate rail transport of passengers, cargo and mail, directly or indirectly carrying out complementary or accessory activities to railway operations

The CFB currently operates 1,289 km stretch of railway, which runs through the provinces of Benguela, Huambo, Bié, Moxico and Moxico Leste to the municipality of Luau, bordering the Democratic Republic of Congo.

Presidential Order No. 55/23 of March 27th authorises the expenditure and formalisation of the opening of the Simplified Contracting Procedure, based on material criteria, for the conclusion of the Design and Construction Contract for the Luena — Saurimo section of the Benguela Railway (260 km), to be concluded with the consortium formed by the companies ODEBRECHT — Engenharia e Construção Internacional, Sucursal de Angola — OECI, S.A. and Bento Pedroso Construções — BPC.

4.7 Lender appraisal standards

The Project intends to apply for international finance and will, therefore, need to not only meet national standards, but also international lender appraisal standards (LAS). The following LAS are applicable:

- World Bank Group Environmental and Social Framework, 2018, including, inter alia:
- OECD Common Approaches on environment and officially supported export credits
- International Finance Corporation (IFC) Performance Standards (PS`s) 1-8, Environmental and Social Sustainability (2012), including relevant Guidance Notes (GN's)
- World Bank Group (WBG) General Environmental, Health, and Safety (EHS) Guidelines, and relevant WBG sector specific EHS guidelines, 2007
- EHS Industrial Sector Guidelines for Railways, 2007
- Equator Principles IV (EP4, 2020) as well as Equator Principles guidance and requirements on greenhouse gas emissions and climate change risk
- United Nations Guiding Principles on Business and Human Rights ("UNGPs")
- International Law, including conventions, treaties and protocols assented to by the Angolan Government.

4.7.1 IFC Sustainability Framework

The IFC's sustainability framework articulates the corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. The sustainability framework consists of IFC's policy on environmental and social sustainability and IFC PS on environmental and social sustainability. The policy on

environmental and social sustainability describes IFC's commitments, to environmental and social sustainability. The PS prescribe the clients responsibilities for managing their environmental risks, provide guidance on the identification, characterisation and assessment of project risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the PSs to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the sustainability framework along with other strategies, policies, and initiatives to direct the business activities of the corporation to achieve its overall development objectives. Together, there are eight established PSs that the client is to meet throughout the life of an investment by IFC.

Table 4-2 below provides an overview of IFC PS triggered by the proposed Luena-Saurimo Project.

Table 4-2 Overview of IFC Performance Standards triggered and key relevance to the Luena-Saurimo Project

IFC PS	Triggered	Key points relevant to the relocation host sites Project
PS1: Assessment and Management of Environmental and Social Risks and Impacts	Yes	PS1 underscores the importance of managing social and environmental performance throughout the life of a project by using a dynamic social and environmental management system. The Project has committed to abiding by PS1, including undertaking environmental and social assessments and full consultation with local communities and setting up mechanisms for working with Affected Communities Development of Project Environmental and Social Management System (ESMS)
PS2: Labour and Working Conditions	Yes	The Project will ensure that it upholds labour rights, protect workforce by addressing forced, migrant and child labour, human rights and provide safe working conditions during both construction and operation
PS3: Resource Efficiency and Pollution Prevention	Yes	Pollution prevention and abatement in line with international available technologies and practices; energy and resource efficient approaches during construction and operation phases of the Project. These considerations have been made during Project design

IFC PS	Triggered	Key points relevant to the relocation host sites Project
PS4: Community Health, Safety and Security	Yes	Project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase risks arising from accidents, releases of hazardous materials, exposure to diseases, and the use of security personnel. Community health and safety plans will be included in the Project
PS5: Land Acquisition and Involuntary Resettlement	Yes	Project is likely to trigger involuntary displacement especially economic along the railway line. Some existing smallholder farms in the corridor. Commitment to develop and implement a Resettlement Action Plan (RAP) and Livelihoods Restoration Plan (LRP). A Resettlement Policy Framework (RPF) has been developed along with this ESIA.
PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resource	Yes	The Project shall undertake dry and wet season baseline surveys, including critical habitat assessments and development of required management/action plan addressing pertinent biodiversity issues along the corridor; undertake ecosystem services assessment and continuous ecological monitoring throughout all phases
PS7: Indigenous Peoples	No	There are no known Indigenous Peoples within the Project AoI. Refer IPs Screening in the Baseline chapter
PS8: Cultural Heritage	Yes	The Project will protect irreplaceable cultural heritage resources identified within Project AoI including application of Chance Finds Procedure

4.7.2 Performance Standard 1 (PS1): Assessment and management of environmental and social risks and impacts

PS1 requires a thorough environmental and social assessment, as well as adequate stakeholder engagement and disclosure of project information. Critically, the Project must maintain a GRM and be responsive to grievances received through the full life of the project. PS1 requires a policy commitment from the proponent, and sufficient organisational capacity to implement its ESMS efficiently, encompassing environmental and social policies, plans and procedures. PS1 also requires an emergency preparedness and response system and plan.

Subsequent to the ESIA process, a project specific ESMS should be developed. The following Project policies, plans and procedures have been developed and further

documents are recommended in the ESMP (refer to Appendix 17) that will be needed as part of the projects ESMS for construction and operation

4.7.3 Performance Standard 2 (PS2): Labour and working conditions

PS2 recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers, non-discrimination, and equal opportunity. Additionally, PS2 requires the client to provide a safe and healthy work environment, considering inherent risks in its sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women. According to IFC, the implementation of the actions necessary to meet the requirements of PS2 is managed through the client's ESMS. Policy commitment and a system for active monitoring and prevention of child labour, forced labour and unfair or unsafe working conditions is required, within its own organisation, as well as within its supply chain.

In Angola, there are various principal legislations that address the issue of labour and work conditions, including:

- General Labour Law of 2015
- General Regulation of Occupational Safety and Hygiene Services in Organizations of 1996
- Occupational Hygiene and Safety System of 1994
- Legal Regime of Occupational Accidents and Occupational Illnesses of 2005.

The legislation enables that workers are treated well and that their rights are protected including the right to work in a healthy environment. A Project policy commitment and provisions for prevention of child labour, forced labour and unfair or unsafe working conditions is in place, extending to suppliers and contractors (code of conduct and procurement policy).

4.7.4 Performance Standard 3 (PS3): Resource efficiency and pollution prevention

IFC recognises that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use, and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world. These are often implemented through continuous improvement methodologies like those used to enhance quality or productivity, which are generally well known to most industrial, agricultural, and service sector companies. The applicability of PS3 is established during the environmental and social risks and impacts identification process in PS1. According to IFC, the implementation of the actions necessary to meet the requirements of PS3 is managed through the projects ESMS.

In Angola, the various environmental legislations address the issue of resource use efficiency and pollution prevention. The Project activities trigger PS3 and a project specific ESMS must be developed manage these impacts.

4.7.5 Performance Standard 4 (PS4): Community health, safety and security

PS4 recognises that project activities, equipment and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, PS4 addresses the investor's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related activities, with particular attention to vulnerable groups. The implementation of the actions necessary to meet the requirements of PS4 must be managed through the projects ESMS.

In Angola, environmental legislation requires project development to take appropriate actions and mitigation measures to ensure that the project is safe to the workers and the surrounding communities during mobilization, construction, and operation phases of the project.

4.7.6 Performance Standard 5 (PS5): Land acquisition and involuntary resettlement

PS5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in physical or economic displacement. This occurs in cases of (i) lawful expropriation or temporary or permanent restrictions on land use and (ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail. Where involuntary resettlement is unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented.

4.7.7 Performance Standard 6 (PS6): Biodiversity conservation and sustainable management of living natural resources

PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.

The requirements set out in PS6 have been guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems."

The ecosystem services are the benefits that people, including businesses, derive from ecosystems. Ecosystem services are organized into four types: provisioning services, regulating services, cultural services and supporting services.

Further, PS6 categorizes environment into three habitats which are: modified, natura and critical. These habitat types are required to be fully assessed.

4.7.8 Performance Standard 7 (PS7): Indigenous people

PS7 recognizes that indigenous people, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable segments of the population. Their economic, social, and legal status often limits their capacity to defend their interests in, and rights to, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. They are particularly vulnerable if their lands and resources are transformed, encroached upon by outsiders, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also be under threat. These characteristics expose indigenous people to different types of risks and severity of impacts, including loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and disease.

4.7.9 Performance Standard 8 (PS8): Cultural heritage

PS8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, PS8 aims to protect cultural heritage during a client's project activities. In addition, the requirements of PS 8 on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

For the purposes of this Performance Standard, cultural heritage refers to (i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles. During the project life cycle, the client will consider potential project impacts to cultural heritage and will apply the provisions of this Performance Standard.

In addition to complying with applicable law on the protection of cultural heritage, including national law implementing the host country's obligations under the Convention Concerning the Protection of the World Cultural and Natural Heritage, the host country will identify and protect cultural heritage by ensuring that internationally recognized practices for the protection, field-based study, and documentation of cultural heritage are implemented.

During the project life cycle, the client will consider potential project impacts to cultural heritage and will apply the provisions of PS8. In Angola, the EFL will require project development to take appropriate actions and mitigation measures to avoid or minimize impacts to cultural resources.

4.7.10 World Bank Group Environmental, Health and Safety (EHS) Guidelines (2007)

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the

establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines is meant to be tailored to the hazards and risks established for each project based on the results of an environmental assessment in which site-specific variables, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations will be based on the professional opinion of qualified and experienced persons. This ESIA study is in line IFC EHS guidelines requirements.

4.7.11 Environmental, Health, and Safety Guidelines for Railways (2007)

The EHS Guidelines for Railways are applicable to activities typically conducted by rail infrastructure operators dedicated to passenger and freight transport. The document is organized into two main areas, namely rail operations, covering construction and maintenance of rail infrastructure as well as operation of rolling stock, such as locomotives and rail cars; and, locomotive maintenance activities, including engine services, and other mechanical repair and maintenance of locomotives and railcars.

The guideline states that “locomotive engines may be significant contributors to air pollution in urban areas, especially in the vicinity of rail yards. Worldwide, approximately 60 percent of passenger trains and 80 percent of freight trains are powered by diesel locomotives which emit combustion products, including nitrogen oxides (NOX) and particulate matter (PM), both of which contribute to public health problems, and carbon dioxide (CO_2), a greenhouse gas. Transportation and transfer of dry granular materials (e.g. minerals and grain) may result in dust emissions, while the storage and transfer of fuels or volatile chemicals may result in fugitive emissions.

The guideline provides additional health and safety issues specific to railway operations (not addressed in general EHS guideline) including rail operational safety; transport of dangerous goods; level crossing safety and pedestrian safety; train/worker accidents; noise and vibration; diesel exhaust; fatigue; electrical hazards, and electric and magnetic fields.

The guideline also provides community health and safety impacts during the construction, rehabilitation, and maintenance of railways. These impacts include, among others, dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of temporary construction labour. Performance indicators and monitoring guidelines for both environment and occupational health and safety are included.

4.7.12 IFC EHS Guidelines for Construction Materials Extraction (2007)

This guideline includes information relevant to construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite, as well as to the extraction of dimension stone. It addresses stand-alone projects and extraction activities supporting construction, civil works, and cement projects. The guideline also provides a summary of EHS issues associated with construction materials extraction that occur during the operational, construction, and decommissioning phases, along with recommendations for their management.

Community health and safety issues specific to construction materials extraction projects primarily including land instability, water, explosives safety and decommissioning are addressed. Additional potential risks to community health and safety include risks from

uncontrolled access to construction sites, exposure to waterborne, water-washed, and water-associated diseases from creation of water impoundments, and exposure to increased traffic of materials transport vehicles.

The guideline also provides performance indicators and monitoring guidelines for both environment and occupational health and safety.

4.7.13 IFC and EBRD workers' accommodation: Processes and Standards

Jointly developed by the IFC and the European Bank for Reconstruction and Development (EBRD), this guidance note looks at the provision of housing or accommodation for workers by employers and the issues that arise from the planning, construction, and management of such facilities.

Provision of worker housing may relate to a temporary phase of a project (e.g. an exploration or construction camp) or may be more permanent (e.g. a factory dormitory or plantation camp). Dependent on the type of accommodation, there are a range of considerations relating to both the living conditions of the workers themselves, and to the impact that workers' housing facilities may have on surrounding communities.

Both the EBRD and IFC apply environmental and social performance standards in relation to their investments that include provisions on labour and working conditions. The EBRD has included a specific provision in its Environmental and Social Policy addressing workers' accommodation; paragraph 16 of Performance Requirement 2 (PR2) stipulates: "Where a client provides accommodation for workers, the accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. In particular, the provision of accommodation shall meet national legislation and international good practice in relation, but not restricted, to the following: the practice for charging for accommodation; the provision of minimum amounts of space for each worker; provision of sanitary, laundry and cooking facilities and potable water; the location of accommodation in relation to the workplace; any health, fire safety or other hazards or disturbances and local facilities; the provision of first aid and medical facilities; and heating and ventilation. Workers' freedom of movement to and from the employer-provided accommodation shall not be unduly restricted."

4.7.14 IFC EHS Guidelines: Section 1.3 Wastewater and Ambient Water Quality

This guideline sets out guidelines for the management and proper disposal of wastewater. For better management it is necessary to:

- understand the quality, quantity, frequency and sources of liquid effluent in your facility. This includes knowledge about the locations, routes, and integrity of internal drainage systems and discharge points
- plan and implement the segregation of liquid effluents mainly in the industrial, utility, sanitary and rainwater categories, to limit the volume of water that requires specialized treatment. The characteristics of each stream can also be used for source segregation
- identify opportunities to prevent or reduce wastewater pollution through measures such as recycling/reuse at your facility, substitution of inputs or modification of processes (e.g. change of technology or operating conditions/modes)

- assess the compliance of your wastewater discharges with the applicable standards: (i) discharge (if the wastewater is discharged to surface water or sewage) and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).

4.7.15 IFC EHS Guidelines: Section 1.4 Water Conservation

This section establishes guidelines to be applied when using water for consumption, services and sanitation. Guidelines should be established to promote the continuous reduction of water consumption, and the reduction of water destined for treatment and disposal. Water conservation programmes should be implemented according to the magnitude and cost of water use.

4.7.16 WHO ambient air standards

4.7.16.1 WHO Air Quality Guidelines, 2000 & 2005

The World Health Organisation (WHO) Air Quality Guidelines have been widely used as a reference tool to assist decisionmakers around the world in setting air quality standards and goals. The WHO Air Quality Guidelines Global Update, 2005 provides global recommendations on important air contaminants that pose health concerns, including thresholds and restrictions.

The Guidelines apply worldwide to both outdoor and indoor environments and are based on expert evaluation of current scientific evidence.

The IFC Environmental, Health, and Safety (EHS) General Guidelines reproduce the 2005 WHO Guidelines as recommended criteria for air quality, in the absence of national standards.

Table 4-3: Relevant WHO Air Quality Guidelines 2005 & interim targets

Pollutant	Averaging time	Interim target				Air Quality Guideline
		1	2	3		
Particulate matter, $PM_{2.5}$, µg/m^3	Annual	35	25	15		10
	24-hour[a]	75	50	37.5		25
Particulate matter, PM_{10}, µg/m^3	Annual	70	50	37.5		20
	24-hour[a]	150	100	75		50
Ozone, O3, µg/m^3	8-hour[a]	-	-	-		100
Nitrogen dioxide, µg/m^3	Annual	-	-	-		40
	1-hour	-	-	-		200
Sulphur dioxide, µg/m^3	24-hour[a]	-	-	-		20
	10-minute	-	-	-		500

[a] 99th percentile (i.e. 3–4 exceedance days per year).

[a] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

4.7.16.2 *World Health Organisation (WHO) Air Quality Guidelines, 2021*

The WHO has established air quality guidelines that have been used internationally as a reference tool to assist policy and decision makers around the world in setting air quality standards and goals. The Guidelines established in 2000 were updated in 2005, with the 2005 WHO Air Quality Guidelines Global Update, providing global recommendations on criteria air pollutants, i.e. air pollutants considered to pose great health concerns, including thresholds and restrictions. The Guidelines apply internationally to both outdoor and indoor environments and are based on expert evaluation of current scientific evidence.

In the absence of national ambient air quality standards, as is the case for Angola, the IFC Environmental, Health, and Safety (EHS) General Guidelines replicates the 2005 WHO Guidelines (updated in 2021) are to be used as assessment criteria for air quality. More stringent air quality guidelines are stipulated for PM and NO2 in the 2021 WHO Air Quality Guidelines Global Update which establishes interim targets which can be used as achievable milestones, as industries work towards meeting the stipulated guidelines.

Table 4-4: Relevant WHO Air Quality Guidelines 2021 & interim targets (source WHO, 2021)

Pollutant	Averaging time	Interim target				Air Quality Guideline
		1	2	3	4	
Particulate matter, PM2.5, µg/m^3	Annual	35	25	15	10	5
	24-hour[a]	75	50	37.5	25	15
Particulate matter, PM10, µg/m^3	Annual	70	50	30	20	15
	24-hour[a]	150	100	75	50	45
Ozone, O3, µg/m^3	8-hour[a]	100	70	-	-	60
	Annual	160	120	-	-	100
Nitrogen dioxide, µg/m^3	Annual	40	30	20	-	10
	24-hour[a]	120	50	-	-	25
Sulphur dioxide, µg/m^3	24-hour[a]	-	-	-	-	40
Carbon monoxide, CO, mg/m^3	24-hour[a]	-	-	-	-	4

[a] 99th percentile (i.e. 3–4 exceedance days per year).

[a] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

4.7.17 Guidance on the Assessment of Dust from Construction (and Demolition)

The Institute of Air Quality Management (IAQM) published a guidance document (Holman et al., 2014 with minor updates in 2016) on the assessment of construction phase impacts

(herein the "IAQM construction dust guidance"). The guidance was produced to provide advice to developers, consultants, and environmental health officers on how to assess the impacts arising from construction activities. The emphasis of the methodology is on classifying sites according to the risk of impacts (in terms of dust nuisance, PM10 impacts on public exposure and impact upon sensitive ecological receptors), and to identify mitigation measures appropriate to the level of risk identified.

The IAQM guidance is a qualitative method to determine potential air quality impacts associated with the proposed project during construction in the final AQIA.

4.7.18 IAQM Guidance of Air Quality Monitoring in the Vicinity of Construction (and Demolition) Sites

The IAQM published revised guidance in 2018 (Bull et al; 2018) on air quality monitoring in the vicinity of construction sites, which provides high level advise on monitoring. However, it is not designed to be prescriptive with regards to the monitoring methods/techniques that can be used.

For the proposed project, ambient air quality monitoring was done at representative sensitive receptor sites along the alignment of the Luena-Saurimo section to establish a baseline for the purposes of the impact assessment and prescribe mitigation measures.

4.7.19 Equator Principles (4th iteration) (EP4)

The Equator Principles are a financial industry benchmark for determining, assessing and managing environmental and social risks in projects. The fourth iteration of the Equator Principles (EP4) came into effect in October 2020, which is a risk management framework adopted by financial institutions, comprising of ten principles which are implemented by Equator Principles Financial Institutions (EPFIs) to comply with EP4. The Equator Principles are primarily intended to ensure that the projects financed by these institutions are socially responsible and reflect sound environmental management practices.

4.8 International conventions and treaties

Angola is a signatory to several international treaties and conventions pertaining to environmental and social matters of potential relevance to the Project including environmental protection, sustainable natural resource development etc. Table 4-4 outlines the international treaties and conventions identified as relevant to Project activities.

4.9 Other regional standards

4.9.1 National Environmental Management: Air Quality Act of South Africa, 2004

Angola is a member of the Southern African Development Community (SADC). Although SADC does not have a unified or region-wide air quality standard that applies across all its member states, it encourages regional cooperation in environmental policies, including air quality management, among its member states. Since Angola does not have its own specific national air quality standards, the National Environmental Management: Air Quality Act (2004) adopted in South Africa, one of the key SADC member states, are

used as a reference to assess the air quality in Angola. The South African standards (Air Quality Act) (hereafter referred to as SA AQA) are aligned with international guidelines and suitable for evaluating and managing air quality in Angola.

Table 4-5: International treaties and conventions pertaining to environmental and social matters relevant to the Project

Treaty/ convention ratified	Relevance to the Project
Millenium Sustainable Development Goals (SDG) 2030 (adopted by all United Nations Member States in 2015)	The SDG's aim to achieve a better and more sustainable future for all. The following list of SDGs concerning environmental and social protections are identified as relevant to the Project: • Goal 03 (Good Health and Wellbeing) - reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being • Goal 06 (Clean Water and Sanitation) - ensure availability and sustainable management of water and sanitation for all • Goal 07 (Affordable and Clean Energy) - enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology • Goal 11 (Sustainable Cities and Communities) - to accommodate everyone, we need to build modern, sustainable cities • Goal 13 (Climate Action) - urges to take action to combat climate change and its impacts • Goal 14 (Life below Water) - safeguard the life in water by conserving and sustainably using oceans, seas and marine resources • Goal 15 (Life on Land) - protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
The United Nations Framework Convention on Climatic Change (1992)	The objective of the United Nations Framework Convention on Climatic Change (UNFCCC) is to stabilise the concentration of greenhouse gas (GHG) in the atmosphere, at a level that allows ecosystems to adapt naturally and protects food production and economic development. The Project activities will include construction activities and land-use change that will emit CO_2, and Angola is obliged to include such activities in its published national GHG statistics Article 4 commits parties to develop, periodically update, publish and make available national inventories of anthropogenic emissions of all GHGs not controlled by the Montreal Protocol (by source) and inventories of their removal by sinks, using agreed methodologies. It commits parties to mitigate GHG as far as practicable. Project activities will generate GHG during construction phase. Key sources of emissions include construction vehicles, equipment and power generators, and operation of the trains/wagons. A separate GHG emission assessment for the Project is ongoing

Treaty/ convention ratified	Relevance to the Project
Convention on Biological Diversity (CBD)	A United Nations treaty that is responsible for the conservation of Biological Diversity around the world, aiming to restore at least 15% of the degraded ecosystem in the world through: • convention of biological diversity • sustainable use of the components of the biodiversity • fair and equitable sharing of benefits arising from genetic resources
United Nations Conventions to Combat Desertification and Biodiversity Diversity (UNCCD)	UNCCD is a sole legally binding environment convention that links development and environment to sustainable land management. It aims to combat desertification and the ill-effects of drought through: • the restoration of productivity of degraded land • enhancing the livelihoods of people dependent on them • mitigating the impact of droughts on vulnerable populations The convention focuses on having a bottom-up approach to achieve its goals, by involving the local communities
The Convention on Wetlands of International Importance (RAMSAR Convention) (1971)	The "Ramsar Convention", is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the sustainable use, of all the wetlands in their territories
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1975	The CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival
Basel Convention	Regulates the transboundary movements of hazardous and other wastes. The project will generate various types of waste throughout its lifecycle
Bamako Convention	Prohibits imports of hazardous waste and controls transboundary movement and management of hazardous waste within Africa. The project will generate various types of waste throughout its lifecycle
Stockholm Convention	Regulates the use, transboundary movements and management of persistent organic pollutants
Rotterdam Convention	Promotes shared responsibility and cooperative effort among parties in the international trade of hazardous chemicals. The Project will use chemicals and fuel during construction activities
Lusaka Agreement (1994)	The Lusaka agreement details co-operative enforcement operations directed at illegal trade in wild fauna and flora
ILO Convention: C138 Minimum Age Convention, 1973	Prohibits child labour. Specifically, it stipulates the minimum age specified for work in general be 15, and underground work in mines be 18 years. The Project will employ skilled and unskilled labour

Treaty/ convention ratified	Relevance to the Project
ILO Convention: C182 Worst Forms of Child Labour Convention, 1999	Prohibits and eliminates the worst forms of child labour, including slavery, child prostitution, use of children in criminal activities, and dangerous labour The Project will institute strict measures to avoid child labour
ILO Convention: C148 Working Environment (Air Pollution, Noise and Vibration) Convention, 1977	Protects workers against occupational hazards in the working environment due to air pollution, noise and vibration
The 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import Export and Transport of Ownership of Cultural Property	An international law which prohibits importation and exportation of cultural assets without complying with the national and international laws. With this project, the law is important to ensure no cultural object is imported from or exported to the near countries of Rwanda and Burundi
The 2005 UNESCO Convention on the Protection and Promotion of Diversity of Cultural Expressions	This UNESCO convention deals with creative diversity, natural and cultural heritage, movable cultural property, contemporary creativity, and intangible cultural heritage
The 2001 UNESCO Universal Declaration on Cultural Diversity	This convention is meant to recognize diversities of people's cultures in the respective area. With the relation site, considering the diversities of people including transboundary cultures, this convention is equally important
The 2015 Paris Agreement	This treaty commits Parties to the UNFCCC to objectives to reduce GHG emissions, with the view to limiting the global average temperature rise to well below 2˚C above pre-industrial levels, whilst "pursuing efforts to limit the temperature increase to 1.5˚C"
Kyoto Protocol	This treaty aims at reducing the global GHG emissions, with focus of six categories of GHG emissions weighted by their global warming potential and aggregated to give total greenhouse gas emissions in CO2 equivalents. However, this treaty was effectively replaced by the Paris Agreement, which came into effect in 2016
The Glasgow Climate Pact	This Pact is an agreement adopted by nations at the COP26. The Pact provides further details on the operationalisation of the 2015 Paris Agreement and reaffirms global commitment to the low-carbon energy transition in line with the 2015 Paris Agreement

4.10 OEC Corporate standard operating procedures, policies and commitments for Luena-Saurimo railway

From an institutional point of view, the project Consortium is responsible for the overall implementation and management of the project and has the following responsibilities:

- implementation of an ESIA in terms of local legislation and the LAS to identify and assess project specific impacts and the formulation of and ESMP describing mitigation and monitoring measures that address the impacts identified
- establishment of an ESMS that incorporates all the requirements of the ESIA and ESMP
- project implementation and day-to-day environmental management and monitoring according to the ESMP and ESMS
- subjecting the project to environmental auditing by independent auditors.

The Consortium's implementation organisation for the design and build of the Project, and any third-party contractors will be contractually bound to the ESMS and ESMP. The Consortium already has many of the plans and procedures in place, which may need to be updated to include and new mitigations arising out of the ESIA.

The existing OEC's procedures, policies, plans and commitments for the development and construction of Luena-Saurimo railway Project are broadly grouped into the below sub-themes:

- sustainability management
- occupational health
- safety
- environment
- social responsibility
- administration, training and development.

Appendix 04 provides a master list of all SOPs and plans (as of 29 June 2024) including a brief highlight on the coverage/scope of each. The list and plans are both living documents subject to regular updates.

4.11 Permitting requirements

Different statutory permits, licences, approvals or authorizations will be required during the course of Project development and implementation as per Angolan legislative requirements covering environmental protection, public health, waste, occupational safety, building compliance, and railway safety operations required for the Project. A tentative permitting register is provided in Appendix 05. The Register shall be updated at least monthly to guide the Project and forecast required permits and timelines. These compliance obligations will be integrated into the Project's Environmental and Social Management System (ESMS), construction and operational management plans, and permitting procedures. Therefore, all necessary permits and licenses shall be obtained from the competent authorities prior to the commencement of construction and operation, ensuring full compliance with applicable national legislation and regulatory requirements.

5 STAKEHOLDER ENGAGEMENT

This Chapter presents stakeholders identification and engagement process undertaken for the proposed Luena-Saurimo railway Project. Further, main issues and concerns raised by stakeholders and integration in the ESIA and Project decision making process are presented. The detailed stakeholder engagement process and consultative meetings were undertaken in accordance with the international requirements as set out in the IFC PS 1 paragraphs 25-33, Equator Principles IV and Angolan legislative requirements. The key legislations considered are mainly the Presidential Decree 117/20 of April 20th - General Regulation for EIA and Environmental Licensing Procedure and Executive Decree 87/12 of February 24th - Regulation of Public Consultations of Projects Subject to Environmental Impact Assessment.

The Executive Decree 87/12 sets out various requirements for carrying out public consultations for projects subject to environmental impact assessments including modalities and pertinent documentation.

The nature and frequency of stakeholder engagement have been tailored in accordance with the Project's risks to, and adverse impacts on the affected communities traversed by the proposed railway corridor.

The chapter includes:

- objectives of the stakeholder engagement
- stakeholder identification and analysis
- stakeholder engagement activities undertaken as part of the ESIA process
- summary of the key findings from the stakeholder consultations and an analysis of stakeholder issues and concerns
- an overview of future stakeholder engagement activities
- the grievance management procedure.

5.1 Objectives of stakeholder engagement

Stakeholder engagement is an important aspect and an integral part of any development project; hence engagements should be carried out as an on-going process involving the disclosure of information to affected communities and other interested and affected parties. Timely and inclusive stakeholder engagement can ensure early identification of stakeholders' concerns and needs, build trust and positive relationships with affected communities, thereby building the foundation for developing and maintaining the project's social licence to construct and operate.

Engagements with stakeholders play a fundamental role in the Luena – Saurimo railway Project planning and implementation process, especially during construction and operation of the railway line. Engagement aims to ensure transparency, promote open and inclusive dialogue, and ensure that the concerns and interests of the parties involved are duly considered.

The objectives of the stakeholder engagements conducted during the ESIA were to:

- disclose information to stakeholders on the proposed project activities, potential issues and the ESIA process to facilitate community and other key stakeholders' awareness on Project process and operations
- present the Luena-Saurimo railway line construction Project to the institutions involved in the provinces where the Project is located (Provincial Governments and Municipal Administrations) so that the Project objectives are aligned with local and regional development priorities. This involved discussions on how the Project can contribute to the economic, social and infrastructural development of the region
- coordinate efforts between the Provincial Government, Municipal Administrations and those responsible for the Project to ensure effective and harmonious implementation
- solicit, document, and incorporate stakeholders' views, concerns, issues and expectations in the design, development and operation of the proposed Luena-Saurimo Project and ESIA process as well
- integration of considerations from affected communities and local authorities into project planning and implementation, ensuring that the Project addresses the needs and concerns of local communities
- identify and map relevant additional stakeholders
- collection of baseline information within Project area.

5.2 Stakeholder identification, analysis and mapping

Stakeholders are defined as persons or groups external to project that may be affected by, have an interest in or have influence over the Project (IFC PS 1), in this case the Luena-Saurimo railway Project. Stakeholder engagement involved a complex and ongoing process necessitating the identification and analysis of stakeholders at various levels, influence and their connections to the Luena-Saurimo Project. This process is crucial in designing a comprehensive plan that specifies the timing and approach for engaging various stakeholder groups at different phases of the Project.

For the outcomes of stakeholder engagement to hold significance, they are integrated into the Project's decision-making and design through a transparent and well-documented process. Therefore, a Stakeholder Engagement Plan (SEP) for the Luena-Saurimo Project was developed to guide the engagements at the Scoping stage and subsequent stages of the ESIA development The SEP outlines key stakeholders to be consulted and engagement approaches and it aligns with IFC PS1, Equator Principles IV and Angolan regulatory requirements (see SEP in Appendix 06).

Stakeholders were identified based on the following:

- preliminary identification and validation of the existing communities within 5 km buffer along the proposed corridor using satellite imageries
- proximity with the proposed railway line
- consultant experience with similar Projects in Angola and across Africa
- stakeholder roles, relevance and influence on the Project
- consultative meetings with OEC and Angolan partners
- review of previous studies conducted in the area and documentations

- the snowballing effect, where stakeholders met were asked to identify additional stakeholders
- recommendations from dry season survey visit and Scoping Phase site visits.

Further, the identified stakeholders were broadly categorized as:

- Affected parties: individuals or groups within the Project Area of Influence that are directly affected by the project and that have been identified as most susceptible to life changes associated with Project implementation
- Interested Parties: individuals or groups that may not be impacted/directly involved in the Project, but whose interests might be affected by the project and are able to influence its implementation process
- Vulnerable groups: vulnerable individuals and groups who may not have a voice to express their concerns or understand the impacts of the Project and are sometimes excluded from engagement and /or project benefits (disabled, women, elderly, youth, illiterate individuals)
- Project Affected Communities (PACs), Project affected households (PAHs) and Project affected persons (PAPs): this group is a subset of affected parties and includes communities, households and persons that will be physically or economically displaced by the project. For ESIA level assessment, PACs are identified. Identification and census of PAP and PAHs is typically undertaken through a resettlement assessment process.

A Stakeholder identification and mapping was developed to provide effective consulting and engagement strategies. This exercise included a comprehensive, detailed overview of all Project stakeholders including their specific relevance to and weighted influence over the Project. For Stakeholder analysis the following criteria were used:

- level of influence on the Project: Stakeholders that have control over decision-making process through all Project stages from planning to operation (protesting, blocking, or causing conflicts during Project development - provide comments on issues and concerns related to Project)
- level of interest in the Project: understanding stakeholders needs can help clarify the motivations of different stakeholder groups and if they are able to influence the Project (how will the Project intervene on their needs/way of life)
- level of impact of the Project: understand how the Project will interfere with stakeholders needs/way of life.

As a result of the analysis, some stakeholders were prioritised as key stakeholders for the ESIA because of the degree to which they may be affected by and/or influence the Project. Priority stakeholders for the ESIA are set out in the SEP (Appendix 06). It is important to note that the process of stakeholder identification and analysis is dynamic and ongoing throughout the life of the ESIA. It is noted that the positions of stakeholders may change during Project stages and that Stakeholder mapping should be reviewed and updated as appropriate. In addition, any new stakeholders identified should be added into the map.

5.3 Engagement activities undertaken for ESIA

5.3.1 Overall approach and phases

The Luena-Saurimo Project engagement activities entailed an inclusive, transparency and culturally appropriate on-going process which involved sharing information and knowledge, seeking to understand the concerns of key stakeholders, and building relationships based on collaboration.

Overall, detailed, extensive, inclusive, transparent and culturally-appropriate engagement activities have been undertaken in all PACs (refer Table 2-1) at varying levels. The engagement process is compliant with IFC, EP4 and Angolan legislative requirements.

The engagement sessions involved diverse groups, including Provincial Governments in the two Provinces, Municipal Administrations (Saurimo, Dala, Camanongue and Luena), Traditional authorities, local authorities, local leaders, communities, women, men, vulnerable and marginalized populations and non-governmental organizations. During consultations, emphasis was placed on the involvement of the key stakeholders, gathering their fundamental concerns and incorporation of the stakeholders' issues in the decision-making process and entire Project life cycle.

At the community level, engagements were undertaken to cover a wider project AoI extending 5km radius both ways from the centreline (Figure 5-1) to capture multiple settlements/neighbourhoods, socio-economic and cultural dynamics, severance issues, establish cultural heritage resources and verify presence of any IPs.

Stakeholder engagement rounds/phases are highlighted below:

- first phase during Scoping Stage (September 2023 and March – April 2024). The team held public meetings with 29 communities/settlements/neighbourhoods at 18 locations along the proposed railway corridor (Table 5-4, Table 5-5 and Table 5-6)
- second phase during detailed baseline assessments for ESIA (May – June 2024). The team held focus group discussions with six communities at six locations (Table 5-7 and Table 5-8)
- third phase - Resettlement Policy Framework (RPF) fieldwork engagements undertaken in Dec.2025 with Provincial Governments (Moxico and Lunda Sul), Municipal Authorities, and Traditional Authorities (local leaders – Sobas) in all 33 PACs along the railway line. These engagements focused solely on resettlement issues. The RPF engagements are dealt with separately in a separate RPF Report
- fourth phase engagement will be in line with IFC PS1 and EP4, during public disclosure of the ESIA Report (see Section 5.7)
- further, additional consultations at each PAC will be conducted during development of the Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) and detailed design stage before commencement of construction works. The planned resettlement related engagements will be used to verify further cultural heritage resources and any other IPs within project AoI.
- the 52 indicative communities, settlements and neighbourhoods presented in Table 5-3 are all within the PACs provided in Table 2.1 (Chapter 2 Project Description) and partly extended beyond to cover various dynamics and data collection for engagement purposes.

5.3.2 Arranging and approvals for meetings

The first step was to identify the relevant government authorities, including Provincial Governments and Municipal Administrations where the Project is situated. Based on the identification of relevant authorities, formal letters requesting consultative meetings were prepared. The request letters were prepared in local language (Portuguese) in a concise manner presenting the objectives of the meetings, the topic to be discussed, the importance of the authorities' participation in the discussion of the Project and probable dates for the meetings. These letters were sent to the Moxico and Lunda Sul Provinces and approvals obtained beforehand (see Appendix 07).

Regarding meetings with communities, appointments were made based on prior contact with the traditional and administrative authorities of each district where engagement activities were tentatively planned.

5.3.3 Disclosure materials

After confirmation of the meetings with approval of the proposed dates at Provincial and municipal levels, all relevant materials and information for the discussion of the Project were prepared. This included a short presentation about the project and Background Information Document (BID) in the form of poster. The BID and Project presentations were prepared in English and translated into Portuguese for clint approval before using as disclosure materials during consultations with communities and authorities along the railway corridor. The BID and project presentation are provided in Appendix 08.

5.3.4 Conducting and recording engagement meetings

All engagements were conducted using combination of national language (Portuguese) and local language in areas where communities are not conversant with Portuguese. In the Moxico Province, Chokwe is the most spoken language, and in the Lunda Sul Province, it is Chokwe and Chilunda. Chokwe is spoken in nearly all communities, while Portuguese is only spoken in some of the communities. The Engagement team was divided into two sub-teams to ensure proper coverage of the corridor within short time frame. Each sub-team was composed of facilitators and note takers.

A brief presentation of the proposed Luena-Saurimo railway Project, the need for ESIA process and the Grievances Redress Mechanism (GRM) were undertaken at the beginning of each meeting. After the presentation, discussions and question and answers session were held whereby community members could voice their questions, issues, and concerns.

The active listening methodology was used in all meetings with local authorities and their participation in the communities was essential for establishing solid, constructive, and appropriate relationships, essential for the successful management of the impacts generated by the Project.

Ample time was allocated for the question-and-answer segments to accommodate the voices of all stakeholders present. Specifically, separate other meetings were arranged for women, ensuring their active participation, comprehension of the Project and ESIA process, and the opportunity to express their perspectives and opinions.

Meeting minutes and attendance were recorded at each meeting and photographs were taken (where permission was granted). All stakeholder suggestions, comments and responses from the stakeholder team were recorded on the agreed meeting minutes and signature sheet templates and group photographs were taken after seeking permission from the participants. All records are appended in this ESIA report.

- Appendix 09: Information collected from community level engagement at Scoping Phase
- Appendix 10: Meeting minutes and attendance sheets engagements with local government authorities (Scoping Phase)
- Appendix 11: Meeting minutes and attendance sheets engagements with communities (Scoping Phase)
- Appendix 12: Meeting minutes and attendance sheets engagements with communities (ESIA Phase)
- Appendix 13: Attendance sheets during human rights assessment engagements (ESIA Phase).

5.4 Stakeholders Consulted in Phase 1 (Scoping)

5.4.1 Provincial Governments, Municipal and Traditional Authorities

The team conducted six meetings with local government authorities: the Provincial Governments of Moxico and Lunda Sul, and the municipal offices of Dala, Camanongue, Moxico and Saurimo (Table 5-1 below). The dates and purpose of these meetings are presented in Table 5-2 below.

Table 5-1: Provincial and municipal authorities consulted

Provincial and municipal authorities	Number of Males	Number of Females	Total participants
Provincial Government of Lunda Sul	12	5	17
Saurimo Municipal Administration	45	7	52
Dala Municipal Administration	43	8	53
Provincial Government of Moxico	20	4	24
Moxico Municipal Administration	20	3	23
Camanongue Municipal Administration	35	4	39
Total			**208**

Table 5-2: Engagement activities undertaken with local government authorities during Scoping Stage

Date	Institution/Authority	Stakeholders	Activity	Purpose of Engagement
Monday 04th March 2024	Provincial Government of Lunda Sul	Province Directors of Lunda Sul (Agriculture, Environmental, Energy and Water, Transport, Social Action)	Project presentation Question and answer session Distribution of the Project Information Document	• Presentation of the project in its most different phases • Present the engagement plan with other stakeholders foreseen in the project • Study issues related to the livelihoods of communities and the main existing community issues • Collect documentary information from administrations, maps and the municipal social profiles, that can support the social and environmental impact study • Understand the expectations of the local government regarding the implementation of the project • Obtain authorization for visiting obligations to local communities
	Saurimo Municipal Administration	Municipal directors of Saurimo Administration (Human Resources, Legal Office of the Municipal Administration Territorial Planning, Social Action) Deputy advisor to the Municipal Administrator Traditional authorities Religious and Civil Society entities		
Tuesday 05th March 2024	Provincial Government of Moxico	Vice-Governor of Moxico (Social and Economic Sector, Technical and Infrastructure Sector) General secretary of the Provincial Government The Provincial Delegate of the National Police The Municipal Administration of Moxico	Project presentation Question and answer session Distribution of the Project Information Document	• Presentation of the project in its most different phases • Present the engagement plan with other stakeholders foreseen in the project • Study issues related to the livelihoods of communities and the main existing community issues • Collect documentary information from administrations, maps and

Date	Institution/Authority	Stakeholders	Activity	Purpose of Engagement
		Second Provincial Commander of the National Police		the municipal social profiles, that can support the social and environmental impact study • Understand the expectations of the local government regarding the implementation of the project • Obtain authorization for visiting obligations to local communities
	Moxico Municipal Administration	Municipal Administrator Secretary of the Municipal Administrator Second Commander of the National Police Province Directors of Moxico (Culture, Environmental, Technical Services and Infrastructure, Transport, Social Communication)		
Wednesday 06th March 2024	Camanongue Municipal Administration	Representative of the Municipal Administrator Head of Municipal Administration Traditional Authorities Neighbourhood Coordinators Representatives of Political Parties Religious Entities Chief of Operations of the National Police Head of SIC Section Specialist of Municipal Civil Protection and Fire Service Chief of Staff of the Municipal Administrator	Project presentation. Question and answer session Distribution of the Project Information Document	

Date	Institution/Authority	Stakeholders	Activity	Purpose of Engagement
	Dala Municipal Administration	Administrator of the Municipality of Dala General Secretary of Municipal Administration Municipal Director Municipal Director of Social Action Deputy Secretary of Municipal of Municipal Administration Head of Agriculture Section Head of Human Resources Section UNITA Municipal Secretary Deputy Secretary of the PRS School Directors, Religious Entities Traditional Authorities Members of Civil Society	Project presentation. Question and answer session Distribution of the Project Information Document	• Presentation of the project in its most different phases • Present the engagement plan with other stakeholders foreseen in the project • Study issues related to the livelihoods of communities and the main existing community issues • Collect documentary information from administrations, maps and the municipal social profiles, that can support the social and environmental impact study • Understand the expectations of the local government regarding the implementation of the project • Obtain authorization for visiting obligations to local communities

5.4.2 Community engagements

Using tools such as Geographic Information Systems (GIS), an exhaustive list of communities located within a radius of 5 km AoI from centreline was compiled as illustrated in Figure 5-1 below and Table 5-3. During preliminary identification and validation of the communities within Dala municipality, the Consultant team collaborated with the Municipal Administrator to confirm the current existing communities/settlements and neighbourhoods identified by the team. Further, the Administrator affirmed the commitment to provide the required assistance to the team during the Studies phase and in the scheduled engagement activities.

In Saurimo municipality, the team was assisted by the Municipal Director of Culture of Saurimo. As for the Municipality of Camanongue, team contacted the Municipal Administrator for the validation of communities. The Administrator affirmed that he is available to give all the necessary support to carry out the ESIA for the Luena-Saurimo railway project.

In Moxico municipality, the team managed was supported by the Municipal Administrator and the Deputy Administrator for the Technical Sector and Infrastructures. They both assisted the team in the confirmation of the communities/settlements and neighbourhoods locations.

The 52 indicative communities, settlements and neighbourhoods presented in Table 5-3are all within the PACs provided in Table 2.1 (Chapter 2 Project Description) and partly extended beyond to cover various dynamics and data collection for engagement purposes.

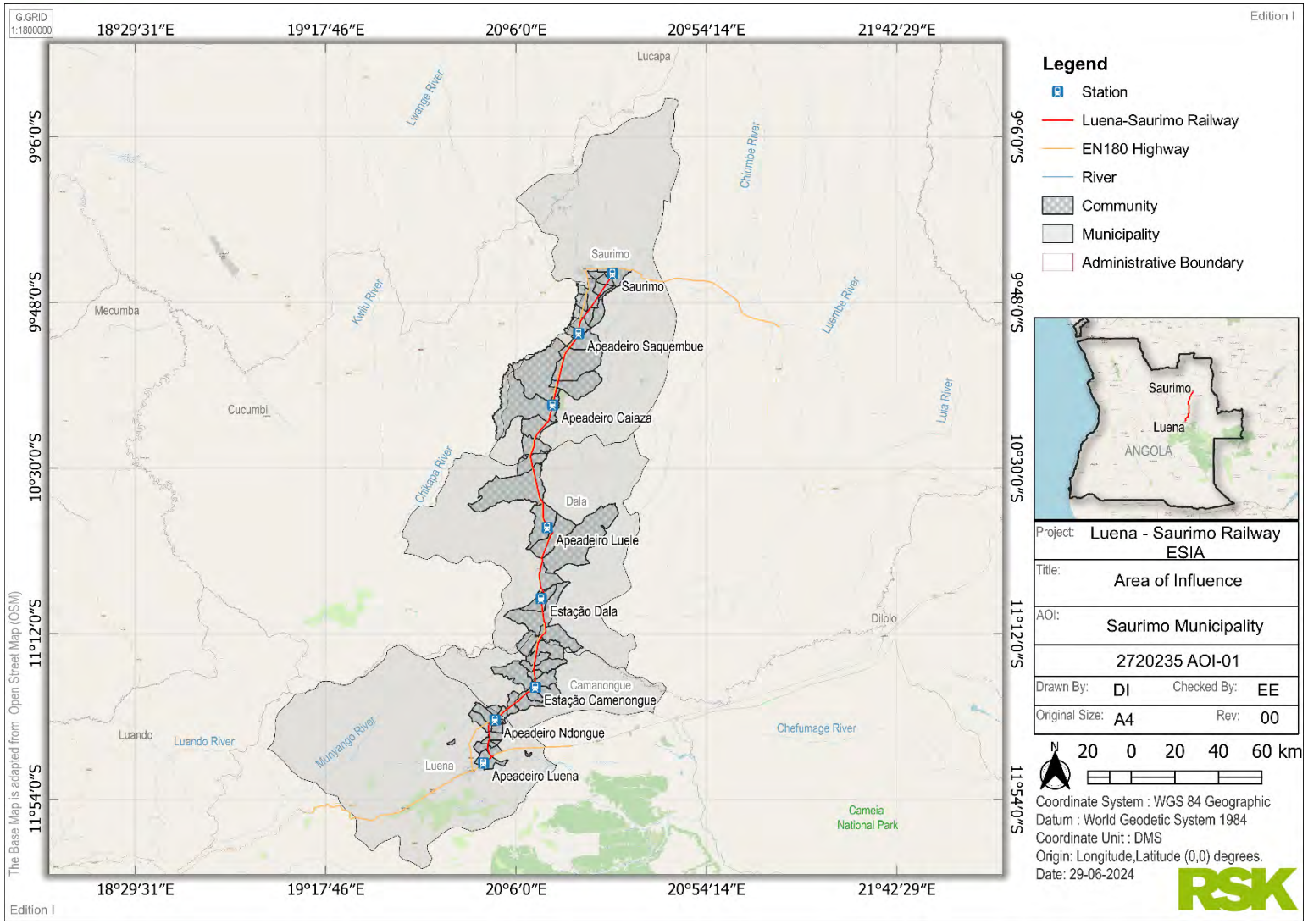


Figure 5-1: Communities/settlements and neighbourhoods located within 5km of the proposed Luena-Saurimo Railway line

Table 5-3: Indicative communities/settlements and neighbourhoods identified and validated with the assistance of municipal authorities

Province	Municipality	Commune	Neighbourhood/ commune/ settlement/ town	Approx. distance between the railway line and the community	Type of leadership in the community
Moxico Province	Moxico	Luena	Cassolê (crop area without households)	850 m	Traditional Authority
			Sacapiasso	1 km	Traditional Authority
			Samene (crop area without households)	2.028 km	Traditional Authority
			Samauzo (crop area without households)	176 m	Traditional Authority
			Sacambulo	2.84Km	Traditional Authority
			Canda I	857 m	Traditional Authority
			Catembo Nowa	223 m	Traditional Authority
			Migotchi	389 m	Traditional Authority
	Camanongue	Camanongue	Cassai Ponte	188 m	Traditional Authority
			Samalengue	167 m	Traditional Authority
			São João (Small community)	Impossible to observe the distance with satellite imagery	Traditional Authority
			Mazemba	696 m	Traditional Authority
			Kalundungo	4.8 km	Traditional Authority
			Sapombo Velho	564 m	Traditional Authority
			Sambavo	324 m	Traditional Authority
			Camanongue sede (Casco Urbano)	662 m	Traditional Authority
			Muapezo	412 m	Traditional Authority
			Mumanga (Large Community)	289 m	Traditional Authority

Province	Municipality	Commune	Neighbourhood/ commune/ settlement/ town	Approx. distance between the railway line and the community	Type of leadership in the community
			Mussala II	673 m	Traditional Authority
			Ndongue I	847 m	Traditional Authority
			Ndongue II	702 m	Traditional Authority
			Chilonga	691 m	Traditional Authority
			Musseringinge	2 km	Traditional Authority
Lunda – Sul Province					
	Saurimo	**Saurimo**	4 de fevereiro	1.6 Km	Traditional Authority
			Luari I	1.097 Km	Traditional Authority
			Tchaingo	504 m	Traditional Authority
			Sambau	2.6 Km	Traditional Authority
			Camundabila	692 m	Traditional Authority
			Tchapoji	190 m	Traditional Authority
			Caxico	3.2 Km	Traditional Authority
			Nanguanza	760 m	Traditional Authority
			Saquembue	203 m	Traditional Authority
			Muanguigi	201 m	Traditional Authority
			Muicaimbo	302 m	Traditional Authority
			Mwatximbia	789 m	Traditional Authority
			Lundjate	502 m	Traditional Authority
			Cassamba I	163 m	Traditional Authority
			Cassamba II	467 m	Traditional Authority
			Muamucalanganza	348 m	Traditional Authority
			Muxie	352 m	Traditional Authority

Province	Municipality	Commune	Neighbourhood/ commune/ settlement/ town	Approx. distance between the railway line and the community	Type of leadership in the community
	Dala	**Dala**	Luachimo	492 m	Traditional Authority
			Luele	306 m	Traditional Authority
			Mukuanguaji	749 m	Traditional Authority
			Satxitende	157 m	Traditional Authority
			Nacatoco	120 m	Traditional Authority
			Dala sede	916 m	Traditional Authority
			Muliata	458 m	Traditional Authority
			Sangoma (small community)	79 m	Traditional Authority
			Sacacuca (crop area without households)	107 m	Traditional Authority
			Biula	306 m	Traditional Authority

During Scoping the team held public meetings with 29 communities at 18 locations along the proposed railway corridor. These engagement meetings were held between the 11th and 20th of March 2024 as summarised in Table 5-4, Table 5-5 and Table 5-6 overleaf. The shortlisted communities engaged during Scoping Phase were selected based on the size of the settlements (considered a combination of larger centres, medium sized settlements and small settlements) visually observed on Google Earth images, the proximity to proposed quarry sites and proximity to the proposed railway line.

Table 5-4: Communities consulted during Scoping Phase

Province	Municipality	Commune	Neighbourhood/town	Distance between the railway line and the community	Type of leadership in the community	Engaged during scoping phase
Moxico Province	Moxico	Luena	Cassolê (crop area without households)	850 m	Traditional Authority	
			Sacapiasso	1 Km	Traditional Authority	Yes
			Samene (crop area without households)	2.028 Km	Traditional Authority	
			Samauzo (crop area without households)	176 m	Traditional Authority	Yes
			Sacambulo	2.84 Km	Traditional Authority	
			Canda I	857 m	Traditional Authority	Yes
			Catembo Nowa	223 m	Traditional Authority	
			Migotchi	389 m	Traditional Authority	Yes
	Camanongue	Camanongue	Cassai Ponte	188 m	Soba	
			Samalengue	167 m	Soba	Yes
			São João (Small Community)	To be confirmed	Soba	
			Mazemba	696 m	Soba	
			Kalundungo	4.83 Km	Soba	
			Sapombo Velho	564 m	Soba	
			Sambavo	324 m	Regedor	
			Camanongue sede (Casco Urbano)	662 m	Soba	
			Muapezo	412 m	Soba	Yes
			Mumanga (Large Community)	289 m	Soba	Yes
			Mussala II	673 m	Soba	
			Ndongue I	847 m	Soba	
			Ndongue II	702 m	Soba	
			Chilonga	691 m	Soba	
			Musseringinge	2 km	Regedoria	Yes
			Samucanda	190 m	Soba	Yes
			Sakambudji	180 m	Soba	Yes
			Kamuleke	1 km	Soba	Yes
Lunda Sul	Saurimo	Saurimo	4 de fevereiro	1.6 Km	Soba	
			Luari I	1.097 Km	Soba	Yes
			Tchaingo	504 m	Soba	

Province	Municipality	Commune	Neighbourhood/town	Distance between the railway line and the community	Type of leadership in the community	Engaged during scoping phase
			Sambau	2.6 Km	Soba	
			Camundabila	692 m	Soba	
			Tchapoji	190 m	Soba	
			Caxico	3,200 Km	Soba	
			Nanguanza	760 m	Soba	Yes
			Saquembue	203 m	Soba	Yes
			Muanguiji	201 m	Soba	Yes
			Muicaimbo	302 m	Soba	
			Mwatximbia	789 m	Soba	
			Lundjate	502 m	Soba	
			Cassamba I	163 m	Soba	Yes
			Cassamba II	467 m	Soba	
			Muamucalanganza	348 m	Soba	Yes
			Muxie	352 m	Soba	
			Muamuyeye	500 m	Soba	Yes
			Cayaza	180 m	Soba	Yes
	Dala	**Dala**	Luatchimo	492 m	Soba	
			Luele	306 m	Soba	Yes
			Mukuanguaji	749 m		Yes
			Satxitende	157 m	Soba	Yes
			Nacatoco	120 m	Soba	Yes
			Dala sede	916 m	Soba	
			Muliata	458 m	Soba	
			Sangoma (small community)	79 m	Soba	Yes
			Sacacuca (crop area without households)	107 m		Yes
			Biula	306 m	Soba	Yes
			Mombo	2 km	Soba	Yes
			Sayassua	306 m	Soba	Yes
			Nacatoco	306 m	Soba	Yes

Table 5-5: Breakdown of engagement meetings participants during Scoping phase

Community/Settlements Along the Railway Corridor	Number of Males	Number of Females	Total participants
■ Muamuyeye community	43	43	86
■ Luari community	47	■ 15	■ 62
■ Nanguanza community	26	29	55
■ Muanguiji community	34	16	50
■ Muamucalangaza community	37	27	60
Saquembue community	81	37	118
■ Caiaza community ■	39	55	94
■ Cassamba I community	12	6	18
■ Mombo/front School nº9 community	38	15	53
■ Mukuanguaji community	25	16	41
■ Satxitende community "Dala Velho"	90	47	137
■ Sayassua community ■ Nacatoco community	25	13	38
■ Luele community	32	43	75
■ Biula community ■ Sacacuca, and Sassuco community	102	87	189
■ Sangoma community	44	8	52
Musseringinge community	93	42	135
Samucanda community and Sakambudji community	74	87	161
■ Muapezo community	58	65	123
■ Mumanga, Saissazo and Caiza communities	113	103	216
■ Camanongue Sede community (central neighborhood, Samalengue, 5000, 200 casas, Mazemba, neighborhoods)	53	33	86
■ Kamaleke community	41	39	80
■ Canda I, Canda II and Samahuzo "Canda III" communities	65	42	107
■ Sacapiasso community and Migotchi community ■	58	34	92
■ **Total**	**1,230**	**902**	**2,128**

Table 5-6: Engagement activities undertaken with the communities during Scoping Phase

Date	Municipality	Community/Location	Stakeholders	Activity	Purpose of Engagement
Monday 11th March 2024	Saurimo	Muamuyeye community	■ Soba of the community ■ Community members	Public meeting to inform and present to communities the Luena – Saurimo Railway Project	• Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Luari community	Regedor of the Saurimo Municipality Soba of the community Community members		
Tuesday 12th March 2024		Nanguanza community	Main Soba of the community 5 local sobas of the process of unification of neighborhoods Community members	Public meeting to inform and present to communities the Luena – Saurimo Railway Project ■	■ ■ • Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Muanguiji community	Soba of the Saquembue community Soba of de Muamucalangaza Community Community members		
		Saquembue community Muamucalangaza community	Soba of Saquembue community Soba of Muamucalanganza Deputy of Saquembue community		

Date	Municipality	Community/Location	Stakeholders	Activity	Purpose of Engagement
			Autotone representatives from Saquembue Community members		
Wednesday 13th March 2024		■ Caiaza community ■ Cassamba I community	Soba of the Saquembue community Soba of the Cassamba I Community Community members	Public meeting to inform and present to communities the Luena – Saurimo Railway Project ■	■ ■ • Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
	■ ■ ■ ■ ■ ■ ■ Dala	■ Mombo/front School nº9 community	Soba of the community Community members		
		■ Mukuanguaji community	Soba of the community Community members		
		■ Satxitende community "Dala Velho"	Soba of the community Community members		
		■ Sayassua community ■ Nacatoco community	Neighborhood governor 6 representatives from the Nacatoco area Community members		
Thursday 14th March 2024		Luele community	Soba of the community Secretary and Coordinator of the Neighborhood Community members	Public meeting to inform and present to communities the Luena – Saurimo Railway Project	• Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Biula community Sacacuca, and Sassuco community	Community Governor Soba of the Sacacuca Saissazo Neighborhoods community Community members		
		Sangoma community	Neighborhood Soba Community members	Public meeting to inform and present to	• Presentation of the project in its most different phases
		Musseringinge community	Community governor Soba of the community		

Date	Municipality	Community/Location	Stakeholders	Activity	Purpose of Engagement
Friday 15th March 2024	Camanongue		Secretary of the governor Community members	communities the Luena – Saurimo Railway Project	• Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Samucanda community and Sakambudji community	Soba of the Samucanda community Pastor of the IEIA church Community members		
Monday 18th March 2024		Muapezo community	Soba of the community Community members	Public meeting to inform and present to communities the Luena – Saurimo Railway Project ■	• Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Mumanga, Saissazo and Caiza communities	Soba of the Mumanga community Soba of Saissazo community Soba of Caiza community Community members		
Tuesday 19th March 2024	Camanongue	Camanongue Sede community (central neighborhood, Samalengue, 5000, 200 casas, Mazemba, neighborhoods)	Soba of the Central community Responsible for neighbourhood 5000 Community members	Public meeting to inform and present to communities The Luena – Saurimo Railway Project	• Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Kamaleke community	Soba of the community Community members		

Date	Municipality	Community/Location	Stakeholders	Activity	Purpose of Engagement
Wednesday 20th March 2024	Luena	Canda I, Canda II and Samahuzo "Canda III" communities	Soba of the Canda I neighbourhood Soba of the Canda II neighbourhood communities Community members	Public meeting to inform and present to communities The Luena – Saurimo Railway Project	• Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study
		Sacapiasso community and Migotchi community	Sobas of the community Community members	Public meeting to inform and present to communities The Luena – Saurimo Railway Project	• Presentation of the project in its most different phases • Understand expectations of communities with project implementation • Data collection on the socio-economic context of the communities that can support the Environmental and Social Impact Study

5.5 Stakeholders Consulted in Phase 2 (ESIA)

5.5.1 Community engagement during the ESIA phase

During the second phase of the stakeholder engagement the team held focus group discussions with six communities at six locations. These were held between the 13th and 17th of May 2024 as summarised in Table 5-7 and Table 5-8 overleaf.

The shortlisted communities engaged during ESIA phase were selected based on:

- demographical density
- proximity to project area
- access paths frequency
- stakeholder concerns expressed during Scoping stage
- livelihoods vulnerability.

Table 5-7: Selected communities consulted during ESIA Phase

Community/Settlements Along the Railway Corridor	Number of Males	Number of Females	Total participants
■ Nanguanza community	■ 26	■ 26	52
■ Saquembue community	28	■ 21	49
■ Satxitende community	28	21	49
Muapezo community ■	26	12	38
São João Baptista community ■	28	21	49
Sacapiasso community ■	17	13	30
Total	**153**	**114**	**267**

Table 5-8: Engagement activities undertaken with the communities during ESIA Stage (Phase 2)

Date	Municipality	Location	Stakeholders	Activity	Purpose of Engagement
Friday 17th May 2024	Saurimo	Nanguanza community	• 1 Deputy Regedor of Nanguanza • 2 Local Sobas of the neighbourhood unification process • 49 number of community members (men, women, elders, youths)	• 4 FGDs on the potential impacts associated with the construction and operation phase of the Luena-Saurimo railway project • Women's Group of 26 people, Men's Group of 26 people	• Social research to identify the main social impacts associated with the project • Gather insights on community's expectations considering the potential predicted impacts
Friday 17th May 2024		Saquembue community	• 2 Local Soba of Saquembue • 1st and 2nd Soba secretaries • 1 Sobeta • 49 number of community members (men, women, elders, youths)	• 5 FGDs on the potential impacts associated with the construction and operation phase of the Luena-Saurimo railway project • Women's Group of 21 people, Men's Group of 28 people	• Social research to identify the main social impacts associated with the project • Gather insights on community's expectations considering the potential predicted impacts
Thursday 16th May 2024	Dala	Satxitende community	• 1 Local Soba of the neighbourhood unification process • 4 Sobetas • 1 Soba adviser • 72 Community members (men, women, elders, youths)	• 5 FGDs on the potential impacts associated with the construction and operation phase of the Luena-Saurimo railway project • Women's Group of 29 people, Men's Group of 43 people	• Social research to identify the main social impacts associated with the project • Gather insights on community's expectations considering the potential predicted impacts

Date	Municipality	Location	Stakeholders	Activity	Purpose of Engagement
Tuesday 14th May 2024	Camanongue	Muapezo community	• 1 Soba of the community • 38 Community members (men, women, elders, youths)	• 5 FGDs on the potential impacts associated with the construction and operation phase of the Luena-Saurimo railway project • Women's Group of 26 people, Men's Group of 12 people	• Social research to identify the main social impacts associated with the project • Gather insights on community's expectations considering the potential predicted impacts
Wednesday 15th May 2024		Camanongue Sede – João Baptista community	• 1 Regedor of the Camanongue • 2 Sobas of the João Baptista community • 49 Community members (men, women, elders, youths)	• 3 FGDs on the potential impacts associated with the construction and operation phase of the Luena-Saurimo railway project. Women's Group of 21 people, Men's Group of 26 people	• Social research to identify the main social impacts associated with the project • Gather insights on community's expectations considering the potential predicted impacts
Monday 13th May 2024	Moxico	Sacapiasso community	• 2 Sobas of the communities • 30 Community members (Women's Group, Men's Group, Youths)	• 4 FGDs on the potential impacts associated with the construction and operation phase of the Luena-Saurimo railway project • Women's Group of 13 people, Men's Group of 17 people	• Social research to identify the main social impacts associated with the project • Gather insights on community's expectations considering the potential predicted impacts

5.5.2 Provincial and Municipal Government engagement during the ESIA phase

The Consultant team held four meetings with local government authorities, namely, the Municipal Administration of Moxico and the Provincial Office for Social Action, Family and Gender Equality, Municipal Administration of Camanongue, Municipal Administration of Dala and Municipal Administration of Saurimo. The consultative meetings were held between 13th and 15th May 2024 and the purpose of collecting additional views and baseline information on human rights and vulnerability related issues as presented in Table 5-9 overleaf.

Table 5-9: Meetings held with local government authorities as part of the human rights and vulnerability engagements

Date	Government Authority	Stakeholders	Activity	Purpose of Meeting
Monday 13th May 2024	Provincial Office for Social Action, Family and Gender Equality	• Municipal Directors of the Administration of Saurimo (Technical services and infrastructures, Social Action and human resources) Technicians from the Provincial Social Action Office	• Presentation of context of the meeting. • Question and answer session	• Collect information from local state administrations on human rights issues at the municipal and provincial level in general, to be considered in the ESIA
Tuesday 14th May 2024	Camanongue Municipal Administration	• Municipal Directors of the Administration of Saurimo (Technical services and infrastructures, Social Action and human resources, Legal Office, Youth and Sports Office, Municipal Human Rights Council, Civil Protection and Firefighters, National Police and education and Planning and Statistics Office) • Traditional Authorities, Leader Religious and Community	• A presentation of context of the meeting. • Question and answer session	• Collect information from local state administrations on human rights issues at the municipal and provincial level in general, to be considered in the ESIA
Wednesday 15th May 2024	Saurimo Municipal Administration	• Municipal Directors of the Administration of Saurimo (Human resources, Legal Office, Youth and Sports Office, Culture, Social action and Planning and Statistics Office)	• A presentation of context of the meeting • Question and answer session	• Collect information from local state administrations on human rights issues at the municipal and provincial level in general, to be considered in the ESIA
	Dala Municipal Administration	• Municipal Directors of the Administration of Saurimo (Human resources, Legal Office, Youth and Sports Office, Culture, Social action, Youth and Sport, War veteran and Planning and Statistics Office)		

5.5.3 Engagement with Non-Governmental Organization during the ESIA Phase

The team held three meetings with representatives of Non-Governmental Organizations that work to protect Human Rights (Table 5-10). The meetings were held in the Municipality of Moxico, Saurimo and the Province of Luanda. The organizations consulted were:

- Associação Tala Kulutwe
- Associação Mwana Pwo
- Associação Kwassa Mbunda
- Associação Home of Wisdom
- Associação Makita
- Associação for the Development of Angolan Civil Society (ADESCA)
- Mosaiko Angola
- Council of Christian Churches of Angola (CICA)
- Community Development Relief Organization (OADEC)
- Community Development Support and Promotion Center (CAPDC).

Table 5-10: Engagements held with non-governmental organizations

Date	Local	Stakeholders	Activity	Purpose of Meeting
■ Tuesday 14th May 2024	■ Provincial Office of Social Action, Family and Gender Equality	• Associação Tala Kulutwe and Associação Mwana Pwo	• A presentation of context of the meeting. • Question and answer session. • Distribution of Project presentation summary (BID)	• Collect information from local state administrations on human rights issues at the municipal and provincial level in general, to be considered in the ESIA • Analyse the perspective of non-governmental organizations on human rights
■ Wednesday 15th May 2024	■ Saurimo ■ Municipal Administration ■	• Associação Tala Kulutwe • Associação Mwana Pwo • Associação Kwassa Mbund, • Associação Home of Wisdom • Associação Mbakita • Associação for the Development of Angolan Civil Society (ADESCA) • Mosaiko Angola • Council of Christian Churches of Angola (CICA) • Community Development Relief Organization (OADEC) • Community Development Support and Promotion Canter (CAPDC)	• A presentation of context of the meeting. • Question and answer session • Distribution of Project presentation summary (BID)	• Collect information from local state administrations on human rights issues at the municipal and provincial level in general, to be considered in the ESIA • Analyse the perspective of non-governmental organizations on human rights

Date	Local	Stakeholders	Activity	Purpose of Meeting
■ Friday 17th May 2024	■ Mosaiko offices in Luanda	• Mosaiko Angola	• A presentation of context of the meeting. • Question and answer session • Distribution of Project presentation summary (BID)	• Collect information from local state administrations on human rights issues at the municipal and provincial level in general, to be considered in the ESIA • Analyse the perspective of non-governmental organizations on human rights

5.6 Summary of stakeholder concerns and issues raised during engagements

5.6.1 Summary of local government feedback for consideration in the ESIA

The Table 5-11 below is a summary of the main questions, clarifications, concerns raised during the meetings with the local government authorities. Consideration for the ESIA has been noted in relation to each respective question/comment raised as and if applicable to the ESIA and Project.

Table 5-11: Summary of issues raised by Provincial and Municipal authorities

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
Provincial Government of Lunda Sul	A member of the Government of Lunda Sul questioned whether the Pantheroil team is already here in the field	The team responded that yes, it is already in the field	• n/a
	A member of the Government of Lunda Sul asked if RSK already has facilities in Angola and Who is your representative	The team responded that RSK is a multinational company and, here in Angola, is a partner of Pantheroil. At the moment the representative present is Mr. Edward Ezekiel who is Project Director for this ESIA Project	• n/a
	A member of the Government of Lunda Sul asked if the management team is already in the field. And he added that the implementation of activities must be hastened.	The team responded that the ESIA phases are followed and corresponds to the project timeframe	• n/a
	The team asked what impacts we would encounter with the implementation of the project	The Provincial Government's Environment representative responded that the impact could be on flora. He mentioned the *'Mussivi'* plant that is found in Dala and must be preserved	• Inclusion of preliminary survey to identify the Mussivi tree that is culturally used for medicinal purposes along the right of way to include in a separate Ecosystem Service Assessment during mobilisation • ESMP includes prohibition to remove tree without Provincial Government authorisation and offsetting plan
	The team asked what the social services may be affected by the implementation of the project	The Head of the Social in the Provincial government responded that the Project is likely to affect some small holder farms, and access to rivers. It was indicated that people live far from the rivers but travel for fishing and they will be affected if don't have access. Some people have a strong connection with	• The railway track design prioritizes avoidance of physical displacement, community graves, land take and minimizing livelihood disturbances • Asset inventory for potential economic displacement to determine magnitude of the impact on access to livelihoods

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
		loved ones who are buried near them and when they move there is a tendency to take the bodies with them. Local communal authorities can also create barriers because they feel like they own the land	(farmland, fishing grounds) and displacement of houses. This will be undertaken through a detailed RAP and LRP. Further, the track design will include provisions for community safe crossings
	The team asked what suggestion the project management team gives if an agricultural area is affected	A member of the Provincial government responded that: If you pass through a cemetery, the resolution process will be the same, compensation and the exhumation and animation of the bones must be carried out For conflict management, compensation is necessary	• Confirmation of affected assets to be carried out through a detailed asset inventory and a Resettlement Action Plan prepared to determine types and level of compensation required • Design to avoid cultural heritage sites as a priority • The Project Grievance Redress Mechanism will be established and implemented to capture, and timely address all raised community grievances
Provincial Government of Moxico	A member of the Government of Moxico asked what the community close the project refers to	The team responded that these are communities and settlements that are located closer to the railway route and whose farms or livelihoods are potentially to be affected or benefit from the Project directly	• The social AoI to include the communities that have administrative boundaries overlapping with the railway RoW • The ESIA includes a comprehensive characterization of the existing communities including potential impacts identification and management measures
	A member of the Government of Moxico asked how the project's public consultation levels will be carried out	The team responded that the levels of public consultation of the community in the first phase will be carried out at the community level along the entire corridor including Provincial, Municipal and traditional authorities within the Project area	• Project Stakeholder Engagement Plan in place • Key stakeholder concerns and issues shall be integrated in the Project design and decision-making process

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
	A member of the Government of Moxico asked if an initial layout already exists	The team responded that the project does not yet have a defined outline i.e. detailed design of the alignment. However, a basic design exists, and detailed design process is ongoing	• Future engagement activities to include full disclosure of the Project's design upon completion and approval of the detailed design
	A member of the Government of Moxico asked about the functioning of the grievance mechanism	The team informed that the grievance mechanism is a tool that serves to ensure that the concerns and complaints of stakeholders are considered, addressed and responded to in a transparent process at this stage of Social and Environmental Studies. It is essential that it is presented as a way of increasing the confidence/trust of people living in the communities in relation to the purpose of the project in its construction phase. It was highlighted that it is a requirement of the financing entity that a grievance mechanism is always incorporated in terms of the IFC Performance Standards	• Project Stakeholder Engagement Plan in place that includes the Grievance Mechanism is included in the ESIA • The Grievance Mechanism is to be shared with stakeholders
	The team asked what expectations there are from the government regarding the Project	The Provincial government responded that there are several expectations, including an increase/improved: movement of between people and goods Commercial exchange/trade Circulation of money Development of partnerships lives of communities	• ESIA includes enhancement measures for the anticipated positive impacts of the Project during operation phase
Saurimo Municipal Administration	A member of the Municipal Administration asked what the phases of the project will be	The team responded that the project comprises the initial presentation phase to Provincial Governments and Municipal Administrations and will be followed by all local communities along proposed railway line	• Project Stakeholder Engagement Plan in place

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
	A member of the Municipal Administration asked what the community engagement plan will be	The team responded that contacts and studies will be made with the communities, to present the project and collect information about the construction of the railway line	• Project Stakeholder Engagement Plan in place
	A member of the Municipal Administration asked what the project's execution period will be	The team responded that the Project definite execution plan is currently developed, and it will be communicated later to all key stakeholders	• Future stakeholder engagements to disclose Project's approved timeframe
Moxico Municipal Administration	The team asked what the expectations are do they have with the implementation of the Project	The member of Administration responded that with the implementation of the Project it is expected that there will be development in the region, and the guarantee of employability	• ESIA includes enhancement measures for the anticipated positive impacts of the Project during operation phase
	The team asked what the challenges are faced with the Benguela railway	The Administration responded that the challenges faced are: floods at stations low frequency of trains in the region people sleeping in the open areas to catch the train	• Potential negative impacts related to drainage and community safety included in the ESIA • Luena railway design will take into considerations lessons learned from currently operating Benguela line • Detailed hydrological assessments will be undertaken as part of design process to inform flood controls
	A member of the Administration asked where the railway will start in Luena	The team responded that there is still no definite route i.e. detailed design, but care is taken that the project does not affect physical structures	• Future engagement activities to include full disclosure of the Project's design especially during development of RA
	A member of the Administration asked what the issue will be like for communities that live far from train stations	Indicative stations have been identified; however specific locations will be confirmed during detailed design	• SEP in place to inform future engagement and feedback mechanism with the communities

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
			• Design to make efforts in locating stations in optimal locations
Camanongue Municipal Administration	A member of the Administration asked how the issue of landslides and ravines will be addressed with	The team responded that there will be a topographic study to consider this situation	• Potential negative impact of landslides and erosion near ravines included in the ESIA
	A member of the Administration asked what the implementation date of the project is	The team responded that there is still no implementation date for the project	• Future engagement activities to include full disclosure of the Project's schedule
	The team member asked how the Administration thinks the community will benefit from implementing the project	The Administration responded that with the implementation of the project there will be greater mobility of people and goods, increasing the level of employability and development of the municipality	• Anticipated positive impacts of the Project during operation phase included in the ESIA
	A member of the Administration asked what we are thinking about in terms of stations, since the communities are about 7-10 km apart	The team responded that the specific/exact locations for stations have not yet been defined, the technical team is carrying out the detailed design	• Future engagement activities to include full disclosure of the Project's design
	A member of the Administration asked how we will resolve crossing of ravines	The team responded that there will be a specific study to address all crossings over the ravines	• Future engagement activities to include full disclosure of the Project's design
	A member of the Administration asked what day the project start will	The team responded that there is no start date yet	• Future engagement activities to include full disclosure of the Project's schedule
	A member of the Administration asked what the projects has	ESIA in the process to address Project's environmental and social issues	• The ESMP to include applicable mitigation measures to avoid and reduce biodiversity impacts

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
	outlined for environmental conservation		
	A member of the Administration asked what the main point is for presenting the project in the municipality	The team responded that we are in the ESIA phase, and it is governed by Decree 117/20 of April 22nd and as a requirement of international financial entities	• ESIA Report complies with Angolan legislative requirements and international standards
	A member of the Administration asked within the field team, will local people be included in case of local language	The team responded that we have two local people on the field team to help with the local language	• Stakeholder engagement team comprises members who are fluent in local communities' language apart from Portuguese
	A member of the Administration asked how you are careful if the line passes through a neighbourhood	The team responded that in principle, the railway line will not pass through any neighbourhood or houses.	• The existing railway track design avoids physical displacement and minimizes economic displacement to the extent feasible • Confirmation of affected assets to be carried out through a detailed asset inventory in RAP survey
	The team member asked they could provide data on the demographics of the municipality	The Administration responded yes, that in principle we work with data from the 2014 census	• Socio-economic chapter of the ESIA to use the 2014 census as a basis
	The team member asked what the municipality's main challenges are	The Administration responded that: the reconstruction of social infrastructures reliable electricity supply challenges in accessing potable water supply the land is arable and there are many rivers.	• Water and power supply considered in the social baseline and project detailed design process including camps and stations considerations
	The team member asked how the Administration thinks the municipality will benefit from the railway	The Administration responded that there will be improved social and economic mobility, the level of local employment will increase.	• Anticipated positive impacts of the project during construction and operation phases are included in the ESIA Report

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
Dala Municipal Administration	A member of the Administration asked when the project will begin	The team responded that there is still no date for the start of the project, as it is in the initial phase conducting studies.	• Future engagement activities to include full disclosure of the Project's schedule
	A member of the Administration asked what the roles of each company involved were	The team responded that the company responsible for construction is, CONSÓRCIO OECI, S.A – SUCURSAL EM ANGOLA E BENTO PEDROSO CONSTRUÇÕES S.A. Pantheroil and RSK are responsible for studying the environmental and social impact	• Details of the Project team and key parties involved are included in the ESIA Report
	The member of Administration asked how many jobs the project will provide	The team responded that it is not possible to present exact number of people to be employed at this stage. Project design and planning process who will be employed when implementing the project	• Employment priority to local communities along the railway corridor included in the ESIA Report • Future engagements to include employment opportunities, recruitment process and how local communities can benefit
	The member of Administration asked who will compensate if there is damage, the construction company, or the owner of the work	The team responded that the design strives to avoid and minimize resettlement related impacts. The Project detailed design is in process	• The existing railway track design avoids physical displacement and minimizes economic displacement to the extent feasible • Confirmation of affected assets to be carried out through a detailed asset inventory in RAP survey • RAP specific engagements and community sensitizations to be undertaken
	The member of Administration asked what the deadline is for completing the construction of the project	The team responded that there is no time forecast, as the project has not yet started construction	• Future engagement activities to include full disclosure of the Project's schedule

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
	The member of Administration asked what the adopted compensation policy is	The team responded that the management team will adopt the best policy and guidelines for both parties	• The existing railway track design avoids physical displacement and minimizes economic displacement to the extent feasible • Confirmation of affected assets to be carried out through a detailed asset inventory in RAP survey • RAP specific engagements and community sensitizations to be undertaken
	The member of Administration asked if there will be a station in João Kwana Mucua	Indicative locations for stations exist in the basic design but specific locations will be confirmed as the detailed design progresses	• Future engagement activities to include full disclosure of the Project's design
	The member of Administration asked what the contingency measure is to protect fauna and flora	The team responded that Biodiversity assessments are ongoing to capture and address biological environment issues	• ESIA included dry and wet season biodiversity characterization of the Project corridor including Critical Habitats Assessment, impacts identification and development of management measures captured in the ESMP
	The member of Administration asked what the projects employability number was i.e. how many people will be employed by the Project	As above response	• As above response
	The member of Administration asked what route the train will take	The team responded that overall, the railway line will start in Luena branching off existing Benguela line, towards the Camanongue, Dala up to Saurimo. The detailed design in is ongoing to demarcate definite route	• Future engagement activities to include full disclosure of the Project's design and specific areas traversed by the proposed railway line • Project description in the ESIA provides for generic communities, settlements and towns along the Project route

Stakeholder	Question/comments raised	Response	ESIA Consideration & Integration in the Project
	The member of Administration asked if there will be a team to carry out exhumation	The team responded that the design strives to avoid and minimize physical resettlement related impacts. The Project detailed design is in process	• The existing railway track design avoids physical displacement and minimizes economic displacement to the extent feasible • Identified graves and cultural heritage sites included in the ESIA. The railway track design prioritizes avoidance of community graves and other cultural heritage sites identified • Confirmation of affected assets to be carried out through a detailed asset inventory in RAP survey • RAP specific engagements and community sensitizations to be undertaken
	The member of Administration asked if there will be local labor	The team responded that the project envisages working with local people from within the Project area	• Employment priority to local communities along the railway corridor included in the ESIA Report • Future engagements to include employment opportunities, recruitment process and how local communities can benefit
	The member of Administration asked if there will be a standard pay	The team responded that remuneration of people employed in the Project will be set considering the context, laws and local situation	• The ESMP includes labour welfare issues management measures

In summary, the key concerns raised by government authorities along the Project corridor includes:

- involuntary physical and economic displacement and related compensation issues as a result of Project
- graves impacts and associated relocation
- expectations for employment opportunities
- biodiversity impacts (flora and fauna)
- details on project design especially project schedule, timing, exact alignment of the railway track and station's locations
- community health and safety issues including crossings
- further engagements and feedback mechanism with the stakeholders.

5.6.2 Summary of community feedback for consideration in the ESIA (Scoping Phase)

Detailed records of the meeting minutes, attendance sheets and photos from community engagement are presented in Appendices 07, 09 and 10. However, the key concerns raised by community members for ESIA consideration includes:

- community is ready and willingly accepts development of the railway because of anticipated positive socio-economic impacts
- the community members anticipate that the railway will help reduce the cost of transport through improved mobility of people and goods, hence also reducing the cost of goods
- the community are open to be receiving regular updates and information about the Project (majority directly from the Project team). This demonstrates the importance of continuous stakeholder engagement throughout the ESIA and construction. The deployment of a Community Liaison Officer for the Project will be beneficial to continue to build relations with the community and channel information from the Project team to the Sobas (see further details in Table 5-12)
- there are occupational health and safety precautions in Sambuamba River that is reported to have whirlpools
- there is a medicinal tree (*Muxihi* in local vernacular or *Mussivi* in Portuguese) protected by the community that will need to be inventoried during pre-construction establishment of the RoW and access road. This will assist to ensure that any vegetation clearance that may include this tree is replanted in locations agreed with the community
- food security issues
- expectation of livelihood improvement
- community accessibility and mobility during construction
- expectations for local employment opportunities amongst youths
- compensation for the affected crops along the railway route
- stations to be located closers to the communities
- further community support during construction through Corporate Social Responsibility.

Table 5-12 below presents a summary of community expectations from the Project and indicates the preferred modes of communication.

Table 5-12: Community expectations and preferred method of receiving project information

Sn	Stakeholder	What are the community's expectations with the construction of the Luena-Saurimo railway line?	How would you like to receive information about the project (from project team, or Administration)?
1	Muamuyeye community	The community hopes that the construction of the Luena – Saurimo Project will bring benefits, such as growth to the community and that during the construction phase, it includes residents in employment and that it is not just another promise that is not fulfilled, like other projects	The community would like to receive this information from the Project team
2	Luari community	The community was happy that the team went through the community to inform them about the project, something that has not happened before with other projects and added that there are whirlpools in the Sambuamba River	The community would like to receive this information from the Soba and Project team
3	Nanguanza community	The community hopes that with the construction of the Luena Saurimo railway will bring improvements and minimize transport costs and prices of goods and other services, community development and youth employment	The community prefers to receive information from the project team and from Soba
4	Muamucalanganza community	Guaranteeing employment for community residents, community development through improved mobility of people and goods	The community would like to receive information from the Project team
5	Muanguiji community	The community hopes that with the construction of the Luena-Saurimo railway line the neighbourhood will develop and bring down the prices of rural products and reduce the price of transport If crops are affected, what will be the community's position? If the railway line passes through someone's crops, the population suggests that the affected people be compensated with money	The community prefers to receive information from the Project team
6	Saquembue community	Employment for community residents Community development Improved mobility of people and goods	The community would like to receive information from the Project team

Sn	Stakeholder	What are the community's expectations with the construction of the Luena-Saurimo railway line?	How would you like to receive information about the project (from project team, or Administration)?
7	Mombo community/ In front of the school nº9	The community hopes that the Luena-Saurimo railway line construction Project will bring development and employment to local residents Compensation for the affected crops if it happens	As for information regarding the Project, the community would like to receive this information from the Soba
8	Mukuanguaji community	Employment opportunities for community residents Community development Greater mobility of people and goods	The community would like to receive information from the Project team
9	Caiaza community	The community hopes that this Project will bring more development and facilitate employment	They prefer to receive Project information from the Project team
10	Cassamba I community	With the construction of the Luena Saurimo railway, people expect development for the community and employment for youths	Information about the project would like to receive it from the Project team
11	Satxitende community "Dala Velho"	Employment for community residents, in this case young people Community development Improved mobility of people and goods Reduced prices for goods due to reliable transport Participants defended the experience of a stop because it is the centre of several surrounding locations, and because it is an area that produces various cultures on a large scale Large quantities of *Muxihi*, locally protected tree in the surrounding area	The community would like to receive information from the Project team
12	Sayassua and Nacatoco communities (Regedoria of Sayassua)	Expectations on community socio-economic development	The community prefers to receive information from the Project team

Sn	Stakeholder	What are the community's expectations with the construction of the Luena-Saurimo railway line?	How would you like to receive information about the project (from project team, or Administration)?
13	Luele community	Employment for community residents. Socio-economic development of the community Reduced prices of various goods Stations to be located closer to communities	The community would like to receive information from the Project team
14	Biula community (More two unified communities: Sacacuca and Sassuco)	The community hopes that with the construction of the Luena-Saurimo railway line, the neighbourhood will develop in the same way as other towns where trains pass Improved local mobility and transportation of goods Reduced prices of various goods	The community prefers to receive information from the local Soba
15	Sangoma community	The community hopes that with the construction of the Luena-Saurimo railway line, the neighbourhood will develop in the same way as other towns where trains pass Improved local mobility and transportation of goods Reduced prices of various goods	The community prefers to receive information from the local Soba
16	Musseringinge community (the meeting place was at Jango Comunitário da Regedoria)	Employment for community residents. Socio-economic development of the community Improved mobility of goods and services	The community would like to receive information from the Project team
17	Sakambundji and Samucanda communities	Employment for community residents. Socio-economic development of the community Improved mobility of goods and services	The community would like to receive information from the Project team
18	Muapezo community	The community hopes that with the construction of the Luena-Saurimo railway line will bring development and employment to local youths	The community prefers to receive Project team

Sn	Stakeholder	What are the community's expectations with the construction of the Luena-Saurimo railway line?	How would you like to receive information about the project (from project team, or Administration)?
19	Mumanga, Saissazo and Caiaza communities	Employment for community residents Socio-economic development of the community Greater mobility of people and goods	The community would like to receive information from the Project team
20	Camanongue Sede Community	Employment for community residents Socio-economic development of the community Greater mobility of people and goods	The community would like to receive information from the Project team
21	Kamaleke community	The community hopes that with the construction of the Luena-Saurimo railway line and neighbourhood it will bring development to the community; low costs of transport prices and employment opportunities	The community prefers to receive information from the Project team
22	Canda I, Canda II and community Samauzo (Canda III) communities	The community hopes that this Project will bring development, through the generation of employment for young people; reduced transport taxes, as well as products prices. They also hope that there will be social responsibility support for the construction of infrastructure in the community	They prefer to receive information about the project from the Project team
23	Sacapiasso and Migotchi communities	With the implementation of the project there will be greater mobility of people and goods	The community would like to receive information from the Sobas

5.6.3 Summary of community feedback during ESIA Phase engagements

Feedback and concerns raised by communities is presented in Table 5-13 to Table 5-18 overleaf.

Table 5-13: Nanguanza community engagement – ESIA Phase

Stakeholder	Question/comments raised	Response	ESIA Consideration
Nanguanza (Municipality of Saurimo)	The community member questioned whether their fields will be affected, or if they would be impacts on any ecosystem services (river, firewood collection, collection of food/medicinal plants). How will the project influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them? The community member demonstrated concerns regarding the area where the animals graze, ploughs and medicinal trees are located expressing that they should not be affected	The team responded presenting a map and the area designated to project implementation. The team reinforced that the construction will not affect the rivers that cross the community	Current design avoids physical displacement and minimizes economic displacement. Confirmation of affected assets to be carried out through a detailed asset inventory and a Resettlement Action Plan to be prepared Measures to facilitate continued access to ecosystem services are included in the ESMP
	The team member asked what benefits and opportunities project team foresee the railway line will bring to their community	The community member responded that with the implementation of the Project is expected to foster development in the region, and generation of employment opportunities	ESIA and ESMP includes provisions for local content optimization including priority to local communities in employment opportunities and gender considerations
	The team questioned what negative impacts the railway line will have on the community	The women of the community responded that one element that can be considered as negative will be the non-placement of signage at construction sites, as well as the destruction of the fields due to deforestation activity. And that if the destruction of crops is inevitable, then the company must pay for the damages. The men of the community responded that the	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority

Stakeholder	Question/comments raised	Response	ESIA Consideration
		construction of the railway can affect the access path to other neighbourhoods as well as to go to the crop's areas	
	The project team asked the communities, their perceptions about the impact of noise, construction activities, construction teams, safety and air pollution in the area	The community responded that the machines should be far away from the residences at up to 1 km to avoid excessive noise. In the case of dust, the community states that the increase of dust in the construction phase must be managed. As for safety, the community says that there should be a security guard assigned to the project to indicate the crossing areas for children and the elderly, also signs prohibiting access to the construction site	ESIA and ESMP includes noise and dust mitigations measures
	The project team asked the communities their perspective on the current accessibility of transport. How do they currently move around? Are there any costs associated with their current transport? Would they be willing/able to pay for rail transport? How important is accessing areas outside of the village currently	The community responded that the movement of people is done with the use of motorcycle taxis, with an estimated cost of 300Kz in the trips between Nanguanza and Saurimo. The motive that leads to the dislocations are the search for educational institutions as well as healthcare facilities. Another great reason that leads them to travel is the commercial exchanges carried out in the municipal headquarters (Saurimo) The women and men of the community are willing to pay for the costs associated with using the train	Enhancement measures for anticipated positive impacts of the project during operation phase are include in the ESIA
	The project team asked the communities if they have any specific concerns about the project during construction and during operation	The team responded that the project envisages working with local people, as long as they fill the available vacancy	ESIA and ESMP includes provisions for local content optimization including priority to local communities in employment opportunities and gender considerations

Table 5-14: Saquembue community engagement – ESIA Phase

Stakeholder	Question/comments raised	Response	ESIA Consideration
Saquembue (Municipality of Saurimo)	The project team asked to the local communities how they think the project will influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them	The community members responded that there are farms that will be affected and some houses that will be very close to the line. This allocation must be remedied by means of compensation in cash. The women of the community expressed that access path to the ploughs will be affected	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority Confirmation of affected assets to be carried out through a detailed asset inventory and a Resettlement Action Plan will be prepared to determine types and level of compensation required Maintained community access and safe crossings at designated locations along the railway track included in the ESIA & ESMP
	The community welcome the project and express that with the arrival of this project in the community the community is looking forward to the employment to be generated	Employment opportunities for community members from the project area will be prioritized	Employment opportunities for community members from the project area will be prioritized
	The project team asked the communities what negative impacts the railway line will have on their community	The men of the community responded that one of the negative impacts is related to the blocking of access roads at the time of construction. Additionally, they reinforce that the failure to create working conditions for the employees linked to the project can lead to theft of cattle or other elements in the community and consider it a negative point	Project community health and safety management plan and labor and human rights management plan to include measures to avoid social conflict resulting of the interaction of workers with local communities
	The project team asked the communities their perceptions about the impact of noise, construction activities,	The women of the community expressed that noise is not a problem for the community, however, if they have health problems caused by the project, the project team should set up health centres in the neighbourhood	Future engagement activities to include full awareness of project risks and hazards and the ESMP to include measures to reduce/prevent dust

Stakeholder	Question/comments raised	Response	ESIA Consideration
	construction teams, safety and air pollution	As for dust, the company must irrigate the deforested area to prevent the increase of dust As for safety, the women of the community responded they will provide guidance to the children to not access the construction area and appealed that this task should also be the responsibility of the project's site safety	emissions and traffic accidents reduction
	The project team asked the communities their perspective on the current accessibility of transport. How do they currently move around? Are there any costs associated with their current transport? Would they be willing/able to pay for rail transport? How important is accessing areas outside of the village currently	The community responded that the transport of people is done using moto-taxis, which have a cost that varies 500Kz per person in the trips made to the Municipality of Saurimo. People go out largely to do business. The community affirm the train will reduce transportation costs	Anticipated positive impacts of the project during operation phase
	The project team asked the communities if they have any specific concerns about the project during construction and during operation	The community recommended the construction of a local market to absorb the agricultural products, considering the possibility of having a railway station	Anticipated indirect/associated positive impacts of the project during operation phase

Table 5-15: Satxitende community engagement – ESIA Phase

Stakeholder	Question/comments raised	Response	ESIA Consideration
Satxitende (Municipality of Dala)	The project team asked to the local communities how they think the project will influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them	The community unanimously express that, if there are crops, to be affected, the project must compensate for the damages	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority Confirmation of affected assets to be carried out through a detailed asset inventory and a Resettlement Action Plan prepared to determine types and level of compensation required
	The team member asked what benefits and opportunities project team foresee the railway line will bring to their community	The women of the community responded that with the arrival of the train their lives will improve, because they will be able to pay less for travel to Luena and Saurimo. The men of the community responded that the benefit will be felt in the best way if a railway station is placed in Satxitende since Satxitende is the centre of Dala	Anticipated positive impacts of the project during operation phase
	The project team asked the communities what negative impacts the railway line will have on their community	According to the men of the community, the negative impacts of the project may be the effect of the access roads used to go to the crops and to other neighbourhoods in some cases by motorbikes and car	Maintained community access and safe crossings at designated locations along the railway track included in the ESIA & ESMP
	The project team asked the communities their perceptions about the impact of noise, construction activities, construction teams, safety and air pollution	The men of the community responded that one of the ways to reduce noise is to always place the machines in the construction site area and not to constantly circulate in the neighbourhood. As for the dust, its management must include dust suppression measures such as sprinkling	Dust control and management measures included in the ESIA & ESMP Future engagement activities to include full awareness of project risks and hazards and the ESMP to include measures to delimitated construction perimeter

Stakeholder	Question/comments raised	Response	ESIA Consideration
		The women of the community responded that the issue of safety will be managed by each parent, through sensitization of their child about the risks associated with the construction activity. However, they also suggest the use of protective barriers	Community health and safety measures including safe crossings, traffic accidents avoidance and special provisions for construction activities nearby schools are included in the ESIA & ESMP
	The project team asked the communities their perspective on the current accessibility of transport. How do they currently move around? Are there any costs associated with their current transport? Would they be willing/able to pay for rail transport? How important is accessing areas outside of the village currently	The community responded that the costs associated with interprovincial travel are quite high, reaching 2500Kz added to the cost of the transported products reaches 4000Kz. The reason for peoples from the community is usually associated with education and health care.	Anticipated positive impacts of the project during operation phase
	The project team asked the communities if they have any specific concerns about the project during construction and during operation	As for the main aspects raised by the community, respect for the local culture stands out. The community requests that the project team respect the habits and customs of the local communities during the construction period Another concern raised is related to local hiring. The team requests that local young people be hired to join the work team	Labour management to include prioritization of local content and Future engagement activities to include local customs for construction workers Influx management measures included in the ESIA & ESMP

Table 5-16: São João Baptista community – ESIA Phase

Stakeholder	Question/comments raised	Response	ESIA Consideration
São João Baptista (Municipality of Kamanongue)	The project team asked to the local communities how they think the project will influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them	The regent De Camanongue responded that after seeing the map printed by the team is possible to acknowledge that within the project area of influence there are crops and medicinal plants	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority Confirmation of affected assets to be carried out through a detailed asset inventory and a Resettlement Action Plan prepared to determine types and level of compensation required Ecosystem services and vegetation clearance shall avoid medicinal plants used by community
	The team member asked what benefits and opportunities project team foresee the railway line will bring to their community	The men of the communities responded that the railway would improve mobility. Women, on the other hand, responded that it will make it easier to find business in other locations and people will reduce expenses with transporting goods	Anticipated positive impacts of the project during operation phase
	The project team asked the communities what negative impacts the railway line will have on their community	The community unanimously responded that the arrival of the railway will bring only benefits, including the possibility of local youth having job opportunities	Anticipated positive impacts of the project during construction and operation phases Employment opportunities for community members from the project area will be prioritized
	The project team asked the communities their perceptions about the impact of noise, construction activities, construction teams, safety and air pollution	As for the noise, the community responded that is important that the project team can find a way to reduce its generation. Regarding air pollution, the men of the community express that from the experience they had with the construction of the EN-180 road, it is common	Dust and noise control measures are included in the ESIA and ESMP

Stakeholder	Question/comments raised	Response	ESIA Consideration
		for this type of activity to use water for dust suppression	
	The project team asked the communities their perspective on the current accessibility of transport. How do they currently move around? Are there any costs associated with their current transport? Would they be willing/able to pay for rail transport? How important is accessing areas outside of the village currently	As for accessibility, the men of the community responded that the trips to another municipality are made by private taxis with values ranging from 1000 to 2000Kz. Women in the community express they are willing to pay for the use of the train. Regarding access, the community requests the rehabilitation of the road that connects Camanongue to Lumeje Camenha	Anticipated positive impacts of the project during operation phase
	The project team asked the communities if they have any specific concerns about the project during construction and during operation	The Regedor and Soba of Camanongue expressed satisfaction with the arrival of the project and informed that the project is welcome. However, previously to construction activities, rituals must be conducted. This ritual includes the use of beverages such as wine and local fermentation drink and beer. The community raised concerns related to the hiring of locals and expressed that foreign workers are not authorized to join the project without a confirmation of hiring locals	Labour management to include prioritization of local content and Cultural Heritage management plan to include local customs and approvals required by local traditional authorities

Table 5-17: Muapezo community engagement – ESIA Phase

Stakeholder	Question/comments raised	Response	ESIA Consideration
Muapezo (Municipality of Camanongue)	The project team asked to the local communities how they think the project will influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them	The women of the community stated they have agricultural fields that will be affected and as well the river. The same opinion was shared by the men present at the session They also reinforced that their accesses will be affected by the railway implementation. To overcome this situation, they suggested that the project management team should include in the construction scope crossing points	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority Confirmation of affected assets to be carried out through a detailed asset inventory to determine types and level of compensation required Traffic management plan to include future engagement activities of traffic risks and hazards for communities, and defensive driving for workers Current design includes provision for maintained community accessibility to farms, water sources, neighbouring villages and safe crossings
	The team member asked what benefits and opportunities project team foresee the railway line will bring to their community	The community expressed that the greatest opportunity they will have with the implementation of the railway project is to have a greater possibility of traveling to several provinces. The women responded that the railway would reduce the time needed to visit their relatives in other provinces	Anticipated positive impacts of the project during operation phase
	The project team asked the communities what negative impacts the railway line will have on their community	As for the negative impacts, the women expressed that the lack of information about the train's schedule to prevent local accidents related to children circulating on/near the railway. On the other hand, they also request an audible warning to be emitted for the arrival of the train and a metal protection network to isolate the neighbourhood from the railway	Community health and safety management plan to include measures to prevent local accidents and engagement activities in project risks and hazards awareness

Stakeholder	Question/comments raised	Response	ESIA Consideration
		line. The men expressed concern about the damage to the crops and if that occurs, they indicate the resolution should involve monetary compensation	Confirmation of affected assets to be carried out through a detailed asset inventory Maintained communities' connectivity provisions included in the design.
	The project team asked the communities their perceptions about the impact of noise, construction activities, construction teams, safety and air pollution	The women expressed that the dust could affect the health of the children, so the project team must provide medical assistance and assist in implementation of local health post while the construction is ongoing The men of the community responded that to minimize this impact of dust after deforestation, tankers should be used to sprinkle the perimeter The community reinforces that the integration of foreign (project workers) must be conducted with care to respect the cultural habits of the locality and ensure a harmonious coexistence	Dust management measures to be considered on Pollution management plan Labour management to include prioritization of local content and Cultural Heritage management plan to include future engagement activities of local customs for construction workers
	The project team asked the communities their perspective on the current accessibility of transport. How do they currently move around? Are there any costs associated with their current transport? Would they be willing/able to pay for rail transport? How important is accessing areas outside of the village currently	The community expressed that most of the population is only able to travel to Camanongue. For those who have the possibility, take a private taxi whose cost varies between 1000Kz. In the case of interprovincial travel to visit relatives, the communities use the Benguela railway, whose station is in Luena	Anticipated positive impacts of the project during operation phase
	The project team asked the communities if they have any specific concerns about the project during construction and during operation	The Soba of the community expressed that the community of Muapezo does not have a telephone network signal, which may make it difficult during the period of construction to maintain communications with the project team,	Future engagement activities to include full disclosure of the Project's schedule, design and scope details

Stakeholder	Question/comments raised	Response	ESIA Consideration
		so he requests the placement of a telephone connection as well as the transmission of electricity. Another important recommendation placed by the Soba is related to the implementation of the project because it raises enormous expectations within the communities	Community expectations management to be undertaken as part of continued stakeholder engagement under the SEP provided in the ESIA

Table 5-18: Sacapiasso community engagement – ESIA Phase

Stakeholder	Question/comments raised	Response	ESIA Consideration
Sacapiasso (Municipality of Moxico)	The project team asked to the local communities how they think the project will influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them	The community responded by saying that their farms are about 1km from the community and that if they are affected, they should be compensated in cash	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority Confirmation of affected assets to be carried out through a detailed asset inventory to determine types and level of compensation required
	The team member asked what benefits and opportunities project team foresee the railway line will bring to their community	The men of the communities responded that one of the main benefits of the railway line will be the creation of jobs for young people and the reduction of the cost of travel between Luena and Camanongue with the arrival of the railway line	Anticipated positive impacts of the project during operation phase. Employment opportunities for community members from the project area will be prioritized including gender considerations
	The project team asked the communities what negative impacts the railway line will have on their community	Women responded they cannot see significant impacts for now. The men expressed that the impacts they foresee are related to damage to their fields	Existing alignment design strived to avoid economic and physical displacement impacts as a topmost priority Confirmation of affected assets to be carried out through a detailed asset inventory

Stakeholder	Question/comments raised	Response	ESIA Consideration
	The project team asked the communities their perceptions about the impact of noise, construction activities, construction teams, safety and air pollution	The community responded that the dust would cause them illnesses such as coughing	Dust management measures presented in the ESIA and ESMP
	The project team asked the communities their perspective on the current accessibility of transport. How do they currently move around? Are there any costs associated with their current transport? Would they be willing/able to pay for rail transport? How important is accessing areas outside of the village currently	The community responded that currently the trips are made by motorbike, but if they want to make more distant trips, they use private taxis either to go to Camanongue or to Luena, where the cost will be between 2000 to 1500Kz per trip. The community expresses it would be willing to pay to use the train because it is an investment that the state is making, and it needs a return. The community believes that the creation of new access routes resulting from project activities would be beneficial by reducing travel distances	Anticipated positive impacts of the project during operation phase
	The project team asked the communities if they have any specific concerns about the project during construction and during operation	The first concern is related to the placement of a railway station in the community, the second is related to the construction of a road, school as well a hospital and the last concern presented by the community is related to the availability of employment for local young people	Labour management to include prioritization of local content. Future engagement activities to include full disclosure of the Project's schedule, design and scope details Community expectations management to be undertaken as part of continued stakeholder engagement under the SEP provided in the ESIA

In summary, the key issues raised by communities during ESIA Phase includes:

- employment opportunities expectations
- improved mobility, reduced transport costs and prices for goods and services
- economic displacement and livelihood impact around affected farms
- community health and safety issues
- access roads/tracks to the rivers/water sources and farms
- communities' separation/disconnections by the railway track
- dust and noise pollution.

5.6.4 Municipal Administration authorities feedback for consideration in the human rights and vulnerability

Feedback and concerns raised by municipalities in relation to human rights issues is presented in Table 5-19 overleaf.

Table 5-19: Municipal Administrations feedback on human rights and vulnerability

Stakeholder	Question/Suggestions	Response	ESIA Consideration
Moxico Municipal Administration I and Provincial Office of Social Action, Family and Gender Equality	A Technician from the Municipal Administration suggested that the project hire local labour	The team responded that, as already mentioned, these suggestions will be included in the ESIA so that they can be observed	Employment opportunities for community members from the project area will be prioritized including gender considerations
	The Technician of technical services and infrastructure of the Municipal Administration of Moxico referred to previous projects that did not observe human rights issues and, therefore, requests the project to do the opposite	The team responded that the surveys and meetings we have held with different stakeholders should serve to collect important contributions to consider in the ESIA	Human rights considerations are provided for in the ESIA & ESMP
	An employee from the Provincial Social Action Department recommended the inclusion of albino people in the project	The team responded that, as already mentioned, these suggestions will be included in the ESIA so that they can be observed	ESIA includes characterization and inclusion of the vulnerable groups along the railway corridor
Camanongue Municipal Administration	The Municipal Director of Social Action commented that it is essential that the Project pays attention to the cultural issues of the people	The team responded that the suggestions will be incorporated into the impact study so that the project considers and minimizes negative impacts	Cultural heritage assessment included in the ESIA
	The Municipal Youth representative asked that the Project have local labor recruitment policies that will include the youths in the Municipality	The team responded that, as already mentioned, these suggestions will be included in the ESIA so that they can be observed	Employment opportunities for community members from the project area will be prioritized including gender considerations
	The Director of Social Action asked for the project to have social initiatives for communities, especially for children in very precarious situations	The team responded that, as already mentioned, these suggestions will be included in the ESIA so that they can be observed	Part of the CSR programme

Stakeholder	Question/Suggestions	Response	ESIA Consideration
Saurimo Municipal Administration	A Technician from the Municipal Planning and Statistics Office (GEPE) asked when the works are scheduled to begin and end How many stations are planned to be built along the 260 km section	The team responded that at this stage the environmental impact study is being prepared to liberalize financing and as soon as this phase is completed, work can begin The project team responded that so far, the project envisages the construction of a total of 8 stations	Future engagements under SEP to include approved detailed design disclosure
	The municipality's Head of Youth and Sports reinforced the need for the project to recruit young people locally, as the municipality of Saurimo has a high number of unemployed young people	The team responded that, as already mentioned, these suggestions will be included in the ESIA so that they can be observed	Covered above on employment priorities and gender
Dala Municipal Administration	The Human Resources Director of the Municipal Administration recommended that the Project use old carriages, as they are safer for transporting goods	The team responded that the suggestion will be incorporated into the ESIA to be observed by the construction company and the developer	N/A
	The Municipal Director of Culture asked that the project bring social support initiatives to help the vulnerable	The team responded that, as already mentioned, these suggestions will be included in the ESIA so that they can be observed	Part of the CSR programme

5.6.5 Non- Governmental Organizations feedback for consideration in the human and vulnerability

Feedback and concerns raised by NGOs in relation to human rights issues is presented in Table 5-20 overleaf.

Table 5-20: Non-Governmental Organizations feedback on human rights and vulnerability

Stakeholder	Question/Suggestions	Response	ESIA Consideration
Tala Kulutwe Mwana Pow Moxico Province	The Representative of the Tala Kulutwe organization asked: How interested is the team of consultants from the Luena-Saurimo Railway Construction Project in meeting with NGOs	The team of consultants requested a meeting with the NGOs to comply with the guidelines required by the funder for the preparation of Environmental Impact Studies. Furthermore, it is also essential to know the perspective of organizations whose corporate purpose is to advocate for human rights so that we can incorporate them into the ESIA	Employment opportunities for community members from the project area will be prioritized including gender considerations
Associação Tala Kulutwe Associação Mwana Pwo Associação Kwassa Mbunda, Associação Home of Wisdom Associação Mbakita Associação for the Development of Angolan Civil Society (ADESCA) Mosaiko Angola Council of Christian Churches of Angola (CICA) Community Development Relief Organization (OADEC) Community Development Support and Promotion Canter (CAPDC) Lunda-Sul Province	The representative of the Mwana Pwo Organization suggested that the Project hire locally, with particular emphasis on young people in the Municipality	The team responded that the suggestion will be considered and included in the ESIA as a measure to be implemented	Employment opportunities for community members from the project area will be prioritized including gender considerations
	The representative of CICA suggested that the Project value local labor, specifically women	The team responded that the suggestion will be considered and included in the ESIA as a measure to be implemented	Employment opportunities for community members from the project area will be prioritized including gender considerations
	The representative of the Kwassa Mbunda Association called for the Project to collaborate with communities to avoid violating their rights	The team responded that the suggestion will be taken considered and included in the ESIA as a measure to be implemented	SEP and Grievances Redress Mechanism are provided for in the ESIA

Stakeholder	Question/Suggestions	Response	ESIA Consideration
Mosaiko Angola Luanda Province	The Mosaiko team recommended that we work in partnership with local communities and associations to ensure the Project's successful execution	The team responded that the suggestion will be taken considered and included in the ESIA as a measure to be implemented	SEP provided in the ESIA to guide engagements throughout the Project

5.7 ESIA Report translation and disclosure

In line with the requirements of Equator Principles 4 and IFC PS1, the Project will publicly disclose online the ESIA, the Human Rights Risk Assessment (HRRA) and Climate Change Risk Assessment (CCRA) in full or summary form. In line with PS1, the Project will also disclose the SEP and its Community Grievance Mechanism. After completion of lenders' review process, the full ESIA report will be translated from English to Portuguese first to allow disclosure in both English and Portuguese. The disclosure will be done online in full or summary form of the reports in both languages. The documents will be disclosed by a web portal, or a website Railway Project Luena-Saurimo

Further, in line with IFC PS1, summaries of the ESIA, the SEP and the Community Grievance Mechanism will be distributed in hardcopies (Portuguese language) to all Municipalities crossed by the Project.

In terms of timing, the documents will be disclosed by a web portal, or a website Railway Project Luena-Saurimo in English and Portuguese before the construction site works start.

Further, the publicly disclosed reports will not include any personal information, e.g. if the full ESIA is to be disclosed then Appendices with meeting sign-in sheets will be omitted. Photos and other personal details will either be redacted, removed or blurred.

5.8 Continued stakeholder engagement

The transparent and on-going engagement with interested and affected parties (as outlined in the SEP) shall continue during construction and operation phases of the Project. Engagement with the communities and other interested and affected stakeholders will follow the established mechanisms under Project SEP through OEC's and the operators (or Ministry's) Community Relations Office.

The key to continued engagement (as aligned with IFC requirements) will target:

- ensuring understanding and awareness by facilitating an open, culturally appropriate, and inclusive approach to engagement that provides timely and accurate information in an accessible and transparent way to all stakeholders, regardless of their status
- managing community and stakeholders' expectations and concerns along the railway line by providing a mechanism, which not only provides stakeholders an opportunity to freely provide comment and feedback but also allows the Project to respond to this feedback, thereby addressing concerns
- managing risks through building sustainable relationships. Stakeholder risks are widely recognised to be one of the key challenges facing large-scale development Projects like Luena-Saurimo railway
- creating value where engagement allows for partnerships to be developed for the mutual benefit of the Project and the stakeholders.

Further, additional consultations at each project affected community will be conducted during development of the Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) before commencement of construction works. The planned resettlement

related engagements will be used to verify further cultural heritage resources and any other IPs within project AoI.

Further, The continued engagement will be undertaken by OEC during detailed design stage to inform and sensitize various stakeholders including communities on construction plans, pertinent feedback on key issues like type and locations for crossings, proposed stations etc.

5.9 Grievances redress mechanism

The Grievance Redress Mechanism (GRM) is crucial for ensuring that any issues relating to adverse impacts are reported, mitigated, and monitored. It allows stakeholders to externalize their concerns about the way the Project is being implemented and its impact on their lives. The proposed GRM procedure is detailed in the SEP (see Section 4 of the SEP in Appendix 06) whereby OEC will assume direct responsibility for the management of any grievances during construction phase.

The procedure is in accordance with international good practices and entails:

- publicising grievance procedures
- receiving and recording the grievances (acknowledge receipt and keeping track of grievances)
- reviewing and investigating the grievances
- developing resolution options and preparing responses
- monitoring, reporting, and evaluating.

6 SOCIO-ECONOMIC BASELINE

6.1 Overall approach

A participatory approach was considered the best way to approach social survey in the Angolan context. The findings presented in this report are based on primary and secondary (desk) research. A mixed methods (qualitative and quantitative) approach was followed during social surveys and analyses whereby the Consultant conducted extensive desk surveys, two rounds of field visit/ground-truthing along the proposed railway corridor and series of engagements at various levels within the Project AoI.

A literature search and review were undertaken to obtain secondary data for the baseline description of the socio-economic environment. The information in this report was acquired via statistical data obtained from Angola's National Statistics Office (Instituto Nacional de Estatistica), SIA literature (see footnotes), previous SIA studies conducted in the area, the ESIA's public consultation process, information provided by the affected municipalities, and information from reputable sources on the World Wide Web.

The following information sources were used:

- secondary data from available sources in the public domain (desk research)
- secondary data received from the Angola Black Panther Group (ABP)
- primary data from a social survey conducted by ABP
- information obtained through the stakeholder engagement process
- Municipal profiles received from the municipalities through the stakeholder engagement process
- interviews with key stakeholders
- professional judgement based on experience gained with similar projects.

Consultations took place with the Provincial Administrations of the Moxico and Lunda Sul Provinces, as well as with the Municipalities of Moxico, Camanongue, Dala, and Saurimo. All the communities traversed by the railway route were consulted to gather baseline information during the Scoping and ESIA phases.

The theoretical model used for this social impact assessment was developed by Slootweg, Vanclay and Van Schooten and presented in the International Handbook of Social Impact Assessment[7]. This model identifies pathways by which social impacts may result from proposed projects.

In addition, important ethical considerations that were observed during fieldwork and reporting included informed consent, confidentiality, anonymity, and discontinuance. This is in line with international research practice such as the World Association for Market, Social and Opinion Researchers (ESOMAR) and Southern African Marketing Research Association (SAMRA) codes of conduct.

The Equator Principle[8], International Finance Corporation Performance Standards on Environmental and Social Sustainability[9] and World Bank Environmental, Health and

[7] Vanclay, F. 2003. Conceptual and methodological advances in Social Impact Assessment. In Vanclay, F. & Becker, H.A. 2003. The International Handbook for Social Impact Assessment. Cheltenham: Edward Elgar Publishing Limited.

[8] Equator Principles. July 2020. EP4: https://equator-principles.com/app/uploads/The-Equator-Principles_EP4_July2020.pdf

[9] https://www.ifc.org/content/dam/ifc/doc/2010/2012-ifc-performance-standards-en.pdf

Safety General[10] and Railway[11] Guidelines were consulted in the development of social baseline and subsequent impacts assessment. Additional guidelines incorporated included International Principles for Social Impact Assessment[12], and the Guidance Document for Assessing and Managing the Social Impacts of Projects of IAIA[13].

Assumptions and limitations

The following assumptions and limitations applied during the preparation of this ESIA report:

- not every individual in the community could be interviewed therefore only key people in the community were approached for discussion. Additional information was obtained using existing data
- the social environment constantly changes and adapts to change, and external factors outside the scope of the Project can offset social changes, for example changes in local political leadership, droughts, or economic conditions. It is therefore difficult to predict all impacts to a high level of accuracy, although care has been taken to identify and address the most likely impacts in the most appropriate way for the current local context within the limitations. In addition, it is also important to manage social impacts for the life of the project, especially in the light of the changing social environment
- social impacts can be felt on an actual or perceptual level, and therefore it is not always straightforward to measure the impacts in a quantitative manner
- there are different groups with different interests in the community, and what one group may experience as a positive social impact, another group may experience as a negative impact. This duality will be pointed out in the impact assessment section of the report
- language was one of the biggest constraints. Discussions and surveys were conducted in Portuguese by the Angolan social researchers and was then translated into English. It is therefore possible that some of the finer nuances may get lost in translation.

6.2 Receiving social environment

When viewing the environment from a socio-economic perspective the question can be asked what exactly the social environment is. Different definitions for social environment exist, but a clear and comprehensive definition that is widely accepted remains elusive. Barnett & Casper (2001)[14] offers the following definition of human social environment:

“Human social environments encompass the immediate physical surroundings, social relationships, and cultural milieus within which defined groups of people function and interact.

[10] https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf

[11] https://www.ifc.org/content/dam/ifc/doc/2000/2007-railways-ehs-guidelines-en.pdf

[12] International Association for Impact Assessment. 2003. Social Impact Assessment: International Principles. Special Publication Series no.2. IAIA; Fargo.

[13] Vanclay, F., Esteves, A.M., Aucamp, I. & Franks, D. 2015. Social Impact Assessment: Guidance for assessing and managing the social impacts of projects. Fargo ND: International Association for Impact Assessment.

[14] Barnett, E. & Casper, M. 2001. Research: A definition of “social environment”. American Journal of Public Health. 91(3): 465

Components of the social environment include built infrastructure; industrial and occupational structure; labour markets; social and economic processes; wealth; social, human, and health services; power relations; government; race relations; social inequality; cultural practices; the arts; religious institutions and practices; and beliefs about place and community.

The social environment subsumes many aspects of the physical environment, given that contemporary landscapes, water resources, and other natural resources have been at least partially configured by human social processes. Embedded within contemporary social environments are historical social and power relations that have become institutionalized over time.

Social environments can be experienced at multiple scales, often simultaneously, including households, kin networks, neighbourhoods, towns and cities, and regions. Social environments are dynamic and change over time as the result of both internal and external forces. There are relationships of dependency among the social environments of different local areas, because these areas are connected through larger regional, national, and international social and economic processes and power relations."

Environment-behaviour relationships are interrelationships[15]. The environment influences and constrains the behaviour of people, but behaviour also leads to changes in the environment. The impacts of a project on people can only be truly understood if their environmental context is understood. The baseline description of the social environment will include a description of the area within a provincial, district and local context that will focus on the identity and history of the area as well as a description of the population of the area based on a number of demographic, social and economic variables.

Area of Influence

Considering the above, the area of influence that was applied during the preparation of the description of the existing socio-economic context (for Social, Labour, Health, Safety and Security, Human Rights) is as follows:

- primary level – Project Affected Communities (PACs) direct project footprint (described above) and area within a 5 km zone around the direct footprint. It Includes settlements, communities' villages and centres/towns within a geographical boundary defined by project land take requirements, construction, and operation activities. These communities will be directly (e.g., through economic displacement and loss of livelihoods, community health and safety, noise, and other related impacts) and indirectly (e.g., through in-migration or indirect economic impacts) impacted
- secondary level (indirect) – municipalities (Luena, Camanongue, Dala and Saurimo) through which the railway passes, in which project facilities are located or which could be associated with other project activities such as transportation
- tertiary level – Provinces traversed by the railway line (Moxico and Lunda Sul) and the nation, which stands to benefit from the improvement in rail infrastructure and revenue generation and which provide a general context for the Project
- the extent of the AoI for potential impacts on the livelihoods, health, safety, and security of project-affected communities is subject to review pending the completion of detailed design for the Project

[15] Bell, P.A., Fisher, J.D., Baum, A. & Greene, T.C. 1996. Environmental Psychology – Fourth Edition. Florida: Harcourt Brace College Publishers.

6.3 Geographical and administrative context

The Republic of Angola is the seventh largest country[16] in Africa, covering an area of 1,246,700 km^2. The country is located in Southern Africa and borders the Atlantic Coast with a 1,650 km long coastline. It borders the Republic of Congo, the Democratic Republic of Congo, the Republic of Zambia, and the Republic of Namibia.

The country is divided into 18 Provinces and the northernmost province, Cabinda, constitutes an enclave separate from the rest of the country by the Democratic Republic of Congo. Provinces are further subdivided into municipal councils, communes, neighbourhoods, and villages. The main urban centres beside the country's capital, Luanda, are the cities of Lubango, Benguela, Huambo, Cabinda, Lobito, Namibe, Malanje and Soyo. The three main ports are at Luanda, Lobito and Namibe.

The Government of Angola is composed of three branches of government: executive, legislative, and judicial. The President of the Republic is also the head of state and government and is advised by a Council of Ministers. The President and Council of Ministers form the national executive power. The legislative power rests with the members of parliament that are elected to the National Assembly. The National Assembly consists of 223 members - 130 members elected by proportional representation, 90 members in provincial districts, and 3 members elected to represent Angolans abroad.

On a village level the Soba holds the highest authority and there are two types of Sobas – the Soba Grande (Regedor) and the Soba[17]. The Soba Grande assumes leadership over other Sobas in the community, reflecting a deeply traditional hierarchy. In certain regions, a council of Sobas plays a role in selecting the Soba, while in others, succession follows a lineage-based approach. The primary task of the Soba Grande is to address local social and traditional issues. The Soba acts as a representative of the people when engaging with the Municipal Administration when there is local discontent to articulate concerns and seek solutions. They are furthermore responsible for ensuring the safety of the community.

The economic potential of Angola is high, diversified, and has been receiving a lot of attention from the national and foreign business community. The main exports of the country are oil, diamonds, wood, fish, coffee, and sisal among others, while the imports include food, medicine, vehicles, machines, electrical equipment, and textiles, amongst others.

The official language of Angola is Portuguese, and the national languages are Umbundu, Kimbundu, Kikongu, Chokwe, Fiote, Kwanyama and Nhaneca. Christianity is the country's main religion, with most Angolans practicing Catholicism, followed by Protestant denominations. Adherents to African traditional religions and Islam constitute small minority.

Angola has two seasons, namely the rainy hot season from October to April, and the dry season known as *Cacimbo* from May to September. Angola is divided into two climatic regions, the Coastal Region, and the Interior Region, which is further subdivided into the

[16] https://www.angola.or.jp/angola-en/

[17] https://angola.org/grupos-etnicos/

North Zone, the Altitude Zone, and the Southwest Zone. The country has five types of natural regions, namely humid and dense forests, savannahs, dry savannahs, steppe zones and the desert. A diverse wildlife exists in the various regions of Angola.

The country has a rich cultural history, and the territory of present-day Angola has been inhabited since prehistoric times. The Portuguese arrived in 1482 and initially were friendly until the slave trade started taking place. The slave trade only ended in the late 18th century at the time of the Berlin Conference. The division of Africa, as agreed by European powers at the Berlin Conference, forced Portugal to start a prolonged fight for occupation and administration of the entire Angolan territory. Angola became a Portuguese overseas Province in 1910.

Figure 6-1

Figure 6-1: Remains of the civil war observed during socio-economic fieldwork

Moxico Province

The planned railway line between Luena and Saurimo spans across the Moxico and Lunda Sul Provinces. The Moxico Province covers an area of 223,023 km^2 and is the largest Province of Angola. It borders Zambia to the east and the Democratic Republic of the Congo in the northeast. The Province is one of the most scarcely populated areas in Angola and was the scene of much guerrilla fighting during the Angolan Civil War that has left Moxico with residual landmine contaminations. And unexploded ordinances (UXOs). Displaced residents have slowly been returning to Moxico since the end of the Angolan Civil War in 2002.

Luena is the capital of the Moxico Province. The Province consists of nine municipalities, each consisting of a number of communes. The proposed railway line will run through the Moxico (Figure 6-2) and Camanongue (Figure 6-3) municipalities. The communes are listed in Table 6-1. Chokwe is the most spoken language in the Province. The Province is composed of a diversity of ethnic groups and populations of Chokwe, Lovale, Mbunda, Lucazi, and Ovimbundu makes up the majority of the Province. Isolated communities of other ethnic groups exist throughout Moxico.

Table 6-1: Identified communities along railway line in the Moxico Province [18]

Province	Municipality	Commune	Communities
Moxico	Moxico	Luena	Tchiteno, Canda I, Samauzo (including Catembo Nova)
	Camanongue	Camanongue	Ndongue, Mumanga (including Saissazo and Caiza), Muapezo, Tchilonga, Mazemba, Samalengue, Camuleque, Cassai Ponte, São João, Musseringinge (including Samucanda and Malasa)

[18]Data on village level was not available at the time of writing of the ESIA. Further surveys conducted to the development of the Resettlement Policy Framework confirmed the communities traversed by the alignment. t.

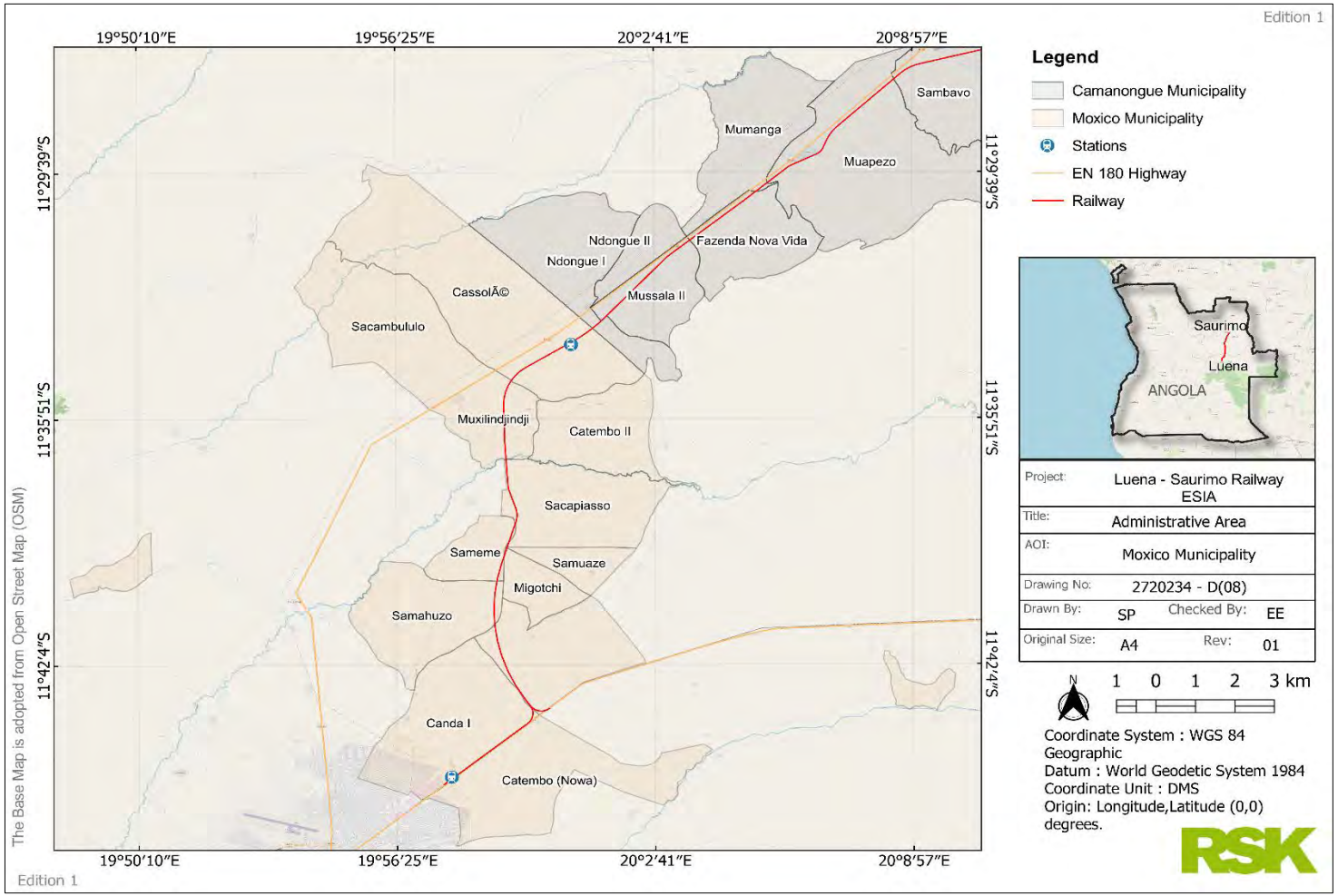


Figure 6-2: **Communities along proposed railway line through Moxico Municipality**

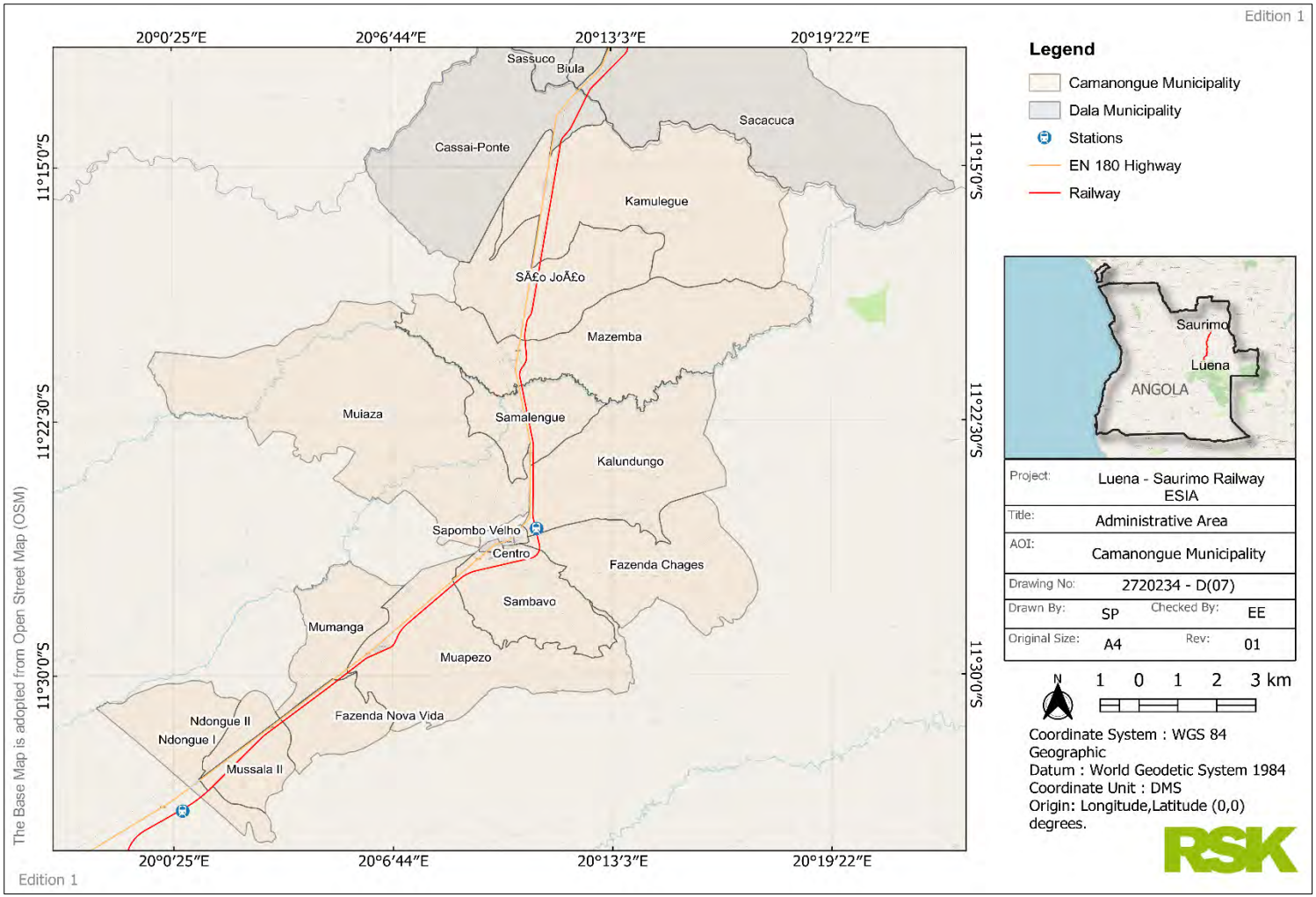


Figure 6-3: Communities along proposed railway line through Camanongue Municipality

Lunda Sul Province

The Lunda Sul Province covers an area of 77,637 km^2 and its capital is Saurimo. The Province borders the Democratic Republic of the Congo to the east. The main road from Luanda to Lubumbashi traverses the province from west to east. The Province consists of four municipalities, each consisting of a number of communes. The proposed railway line will run through the Saurimo (Figure 6-4) and Dala (Figure 6-5) Municipalities. Affected communes are Dala and Saurimo (Table 6-2). Economically, the Province is dominated by the cultivation of peanuts, primarily in the Saurimo area. In the south of the province the production of maize is a major contributor to the economy of the area. Other agricultural products include rice, cassava, and cereals. The region is rich in diamonds, manganese, and iron. The Catoca mine, fourth largest diamond mine in the world, is located about 45 km north of Saurimo town. The main ethnic groups in the region are the Lunda and the Chokwe.

Table 6-2: Identified communities along railway line in Lunda Sul Province[19]

Province	Municipality	Commune	Communities
Lunda Sul	Saurimo (currently known as Cassengo	Saurimo	Muamucalanganza, Saquembue, Muanguigi, Caiza, Muicaimbo, Mwatximbia, Sagungu, Luari, Sambuamba, Nanguanza, Cassamba I, Cassamba II, Maurilo-Sachula, Muxie
	Dala	Dala	Luele, Luachimo, Mukunguaji, Satxitende, Nacatoco, Biula

[19] Data on village level was not available at the time of writing of the ESIA. Further surveys conducted to the development of the Resettlement Policy Framework confirmed the communities traversed by the alignment..

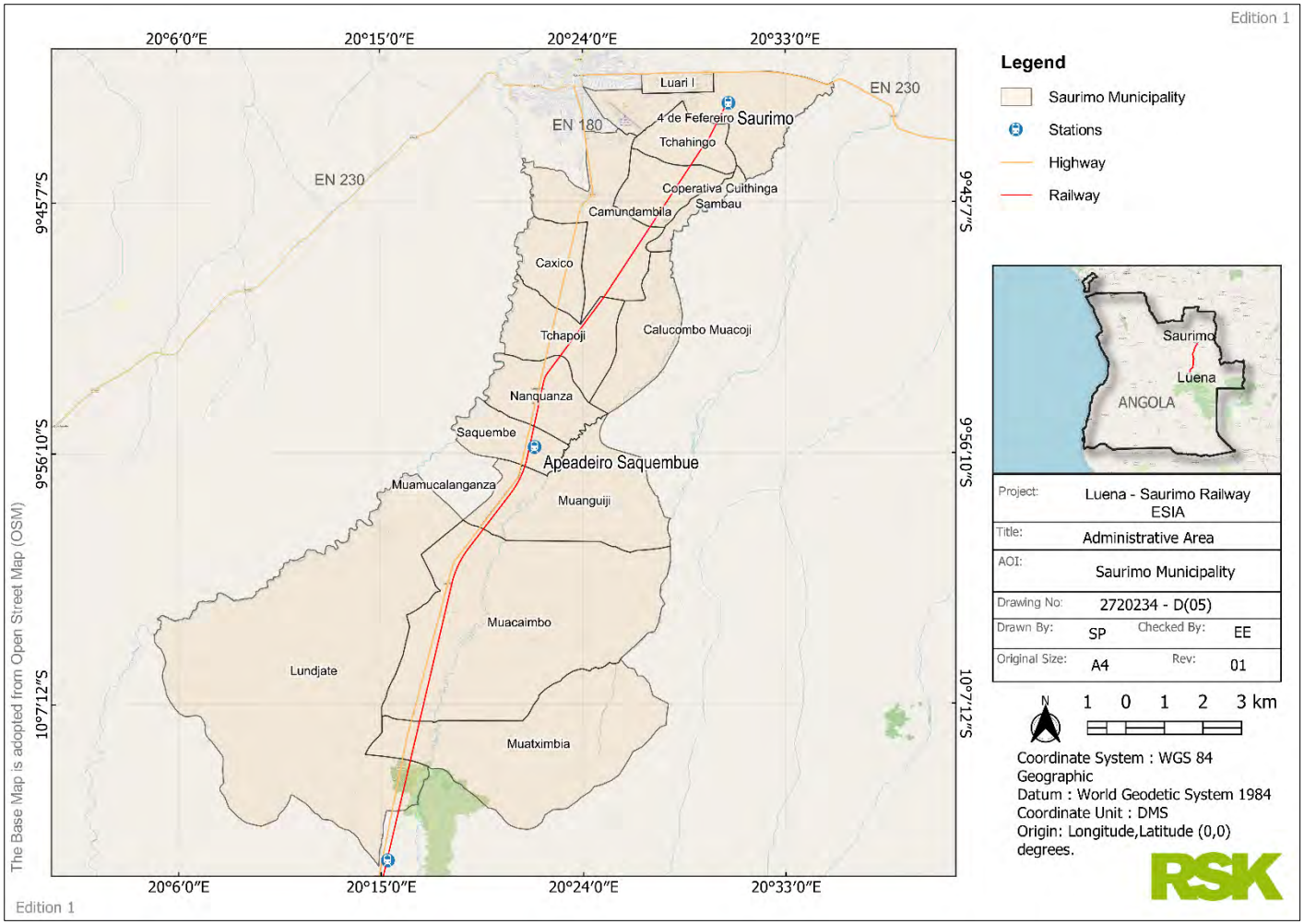


Figure 6-4: Communities along Proposed railway line through Saurimo Municipality

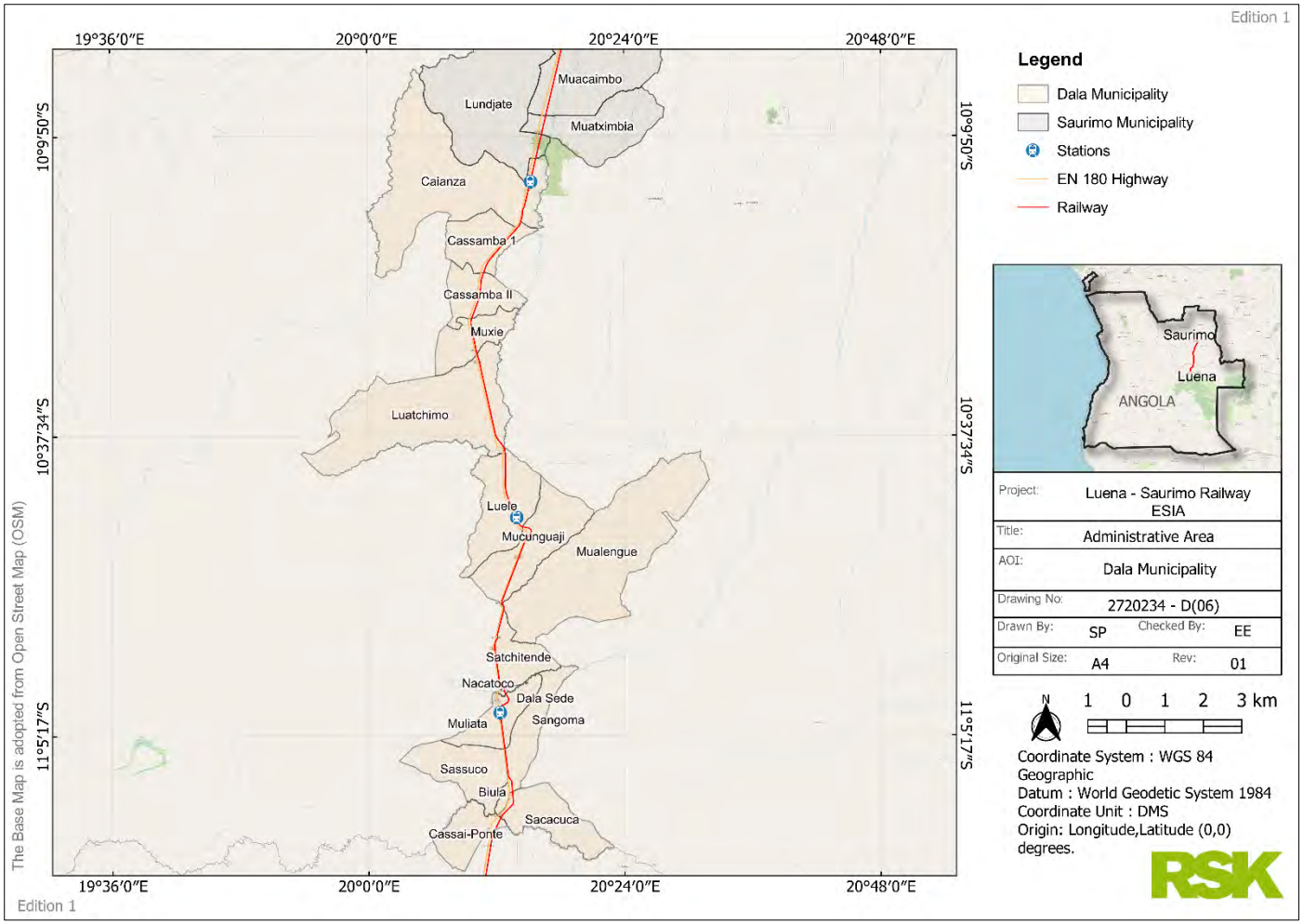


Figure 6-5: Communities along Proposed railway line through Dala Municipality

6.4 Indigenous Peoples (IPs) screening

The IFC Performance Standard 7 (IFC PS 7) also recognizes Indigenous Peoples (IPs) as social groups with unique identities distinct from the main groups in their countries, often being the most marginalized and vulnerable populations. As per PS 7 definition, “Indigenous Peoples are as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. Therefore, Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases”.

The World Bank identifies Indigenous Peoples / Sub-Saharan African Historically Underserved Traditional Local Communities as having the following characteristics, to varying degrees:

- self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others
- collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources of these areas
- customary cultural, economic, social or political institutions that are distinct or separate from those of the dominant society or culture
- a distinct language or dialect, often different from the official language or languages of the country or region in which they reside.

As per IFC PS 7, screening was undertaken at the Scoping Phase and further follow up during ESIA Phase. Results obtained from desk surveys, site visits and consultation indicate absence of people or groups of people who self-identify as IPs within the Project AoI during the time of this study. In this case the Free, Prior, and Informed Consent (FPIC) principle and process is not triggered at the moment.

Angola is ethnically diverse with over 40 languages spoken in the country. Comprehensive information on indigenous peoples in Angola is limited, as the most relevant research was carried out before the 1975-Armed Conflict. Socio-economic data and IPs screening in Angola are very limited. The World Bank has recently carried out assessments of IPs Angola. The study found out that the IPs are primarily located in the Provinces of Namibe, Huila, Cunene and Caundo Cubango. The San (Xun, Khwe, Kwisi and Ovatwa), the Himba (Ovahimba) and their related groups (such as the Kuvale and Zemba), constitute the indigenous peoples of Angola. They total approximately 25,000 people, or 0.1% of the

Angolan population. Most of the indigenous groups reside in the Huíla, Cunene, Kuando and Kubango Provinces in south-western Angola[20] (see Figure 6-6). Specifically, IPs have been identified in the following municipalities in Cunene and Huila provinces: Cahama, Cuanhama (Ondjiva), Namacunde and Ombadja within Cunene province; and Caconda, Cacula, Chibia, Chicumba, Lubango, Matala and Quipungo within Huila province. Therefore, the government of Angola and World Bank have developed an Indigenous Peoples Planning Framework (IPPF) to guide IPs Plan (IPP) for the activities affecting IPs. The overall national IPP will address specific project activities in terms of risks, impacts, mitigations and ensuring participation and benefit of IPs in the projects[21].

In the Provinces of Lunda Sul and Moxico specifically, where the project corridor is located, there are no known populations that meet the criteria of PS7. At this stage, it is considered that PS7 is not triggered hence no further assessment of IPs has been undertaken in this ESIA. Further follow up will be undertaken during detailed RAP and LPR development process.

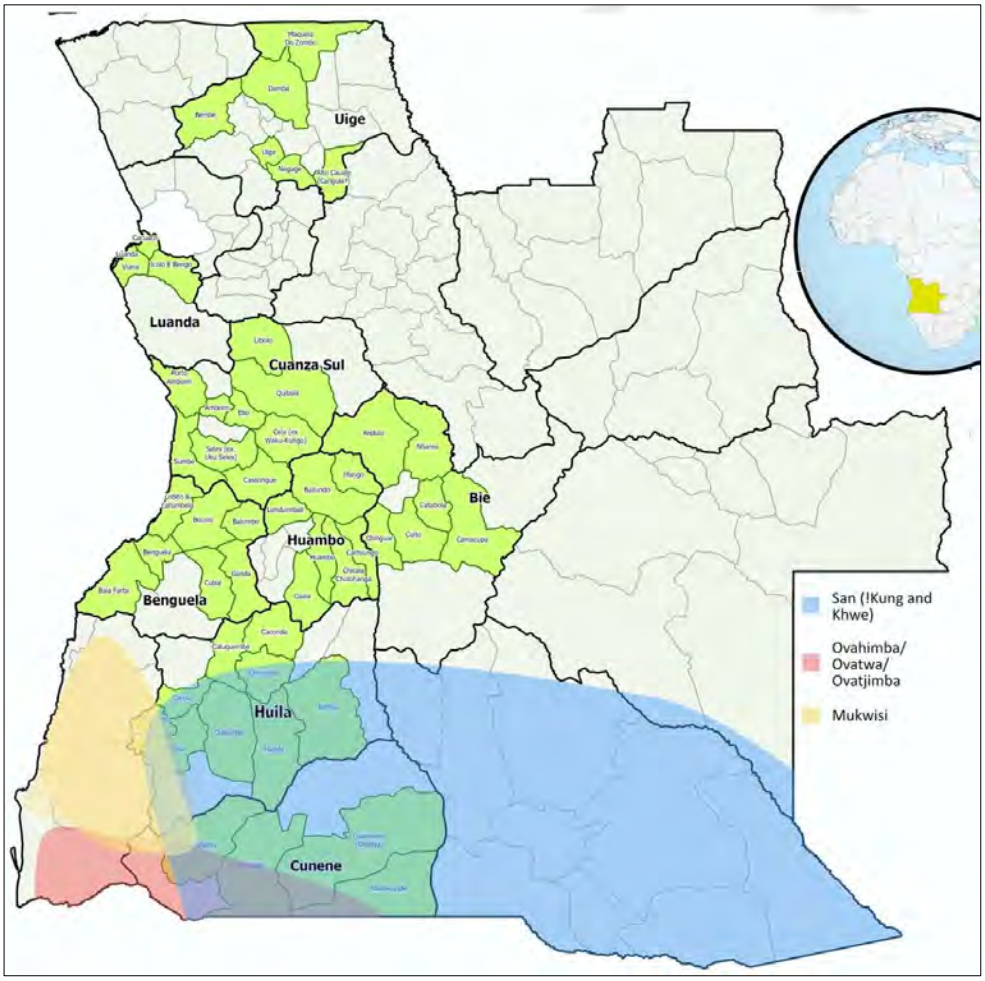


Figure 6-6 Distribution of known IP communities in Angola

Source: Angola Government & World Bank, 2022

[20] https://www.ucm.minfin.gov.ao/cs/groups/public/documents/document/aw4z/mzy0/~edisp/minfin3364858.pdf
International Work Group for Indigenous Affairs (IWGIA), https://iwgia.org/en/angola
Ministry of Agriculture and Forest, Angola, 2018

[21] https://www.ucm.minfin.gov.ao/cs/groups/public/documents/document/aw4z/mzy0/~edisp/minfin3364858.pdf

6.5 Development context

The Human Development Index

The Human Development Index (HDI) is a statistical composite index developed by the UNDP that was published for the first time in 1990[22]. The underlying principle of the HDI is that national development should not only be measured by income per capita, but also by health and education achievements. Additional indices have been developed since 1990 to capture other dimensions of human development to identify groups falling behind in human progress and to monitor the distribution of human health.

In 2010, three indices were launched to monitor poverty, inequality, and gender empowerment across multiple human development dimensions, namely the Multidimensional Poverty Index (MPI), the Inequality-adjusted Human Development Index (IHDI) and the Gender Inequality Index (GII). The Gender Development Index (GDI) was introduced in 2014. Table 6-3 gives a breakdown of the different indices and what they are trying to achieve.

[22] UNDP. 2018. Human Development Indices and Indicators. 2018 Statistical Update

Table 6-3: Human development indices

Index	Dimensions	Indicators	Dimension Index / Measure	Adjustments
Human Development Index (HDI)	Long and healthy life	Life expectancy at birth	Life expectancy index	
	Knowledge	Expected years of schooling Mean years of schooling	Education index	
	A decent standard of living	GNI per capita (PPP $)	GNI index	
Inequality-adjusted Human Development Index (IHDI) The IHDI attempts to capture the distribution of human development within countries. Where there is inequality in the distribution of health, education, and income, the HDI of a society is less than the aggregate HDI. The greater the inequality, the lower the IDHI and the greater the difference between it and the HDI	Long and healthy life	Life expectancy at birth	Life expectancy index	An inequality measure is applied for calculating the IHDI
	Knowledge	Expected years of schooling Mean years of schooling	Education index	
	A decent standard of living	GNI per capita (PPP $)	GNI index	
Gender Development Index (GDI) The **GDI** reports female and male achievements in the basic dimensions of human development	Long and healthy life	Life expectancy at birth	Life expectancy index	HDI calculated separately for males and females
	Knowledge	Expected years of schooling Mean years of schooling	Education index	
	A decent standard of living	GNI per capita (PPP $)	GNI index	
Gender Inequality Index (GII) The **GII** captures the inequalities women face in reproductive health, education, political representation and the labour market. Lack of	Health	Maternal mortality ratio Adolescent birth rate	Female reproductive health index	A female gender index and a male gender index are calculated and used to determine the GII
	Empowerment	Female and male population with at least secondary education	Female empowerment index	

Index	Dimensions	Indicators	Dimension Index / Measure	Adjustments
women's empowerment is a critical aspect of gender inequality		Female and male shares of parliamentary seats	Male empowerment index	
	Labour market	Female and male labour force participation rates	Female labour market index Male labour market index	
Multidimensional Poverty Index (MPI) The **MPI** measures non-income dimensions of poverty and shows how human deprivations overlap. It does not capture all deprivations, so additional indicators are required for a more detailed analysis of poverty.	Health	Nutrition Child mortality	Intensity of poverty Headcount ratio	
	Education	Years of schooling School attendance		
	Standard of living	Cooking fuel Sanitation Drinking water Electricity Housing Assets		

The 2023 update[23] of the HDI presents HDI values for 193 countries and territories with the most recent data for 2022. Of these countries, 69 are in the very high human development group, 49 in the high development group, 42 in the medium development group, and 33 in the low human development group. These classifications are based on HDI fixed cut-off points. Angola is in position 150 and falls in the medium human development group.

Table 6-4: HDI and GDI breakdown[24]

	HDI	GDI	
		HDI Female	HDI Male
Index value	0.591	0.905	
		0.561	0.620
Life expectancy at birth	61.9	64.5	59.5
Expected years of schooling	12.2	11.5	12.9
Mean years of schooling	5.8	4.5	7.2
Gross national income (GNI) per capita (PPP $)	5 328	2 338	4 174

Table 6-5: Inequality-adjusted HDI breakdown[25]

Inequality-adjusted HDI	Value
Index value	0.344
Coefficient of human inequality	40.2
Inequality in life expectancy	28.3%
Inequality-adjusted life expectancy index	0.462
Inequality in education	34.2%
Inequality-adjusted education index	0.351
Inequality in income	58.1%
Inequality-adjusted income index	0.252
Income shares held by:	
Poorest 40%	11.5
Richest 10%	39.6
Richest 1%	26.0
Gini Coefficient	51.3

The country has a Gini Coefficient (Table 6-5) of 51.326 (last measured in 2018) – the Gini Coefficient measure the deviation of the distribution of income among individuals or households within a country from a perfect equal distribution where a value of 0 represents absolute equality and a value of 100, absolute inequality. This indicates an unequal distribution of income.

Angola's GDI places it in Group 4, which comprises countries with medium-low equality in HDI achievements between women and men. Males have a higher Labour force participation rate (79.1%) than females (74.0%), while much less

[23] https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

[24] UNDP. 2024. Human Development Report 2023/2024.

[25] UNDP. 2024. Human Development Report 2023/2024.

[26] https://data.worldbank.org/indicator/SI.POV.GINI?locations=AO

females (28.2%) than males (51.5%) have at least some secondary education (Table 6-5). Women hold 29.5% of seats in parliament.

Angola placed in position 133 in the Gender Inequality Index (GII) with a value of 0.52 (Table 6-6). A value closer to zero indicates greater gender equality, while a value closer to one indicates higher gender inequality.

Table 6-6: GII breakdown[27]

GII	Value	Female	Male
Index value	0.52		
Maternal mortality ratio (deaths per 100 000 live births)	222		
Adolescent birth rate (births per 1000 women aged 15-19)	135.8		
Share of seats in parliament (% held by women)	33.6		
Population with at least some secondary education (% ages 25 and older)		21.3	37.4
Labour force participation rate (% ages 15 and older)		74.7	78.2

The 2021 MPI indicates that Angola has an MPI score of 0.282, a Poverty Headcount of 51.1% and an Intensity of Poverty of 55.3%. Standard of Living (46.8%) is the greatest contributor to the score, followed by Education (32.1%) and Health (21.2%). It must be noted that these scores are based on 2015/16 data. Poverty Headcount refers to the proportion of the population that can be defined as multidimensionally poor by using a predetermined cut-off while the Intensity of Poverty refers to the average proportion of indicators in which people are multidimensionally poor. A higher MPI score indicates a very poor community that is deprived on many indictors. The MPI indicates that 32.3% of the population is living below the national income line while 49.9% is living below the international poverty line.

According to a report on multidimensional poverty in Angola[28], segmented by municipalities, the Dala Municipality is the most multidimensionally poor municipality in the study area with an incidence[29] of poverty of 95.37% and an intensity[30] of poverty 63.33%. The Camanongue Municipality has an incidence of poverty of 92.32% and an intensity of poverty of 61.97%. The levels of poverty in the urban areas are lower with an incidence of poverty in the Saurimo Municipality of 67.31% and an intensity of poverty of 57.52%. In the Luena Municipality the incidence of poverty is 65.58% and the intensity of poverty is 57.01%.

Sustainable Development Goals Index

For 2023, Angola ranks 155th out of 166 countries on the Sustainable Development Goals (SDG) Index[31.] The country has achieved the goals of Climate Action and Responsible Consumption and Production. Scores for Quality Education and Affordable and Clean Energy are moderately improving, but not

[27] UNDP. 2024. Human Development Report 2023/2024.

[28] Instituto Nacional de Estatística. November 2019. Pobreza Multidimensional nos Municípios de Angola.

[29] Proportion of households that can be defined as multidimensionally poor

[30] Proportion of indicators on which a household is deprived

[31] https://dashboards.sdgindex.org/profiles/angola

sufficient to attain these goals. The scores for No Poverty and Sustainable Cities and Communities are decreasing, while the scores for the remaining goals are stagnating, with significant or major challenges remaining. For the goal of Reduced Inequalities, trending information is not available.

Governance performance

The Ibrahim Index of African Governance (IIAG) assesses governance performance in 54 African countries over the latest available ten-year period[32.] It includes the following categories:

- Security and rule of law
  - security and safety
  - rule of law and justice
  - accountability and transparency
  - anti-corruption
  - public perception of security and rule of law
- Participation, rights, and inclusion
  - participation
  - rights
  - inclusion
  - gender
  - Public perception of participation, rights, and inclusion
- Foundations for economic opportunity
  - public administration
  - business environment
  - infrastructure
  - rural sector
  - public perception of economic opportunity foundations
- Human development
  - health
  - education
  - social protection
  - sustainable environment
  - public perception of human development

Angola achieved an overall score of 41.5/100 in 2022, giving the country a rank of 40th out of the 54 countries in Africa. This score represents an increase of +5.4 between 2012 and 2022. Angola showed improvement in all the categories Foundations for economic opportunity (rank 41); Human development (rank 48); Security and rule of law (rank 32) and Participation, rights, and inclusion (rank 35). In 2021 Angola was one of the lowest scoring countries, ranked in 48th position, but showed improvement over the past decade, and in the latest five years, and has done so at an accelerated pace.

[32] https://mo.ibrahim.foundation/sites/default/files/2023-01/2022-index-report.pdf

6.6 Demography

Population and households

Angola's 2014 census reported a population of 25,789,024 people but the World Bank[33] estimates the population of Angola in 2022 as 35,588,987 people. Between 2018 and 2019 almost 25% of households in Angola consisted of seven or more members[34]. Households with four or five members accounted each for about 15% of the total, while single-person households made up 9.4% of the total. The average household size for the period between 2018 and 2019 was 4.9 and approximately 30.5% of households were headed by females. According to the 2014 Census data, rural families had slightly fewer household members than urban families (Table 6-7).

[33] https://data.worldbank.org/indicator/SP.POP.TOTL?locations=AO

[34] https://www.statista.com/statistics/1201120/households-size-in-angola/

Table 6-7: Household sizes[35]

Variable	National	Moxico Province	Lunda Sul Province	Urban	Moxico Province	Lunda Sul Province	Rural	Moxico Province	Lunda Sul Province
Household sizes		National	National		Urban	Urban		Rural	Rural
Total households	**5,544,834**	163 101	111 643	**3 381 209**	85 236	83 175	**2 163 626**	77 865	28 469
One person	**658 889**	19 272	13 422	**388 757**	9 039	8 251	**270 132**	10 233	5 171
Two persons	**621 134**	19 188	13 072	**349 233**	9 048	8 357	**271 901**	10 140	4 715
Three persons	**726 733**	22 140	13 486	**428 626**	10 823	9 816	**298 107**	11 317	3 671
Four persons	**790 259**	22 387	14 013	**479 978**	11 556	10 560	**310 280**	10 831	3 453
Five persons	**765 461**	21 575	13 990	**471 524**	11 451	10 809	**293 937**	10 124	3 181
Six persons	**953 535**	27 257	21 349	**591 683**	15 035	16 719	**361 852**	12 222	4 631
Seven persons	**347 712**	10 371	6 719	**216 499**	5 632	5 262	**131 213**	4 739	1 457
Eight persons	**264 351**	8 257	5 523	**166 902**	4 529	4 519	**97 449**	3 728	1 004
Nine persons	**168 675**	5 084	3 588	**110 264**	2 936	2 991	**58 411**	2 148	598
Ten or more persons	**248 086**	7 570	6 481	**177 742**	5 187	5 892	**70 344**	2 383	588
Average household size	**4.6**	4.6	4.8	**4.8**	4.9	5.1	**4.4**	4.4	4.0

[35] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

Table 6-8 below shows the number of people and average household sizes as reported by the affected communities during primary data collection.

Table 6-8: Number of people and average household sizes for communities along the proposed railway line[36]

Province	Municipality	Communities	Approximate number of people	Average household size
Lunda Sul	Saurimo	Muieie	319	7 - 8
		Luari	12 000	8
		Nanguanza	522	5 - 8
		Muamucalanganza	36 families	9
		Muanguiji	1 878	8
		Saquembue	1 300	12
		Caiaza	552	8
		Cassamba 1	350	5- 8
	Dala	Sangoma	180	10
		Mombo	985	10
		Mukuanguaji	130	5
		Satxitende	568 to 650	8 -13
		Nacatoco, Sayassua	108	6 It should be noted that the neighbourhood has existed for 4 years
		Luele	5 850	9
		Sassuco, Biula, Sacacuca	2302	10
Moxico	Moxico	Canda I, Canda II, Samauzo	250	6
		Sacapiasso, Migotchi	Sacapiasso 680 Migotchi 340	12
	Camanongue	Musseringinge[37]	4 595	10
		Samucanda, Sakambudji	Samucanda 370 Sakambunji 60	8
		Muapezo	1 045	9
		Mumanga, Caiza, Saissazo	Number unavailable due to absence of community secretary	10
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Number unavailable due to absence of community secretary	12

[36] Source: Baseline data collection for SIA, March 2024

[37] It was reported that is a district with about 13 large and 14 smaller neighbourhoods

		Kamaleke	2 500	10

On a national level, Angola has a population density of 20 people per square kilometre. Both the Moxico and Lunda Sul Provinces have a population density that is much lower than the national average (Table 6-9). In terms of sex, there is a very slight bias towards females in all the areas, except in the Dala Municipality.

Table 6-9: Population density and sex[38] breakdown[39]

Locality	Moxico Province	*Luena Municipality*	*Camanongue Municipality*	Lunda Sul Province	*Saurimo Municipality*	*Dala Municipality*
Population	1 058 437	498 701	47 675	750 101	617 339	41 845
Female	538 652	253 528	24 029	376 299	310 877	20 511
Female %	50.9	50.8	50.4	50.2	50.4	49.0
Male	519 785	245 173	23 646	373 802	306 462	21 334
Male %	49.1	49.2	49.6	49.8	49.6	51.0
Area (km^2)	199 986.9	39 085.9	2 575.5	80 614.4	23 401.4	14 704.3
Population density	5.3	12.8	18.5	9.3	26.4	2.8

Age and sex distribution

According to estimates from the World Bank, 50.6% of the population in Angola is female. The proportion of females aged 65 years or older showed a slight increase since 1996 from 2.4% to 2.9%. Table 6-10 shows an even distribution between males and females, but a bias towards adult females in the more rural municipalities of Dala and Camanongue. This was confirmed during the baseline data collection. All the communities along the corridor reported that there were more women in the communities, except for the Samucanda and Sakambudji communities in the Camanongue Municipality in the Moxico Province that reported more males in the communities. All the communities reported that there were more younger people in the communities. Table 6-11 provides age and sex distribution quantitatively at Provincial and municipal levels.

Table 6-10: Sex and age distribution for communities along the proposed railway line[40]

Province	Municipality	Communities	Male/female distribution	Age distribution
Lunda Sul	Saurimo	Muieie	More women	More younger people
		Luari	More women	More younger people
		Nanguanza	More women	More younger people
		Muamucalanganza	More women	More younger people
		Muanguiji	More women	More younger people
		Saquembue	More women	More younger people

[38] Sex refers to biological physical differences while gender involves how a person identifies

[39] https://data.humdata.org/dataset/cod-ps-ago?

[40] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Male/female distribution	Age distribution
		Caiaza	More women	More younger people
		Cassamba 1	More women	More younger people
	Dala	Sangoma	More women	More younger people
		Mombo	More women	More younger people
		Mukuanguaji	More women	More younger people
		Satxitende	More women	More younger people
		Nacatoco, Sayassua	More women	More younger people
		Luele	More women	More younger people
		Sassuco, Biula, Sacacuca	More women	More younger people
Moxico	Moxico	Canda I, Canda II, Samauzo	More women	More younger people
		Sacapiasso, Migotchi	More women	More younger people
	Camanongue	Musseringinge	More women	More younger people
		Samucanda, Sakambudji	More men	More younger people
		Muapezo	More women	More younger people
		Mumanga, Caiaza, Saissazo	More women	More younger people
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	More women	More younger people
		Kamaleke	More women	More younger people

Angola had an age dependency ratio of 91 in 2022. The age dependency ratio is used to measure the pressure on the productive population and refer to the proportion of dependents per 100 working-age population. As the ratio increases, there may be an increased burden on the productive part of the population to maintain the upbringing and pensions of the economically dependent. Angola's age dependency ratio showed a decline since 1996.

Table 6-11: Breakdown by age and sex[41]

	Moxico Province			*Luena Municipality*			*Camanongue Municipality*			Lunda Sul Province			*Saurimo Municipality*			*Dala Municipality*		
	Total	**Female**	**Male**	**Total**	**Female**	**Male**	**Total**	**Female**	**Male**	**Total**	**Female**	**Male**	**Total**	**Female**	**Male**	**Total**	**Female**	Male
Age 0-4 years	20.0	19.5	20.5	19.4	18.9	19.9	21.1	20.6	21.6	19.3	19.2	19.4	19.1	18.9	19.4	20.2	20.3	20.1
Age 5-9 years	17.1	16.7	17.5	17.2	16.7	17.7	18.7	18.2	19.2	16.6	16.5	16.6	16.5	16.5	16.5	17.6	17.2	18.1
Age 10-14 years	13.3	13.1	13.6	13.6	13.6	13.6	12.1	11.4	12.7	12.7	12.8	12.5	12.8	13.1	12.6	11.4	11.3	11.6
Age 15-19 years	10.2	10.1	10.3	10.8	10.9	10.8	8.3	7.9	8.7	10.4	10.4	10.5	10.8	10.8	10.8	8.2	8.0	8.4
Age 20-24 years	7.9	7.9	7.9	8.4	8.3	8.6	6.7	6.6	6.7	7.6	7.7	7.6	7.9	7.9	7.8	6.6	6.5	6.8
Age 25-29 years	6.1	6.3	5.9	6.4	6.5	6.3	5.3	5.4	5.3	6.6	6.9	6.3	6.8	7.1	6.5	5.8	6.0	5.7
Age 30-34 years	5.5	5.8	5.1	5.4	5.6	5.2	4.8	5.2	4.4	5.9	6.3	5.4	5.9	6.3	5.5	5.4	5.9	4.9
Age 35-39 years	4.3	4.5	4.0	4.2	4.4	4.0	4.3	4.7	3.9	5.1	5.0	5.2	5.2	5.1	5.3	4.5	4.7	4.3
Age 40-44 years	3.6	3.8	3.4	3.4	3.7	3.2	3.9	4.5	3.3	4.3	4.2	4.5	4.3	4.1	4.5	4.4	4.6	4.2
Age 45-49 years	3.1	3.2	2.9	3.1	3.3	3.0	3.8	4.1	3.5	3.6	3.3	3.9	3.5	3.2	3.8	4.3	4.4	4.3
Age 50-54 years	2.5	2.5	2.4	2.4	2.5	2.3	3.0	3.3	2.8	2.6	2.4	2.8	2.4	2.3	2.6	3.2	3.2	3.3
Age 55-59 years	1.9	1.9	1.9	1.8	1.7	1.8	2.2	2.3	2.1	1.8	1.7	1.9	1.7	1.6	1.8	2.1	2.2	2.1
Age 60-64 years	1.7	1.8	1.7	1.5	1.6	1.5	2.3	2.3	2.3	1.5	1.4	1.5	1.3	1.3	1.3	2.4	2.2	2.5
Age 65-69 years	1.1	1.2	1.1	0.9	1.0	0.9	1.4	1.6	1.3	0.9	0.9	0.8	0.8	0.9	0.7	1.3	1.3	1.3
Age 70-74 years	0.8	0.9	0.8	0.7	0.7	0.6	1.2	1.0	1.4	0.6	0.6	0.6	0.5	0.5	0.4	1.3	1.2	1.3
Age 75-79 years	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.3	0.2	0.5	0.5	0.5
Age 80+ years	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.5	0.5	0.6

[41] https://data.humdata.org/dataset/cod-ps-ago?

6.7 Education

Angola's education system is structured in three levels, namely primary, secondary, and higher education[42]. Primary education lasts for six years, and its gratuity and compulsory status are stipulated by law. In practice there are not enough schools or teachers to enforce this law. The secondary education system is divided into two cycles of three years each. There is a parallel technical education system that is divided into three years of vocational education and four years of middle technical education. Tertiary education is only offered in major urban centres and the tuitions fees are higher compared to regional competitors like Namibia and South Africa.

Access to education is not only hindered by failure of the education network, but also by socio-economic circumstances. In Angola there are wide gaps between rich and poor, and a typical family with an average of 3-4 children cannot support the indirect costs associated with education such as transport and meals. As a result, children are even withdrawn from compulsory attendance. Girls in particular are affected due to local values and traditional practices.

According to the Census of 2014 approximately 65.6% of the population aged 15 years or older can read and write. In urban areas this figure increased to79.4% compared to rural areas where it is only 41.1%. In terms of gender, the Census indicated that 79.6% of men and 53% of women aged 15 years or older can read or write. When looking at the age group 15 -24 years, about 76.9% could read or write, 84.4% of men and 70% of women. The national literacy rate has increased to 72.28% in 2021[43].

Approximately 13.4% of the population aged 6-17 years have never attended school. In rural areas almost a quarter (25.2%) of the population aged 6-17 years have never attended school. The difference between boys (12.6%) and girls (14.2%) is rather small. In terms of school attendance, the differences between boys and girls are small, with a slightly greater proportion of boys that have attended school. In rural areas less than 10% of children of school going age have ever attended secondary school.

Table 6-12 shows the availability of educational facilities in the communities in the project area. Some of the school buildings are in dire need of renovation, while others are in a relatively good condition (Figure 6-7).

[42] https://opentoexport.com/article/education-sector-in-angola/

[43] https://www.macrotrends.net/countries/AGO/angola/literacy-rate

Figure 6-7: Example of school buildings in the project area

Table 6-12: Identified education facilities within communities along the railway line[44]

Province	Municipality	Communities	Nearest school	Type of school	Equal access to schools for boys and girls
Lunda Sul	Saurimo	Muieie	There is no official public school in the community, children study at church.	Primary school	Yes
		Luari	The community has two schools; one is on the border with the Condoril neighbourhood and the other is in the centre of the community	Primary schools, Secondary schools	Yes
		Nanguanza	The nearest school is in the community	Primary school	Yes
		Muamucalanganza	There are no schools in the community – they are going to schools in Muanguiji community	Primary school	Yes
		Muanguiji	The nearest schools are located in the community less than 100 meters away	Primary school	Yes
		Saquembue	There is a primary school in the community less than 100 meters away	Primary school	Yes
		Caiaza	There is a school in the community	Primary school	Yes
		Cassamba 1	Churches are used as schools	Primary school	Yes
	Dala	Sangoma	The closest schools are 4 km away in the seat of the Municipality of Dala.	Primary schools, Secondary schools	Yes
		Mombo	The nearest school is located in the community	Primary school	Yes
		Mukuanguaji	Schools are close to the community	Primary school	Yes
		Satxitende	The school is close to the community	Primary school	Yes
		Nacatoco, Sayassua	The nearest school is in the Catholic Mission of Nacatoco	Primary school	Yes

[44] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Nearest school	Type of school	Equal access to schools for boys and girls
		Luele	The community has two primary schools, which are located within the community	Primary schools	Yes
		Sassuco, Biula, Sacacuca	The closest schools are in the community.	Primary schools	Yes
Moxico	Moxico	Canda I, Canda II, Samauzo	The nearby school is at the municipal headquarters, which is 7 km away	None	Children do not study (due to distance from schools)
		Sacapiasso, Migotchi	Schools operate within the Church that are in the community	Primary schools	Yes
	Camanongue	Musseringinge	There are schools in the community	Primary schools, Secondary schools	Yes
		Samucanda, Sakambudji	There is no school in either of the communities, children normally study in church chapels, and later continue their studies in the Musseringinge community	Primary schools, Located in another community	Yes
		Muapezo	The nearest school is in the community.	Primary schools	Yes
		Mumanga, Caiza, Saissazo	There is a school in the Mumanga community that also meets the needs of the Caiza and Saissazo communities	Primary schools, Secondary schools	Yes
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	The schools are in Camanongue. There is a vocational training centre, but it has not yet been completed	Primary schools, Secondary schools	Yes
		Kamaleke	The closest schools are located within the community	Primary schools	Yes

In the Camanongue Municipality 16,576 students, of which about 45% are female, have enrolled in school for the 2023/24 school year in 22 existing schools in the municipal area. The net enrolment rate is 71%. Only 2.8% of the students are enrolled in Cycle II (of secondary school), and of these almost a third are female. The enrolment for Cycle 1 is 6.4% of which about 36% are female. According to the Municipal Education Office of Camanongue, more than 58% of students go to school hungry. The Municipality has a School Lunch Programme that reaches about 27.5% of the students. The Municipality does not have higher education centres but made the decision to support nine students with the best academic performance for higher education.

In the Dala Municipality there are currently 20 primary school institutions, one school complex, three secondary schools and one high school. The Municipal Administrator of Dala indicated that it is a major challenge to get skilled people to stay in the municipality. When people are placed out to Dala from Saurimo it is not unusual for these people to leave the area and return to their place of origin. In an attempt to counter the loss of skills in the area, the Dala Municipality has embarked on a programme to send local people from the municipal area to enrol in higher education in Saurimo in the areas of health and education. It is one of the main challenges of the municipality to extend the education system to the whole community, but there are still some communities without schools and some schools with severe challenges.

6.8 Language and cultural practices and norms

The official language of Angola is Portuguese, and the national languages include Umbundu, Kimbundu, Kikongo, Chokwe, Fiote, Kwanyama, and Nhaneca. In the Moxico Province, Chokwe is the most spoken language, and in the Lunda Sul Province, it is Chokwe and Chilunda. Chokwe is spoken in all the communities along the proposed railway corridor (Table 6-13), while Portuguese is only spoken in some of the communities. This suggests that in addition to Portuguese, communication about the Project should also be available in Chokwe. Cultural groups present in the Camanongue Municipality include Chokwe (majority), Luvale, Lucazi, Mbunda, and Umbundu. In the Dala Municipality Chockwe is the main cultural group, with a minority of Luvale and Minungu in the Commune of Cazage.

Table 6-13: Main languages spoken in communities along railway route[45]

Province	Municipality	Communities	Languages spoken
Lunda Sul	Saurimo	Muieie	Portuguese, Chokwe
		Luari	Portuguese, Chokwe
		Nanguanza	Portuguese, Chokwe
		Muamucalanganza	Portuguese, Chokwe
		Muanguiji	Portuguese, Chokwe
		Saquembue	Portuguese, Chokwe
		Caiaza	Portuguese, Chokwe

[45] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Languages spoken
		Cassamba 1	Portuguese, Chokwe
	Dala	Sangoma	Portuguese, Chokwe
		Mombo	Portuguese, Chokwe
		Mukuanguaji	Portuguese, Chokwe
		Satxitende	Portuguese, Chokwe
		Nacatoco, Sayassua	Portuguese, Chokwe
		Luele	Portuguese, Chokwe
		Sassuco, Biula, Sacacuca	Portuguese, Chokwe
Moxico	Moxico	Canda I, Canda II, Samauzo	Chokwe
		Sacapiasso, Migotchi	Chokwe
	Camanongue	Musseringinge	Portuguese, Chokwe, Ngangela, Luvale
		Samucanda, Sakambudji	Chokwe
		Muapezo	Chokwe
		Mumanga, Caiza, Saissazo	Chokwe, Ngangela, Luvale
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Chokwe
		Kamaleke	Chokwe

Traditional Authorities are responsible for making decisions in the villages on a local level (Table 6-14). The Soba is the Traditional Leader of the village and has people assisting him/her with this task (Sobetas and Coordinators). A Regedor oversees a group of Sobas in a specific area. Some villages mentioned decision-making by the king. The Lunda-Chokwe people have a traditional monarchy that is ruled by a king[46]. The Governor or the Soba is responsible for resolving conflict and disagreement in the community. When there is a conflict situation in the community, the Soba will call a meeting with other community members such as neighbourhood secretaries and other neighbourhood elders (Seculos) to resolve the situation. If the situation cannot be resolved with the Soba, it is referred to the Regedor.

46 https://theafricanroyalfamilies.com/2024/03/03/traditional-kings-in-angola/

Table 6-14: Decision-making and conflict resolution in communities[47]

Province	Municipality	Communities	Decision-making	Conflict resolution
Lunda Sul	Saurimo	Muieie	Decisions made through traditional authorities	Traditional authorities
		Luari	Decisions made through traditional authorities	Traditional authorities If the situation relates to crime it is forwarded to the police authorities
		Nanguanza	Decisions made through traditional authorities	Traditional authorities Due to the uniting of neighbourhoods that occurred during the period of armed conflict, the neighbourhood currently has around 5 sobas, but the main soba is Soba Nanguanza
		Muamucalanganza	Decisions made through traditional authorities	Traditional authorities
		Muanguiji	Decisions made through traditional authorities	Traditional authorities
		Saquembue	Decisions made through traditional authorities	Traditional authorities
		Caiaza	Decisions made through traditional authorities	Traditional authorities Cases involving bladed weapons and firearms are referred to the Police
		Cassamba 1	Decisions made through traditional authorities	Traditional authorities Very serious conflicts are referred to the Governor
	Dala	Sangoma	Decisions made through traditional authorities	Traditional authorities
		Mombo	Decisions made through traditional authorities	Traditional authorities Very serious conflicts are referred to the Governor
		Mukuanguaji	Decisions made through traditional authorities	Traditional authorities

47 Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Decision-making	Conflict resolution
		Satxitende	Decisions made through traditional authorities	Traditional authorities
		Nacatoco, Sayassua	Decisions made through traditional authorities	Traditional authorities
		Luele	The most Decisions made through traditional authorities	Coordinators
		Sassuco, Biula, Sacacuca	Decisions made through traditional authorities	Traditional authorities Very serious conflicts are referred to the Governor
Moxico	Moxico	Canda I, Canda II, Samauzo	Decisions made through traditional authorities	Traditional authorities Very serious conflicts are referred to the Governor. If no solution is found, they go to the King. The conflicts that appear most in communities are due to witchcraft
		Sacapiasso, Migotchi	Decisions made through traditional authorities	Traditional authorities
	Camanongue	Musseringinge	Decisions made through traditional authorities	Traditional authorities
		Samucanda, Sakambudji	Decisions made through traditional authorities	Traditional authorities
		Muapezo	Decisions made through traditional authorities	Traditional authorities
		Mumanga, Caiza, Saissazo	Decisions made through traditional authorities	Traditional authorities
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Decisions made through traditional authorities Police	Traditional authorities Very serious conflicts are referred to the Governor
		Kamaleke	Decisions made through traditional authorities	Traditional authorities

The Soba is the guardian of the communal land in the communities and decides how much land a person can get as well as the size of the house that a person

can build (Table 6-15). In general, the person should be a resident of the village in order to access land.

Table 6-15: Access to land in communities along the railway line[48]

Province	Municipality	Communities	Access to land
Lunda Sul	Saurimo	Muieie	Access to land is provided by the *Soba* and is guaranteed to everyone who is a resident of the community. The size of the land allocated is determined by the capacity of the person who is applying for the land
		Luari	Access to the land is granted by the *Soba* to residents both for cultivation and for the construction of a residence
		Nanguanza	Land is allocated by the *Soba*. The size of the share allocated depends on the capacity if the person applying. Women can access land
		Muamucalanganza	The *Sobas* decide on the allocation of land in the communities
		Muanguiji	Land is allocated by the *Soba*
		Saquembue	The *Soba* gives access to land for building houses or practising agriculture. There are local families who claim to be the originators of the land who also have the legitimacy to distribute land
		Caiaza	The *Soba* gives access to land for building houses or practising agriculture. There is no limited size, it depends on the capacity of the person who receives the land
		Cassamba 1	Land is allocated by the *Soba*
	Dala	Sangoma	The *Soba* gives access to land for building houses or practising agriculture. There is no limited size, it depends on the capacity of the person who receives the land
		Mombo	The *Soba* gives access to land for building houses or practising agriculture. There is no limited size, it depends on the capacity of the person who receives the land. The person receiving the land must be a resident
		Mukuanguaji	The *Soba* gives access to land for building houses or practising agriculture
		Satxitende	Land is allocated by the *Soba* or the Governor
		Nacatoco, Sayassua	Land is allocated by the *Regedor*
		Luele	The *Soba* gives access to land for building houses or practising agriculture

[48] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Access to land
		Sassuco, Biula, Sacacuca	The *Soba* gives access to land for building houses or practising agriculture. There is no limited size, it depends on the capacity of the person who receives the land
Moxico	Moxico	Canda I, Canda II, Samauzo	The *Soba* gives access to land for building houses or practising agriculture. There is no limited size, it depends on the capacity of the person who receives the land. For construction the *Soba* gives the measurements in meters
		Sacapiasso, Migotchi	The *Soba* gives access to land for building houses or practising agriculture.
	Camanongue	Musseringinge	The *Soba* and Governor gives access to land for building houses or practising agriculture.
		Samucanda, Sakambudji	Land is allocated by the *Soba*
		Muapezo	Land is allocated by the *Soba*
		Mumanga, Caiza, Saissazo	The *Soba* and Governor gives access to land for building houses or practising agriculture
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	The *Soba* and Administration gives access to land for building houses or practising agriculture
		Kamaleke	Land is allocated by the *Soba*

Gender dynamics are evident, with women often sitting separately and being less vocal in discussions unless prompted. In some cases, their attendance at meetings requires specific invitations, highlighting their marginalized role in decision-making within the villages, contrasting with the presence of women in positions of power within the administration. Infrastructure challenges such as limited access to running water is prevalent across most villages.

In most communities the role of men includes building houses, acquiring land, and cultivating the fields (Table 6-16). The role of women is mainly to support the household. Women would be involved in cultivating the fields together with her husband, or by herself if she does not have a husband. Some communities have indicated that women take part in decision-making meetings, but it has been observed during data collection that in most communities' women are not comfortable (or used to) with expressing their opinions.

There's a cultural tradition of hospitality with food preparation for visitors, predominantly managed by local women, occasionally resulting in their exclusion from meetings.

Table 6-16: Gender roles within communities[49]

Province	Municipality	Communities	Gender roles
Lunda Sul	Saurimo	Muieie	Men are responsible for building houses, acquiring land, and cultivating produce
		Luari	Men are responsible for building houses, acquiring land, and cultivating produce
		Nanguanza	Men are responsible for providing goods for the family, building houses, acquiring land, and cultivating produce. They are also responsible for educating their (male) children. Women's role is to support the household
		Muamucalanganza	Men participate in decision-making meetings, animal husbandry Women raise children, take part in decision-making meetings and cultivation activities
		Muanguiji	Men are responsible for building houses, acquiring land, and cultivating produce
		Saquembue	Women participate in decision-making meetings, in raising children, providing food for their children
		Caiaza	Men are responsible for acquiring land, building houses, hunting, working in the field
		Cassamba 1	Men are responsible for building houses, acquiring land, and cultivating produce. Women carry out domestic activities and when a couple go to the field together, women would take the cassava to the river while men would cut the firewood. In this community women are not allowed to cut down trees
	Dala	Sangoma	They do field activities that are also carried out by women, they build houses, go hunting or fishing
		Mombo	Men are responsible for building houses, acquiring land, and cultivating produce
		Mukuanguaji	Both genders take part in making decisions, bringing up children and supporting them
		Satxitende	The role of men is to participate in decision making meetings in agricultural work.

[49] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Gender roles
			Women participate in community meetings, decision-making and in the work of farming and raising children
		Nacatoco, Sayassua	Men are responsible for building houses, acquiring land, and cultivating produce
		Luele	In the community, the roles of women and men do not differ much, that is, women participated in meetings and decision-making and provided food for their children
		Sassuco, Biula, Sacacuca	Men are responsible for doing everything, building the house, going hunting or fishing
Moxico	Moxico	Canda I, Canda II, Samauzo	The men of the neighbourhoods have the mission of building the houses, digging the grave. The women are midwives, a job that the men cannot do
		Sacapiasso, Migotchi	The role of men is to participate in decision-making meetings, cut wood, collect firewood, dig a ditch for the garden, build houses and help women with domestic activities The role of women is to take part in decision-making meetings, perform domestic activities, collect cassava from the river and then turn it into "*bombó*"
	Camanongue	Musseringinge	The man provides for his family. Women in this community have very little decision-making power and they are separated from the men while important decisions are being made. They are tasked with the preparations for welcoming visitors
		Samucanda, Sakambudji	The role of men is to participate in decision-making meetings
		Muapezo	Men have a fundamental role in the community, as they are responsible for taking care of families, agricultural activities, among others Women participate in meetings and decision-making, and domestic activities
		Mumanga, Caiza, Saissazo	Men participate in decision-making, agricultural activities, and others Women participate in decision-making and women's education
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	The role of men is based on leadership in the home. Women participate in decision-making meetings
		Kamaleke	Men are responsible for doing almost everything, such as field activities, building houses, going hunting or fishing.

Province	Municipality	Communities	Gender roles
			Women practice agricultural activities

Sites of cultural significance (Figure 6-8) in the in the communities consist mostly of tombs where Sobas were buried and cemeteries (Table 6-17). Dancing is an important way through which communities express themselves culturally, and there are several different dances that is performed at different times. Cultural practices include male (Mucanda) and female (Cafundes) initiation that prepare adolescents for their transition into adulthood. Boys are circumcised during Mucanda and one of the communities indicated that it could only be performed in cold weather. Detailed cultural heritage assessment is presented in Chapter 7 of this ESIA report.

Figure 6-8: Some sites and artefacts of cultural significance within the Project AoI

Table 6-17: Cultural sites and practices in communities[50]

Province	Municipality	Communities	Cultural sites	Cultural practices
Lunda Sul	Saurimo	Muieie	Tombs	Dances are performed at different times, such as wedding parties and *Mucanda*.
		Luari	Tombs and cemeteries	*Mucanda*

[50] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Cultural sites	Cultural practices
		Nanguanza	Nanguanza Museum (where the former chieftain of Nanguanza was buried) Museum also houses several works of art that represent cultural Lunda Chokwe.	*Mucanda* *Cafundes*
		Muamucalanganza	No places of cultural importance	*Mucanda* *Cafundes*
		Muanguiji	Cemetery of the kings	*Cafundes* Traditional dances: Tchissela, Tchiyanda
		Saquembue	No places of cultural importance	*Mucanda* *Cafundes*
		Caiaza	Cemetery	Traditional dances: Tchiyanda, Tchissela and Mapopo
		Cassamba 1	Cemetery There might be some graves in the woods near the neighbourhood	*Mucanda* *Cafundes* Traditional dances: Tchiyanda and Mapopo
	Dala	Sangoma	Tombs that are considered historical monuments - 5 km away from the neighbourhood	Traditional dances: Tchilunda, Mukanda, and Ulungui
		Mombo	Tombs where the ancient sobas were buried, but these tombs are very far from the community	Traditional dances: Tchiyanda, Ulengo, Tchissela
		Mukuanguaji	No places of cultural importance	Circumcision, which is only carried out in cold weather
		Satxitende	No places of cultural importance	Circumcision
		Nacatoco, Sayassua	Tomb where the old chief of the neighbourhood was buried (considered a historical monument). It is next to the road, 500 m away from the neighbourhood	Traditional dances: Tchilunda, Tchombe, Kalucuta, Tchiyanda and others
		Luele	Two cemeteries – one specifically for family members of Sobas	No response

Province	Municipality	Communities	Cultural sites	Cultural practices
		Sassuco, Biula, Sacacuca	Tombs	Traditional dances: Tchombue, Tchiyanda, Tchilunda
Moxico	Moxico	Canda I, Canda II, Samauzo	Cemetery, which is 600 meters away of the houses	*Mukanda* Traditional dances: Tchiyanda,
		Sacapiasso, Migotchi	No places of cultural importance	Tchilunda Tchatundage circumcision festival) and Tchilunga Thacuhama Muanaculo (Alambamento festival)
	Camanongue	Mussirinjiji	No places of cultural importance Scattered graves of soldiers within the forest	No practices of great relevance were presented
		Samucanda, Sakambudji	Cemetery two kilometres from the community	Circumcision
		Muapezo	Cemetery where sobas are buried (located 4 km from the neighbourhood)	Mukanda Muali (Ritual for women of transition to adulthood) Traditional dances: Tchissela, Ulengo, Tchiyanda
		Mumanga, Caiza, Saissazo	No places of cultural importance	Circumcision and male and female initiation rituals
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	No places of cultural importance	Mukanda Alambamento
		Kamaleke	Tombs	Mukanda Traditional dances: Tchilunda and Ulungui

Graveyards are close to the villages, with unmarked graves and varying attitudes toward tomb preservation and reburials, reflecting cultural beliefs and practices around ancestor worship. Not all communities have indicated that there are graves in the area (Table 6-18). It is not clear where the communities that do not have graves in the area bury their dead, but it is possible that the graves are a distance away from the community. Not all the communities were sure what should happen if the relocation of a grave is unavoidable for the Project. In the Caiaza community there is strong resistance against the moving of graves.

Cultural heritage sites are discussed in more detail in the Cultural Heritage chapter 07.

Table 6-18: Graves and grave relocation willingness within communities[51]

Province	Municipality	Communities	Presence of graves	Procedure for moving graves
Lunda Sul	Saurimo	Muieie	Yes	Community unable to inform
		Luari	Yes	Community unable to inform
		Nanguanza	Yes	Community unable to inform
		Muamucalanganza	No	n/a
		Muanguiji	Yes	Community unable to inform
		Saquembue	No	n/a
		Caiaza	Yes	Not possible to move graves. The traditions of the community do not allow for the tombs of ancestors to be moved. If it happens, the community may face several problems as a result of this
		Cassamba 1	Yes	Community unable to inform
	Dala	Sangoma	No response	No response
		Mombo	No	n/a
		Mukuanguaji	No	n/a
		Satxitende	No	n/a
		Nacatoco, Sayassua	Yes	A ceremony is required before the graves can be moved
		Luele	Yes	Before exhumation permission must be requested from the Soba, and a ritual offering wine and a blanket to the family of the deceased should be performed
		Sassuco, Biula, Sacacuca	Yes	Exhumation is possible. Compensation in the form of food, drinks and money must be paid and a new space for reburial must be provided
Moxico	Moxico	Canda I, Canda II, Samauzo	Yes	A ceremony is required before the graves can be moved
		Sacapiasso, Migotchi	No	n/a

[51] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Presence of graves	Procedure for moving graves
	Camanongue	Musseringinge	No	n/a
		Samucanda, Sakambudji	No	n/a
		Muapezo	Yes	A ceremony is required before the graves can be moved
		Mumanga, Caiza, Saissazo	No	n/a
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	No	n/a
		Kamaleke	Yes	A ceremony is required before the graves can be moved

6.9 Livelihoods and vulnerability

Angola has a national employment rate[52] of approximately 63.1%, with rural employment being approximately 79.7%. In both the Moxico and Lunda Sul Provinces only a small proportion of the economically active people are in formal employment (Table 6-21). Most people earn a living through subsistence farming, hunting or artisanal fishing (Table 6-19), although a large proportion of households did not declare their main economic activity. Women usually take care of the children and make a living through farming activities. According to the 2014 Census approximately 82% of rural households practice agriculture on their own. In the Moxico and Lunda Sul Provinces most households grow cereal grains or practice forestry (Table 6-22). Slightly more women than men are involved in subsistence agriculture. A large part of the population in the area makes a living through the informal sector. Main economic sectors include energy, agriculture, textiles, and beverages.

Table 6-19: Main economic activity[53]

Variable Main economic activity	National	Moxico Province	Lunda Sul Province
Agriculture, animal production, hunting, forestry and fishing	**2 403 090**	74 492	17 484
Industry	**98 157**	714	1 524
Construction	**222 584**	2 914	2 295
Wholesale and retail trade; repair of motor vehicles and motorcycles	**328 771**	2 931	3 210
Transport, storage and communication	**162 475**	1 209	1 679
Administrative activities and support services	**198 929**	1 466	1 921

[52] https://angop.ao/en/noticias/economia/populacao-empregada-sobe-1-9-no-iv-trimestre/

[53] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

Public administration and defence; mandatory social security	**349 205**	10 564	7 057
Education	**118 595**	1 887	1 602
Other activities and services	**281 376**	2 605	2 676
Not declared	**1 279 502**	18 632	22 104
Total	**5 442 685**	117 415	61 552

The communities have indicated that most people are farmers, and in a few communities, there are also pastoralists (Table 6-20). Crop farming is the main source of income in all communities (Figure 6-9, Figure 6-10). In Musseringinge there is small mill that the community use make flour.

Table 6-20: Main occupation and source of income in communities[54]

Province	Municipality	Communities	Main occupation	Main source of income
Lunda Sul	Saurimo	Muieie	Farmer	Farming (crop and tree production)
		Luari	Farmer	Farming (crop and tree production)
		Nanguanza	Farmer	Farming (crop and tree production)
		Muamucalanganza	Farmer	Farming (crop and tree production)
		Muanguiji	Farmer, Pastoralism	Farming (crop and tree production)
		Saquembue	Farmer	Farming (crop and tree production)
		Caiaza	Farmer	Farming (crop and tree production)
		Cassamba 1	Farmer	Farming (crop and tree production)
	Dala	Sangoma	Farmer, Pastoralism	Farming (crop and tree production)
		Mombo	Farmer	Farming (crop and tree production)
		Mukuanguaji	Farmer	Farming (crop and tree production)
		Satxitende	Farmer	Farming (crop and tree production)
		Nacatoco, Sayassua	Farmer, Pastoralism	Farming (crop and tree production)
		Luele	Farmer	Farming (crop and tree production)

[54] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Main occupation	Main source of income
		Sassuco, Biula, Sacacuca	Farmer	Farming (crop and tree production)
Moxico	Moxico	Canda I, Canda II, Samauzo	Farmer	Farming (crop and tree production)
		Sacapiasso, Migotchi	Farmer	Farming (crop and tree production)
	Camanongue	Musseringinge	Farmer	Farming (crop and tree production)
		Samucanda, Sakambudji	Farmer	Farming (crop and tree production)
		Muapezo	Farmer	Farming (crop and tree production)
		Mumanga, Caiza, Saissazo	Farmer	Farming (crop and tree production)
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Farmer	Farming (crop and tree production)
		Kamaleke	Farmer	Farming (crop and tree production)

Table 6-21: Economic activity and employment[55]

Variable	National	Moxico Province	Lunda Sul Province	Urban	Moxico Province	Lunda Sul Province	Rural	Moxico Province	Lunda Sul Province
Economic activity		**National**	**National**		**Urban**	**Urban**		**Rural**	**Rural**
Population aged 15 or over									
Total	**13 592 528**	374 580	275 881	**8 706 581**	205 917	215 171	**4 885 947**	168 663	60 710
Male	**6 447 391**	178 018	136 571	**4 198 111**	97 357	105 734	**2 249 280**	80 662	30 837
Female	**7 145 137**	196 562	139 310	**4 508 470**	108 560	109 436	**2 636 667**	88 002	29 873
Economically Active Population (%)									
Total	**52.8**	44.3	39.0	**49.7**	39.7	37.8	**58.4**	50.0	43.4
Male	**61.1**	53.1	49.0	**60.0**	50.3	49.0	**63.0**	56.5	49.2
Female	**45.4**	36.4	29.2	**40.2**	30.1	27.0	**54.4**	44.1	37.4
Employment									
Population aged 15 or over									
Total	**5 442 685**	117 415	61 552	**2 997 548**	49 558	43 911	**2 445 137**	67 856	17 642
Male	**3 005 756**	66 925	40 781	**1 823 508**	31 349	31 031	**1 182 248**	35 576	9 750
Female	**2 436 929**	50 489	20 772	**1 174 040**	18 209	12 880	**1 262 889**	32 281	7 891
Employed Population (%)									
Total	**40.0**	31.3	22.3	**34.4**	24.1	20.4	**50.0**	40.2	29.1
Male	**46.6**	37.6	29.9	**43.4**	32.2	29.3	**52.6**	44.1	31.6
Female	**34.1**	25.7	14.9	**26.0**	16.8	11.8	**47.9**	36.7	26.4

Table 6-22: Type of agriculture practiced[56]

[55] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

[56] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

Variable	National	Moxico Province	Lunda Sul Province	Urban	Moxico Province	Lunda Sul Province	Rural	Moxico Province	Lunda Sul Province
Type of agriculture practiced		National	National		Urban	Urban		Rural	Rural
Total households	**5 544 834**	163 101	111 643	**3 381 209**	85 236	83 175	**2 163 626**	77 865	28 469
Households that practice agriculture	**2 570 003**	93 129	38 422	**796 261**	31 461	16 252	**1 773 742**	61 667	22 170
Forestry	**406 247**	41 523	11 455	**196 720**	14 202	5 197	**209 527**	27 321	6 259
Fruit growing	**321 907**	10 403	7 328	**166 859**	5 153	3 626	**155 048**	5 249	3 701
Horticulture	**582 072**	13 393	11 087	**287 557**	7 084	6 981	**294 515**	6 310	4 106
Cereal grains	**1 893 444**	47 874	14 092	**475 931**	15 258	5 784	**1 417 513**	32 616	8 309

Figure 6-9: Example of small fields farming practices along the corridor

Figure 6-10: Protected horticulture plot along the railway corridor

Figure 6-11: Goats rearing along the railway corridor

The Camanongue Municipality estimates its agricultural production for 2020/2024 on 30 891 metric tons, and there are a number of small-scale producers, peasant associations, agricultural cooperatives and field schools in the municipal area. The municipality has an agricultural support programme and approximately 3,000 families have registered for support and monitoring for the 2023/2024 agricultural year. The municipality has delivered the following seeds and materials to the families – 3,000 kg of rice, 3,000 kg of corn, 1,000 kg of butterbeans, 500 kg of Macunde beans, 1.000 kg of Massambala, 1,000 kg Massongo, and 1,000 kg of Ammonium Sulphate. In addition, the Provincial Administration made available made available a total of 4,500 tonnes of different seeds, as well as tractors, 200 hoes, and 50 machetes to promote local agricultural production (Figure 6-12).

Furthermore, the Municipal Administration has implemented the National Plan for the Promotion of Grain Production (PLANAGRÃO), on a commercial scale, which aims to produce grains in the five-year period 2022-2027, such as wheat, rice, soybeans and corn, with greater attention to the East of the country (Moxico Province).

In terms of livestock the municipality has a total of 30,000 hectares for pasture and capacity for the settlement of more than 6,900 animals of different species. It is estimated that there are over 900 head of cattle, 1 500 goats (Figure 6-11), 800 sheep, 700 pigs and a further 3 000 birds (poultry) in the municipal area. Beekeeping in the municipality is practiced in a traditional way, and there are currently 149 beekeepers and 5 cooperatives in the municipal area with an estimated production of 863 liters per year. A new project that promotes fish

farming that can benefit about 100 families directly, and that can produce 18 tons of fish annually is foreseen.

Figure 6-12: Farming activities using Tractors along the corridor

There are 17 licensed commercial and commercial service establishments in the Camanongue Municipality, predominantly in the retail trade sector. It must be noted that most of these is controlled by expatriates. The municipality does not have the infrastructure for vocational training, but technical courses are from time to time presented by INEFOP technicians. To promote self-employment 69 kits (PIDLCP and PAPE) were distributed that resulted in the creation of 192 direct jobs for local youth. The industrial sector is characterized by the existence of small industrial units, with 18 mills that are installed, of which 10 are licensed.

The economy in the Saurimo Municipality is dominated by diamond mining, with the largest mining company in the country, Sociedade Mineira de Catoca, being the largest private employer in the municipal area. There are four other mining cooperatives in the municipality that is in the process of being transformed into a mining company. The tourism industry has shown some positive growth with the constant emergence of hotels, leisure facilities and other spaces that attracts tourists. The main hotels are the Chik Chik Group, Hotel Lunda, and Hotel Princezinha. The commerce sector is showing some growth with young people increasingly setting up small businesses, mainly boutiques and cosmetic shops, catering and services, not only employing themselves but also generating jobs for other people. This is the third largest private employer in the municipal area. There are currently about 1,812 stores of different sizes in the municipality. Large stores include Shoprite, Nosso Super, Angomarte, and the Newaco Group, while small stores include stores selling food, clothing, plastics and other items, mini

markets, canteens and others (Figure 6-13). Industry mainly consists of factories producing concrete blocks and reinforced concrete for civil construction, carpenters, locksmiths, and the recently inaugurated school lunch factory. Subsistence agriculture is the backbone of the rural economy and the most common agricultural products are cassava, corn, peanuts, sweet potatoes, pineapples, beans, wheat, sorghum, soybeans, vegetables and fruit trees, while the most common livestock are cattle, goats, poultry, and pigs. Artisanal fishing in the rivers is used largely by the population to obtain food or make a livelihood.

Figure 6-13: Examples of small shops in Saurimo city

In the Dala Municipality the main means of subsistence is agriculture, followed by fishing, charcoal production, and honey production.

In all communities along the railway line, people make a living as a family from subsistence farming (Table 6-23). Although community members sell their produce and take the produce to the market, it is not commercial farming, but rather a means to get money to buy soap, oil and other necessities that are not available in the villages (Figure 6-14). The crops planted in each area vary; many people grow beans, cassava, cabbage, maize, rice, and potatoes.

Figure 6-14: Sample produce being prepared for selling

Table 6-23: Type of agriculture and crops grown by communities along the railway corridor[57]

Province	Municipality	Communities	Type of agriculture	Crops grown
Lunda Sul	Saurimo	Muieie	Family farming for subsistence	Cabbage, Cassava, Maize, Potatoes, Tomatoes, Radishes
		Luari	Family farming for subsistence	Beans, Cabbage, Cassava, Ground nuts, Potatoes, Yams, Radishes
		Nanguanza	Family farming for subsistence	Beans, Cassava, Ground nuts, Maize, Potatoes
		Muamucalanganza	Family farming for subsistence	Cassava, Ground nuts, Maize, Potatoes
		Muanguiji	Family farming for subsistence	Beans, Ground nuts, Maize, Rice
		Saquembue	Family farming for subsistence	Cassava, Ground nuts, Maize, Potatoes
		Caiaza	Family farming for subsistence	Beans, Cassava, Maize, Rice
		Cassamba 1	Family farming for subsistence	Beans, Cassava, Maize, Rice

[57] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Type of agriculture	Crops grown
	Dala	Sangoma	Family farming for subsistence	Beans, Carrots, Potatoes, Rice, Eggplant, Radish, Gindungo[58]
		Mombo	Family farming for subsistence	Beans, Cabbage, Ground nuts, Potatoes, Tomatoes, Kale, radishes, yams
		Mukuanguaji	Family farming for subsistence	Beans, Cassava, Maize
		Satxitende	Family farming for subsistence	Beans, Cassava, Maize, Potatoes, Yams
		Nacatoco, Sayassua	Family farming for subsistence	Beans, Carrots, Potatoes, Rice
		Luele	Family farming for subsistence	Beans, Maize, Yams
		Sassuco, Biula, Sacacuca	Family farming for subsistence	Cassava, Maize, Potatoes, and other vegetables
Moxico	Moxico	Canda I, Canda II, Samauzo	Family farming for subsistence	Beans, Maize, Ginger
		Sacapiasso, Migotchi	Family farming for subsistence	Beans, Cabbage, Cassava, Ground nuts, Maize
	Camanongue	Mussirinjiji	Family farming for subsistence	Beans, Cassava, Potatoes
		Samucanda, Sakambudji	Family farming for subsistence	Beans, Cassava
		Muapezo	Family farming for subsistence	Beans, Cassava, Maize, Potatoes
		Mumanga, Caiaza, Saissazo	Family farming for subsistence	Cassava, Maize, Potatoes
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Family farming for subsistence	Beans, Cassava, Ground nuts, Maize, Potatoes
		Kamaleke	Family farming for subsistence	Carrots, Cassava, Potatoes

In most of the communities the young people tend to migrate to other locations mostly major towns in search of employment opportunities (Table 6-24).

[58] A type of pepper

Table 6-24: Youth mobility in communities along the railway line[59]

Province	Municipality	Communities	Young people move to other locations for employment reasons
Lunda Sul	Saurimo	Muieie	Yes
		Luari	Yes
		Nanguanza	No
		Muamucalanganza	Yes
		Muanguiji	Yes
		Saquembue	Yes
		Caiaza	Yes
		Cassamba 1	Yes
	Dala	Sangoma	Yes
		Mombo	Yes
		Mukuanguaji	Yes
		Satxitende	No
		Nacatoco, Sayassua	Yes
		Luele	Yes
		Sassuco, Biula, Sacacuca	Yes
Moxico	Moxico	Canda I, Canda II, Samauzo	Yes
		Sacapiasso, Migotchi	Yes
	Camanongue	Mussirinjiji	Yes
		Samucanda, Sakambudji	Young people rarely move to other locations in search of other opportunities
		Muapezo	Yes
		Mumanga, Caiaza, Saissazo	Yes
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Young people rarely move to other communities in search of better conditions
		Kamaleke	Yes

Vulnerability

The residents living in the communities in close proximity to the proposed railway are all experiencing severe levels of poverty on multiple dimensions. In the areas close to the cities and towns, the poverty levels seem slightly less severe. As such the communities can all be considered as vulnerable. Within the vulnerable communities there are groups that can be considered more vulnerable, such as

[59] Source: Baseline data collection for SIA, March 2024

the elderly, people with physical and mental disabilities, refugees, migrant workers, and people that are small scale pastoralist (move around between areas with their animals). Table 6-25 gives an indication of the presence of vulnerable groups in the affected communities as reported by the communities.

Child labour is a contentious issue from a human rights perspective, and children performing labour activities within these communities should be understood within context.

Table 6-25: Presence of vulnerable groups along the railway line [60]

Province	Municipality	Communities	Vulnerable groups present
Lunda Sul	Saurimo	Muieie	Migrant workers
		Luari	Migrant workers, small scale livestock herders
		Nanguanza	Migrant workers
		Muamucalanganza	Migrant workers
		Muanguiji	None reported
		Saquembue	None reported
		Caiaza	None reported
		Cassamba 1	Migrant workers
	Dala	Sangoma	Small scale livestock herders
		Mombo	Internally displaced people/ refugees, Migrant workers
		Mukuanguaji	None reported
		Satxitende	None reported
		Nacatoco, Sayassua	None reported
		Luele	Children working in the informal sector
		Sassuco, Biula, Sacacuca	None reported
Moxico	Moxico	Canda I, Canda II, Samauzo	Children help in the fields, but they don't sell informally
		Sacapiasso, Migotchi	None reported
	Camanongue	Musseringinge	Migrants from other African countries
		Samucanda, Sakambudji	None reported
		Muapezo	Internally displaced people/ refugees
		Mumanga, Caiaza, Saissazo	None reported
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Children working in the informal sector

[60] Source: Baseline data collection for SIA, March 2024

		Kamaleke	Small scale livestock herders, as for work, there are children who help in the fields, but they don't sell informally

The community's livelihood relies on limited livestock, mainly chickens, pigs, and goats, with a strong desire for job opportunities and local involvement in upcoming projects to address unemployment concerns. Social and economic issues like skill utilization, education accessibility, and health concerns such as malaria and TB are prevalent, alongside expectations for positive impacts from the upcoming railway project, albeit with concerns about its implementation, particularly regarding affordability and local benefit. Social perspectives highlight vulnerabilities in rural areas, potential impacts on water access due to construction, and the need for gender equality, local recruitment procedures, and health considerations in the Project's planning and execution, emphasizing the railway's critical role in community development and accessibility.

6.10 Housing

The 2014 Census shows that most households (70%) live in dwellings that they constructed themselves, about 19% live in rented houses, and only 6% live in houses purchased or in the process of being purchased. In the rural areas between Saurimo and Luena the dwellings are mostly constructed with cement bricks, mud bricks or traditional materials (Figure 6-15, Figure 6-16, Figure 6-17, Figure 6-18). Most dwellings have zinc roofs, but some dwellings have thatched roofs. Community members have indicated that the Lunda Sul Province has a programme where residents can get a determined number of zinc plates for roofs if they build a dwelling (Figure 6-19). The Moxico Province did not have a similar programme. Potential Affected Communities (PACs) that have buildings/houses within the direct footprint i.e. within the 100 m buffer of the railway (50 m on either side of the centreline of the railway alignment) are presented in Table 6-26.The separate Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) for the Project are is required to determine the extent and magnitude of potentially affected households both economically and physically. The RAP and LRP will be developed at later stages as part of Project.

Figure 6-15: Typical dwellings along the railway route (1)

Figure 6-16: Typical dwellings along the railway route (2)

Figure 6-17: Typical dwellings along the railway route (3)

Figure 6-18: Typical dwellings along the railway route (4)

Figure 6-19: Houses waiting for roofing

Table 6-26: Potentially affected communities

Community	Comments
Nanguanza (Figure 6-22)	There are half-finished houses within 100 m of the proposed railway. According to the local people they build houses and then wait until they can afford zinc roofs before they complete the house. In Linda Sul Province there is a programme that provide people with zinc sheets, but this programme is not in Moxico. The community and tar road are within 500 m of the railway
Saquembue	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Muamucalanganza	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Caiza	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Cassamba 1	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Maurilio	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Muxie	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m. All the homes are across the tar road from the railway line
Luachimo	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m. Most of the homes are across the tar road from the railway line
Luele	The community and tar road are within 500 m of the railway, and although there are no buildings within 100 m, there are clearings
Mukuanguaji (Figure 6-21)	The community is in-between the tar road and the railway, and approximately half of the houses are within 100 m of the railway. An isolated house seems to be on top of the railway
Satxitende (Figure 6-23)	The community is in-between the tar road and the railway, and within 500 m of the railway. There are buildings within 100 m of the railway
Biula	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Camuleque	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Community at 64.5km mark	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m
Community at 56 km mark	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m. All the homes are across the tar road from the railway line
Muapezo (Figure 6-20)	The community is within 500 m of the railway. There are buildings within 100 m of the railway
Saissazo	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m. All the homes are across the tar road from the railway line

Community	Comments
Caiza,	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m. All the homes are across the tar road from the railway line
Mumanga	The community and tar road are within 500 m of the railway, but there are no buildings within 100 m. All the homes are across the tar road from the railway line

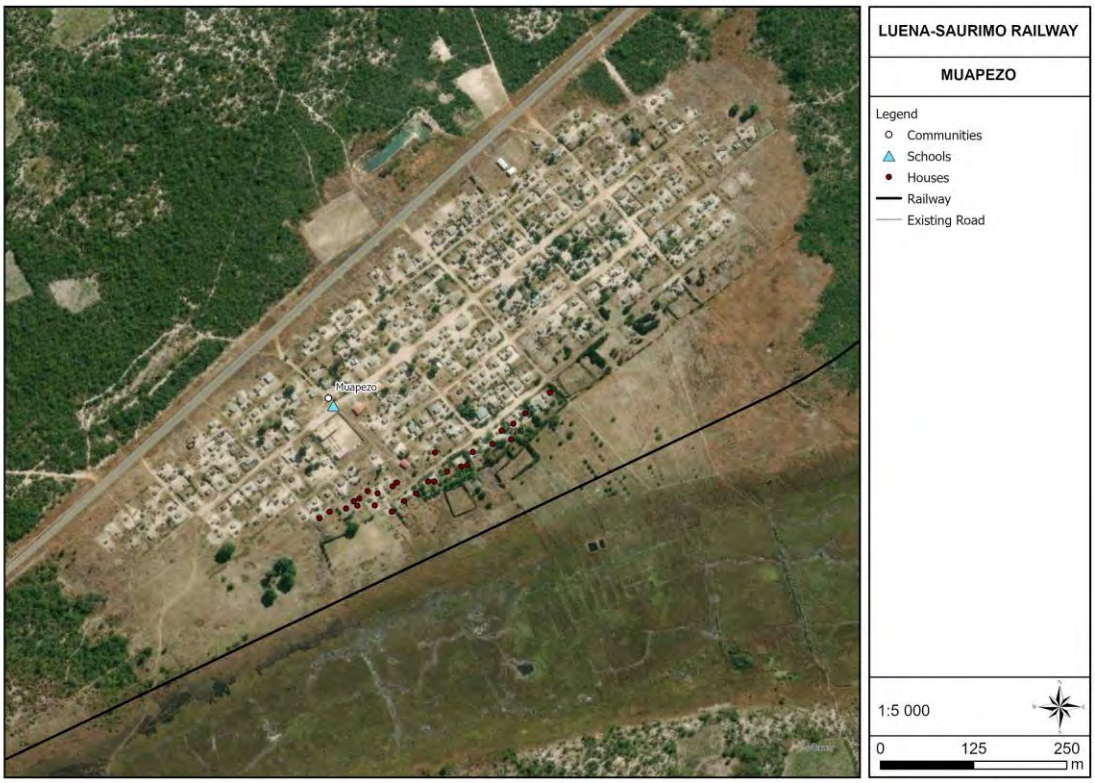


Figure 6-20: **Proximity of Muapezo to railway line**

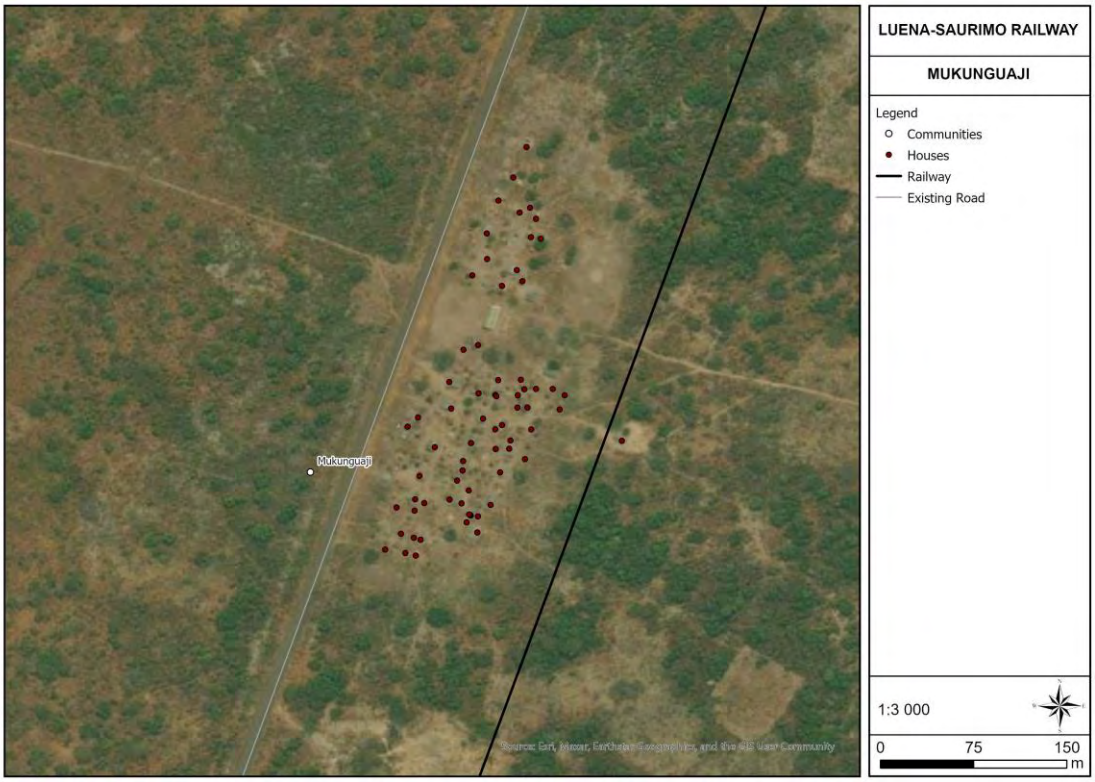


Figure 6-21: Proximity of Mukuanguaji to railway line

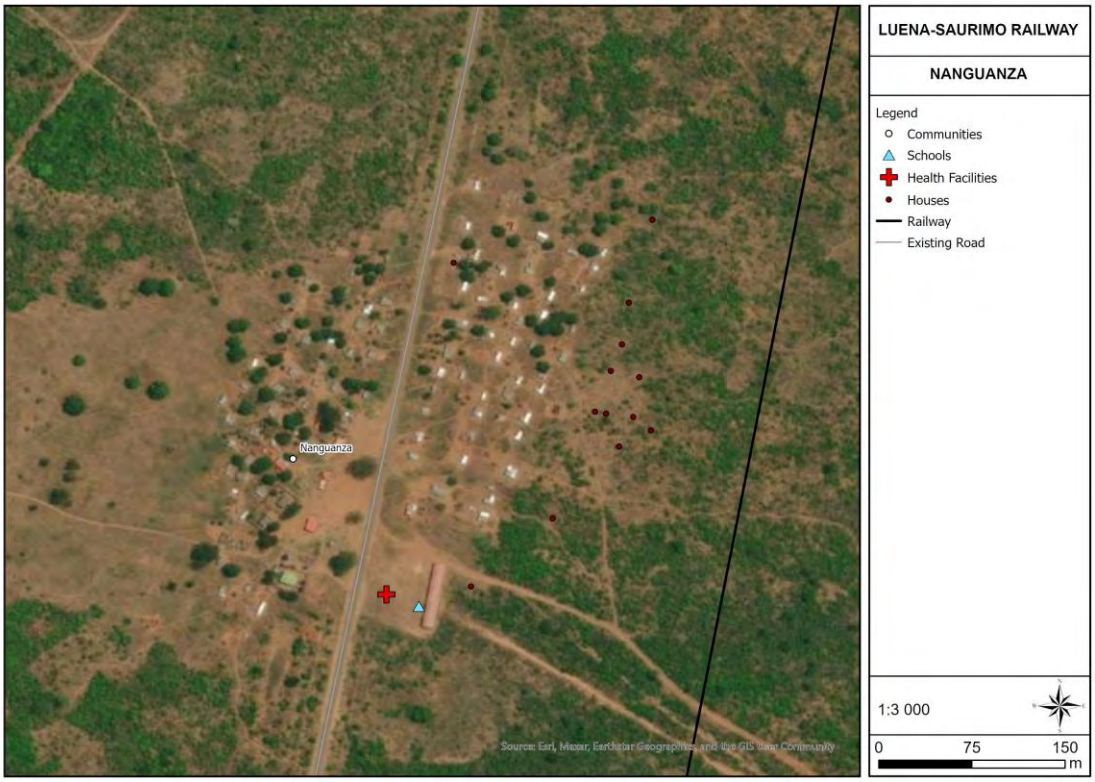


Figure 6-22: Proximity of Nanguanza to railway line

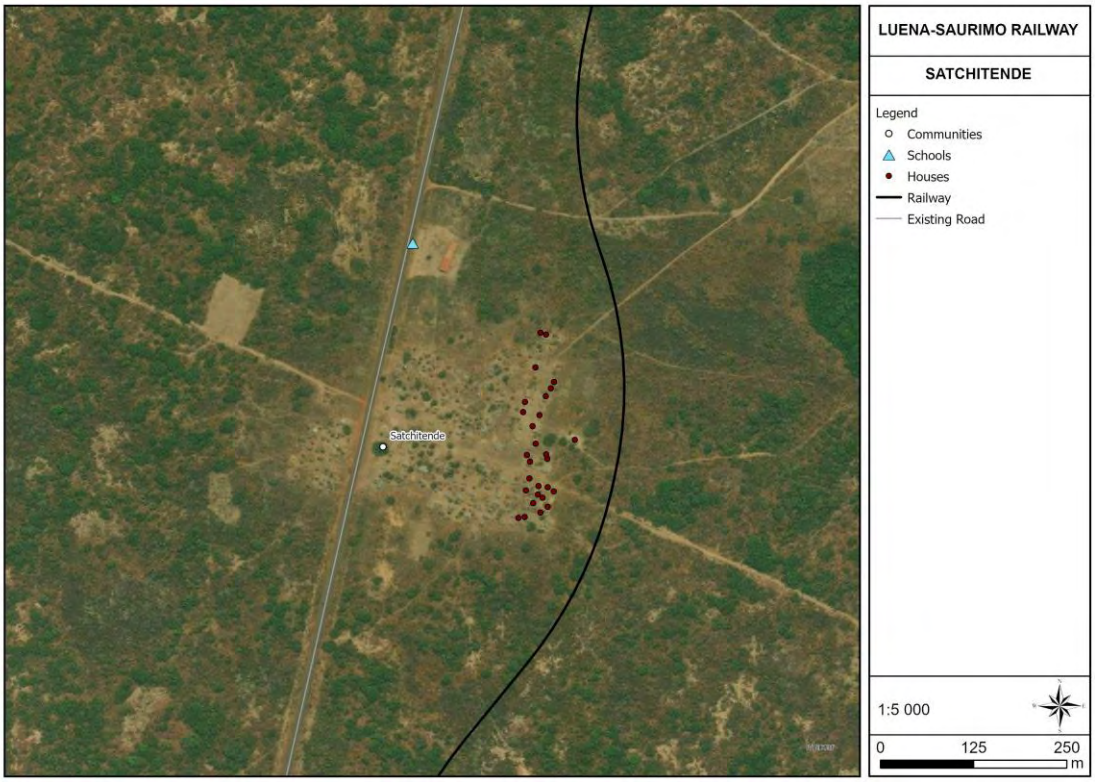


Figure 6-23: Proximity of Satchitende to railway line

6.11 Water and sanitation

Table 6-27 shows that households in rural areas have very limited access to resources such as clean drinking water, sanitation facilities, electricity, and garbage disposal. Even in urban areas, many households are to some extent deprived. Municipal water supply, where present, is limited in both coverage and reliability. Seasonal shortages and equipment failures occur frequently, and service delivery prioritises residential demand, leaving little surplus capacity for industrial use. As such, municipal systems cannot be assumed to provide consistent or high-volume supply to the Project without upgrades or supplementary arrangements. The communities along the alignment primarily rely on boreholes and hand-dug wells for domestic use, with limited and often unreliable municipal reticulation in larger settlements. Field surveys for the Project confirmed that several community and municipal boreholes were non-functional due to pump failure, and that many households depend on shallow or seasonal sources during the dry season. Existing groundwater abstraction in rural areas is generally low, but aquifer productivity is variable.

Access to functional infrastructure like boreholes is inconsistent, with challenges in water access and functional public services noted by local administrations.

Table 6-27: Access to resources at national level - urban and rural area (source: Census 2014)

Resources	National	Urban	Rural
Proportion of households with access to an appropriate drinking water source	44.0%	57.0%	22.3%
Proportion of households that uses appropriate treatment for drinking water	36.1%	51.4%	13.0%
Proportion of households with access to adequate sanitary facilities	60.0%	81.0%	25.9%
Proportion of households with access to electricity	31.9%	50.9%	2.2%
Proportion of households that uses solid fuel for cooking	55.0%	30.7%	93.5%
Proportion of households that deposits garbage in an appropriate place	26.3%	37.5%	8.8%

In both the urban parts of the Moxico and Lunda Sul Provinces, most households get their water from a tanker truck (Table 6-28), while most households in the rural parts get their water from an unprotected waterhole or a river or creek. During site visit it was observed that most of the installed boreholes (for communities along the railway corridor) are not functioning. Alternatively, existing rivers and streams are critical water sources for domestic uses and all other uses. Hence, most settlements along the railway line are located adjacent to existing perennial rivers and streams.

Nearly all communities along the railway corridor source their water from the river (Figure 6-24,Table 6-29). In some communities the residents have indicated that there are natural springs in the area where they source their water from. In some communities' residents have reported that the water supply system is not functional.

Table 6-28: Main source of drinking water at Provincial level[61]

Variable	National	Moxico Province	Lunda Sul Province	Urban	Moxico Province	Lunda Sul Province	Rural	Moxico Province	Lunda Sul Province
Main source of drinking water		National	National		Urban	Urban		Rural	Rural
Total households	**5 544 834**	**163 101**	**111 643**	**3 381 209**	**85 236**	**83 175**	**2 163 626**	**77 865**	**28 469**
Tap in the residence connected to the public network	**616 037**	664	10 661	**595 003**	534	10 499	**21 033**	130	163
Tap in the building/neighbour connected to the public network	**329 248**	230	10 663	**324 289**	195	10 601	**4 959**	35	62
Public fountain	**571 279**	16 138	7 978	**442 895**	13 543	5 183	**128 384**	2 595	2 795
Waterhole with pump	**99 290**	14 552	103	**47 803**	11 201	56	**51 487**	3 351	48
Protected waterhole	**682 930**	8 649	420	**485 839**	6 248	378	**197 091**	2 400	42
Protected spring	**118 942**	5 725	1 395	**37 408**	4 249	979	**81 534**	1 475	416
Tanker truck	**926 927**	28 086	33 354	**879 320**	27 244	33 243	**47 608**	843	111
Unprotected waterhole	**798 679**	43 294	1 829	**274 741**	11 998	851	**523 939**	31 296	978
Unprotected spring	**357 340**	11 495	5 809	**55 372**	3 429	3 271	**301 967**	8 066	2 538
Rainwater/open ponds	**70 280**	312	391	**3 467**	98	225	**66 813**	213	166
Harbour/River/Creek	**848 572**	33 645	38 207	**119 755**	6 356	17 111	**728 817**	27 289	21 096
Other	**125 310**	313	832	**115 317**	6 356	777	**9 993**	173	55

[61] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

Table 6-29: Access to water for communities along the project corridor[62]

Province	Municipality	Communities	Source of drinking water	Source of water for livestock	Source of water for crops	Seasonal availability of water
Lunda Sul	Saurimo	Muieie	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Luari	Hole with pump	Canal, river, pond	Canal, river, pond	Always available
		Nanguanza	Puddle/river/creek, Hole with pump	Canal, river, pond	Canal, river, pond	Always available
		Muamucalanganza	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Muanguiji	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Saquembue	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Caiaza	Puddle/river/creek, Hole with pump	Canal, river, pond	Canal, river, pond	Always available
		Cassamba 1	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
	Dala	Sangoma	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Mombo	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Mukuanguaji	Hole with pump	Canal, river, pond	Canal, river, pond	Always available
		Satxitende	Hole with pump	Canal, river, pond	Canal, river, pond	Always available
		Nacatoco, Sayassua	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Luele	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Sassuco, Biula, Sacacuca	Puddle/river/creek, Hole with pump	Canal, river, pond	Canal, river, pond	Always available
Moxico	Moxico	Canda I, Canda II, Samauzo	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Community members are currently having difficulty accessing

[62] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Source of drinking water	Source of water for livestock	Source of water for crops	Seasonal availability of water
						water as a large part of the river has been privatised
		Sacapiasso, Migotchi	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
	Camanongue	Mussirinjiji	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available. Water source in community not working
		Samucanda, Sakambudji	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available. Conventional system in community not working
		Muapezo	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available. There are reservoirs, but they are not operational
		Mumanga, Caiaza, Saissazo	Puddle/river/creek	There are no livestock in the community	Canal, river, pond	Always available. Water source on Mumanga, but not operational
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available
		Kamaleke	Puddle/river/creek	Canal, river, pond	Canal, river, pond	Always available

Some villages in the Saurimo have a PSA (small water system) that provides water, while others use the rivers to source water (Table 6-30). The water for the PSAs is treated and analysed by a laboratory before it is used. There is water supply infrastructure for the villages along the route, consisting of reservoirs/tanks, fountains, pipes, and artisanal boreholes with suction pumps. There are plans to expand the water network at municipal level with the new Luachimo Water Treatment Plant (WTP) and some isolated water systems. According to the municipality, a considerable number of communities have access to sanitation facilities due to a village improvement program that was implemented, eliminating the need to defecate in the open.

Despite the presence of several rivers in the area, the Municipal Administration of Dala has indicated that there is no system to supply running water throughout the Municipality and in some villages, there are boreholes and gravity pumping systems (Table 6-31). There are 58 villages in the municipal area, but only 22 water points or holes. In the remote areas people carry water for a distance of 100 m to 1 km. For the Municipal Administration the supply of running water is a challenge as the existing pipeline dates back to the colonial era. There is currently a project to build a water treatment plant to strengthen the water supply in the municipality, including villages close to the municipal headquarters.

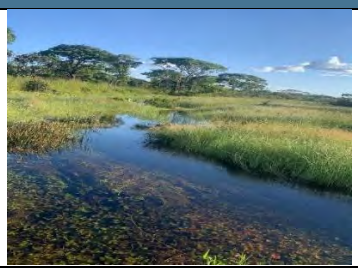
Figure 6-24: Rivers utilised for water sources along the Project area corridor

Table 6-30: water supply structures in Saurimo Municipality

Water supply and sanitation structure	Photography	Relevance
Luari neighbourhood		The community benefits from a functional water supply system, built as part of the water for all program
Muieie neighbourhood		Water is collected in this community by the river, which is 800 meters away
Nanguanza neighbourhood		The water supply structure in the Nanguanza neighbourhood is broken. The community is using water from the Luachimo River, which is 3 km away. This system is part of the public water supply program for communities, called water for all"

Water supply and sanitation structure	Photography	Relevance
Muamucalanganza neighbourhood		The community uses the Luachimo River as its main source of water. This river is at a distance of 1.5 km from the community
Caiaza neighbourhood		The community's water supply structure is fully operational

Table 6-31: water supply structures in Dala Municipality

Water supply and sanitation structure	Photography	Relevance
Sangoma neighbourhood		In the Sangoma neighbourhood, the only access point to water is the river, which is 1.5 km from the neighbourhood

Water supply and sanitation structure	Photography	Relevance
Biula neighbourhood		The Biula neighbourhood is one of the neighbourhoods that went through the neighbourhood unification process, and this increased its population density because the Sassuco neighbourhoods and the Sassuco neighbourhood, Sacacuca were included. The community has two water supply systems, one of which was built under the water for all program, but they work very intermittently due to a failure in the pumping system. Because of this, they are often forced to turn to Rio to access water
Saiassua neighbourhood		Considering that the community is located close to the Tchiumbwe River, the community in question uses this river to access water
Luele neighbourhood		In Bairro Luele, there is a water collection system through boreholes, which were installed at different points in the neighbourhood
Satxitende neighbourhood		In the Satxitende neighbourhood, there is a water collection system installed as part of the water for all program that is functional. In different parts of the neighbourhood, it is possible to see fountains that were installed in different parts of the neighbourhood

Water supply and sanitation structure	Photography	Relevance
Mukuanguaji neighbourhood		In the Mukuanguaji neighbourhood there is a water harvesting system installed as part of the water for the entire program that is in operation. In different parts of the neighbourhood, it is possible to see fountains that were installed in different parts of the neighbourhood

Table 6-32: water supply structures in Camanongue Municipality

Water supply and sanitation structure	Photography	Relevance
Municipal of Camanongue		Water and sanitation structure in Camanongue

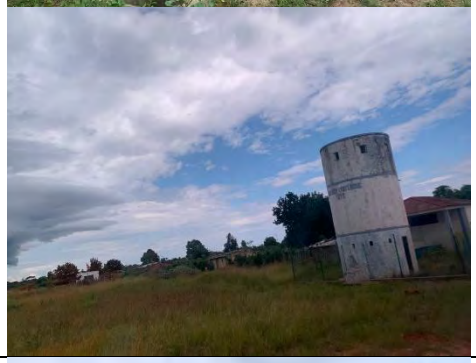
Water supply and sanitation structure	Photography	Relevance
Mussirinjiji neighbourhood		The water structure of the neighbourhood is found dead
Samucanda neighbourhood		The water structure of the neighbourhood is found dead
Muapezo neighbourhood		The water structure of the neighbourhood is found dead at the moment, the population uses the river, which is at a distance of 1.5 km

Table 6-33: water supply structures in Moxico Municipality

Water supply and sanitation structure	Photography	Relevance
Luena neighbourhood	At the level of the Municipality of Moxico there is a drinking water supply system that supplies the municipality	In the Sangoma neighbourhood, the only access point to water is the river, which is 1.5 km from the neighbourhood
Sacapiasso neighbourhood		In this community, the only source of water that the community has is the river, which is located at the

Very few households have access to sanitation services inside their dwelling (Table 6-34, Table 6-35) and a very large proportion of households have no access to sanitation. In most communities there are no toilets, except in the areas that are close to the larger towns that are connected to a septic tank. Even where there are toilets connected to infrastructure; the toilets are not fully functional due to a lack of running water. There are communal taps in all the communities, but most are not currently functional.

Table 6-34: Access to sanitation for communities along the project corridor[63]

Province	Municipality	Communities	Access to sanitation
Lunda Sul	Saurimo	Muieie	No outdoor toilet
		Luari	No outdoor toilet
		Nanguanza	No outdoor toilet
		Muamucalanganza	No outdoor toilet
		Muanguiji	No outdoor toilet
		Saquembue	No outdoor toilet
		Caiaza	No outdoor toilet
		Cassamba 1	No outdoor toilet
	Dala	Sangoma	No outdoor toilet
		Mombo	No outdoor toilet
		Mukuanguaji	No outdoor toilet
		Satxitende	Toilet/latrine connected to the septic tank
		Nacatoco, Sayassua	No outdoor toilet
		Luele	No outdoor toilet, Toilet connected to the septic tank
		Sassuco, Biula, Sacacuca	No outdoor toilet, Toilet connected to the septic tank

[63] Source: Baseline data collection for SIA, March 2024

Table 6-35: Type of toilet recorded at provincial level[64]

Variable	National	Moxico Province	Lunda Sul Province	Urban	Moxico Province	Lunda Sul Province	Rural	Moxico Province	Lunda Sul Province
Type of toilet		National	National		Urban	Urban		Rural	Rural
Total households	**5 544 834**	**163 101**	**111 643**	**3 381 209**	**85 236**	**83 175**	**2 163 626**	**77 865**	**28 469**
Inside the house	***2 157 722***	*33 596*	*31 647*	***1 945 409***	*28 926*	*30 750*	***212 313***	*4 670*	*898*
Toilet connected to the public sewage network	**153 340**	981	1 221	**148 055**	924	1 167	**5 284**	57	54
Toilet connected to the septic tank	**1 555 812**	6 498	12 551	**1 476 858**	5 905	12 337	**78 954**	592	213
Toilet connected to the open pit (ditch or river)	**49 823**	444	2 187	**39 149**	358	2 143	**10 674**	86	44
Latrine connected to the public sewage network	**10 119**	467	436	**8 028**	441	344	**2 091**	25	92
Latrine connected to the septic tank	**347 054**	22 728	13 340	**248 799**	19 477	12 885	**98 256**	3 251	455
Latrine connected to the open pit (ditch or river)	**41 574**	2 478	1 912	**24 519**	1 821	1 873	**17 054**	658	39
Outside the home (Includes the perimeter of the yard)	***3 377 007***	*129 321*	*79 874*	***1 428 168***	*56 181*	*52 327*	***1 948 838***	*73 140*	*27 547*
Toilet connected to the public sewage network	**25 855**	418	371	**23 944**	362	353	**1 911**	56	18
Toilet connected to the septic tank	**619 343**	3 379	10 865	**545 346**	2 738	10 716	**73 997**	641	149
Toilet connected to the open pit (ditch or river)	**58 342**	957	2 999	**39 151**	618	2 731	**19 191**	339	268
Latrine connected to the public sewage network	**8 796**	390	404	**6 703**	366	358	**2 093**	23	46
Toilet/latrine connected to the septic tank	**604 070**	56 567	21 913	**306 779**	36 170	20 730	**297 291**	20 397	1 183
Latrine connected to the open pit (ditch or river)	**96 236**	7 508	3 432	**43 728**	4 456	3 235	**52 509**	3 052	197
No toilet/Open air	***1 964 364***	*60 102*	*39 889*	***462 517***	*11 470*	*14 204*	***1 501 846***	*48 632*	*25 685*
Not declared	**10 106**	185	122	**7 632**	129	98	**2 474**	56	24

[64] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

6.12 Energy sources

The regional energy supply within the AoI is mixed, with a dependency on the national electricity grid where available, supplemented by fossil fuels for power and lighting particularly in the rural areas (World Bank, 2022). Although, the region is dominated by hydropower generation capacity, electricity access remains absent or inconsistent, particularly in rural areas and outside major urban centres (World Bank, 2022). This uneven access reflects ongoing challenges in extending and modernising the national grid infrastructure. Most households in the Moxico and Lunda Sul Provinces use a flashlight as source of energy for lighting (Table 6-36).

In the Saurimo Municipality in many instances private generator sets are used to generate electricity. In the communities of Camundambala and Nanguanza there is public solar lighting, and part of the solar annex project for lighting of schools, health centres and the homes of *Sobas* and/or *Regedores*. There are plans to build a medium-voltage distribution network from the thermal power station to the Luachimo WTP, that could run along or intersect with the proposed railway line.

The Tchiumbwe-Dala Hydro Plant is in the Municipality of Dala and has a capacity of 12.5 MW. A portion of the electricity that is produced here is distributed to the Municipality of Camanongue, leaving the Municipality of Dala with around 5.6 MW that is supplied only in the Municipal Headquarters. It is a challenge for the Municipal Administration of Dala to distribute energy to some of the neighbourhoods.

The Camanongue Municipality only has power capacity of 2.14 MW in the seat of the municipality. The communities along the EN180 highway do not have access to electricity and within the scope of the PIMM (Integrated Municipality Intervention Plan (PIMM) the acquisition of transformer stations is envisioned to expand the network. The municipality has 26 Small Water Systems that serve as sources of water supply and distribution for the population, but only 12 of these are still operational.

None of the communities, except in the Camanongue town area, have access to electricity (Table 6-37), and they are very reliant on firewood as a source of energy for cooking. For lighting purposes most communities use lanterns, flashlights, candles, or a solar source.

Table 6-36: Type of lighting[65]

Variable	National	Moxico Province	Lunda Sul Province	Urban	Moxico Province	Lunda Sul Province	Rural	Moxico Province	Lunda Sul Province
Type of lighting		National	National		Urban	Urban		Rural	Rural
Total households	**5 544 834**	**163 101**	**111 643**	**3 381 209**	**85 236**	**83 175**	**2 163 626**	**77 865**	**28 469**
Public electricity	1 770 728	9 652	22 442	1 722 556	9 202	21 950	48 173	450	492
Lamp	790 341	3 187	1 860	310 404	1 557	972	479 937	1 630	888
Candle	418 062	6 725	9 092	355 111	5 729	8 706	62 951	996	386
Firewood	288 800	9 319	2 957	12 753	897	357	276 047	8 423	2 600
Generator	515 672	23 005	17 292	430 622	20 502	16 325	85 050	2 503	967
Flashlight	1 751 127	111 029	57 878	542 134	47 221	34 768	1 208 993	63 808	23 111
Other	10 104	185	122	7 630	129	98	2 474	56	24

Table 6-37: Access to electricity in affected communities[66]

Province	Municipality	Communities	Access to electricity	Source of energy for cooking	Source of energy for light
Lunda Sul	Saurimo	Muieie	No	Firewood	Candles, Solar, Lanterns
		Luari	No	Gas, Firewood, Coal	Candles, Artisanal lamps
		Nanguanza	No	Firewood, Coal	Flashlights
		Muamucalanganza	No	Firewood	Solar, Flashlights
		Muanguiji	No	Coal	Solar, Flashlight
		Saquembue	No	Firewood	Flashlights
		Caiaza	No	Firewood	Firewood and lanterns
		Cassamba 1	No	Firewood	Solar, Firewood

[65] Instituto Nacional de Statística. Março 2016. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014

[66] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Access to electricity	Source of energy for cooking	Source of energy for light
	Dala	Sangoma	No	Firewood	Candles, Solar, Flashlight
		Mombo	No	Firewood, Solar	Firewood, Lanterns
		Mukuanguaji	No	Firewood	Lanterns
		Satxitende	No	Firewood, Coal	Lanterns
		Nacatoco, Sayassua	No	Firewood	Solar, Lantern and Firewood
		Luele	No	Firewood	Solar, Lanterns
		Sassuco, Biula, Sacacuca	No	Firewood	Lanterns
Moxico	Moxico	Canda I, Canda II, Samauzo	No	Firewood	Lanterns
		Sacapiasso, Migotchi	No	Firewood	Solar, Lanterns
	Camanongue	Mussirinjiji	No	Firewood	Solar, Lanterns
		Samucanda, Sakambudji	No	Firewood	Solar, Lanterns
		Muapezo	No	Firewood	Lanterns and Firewood
		Mumanga, Caiaza, Saissazo	No	Firewood	Lanterns
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Yes	Firewood, Coal	Electricity, Solar, Lanterns
		Kamaleke	No	Firewood	Flashlight

6.13 Transport and traffic

The EN180 highway runs between Saurimo and Luena. The existing road was upgraded and close to Saurimo the road is still under construction. Saurimo and Luena have paved roads (Figure 6-25). The road is in a very good condition, although some potholes are already starting to appear. Secondary and tertiary roads are not in a good condition. Most of the communities along the railway corridor are located in close proximity to the tar road, with the communities of Sacapiasso and Migotchi quite a distance away from the tar road, and only accessible by an earth road that is in a very poor condition (Figure 6-26).

If the community members need to travel outside the community they move by foot, using one of the many footpaths in area, or by bicycle. To travel long distances, motorcycles, three-wheeler motorcycles (commonly referred to as *bajaji*), or they pay someone to take them by car (Table 6-38, Figure 6-25). In almost all instances' people need to make their way to the EN180 or the nearest town to access motorised transport such as a car or a three-wheel motorcycle (Figure 6-26). The amounts paid depend on the mode of transport and the distance travelled and range from 1 000 Kwanza to 4 000 Kwanza per person as well as a charge for each bag of produce (Figure 6-29). There is a long-distance bus service that runs from Luena Station (Figure 6-28).

The Camanongue Municipality has a road network that comprises approximately 564 km, of which 78 km is paved. Secondary roads make up 7.5 km of the network, tertiary roads 36 km, and the complimentary network about 442 km. The bridges over the rivers in the area (Lumeje (Nacavungo), Luatchi (Mbuato), Catueji, Luri (Calundungo and Sawatata)) are in an operational condition. The roads giving access to different localities in the municipal area are not in a good condition and hinders the movement of people and goods. There are no buses for public transport in the municipality and the private services of blue and white taxis are available.

Figure 6-25: Primary, secondary and tertiary roads along the railway line

Figure 6-26: Common transport modes along the railway corridor

Figure 6-27: Streets in Saurimo

Figure 6-28: Long-distance bus at Luena Station

Figure 6-29: Produce next to the EN180 waiting to be sold or transported to the markets

Table 6-38: Transport of produce in communities along the railway line

Province	Municipality	Communities	Transport infrastructure	Means of transport used	Transport to market
Lunda Sul	Saurimo	Muieie	Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki)
		Luari	Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle
		Nanguanza	Tar road, Dirt road	Travel by foot, Bicycle, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle
		Muamucalanganza	Tar road, Dirt road, Foot path	Travel by foot, Motorcycle, Keweseki	Products produced in the community are only used for consumption
		Muanguiji	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle
		Saquembue	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle
		Caiaza	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki)
		Cassamba 1	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki)
	Dala	Sangoma	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki)
		Mombo	Tar road, Dirt road, Foot path	Travel by foot, Motorcycle, Keweseki	By foot, Someone with a tricycle (Keweseki)
		Mukuanguaji	Tar road, Dirt road, Foot path	Travel by foot, Motorcycle	By foot, Someone with a tricycle (Keweseki)

Province	Municipality	Communities	Transport infrastructure	Means of transport used	Transport to market
		Satxitende	Tar road, Dirt road, Foot path	Travel by foot, Motorcycle, Keweseki	Products produced in the community are for personal consumption only
		Nacatoco, Sayassua	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot
		Luele	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot
		Sassuco, Biula, Sacacuca	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	No response
Moxico	Moxico	Canda I, Canda II, Samauzo	Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot
		Sacapiasso, Migotchi	Tar road, Dirt road, Foot path	Travel by foot, Motorcycle	By foot, Products produced in the community are only for consumption, a small portion is sold
	Camanongue	Mussirinjiji	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	Products produced in the community are only used for consumption
		Samucanda, Sakambudji	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	Products produced in communities are only for personal consumption
		Muapezo	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle
		Mumanga, Caiaza, Saissazo	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	Products produced in communities are for consumption only
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle

Province	Municipality	Communities	Transport infrastructure	Means of transport used	Transport to market
		Kamaleke	Tar road, Dirt road, Foot path	Travel by foot, Bicycle, Motorcycle	By foot, Someone with a tricycle (Keweseki), Someone with a motor vehicle

During community consultations, it was observed that expectations regarding the forthcoming project are high, reflecting the community's eagerness for rapid progress. Both the authorities and the communities have great expectations in terms of the benefits that the Luena-Saurimo railway line will bring. The authorities expect that the railway line will make services more accessible to the communities so that they can benefit directly from the services, and that it would facilitate the flow of produce from the communities, ensuring development for the communities. Communities expect that the railway will offer them greater mobility, reduce the cost of transport and products, bring community development and youth employment. Communities fear that if there is not a station for their community that the community will be left behind and that no development will take place there. Every community would like to have access to the railway services from their own community. Some communities are of the opinion that their community should be the preferred location for a station. The community in Nanguanza, for example, has indicated that they should have a station as the Regedor is in their community and as such the community is of greater cultural importance, rather than having a station at the much larger nearby community of Saquembue.

6.14 Community health and diseases

Angola is vulnerable to outbreaks of diseases such as yellow fever, malaria, cholera and zika that overload the health services and compromise the health and lives of its citizens[67]. Communicable diseases account for more than 50% of deaths recorded within the population. The prevalence of malaria in children aged between 6 – 59 months is 40% in the Moxico Province[68], and in the Lunda Sul Province it is 9%. The country continues to struggle to improve child and maternal mortality rates which are among the highest in the world[69] whereby almost 1 in 5 children dies before the fifth birthday, and the maternal mortality rate is 610 deaths per 100,000 live births. A high fertility rate of 5.8 births per woman places pressure on an already struggling health system to keep up with the growing population's needs.

In both the Lunda Sul and Moxico Provinces only 4% of women between the ages of 15 – 49 years use modern family planning methods[70]. Only 21% of children between the ages of 12 – 23 months in the Lunda Sul Province and 10% of children between the ages of 12 – 23 months in the Moxico Province have received all basic vaccinations. In the Lunda Sul Province, 42% of children under the age of five years are stunted, compared to 39% of children in the Moxico Province. Stunting is an indication of chronic undernutrition.

Angola's healthcare system is inadequate to fulfil the needs of the population. The healthcare sector consists of public and private service providers. Public hospitals cater for almost 60% of the population, and while access is free of charge, the quality of care

[67] https://apps.who.int/iris/bitstream/handle/10665/136994/ccsbrief_ago_en.pdf;jsessionid=7D0C505C84FFF2B08483A74F0C55363C?sequence=1

[68] Instituto Nacional de Estatística (INE), Ministério da Saúde (MINSA), Ministério da Planeamento e do Desenvolvimento Territorial (MPDT) and ICF, 2017. Key Findings of the 2015-16 Angola IIMS. Luanda, Angola.

[69] https://www.usaid.gov/angola/global-health

[70] Instituto Nacional de Estatística (INE), Ministério da Saúde (MINSA), Ministério da Planeamento e do Desenvolvimento Territorial (MPDT) and ICF, 2017. Key Findings of the 2015-16 Angola IIMS. Luanda, Angola.

is not perceived as good by the general public[71]. Private clinics are overpriced, and those that can afford these clinics still experience the need for improved infrastructure and services. The healthcare system further has a shortage of medical professionals and skilled practitioners.

There are three public hospitals in the Moxico Province[72], namely the Hospital Provincial do Moxico, the Hospital Sanatório do Moxico, and the Maternidade Provincial do Moxico, all located in Luena. There is a municipal hospital in the Camanongue Municipality at the Municipal headquarter with 70 beds and 17 health centres with a total of 51 beds in the municipal area. The existing medical care units in the municipality are insufficient to meet the current demand for health services in the municipality. The municipality has a total of 126 health care employees consisting of 5 doctors, 6 nurses, 13 diagnostic and therapeutic technicians, 9 administrative, and 23 hospital support staff that support the health network.

In the Saurimo Province there are three public hospitals, namely the Consol Provincial do Lunda Sul, Hospital Geral do Saurimo, and Hospital Municipal Cacolo, all of which are located in the town of Saurimo. In the Dala Municipality there are one municipal hospital, one municipal maternity hospital, three health posts and 20 health centres (Figure 6-30). A number of public health programs are active in the municipality. The Dala Municipal Administration has indicated that they are facing several challenges in terms of providing health care, ranging from a lack of qualified staff and sanitary facilities, and a lack of resources in the existing units. They have indicated that there are communities that need to travel approximately 20 km when they require medical assistance or medication, and reversing this situation is a great challenge for the municipality.

People in the affected communities have indicated that they have limited access to health care (Table 6-39). Some communities have a medical centre or health post in the community that operates for limited hours, with often only a nurse and no doctor. Limited medication is available on a community level. Some communities do not have access to health care in the community and need to visit another community if they have medical needs.

[71] https://www.trade.gov/country-commercial-guides/angola-healthcare

[72]https://www.medpages.info/sf/index.php?page=listing&servicecode=77&countryid=26&regioncode=0&subregioncode=0&suburbcode=0&pageno=21

Figure 6-30: Medical facilities in Saquembue along the project route

Table 6-39: Access to health care in for communities along the project route[73]

Province	Municipality	Communities	Location of reference hospital	Access to health care
Lunda Sul	Saurimo	Muieie	Municipal headquarters	No access
		Luari	Municipal headquarters	Medical post in community
		Nanguanza	Municipal headquarters	Medical centre in community that operates from 8 am to 2 pm
		Muamucalanganza	Municipal headquarters	Use health centre in Nanguanza
		Muanguiji	Municipal headquarters	Medical centre that operates from 10 am to 12 pm, but does not have sufficient medication to meet demand
		Saquembue	Municipal headquarters	Public medical centre that is operational during the day

[73] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Location of reference hospital	Access to health care
		Caiaza	Municipal headquarters	Medical centre in community that operates from 7 am to 3 pm with one nurse
		Cassamba 1	Municipal headquarters	Use medical centre in Caiaza
	Dala	Sangoma	Municipal headquarters	No access
		Mombo	Municipal headquarters	Maternity hospital that operates from 7 am to 4 pm
		Mukuanguaji	Municipal headquarters	Use health centre in Luele
		Satxitende	Municipal headquarters	Use health centre in Dala
		Nacatoco, Sayassua	Municipal headquarters	Use reference hospital at municipal headquarters about 2 km away
		Luele	Municipal headquarters	Medical centre in community
		Sassuco, Biula, Sacacuca	Municipal headquarters	No access
Moxico	Moxico	Canda I, Canda II, Samauzo	Municipal headquarters	No access
		Sacapiasso, Migotchi	Municipal headquarters	Use health post in Mussirinjiji (2 hour walk away) – unable to go there when water levels in river increase
	Camanongue	Musseringinge	Municipal headquarters	Health post in community
		Samucanda, Sakambudji	Municipal headquarters	No access
		Muapezo	Municipal headquarters	Health centre that operates from 8 am to 2 pm
		Mumanga, Caiza, Saissazo	Municipal headquarters	Mumanga has a health centre that only operates during the day that also services Caiza and Saissazo
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Municipal headquarters	Reference hospital in community

Province	Municipality	Communities	Location of reference hospital	Access to health care
		Kamaleke	Municipal headquarters	No access

In most of the communities, Malaria is the disease with the highest incidence, followed by diarrhoea (Table 6-40). The Camanongue Municipality confirmed that malaria is the disease with the greatest incidence, followed by acute respiratory diseases, acute diarrhoeal diseases, typhoid fever, and hypertension.

Table 6-40: Diseases with the highest incidence along the project area[74]

Province	Municipality	Communities	Disease
Lunda Sul	Saurimo	Muieie	None
		Luari	Malaria, Diarrhoea
		Nanguanza	Malaria, Respiratory diseases
		Muamucalanganza	Malaria, Diarrhoea
		Muanguiji	Malaria
		Saquembue	Malaria
		Caiaza	Malaria, Diarrhoea
		Cassamba 1	Malaria, Diarrhoea
	Dala	Sangoma	Malaria
		Mombo	Malaria
		Mukuanguaji	Malaria
		Satxitende	Malaria
		Nacatoco, Sayassua	Malaria, Diarrhoea
		Luele	Malaria
		Sassuco, Biula, Sacacuca	Malaria
Moxico	Moxico	Canda I, Canda II, Samauzo	Malaria
		Sacapiasso, Migotchi	Malaria
	Camanongue	Mussirinjiji	Malaria
		Samucanda, Sakambudji	Malaria
		Muapezo	Malaria
		Mumanga, Caiza, Saissazo	Malaria
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Malaria, Tuberculosis
		Kamaleke	Malaria

[74] Source: Baseline data collection for SIA, March 2024

6.15 Other social infrastructure

Social infrastructure in the villages is extremely limited, and mostly consist of schools, and in some villages, a health post or medical centre. Most communities have a *jango* (Figure 6-31), which is space that is traditionally used as a forum for debate and discussion in the community[75]. In some of the villages, the Angolan Women's Organisation (OMA) is active in the community. It is possible that this organisation is active in other communities as well, but that it was not mentioned. Almost no civil society organisations are active in the communities (

Table 6-41).

[75] https://www.unicef.org/stories/angola-keeping-yellow-fever-cases-zero

Figure 6-31: Examples of *jangos* along the project area

Table 6-41: Civil society organisations in the communities[76]

Province	Municipality	Communities	Civil Society Organisations	Organisations for women
Lunda Sul	Saurimo	Muieie	None	Angolan Women's Organisation (OMA)
		Luari	None	Angolan Women's Organisation (OMA)
		Nanguanza	None	None
		Muamucalanganza	None	None
		Muanguiji	None	Angolan Women's Organisation (OMA)
		Saquembue	Organisation with the objective to distribute school materials and snacks	None
		Caiaza	None	None
		Cassamba 1	None	None

[76] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Civil Society Organisations	Organisations for women
	Dala	Sangoma	ADECOPCI	Angolan Women's Organisation (OMA)
		Mombo	None	Angolan Women's Organisation (OMA)
		Mukuanguaji	PSI (addresses various issues in the community)	None
		Satxitende	Organisation involved with school	None
		Nacatoco, Sayassua	None	None
		Luele	Lutheran Federation (help community in construction and treatment of latrines)	None
		Sassuco, Biula, Sacacuca	None	Angolan Women's Organisation (OMA)
Moxico	Moxico	Canda I, Canda II, Samauzo	None	None
		Sacapiasso, Migotchi	None	None
	Camanongue	Mussirinjiji	None	None
		Samucanda, Sakambudji	Unspecified organisation	None
		Muapezo	None	Angolan Women's Organisation (OMA)
		Mumanga, Caiza, Saissazo	None	None
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	None	None
		Kamaleke	None	None

6.16 Crimes and violence

Most of the communities have indicated that there is almost no crime and violence in the communities (Table 6-42). The communities are small, and people know one another. Crime is more prevalent in the areas that are located closer to the cities and towns, and then mainly consist of stock theft and robberies.

Table 6-42: Incidence of crime in communities[77]

[77] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Incidence of crime
Lunda Sul	Saurimo	Muieie	No crime or violence
		Luari	No crime or violence
		Nanguanza	Cattle theft – small groups of young people come from Saurimo to steal in the community. According to the community this is due to unemployment of the youth.
		Muamucalanganza	No crime or violence
		Muanguiji	No crime or violence
		Saquembue	Cattle theft
		Caiaza	Goat theft by people coming from other locations
		Cassamba 1	Young people come from other location to commit robberies
	Dala	Sangoma	No crime or violence
		Mombo	No crime or violence
		Mukuanguaji	Cattle theft Community conflict – reason for some residents to move to other locations
		Satxitende	No crime or violence
		Nacatoco, Sayassua	No crime or violence
		Luele	There is crime in the community
		Sassuco, Biula, Sacacuca	No crime or violence
Moxico	Moxico	Canda I, Canda II, Samauzo	Robberies
		Sacapiasso, Migotchi	Violence, theft and land conflicts
	Camanongue	Mussirinjiji	No crime or violence
		Samucanda, Sakambudji	No crime or violence
		Muapezo	No crime or violence
		Mumanga, Caiza, Saissazo	No crime or violence
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Cattle theft, theft of houses and agricultural products.
		Kamaleke	There are cases of violence and crime

6.17 Ecosystem services

This section provides a rapid and high level description of the key ecosystem services along the proposed railway line as guided by IFC and World Resource Institute (WRI)

Guidelines, 2013 to the extent possible[78]. The appraisal is based on desk surveys, extensive stakeholder engagements along the corridor (refer Chapter 5) and site visits undertaken by multiple teams. The first step in the analysis was to identify at of the ecosystems within the area of influence that are believed to provide ESs to beneficiaries and that could potentially be adversely impacted by project-related activities. The ESs and beneficiaries thereof are identified based on findings from biodiversity baseline studies, social baseline, cultural heritage baseline and other relevant dedicated baseline surveys.

Ecosystem services (ES) are defined as the direct and indirect benefits that people (including PACs) derive from ecosystems, which are a dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit (World Resources Institute (WRI), 2013). These are the benefits that people, including businesses, derive from ecosystems (IFC PS6). ES valued by humans are often underpinned by biodiversity, hence adverse impacts on biodiversity can often adversely affect the delivery of ecosystem services.

ESs are categorised by IFC Guidance Note 6 (IFC, 2019) as follows

(i) *provisioning services*, which are the products people obtain from ecosystems – these include, among others, (a) agricultural products, seafood and game, wild foods, and ethnobotanical plants; (b) water for drinking, irrigation, and industrial purposes; and (c) forest areas, which provide the basis for many biopharmaceuticals, construction materials, and biomass for renewable energy (see Biodiversity baseline Chapter 9, Table 9-10 and Table 9-19)

(ii) *regulating services,* which are the benefits people obtain from the regulation of ecosystem processes - include, among others, (a) climate regulation and carbon storage and sequestration; (b) waste decomposition and detoxification; (c) purification of water and air; (d) control of pests, disease, and pollination; and (e) natural hazard mitigation

(iii) *cultural services*, which are the nonmaterial benefits people obtain from ecosystems - include, among others, (a) spiritual and sacred sites; (b) recreational purposes such as sport, hunting, fishing, and ecotourism; and (c) scientific exploration and education (see Cultural heritage baseline Chapter 7)

(iv) *supporting services*, which are the natural processes that maintain the other services - such as (a) nutrient capture and recycling, (b) primary production, and (c) pathways for genetic exchange.

A list of ecosystem services that were likely to exist within the direct and indirect social AoI, was established. This was developed using a combination of recent community characterisation completed in key PACs along the corridor, information gathered during field visits, and information reviewed as part of the socioeconomic, cultural heritage and biodiversity baseline assessments.

[78] Detailed stand-alone Ecosystem Services survey is not part of the scope of this ESIA.

In summary, the main local level ESs of importance identified within Project AoI and findings of the ES screening include (see Table 6-43 and Table 6-44 and Figure Figure 6-32 to Figure 6-37 below):

Provisioning services:

- subsistence farming: cassava is widely grown in along the corridor; other crops include maize, beans, bananas, mangoes, pineapples and horticulture
- livestock grazing mainly sheep, goat, chicken and pigs
- collection of firewood for cooking
- charcoal making for local use and selling
- sourcing of building materials such as thatching grass, poles, wood/timber
- water access for both people and livestock in all 11 river crossings, streams, shallow wells
- wild fruits collection
- honey collection
- local bricks making 'clay soil bricks'
- wild animals hunting small mammals (rodents) for meat
- sourcing medicinal plants for curing different illnesses. This is further described and mapped separately below given its importance to the community

Regulating and supporting services:

- miombo woodland, savannah grassland habitats provide vegetation cover
- seasonal wetlands regulating surface drainage and flood control
- temperature regulation
- water cycle management
- erosion prevention

Cultural services:

- spiritual connection to land
- cultural and tribal traditions
- archaeological heritage
- traditional knowledge and livelihoods
- traditional rituals and ceremonies.

Findings from community engagements and site observations show that overall, provisioning services appear to be of high importance to the PACs. Apart from medicinal plants described below, the communities are surrounded by natural resources that they use as part of their livelihood strategies (Table 6-43). The wood from trees is used for firewood, to make charcoal for own use and to sell, construction material such as timber and beams. There are medicinal plants in the bush areas, people collect honey and clear

areas to make fields to cultivate. In some areas wild fruit is eaten and mice are hunted (Figure 6-32).

In terms of water provisioning services, the project affected communities depend on hand-dug wells, few functional boreholes along the corridor, and surface water. The 11 rivers crossed by the proposed railway line forms critical primary source of domestic water supply for the communities.

Figure 6-32: Wild fruits accessed by communities (left) and mice hunting (right) within project AoI

Figure 6-33: Charcoal making and selling g along the project corridor

Figure 6-34 Cassava and honey making

Figure 6-35 Water sourcing and use of rivers for domestic purposes

Figure 6-36 Local bricks making along the project area of influence

Figure 6-37 Sourcing of construction materials

Table 6-43: Use of ecosystem services in communities[79]

Province	Municipality	Communities	Ecosystem services
Lunda Sul	Saurimo	Muieie	Charcoal and wood
		Luari	Charcoal and wood
		Nanguanza	Charcoal and wood
		Muamucalanganza	Firewood and medicinal purposes
		Muanguiji	Honey
		Saquembue	Firewood and medicinal purposes

[79] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Ecosystem services
		Caiaza	Farming, hunting, firewood and charcoal
		Cassamba 1	Charcoal, firewood, timber, beams
	Dala	Sangoma	Firewood and medicinal purposes
		Mombo	Charcoal and wood
		Mukuanguaji	Firewood and medicinal purposes
		Satxitende	Farming, hunting, firewood and charcoal
		Nacatoco, Sayassua	Honey
		Luele	Cultivation, firewood and charcoal
		Sassuco, Biula, Sacacuca	Firewood
Moxico	Moxico	Canda I, Canda II, Samauzo	Cultivation and firewood
		Sacapiasso, Migotchi	Firewood and medicinal purposes
	Camanongue	Mussirinjiji	Firewood and medicinal purposes
		Samucanda, Sakambudji	Firewood and medicinal purposes
		Muapezo	Cultivation and honey
		Mumanga, Caiza, Saissazo	Firewood and medicinal purposes
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Firewood and medicinal purposes
		Kamaleke	Produce honey, make beams, boards, and others

Medicinal plants along the corridor

Communities have for many years had access to medicinal plants for curing illnesses. The anticipated changes that the construction and operational phase of the new railway project brings may see their access either changed due to the plant being removed and not replaced or protected as part of the proposed development and/or their access through the railway line is changed or prohibited.

Traditional medicine, primarily reliant on botanical resources, has been integral in addressing health-related concerns within these communities. Almost all the affected communities, except *Mussirinjiji*, have indicated that they make use of medicinal plants (**Error! Reference source not found.**) to treat illnesses such as headaches, stomach ailments, typhoid fever and others. A wide variety of medicinal plants are used (Table 6-44).

Figure 6-38: Examples of medicinal plants used by communities

A particular recommendation was expressed towards the protection of the *Muxihi/Mussivi* plant species, recognized as highly valued for its medicinal properties among rural communities, notably prevalent in the vicinity of Dala. While the exact abundance of these species within the Project's area of influence remained unspecified during consultations, it was acknowledged that these plants hold significant cultural and medicinal importance.

Consultations with local communities revealed a reliance on various medicinal plants indigenous to the area, particularly within the Muieie and Luele neighbourhoods. The Mulima plant species was noted for its abundance in the Muieie neighbourhood, with indications that community members cultivate it within their surroundings. In the Luele neighbourhood, medicinal plant species such as *Munguindo, Muxie, Mufundje, and Muvuca* (used for malaria treatment) were referenced as commonly used.

In the Moxico Province, consultations with Traditional Authorities of Camanongue and Moxico revealed a reliance on various medicinal plants, including Mumanga, Mutxatxa, Muaio, Mucondo, Mussala, and Mutongo. It was observed that many of these plant species extend over a vast area that goes throughout the community, reaching the Project area and beyond. However, Traditional Authorities and community members asserted that the clearance of the plants within the Project area of influence does not prevent their continued use for medicinal purposes.

Additionally, in Kamuleque, the local chief reported that during the construction of the high voltage overhead electric transmission line supplying energy to the municipality of Camanongue, several plant species were cleared for project implementation purposes and no constraints were caused to the communities. Despite this situation, community members continue to utilize medicinal plants, as the Sobas (traditional leaders)

consistently ensure the preservation of these species by reserving plantations within the neighbourhoods.

Table 6-44: Usage of medicinal plants in affected communities[80]

Province	Municipality	Communities	Use medicinal plants	Types of plants used
Lunda Sul	Saurimo	Muieie	Yes	*Mulima* – treats headaches, stomach, typhoid fever and others. Highly sought after by people from other locations
		Luari	Yes	Traditional plants (unspecified)
		Nanguanza	Yes	Traditional plants (unspecified)
		Muamucalanganza	Yes	Traditional plants (unspecified)
		Muanguiji	Yes	Traditional plants – e.g. *Mulima, Tchicamba*
		Saquembue	Yes	Traditional plants (unspecified)
		Caiaza	Yes	Traditional plants – e.g. *Mutchatcha, Mussala, Mucula*
		Cassamba 1	Yes	Traditional plants – e.g. *Mutchatcha, Mussala, Mucula, Munanguina, Cuaji*
	Dala	Sangoma	Yes	Traditional plants – e.g. *Eucalyptus, Santa Maria, Muxivi, Mussesse*
		Mombo	Yes	Traditional plants – e.g. Mulima, Mutchatcha, Tchicamba
		Mukuanguaji	Yes	Traditional plants (unspecified)
		Satxitende	Yes	Traditional plants e.g. *Pau Ferro, Muxivi*
		Nacatoco, Sayassua	Yes	Traditional plants – e.g. *Mutazumbi, Mutchatcha, Cassasso*
		Luele	Yes	Traditional plants (unspecified)
		Sassuco, Biula, Sacacuca	Yes	Do not use traditional plants for treatment
Moxico	Moxico	Canda I, Canda II, Samauzo	Yes	Traditional plants – e.g. *Mutchatcha, Mululu, Mulima*
		Sacapiasso, Migotchi	Yes	Traditional plants (unspecified)
	Camanongue	Mussirinjiji	No	Traditional plants (unspecified)
		Samucanda, Sakambudji	Yes	Traditional plants (unspecified)
		Muapezo	Yes	Traditional plants - e.g. *Eucalyptus, Caxinde tea*

[80] Source: Baseline data collection for SIA, March 2024

Province	Municipality	Communities	Use medicinal plants	Types of plants used
		Mumanga, Caiza, Saissazo	Yes	Traditional plants (unspecified)
		Camanongue Municipality, Central neighbourhood, Neighbourhood 5000, Neighbourhood 200 casas, Samalengue	Yes	Traditional plants (unspecified)
		Kamaleke	Yes	Traditional plants – e.g. *Muxi, Chicamba, Mulima*

6.18 Human rights context

With the endorsement of the United Nations Guiding Principles on Business and Human Rights (UNGP) by the Human Rights Council in 2011, increased attention has been focussed on the accountability of businesses for their human rights impacts (OHCHR, 2020; The Danish Institute for Human Rights, 2020). It has been established that businesses have a responsibility to respect human rights, and companies are increasingly engaging in Human Rights Risk Assessments (HRRAs) and/or Human Rights Impact Assessments (HRIAs) in their business operations, activities and relationships, including supply chains. A stand-alone detailed HRRA Report for Luena-Saurimo project is provided in Appendix 14 considers standards and principles indicated in Table 6-45. The HRRA (Appendix 14) provides further details including area of influence, methodology, findings, recommendations and a human rights action plan for incorporation into the Project.

The United Nations Guiding Principles on Business and Human Rights (UNGPs) highlight that businesses can affect human rights positively and negatively for employees, contract workers, supply chain workers, communities, and end users. Since the UNGP Human Rights Council's 2011 endorsement, businesses are responsible for respecting human rights, including identifying, avoiding, mitigating, and remedying impacts. Therefore, a HRRA was undertaken to aid the proposed Project in identifying, assessing and addressing human rights risks and ensure most salient human rights risks and potential impacts are identified and addressed before construction commences.

The data gathering process for Luena-Saurimo HRRA included a desktop review and primary data collection within the Project area. The desktop review aimed to identify Project components with potential human rights impacts, focusing on specific relevant rights. It included a review of Angola's governance, rule of law, potential human rights risks to the Project and stakeholder identification. The primary data collection included social baseline surveys and Focus Group Discussions (FGDs) conducted by the ESIA team with Project Affected Communities (PACs) and Key Informant Interviews (KIIs) and FGDs with Municipality officials (Moxico, Camanongue, Dala and Saurimo), civil society organization and the client conducted by the human rights team.

The relevant key standards and principles applied are:

Table 6-45 Key standards and principles applied in the HRRA

Standard	Year	Ratified by Angola
International standards		
United Nations Guiding Principles on Business and Human Rights (UNGP)[81]	2011	N/A
Universal Declaration of Human Rights (UDHR)[82]	1948	N/A
International Covenant on Civil and Political Rights (ICCPR)[83]	1966	1992
International Covenant on Economic Social and Cultural Rights (ICESCR)[84]	1966	1992
The Convention on the Elimination of All Forms of Discrimination against Women[85]	1979	1986
Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families (ICMW)[86]	1990	N/A
Convention against Torture and Other Cruel, Inhuman or Degrading Treatment of Punishment (CAT)[87]	1984	2019
Convention on the Rights of the Child (CRC)[88]	1989	1990
Convention on the Rights of Persons with Disabilities (CRPD)[89]	2006	2014
International Labour Organisation (ILO) Core Labour Conventions[90]	Various	Various
UN Office of the High Commissioner for Human Rights, Basic Principles and Guidelines on Development-Based Evictions and Displacements[91]	2019	N/A
OECD Guidelines on Multinational Enterprises on Responsible Business Conduct[92]	2023	N/A
Regional standards		

[81] UNGPs
[82] OHCHR | Universal Declaration of Human Rights - English
[83] International Covenant on Civil and Political Rights | OHCHR
[84] International Covenant on Economic, Social and Cultural Rights | OHCHR
[85] Convention on the Elimination of All Forms of Discrimination against Women New York, 18 December 1979 | OHCHR
[86] International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families | OHCHR
[87] Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment | OHCHR
[88] Convention on the Rights of the Child | OHCHR
[89] Convention on the Rights of Persons with Disabilities | OHCHR
[90] ILO Core Conventions
[91] Basic Principles and Guidelines on Development-Based Evictions and Displacements
[92] OECD Guidelines on Multinational Enterprises

Standard	Year	Ratified by Angola
African Charter on Human and Peoples' Rights (ACHPR)[93]	1998	1990
The African Charter on the Rights and Welfare of the Child[94]	1999	1992
National standards		
Angolan Constitution[95]	2010	N/A
New General Labor Law (NGLL)	2024	N/A
Land Act No. 9/04	2004	N/A
Decree No. 58/07 approving the General Regulation for Land Concession	2007	N/A
Law No. 38/20 approving the Penal Code of Angola	2020	N/A
Civil Code	1966	N/A
Decree No. 31/94 of August 5, 2016, Health and Safety Conditions at Work System	2016	N/A
Basic Environmental Law No. 5/98	1998	N/A

The salient human rights identified as relevant for this Project is provided in Table 6-46. The severity of the risk, likelihood of occurring and proposed mitigation measures to avoid the identified salient human rights risks is provided in a stand-alone Human Right Risk Assessment Report in Appendix 14. The HRRA (Appendix 14) provides further details including methodology, findings and recommendations.

Table 6-46 Relevant human rights for the Project

Human Right	Relevant UDHR Article(s)
Positive Impact on Human Rights	
Improved livelihoods	**Article 23 and 25**
GHG and road traffic reduction	**Article 25**
Labour and Working Conditions	
Equal opportunity and non-discrimination	Articles 1, 2 and 23(2)
Just and favourable working conditions	Article 7
Child labour	Articles 25(2) and 26(1)
Freedom of association and collective bargaining	Articles 20 and 23(4)
Safe and healthy working conditions	Article 7
Community Level Human Rights	
Access to information, consultation and freedom of opinion	Article 19

[93] African Charter on Human and Peoples' Rights | African Commission on Human and Peoples' Rights (au.int)
[94] African Charter on the Rights and Welfare of The Child
[95] Angolan Constitution (2010)

Gender equality	Articles 1, 2 and 23(2)
Community Health and safety	Article 25(1)
Land, natural resources and livelihoods	Articles 17, 25 and 27
Environment	Article 25(1)
Security	Articles 3 and 25(1)
Access to remedy	Articles 7 and 8

7 CULTURAL HERITAGE BASELINE

This chapter presents the distribution of cultural heritage as per IFC PS8 definition[96] and highlights their importance for the communities along the Luena - Saurimo Railway Project corridor. Through a characterisation of historical and cultural dimensions, this assessment endeavours to provide a nuanced understanding of the cultural landscape, facilitating informed decision-making and fostering proposed Project sustainability.

This chapter aims to encompass both tangible and intangible elements that serve as evidence of the historical and cultural richness of communities of Saurimo, Dala, Camanongue and Moxico Municipalities.

IFC PS 8 defines intangible cultural heritage as cultural resources, knowledge, innovations and/or practices of local communities embodying traditional lifestyles. In relation to the Luena-Saurimo railway project, intangible cultural heritage was identified through the consultative meetings and the baseline surveys. These are further elaborated at the Province level and each municipality crossed by the proposed railway line.

Tangible components include physical infrastructures such as historical monuments and sites, while intangible comprise traditional knowledge, rituals, and cultural customs intrinsic to local communities. Understanding and preserving cultural heritage is crucial for the environmental and social impact assessment, as it provide insights into the interactions between local communities and their environment.

7.1 Area of influence

The scope of this assessment encompasses an extensive geographical area covering mainly all four municipalities where the project is situated, the proposed railway corridor direct RoW (60m) and communities within the corridor covering the identification and mapping of all cultural heritage with symbolic relevance to the communities within 5 km both sides from the centreline along the corridor (refer Figure 5-1). However, cultural heritage resources identified beyond the 5km radius where also included in the study for reference purposes.

7.2 Methodology

The methodology adopted to identify and assess the distribution of cultural heritage resources within Luena-Saurimo project AoI involved mainly desktop survey, examination of public records, evaluation of historical landmarks, community, and government authorities' consultations and ground truthing walkover along the corridor.

The categorisation and inventorying of Angola's National Cultural Heritage are overseen by the National Institute of Cultural Heritage in accordance with the Cultural Heritage Law No. 14/05, dated October 07th. However, there exist initiatives led by Provincial

[96] IFC PS8 definition has been adopted which refers to: (i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

Governments and Municipal Administrations aimed at identifying locations, sites, or customs deemed significant by local communities in terms of their relevance, impact, and cultural symbolism. Subsequently, these entities submit such findings to the National Institute of Cultural Heritage for evaluation intending to request their inclusion in the National Heritage Registry. However, these heritage assets are initially integrated into the provincial or municipal patrimony where they are identified, thereby being categorised based on their respective levels of significance.

7.2.1 Desktop survey

The desktop review encompasses comprehensive exploration of secondary sources to explore a foundational understanding of the significance, relevance, and dispersion of cultural heritage along the railway line and communities. With a complex review of secondary sources, including publicly available documents, reports, articles, government records, cultural inventories, and any other relevant literature pertaining to cultural heritage within the study area. The desktop survey aimed to gather information into the historical, social, and cultural aspects that contribute to the identity and significance of cultural heritage in the region.

7.2.2 Consultations within Project area

The cultural heritage assessment incorporated consultations with stakeholders identified during stakeholder engagement (see Chapter 5 – Table 5-4, Table 5-7 and Table 5-8). This includes consultations with the Provincial governments, Municipal administrations, Traditional authorities, and local communities within Project area, that is, Lunda-Sul Province (Saurimo and Dala municipalities) and Moxico Province (Moxico and Camanongue municipalities) to elicit local perspectives and insights on existing cultural heritage.

Consultations were undertaken to identify and assess tangible and intangible cultural heritage relevant to the project, the team consulted and collaborated with Traditional Authorities (*Regedores*, *Sobas*, and Neighborhood Coordinators) and cultural technicians from municipal administrations, forming a multifaceted working group to carry out field findings in the consulted localities. The priority elements were placed to the Traditional Authorities due to their custodianship of generational legacies and cultural identity within the respective localities. During cultural heritage engagements, communities were specifically asked the existence and location of tangible cultural heritage resources. As a result, graves and cemeteries were identified and georeferenced, based on information provided directly by the *Sobas* and designated local representatives, who possess community knowledge regarding the location and cultural significance.

Further consultations will be undertaken during the RAP process. As part of this process, further stakeholder engagements will be undertaken with all communities transversed by the railway line and the cultural heritage baseline will be updated with additional identified heritage features and information related to land use and cultural significance of areas along the rail corridor.

7.2.3 Field transects and ground-truthing

The field assessment was undertaken to validate information gathered from secondary sources and consultations with relevant stakeholders. The ground-truth process aimed to identify and delineate areas of potential cultural heritage significance, as well as assess their vulnerability to project-induced impacts and facilitate the formulation of mitigation strategies to safeguard these assets.

Trained cultural heritage field team, with the support of Traditional Authorities and community representatives, conducted site inspections to identify archaeological sites, historical structures, sacred sites, ethnographic resources, and other tangible and intangible cultural heritage features. The fieldwork was conducted from March 05th to 27th of 2024 comprising engagement sessions with potentially affected communities.

The fieldwork involved the identification of tangible and intangible cultural heritage resources within the direct project footprint and around 5 km buffer through transect walks and spot checks. The collection of field data included photographic registers, GIS coordinates marking and documentation of identified features historical relevance to the local communities.

Other areas of concern were the burial grounds, and spiritual places such as mosques, churches and shrines which are physically observable along the project corridor. These were documented based on the location's proximity to the project corridor. Data was obtained through observation, recording, photographing and measurement of site proximity in relation to the project RoW. All identified cultural sites, and other environmental features likely to be impacted on directly or indirectly by the project were documented. The information from the survey was recorded and further inputs into the Resettlement Action Plan (RAP) study.

In the context of identifying tombs and cemeteries, which emerged as the predominant cultural artifacts during fieldwork, the pivotal role of *Regedores* was fundamental. The *Regedores* hold significant authority in determining the locations for burial sites, according to the importance of the individual to be buried during life. Additionally, the team relied heavily on their guidance to pinpoint specific sites reserved for the interment of individuals such as *Sobas, Regedores,* or their close relatives. This collaborative effort facilitated the precise identification of culturally significant burial grounds within the Project area.

Throughout the assessment process, ethical considerations such as the commitment to upholding the principles of cultural sensitivity, community engagement, and participatory decision-making were implemented.

7.2.4 Cultural heritage resources characterisation

Apart from identification and broad categorisation of cultural heritage resources as tangible or intangible, further characterisation has been undertaken as per IFC PS8 (paragraphs 11, 12 and 13) and Angola's legislations as below:

- *replicable cultural heritage*: tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered

replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures

- *non-replicable cultural heritage*: may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site
- *critical cultural heritage*: consists of one or both of the following types of cultural heritage: (i) the internationally recognised heritage of communities who use or have used within living memory the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas e.g., world heritage sites and nationally protected areas, including those proposed by host governments for such designation.

7.2.5 Limitations and opportunities

- unavailability of precise information regarding the exact location of cultural artifacts, sacred sites, and monuments within the Project area, due to factors such as lack of historical records and limited archival documentation
- absence of an inventory of registered and unregistered cultural heritage sites/monuments in the Ministry of Culture and the National Institute of Cultural Heritage that are specifically for Lunda Sul and Moxico Provinces. In this sense, monuments/sites within the Project area and in the vicinity were also included in the survey, considering the potential risk of being negatively impacted in the construction phase of the Project
- without a national/provincial/municipal cultural heritage inventory, the assessment may overlook culturally significant sites and underestimate the potential impacts of the project on cultural heritage resources
- during fieldwork, demining along the corridor was not done. Field observations and ground truthing were undertaken in areas deemed safe with guidance from local leaders and community members along the corridor. However, additional follow up verification surveys will be undertaken during detailed design and RAP development process
- at the time of the ESIA, the final route alignment and coordinates of stations were not finalised, therefore the community-based cultural heritage data collection activities were focused on communities located in proximity to the indicative direct project footprint. As the final railway alignment and design is confirmed, further community engagement is to be undertaken to ensure that all cultural heritage sites along the final alignment are identified and adequately documented. At this stage, no cultural heritage sites were identified within 60 m of the indicative project footprint. Additionally, the RAP will also confirm the final impacts on cultural heritage once the final railway design is available.

7.3 General baseline overview

7.3.1 Moxico and Lunda Sul Provinces

Angola experienced approximately 500 years of colonial occupation, which led to the creation of numerous memories and a manifest resistance to Western culture. This resistance is expressed through symbols that represent Angolan values and culture, deeply embedded in community life. These symbols manifest in various forms such as dance, languages, rituals, and ancestry cults (intangible heritage), as well as through drawings, paintings, and sites that have become symbols of cultural heritage due to their association with resistance to colonial rule.

In the Provinces of Lunda Sul and Moxico, cultural heritage plays a vital role in preserving the identity and legacy of local communities. In these Provinces, both tangible and intangible cultural heritage are sources of pride and significance for the inhabitants, offering various social, economic, and cultural benefits.

Luena, the capital of Moxico Province, is nationally recognized as the "City of Peace" and holds historical significance as it is an area where Angola's 27-year civil war ended (1975 - 2002), marking the signing of the National Day of Peace in Angola on April 4th, 2002, as a significant milestone in the nation's history. Within Moxico Province, a monument known as the Monument of Peace was constructed to symbolize the attainment of peace. This monument serves as a tangible cultural heritage asset, reflecting the cultural and historical importance of Luena and its pivotal role in Angola's transition to peace.

In Moxico Province, the Provincial Directorate of Culture has identified a total of 94 monuments, architectural heritage sites, and historical places, as reported by local public news sources. Despite this significant number, only one monument, the Ruins of the Fort da Cameia, has been officially registered and classified as national heritage. The Ruins of the Fort da Cameia are emblematic, symbolizing the resistance of indigenous populations against Portuguese colonial era. This heritage site holds substantial historical and cultural significance, reflecting the enduring spirit and resilience of the local communities in the face of colonial oppression.

In addition to the Ruins of Forte da Cameia, recognized as a national heritage site, the Province of Moxico boasts several other monuments and sites of significant cultural symbolism. Despite lacking validation from the Ministry of Culture, these locations hold local importance and representation. They include:

- Tomb of the first Queen Nhakatolo
- Kalundo Lake
- Lunhameji Sites
- Kassongo Sites
- Kassamba Sites
- Building of the former colonial administration of the district of Moxico
- Peace Memorial
- Ruins of the mission of the Evangelical Church (IEIA).

7.3.2 Intangible cultural heritage

The two Provinces boast a rich tapestry of intangible cultural heritage deeply rooted in the historical legacies and diverse ethnic composition of the region. Home to various Bantu peoples, including the Cokwe, Lunda, Gangela, and Lubas, this region has been shaped by centuries of cultural exchange and development. In the 17th century, the Lunda State witnessed the emergence of the first Lunda Empire under the reign of Queen Lweji Nkonde, expanding across present-day Democratic Republic of Congo, Zambia, and the eastern part of Angola. Subsequently, in the 19th century, a second Lunda Empire arose, centred in Luena, under the governance of the Lunda-TChokwé kingdom.

The local cultural heritage landscape is characterised by a mosaic of ethnic groups, including the Tchokwes, Luchazes, Luvales, Umbundus, Lunda-Dembos and Bundas. Each group contributes distinct traditions, practices, and expressions to the region's intangible cultural heritage, shaping its social fabric and identity. These traditions encompass a wide array of domains, including oral traditions, traditional music and dance, rituals, and ceremonies, reflecting the communities' historical experiences, spiritual beliefs, and socio-economic dynamics. These traditions include the handmade mask Mwana Pwo and musical instruments such as the Ngoma drum, the Pwita and the Kalyalya.

7.3.2.1 Ecosystem services and medicinal plants

Historically, the people of the Tchokwe culture have always resorted to traditional medicine to solve their health-related issues. Through conversations and consultations with Traditional Authorities, the significance of traditional medicinal practices among the Tchokwe culture was highlighted.

Traditional medicine, primarily reliant on botanical resources, has been integral in addressing health-related concerns within these communities. A particular recommendation was expressed towards the protection of the Muxihi/Mussivi plant species, recognized as highly valued for its medicinal properties among rural communities, notably prevalent in the vicinity of Dala. While the exact abundance of these species within the Project's area of influence remained unspecified during consultations, it was acknowledged that these plants hold significant cultural and medicinal importance.

Consultations with local communities revealed a reliance on various medicinal plants indigenous to the area, particularly within the Muieie and Luele neighborhoods. The *Mulima* plant species was noted for its abundance in the Muieie neighborhood, with indications that community members cultivate it within their surroundings. In the Luele neighborhood, medicinal plant species such as *Munguindo, Muxie, Mufundje*, and *Muvuca* (used for malaria treatment) were referenced as commonly used.

In the Moxico Province, consultations with Traditional Authorities of Camanongue and Moxico revealed a reliance on various medicinal plants, including *Mumanga, Mutxatxa, Muaio, Mucondo, Mussala, and Mutongo*. It was observed that many of these plant species extend over a vast area that goes throughout the community, reaching the Project area and beyond. However, Traditional Authorities and community members asserted that the clearance of the plants within the Project area of influence does not prevent their continued use for medicinal purposes.

Additionally, in Kamuleque, the local chief reported that during the construction of the high voltage overhead electric transmission line supplying energy to the municipality of Camanongue, several plant species were cleared for project implementation purposes, and no constraints were caused to the communities. Despite this situation, community members continue to utilize medicinal plants, as the Sobas (traditional leaders) consistently ensure the preservation of these species by reserving plantations within the neighborhoods.

Considering the reliance of local communities on these botanical resources for healthcare, any potential impact of the project on these plants warrants careful consideration and mitigation strategies to preserve both cultural heritage and essential medicinal practices.

7.3.2.2 Traditional cultural manifestations

Likumbi ya Vaka Cinyama Festival

The Luvale Traditional International Festival, known in the region as Likumbi ya Vaka Cinyama ("Days of the descendants of the Cinyama"), holds significant cultural importance for the Moxico Province. This annual festival, celebrated since July 1956, serves as a vibrant showcase of the customs, traditions, and heritage of the Luvale people, who inhabit the eastern region of Angola (including parts of Moxico and Lunda - Sul) and neighbouring Zambia.

The festival provides a platform for the preservation and promotion of Luvale culture, serving to pass down traditional knowledge, values, and practices from one generation to the next. It plays a crucial role in fostering a sense of community cohesion and pride among the Luvale people, as well as promoting cultural exchange and understanding among diverse communities within Moxico and beyond.

Likumbi ya Vaka Cinyama is also an occasion for the reenactment of historical events and legends, paying homage to figures such as King Cinyama Kakengue, in whose honor the festival is named. Through various performances, rituals, and ceremonies, participants engage in storytelling, music, dance, and other artistic expressions that reflect the rich tapestry of Luvale culture.

Queen Nyakatolo Tchilombo has presided over the festival on multiple occasions. Lasting three days, the festival takes place in Cazombo Commune (Alto Zambezi Municipality - Moxico Province) featuring traditional dance, music rituals, and a parade of important figures such as princes, Regedores, Sobas, and *makixi*. These figures wear original clothing and engage in rhythmic movements, adding to the cultural richness of the event (Figure 7-1).

Figure 7-1: Likumbi ya vaka cinyama festival
Source: Cilende - Luvale Cultural Festival, 2012

Txianda dances

Dance holds significant cultural and ceremonial importance for the Tchokwe people in Angola. Using masks, dance, and musical instruments, the Tchokwe express specific meanings and mark various types of ceremonies. The masks serve as identifiers of the ceremony type and help specify its purpose. Different dances are performed in designated locations during specific periods, each carrying its own significance. For instance, initiation rituals feature distinct dances from other ceremonial performances.

The Txianda dance, a hallmark of the Lunda Tchokwe ethnic group, embodies moments of joy and reverence for ancestors. Both men and women participate in this dance, underscoring its communal and inclusive nature. Overall, dance serves as a vital means of cultural expression, communication, and preservation for these communities in Angola, reinforcing their identity and heritage.

The predominant dances in this region include Macoopo, Txianda, Txissela, Txiliapanga, Mitting, and Muquixi. Txianda holds significance particularly in welcome ceremonies and Mukanda ceremonies (transition of boys into adulthood through circumcision). These dances serve as integral components of various dance groups, contributing to the cultural fabric and community unity.

Rituals

The circumcision ceremony among the Lunda people involves a series of rituals and practices performed by the community. Prior to the procedure, rituals are conducted, accompanied by chanting and the wearing of specific attire by parents. Boys undergoing circumcision are prohibited from engaging in activities that may cause injury. On the day of the procedure, at dawn, the village chief and family members gather at the designated

site to pray for protection and success. This prayer, known as "*kusakwia*," involves touching the earth and clapping hands while expressing gratitude. The procedure begins with the chief operator leading songs, followed by the community's participation. The procedure, conducted without anaesthesia, is performed while the boys are seated with legs spread and heads turned down. Family members and boys may cry during the operation. Post-procedure, efforts are made to stop bleeding, and teachers oversee the healing process, which includes a ritual of sun worship lasting more than a day.

Sona drawings

"Sona" is an ancient art form of the Lunda Cokwe people from Angola, classified by UNESCO as Intangible Cultural Heritage of Humanity (Figure 7-2). It involves creating drawings and geometric figures in the sand. These graphic symbols serve various purposes, including conveying geographical positions such as the cardinal points (North, South, East, and West), teaching arithmetic geometry, and facilitating traditional games. The practice of Sona has cultural significance among the Lunda people, contributing to the preservation of their heritage and knowledge transmission.

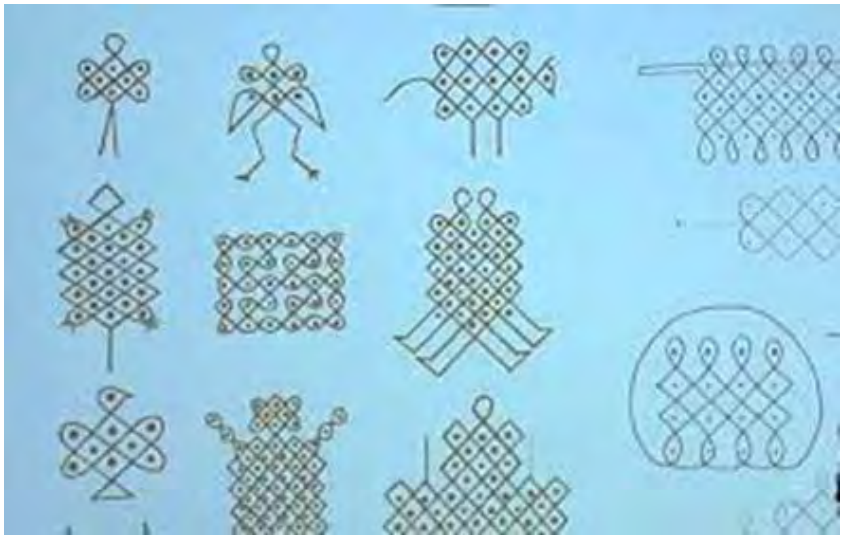


Figure 7-2: Sona by Lunda people
Source: observalinguaportuguesa.org, 2024.

Customary beliefs

In this region the main cultural belief is related to death and emphasizes that represents the transition of individuals from the realm of the living to the world of ancestors, undergoing metamorphosis. According to Kisadila (2004), death signifies passage into the ancestral world. The deceased's children, if absent at the time of death, are expected to return, depending on their location and travel time.

Typically, corpses are buried in cemeteries near villages or roadsides to allow the living to pay their respects. Burials involve wrapping the deceased in blankets and mats, tied with ropes to prevent their return. When an elderly person dies, there is often a festive atmosphere with singing, dancing, and traditional music, celebrating their life. However, children and pregnant women are usually prohibited from attending burials due to cultural beliefs about potential harm to the foetus.

Funeral practices in the Lunda Tchokwe region, encompassing parts of Angola, incorporate traditional rituals reflecting cultural values and worldviews, although, variations in practices exist among different communities and subgroups within the region:

- announcement of death: when a person dies, it is common to announce the death to the community. This is often done through messengers or in a public manner, depending on the importance of the deceased
- grief and body preparation: the community enters a period of mourning, during which relatives and friends offer condolences to the bereaved family. The body of the deceased is prepared for the funeral, often involving specific rituals
- funeral rituals: funeral rituals may involve dancing, singing, and ceremonies conducted by older members or spiritual leaders of the community. These rituals can vary, but they often include both symbolic and spiritual element
- burial: burial is a crucial aspect of the funeral. Depending on specific beliefs and traditions, the deceased may be buried in a local cemetery or designated area
- offerings and tributes: During and after the funeral, it is common to offer gifts, food, and tributes to the deceased. These offerings can be considered to honor the memory of the deceased and support the family
- continuity of rituals: Some Lunda Tchokwe communities perform additional rituals in the days, months, or years following death, marking events such as the "*kwilu dianga*" (mourning closing ceremony) or other periodic rituals of remembrance.

From a cultural standpoint, ethnographic traditions and handicrafts constitute integral elements of the unique heritage preserved by the Lunda-Tchokwe peoples with steadfast determination. Notable among these traditions is the artisanal production of masks, exemplified by the Mwana Pwo Statue, used in rituals, alongside musical instruments like the Ngoma drum, the Pwita, and the Kalyalya. The Lunda region boasts a robust artistic culture, elevating Angola's prominence in international art fairs.

Objects and artifacts originating from Lunda-Tchokwe culture hold significant value, leading to high demand and, consequently, incidents of theft and trafficking in the black market, with masks and sculptures being particularly coveted items.

7.3.3 Tangible cultural heritage

7.3.3.1 Masks

The Mwana-Pwo mask, signifying "young woman or girl," holds significant cultural meaning within the Lunda Tchokwe community. In this culture, women are revered as embodiments of maturity, wisdom, and experience. Despite contemporary influences, the use of masks retains its importance, serving as conduits for evoking ancestral connections and guiding societal education and direction. Associated primarily with initiation rituals marking the transition from puberty to adulthood for both genders, the mask is used in the community in the form of dance (Txianda) to entertain and celebrate with the community the passage of this phase. Crafted with meticulous attention to detail by selected artists, these masks symbolize youth's qualities of fertility, beauty, and strength (CACULO, 2018) (Figure 7-3).

Figure 7-3: Mwana Pwo mask
Source: Arquipelagos.pt, 2024

The Chihongo mask (Figure 7-4) features scarification on its wooden surface and is often adorned with feathers on top, symbolising its connection to wealth and power. Representing a masculine spirit embodying influence and authority, the mask plays a central role in various ceremonies within Tchokwe culture. It is present in initiation rituals for chiefs' children, enthronement ceremonies, and acts depicting the supernatural nature of ancestors. Traditional authorities send Chihongo masks, considered sacred symbols, to tributary villages where they receive offerings and tribute in exchange for their auspicious presence, signifying the importance of these symbols in maintaining social order and hierarchy.

The Chihongo mask in Lunda tradition embodies tribal austerity and aristocratic traits. As a strain mask, it is revered in villages with drumbeats, symbolizing its significance within the collective. Often performed by local tribal chiefs, the Chihongo evokes the past and its strict formalities, serving as a cultural emblem of historical continuity and social hierarchy.

Figure 7-4 Chihongo mask
Source: Arquipelagos.pt, 2024

7.3.3.2 *Monuments and architectural structures*

The following sites are classified at the Lunda – Sul Provincial level as tangible cultural heritage sites:

- monument of the Catholic Mission built in 1948
- residence of former employees of the Public Administration
- Governor's Residence
- CTT Building
- delegation of Endiama and the former Government Headquarters.

The following spaces, although not officially registered as monuments, merit highlighting at the Provincial level due to their cultural significance:

- Luachimo Falls
- Luaxi River Falls
- Chicapa River Falls
- Chiumbe River Falls
- Samussanda Falls.

According to the Municipal Master Plan of Saurimo Municipality formulated in 2014, a series of monuments categorized as Classified, inventoried, and proposed for classification to the Ministry are identified within the municipality of Saurimo. These sites are subject to protection by the local government to preserve their historical and cultural significance. The following historical and cultural heritage sites have been identified and monitored, although they are not currently classified as official cultural heritage:

- Moonlight Historic Site
- Catholic Women's Mission
- Camundambala Mission
- Cathedral of Saurimo (Catholic Church)
- Municipal Cemetery of Saurimo
- Natural moonlight lake
- Falls of the Chicapa River.

7.4 Municipalities and communities along the railway corridor

7.4.1 Dala Municipality

7.4.1.1 *Intangible cultural heritage*

Regarding the pertinent intangible cultural heritage identified within the direct project area within Dala municipality is the traditional marriage festivities between a man and a woman. These festivities embrace active involvement from the families of both the bride and groom. Additionally, significant cultural celebrations such as the Municipality of Dala festivities, typically in August, remain prevalent. Another noteworthy event, albeit infrequent, is the coronation ceremony of a new Soba (traditional leader) in where communities vacancies arise due to the resignation or advanced age of the incumbent. This ceremony comprises several distinct moments and rituals.

7.4.1.2 *Tangible cultural heritage*

Dala municipal cemetery

The Dala Municipal Cemetery is in the centre of the town of Dala on the main axis that runs parallel to the EN180 national road. The graves are in plain sight and there is no barrier delimitating the cemetery (Figure 7-5). Table 7-1 and Figure 7-14 provides further details of the identified heritage sites including specific locations (coordinates) and estimated distances from the proposed railway track.

Figure 7-5: Dala municipal cemetery
Source: Pantheroil, 2024

Sangoma Neighborhood Cemetery

The Sangoma cemetery is located more than 1 km from the neighbourhood and near the Txitango River and is the place where only the bodies from this neighbourhood are buried (Figure 7-6).

Figure 7-6 Sangoma neighborhood cemetery
Source: Pantheroil, 2024

Biula Neighborhood Cemetery

The cemetery is situated in Biula neighborhood and positioned adjacent to the access road linking Biula with the Municipality of Muconda/Cazagi. Notably, with the amalgamation of the Buíla district encompassing Sassuku, Biula, and Sakakuka, this cemetery serves as the burial ground for all three communities. Specifically, the Sassuku district serves as the focal point of traditional authority among the districts (Figure 7-7).

Figure 7-7: Buíla neighborhood cemetery
Source: Pantheroil, 2024

Saiassua Neighbourhood Cemetery

Saiassua Neighbourhood is part of one of the Regidors in the municipality of Dala, where the Regidor lives and has more than 13 neighbourhoods under his control. The Saiassua cemetery (Figure 7-8) is the general burial place for all those who, for cultural reasons, cannot be buried in the Municipal Cemetery due to its proximity. According to the Regidor, the remains of the first Regidor (his father) rest in this cemetery, and the cemetery is currently active.

Figure 7-8:Saiassua neighbourhood cemetery
Source: Pantheroil, 2024

Grave of the second Soba of the Luele Neighborhood

The Luele neighbourhood, situated within Dala municipality, boasts a notably high population density. Within this locality lie two distinct burial sites. One serves as the final resting place for Sobas and designated members of the Soba lineage (Figure 7-9). Notably, this cemetery is near the EN180 national road, facilitating accessibility.

Figure 7-9: Grave of the Second Soba of the Luele neighbourhood
Source: Pantheroil, 2024

General cemetery in the Luele Neighbourhood

The second cemetery in Luele, is known as the general neighbourhood cemetery, where the general population is buried, including children (Figure 7-10).

Figure 7-10:General cemetery in the Luele neighbourhood
Source: Pantheroil, 2024

It is expected that the railway Station no. 5 will be in Luele area. Initial field visit indicates that the Luele general cemetery lies about 1.76 km from the designated station general

area, while the Grave of the Luele Soba Grande is situated 2.80 km away. It has been verified that neither of these assets will be impacted during the project implementation (encompassing both construction and operational phases).

Despite the considerable spatial separation between the cemeteries and the designated construction zone for the station, prudent measures are recommended to address potential challenges arising from the transportation needs of residents. Accordingly, it is recommended that pre-construction awareness sessions be conducted for the local community. These sessions should aim to elucidate the anticipated areas of obstructed access, elucidate the inherent risks associated with construction activities, and outline the mitigation measures that will be implemented to minimise any resulting constraints.

Grave of Nossa Senhora

The grave of Nossa Senhora da Viagem is a historical monument of the Catholic Church in honor of a nun who died during the civil war in Angola (Figure 7-11). The monument itself has been visited several times as part of religious tourism. The grave is located adjacent to the EN180.

Figure 7-11: Grave of Nossa Senhora da Viagem
Source: Pantheroil, 2024

Satxitende neighbourhood cemetery

The Satxitende neighbourhood cemetery, located on the side of the EN180 national road, is where the people of the Satxitende neighbourhood are buried (Figure 7-12).

Figure 7-12:Satxitende neighbourhood cemetery
Source: Pantheroil, 2024

Txiumbwe river monuments

This monument is located close to the town hall and was built as part of the seven natural wonders of Angola project in the rivers category (Figure 7-13). The monument was built next to the EN180 national road.

Figure 7-13: Txiumbwe River monument and water falls
Source: Pantheroil, 2024

Table 7-1: Tangible cultural heritage identified in Dala Municipality (Pantheroil, 2024)

ID	Tangible Cultural Heritage Assets (Dala municipality)	Coordinates		Estimated Distance from the Railway Line	IFC PS8 status
		Latitude	Longitude		
D1	Dala municipal cemetery	11°2'27.04"S	20°12'6.94"	630 m	Non-replicable
D2	Sangoma neighbourhood cemetery	11° 2'33.99"	20°14'56.45"	4.80 km	Non-replicable
D3	Biula neighbourhood cemetery	11°10'25.44"	20°13'46.43"	600 m	Non-replicable
D4	Saiassua neighbourhood cemetery	11° 0'39.94"	20°17'49.87"	8.8 km	Non-replicable
D5	Grave of the second Soba of the Luele neighborhood	10°46'25.30"	20°14'49.10"	830 m	Critical
D6	Luele neighbourhood public cemetery	10°46'1.92"	20°14'21.70"	290 m	Non-replicable
D7	Grave of Nossa Senhora da Viagem	10°47'54.31	20°14'21.97"	180 m	Critical
D8	Satxitende neighbourhood cemetery	10°55'20.70"	20°12'10.33"	150 m	Non-replicable
D8	Tchiumbwe River Monuments	11° 1'19.82"	20°12'7.42	1.2 km	Critical

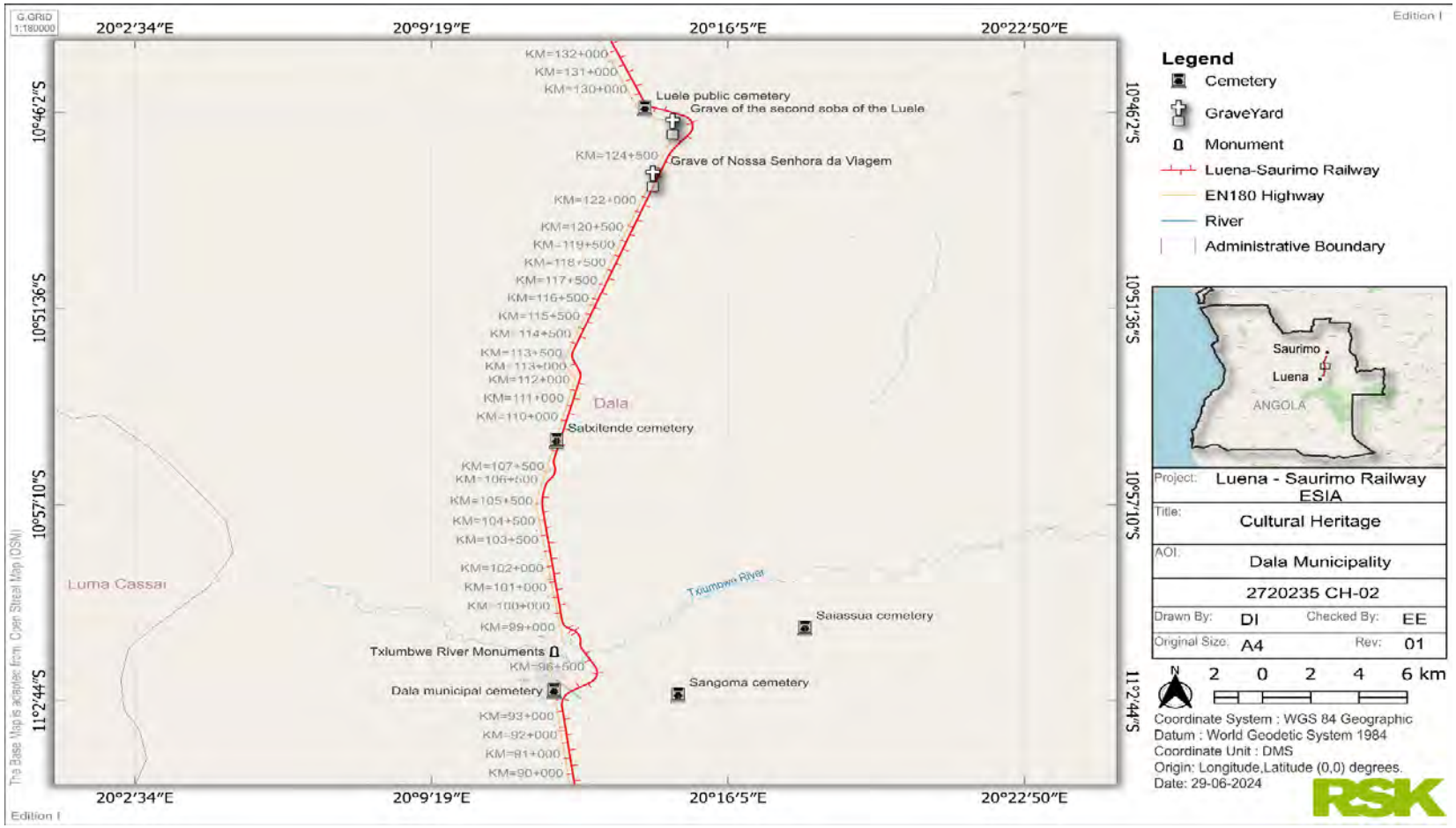


Figure 7-14 Tangible cultural heritage identified in Dala municipality indicated in Table 7-1 above

7.4.2 Saurimo Municipality

7.4.2.1 Intangible cultural heritage

Consultation with Traditional Authorities and municipal Technicians identified several significant cultural manifestations. The enthronement of a Soba is conducted in instances where a community is without a Soba due to death or advanced age of the predecessor. This ceremony encompasses multiple phases and specific rituals, typically necessitating the participation of village elders, referred to as "the century."

Another important cultural practice identified is traditional marriage ritual. The ritual occurs when a man formally requests his wife's hand in marriage, involving active participation from both families and the wider community. The bride's family determines a dowry, which they communicate to the groom's family. At this point, both families discuss and decide on the terms of the marriage, including whether it will proceed. This entire process is conducted in the presence of the community.

Furthermore, in the community of Caiaza within Saurimo, the local Soba emphasized the cultural significance of tombs. According to tradition, graves must remain undisturbed, as relocating them could result in various community issues due to ancestral displeasure. The Soba explained that these tombs hold profound importance, with local rituals performed wherein sobas visit the graves of ancestors to make requests. These requests are often related to community health, rainfall, and blessings for successful agricultural harvests. The railway track design prioritizes avoidance of community graves to avoid relocation of the graves and community issues.

7.4.2.2 Tangible cultural heritage

Muiele Neighbourhood cemetery

The Muieie neighbourhood cemetery, while small, serves as the primary burial site for the community (Figure 7-15). Although this cemetery it is not located within the Project's immediate AoI but the local Soba has recommended that, if during the construction phase (whether due to the opening of access roads or other technical project requirements) it becomes necessary to relocate any graves, the Project must adhere to established cultural procedures. This process must be guided by the Soba, who will conduct a ritual involving the use of beverages (such as beer and wine) and the sacrifice of animals, including chickens and goats as a sign of respect.

Figure 7-15: Muieie neighbourhood cemetery
Source: Pantheroil, 2024

Nanguanza Museum

The Nanguanza Museum serves as a vital repository of the cultural heritage of the people of Lunda Sul (Figure 7-16). This site also holds historical significance as the burial place of the first Regedor. Visitors to the Nanguanza Museum are required to offer a gift, which can be given in cash, to the individual who facilitates their visit. According to one of the local sobas who accompanied the assessment team, the museum houses several culturally significant artifacts. These include masks representing Mwana-Pwo and historical chairs, notably the chair used by President Agostinho Neto during his visit to Lunda Sul.

Figure 7-16: Nanguanza museum
Source: Pantheroil, 2024

Grave of the first Regedor of Nanguanza

This cemetery is a specific burial place for Regedors and their direct line relatives. In addition to the grave of the Regedor, there are other graves of relatives of the Regedor, a little further away (Figure 7-17).

Figure 7-17: Grave of the First Regedor of Nangana
Source: Pantheroil, 2024

Nanguanza General cemetery

The general cemetery of Nanguanza is where all residents in the Nanguanza neighbourhood are buried (children and adults). This cemetery is still active (Figure 7-18).

Figure 7-18: Nanguanza general cemetery
Source: Pantheroil, 2024

Muamucalanganza Neighborhood general cemetery

The General Cemetery in the Muamucalanganza neighborhood is the burial place for the population general and is located next to the Luachimo River (Figure 7-19).

Figure 7-19: Muamucalanganza neighbourhood general cemetery
Source: Pantheroil, 2024

Caiaza General cemetery

According to the Soba of the neighborhood, the Caiaza cemetery is a sacred site where individuals are interred without discrimination based on age or gender (Figure 7-20). The Soba has emphasized that if any graves are identified as being impacted by the Project, it is recommended to modify the railway design to avoid the displacement of these graves. The Project foresees the construction of Station no. 6 in Caiaza. It was assessed that the cemetery is located 340 meters from the railway track and 640 meters from the proposed station location, indicating that this asset is unlikely to be affected directly in the Project implementation process (both construction and operation phases).

Figure 7-20: Caiaza general cemetery
(Source: Pantheroil, 2024).

Table 7-2 Tangible cultural heritage identified in Saurimo Municipality (Pantheroil, 2024)

ID	Tangible cultural heritage assets (Saurimo municipality)	Coordinates		Estimated distance from the railway track	IFC PS8 status
		Latitude	Longitude		
S1	Muieie neighbourhood cemetery	9°42'21.90"	20°28'27.75"	1.94 km	Non-replicable
S2	Nanguanza Museum	9°53'23.01"	20°21'59.54"	610 m	Critical
S3	Grave of the First Regedor of Nanguanza	9°52'43.15"	20°22'12.03"	500 m	Critical
S4	Nanguanza Public Cemetery	9°52'48.16"	20°22'10.54"	520 m	Non-replicable
S5	Muamucalanganza neighbourhood Public Cemetery	9°58'5.80"	20°21'19.29"	1.3 km	Non-replicable
S6	Caiaza neighbourhood Cemetery	10°14'26.20"	20°14'59.07"	340 m	Non-replicable

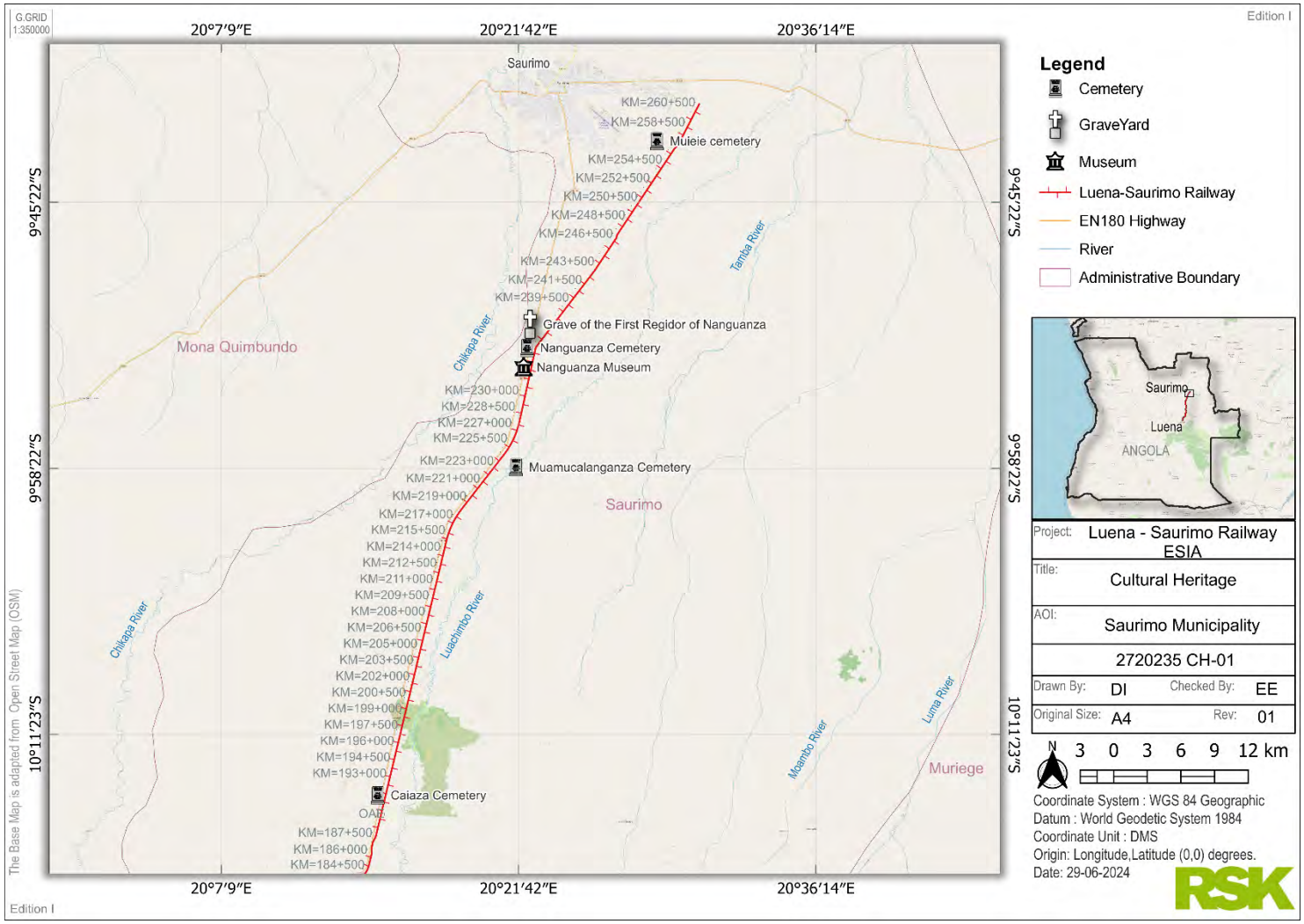


Figure 7-21 Tangible cultural heritage recorded in Saurimo municipality indicated in Table 7-2 above

7.4.3 Moxico Municipality

7.4.3.1 Intangible cultural heritage

In the Municipality of Moxico, an investigation into local intangible cultural heritage, informed by consultations with Traditional Authorities and fieldwork, provided insights into several prevalent practices:

- Tchiwangata Tundange or Mukanda: This ritual marks the initiation of pubescent males through circumcision. Initiation into Mukanda involves a period of seclusion, typically lasting one to two years, during which initiates (tundandji) reside in designated areas known as Mukanda, characterized by circular huts. The ritual, overseen by the traditional authority (Soba), includes ceremonial feasting, dancing, and the singing of local songs. The wearing of the kalelwa mask demarcates the commencement and conclusion of the ritual, with strict prohibitions against female participation. Initiates engage in various cultural activities during seclusion, such as crafting masks and mastering ceremonial dances, culminating in public performances for the community.
- Mahamba: This cultural practice revolves around the veneration of tutelary spirits, encompassing ancestral and nature spirits. Represented through figurines, trees, and masks, Mahamba rituals involve offerings, and prayers aimed at ensuring daily protection and appeasing the spirits. There is a local belief that failure to respect Mahamba can result in spiritual repercussions, including afflictions such as infertility and diminished hunting fortunes.
- Txilunga Tixcuna muana cuno: This tradition formalizes marriage between individuals within the community. Family gatherings are convened to negotiate and finalize marriage arrangements under customary laws. Txilunga Tixcuna muana cuno underscores the significance of familial and communal involvement in matrimonial unions, reflecting the enduring importance of tradition in social institutions.

7.4.3.2 Tangible cultural heritage

Peace Monument

The Peace Monument, built on April 4th, 2012, commemorates the pivotal moment in Angola's history represented by the signing of the Luena Memorandum of Understanding on March 30th, 2002 (Figure 7-22). This agreement signalled the cessation of the long-standing armed conflict in Angola, marking a significant milestone towards peace and reconciliation. The monument stands as a physical reminder of the sacrifices made during the conflict and the collective commitment to peacebuilding.

The inclusion of a library within the monument, displaying a collection of over six thousand documents, serves as a repository of knowledge and a resource for research, education, and intellectual growth within the Moxico Province. This library not only preserves the historical narrative of the conflict and the peace process but also facilitates the dissemination of information and the promotion of literacy and lifelong learning among the local populace.

Figure 7-22: Peace monument
Source: Pantheroil, 2024

Military fighter aircraft exhibit

Moxico Province has been deeply affected by the conflicts that devastated the region and Angola, the presence of these aircraft serves as a reminder of the sacrifices made by both military and civilians in times of conflict. It reinforces a collective memory of resilience, perseverance, and the search for peace amid adversity (Figure 7-23).

Furthermore, aircraft displays contribute to the preservation and promotion of military heritage in Moxico Province. By displaying these artifacts in public spaces, they provide opportunities for education, reflection, and celebration. Visitors, including residents and tourists, gain a deeper understanding of Angola's military history, the challenges faced, and the progress made towards peace and reconciliation.

Figure 7-23: Fighter aircraft in public display
Source: Pantheroil, 2024

Luena Municipal cemetery

The present Luena cemetery, established in 1922, is reportedly operating beyond its designated capacity. Accommodating a chapel for funeral services, it is slated as one of the province's landmarks by the local administration. Efforts are underway to formalize its recognition as a National Cultural Heritage through appropriate registration procedures (Figure 7-24).

Figure 7-24: Luena municipal cemetery
Source: Pantheroil, 2024

Canda I Neighbourhood cemetery

The Canda I neighborhood cemetery, situated within the Kanda I neighborhood and under the supervision of local traditional authorities, is used by adjacent neighborhoods, namely Canda II, Samahuzo (Canda III), Txitemo, and Soba Capaça. According to the soba of the Kanda I neighborhood, the cemetery is approximately 1.5 kilometers long (Figure 7-25).

Figure 7-25: Canda I neighborhood cemetery
Source: Pantheroil, 2024

Canda II Neighbourhood tomb

An isolated tomb was identified within the Bairro Kanda II community (Figure 7-26). Situated within an area of dense vegetation, distanced from the neighbourhood perimeter, local consultations indicate that residents lack knowledge regarding the interred individual's identity and the circumstances surrounding the burial. It was reinforced that the tomb holds no cultural significance for the community, and the location is not designated as a site of spiritual importance or considered as a communal cemetery.

Figure 7-26: Kanda II neighbourhood tomb
Source: Pantheroil, 2024

Sacapiasso Neighbourhood cemetery

The Sacapiasso neighbourhood cemetery, situated approximately 1 km from the neighbourhood's perimeter, functions as the principal burial site for the community (Figure 7-27). Consultations to Soba and residents revealed that in the event of a significant impact on the community, the project is required to present compensatory measures agreeable to traditional authorities. Furthermore, it was observed that the community does not have a tradition of conducting rituals in instances of grave displacement. Additionally, it was verified that the community lacks a customary practice of conducting rituals in situations of grave displacement, with no documented instances of such occurrences to date.

Figure 7-27: Sacapiasso neighbourhood cemetery
Source: Pantheroil, 2024

Tombs of the unknown soldiers

The Tomb of the unknown soldiers stand as a revered cultural heritage site within the municipality of Luena, serving as a symbol of patriotism (Figure 7-28). Positioned at the heart of Luena, its primary objective is to pay homage to the fallen soldiers who made the ultimate sacrifice on the battlefield. This site holds significant importance to the collective memory and identity of Luena, embodying the valor and sacrifice of those who bravely defended their homeland.

Figure 7-28: Tombs of the unknown soldiers
Source: Pantheroil, 2024

Table 7-3 Tangible cultural heritage identified in Moxico Municipality (Pantheroil, 2024)

ID	Tangible cultural heritage assets (Moxico municipality)	Coordinates		Estimated distance from the railway line	IFC PS8 status
		Latitude	Longitude		
M1	Peace Monument	11° 47.188'	19° 54.910'	7.15 km	Critical
M2	Military exhibition	11°47'4.70"	19°54'54.68"	6.02 km	Replicable
M3	Luena Municipal Cemetery	11°45'41.35"	19°54'50.71"	5.06 km	Non-Replicable
M4	Canda I neighborhood Cemetery	11°43'15.12"	19°56'40.78"	3.73 km	Non-replicable
M5	Canda II Neighborhood tomb	11°42'21.05"	19°55'48.93"	6.34 km	Non-replicable
M6	Tombs of the unknown soldiers	11°47'3.68"	19°54'53.56"	6.06 km	Critical
M7	Sacapiasso neighborhood Cemetery	11°37'31.10"	20° 1'4.10"	3.45 km	Non-Replicable

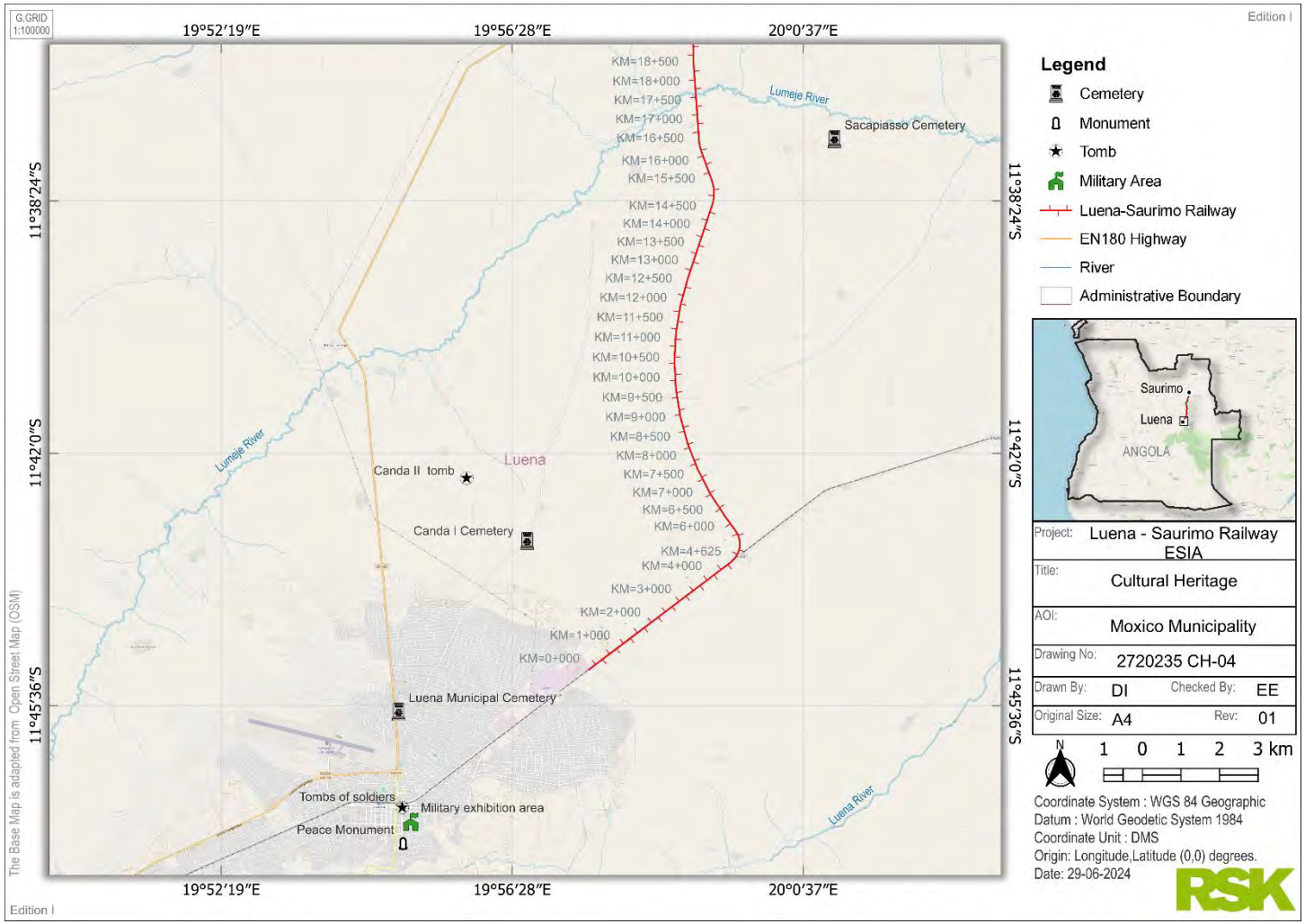


Figure 7-29 Tangible cultural resources recorded in Moxico municipality indicated in Table 7-3 above

7.4.4 Camanongue Municipality

7.4.4.1 Intangible cultural heritage

Existence of the following intangible cultural practices of relevance to the communities were identified as detailed below.

Ukule, which consists of a female initiation ritual, takes place at the time of the adolescent's first menstruation (*ukule*). This ceremony consists of several stages during which the young girls (*kafundeji)* learn a belly dance (much venerated by the Tshokwe and which anticipates the beginning of sexual intercourse). The girl receives instructions on how to live as husbands and wives. In this ceremony, the girl is painted with tattoos (*mikonda*) for erotic purposes and, together with her future fiancé, they perform various rituals that end with the consummation of the marriage of the two young men.

Camanongue in the communities of Muapezo and Musseringinge, the obligation of the Traditional Marriage (*Mutaixi*) was mentioned. That is, in these communities every relationship between a man and a woman must be preceded by a formal ceremony called *Mutaixi*, if this requirement is not fulfilled, the union between the couples will be disturbing in the sense that the couple may see their fertility affected (not having children) and with that not many other problems will arise. On the other hand, the woman who married a man without the traditional wedding ceremony being fulfilled, her reputation and family reputation are tainted.

7.4.4.2 Tangible cultural heritage

Ruins of the church of Santana

Located in the heart of Vila Sede de Camanongue, the ruin of Santana Church is part of a cultural collection belonging to the Roman Catholic Church, but because of its influence and symbolism it is considered a monument by the residents of Camanongue (Figure 7-30).

In order to better understand its importance and history, the team spoke to the Vicar of the Parish (Father José Nunda) who provided the following information about the monument: "It is a structure that was erected in 1966, three years after the creation of the Diocese of Luena, which was one of the first Parishes to be built in the province of Moxico and which, as a result of its social action, served as a reception and training point for staff from the Municipality of Camanongue. According to the Church official, the structure worsened during the civil war that took place in Angola."

Figure 7-30: Ruins of the church of Santana
Source: Pantheroil, 2024

Camanongue Municipal cemetery

Camanongue's municipal cemetery is at centre of the municipality, and it is located along EN180 national road (Figure 7-31). The neighbourhoods surrounding the municipality have their burials in this cemetery. The graveyard has a masonry fence, but there is a grave outside the fence. Information received from the community indicated that when the cemetery was fenced off, the grave was already there and, in obedience to local custom, the grave was kept outside.

Figure 7-31: Camanongue municipal cemetery
Source: Pantheroil, 2024

Tomb of the unknown soldiers

The Tomb of the Unknown Soldier is a place of patriotic symbolism, whose purpose is to honour the soldiers who lost their lives at the front in the municipality of Camanongue. The graveyard is located near the square of nations within the municipality (Figure 7-32).

Figure 7-32: Tomb of the unknown soldiers
Source: Pantheroil, 2024

Muapezo Neighbourhood Old Cemetery

The cemetery situated in the Muapezo neighbourhood has ceased operations, with a portion of the local population duly informed of its non-functionality for burials (Figure 7-33). The establishment of this cemetery was due to the proximity of the area to the Muapezo neighbourhood. It is noteworthy that this neighbourhood was relocated as part of a broader initiative aimed at the consolidation of residential areas, a process overseen

and completed by the pertinent municipal administrative authorities. The designated neighbourhood is no longer in this location.

Figure 7-33: Muapezo neighborhood old cemetery
Source: Pantheroil, 2024

Kamuleque Neighbourhood cemetery

The cemetery situated in the Kamuleque neighbourhood lies within a proximity of less than 1 kilometre from the community and intersects with an RNT high-voltage power line (Figure 7-34) As per the local Soba's guidance, in the event of any graves being impacted, no ritual procedures are applicable. However, the project will be obligated to provide social enhancements within the neighbourhood. Such enhancements may encompass initiatives such as facilitating access to potable water, the installation of electricity infrastructure, or even the establishment of a train station.

Moreover, within the described locality, the Jango in the Kamuleque neighbourhood holds significant cultural importance. Functioning as a venue for conflict resolution arising from social interactions among villagers, it serves as a pivotal communal space. According to the local soba, the Jango is enveloped by medicinal trees, meticulously chosen for their therapeutic properties, catering to various ailments prevalent within the community. Additionally, these trees are believed to provide protection against malevolent spiritual influences.

The identified medicinal trees in this area include *Mussambi, Mufungo, Mumanga, Mucondo, Mussala, and Mutongo,* that occupy a revered status within the community and are deemed sacred. It is explicitly forbidden to clear these trees, as they play an integral role in safeguarding the well-being and cultural customs of the community.

Figure 7-34: Kamuleque neighbourhood cemetery and the Jango in the Kamuleque neighbourhood

Source: Pantheroil, 2024

Samucanda Neighbourhood Cemetery

The cemetery situated in the Samucanda neighbourhood occupies a unique position, straddling the boundary between Luena and Camanongue (Figure 7-35). Functioning as a communal burial ground, it accommodates interments not only from the Samucanda neighbourhood but also from the adjacent Sakambudji neighbourhood. This shared utilization underscores its pivotal role as a general repository for deceased individuals within the broader vicinity.

Figure 7-35: Samucanda neighbourhood cemetery

Source: Pantheroil, 2024

Musseringinge Neighbourhood cemetery

The cemetery located in the Musseringinge neighbourhood is designated exclusively for the interment of adults, reflecting a cultural practice wherein children are laid to rest in separate locations (Figure 7-36). This distinction arises from a deeply ingrained belief within the local culture, aimed at averting potential disruptions within the community stemming from suspicions of witchcraft. By segregating the burial grounds in this manner, it is perceived to mitigate the possibility of unrest caused by the perceived presence of spirits of children whose demise may be attributed to such practices.

Figure 7-36: Musseringinge neighbourhood cemetery
Source: Pantheroil, 2024

Cemetery of Regodor, Sobas and their descendants in the* Musseringinge *neighbourhood

The designated Soba cemetery holds a special significance as the resting place for regidors (local administrators) and Sobas (community leaders), along with their descendants (Figure 7-37). Notably, it encompasses the burial site of the inaugural Regedor of Bairro Musseringinge. The selection of this site, facilitated by a family member's recommendation, adheres to cultural protocols mandating that younger family members of lesser rank and responsibility enter the cemetery barefoot as a mark of respect. In the spirit of community engagement, the acting Regedor emphasised that any structural encroachment upon the cemetery would necessitate a ritualistic response from the company involved. This ritual typically entails the presentation of symbolic goods such as blankets and wine, symbolising a gesture of acknowledgment and appeasement to the affected community members.

Figure 7-37: Cemetery of Regodor, Sobas and their descendants in the Musseringinge neighbourhood

Source: Pantheroil, 2024

Table 7-4 Tangible cultural heritage identified in Camanongue Municipality (Pantheroil, 2024)

ID	Tangible Cultural Heritage Assets (Camanongue Municipality)	Coordinates		Estimated Distance from the Railway Line	IFC PS8 status
		Latitude	Longitude		
C1	Ruins of the Church of Santana	11°26'16.44"	20°9'48.76"	900 m	Critical
C2	Cemetery Municipal of Camanongue	11°26'18.81"	20°9'34.01"	920 m	Non-replicable
C3	Tomb of unknown soldiers	11°26'18.81	20°9'34.01"	937 m	Critical
C4	Kamuleque Neighbourhood Cemetery	11°15'24.83"	20°11'23.3"	83 m	Non-Replicable
C5	Jango for Kamuleque Neighbourhood Conflict Resolution	11°15'31.28"	20°11'.44"	630 m	Critical
C6	Samucanda Neighbourhood Cemetery	11°36'59.04"	19°55'46.04"	6.09 km	Non-replicable
C7	Musseringinge Quarter General Cemetery	11°35'55.56"	19°58'16.54"	1.40 km	Critical
C8	Cemetery for Regedors, Sobas and their descendants	11°35'7.14"	19°58'3.51"	1.86 km	Critical
C9	Muapezo Quarter Old Cemetery (deactivated)	11°28'44.30"	20°7'57.89"	1.33 km	Abandoned

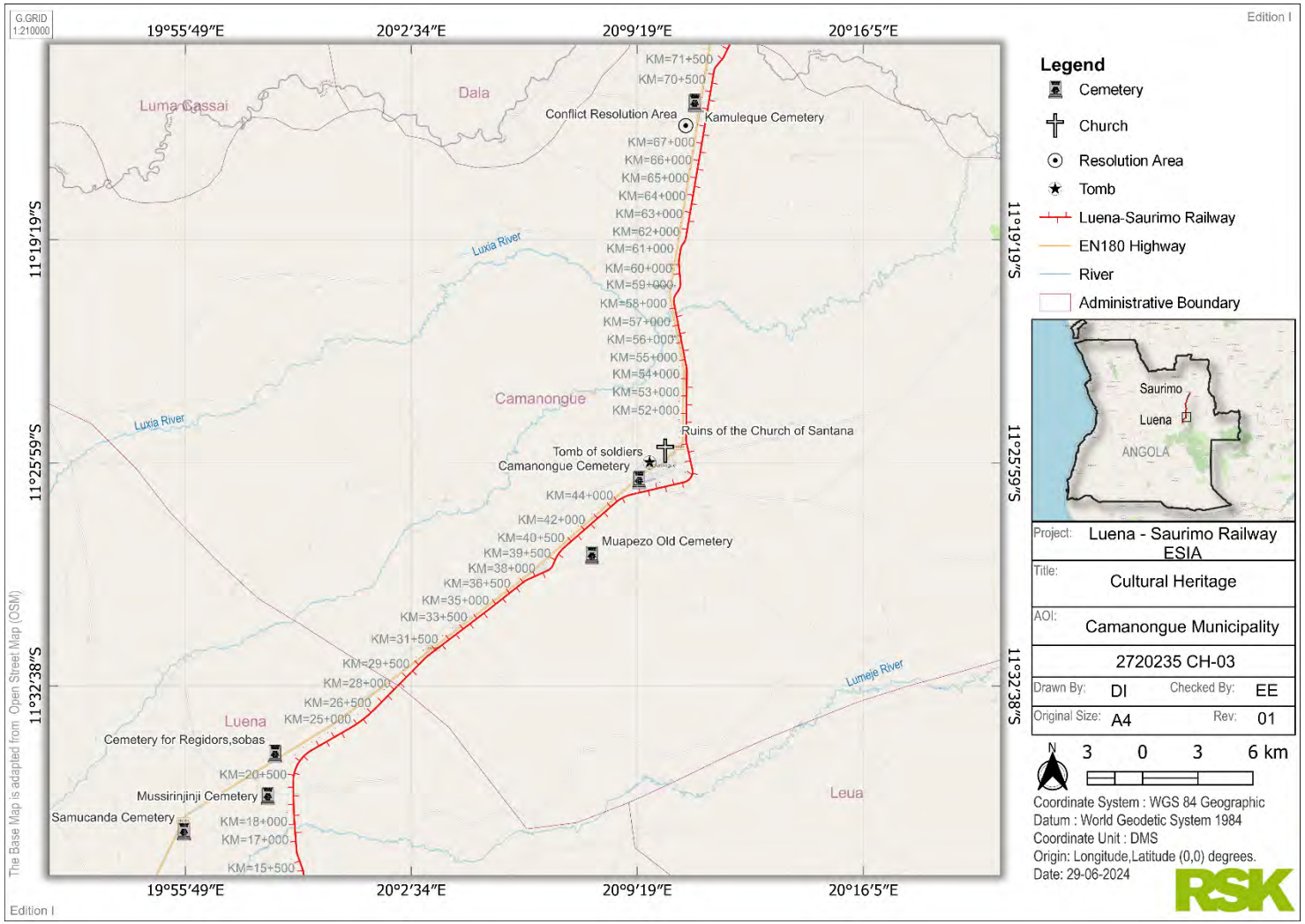


Figure 7-38 Tangible cultural heritage recorded in Camanongue Municipality indicated in Table 7-4 above

Overall, the communities situated within the immediate vicinity of the railway track across the four municipalities share a common heritage characterized by the exhibition of various dances and cultural expressions. These include *akiski, Txianda, cisela, kalukuta, kandowa, makhopo, maringa, kandjendje, and likembe*, which are frequently observed during significant ceremonies such as rituals welcoming visitors, ceremonies marking the accession of traditional leaders, investiture ceremonies for prominent traditional chiefs, and celebratory festivals like Carnival.

These cultural practices are accompanied by the performance of specific musical instruments, including batuques, *cingunvu, ndjimba, cissanje, and muiyemba (xylophones).* Additionally, the cultural milieu is enriched by the presence of *akishi* masquerades and a variety of masks, each imbued with symbolic significance. Notable examples include the *cikunza*, associated with the patron of mukanda rites, the cikungu, integral to investiture ceremonies for great traditional chiefs, the Mwana powo, representing the beauty and allure of Cokwe women, and the *cihongo* mask, among others.

7.4.5 Summary

No cultural heritage resources are anticipated to be affected directly by the Project, as all identified sites are located beyond 60 m from the indicative project footprint. The baseline assessment registered tangible cultural heritage in the broader area, primarily graves, cemeteries, and historical sites. In alignment with IFC Performance Standard 8, these resources are considered critical and non-replicable, as they cannot be replaced or relocated. The current railway alignment does not intersect with these sites and will not restrict community access to them. Consequently, no adverse impacts are expected; however, the Project will reconfirm during RAP that all identified cultural heritage remains protected.

In conclusion, overall, based on current design, the proposed railway track design prioritised avoidance of graves and cemeteries to avoid relocation and community issues. In the meantime, the design provides for safe and continued community access to the graves and cemeteries identified within project area of influence.

8 PHYSICAL ENVIRONMENT BASELINE

8.1 Climate and climatic conditions

The methodology for acquiring climate data included the use of secondary data sources such as the National Aeronautics and Space Administration (NASA) Earth Science research program for the duration of 2013 to 2024 and the World Bank Climate Knowledge Portal for the duration of 1991 to 2022. Long term average daily data, average daily rainfall, minimum and maximum temperatures were obtained at Luachimo, Saurimo and Luena (see Table 8-1). The Project area falls within the summer rainfall region, with a climate of warm to hot (humid) summers and cold to dry winters. The Mean Annual Precipitation (MAP) is approximately 1070 mm/annum and occurs mostly in the summer months (from October to May). Average daily minimum and maximum temperatures range from 11°C during the winter months up to 34°C during the summer months. The monthly average rainfall and temperatures are presented in Table 8-1, Figure 8-1 and Figure 8-2. Moreover, rainfall is primarily influenced by the movement of the Inter-tropical Convergence Zone (ITCZ) as it shifts between the equator and tropics. Rainfall varies across the country, with north-eastern Angola receiving the highest levels of precipitation, while total rainfall decreases southward and westward. In addition, during the summer season, the average daily temperatures typically range between 22 to 23°C. Conversely, the cold to dry season, locally known as '*Cacimbo*' occurs mostly in the winter months (from June to September). Although, the winter months are regarded as cold and dry, Angola experiences periods of cool weather conditions. The winter months typically experience temperatures ranging between 18 to 20°C.

Table 8-1 Monthly average rainfall and temperature in the Project area

Month	Rainfall [mm]			Max Temp [°C]			Min Temp [°C]		
Location	**Luachimo**	**Saurimo**	**Luena**	**Luachimo**	**Saurimo**	**Luena**	**Luachimo**	**Saurimo**	**Luena**
Jan	172	174	217	26	26	27	18	18	19
Feb	178	176	188	26	26	27	18	18	19
Mar	212	158	237	26	26	27	18	18	19
Apr	72	89	56	26	26	28	17	16	18
May	10	9	6	28	28	30	14	13	17
Jun	0	0	0	28	27	30	12	11	14
Jul	1	0	1	29	28	31	12	11	14
Aug	14	8	0	32	31	34	15	14	17
Sep	37	40	14	33	34	34	18	18	20
Oct	77	88	54	31	33	32	19	20	20
Nov	131	136	110	28	30	29	18	19	19
Dec	191	187	173	26	27	27	18	18	19

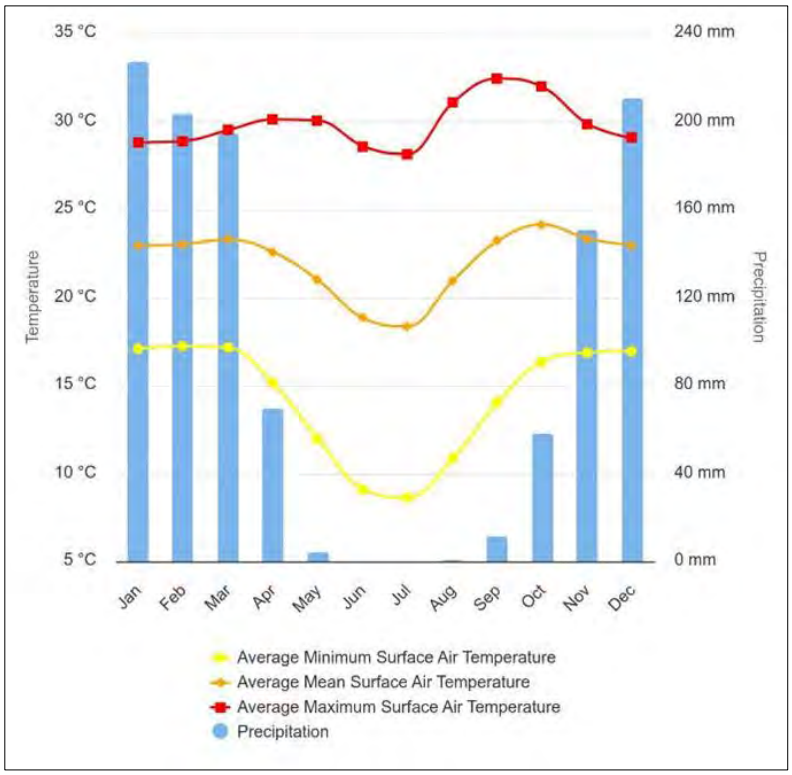


Figure 8-1: The average temperature and precipitation for the Luena 1991-2022

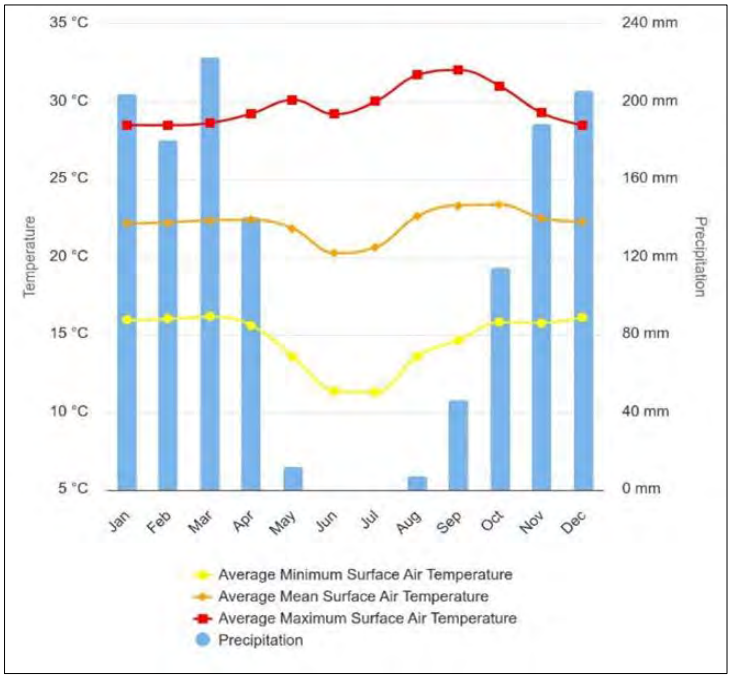


Figure 8-2: The average temperature and precipitation for the Saurimo 1991-2022

8.2 Hydropedology

8.2.1 Area of Influence

The AoI of the project is defined as a basis for identifying the boundaries for baseline data gathering by taking into consideration the spatial extent of potential direct and indirect impacts of the project. The assessment includes a footprint of all project aspects comprising the direct AoI. For the indirect impacts a 20 km AoI has been utilised. The assessment zone was considered to enable identification of sensitive receptors and potential direct and indirect impacts of the Project. As such, the 20 km AoI is considered sufficient for this assessment.

8.2.2 Methodology

A desktop study using literature related to hydropedology was undertaken to identify soil types using the South African soil classification system (Soil Classification Working Group, 2018) and the WRB Soil groups (2014). The study identified specific soil types using the two classification systems and then regrouped these soils based on their hydropedological properties. This methodology was derived from van Tol & Le Roux (2019) whereby soils are regrouped into various hydropedological soil types as shown in Table 8-2.

Table 8-2: Hydrological soil types of the studied hillslopes (van Tol et al., 2019)

Hydrological soil type	Description	Subgroup	Symbol
Recharge	Soils without any morphological indication of saturation. Vertical flow through and out the profile into the underlying bedrock is the dominant flow direction. These soils can either be shallow on fractured rock with limited contribution to evapotranspiration or deep freely drained soils with significant contribution to evapotranspiration	Shallow	
		Deep	
Interflow (A/B)	Duplex soils where the textural discontinuity facilitates build-up of water in the topsoil. Duration of drainable water depends on rate of evapotranspiration, position in the hillslope (lateral addition/release) and slope (discharge in a predominantly lateral direction)	A/B	
Interflow (soil/bedrock)	Soils overlying relatively impermeable bedrock. Hydromorphic properties signify temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction	Soil/bedrock	
Responsive (shallow)	Shallow soils overlying relatively impermeable bedrock. Limited storage capacity results in the generation of overland flow after rain events	Shallow	
Responsive (saturated)	Soils with morphological evidence of long periods of saturation. These soils are close to saturation during rainy seasons and promote the generation of overland flow due to saturation excess	Saturated	
Stagnating	In these soils outflow of water is limited or restricted. The A and/or B horizons are permeable but morphological indicators suggest that recharge and interflow are not dominant. These		

Hydrological soil type	Description	Subgroup	Symbol
	includes soils with carbonate accumulations in the subsoil, accumulation and cementation by silica, and precipitation of iron as concretions and layers. These soils are frequently observed in climate regions with a very high evapotranspiration demand. Although infiltration occurs readily, the dominant hydrological flow path in the soil is upward, driven by evapotranspiration		

A field survey was conducted in March 2024 to obtain information regarding the soil morphology and hydropedological flow paths relevant to the hillslope by means of several representative transects (see Figure 8-3). Moreover, the slopes within the Project area have been assessed during the desktop assessment to identify possible transects that will represent typical terrain and soil distribution patterns. These locations were then altered slightly during the survey depending on the extent of vegetation, slopes, access, and any features that will improve the accuracy of the data acquired.

A total of 18 transects each comprising four sample sites to represent terrain units were implemented along the proposed railway corridor (Figure 8-3). Transects and sample points along the railway route are essential for a hydropedology study for several key reasons:

- Systematic Data Collection: Transects provide a systematic way to collect data across a landscape. By establishing a line (transect) across different terrains, you can ensure that your study captures the variation in soil and water characteristics across different environmental conditions.
- Representation of Variability: Natural landscapes are highly variable. By sampling at multiple points along a transect, you can capture this variability. This helps in understanding how soil and hydrological properties change across different parts of the landscape, which is crucial for accurate hydropedological analysis.
- Gradient Analysis: Transects are particularly useful for studying gradients, such as changes in soil moisture, texture, or composition from a wetland area to an upland area. Sample points along the transect can reveal how these properties transition, providing insights into the processes influencing soil and water interactions.
- Spatial Patterns: By analysing data from multiple sample points along a transect, researchers can identify spatial patterns and correlations between soil and hydrological properties. This can help in identifying zones of similar characteristics, which is important for understanding and managing water flow and distribution.
- Detailed Profiling: Sample points along a transect allow for detailed profiling of soil horizons and water table depths. This detailed profiling is necessary to understand the vertical and horizontal distribution of hydropedological properties.

In summary, transects and sample points along them are crucial for obtaining a comprehensive, systematic, and detailed understanding of the interactions between soil and water across different landscapes. This approach helps in capturing the natural variability and gradients, which are essential for accurate hydropedological studies. The Project's direct AoI does not have a history of industrial establishments, operations and/or extractive investments. The nearest mine (Catoca Diamond Mine) is approximately 45km to the north of Saurimo town. Therefore, there was no literature that indicated the

necessity to conduct a detailed soil contamination baseline survey and subsequent assessment for soil contamination has not been included this ESIA.

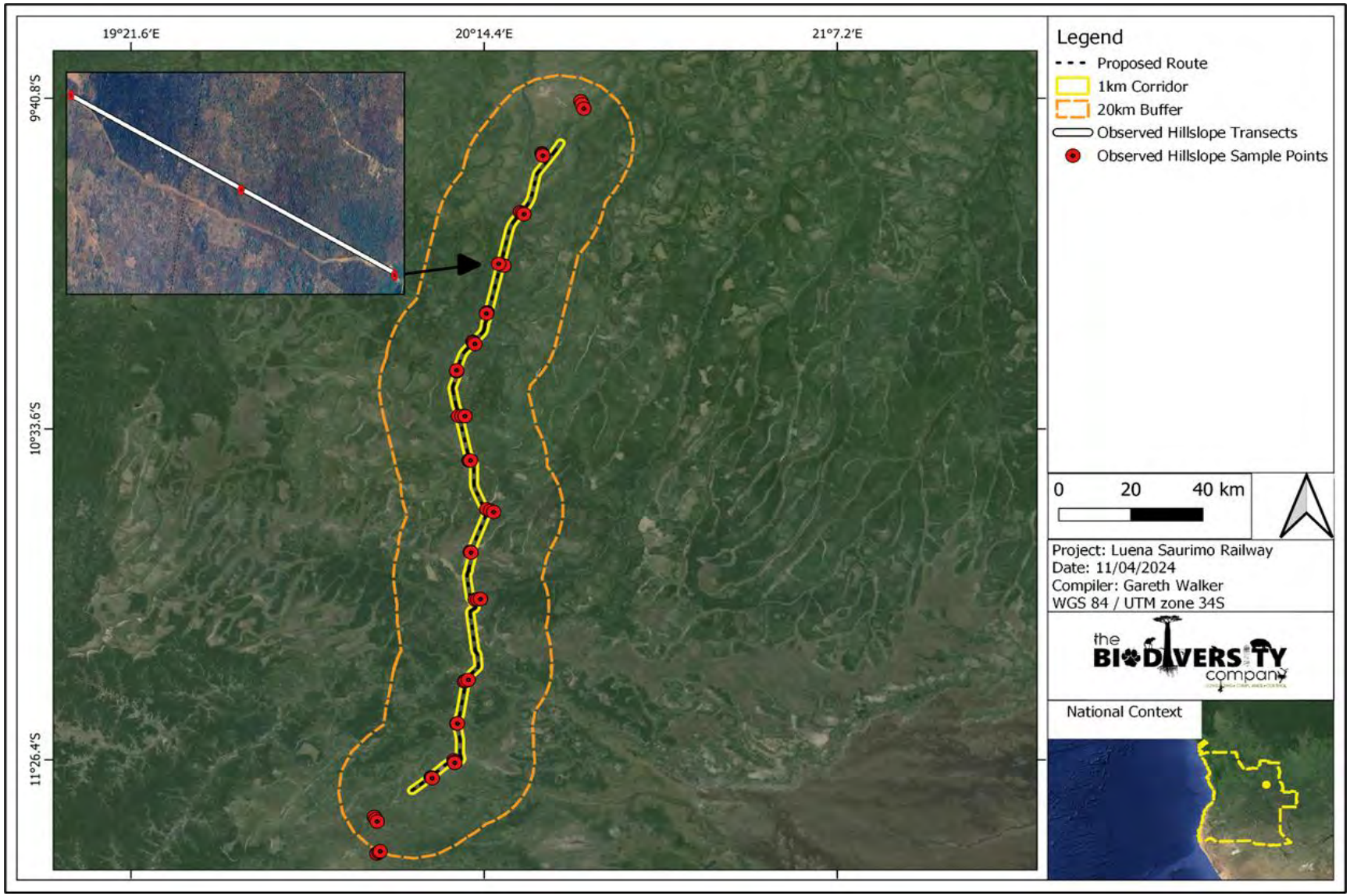


Figure 8-3: Hydropedology transects and observation sites

8.2.3 Geology and soils

The proposed railway route is located in a morphological domain called the Eastern Plateau of Angola, where most of its landscape is dominated by elongated, flat-topped hills, between the altitudes of 1350 m above sea level in Luena, and 1080 m above sea level in Saurimo characterising a gentle dip towards the north. The flattened surface is covered by a thick cover of fine sandy soils resulting from the reworking of materials due to the weathering of the Archean rocks that make up the Angolan craton. The controls of the main drainage lines have structural foundations and the largest river in the region of interest has a west-east direction while its tributaries assume approximately orthogonal directions. The entire drainage runs over very old rocks that constitute the crystalline basement and, it is in the points with less land cover and at the source of the watercourses, that rocky outcrops occur that can be used as a source of material for crushing.

The predominance of pedogenesis over morphogenesis is revealed in the transpositions of these valleys, which only on two occasions have amplitudes greater than 100 meters (Lumeje river, Tchiumbwe/Cassai waterfalls, 7th largest tourist attraction in Angola), occasions in which the petrographic and mineralogical characteristics of the occurring lithologies can be verified.

The soil cover has an average thickness much greater than 5.0 m, presenting lighter tones at altitudes above 1,200 m and tending to a greater degree of laterization/cementation by oxides below elevation 1,200 m and, therefore, with lighter reddish colours which happens from the Chioalua region onwards.

All of these soils from the post-tertiary cover have a fine and very fine sandy texture and characteristics of high susceptibility to erosion processes and should deserve special attention when designing erosion mitigation and prevention solutions.

The morphoclimatic evolution of the region, after the Cretaceous, but mainly from the Tertiary onwards, led to the development of thick soil cover. Thus, the rocky framework is only of direct interest for prospecting and quarrying and for obtaining granular material for carrying out the works and, in this with particular emphasis on obtaining ballast, an essential component in the constitution of the railway superstructure, a position in which strict geotechnical standards are required. Other applications, such as material for mortars and Portland cement concrete, also deserve attention, due to the difficulties in locating occurrences with low sterile cover and always with extreme difficulty in extraction in the few known places where these hard and healthy rocks outcrop.

The rocks that give rise and support to the lands of interest to the enterprise belong to the usually called Cristalino Shield and/or Doubled from the Republic of Angola. These lithologies occur, therefore, in the Shield Archean of Northeast Angola (Lunda)-Kasai, with intense metamorphism cycles and deformation, whose interior has remained stable since around 1,700 Ma (Million years), after the Limpopo-Liberian (Musefu-Moyo) orogenic cycles. Almost the entire area central-eastern Angola is covered by Phanerozoic sediments, already described.

The Project corridor is contained in the geomorphological unit called Cassai Depression, which largely corresponds to the drained Lunda Sul province to the north, in which certain rivers were subject to the effects of tilting in towards the Congo Basin. It is currently a stabilized environment where pedogenesis overlaps with morphogenesis.

The rocks occurring in the substrate are gneissic-migmatitic-granitic undifferentiated and frequently metamorphosed meta-ultramafic-mafic, metasomatized, migmatized and charnoquitized. In the archaic sialic shield of Lunda-Kasai, lithologies associated with the younger gneissic-migmatitic-granitic rocks, often polycyclic, with petrographic evidence of past tensions.

The Zambezi-Cubango is characterised with large peneplain draining deep in the Kalahari sands, mostly associated with slow-flowing rivers through gently dropping plateaus between 1 200 m at the watershed with the Congo Basin and 1000 m at the frontier with Namibia. The climatic gradient across the Kalahari sands can be observed in several ecoregions in this geomorphological unit (Diniz, 2006; Huntley, 2019; Huntley, 2023). Following Jones et al, (2013), the expected soils in the project area namely include, Arenosols (AR) and Gleysols (GL) soil groups (WRB, 2014) (see Figure 8-4). However, the field surveys conducted in March 2023 identified additional soil groups presented in Table 8-3.

The direct project AoI of up to 5km has no historical incidences of earthquakes and volcanoes. The nearest earthquake recorded by the United States Geological Survey in Lunda Sul Province was in a town called Cazeje in 2022 with a magnitude of 4.3 and depth of 10km. Prior to this event, the last earthquake in the Province was before 1970s. Cazeje is more than 50km east from Biula (dirt road at KM 79+100) and therefore outside of the wider AoI for the project. Therefore, a detailed hazard baseline has not been conducted and subsequent hazard assessment has not been included in this ESIA.

Table 8-3: SA soil forms in relation to the WRB soil groups found in the Project footprint

Soil Classification Working Group, (2018)	WRB Reference Soil Groups (RSGs) World (2014)
Glenrosa	Leptosols
Hutton	Ferralsols
Lepellane	Stagnosols
Champagne	Histosols
Dundee,	Fluvisols
Oakleaf, Tukulu, Tubatse, Bethesda, Quaggafontein	Cambisols
Ermelo	Arenosols
Iswepe, Cartref, Kroonstad, Katspruit	Gleysols

Further, the Project area stretches across two ecoregions of Angola namely, the Congo Peneplain (Peneplanicie do Zaire); Angolan Ecoregions 2 and 3, and the Zambezi-Cubango Peneplain; (Peneplaniciendo Zambeze- Cubango); Angolan Ecoregion 7-11 (see Figure 8-4). The Congo Peneplain is characterised with vast sandy peneplain, these have gentle plains between 800 to 1,100 m in height. The Cretaceous sediments found in most rivers of the Lundas are the main source of Angola`s rich diamond sector (Diniz, 2006; Huntley, 2019; Huntley, 2023).

Figure 8-4: The main landscape systems of Angola (Huntley, 2019; Huntley, 2023)

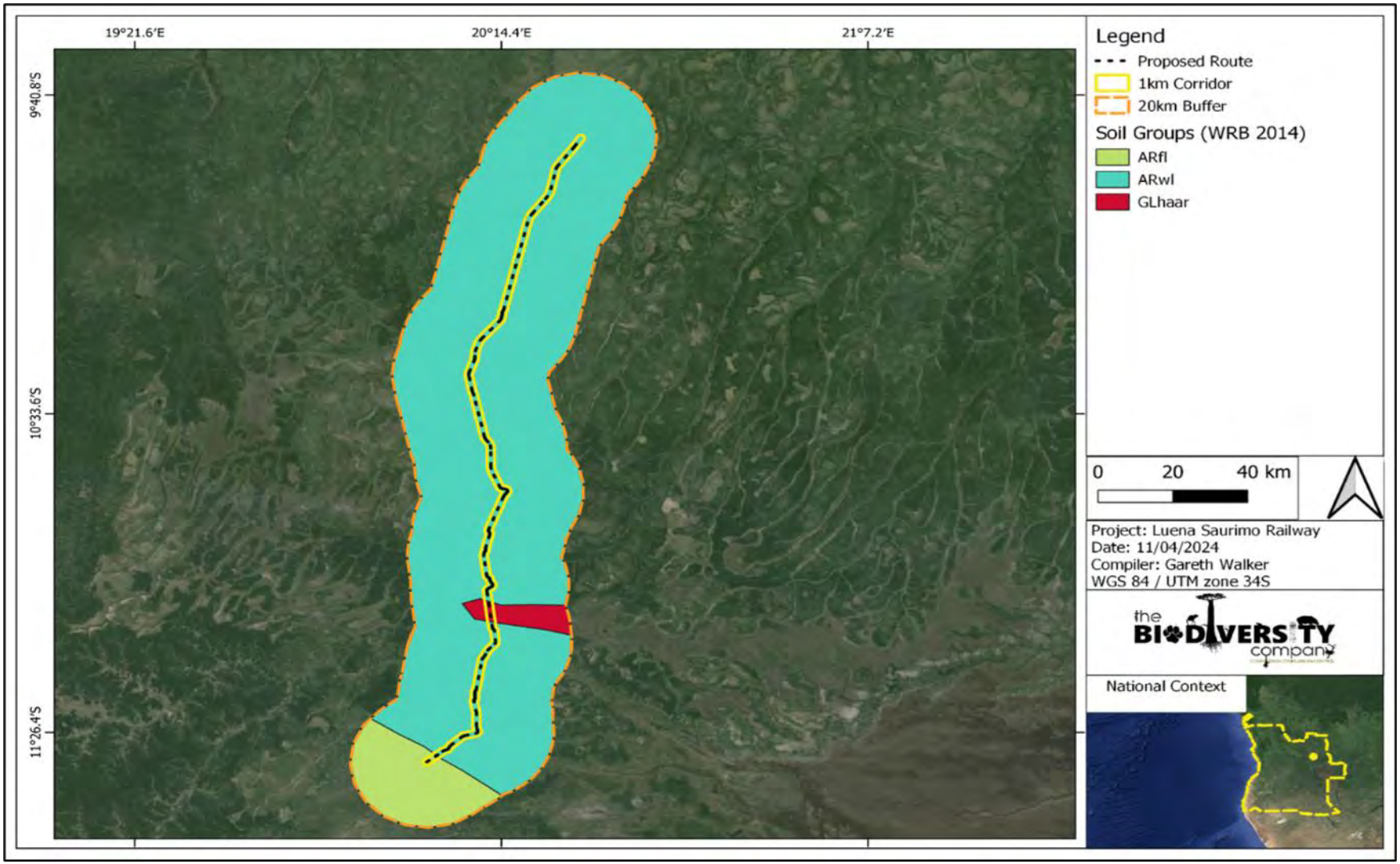


Figure 8-5: Soils within the project area (Jones et al, (2013)

8.2.4 Soil forms

The following soil forms were identified using the Soil Classification Working Group, (2018) on-site whilst surveying the relevant transects. Table 8-3 below presents the soil form type in relation to the respective transect locations along the project RoW.

- Hutton (Orthic topsoil on top of a thick red apedal horizon)
- Ermelo (Orthic topsoil on top of a thick yellow brown apedal horizon)
- Oakleaf (Orthic topsoil on top of a thick neocutanic horizon)
- Tubatse (Orthic topsoil on top of a neocutanic horizon, underlain with a lithic horizon below)
- Tukulu (Orthic topsoil on top of a neocutanic horizon, underlain with a gley horizon below)
- Tshiombo (Orthic topsoil on top of a neocutanic horizon, with unconsolidated material with wetness below)
- Quaggafontein (Orthic topsoil on top of a neocutanic horizon, with alluvial horizon below)
- Bethesda (Orthic topsoil on top of a neocutanic horizon, underlain with a hard rock layer below)
- Kroonstad (Orthic topsoil on top of an albic horizon with a gley horizon below)
- Cartref (Orthic topsoil on top of an albic horizon with a lithic horizon below)
- Iswepe (Orthic topsoil on top of an albic horizon with a hard rock substratum below)
- Dundee (Orthic topsoil on top of an alluvial horizon)
- Lepellane (Orthic topsoil on top of unconsolidated material with wetness (thick)
- Katspruit (Orthic topsoil on top of a gley horizon)
- Champagne (Organic topsoil on top of a gley horizon)
- Glenrosa (Orthic topsoil on top of lithic horizon).

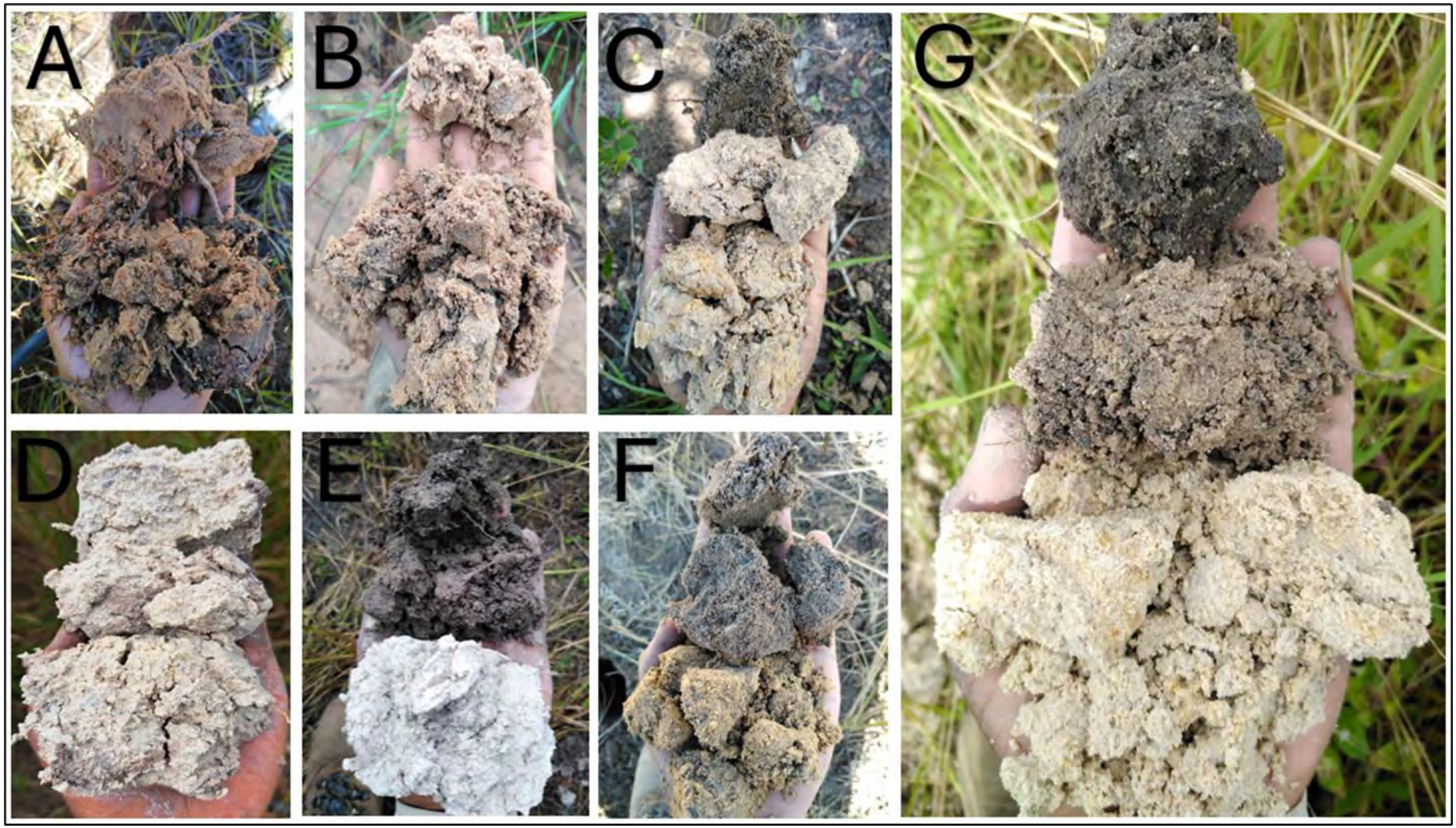


Figure 8-6: Diagnostic soil horizons identified on-site: A&B) Orthic topsoil horizon over gley horizon. C-F) Orthic topsoil horizon on top of an albic horizon with a gley horizon below

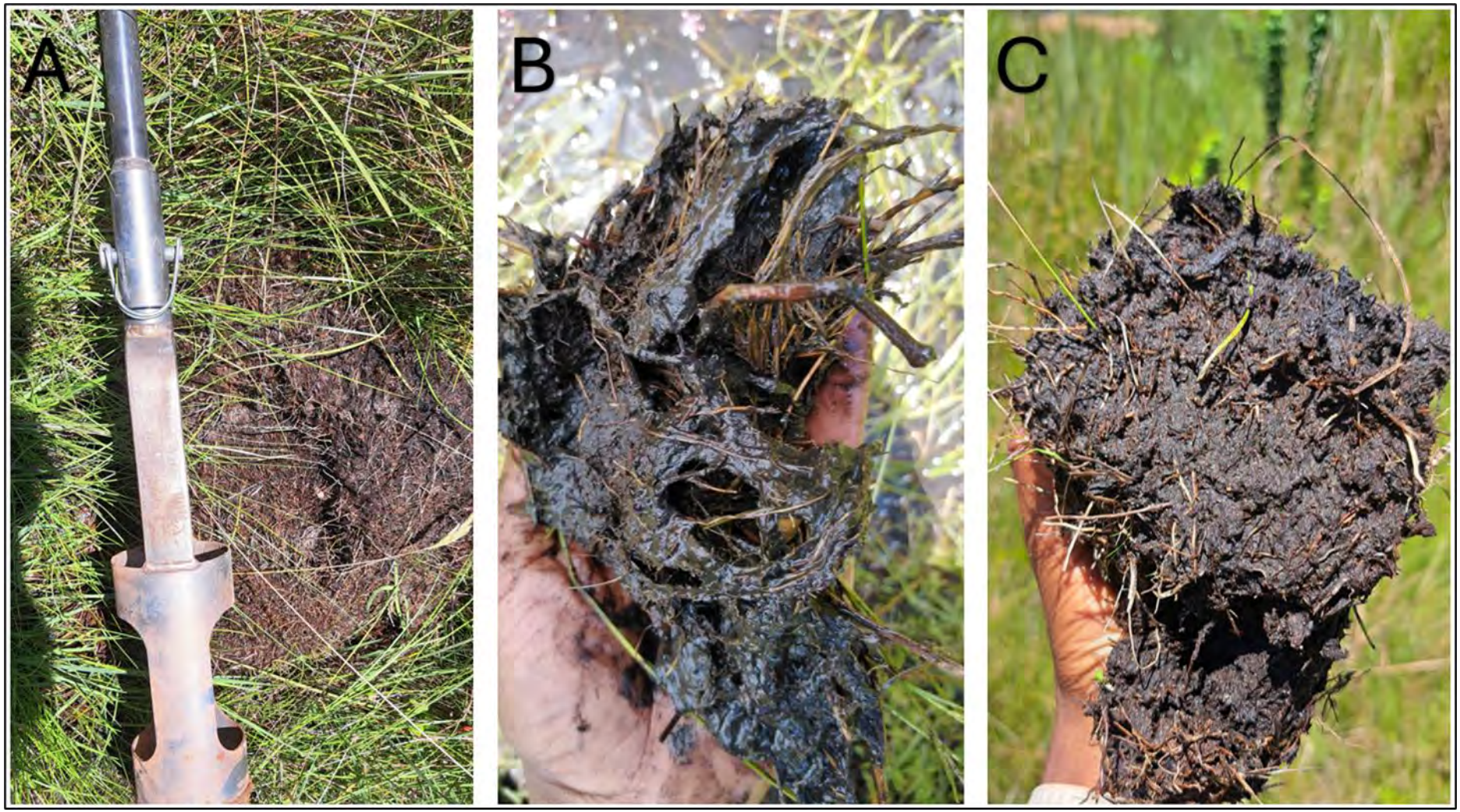


Figure 8-7: Diagnostic soil horizons identified on-site: A-C) Organic topsoil horizons with or without gley horizon below

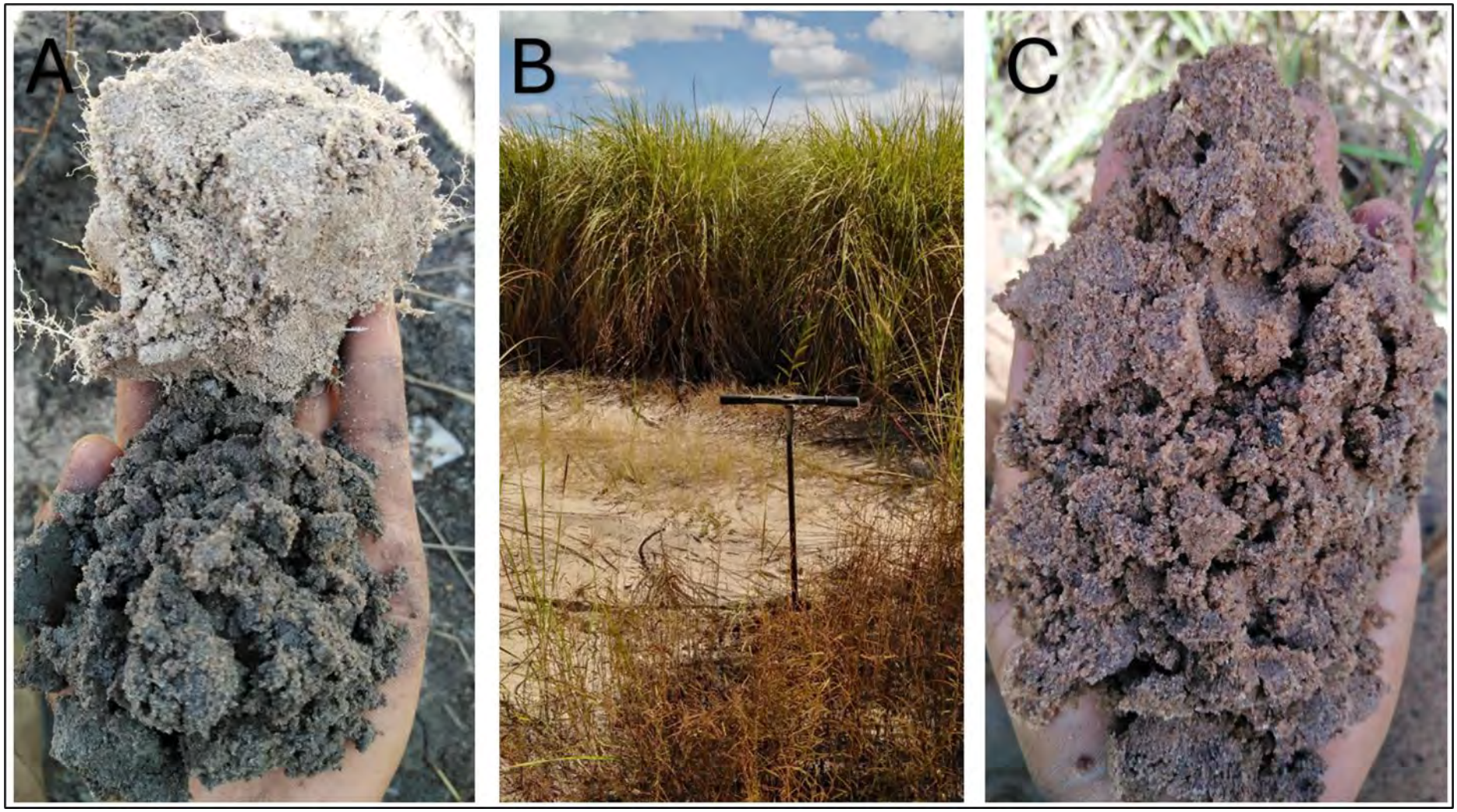


Figure 8-8: Diagnostic soil horizons identified on-site: A) Alluvial horizons over gley horizon below. B&C) Alluvial horizons

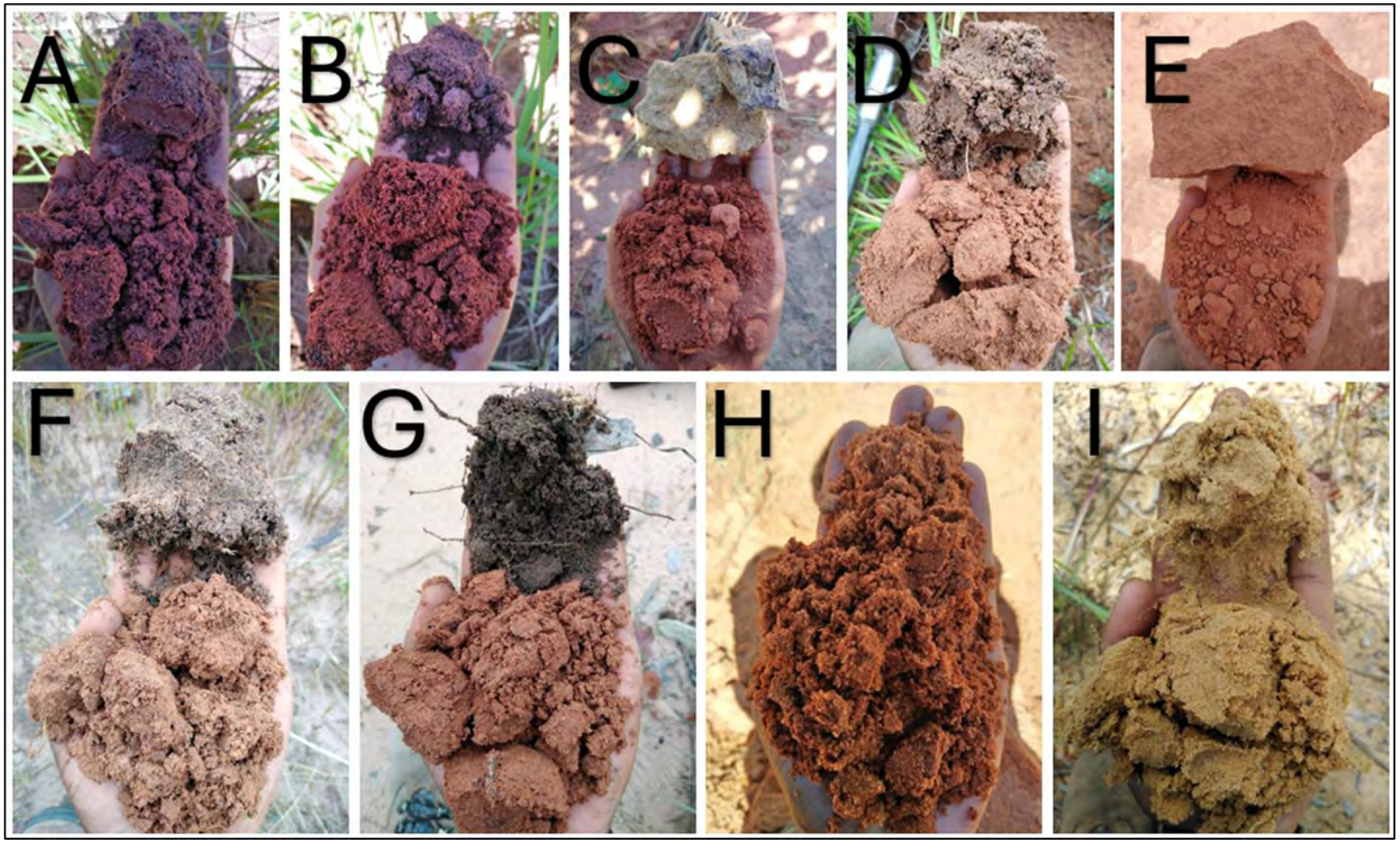


Figure 8-9: Diagnostic soil horizons identified on-site: A-C) Red apedal subsurface horizons. D&I) Yellow-brown subsurface horizons

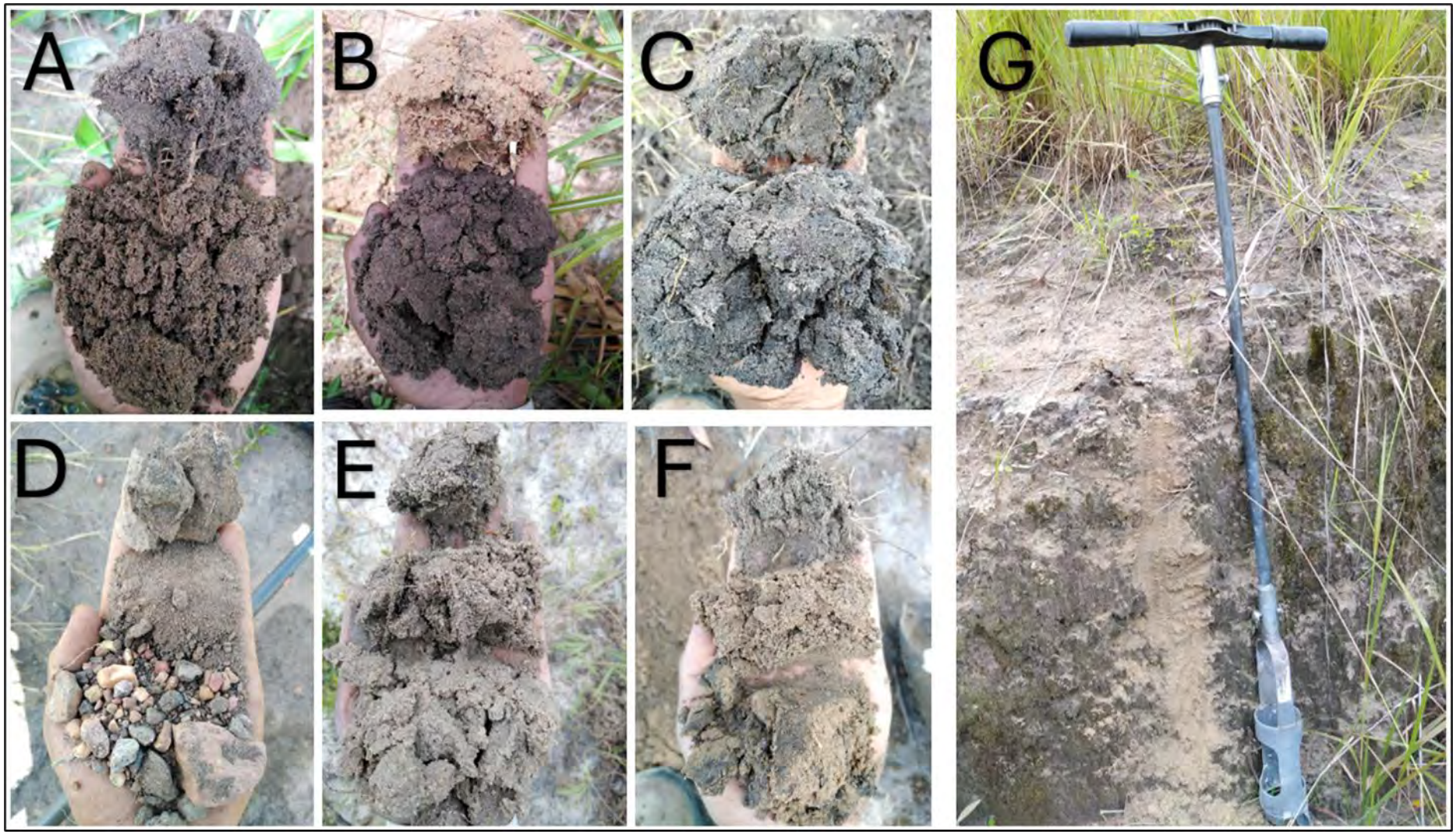


Figure 8-10: Soil profiles identified on-site: A-C) Orthic topsoil over a neocutanic horizon. D) Neocutanic horizon with a lithic horizon below E) Neocutanic with an alluvial horizon below. F&G) Neocutanic with a gley horizon below

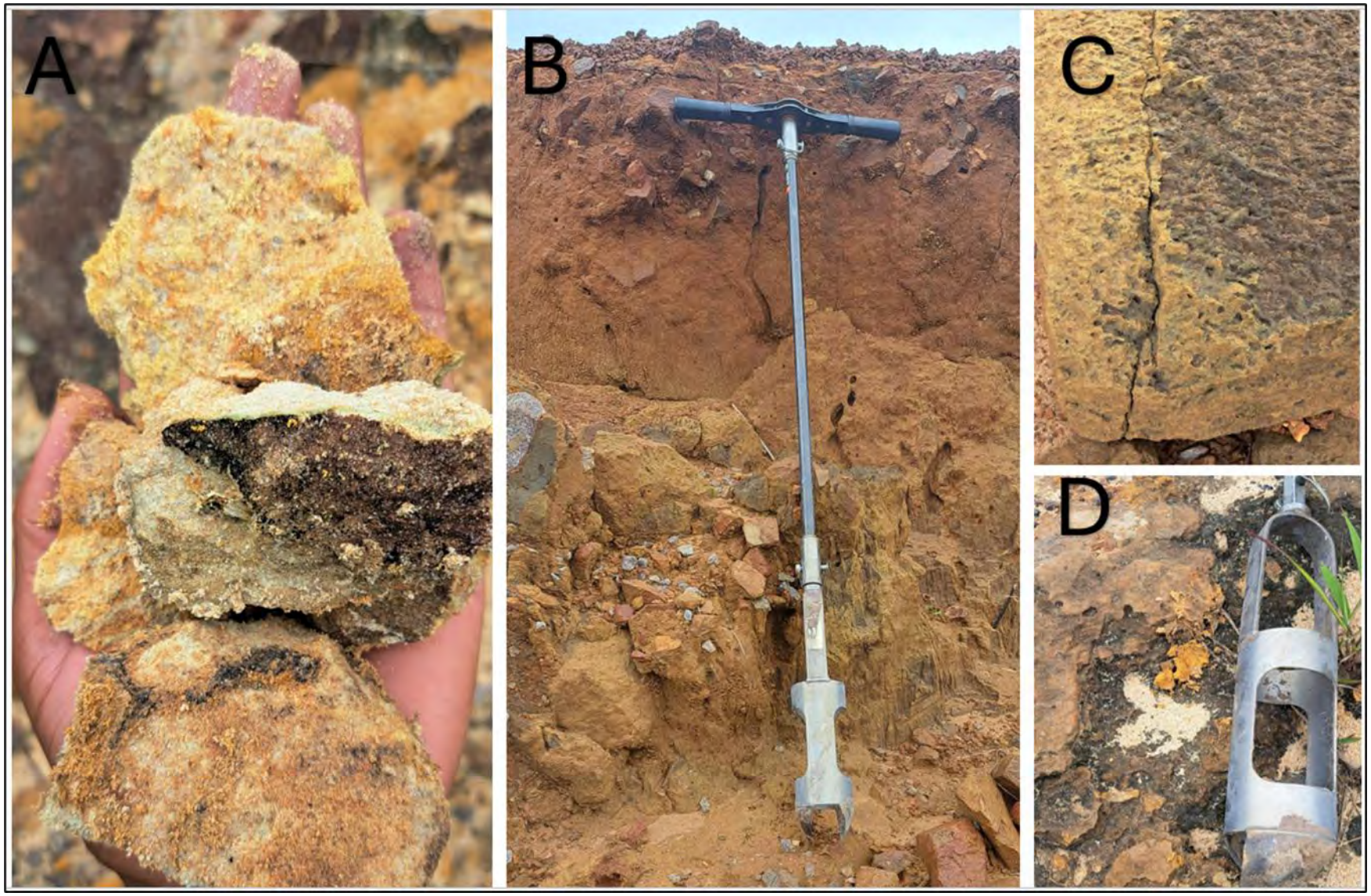


Figure 8-11: Soil profiles identified on-site: A-D) Fractured and permeable substratum with mudstone and sandstone properties

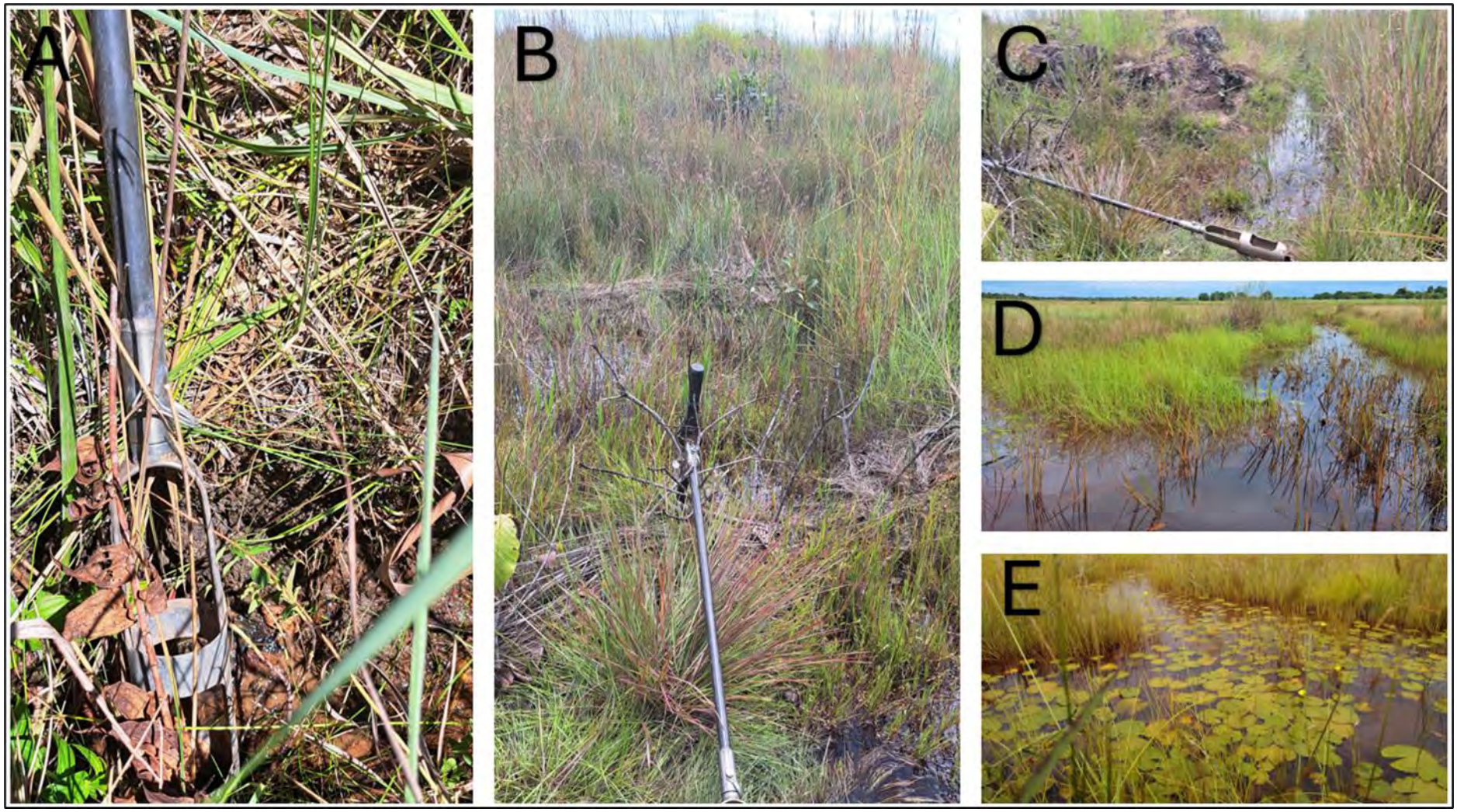


Figure 8-12: Soil profiles identified on-site: A-C) Example of seepages and lateral flows. D&F) Overland flows and surface runoffs

8.2.5 Hillslope hydropedological pattern

The hillslope hydrology of slopes intersected by the proposed Luena - Saurimo Railway Project and its facilities are characterised by their distinct hydropedological patterns. The majority of the hillslopes for the first and second distinctive hydropedological patterns (i.e. H1-H6, H18 see Figure 8-3 above and Table 8-4 below) are characterised by deep recharge (see Figure 8-14 to Figure 8-24) and shallow recharge (see Figure 8-14 to Figure 8-24) hydropedological types. These patterns occur from the crest to the lower mid-slope transecting into responsive (saturated) at the valley bottom which transect into a watercourse. The third and eighth distinctive hydropedological pattern (i.e. H7-H8, H10-H12, H15-H17 see Figure 8-3 above and Table 8-4 below) includes recharge soil forms which transect to interflow (A/B or Soil/Bedrock) hydropedological types. The estimated depth of most hillslope bedrocks (Mudstone or Sandstone) are deeper than 4 m with only a few profiles which are less than 2 m deep. These patterns occur from the crest to the mid-slope which transect to the lower valley bottoms. The nineth distinctive hydropedological pattern are characterized by interflow soil forms from the crest to the valley bottom section.

The tenth and eleventh distinctive hydropedological patterns (i.e. H9, H13- see Figure 8-3 above and Table 8-4 below) includes deep recharge or interflow (Soil/Bedrock) soil forms in the crest which transect to a responsive saturated hydropedological types. At the upper and lower mid-slope section, an increased Saturated Hydraulic Conductivity (Ks) occurs in the soil profile. Restrictions in the water flow occurs within the responsive saturated soils due to the presence of a high clay content and partially or unfractured parent material. The recharge (deep) or interflow (Soil/Bedrock) soil type transitions into a responsive (saturated) hydropedological type at the valley bottom section (see Figure 8-14, Figure 8-23 and Figure 8-24).

The deep Hutton (Ferralsols), Ermelo (Arenosols) and Dundee (Fluvisols) soil forms identified on-site are characterised with well drained profiles. The Hutton soil forms has an orthic topsoil horizon on top of a thick red apedal horizon. The Ermelo soil forms consist of an orthic topsoil with a thick yellow-brown apedal. The Dundee soil forms consist of an orthic topsoil horizon with a thick alluvial horizon below. The yellow-brown or red apedal horizon can also merging into a fractured substratum. These profiles are characterised by extremely high soil hydraulic conductivity (Ks) rates, including the lower lithic horizon.

No signs of leaching or oxidation/reduction processes were identified throughout the soil profile, which, together with the high Ks emphasises rapid vertical recharge of the groundwater stores as being the dominant flow path.

The soil form relevant to some of the foot slope areas has been classified as a recharge shallow hydropedological types namely Glenrosa soil forms (Leptosols). These soil forms are characterised by lithic horizons and fractured substratum. Similar to interflow hydropedological groups lateral sub-surface flows between the topsoil, subsurface soils layer can occur. Most of the lithic horizons in the project area are characterized by very deep profiles, which can also behave as deep recharge soils.

The soil form relevant to some of the foot slope areas has been classified as an interflow (A/B) and interflow (soil/bedrock) hydropedological types. These soil forms are characterised by neocutanic and albic. The interflow (A/B) and interflow (Soil/bed rock)

between the soil and bedrock, is an indicative of lateral sub-surface flows between the topsoil, subsurface soils and bedrock layer. The subsurface layer or bedrock layer displays a very low Ks, which has limited percolation into the bedrock, which can ultimately result in interflow.

Neocutanic horizons are weakly structured subsoil horizons with variegated soil colours. Mostly associated to colluvial or alluvial materials found in the foot-slope and river terraces that have been subjected to an intermediate stage of pedogenic alteration. The colour variegations occur due to illuvial material that coats weak structural units on soil colloids (Soil Classification Working Group, 2018).

Albic horizons are often characterised by uniform white-greyish colours from the residual clay and quartz particles making up the matrix of the horizon. The main characteristic of this diagnostic horizon is a bleached colouration, which is a resultant product of distinct redox and ferrolysis pedological processes combined with eluvial processes. According to the Soil Classification Working Group (2018), albic horizons often receive lateral sub-surface flows from hillslope processes.

Some of the valley bottom regions are characterised by a responsive (wet) hydropedological type. The soil form relevant to this observation point is that of the Katspruit, Kroonstad (Gleysols) and Champagne soil forms (Histosols/Stagnosols). The Kroonstad soil form is characterised by an orthic topsoil horizon with an albic horizon underlain with a gley horizon. The Katspruit soil form is characterised by an orthic topsoil horizon with a gley horizon. The Champagne soil form is characterised by an organic topsoil horizon with a gley horizon. The gley subsoil, is indicative of prolonged/permanently saturated soils which result in the formation of “responsive soils.” Responsive soils will be subject to overland/return flow during precipitation events (due to the naturally high-water content which will ensure rapid saturation). Between rainfall events, these soil forms will steadily feed watercourses and will lose moisture by means of Evapotranspiration (ET).

Organic topsoil horizon has a pronounced accumulation of humified organic materials with partly to advanced stages of decomposition. It occurs mainly in valley bottom positions and in high altitude plateaux and mountainous regions as generally thin organic layers that are subjected to permanent or near permanent saturation with water (Soil Classification Working Group, 2018).

Gley horizons that are well developed and have homogenous dark to light grey colours with smooth transitions. Stagnant and reduced water over long periods is the main factor responsible for the formation of a gley horizon and could be characterised by green or blue tinges due to the presence of a mineral called Fougerite which includes sulphate and carbonate complexes. Even though grey colours are dominant, yellow and/or red striations can be noticed throughout a gley horizon. The structure of a gley horizon mostly is characterised as strong pedal, with low hydraulic conductivities and a clay texture, although sandy gley horizons are known to occur. The gley soil form commonly occurs at the toe of hillslopes (or benches) where lateral water inputs (sub-surface) are dominant and the underlaying geology is characterised by a low hydraulic conductivity. The gley horizon usually is second in diagnostic sequence in shallow profiles yet is known to be lower down in sequence and at greater depths (Soil Classification Working Group, 2018).

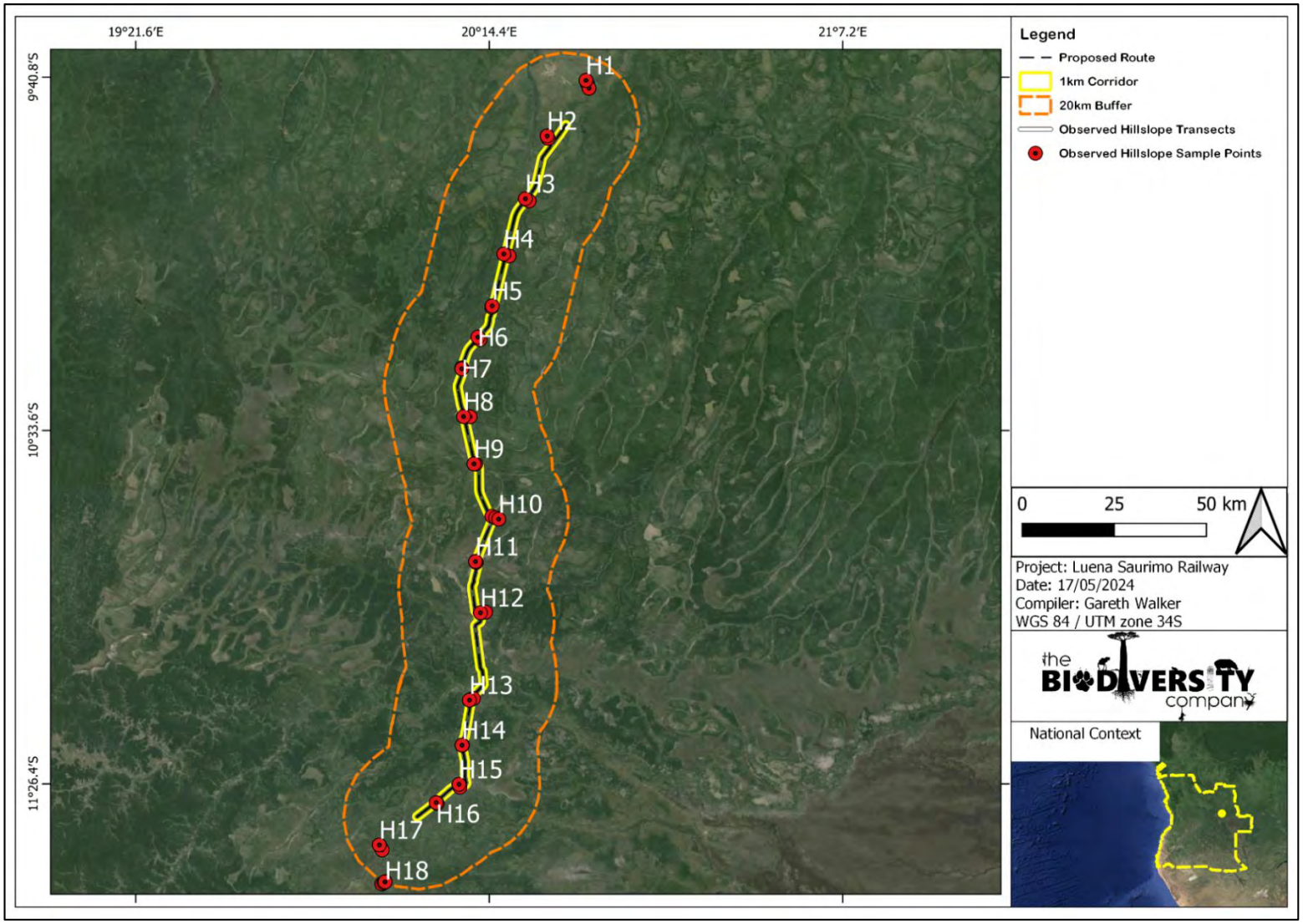


Figure 8-13 Hillslope transects sample point locations within the identified in the proposed Luena - Saurimo Railway Project

Table 8-4: Identified hillslopes dominate soil forms and hydropedological transects

	Terrain Morphological Unit (TMU)							
	1		3		4		5	
Transects	**Soil form**	**Hydroped**	**Soil form**	**Hydroped**	**Soil form**	**Hydroped**	**Soil form**	**Hydroped**
H1	Quaggafontein	Interflow (Soil/Bedrock)	Quaggafontein	Interflow (Soil/Bedrock)	Quaggafontein	Interflow (Soil/Bedrock)	Dundee	Recharge (deep)
H2	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Katspruit	Responsive (Saturated)
H3	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Ermelo	Recharge (deep)	Dundee	Recharge (deep)
H4	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Champagne	Responsive (Saturated)
H5	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Hutton	Recharge (deep)	Champagne	Responsive (Saturated)
H6	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Kroonstad	Interflow (Soil/Bedrock)
H7	Tubatse	Interflow (Soil/Bedrock)	Tubatse	Interflow (Soil/Bedrock)	Tshiombo	Interflow (Soil/Bedrock)	Lepellane	Responsive (Saturated)
H8	Oakleaf	Interflow (Soil/Bedrock)	Glenrosa	Recharge (shallow)	Iswepe	Interflow (Soil/Bedrock)	Iswepe	Interflow (Soil/Bedrock)
H9	Oakleaf	Interflow (Soil/Bedrock)	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Quaggafontein	Interflow (Soil/Bedrock)
H10	Glenrosa	Recharge (shallow)	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Katspruit	Responsive (Saturated)
H11	Oakleaf	Interflow (Soil/Bedrock)	Quaggafontein	Interflow (Soil/Bedrock)	Quaggafontein	Interflow (Soil/Bedrock)	Quaggafontein	Interflow (Soil/Bedrock)
H12	Oakleaf	Interflow (Soil/Bedrock)	Oakleaf	Interflow (Soil/Bedrock)	Oakleaf	Interflow (Soil/Bedrock)	Katspruit	Responsive (Saturated)

	Terrain Morphological Unit (TMU)							
	1		3		4		5	
Transects	**Soil form**	**Hydroped**	**Soil form**	**Hydroped**	**Soil form**	**Hydroped**	**Soil form**	**Hydroped**
H13	Ermelo	Recharge (deep)	Oakleaf	Interflow (Soil/Bedrock)	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)
H14	Oakleaf	Interflow (Soil/Bedrock)	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Dundee	Recharge (deep)
H15	Tubatse	Interflow (Soil/Bedrock)	Tubatse	Interflow (Soil/Bedrock)	Tubatse	Interflow (Soil/Bedrock)	Champagne	Responsive (Saturated)
H16	Oakleaf	Interflow (Soil/Bedrock)	Tukulu	Interflow (Soil/Bedrock)	Tukulu	Interflow (Soil/Bedrock)	Dundee	Recharge (deep)
H17	Tukulu	Interflow (Soil/Bedrock)	Tukulu	Interflow (Soil/Bedrock)	Kroonstad	Interflow (Soil/Bedrock)	Champagne	Responsive (Saturated)
H18	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Ermelo	Recharge (deep)	Dundee	Recharge (deep)

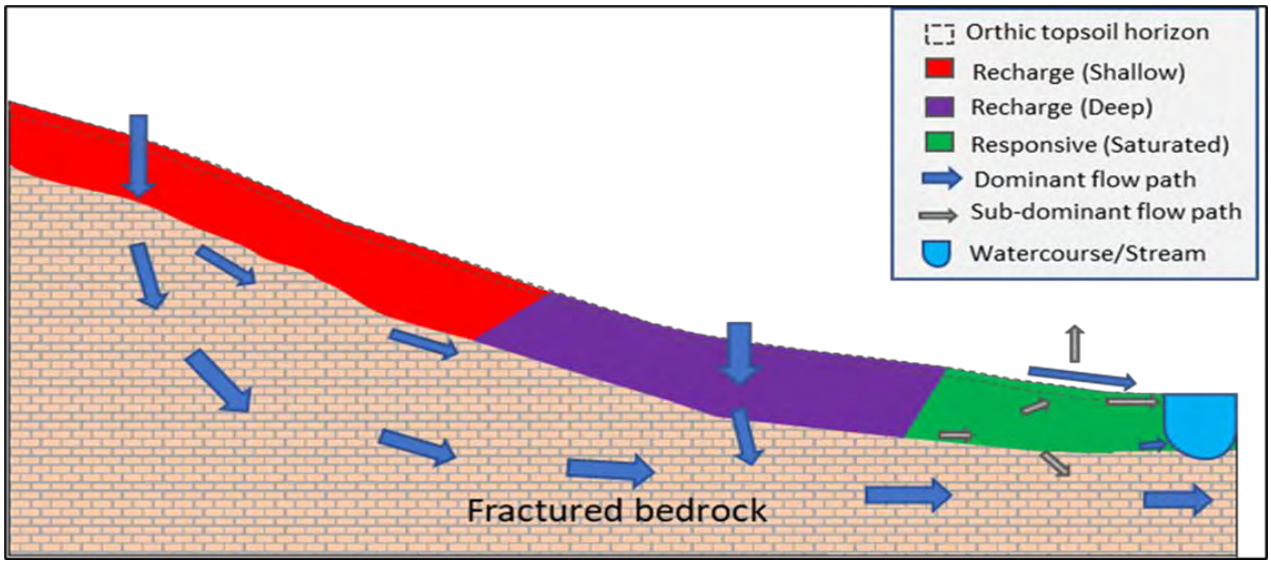


Figure 8-14: Hillslope hydrology of one of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

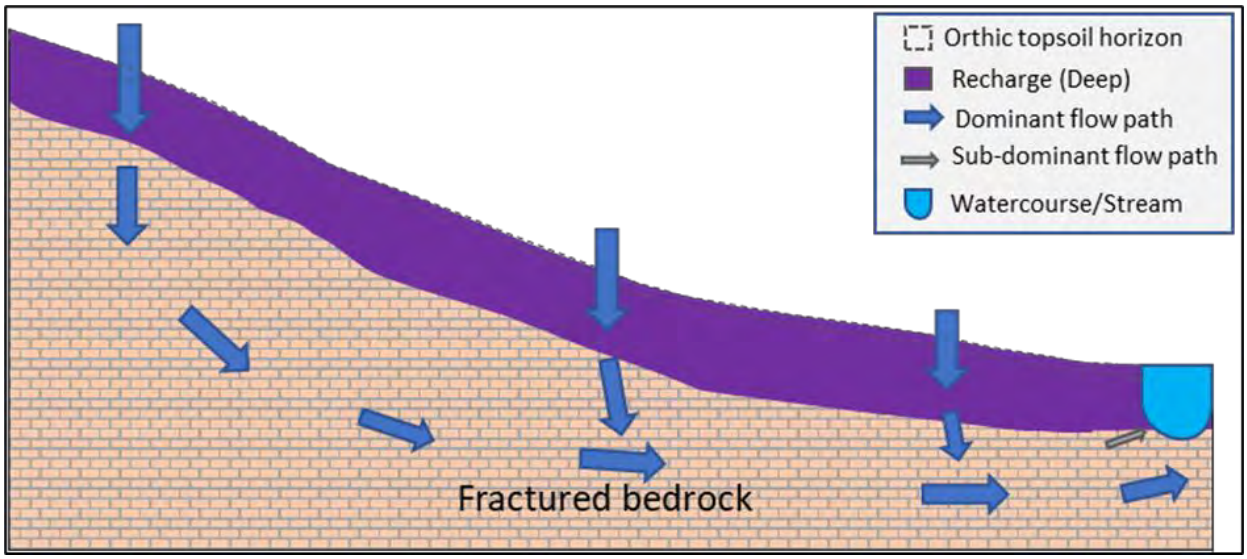


Figure 8-15: Hillslope hydrology of two of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

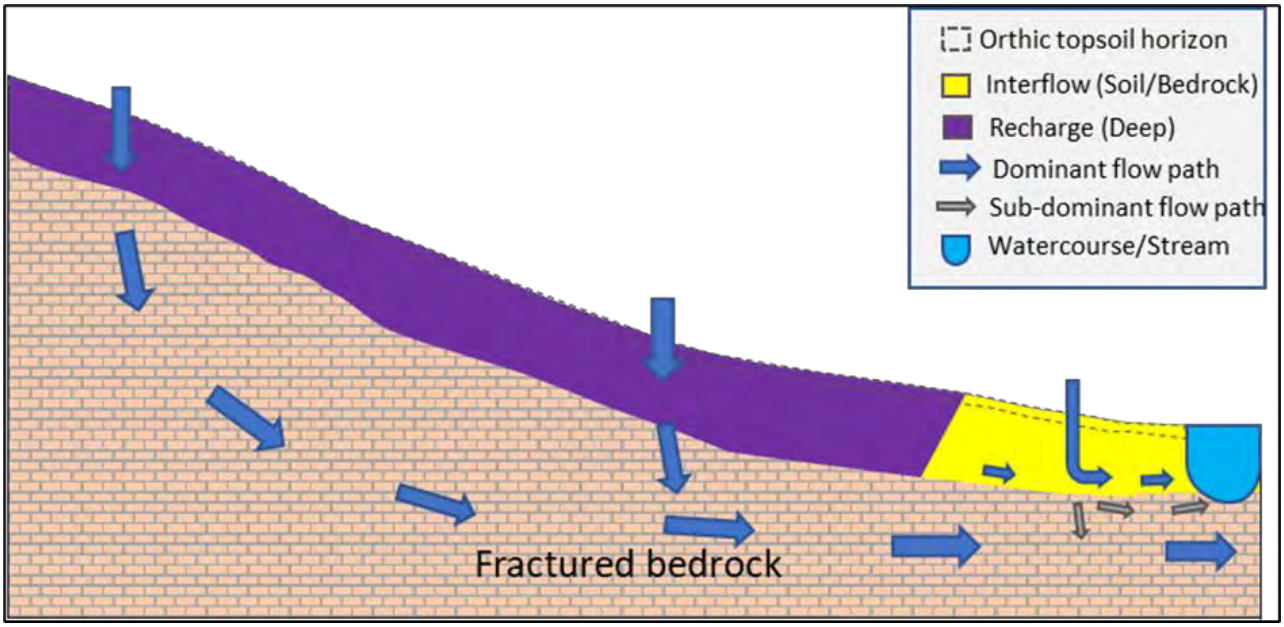


Figure 8-16: Hillslope hydrology of three of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

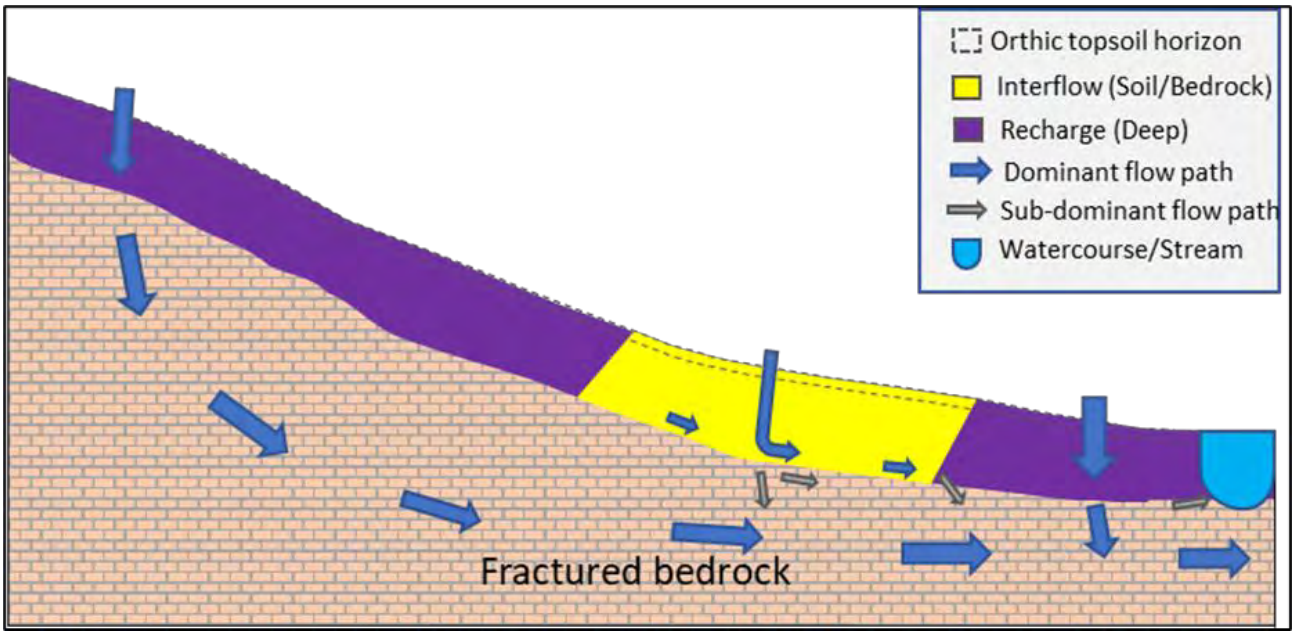


Figure 8-17: Hillslope hydrology of four of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

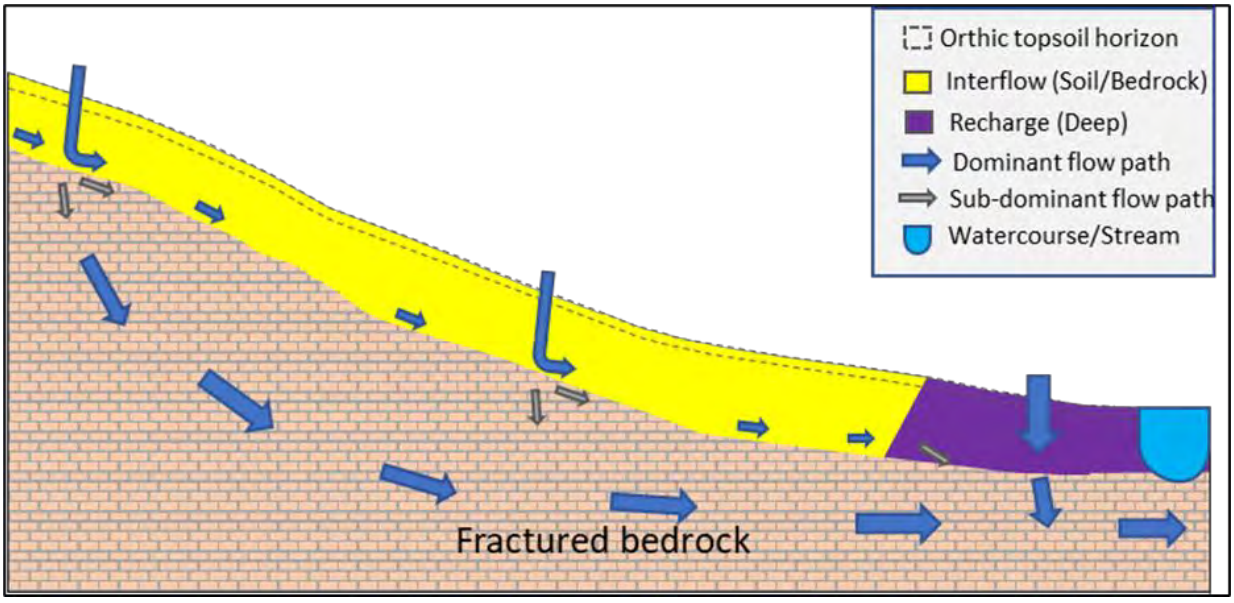


Figure 8-18: Hillslope hydrology of five of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

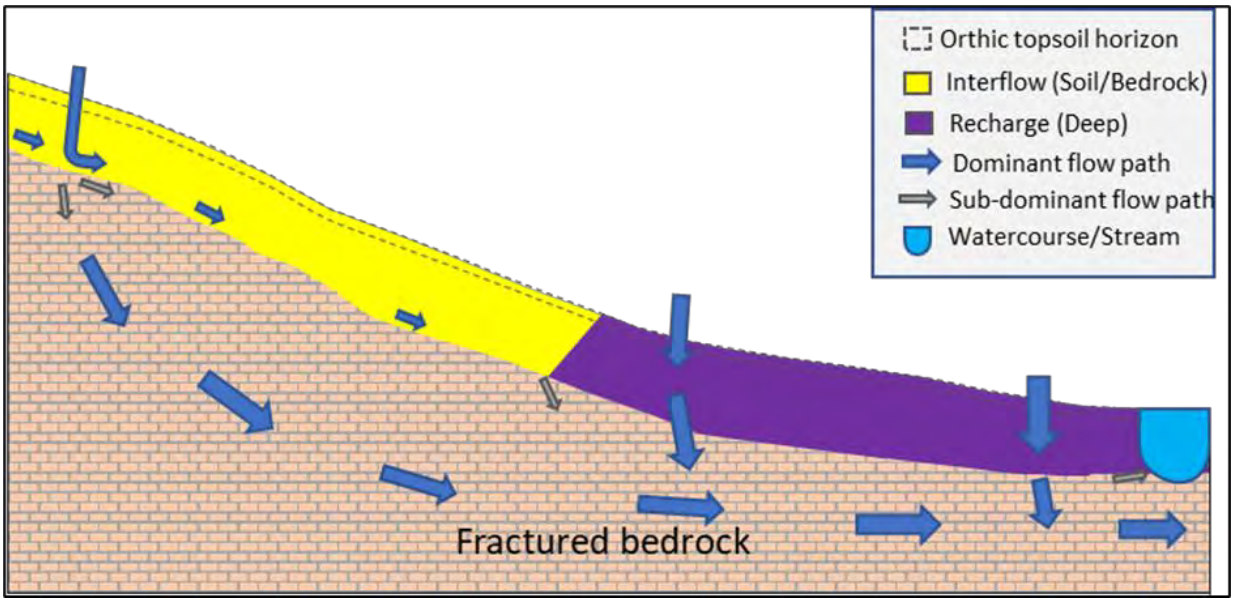


Figure 8-19: Hillslope hydrology of six of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

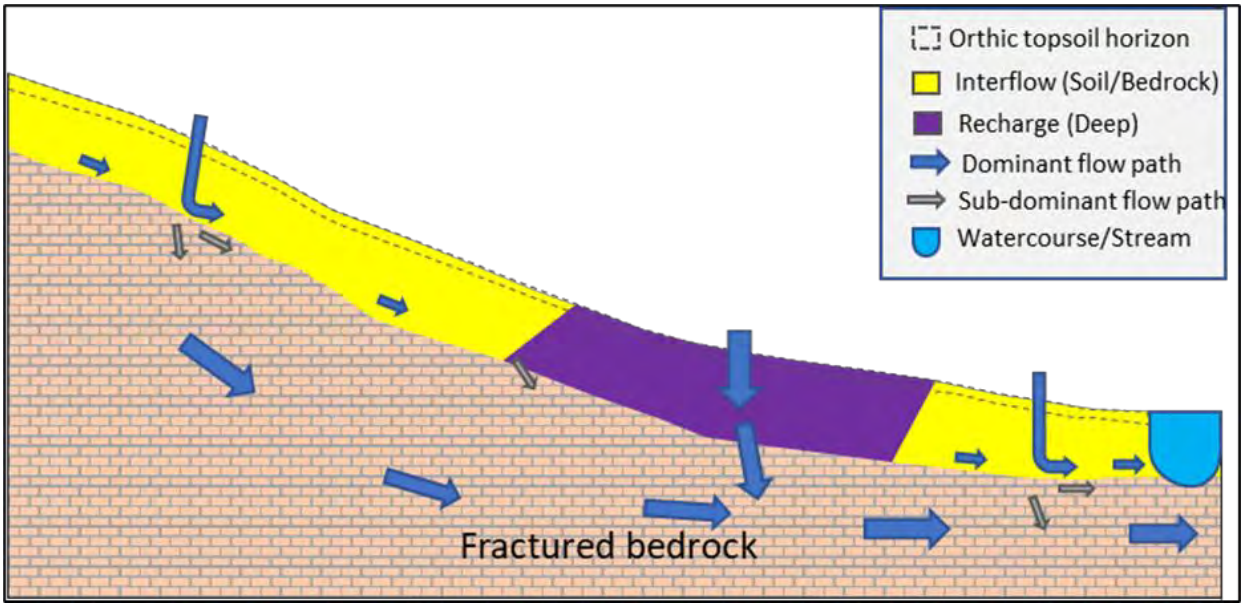


Figure 8-20: Hillslope hydrology of seven of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

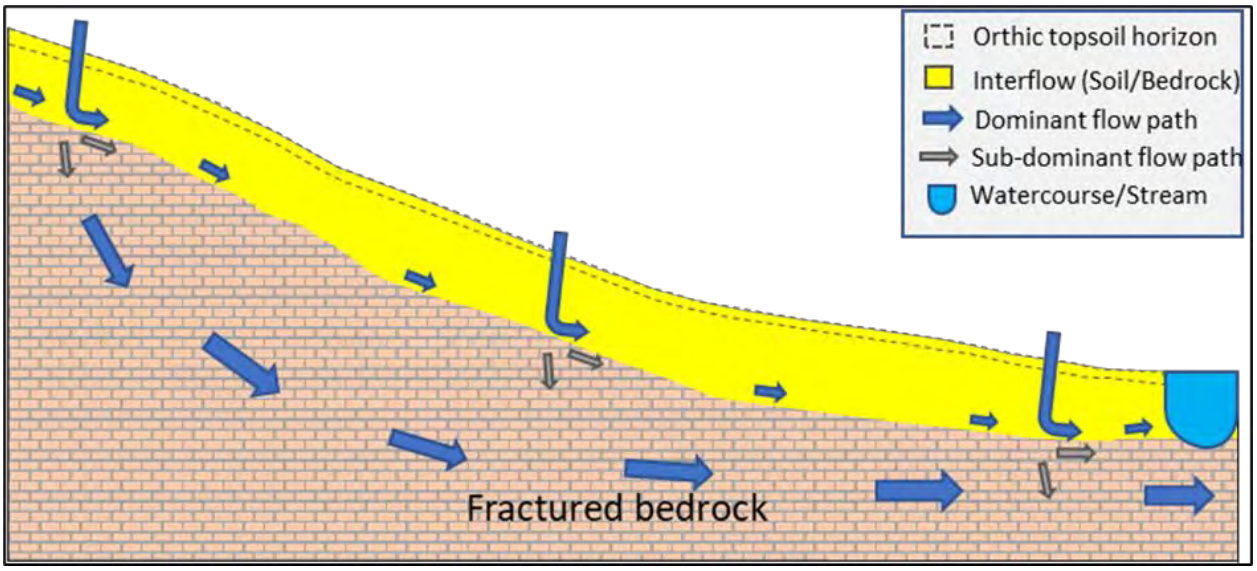


Figure 8-21: ***Hillslope hydrology of eight of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure***

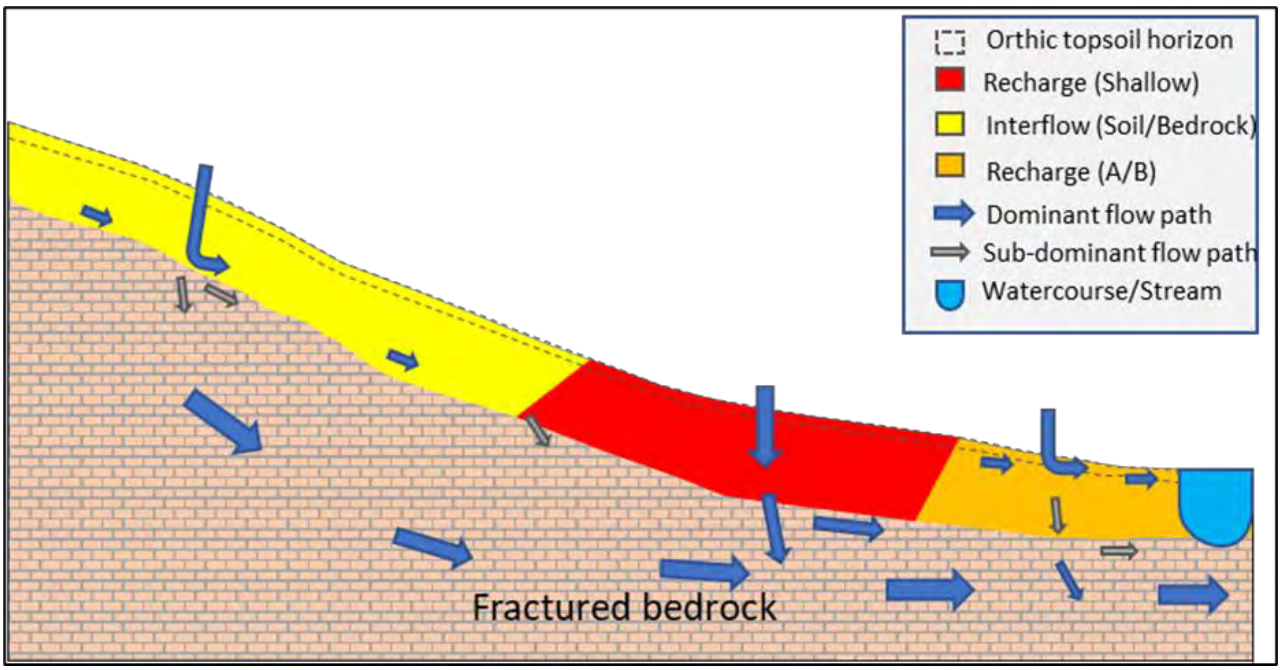


Figure 8-22: Hillslope hydrology of nine of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

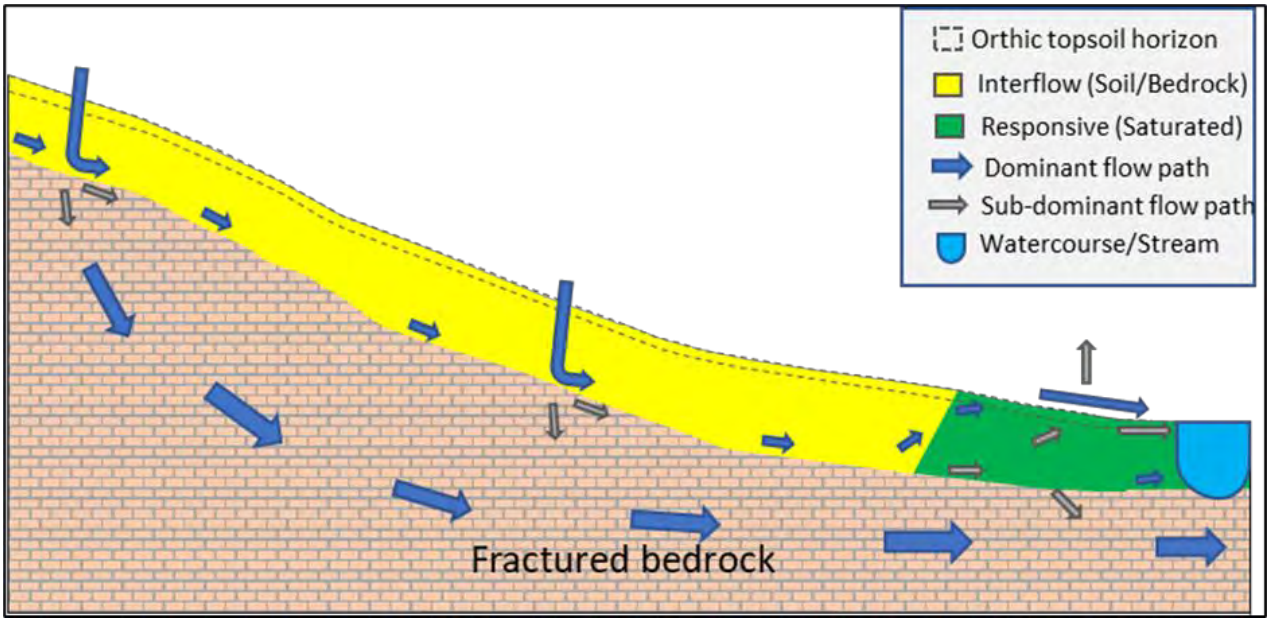


Figure 8-23: Hillslope hydrology of ten of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

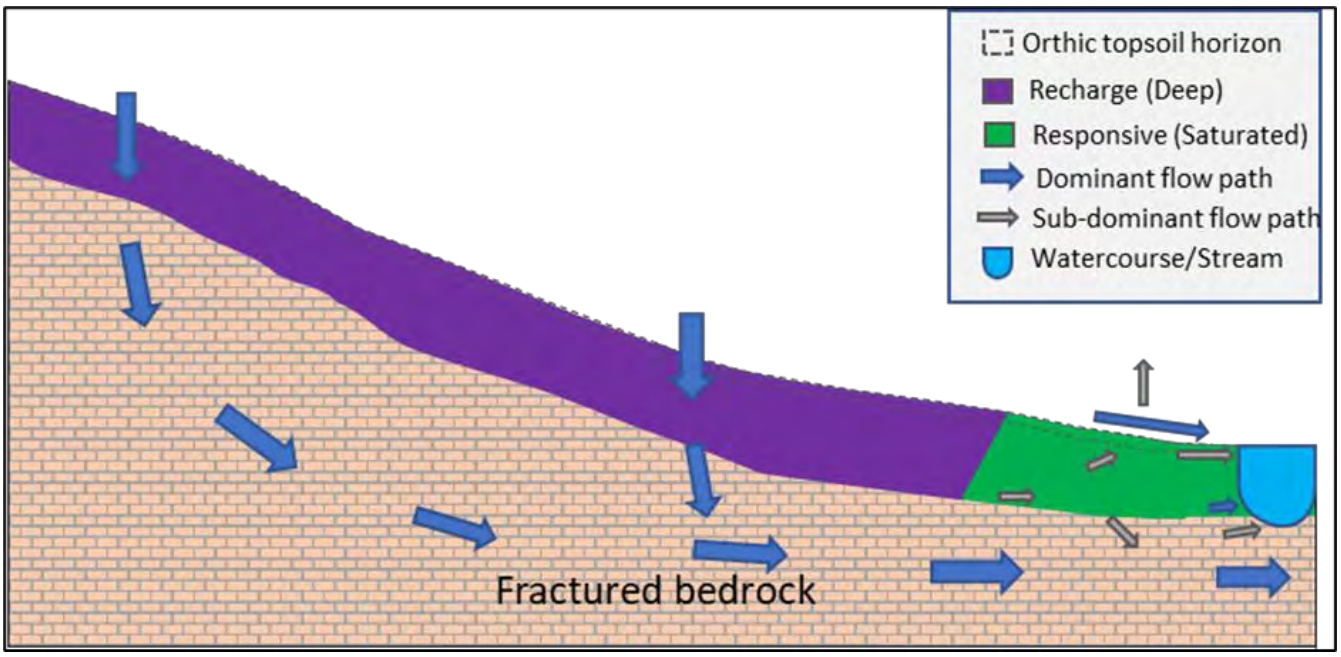


Figure 8-24: Hillslope hydrology of eleven of eleven distinct hydropedological patterns prior to construction of the proposed Luena - Saurimo Railway Project and associated infrastructure

8.2.5.2 Receptor sensitivity

Eleven main hillslope types were identified, which includes the presence of recharge (deep and shallow), interflow (A/B) and interflow (soil/bedrock) and responsive (saturated) hydropedological types. The proposed Luena - Saurimo Railway Project and its infrastructure will have acceptable effects hydropedology of the relevant hillslopes depending on the position of the railway line and associated infrastructure (crest, mid-slope or lower mid-slope). For recharge soils (which are dominant), recharge is unlikely to be affected given the fact that infiltration will only be impeded for the width of the railway line, building (i.e. train stations or offices), bridges, culverts concrete foundations and associated pipelines upgrades, which has been deemed insignificant given the size of the catchments as the dominant flow paths will remain vertical recharging groundwater stores.

Measures can be set on soils with some expected changes in flow paths following the railway construction and associated infrastructure layout. Flow impediment in interflow soil types can be managed well to minimise saturation conditions and surface return flows to promote subsurface groundwater recharge and storage. Most of the valley bottom soils are responsive hydromorphic soils due to long periods of saturation. Development should avoid areas with responsive (saturated) hydropedological soil types (Gleysols, Histosols and Stagnosols soil groups) mostly associated to and found in areas like wetlands which act as water regime receptors for the water balance in the hillslopes' catchment. From a hydropedological perspective, the impact of the development on hydropedological flow paths would be acceptable and the impacts could be managed sustainably.

8.3 Hydrology

8.3.1 Area of influence

In terms of hydrology, the AoI refers to the geographic region that is likely to be affected by a Project's water-related impacts, such as changes in water flow, water quality, and aquatic ecosystems.

The AoI for the construction phase includes:

- the project footprint at the location where the railway crosses a watercourse or waterbody
- surface waterbodies downstream of any project infrastructure and construction facilities
- the AoI varies from 2 to 5 km downstream of route crossing points, access road crossing points, infrastructure or construction facilities, depending on the extant quantity of water and its quality, including sediment concentrations and turbidity, in the watercourse and the quantity and quality of any water discharged
- the AoI also includes surface waterbodies that will be used to supply water to the Project
- the temporal AoI for construction is the period that includes abstraction and discharge and a short recovery period of less than one year
- the spatial AoI for operation is 2 to 5 km downstream of watercourses and waterbodies and the temporal AoI for operations stage is the life of the Project.

8.3.2 Methodology

Desk survey, field investigations including water and sediments sampling were undertaken during dry and wet seasons baseline assessments to characterize the Project setting and collect data detailing the current hydrological and geohydrological setting of the Project area. A desktop study was conducted to collate existing information that could be relevant to the study area and included the interrogation of existing information available on published resources and databases. The initial desktop study undertaken prior to the 2023 dry season field study was updated with relevant information obtained after the dry season study.

During the desktop study phase aerial imagery (google earth) and published hydrological, geological and geohydrological maps were reviewed to identify potential water features, drainage basins, main rivers and other pertinent information.

A literature review was also conducted to retrieve background information on the project corridor and wider regional area.

The baseline field data collection spanned over both a dry season study, conducted in October 2023, and a wet season study, conducted in March 2024.

During the initial dry-season site visit (October 2023), a meeting with OEC revealed that the project had not entered the detailed design phase. Only a high-level hydrological assessment by Intertechne ("Memória descritiva e justificativa - projecto base") was available, with detailed hydraulic modelling deferred to later detailed design phases. During the ESIA, hard copies of proposed infrastructure designs and locations were provided, which were interrogated to identify bridges and culverts locations and initial designs.

In the absence of detailed designs, proposed bridge span lengths, locations, and culvert numbers were field-verified against observed topography and hydraulic features, to provide a qualitative professional opinion on the spanning of these structures to minimize wetland and riparian impacts. The adjacent EN180 road, constructed hydraulically upgradient and in close proximity to much of the proposed corridor, served as a real-world analogy. Field observations revealed inadequacies in its design and installation, including extensive backwater development at crossings (indicating a risk of insufficient hydraulic capacity) and significant downstream scour (suggesting erosional instability). These empirical findings photographically documented enabled benchmarking of the proposed designs. Amendments to spans, locations, and configurations were proposed, evaluated against existing infrastructure performance, and incorporated by OEC.

By the wet-season assessment (April 2024), no detailed designs were available. Impacts were thus evaluated using integrated data from both field campaigns, high-level documents, and literature. Mitigatory measures were proposed based on best-practice hierarchies (avoidance > minimization > rehabilitation), assuming implementation of recommendations per IFC Performance Standards and Equator Principles.

Major hydrological risks were identified and addressed through field-validated assumptions, with contingencies for detailed hydraulic modelling to refine designs and flag residual risks, ensuring regulatory compliance and project resilience.

During both field visits the following main activities were undertaken:

- identification, verification and characterization of the main basins and watersheds, rivers, drainage features and floodplains intersected by the project corridor. Identified features were geographically referenced by collecting geographic coordinates using a GPS device and a photographic record of surrounds collected to provide a visual overview at the time of the studies
- gathering of in-field water quality parameters including pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO) and temperature thought the use of a calibrated Hanna Multiparameter probe (HI 98194) and turbidity with the aid of a calibrated Hanna turbidity meter (HI 98703)
- collection of surface water samples for laboratory analyses by an ISO accredited laboratory to provide insights into the basic chemistry and contamination status of the surface water bodies samples
- collection of sediment samples at most of the surface water sampling localities to further characterize the surface water sediment interactions and for laboratory analyses by an ISO accredited laboratory to provide insights into the basic chemistry and contamination status of the sediments
- for selected water samples (rivers, streams and boreholes) the microbial impacts were determined for the wet season study using in-field sampling protocols including petrifilm and Aqua Screen vials to assess for the presence of faecal coliforms and indicator organisms such as E.coli
- review of the preliminary engineering designs to identify locations of bridges and culverts and design parameters proposed for these features and their adequacy in relation to the expected water flows, erosion control etc.

The sampling protocol employed during sample collection of hydrological features, boreholes etc followed the sampling protocols aligned with US EPA sampling protocols and other international standards.

To provide further clarification on the classification of basins and watersheds the sampled points were categorised as summarised in Table 8-5 below. The sampling density was considered adequate as sampling points covered all of the major crossings and basins and types of features identified during the study.

For the purposes of categorisation, the following definitions apply:

- Major Basin - River basins are the geographic area contained within the watershed limits of a system of streams and rivers converging toward the same terminus, generally the sea or sometimes an inland water body. These basins cover vast areas, often exceeding thousands or millions of square kilometers and can span multiple countries.
- Catchment/Watershed - Every stream and tributary has its own watershed, which drains to a larger stream or wetland. These streams, ponds, wetlands, and lakes are part of a river basin. The boundaries between these catchments/watersheds are defined by drainage divides or high ground. These are smaller, clearly delineated hydrological units, with typical sizes ranging from a few square kilometers to a few thousand square kilometers (e.g., typically from tens of square kilometers to 1,000 square kilometers).

For ease of reference all reference to micro or subbasins were removed in the categorisation.

Table 8-5: Basin information and sampling locations

Major River Basin	Catchment/Watershed	Chainage (km)	Description	Infrastructure to be constructed	Sampling Point
Zambezi	Not defined	8+564	Depression	Culvert	Not visited (access limitations)
Zambezi	Catchment 1 - Lumeje	16+700 to 17+940	River channel (Lumeje) with floodplain wetland	Bridge	SW13 (dry season), SW15 (wet season)
Congo	Not defined	38+221	Channelled valley bottom wetland	Culvert	SW14 (wet season)
Congo	Not defined	45+500	Watering hole	Railway corridor	Not visited (identified by aerial imagery)
Congo	Not defined	46+000	Seep connected to channelled valley bottom wetland	None - runs parallel to feature	Not sampled
Congo	Catchment 2 - Luxia	57+100 to 57+360	River channel (Luxia) with floodplain wetland	Bridge	SW12 (dry season), SW13 (wet season)
Congo	Catchment - Tchihinhi	58+270 to 58+390	(Tchihinhi river) Channelled valley bottom wetland	Bridge	SW11 (dry season), SW12 (wet season)
Congo	Not defined	70+700	Unchannelled valley bottom	Culvert	SW10 (dry season), SW11 (wet season)
Congo	Catchment 3 - Cassai	73+500 to 74+100	River channel with floodplain	Bridge	SW09 (dry season), SW10 (wet season)
Congo	Not defined	86+400	Depression	Culvert	Not visited (access limitations)
Congo	Catchment 4 - Tchiumbwe	96+700 to 97+300	River in steep valley with rapids in the reach (Headwaters)	Bridge	Exact location could not be visited. Upstream sampling points SW08 (dry season), SW09 (wet season)
Congo	Not defined	106+968	Depression	Culvert	Not visited (access limitations)

Major River Basin	Catchment/Watershed	Chainage (km)	Description	Infrastructure to be constructed	Sampling Point
Congo	Catchment 5 - Mombo	113+102 to 113+137	Channelled valley bottom with a seep zone to the south (floodplain)	Bridge	SW07 (dry season), SW08 (wet season)
Congo	Catchment - Luele	127+500 to 127+600	Channelled valley bottom with broad seep zones on either side (Luele river floodplain)	Bridge	SW06 (dry season), SW07 (wet season)
Congo	Catchment 6 - Luachimo	142+193 to 142+294	River channel with floodplain and seepage inputs	Bridge	SW05 (dry season), SW06 (wet season)
Congo	Catchment - Muxie	158+729	Channelled valley bottom with broad seep zone to the north (Rio Muxie)	Culvert	SW04 (dry season), SW05 (wet season)
Congo	Catchment - Riacho	163+160 to 163+320	Unchannelled valley bottom (a discontinuous channel present in areas) with adjacent seep zones	Bridge	SW03 (dry season), SW04 (wet season)
Congo	Not defined	171+400 (170+800 new report)	Channelled valley bottom wetland (channel discontinuous) with broad seep zones	Culvert	SW03 (wet season)
Congo	Catchment - Caiaza	188+810 to 189+150	Channelled valley bottom with broad seep zones	Bridge	SW02 (dry and wet season)
Congo	Not defined	197+850	Depression	Culvert	No water feature identified
Congo	Not defined	222+100	Depression	Culvert	Not visited (access limitations)
Congo	Not defined	238+400	Depression	Culvert	No water feature identified
Congo	Not defined	248+500	Depression	Culvert	Not visited (access limitations)
Congo	Catchment Sambuamba	255+820 to 255+930	Channelled valley bottom with broad seep zones	Bridge	SW01 (dry and wet season)

8.3.3 Hydrological setting

To provide a high-level overview of the hydrological regime present within and near to the project site a literature review was undertaken.

Angola is a source of many major rivers in southern Africa and is referred to as the "water tower" of the region (Lourenco and Woodborne, 2023). The lack of a defined area delineating the Angolan Highlands water tower (AHWT) limits the conservation of this important freshwater source. A 2023 study hydrologically defined the boundary of the AHWT as areas >1274 m above mean sea level within the Central Bié Plateau of Angola. Using the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) data, this study provided a 41-year precipitation budget of the AHWT and surrounding basins. Between 1981 and 2021, the average annual precipitation over the AHWT was 1112 mm and the gross annual average precipitation volume was approximately 423 m3 over an area of 380,382 km2. The AHWT is the southern source of the Congo Basin, the western source of the Zambezi Basin, and the sole water source of the endorheic Okavango Basin and Okavango Delta, a UNESCO World Heritage Site. The dynamics of seasonal precipitation, hydrology and climate change in the AHWT have important repercussions on water budgets, food security and biodiversity throughout southern Africa, requiring continued collaboration between countries to ensure that future development is sustainable.

8.3.4 Hydrological basins

Angola has a diverse hydrological network[97] with considerable water availability (about 8600m^3/year/person) (Deloitte, 2014). The country has 47 major river basins and rivers which are distributed across five principal drainage areas: The Atlantic Ocean (which includes Cuanza, Catumbela, Cunene, Chiloango, M'Brdige, Keve, Longa and other rivers), the Zaire basin (Congo river), the Zambezi basin, the Cuvelai basin (that drains into Etosha Pan) and the Cubango river basin (that drains into the Okavango delta).

The railway line crosses two major basins namely the Zambezi Basin (ZB), shared with 7 Southern Africa Development Community (SADC) countries, in the southern parts of the project area between the towns of Luena and Camanongue and the Congo Basin (CB), shared with 10 countries of Central Africa, further north up to the town of Saurimo (refer to Figure 8-26). The railway line crosses several perennial rivers, water courses and drainage lines as well as numerous wetlands and floodplains. The rivers are of high importance to both ecosystems, but also human populations as local communities are highly dependent on these features as a source of water and for agricultural activities.

A document entitled "Memoria descritiva e justificativa - projecto base[6]" was received from the client and was machine translated to English by Google translate. The document was prepared by Intertechne under contract to OEC. The following main points have been captured from the report.

The area of interest is contained in the geomorphological unit called the Cassai Depression, which largely corresponds to the Lunda region drained to the north, in which

[97] Deloitte Country Water Profiles – Angola, 2014

certain rivers were subject to the effects of tipping towards the Congo Basin. It is currently a stabilized environment where pedogenesis overlaps with morphogenesis.

The digital terrain elevation model that served as the basis for determining local topography and hydrography was created from the SRTM (Shuttle Radar Topography Mission) survey carried out by the National Imagery and Mapping Agency (NIMA) and the National Aeronautics and Space Administration (NASA) in the period from February 11 to 22, 2000 (for 11 days), aboard the spacecraft Endeavour.

A follow-up hydrological report was prepared by Intertechne Consultores S.A in October 2025 and entitled Luena-Saurimo Railway Technical Report Hydrology. According to this report six (6) main basins/catchments were identified and are graphically represented in **Figure 8-25**. These six basins were characterized as shown in Table 8-6 below and correspond to the basins identified during the initial Intertechne report..

Table 8-6: Hydrographic Basins – Main Geometrix Characteristics

Catchment		Area	Length	Highest elevation	Minimum elevation
Bridge	Between km	(km^2)	(km)	(m)	(m)
Lumeje	16+700 and 17+940	1.273,70	67,60	1.420	1.210
Luxia	57+100 and 57+360	1.427,30	75,90	1.370	1.180
Cassai	73+500 and 74+100	6.814,70	236,70	1.510	1.160
Tchiumbwe	96+700 and 97+300	2.175,40	97,10	1.390	1.130
Mombo	113+102 and 113+137	85,20	15,70	1.270	1.230
Luachimo	142+193 and 142+298	1.083,20	50,00	1.320	1.220

Source: (Intertechne report n.d)

In addition to the six (6) main river crossings additional watercourses that will require bridge construction was identified and summarised in **Error! Reference source not found.** below.

Table 8-8-7: Other Hydrographic Basins/Catchments that Require Bridge Construction (Intertechne)

Intertechne further proposed that in the final section of the railway, after basin 06, the main line is positioned in a macro basin divider, according to the available hydrographic

Catchment		Area	Length	Highest elevation	Minimum elevation
Bridge	Between km	(km^2)	(km)	(m)	(m)
Tchinhinhi	58+270 and 58+390	5,7293	4,55	1.272	1.196
Luele	127+500 and 127+600	80,21	15,79	1.271	1.228
Riacho	163+160 and 163+320	16,34	5,76	1.240	1.202
Caiaza	188+810 and 189+150	63,84	13,40	1.220	1.090
Sambuamba	255+820 and 255+930	37,87	9,10	1.098	1.060

base and therefore no hydrologic modelling was undertaken for this region.

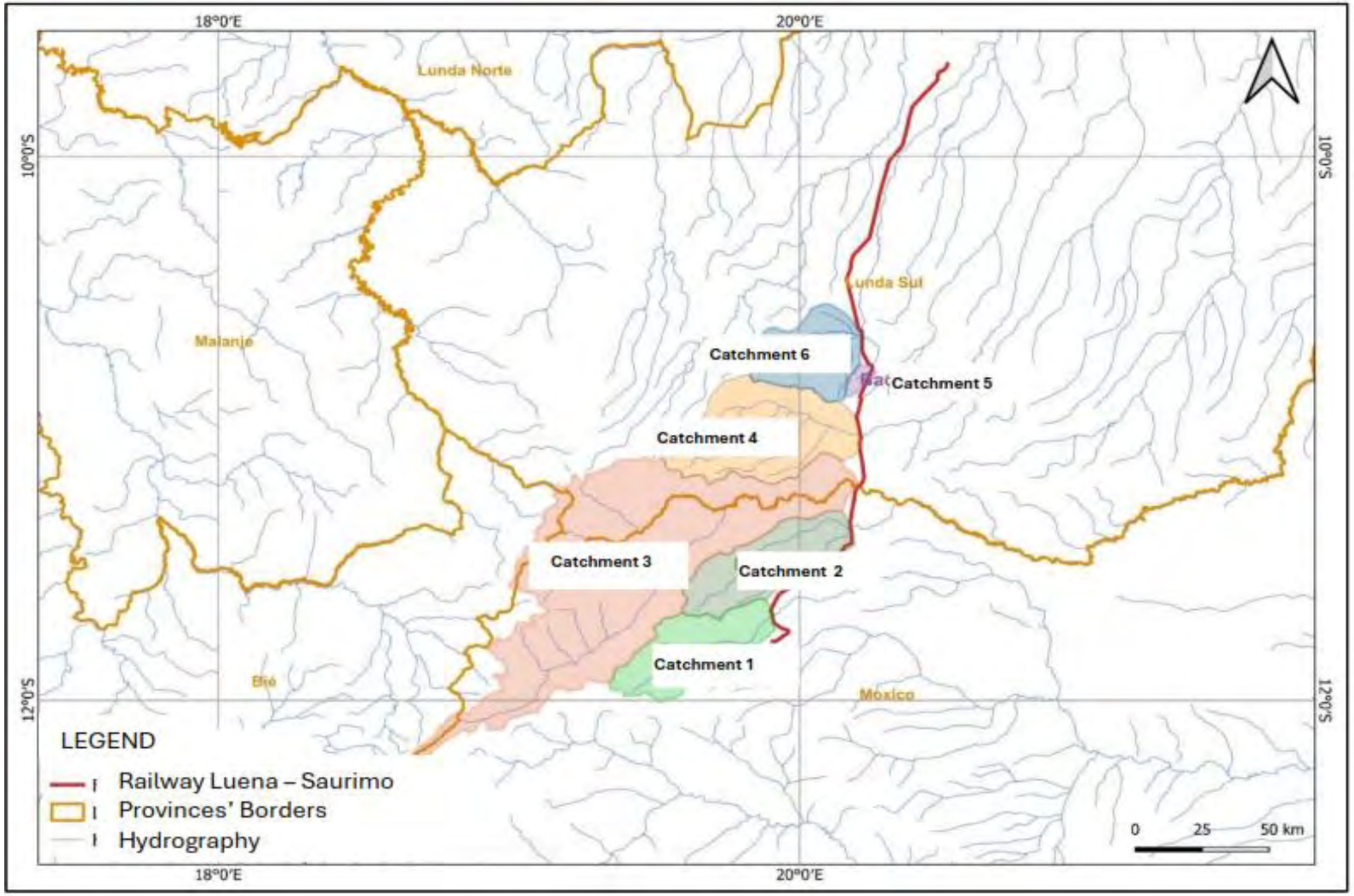


Figure 8-25: Hydrographic Main Basins – Location and Layout (Hidrologia)

Figure 8-26 below illustrates that after basin 06, the large watercourses do not cross the railway and run parallel to the railway.

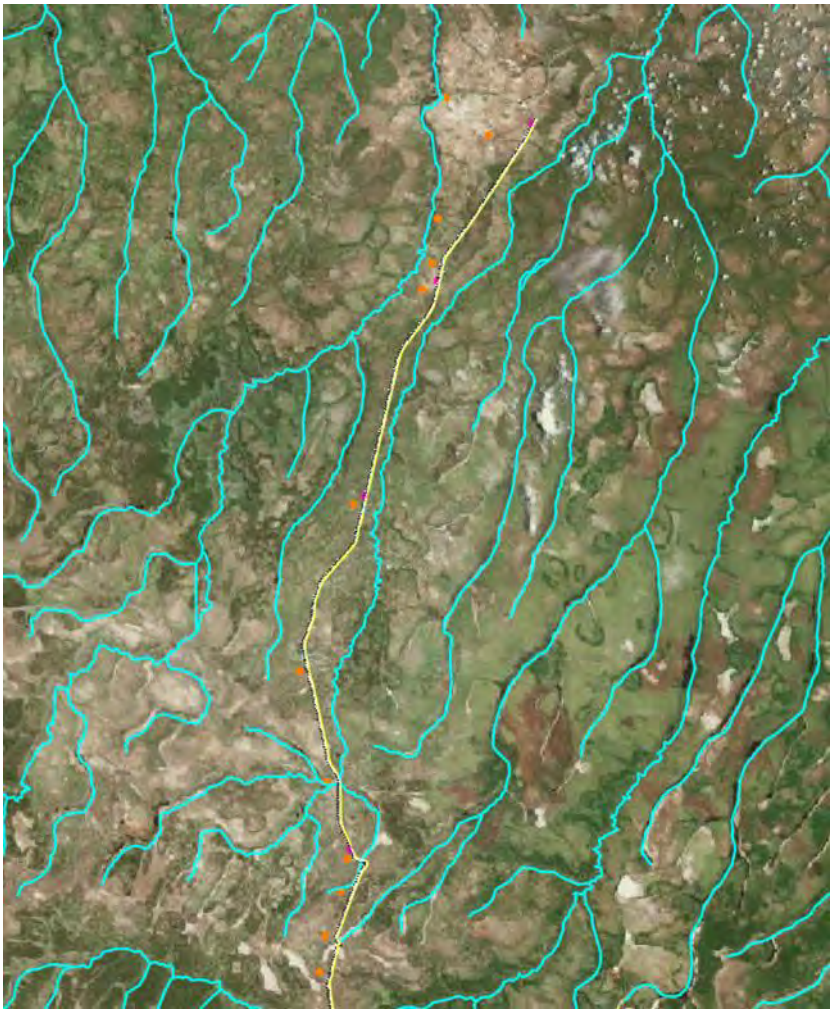


Figure 8-26: Drainage network beyond basin 6

The estimation of flood flows in the sections of interest (the six basins indicated in the Intertechne report) was carried out through rainfall runoff modelling, using the Unitary Hydrograph approach.

The hydrograph can be considered as the response of the river basin to a given precipitation, being influenced by the relief, basin coverage, changes in the river, soil and distribution, duration and intensity of precipitation. The Unitary Hydrograph is a hydrograph where the area under the curve corresponds to a unit volume of direct surface runoff, resulting from effective rain unit intensity and duration.

The calculated maximum flows for each recurrence time were calculated and summarised as represented in Table 8-8

Table 8-8: Maximum Flow (m^3/s)

DESIGN - HYDROGRAPH METHOD							
LOCATION			BASIN/CATCHMENT DATA				EXPECTED SOLUTION
Bridge	RIVER	km	AREA "A" (km^2)	THALWEG (km)	ELEVATION DIFFERENCE (m)	FLOW TR=100 YEARS "Qp" (m^3/s)	
01	LUMEJE	16+700	1273,70	67,60	210,00	1702,00	BRIDGE
02	LUXIA	57+100	1427,30	75,90	190,00	1770,00	BRIDGE
10	TCHINHINHI	58+270	5,70	4,35	75,00	58,20	BRIDGE
03	CASSAI	73+500	6814,70	236,70	350,00	4561,00	BRIDGE
04	TCHIUMBWE	96+700	2175,40	97,10	260,00	2539,00	BRIDGE
05	MOMBO	113+102	38,50	9,73	37,00	232,00	BRIDGE
06	LUACHIMO	127+500	85,20	15,70	40,00	207,00	BRIDGE
07	LUELE	142+193	1083,20	50,00	100,00	1754,00	BRIDGE
11	RIACHO	163+160	16,34	5,77	38,00	84,35	BRIDGE
08	CAIAZA	188+800	61,53	13,40	130,00	171,77	BRIDGE
09	SAMBUAMBA	255+820	37,75	9,10	38,00	128,42	BRIDGE

Source: (Intertechne report n.d)

Apart from the major basin specific micro-basins will be intersected along the railway. These are however much smaller in magnitude than the macro basins but do require the implementation of hydraulic crossings. The number of culverts and design parameters are in Table 8-9 below.

Surface water basins were further delineated using the digital elevation model (DEM) on a 30 m resolution scale (see Figure 8-27). The proposed railway development transects the Zambezi basin towards the south and the Congo basin (catchment) towards the central and northern sections of the railway. The proposed development of the railway intersects a total of 47 sub-catchments within the Zambezi and Congo basins. The catchments and sub-catchment are illustrated in Figure 8-27.

Table 8-9: Culvert Design Parameters

Identification					BASIN/CATCHMENT DATA							FORESEEN CULVERT (PHs)											
					Peak Flow TR=25 years	Coefic. "C" ou "CN"	Rainfall Intensity	Area	Thalweg	Gradient	Tc	Ø	Type	Material	YD	Roughness Coef.n	Wet Area	Hydraulic Radius	Velocity	Minimum Slope	Culvert Flow rate	Verification	Method
Basins/Catchment - Culverts	Side	km			m^3/s	[-]	mm/h	km^2	km	m	h	m	[-]	[-]	[-]	[-]	m^2	m	m/s	m/m	m^3/s	[-]	[-]
1	L	8	+	564	97,68	79,00	28,84	35,74	9,04	61,00	3,71	2,50	TRIPLE	HDPE	0,750	0,010	3,95	0,75	8,29	0,01	98,16	FLOW OK	Hydrograph
2	L	38	+	221	7,34	0,35	122,05	0,62	0,80	9,00	0,47	1,00	DOUBLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	9,48	FLOW OK	Rational
3	L	64	+	098	16,59	0,24	115,60	1,86	1,08	17,00	0,52	1,50	DOUBLE	HDPE	0,938	0,010	1,72	0,44	5,74	0,01	19,77	FLOW OK	IPAIWU
4	L	70	+	700	73,09	77,00	27,97	29,09	11,17	104,00	3,86	2,00	TRIPLE	HDPE	0,938	0,010	3,06	0,58	8,52	0,02	78,22	FLOW OK	Hydrograph
5	R	79	+	880	3,32	0,35	150,50	0,23	0,55	3,00	0,31	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	4,38	0,01	3,35	FLOW OK	Rational
6	R	86	+	400	10,07	0,26	98,91	1,32	1,10	9,00	0,68	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	5,42	0,01	11,94	FLOW OK	IPAIWU
7	L	106	+	968	6,40	0,34	67,96	1,36	2,04	13,00	1,21	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	6,06	0,02	6,68	FLOW OK	IPAIWU
8	R	109	+	850	5,51	0,35	156,00	0,37	0,66	6,50	0,29	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	5,42	0,01	5,97	FLOW OK	Rational
9	R	120	+	300	4,06	0,35	160,29	0,26	0,48	3,00	0,27	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	5,37	0,02	4,11	FLOW OK	Rational
10	R	120	+	662	1,67	0,35	166,74	0,10	0,45	3,00	0,24	0,80	SINGLE	HDPE	0,938	0,010	0,49	0,23	3,78	0,01	1,85	FLOW OK	Rational
11	R	122	+	090	5,66	0,34	66,79	1,26	2,24	15,00	1,27	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	7,71	FLOW OK	IPAIWU
12	R	123	+	550	12,06	0,35	94,24	1,71	1,30	12,00	0,74	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	6,06	0,02	13,35	FLOW OK	IPAIWU
13	R	125	+	250	14,60	0,34	91,04	2,56	2,00	14,00	1,14	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	IPAIWU
14	L	158	+	729	122,72	76,00	29,69	48,34	8,42	54,00	3,58	2,50	TRIPLE	HDPE	0,870	0,010	4,53	0,75	9,08	0,01	123,47	FLOW OK	Hydrograph
15	R	165	+	300	5,82	0,35	152,25	0,40	0,66	5,50	0,30	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	6,06	0,02	6,68	FLOW OK	Rational
16	L	167	+	150	6,84	0,34	133,19	0,55	0,91	7,00	0,40	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	6,45	0,02	7,11	FLOW OK	Rational
17	L	170	+	800	58,53	79,00	37,30	16,94	6,41	50,00	2,69	2,00	DOUBLE	HDPE	0,938	0,010	3,06	0,58	9,84	0,02	60,21	FLOW OK	Hydrograph
18	L	176	+	679	5,16	0,25	61,30	1,33	3,60	49,00	1,39	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	7,71	FLOW OK	IPAIWU
19	L	178	+	700	5,44	0,35	81,84	0,68	1,37	8,00	0,92	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	7,71	FLOW OK	Rational
20	L	181	+	400	3,86	0,24	54,65	1,08	2,84	16,00	1,63	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	6,52	0,02	4,99	FLOW OK	IPAIWU
21	L	192	+	995	12,58	0,24	67,81	2,80	3,00	35,00	1,28	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	IPAIWU
22	L	197	+	300	7,99	0,34	138,41	0,61	0,77	15,50	0,37	1,00	DOUBLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	9,48	FLOW OK	Rational
23	L	198	+	590	14,56	0,21	76,07	1,67	2,11	22,00	1,02	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	IPAIWU

Identification					BASIN/CATCHMENT DATA							FORESEEN CULVERT (PHs)											
					Peak Flow TR=25 years	Coefic. "C" ou "CN"	Rainfall Intensity	Area	Thalweg	Gradient	Tc	Ø	Type	Material	YD	Roughness Coef.n	Wet Area	Hydraulic Radius	Velocity	Minimum Slope	Culvert Flow rate	Verification	Method
Basins/Catchment - Culverts	Side	km			m^3/s	[-]	mm/h	km^2	km	m	h	m	[-]	[-]	[-]	[-]	m^2	m	m/s	m/m	m^3/s	[-]	[-]
24	L	201	+	221	16,00	0,28	147,52	1,30	0,76	21,00	0,32	1,20	TRIPLE	HDPE	0,938	0,010	1,10	0,35	6,06	0,02	20,03	FLOW OK	IPAIWU
25	L	203	+	500	11,67	0,34	150,30	0,82	0,73	21,00	0,31	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	Rational
26	L	203	+	679	4,74	0,34	160,97	0,31	0,66	23,00	0,26	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	6,35	0,02	4,86	FLOW OK	Rational
27	L	204	+	426	4,60	0,34	131,69	0,37	0,90	19,00	0,41	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	4,74	FLOW OK	Rational
28	L	204	+	869	20,39	0,26	121,98	2,18	1,06	21,00	0,47	1,50	DOUBLE	HDPE	0,938	0,010	1,72	0,44	7,03	0,02	24,21	FLOW OK	IPAIWU
29	L	209	+	165	11,51	0,34	139,00	0,88	0,82	19,00	0,36	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	Rational
30	L	210	+	500	4,99	0,35	92,79	0,56	1,36	13,00	0,75	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	7,71	FLOW OK	Rational
31	L	212	+	150	2,11	0,35	142,25	0,16	0,51	5,00	0,35	0,80	SINGLE	HDPE	0,938	0,010	0,49	0,23	5,34	0,02	2,62	FLOW OK	Rational
32	L	212	+	241	5,27	0,35	118,66	0,22	1,00	5,00	0,50	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	4,95	0,01	5,45	FLOW OK	Rational
33	L	214	+	577	6,69	0,34	80,98	0,89	1,75	16,00	0,93	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	7,71	FLOW OK	Rational
34	L	217	+	727	4,54	0,35	81,20	0,58	2,08	27,00	0,93	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	4,74	FLOW OK	Rational
35	L	219	+	700	4,34	0,34	74,32	0,63	1,91	15,00	1,06	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	4,74	FLOW OK	Rational
36	L	221	+	631	3,71	0,34	85,25	0,46	1,40	10,00	0,86	1,00	SINGLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	4,74	FLOW OK	Rational
37	L	224	+	784	7,78	0,25	86,61	1,21	1,67	18,00	0,84	1,00	DOUBLE	HDPE	0,938	0,010	0,77	0,29	6,20	0,02	9,48	FLOW OK	IPAIWU
38	R	228	+	600	6,80	0,25	88,37	1,04	1,71	21,00	0,82	1,20	SINGLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	7,71	FLOW OK	IPAIWU
39	R	231	+	700	24,52	0,27	92,21	3,76	1,99	39,00	0,77	1,50	DOUBLE	HDPE	0,938	0,010	1,72	0,44	8,12	0,02	27,96	FLOW OK	IPAIWU
40	R	233	+	100	24,73	0,26	77,27	4,71	2,47	37,00	1,00	1,50	DOUBLE	HDPE	0,938	0,010	1,72	0,44	8,12	0,02	27,96	FLOW OK	IPAIWU
41	R	237	+	800	54,92	0,25	61,79	12,80	3,23	36,00	1,38	1,80	TRIPLE	HDPE	0,938	0,010	2,48	0,52	9,17	0,02	68,20	FLOW OK	Hydrograph
42	R	243	+	556	8,89	0,26	88,20	1,30	1,25	8,00	0,82	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	IPAIWU
43	L	245	+	100	8,83	0,35	119,43	0,77	0,77	7,00	0,49	1,20	DOUBLE	HDPE	0,938	0,010	1,10	0,35	7,00	0,02	15,42	FLOW OK	Rational
44	L	248	+	222	50,20	75,00	32,02	13,37	4,41	32,00	4,00	2,00	DOUBLE	HDPE	0,938	0,010	3,06	0,58	9,84	0,02	60,21	FLOW OK	Hydrograph
45	L	258	+	300	5,01	0,25	72,16	1,00	1,80	11,00	1,11	1,20	DOUBLE	HDPE	0,780	0,010	0,96	0,34	5,10	0,01	9,60	FLOW OK	Rational

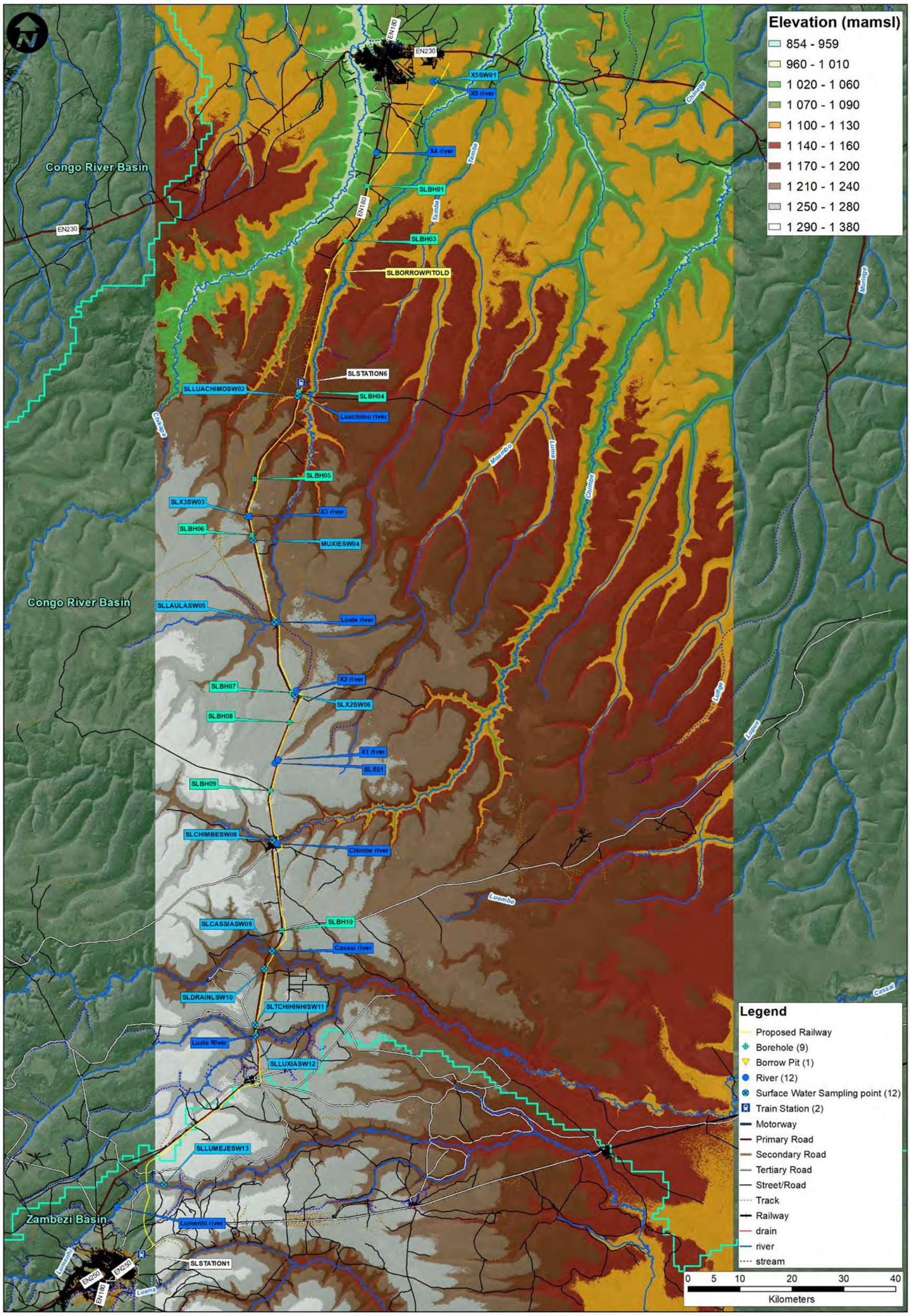


Figure 8-27: Major hydrological basins overlayed on a DEM profile of the project corridor

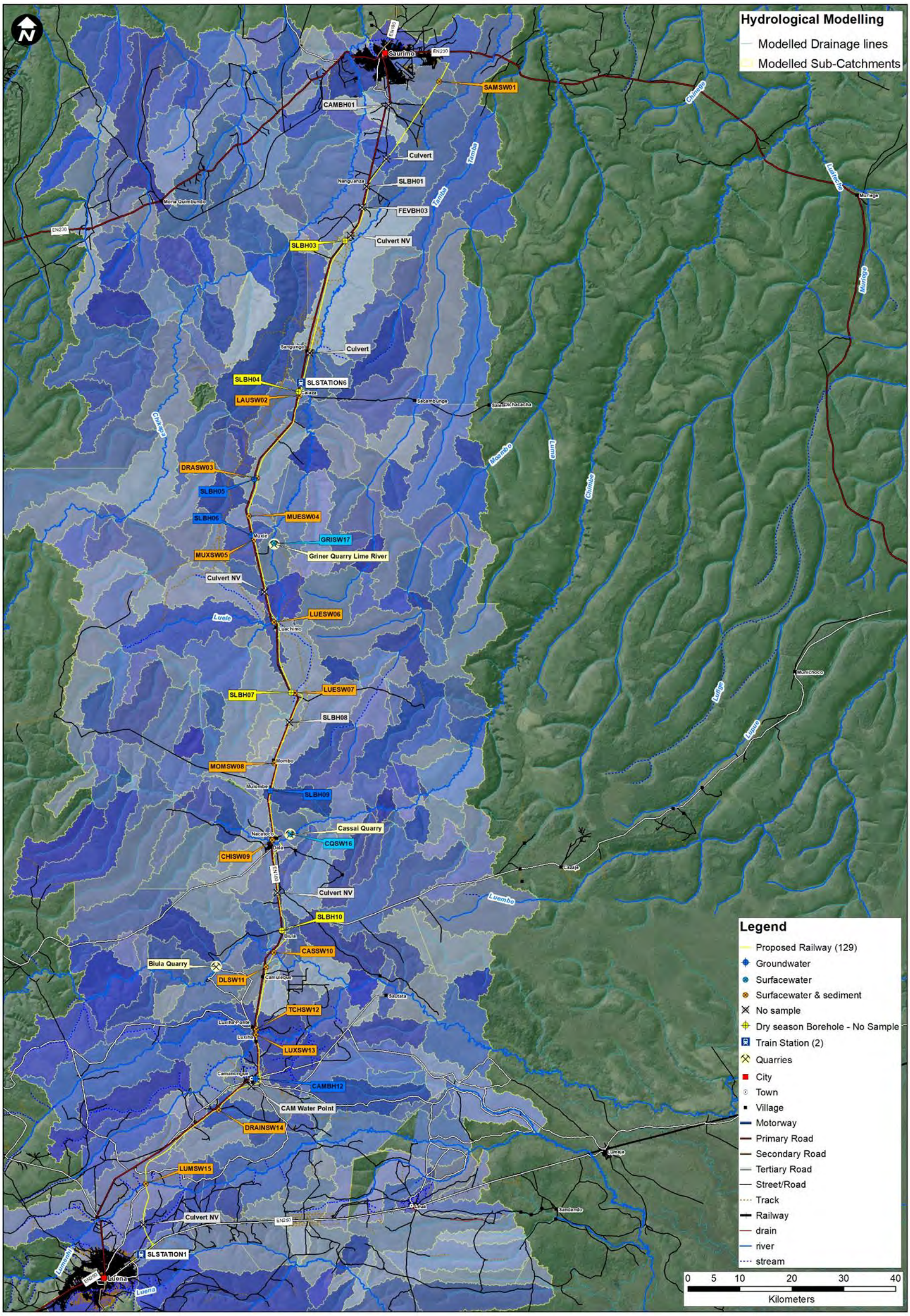


Figure 8-28: Delineated surface water catchment map for the project area

8.3.5 Surface water bodies

The main surface water bodies crossed by the proposed railway line referencing samples undertaken during wet and dry seasons has been summarised in Table 8-10 and graphically represented in Figure 8-29Figure 8-31 and Figure 8-30.

In addition to the sampled surface water features crossed by the railway corridor three existing quarry sites and potentially Catoca mine waste rock facility have been identified as potential aggregate sources. During the wet season survey, it was only possible to visit two of the locations (Dala Quarry and Griner Quarry) as the Buela Quarry access road was inaccessible. Refer to Figure 8-31Figure 8-31 and Figure 8-32**Figure 8-32** for a photographic record of the visited quarry sites.

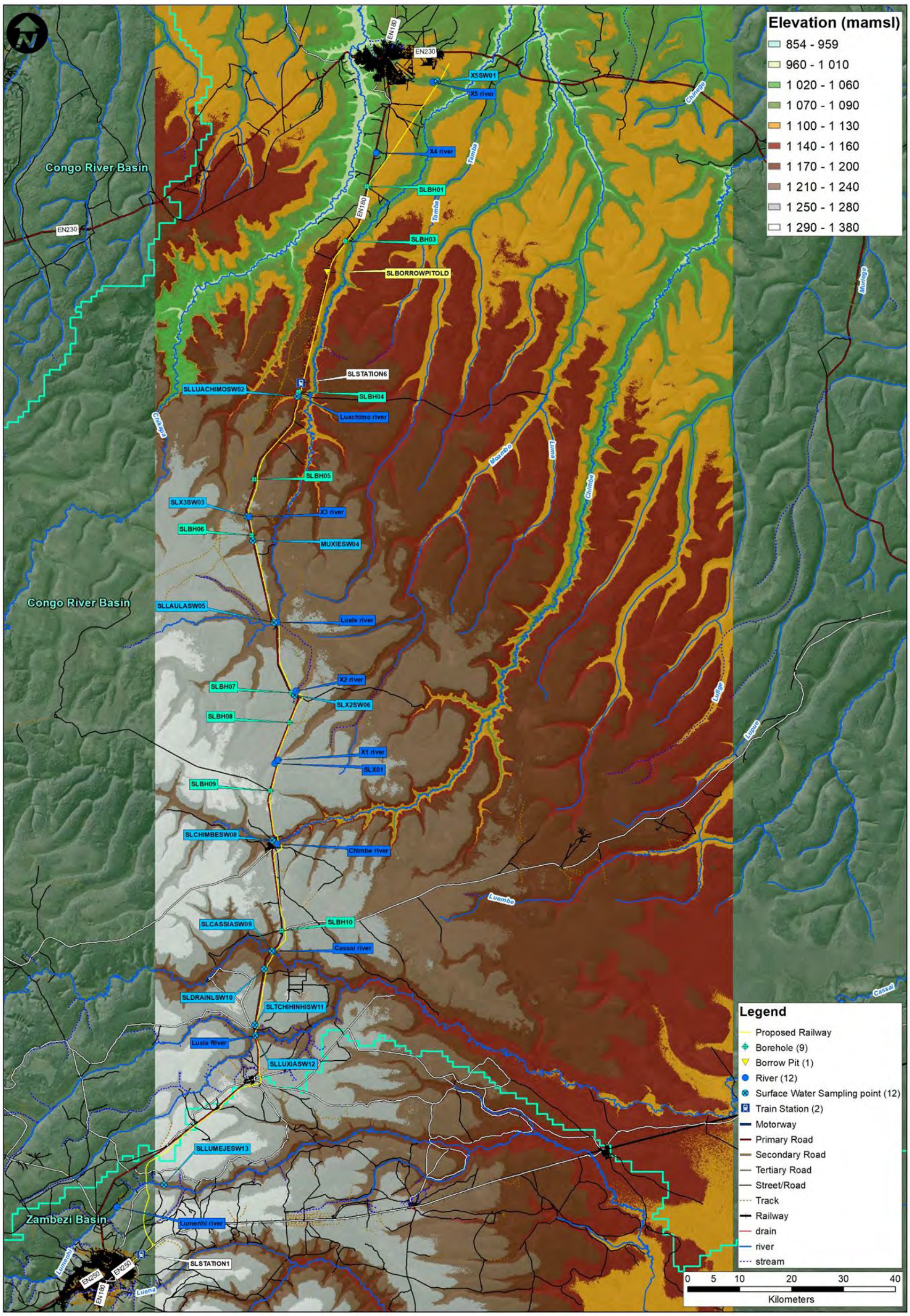


Figure 8-29: Surface water and groundwater network sampled in dry season

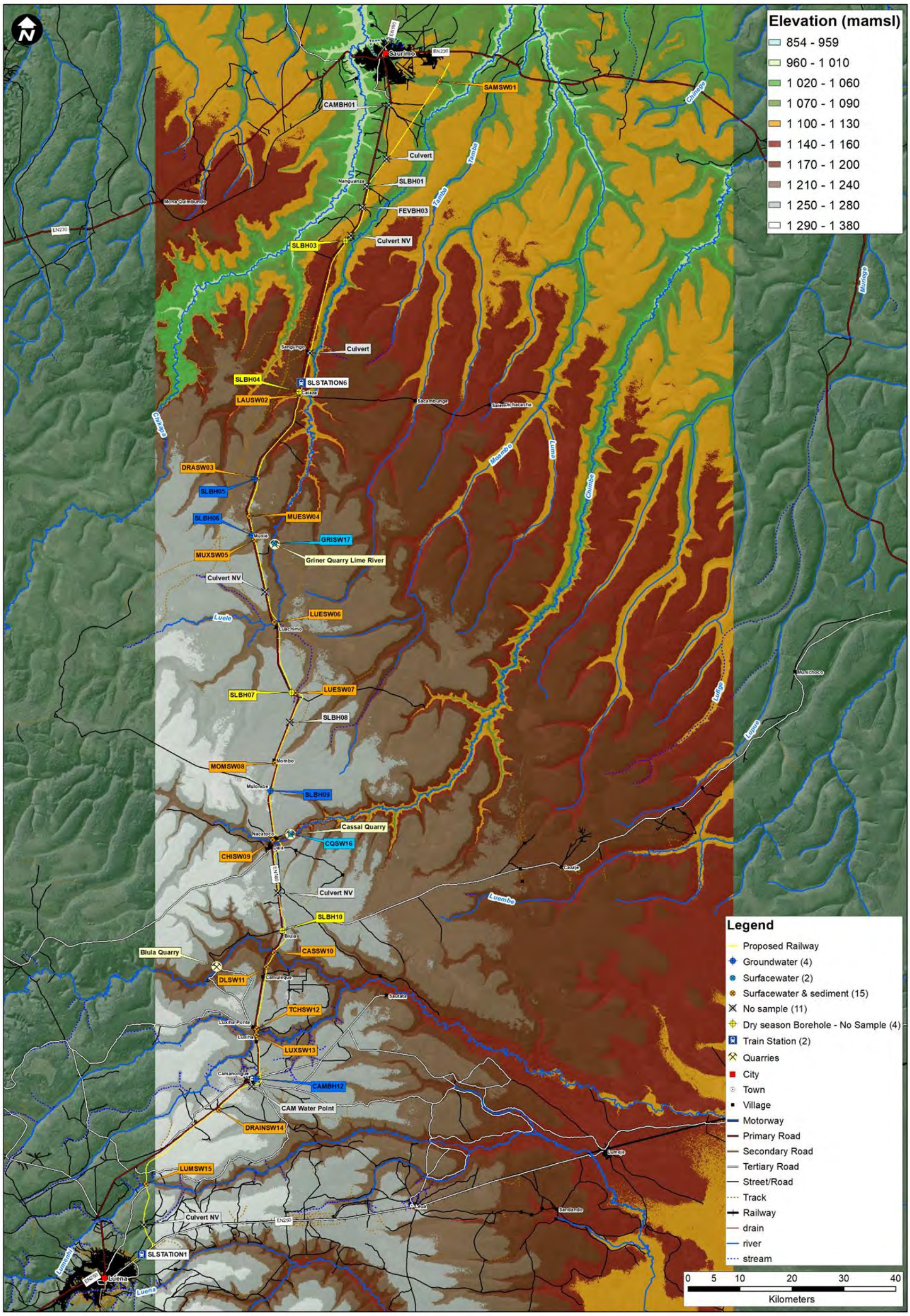


Figure 8-30: Surface water and groundwater network sampled in wet season

Table 8-10: main surface water bodies crossed by the proposed railway line

Chainage (km):	8+500	Watercourse name:	Unknown
Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m each	Watercourse type:	None expected
		Sample point Nr.	Culvert NV
Sample point latitude:	11°41'13.67"S	Sample point longitude:	19°58'49.83"E
Observations and considerations:			
Proposed culvert position not visited as no clear footpath could be identified. Coordinates provided in the above is of the nearest sample point. No distinct watercourse appears to be present at the indicated culvert position based on a desktop interpretation of available aerial imagery. Culvert is included based on an analysis of micro basins, the transposition of sections on embankments and/or the existence of culverts in the road EN 180, in order to provide water flow. Cultivated land was observed in the general vicinity of the visited location.			
Photos:			
None available (crossing not visited).			

Chainage (km):	17+500	Watercourse name:	Rio Lumeje
Proposed infrastructure feature:	Bridge with pillars (span of 1250 m)	Watercourse type:	River channel with floodplain
		Sample point Nr.	LUMSW15
Sample point latitude:	11°36'58.26"S	Sample point longitude:	19°59'4.08"E
Observations and considerations:			
Wide floodplain system next to a small local community (unnamed). The proposed bridge has a span of 1250 m, which transects the river channel and adjacent wetland entirely. The Lumeje River channel has a high channel sinuosity, typical of floodplain wetlands, while meander scars are also present. A wide span crossing, such as the proposed bridge, is regarded as necessary as the position of the river channel will shift across the floodplain over time.			
Photos:			

Wide floodplain wetland viewed along the proposed bridge crossing (photo facing north).

Visible water is not from the main river channel, but from a meander scar that represents a previous (older) main channel of the Lumeje River.

Chainage (km):	38+200	Watercourse name:	Unnamed
Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m each	Watercourse type:	Channelled valley bottom wetland
		Sample point Nr.	DRAINSW14
Sample point latitude:	11°29'19.48"S	Sample point longitude:	20° 6'38.58"E

Observations and considerations:

The railway corridor is located in the outer margins of a channelled valley bottom wetland with a discontinuous channel that is primarily driven by groundwater seepage (interflow). The proposed railway corridor and culverts transect the northern margin of the wetland. The result is that the Muapeso Village will be cut-off from a water resource and cultivated lands by the proposed railway corridor. The sample point is located in the wetland channel along a pedestrian crossing, approximately 365 m east-southeast of the proposed culverts.
The initial engineering design has been updated to provide access to water and cultivated lands for people and livestock. Hydrological design parameters to allow for lateral flow hydrological connectivity will be defined during the detailed design phase of the project.

Photos:

Photo facing east along the proposed railway corridor located in the outer margins of a channelled valley bottom wetland, with the wetter lower-lying area visible to the right (south).

Location of the sample point within the wetland channel along a pedestrian crossing.

Chainage (km):	46+000	Watercourse name:	Unnamed (close to Camanongue Village)
Proposed infrastructure feature:	Non currently planned	Watercourse type:	Seep connected to a channelled valley bottom wetland
		Sample point Nr.	Not sampled
Photo point latitude:	11°26'53.45"S	Photo point longitude:	20°10'1.34"E
Observations and considerations:			
A seep wetland system that changes into a channelled valley bottom wetland is located south of the railway corridor near the Camanongue Village. No culvert is currently proposed to allow lateral surface flow (runoff) towards the wetland. The initial engineering design has been updated to provide access to water and cultivated lands for people and livestock. Hydrological design parameters to allow for lateral flow hydrological connectivity not available yet**.**			
Photos:			

Surface water in the wetland system is used by livestock and for washing clothes.

Chainage (km):	45+500	Watercourse name:	Unnamed (close to Camanongue Village)
Proposed infrastructure feature:	Non currently planned	Watercourse type:	Watering hole
		Sample point Nr.	Not sampled
Point latitude:	11°26'50.45"S	Point longitude:	20°09'30.47"E
Observations and considerations:			
Point was not visited during the assessment but during a review of aerial imagery what appears to be a watering hole was identified that will be completely covered by the railway corridor. Recommended that the presence of this feature is verified and that if it is used as a watering hole an alternative watering hole to be provided.			

Google Earth Image:

Potential watering hole to be verified

Chainage (km):	57+400	Watercourse name:	Rio Luxia
Proposed infrastructure feature:	Bridge with pillars (span of 490 m)	Watercourse type:	River channel with floodplain
		Sample point Nr.	LUXSW13
Sample point latitude:	11°21'30.45"S	Sample point longitude:	20°10'29.56"E

Observations and considerations:

River system with a wide floodplain that is hydrologically driven by flooding and suspected groundwater inputs. The proposed bridge has a span of 490 m, which transects the river channel and adjacent wetland entirely.

Photos:

The Luxia River looking downstream from near the EN180 road crossing.

View of the wide floodplain wetland system adjacent to the river channel that will be spanned by the proposed bridge.

Chainage (km):	58+600	Watercourse name:	Rio Tchihinhi
Proposed infrastructure feature:	Bridge with pillars (span of 210 m)	Watercourse type:	Channelled valley bottom (channel is distinct, but discontinuous)
		Sample point Nr.	TCHSW12
Sample point latitude:	11°20'54.33"S	Sample point longitude:	20°10'31.53"E
Observations and considerations:			
Wetland system driven by groundwater seepage. The proposed bridge has a span of 210 m, which transects the wetland entirely.			
Photos:			

View of the proposed railway corridor crossing through the wetland system from left to right (photo facing north and taken from near the western wetland margin).

Channel with surface water where sample TCHSW12 was collected.

Chainage (km):	70+700	Watercourse name:	Unknown
Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m each	Watercourse type:	Unchannelled valley bottom (narrow discontinuous channel present)
		Sample point Nr.	DLSW11
Sample point latitude:	11°14'27.45"S	Sample point longitude:	20°11'33.22"E

Observations and considerations:

Wetland system driven by groundwater seepage with an incised, narrow and discontinuous channel that is not clearly visible on aerial imagery. The initial engineering design has been updated to shift the culvert locations marginally north to align with the indistinct wetland channel (located at coordinates 11°14'25.74"S 20°11'35.70"E along the railway corridor).

Photos:

View of the proposed railway corridor crossing through the wetland system in the centre of the photo (photo facing north and taken from the southern wetland margin).

Chainage (km):	73+900	Watercourse name:	Rio Cassai
Proposed infrastructure feature:	Bridge with pillars (span of 910 m)	Watercourse type:	River channel with floodplain
		Sample point Nr.	CASSW10
Sample point latitude:	11°12'57.39"S	Sample point longitude:	20°12'21.82"E

Observations and considerations:

River channel with cultivation along right hand channel bank. Furrows are present in sandy soils and with observed isolated peat soils. The proposed bridge has a span of 910 m, which transects the river channel and adjacent wetland habitat.

Photos:

View of the Cassai River downstream of the 110 m wide bridge along the EN180 Road.

Cultivated land with furrows in organically enriched soils that are fed by seepage, located upslope of the right hand river channel bank where cultivation is common on soils that contain isolated areas of peat.

View downslope towards the river channel along the proposed railway corridor crossing (photo taken south of the river channel facing north).

Chainage (km):	86+250	Watercourse name:	Unknown
Proposed infrastructure feature:	One culvert of 2.5 m x 2.5 m	Watercourse type:	Non expected
		Sample point Nr.	Culvert NV
Sample point latitude:	11° 6'45.78"S	Sample point longitude:	20°12'43.48"E
Observations and considerations:			
Culvert position not surveyed due to access limitations (demining not completed and lack of visible access roads). Coordinates provided in the above is of the nearest sample point located 135 m west of the culvert position along the EN180 Road. Currently one culvert of 2.5 m x 2.5 m is proposed. No distinct watercourse appears to be present at the proposed culvert position based on an interpretation of satellite imagery OEC provided further clarification that the objective of the proposed culvert is to avoid erosion in the constructed embankment and to minimise water damming caused by the embankment during water flow events.			
Photos:			
No photographs available.			

Chainage (km):	97+000	Watercourse name:	Rio Tchiumbwe
Proposed infrastructure feature:	Bridge with pillars (span of 665 m)	Watercourse type:	River in steep valley with rapids in the reach
		Sample point Nr.	CHISW09
Sample point latitude:	11° 1'17.19"S	Sample point longitude:	20°12'10.68"E
Observations and considerations:			
Bridge location not visited due to access limitations. Coordinates provided in the above is of the nearest sample point located 1.32 km away to the northwest from the proposed bridge, along the EN180, in an area that forms part of a hydro-electrical power scheme. The proposed bridge is located in a narrower portion of the river valley with steeper slopes compared to the area around the sample point. The result is that the river and adjacent riparian habitat will be entirely spanned by the proposed 665 m wide bridge (based on an interpretation of available satellite imagery) (See Appendix 1-2-14).			
Photos:			

Sample point CHISW09 is located downstream of the EN180 Road in a river reach with rapids. Several men and boys where swimming in the area and washing of vehicles (cars and motorcycles) in the river.

Distant view of the valley where the proposed railway corridor will transect the river valley (photo taken along a footpath from coordinates 11° 1'43.54"S 20°12'18.31"E facing east).

Chainage (km):	106+800	Watercourse name:	Unknown
Proposed infrastructure feature:	One culvert of 2.5 m x 2.5 m	Watercourse type:	None expected
		Sample point Nr.	None recorded
Sample point latitude:	Not applicable	Sample point longitude:	Not applicable
Observations and considerations:			
Not surveyed due to access limitations. Currently one culvert of 2.5 m x 2.5 m is proposed. No distinct watercourse appears to be present at the proposed culvert position based on an interpretation of satellite imagery. OEC provided further clarification that the objective of the proposed culvert is to avoid erosion in the constructed embankment and to minimise water damming caused by the embankment during water flow events.			
Photos:			
No photographs available.			

Chainage (km):	113+300	Watercourse name:	Rio Mombo
Proposed infrastructure feature:	Small bridge (span of 35 m)	Watercourse type:	Channelled valley bottom with a seep zone to the south

		Sample point Nr.	MOMSW08
Sample point latitude:	10°53'17.46"S	Sample point longitude:	20°12'26.31"E

Observations and considerations:

Water flow is expected across the width of swamp forest vegetation in the centre of the wetland, which can be reasonably well accommodated by the proposed 35 m bridge on the condition that it is repositioned. The wetland system is hydrologically well intact with peat soils present, while the channel is not incised and base flow occurs across a wide zone. Surface water visible in the seep zone, outside of the swamp forest area (south-east thereof), is expected to have a low nutrient status based on the recorded presence of *Sphagnum* sp. moss, which is typical of peat wetlands that contain low nutrient levels. The initial engineering design has been updated to move the location of the bridge slightly to the north. Provision should also be made for hydrological connectivity outside of the swamp forest area, in seep zone, through the use of pipes.

Photos:

The Mombo River as it appears downstream of the EN180 Road with a non-incised channel and swamp forest vegetation in the centre of the valley bottom wetland. The proposed railway corridor will transect through this area (from right to left).

Another view downstream of the existing bridge with swamp forest vegetation and an adjoining seep visible.

Uninterrupted hydrological and habitat connectivity between the seep and channelled valley bottom wetland with swamp forest vegetation.

Sphagnum sp. moss identified within the treeless seep zone that surrounds the channelled valley bottom wetland.

Chainage (km):	128+150	Watercourse name:	Rio Luele
Proposed infrastructure feature:	Bridge (105 m span)	Watercourse type:	Channelled valley bottom with broad seep zones on either side
		Sample point Nr.	LUESW07
Sample point latitude:	10°45'59.31"S	Sample point longitude:	20°14'34.58"E
Observations and considerations:			
Water flow is present across the width of valley floor, which include swamp forest vegetation, but also extends beyond it, in a flow path of approximately 75 m wide where base flow regularly occurs. The system is hydrologically well intact with peat soils present. Initial proposed crossing was a small bridge with pillars and a span of only 35 m which has subsequently been updated to a bridge with a span of 105 m which spans the feature completely. Channel widening from scour damage is noticeable at the existing bridge crossing along the EN180, which only has culverts.			
Photos:			

View of the proposed railway corridor wetland crossing downstream of the EN180 Road.

Swamp forest vegetation in the centre of the channelled valley bottom in the proposed railway corridor crossing (photo facing west-northwest from near the edge of the seep zone).

Surface water present in a broad area with no channel incision, at sample point LUESW07.

Chainage (km):	143+000	Watercourse name:	Rio Luachimo and Rio Luele
Proposed infrastructure feature:	Bridge with pillars (span of 105 m)	Watercourse type:	River channel with floodplain and seepage inputs
		Sample point Nr.	LUESW06
Sample point latitude:	10°38'39.21"S	Sample point longitude:	20°12'22.17"E
Observations and considerations:			
Initial bridge location has been updated in subsequent design updates following the field visit. The previously proposed bridge location was not surveyed due to access constrains, but surroundings areas were visited. The new proposed location of the bridge is closer to the N180 highway and the sampled point. River reach with rapids (near road crossing) will be transects by a bridge with a span of 105 m. The wide floodplain system contains pockets of surface water in depressions that contain carnivorous plant species adapted to low nutrient environments. Initially the railway corridor south of the bridge was located in a seep connected to the Luachimo River. However, with the updated design the railway corridor has been relocated to fall mostly outside of the seep.			
Photos:			

River crossing directly downstream of the EN180 Road.

Water ponding in a meander scar along a previous pathway of the river channel, situated on a broad floodplain (photo taken north of the main river channel facing south).

Carnivorous hydrophytes (wetland plants) adapted to low nutrient wetland systems, include a *Drosera* sp. (left panel) and an underwater *Utricularia* sp. (right panel) in water filled depressions on the floodplain.

Chainage (km):	149+000	Watercourse name:	Unknown
Proposed infrastructure feature:	One culvert of 2.5 m x 2.5 m	Watercourse type:	None expected
		Sample point Nr.	Culvert NV
Sample point latitude:	10°35'30.83"S	Sample point longitude:	20°11'23.97"E
Observations and considerations:			
Not surveyed due to access limitations. Coordinates provided in the above is of the nearest sample point located 225 m west of the culvert position along the EN180 Road. Currently one culvert of 2.5 m x 2.5 m is proposed. No distinct watercourse appears to be present at the proposed culvert position based on an interpretation of satellite imagery. OEC provided further clarification that the objective of the proposed culvert is to avoid erosion in the constructed embankment and to minimise water damming caused by the embankment during water flow events.			
Photos:			
No photos available			

Chainage (km):	159+400	Watercourse name:	Rio Muxie
Proposed infrastructure feature:	Three culverts of 3.5 m x 3.5 m each	Watercourse type:	Channelled valley bottom with broad seep zone to the north
		Sample point Nr.	MUXSW05

Sample point latitude:	10°30'3.41"S	Sample point longitude:	20°10'16.73"E

Observations and considerations:

Channel confirmed within swamp forest vegetation in the centre of the valley bottom with a width of approximately 15 m and depth of approximately 1.5 m to 1.75 m. The flow path can increase across the width of the swamp forest. System is hydrologically well intact with peat soils present, which indicate low energy environments (wetland as opposed to riparian conditions). Initial design only included two culverts of 2.5 m x 2.5 m each that were proposed at a position outside of the channel and main area of flow. Engineering design was updated to allow for three culverts of 3.5xm x 3.5 m each, at a location more central to the observed channel. The swamp forest channel position along the railway corridor crossing is at coordinates 10°30'3.41"S 20°10'16.73"E. Any future crossing structure should make provision for this channel and adjacent flow.

Photos:

Muxie River directly upstream of the EN180 Road, located approximately 300 m west-southwest of the railway corridor watercourse crossing. Crystal clear water, submerged hydrophytes (wetland plants), and swamp forest vegetation are visible.

Culverts are already partially silted as seen downstream of the EN180 Road, which transects the Muxie River.

A broad seep wetland adjacent to tall swamp forest vegetation in the lower-lying channelled valley bottom wetland, illustrating where the proposed railway corridor will transect the watercourse from south (visible on the right) to north (visible on the left).

Non-incised river channel in the swamp forest system with sandy soils in the channel bed (coordinates 10°30'3.41"S 20°10'16.73"E).

Chainage (km):	163+800	Watercourse name:	Rio Maurilio
Proposed infrastructure feature:	Bridge with pillars (142 m span)	Watercourse type:	Unchannelled valley bottom (a discontinuous channel present in areas) with adjacent seep zones
		Sample point Nr.	MUESW04
Sample point latitude:	10°27'39.18"S	Sample point longitude:	20° 9'46.67"E
Observations and considerations:			
Water flow expected across the width of the swamp forest of approximately 70 m wide. System is hydrologically well intact with peat soils present, but no distinct channel. Proposed crossing is a bridge with pillars with a span of approximately 142 m. Initial design was updated to shift the location of the bridge marginally north to accommodate swamp forest vegetation (see Appendix 1-2-8).			
Photos:			

Ponding caused by the EN180 Road with a culvert inlet that is raised higher than the natural channel bed level. Road crossing is located approximately 380 m west of the proposed railway corridor bridge.

A seep zone with bright green grass and sedge species, as well as groundwater seepage on the surface, is connected to swamp forest vegetation located in a lower-lying valley bottom landscape setting, close to the proposed railway corridor crossing (photo facing east or downstream).

Swamp forest tree with adaptive roots to grow in permanently saturated wetland soils.

Chainage (km):	171+400	Watercourse name:	Unknown
		Watercourse type:	Channelled valley bottom wetland (channel

Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m		discontinuous) with broad seep zones
		Sample point Nr.	DRASW03
Sample point latitude:	10°23'41.51"S	Sample point longitude:	20°10'37.02"E
Observations and considerations:			
Channel confirmed within swamp forest vegetation in the centre of the valley bottom with a width of 5-8 m and depth of approximately 1.5 m. System is hydrologically well intact with peat soils present. Initially only a single culvert of 2.5 m x 2.5 m was proposed however engineering design was updated to accommodate two culverts.			
Photos:			

The proposed railway corridor will transect a wetland with swamp forest vegetation and localised peat soils.

Chainage (km):	189+500	Watercourse name:	Rio Luachimo
Proposed infrastructure feature:	Bridge with pillars (560 m span)	Watercourse type:	Channelled valley bottom with broad seep zones
		Sample point Nr.	LAUSW02
Sample point latitude:	10°15'7.83"S	Sample point longitude:	20°15'2.09"E
Observations and considerations:			
Significant sedimentation impacts observed from ill-designed road culverts and poorly vegetated embankments located approximately 350 m upstream of the proposed railway crossing. Road culverts were observed to be silted (blocked) more than half their height. Once completely block this will result in severe damming and possible road failure. The latter will result in the release of massive amounts of sediment towards the proposed railway line and possible channel incision within the watercourse. The wetland is dependent on groundwater input (interflow) with widespread signs of iron precipitation, which is indicative of groundwater discharge. The proposed bridge crossing of 560 m wide will span the entire wetland, including the channelled valley bottom and adjacent seeps located on steeper slopes.			
Photos:			

Erosion from the EN180 embankment, which is poorly vegetated, resulted in sedimentation with the Luachimo River and adjacent valley bottom wetland habitat.

More evidence of erosion and sedimentation on the upstream side of the EN180 crossing, which have resulted in most of the road culverts to be closed due to siltation.

Sedimentation from erosion along the EN180 is also very prominent downstream of the road crossing and upstream of the proposed railway crossing. Also notice the bright green seep zones that border the channel valley bottom wetland.

Illustrates sample point LAUSW02 in the river channel with the adjacent channel valley bottom wetland in the valley floor, and higher-lying seep zones on steeper slopes on either side of the valley floor.

Signs of iron precipitation indicative of groundwater (interflow) discharge in the wetland.

Chainage (km):	197+850	Watercourse name:	Unknown
Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m each	Watercourse type:	No distinct watercourse observed
		Sample point Nr.	Culvert
Sample point latitude:	10°10'43.19"S	Sample point longitude:	20°16'3.84"E
Observations and considerations:			
No sample was collected as no surface water was present during the site survey. Currently two culverts of 2.5 m x 2.5 m each are proposed.			
Photos:			

No surface water or distinct watercourse features, such as wetland vegetation, a channel bed, or channel banks, were recorded at the proposed culvert position along the railway corridor.

Chainage (km):	222+100	Watercourse name:	Unknown
		Watercourse type:	None expected

Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m each	Sample point Nr.	Culvert NV
Sample point latitude:	9°58'31.19"S	Sample point longitude:	20°20'19.85"E
Observations and considerations:			
Not surveyed due to access limitations. Coordinates provided in the above is of the nearest sample point located 130 m southwest of the culvert position along the proposed railway corridor. Currently two culverts of 2.5 m x 2.5 m are proposed. No distinct watercourse appears to be present at the proposed culvert position based on an interpretation of satellite imagery. OEC provided further clarification that the objective of the proposed culvert is to avoid erosion in the constructed embankment and to minimise water damming caused by the embankment during water flow events.			
Photos:			
No photos are available			

Chainage (km):	238+400	Watercourse name:	Unknown
Proposed infrastructure feature:	Two culverts of 2.5 m x 2.5 m each	Watercourse type:	No distinct watercourse observed
		Sample point Nr.	Culvert
Sample point latitude:	9°50'34.12"S	Sample point longitude:	20°24'0.21"E
Observations and considerations:			
Currently two culverts of 2.5 m x 2.5 m each are proposed.			
Photos:			

No surface water or distinct watercourse features, such as wetland vegetation, a channel bed, or channel banks, were recorded at the proposed culvert position along the railway corridor. OEC provided further clarification that the objective of the proposed culvert is to avoid erosion in the constructed embankment and to minimise water damming caused by the embankment during water flow events.

Chainage (km):	248+500	Watercourse name:	Unknown
		Watercourse type:	None expected

Proposed infrastructure feature:	One culvert of 2.5 m x 2.5 m	Sample point Nr.	Not recorded
Sample point latitude:	Not applicable	Sample point longitude:	Not applicable
Observations and considerations:			
Not surveyed due to access limitations. Currently one culvert of 2.5 m x 2.5 m is proposed. No distinct watercourse appears to be present at the proposed culvert position based on an interpretation of satellite imagery. OEC provided further clarification that the objective of the proposed culvert is to avoid erosion in the constructed embankment and to minimise water damming caused by the embankment during water flow events.			
Photos:			
No photos are available.			

Chainage (km):	256+300	Watercourse name:	Rio Sambuamba
Proposed infrastructure feature:	Bridge with pillars (span of 140 m)	Watercourse type:	Channelled valley bottom with broad seep zones
		Sample point Nr.	SAMSW01
Sample point latitude:	9°42'30.91"S	Sample point longitude:	20°29'31.58"E
Observations and considerations:			
Agricultural activities dependent on watercourse and within seepage area with created (man-made) furrows. Seeps are selected for cultivation as they are located on slopes that can be drained more effectively using furrows. Signs of groundwater discharge caused by interflow that intersects with the wetland surface is common. The proposed crossing is a bridge with pillars with a span of approximately 140 m. Initial design was updated to shift the location of the bridge marginally north**.**			
Photos:			

Swamp forest vegetation is located in the narrow channel, while the adjacent seep zone to the north contains furrows to enable cultivation on soils that are seasonally and event permanently saturated (depending on the position along the seep profile).

In addition to the sampled surface water features crossed by the railway corridor three existing quarry sites and potentially Catoca mine waste rock facility have been identified as potential aggregate sources. During the wet season survey, it was only possible to visit two of the locations (Dala Quarry and Griner Quarry) as the Buela Quarry access road was inaccessible. Refer to Figure 8-31 and Figure 8-32 for photographic record of the visited quarry sites.

Figure 8-31: Photos of Dala Quarry with different portions of the quarry visible, including steep slopes along its south-eastern boundary (top three panels), a berm and excavation along its northern boundary (fourth panel from the top), and a stream where a sample was collected along the eastern boundary of the quarry (bottom panel)

Figure 8-32: Photos of Griner Quarry illustrating the working area (top two panels), the eroded vehicle track along a steep slope to the Luele River (third panel from the top) and the Luele River that borders the quarry (bottom panel)

8.3.6 Surface water quality

In-field water quality testing included the measurement of pH, Electrical Conductivity (EC), temperature, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Oxidation Reduction Potential (ORP) and turbidity with the aid of a Hanna Multiparameter probe (HI98194) and Hanna portable turbidity meter (HI98703) and the results are summarised in Table 8-11 and Table 8-12 for the dry season and wet season.

The dry and wet seasons' water quality show similar conditions. The measured pH of the sampled waters ranged between 4.5 and 6.9 and can be described as acidic to slightly acidic. During the dry season the lowest pH values were recorded near Saurimo and generally increased as surface water features were sampled further south. The highest pH was recorded at the Cassai River and Lumeje rivers located in the southern portion of the project corridor. During the wet season, the lowest pH values were recorded near Saurimo in the Sambuamba river and south of Luachimo in the Luele river, with pH values less than 5. The highest pH values were recorded near Dala in the Tchiumbwe river, and further south in a tributary of the Cassai and Cassai River itself, with pH values above 6.

The EC and TDS values across the project corridor were extremely low indicating that very little soluble ions were present in the sampled waters. The EC and TDS concentrations range from 3 to 66 uS/cm and 2 to 36 mg/l, respectively. This could indicate that the soils through which the surface water infiltrates and flows has been highly leached. Low EC has no aesthetic or health impact, and the recorded values are well below the Angolan drinking water standard of 1000 µS/cm and the WHO drinking water criteria. Water low in minerals is usually corrosive towards materials with which it comes into contact, such as materials used for distribution pipes, storage and plumbing. Water must be stabilized or remineralized prior to distribution to reduce its corrosive nature.

During the dry season DO concentrations ranged between a low of 1.6 mg/l at sampling point SW11 (collected in the near stagnant Tchihinhi stream) and a high of 7.43 collected at sampling point SW12 (Luxia River). During the wet season, DO concentrations ranged between 2.6 (at Luele river) to 8.6 (at tributary of the Tchiumbwe river). Generally, DO values are higher in more turbulent river systems and lower in stagnant systems with high organic material. The oxygen content of surface waters of normal salinity in the summer is typically more than 8 milligrams per litre (8 mg/L); when oxygen concentrations are less than 2 mg/L, the water is defined as hypoxic (CENR, 2000).

The measured ORP values are all elevated indicative of oxidizing conditions in the sampled surface waters. ORP measures[98] the ability of a lake or river to cleanse itself or break down waste products, such as contaminants and dead plants and animals. When the ORP value is high, there is lots of oxygen present in the water. This means that bacteria that decompose dead tissue and contaminants can work more efficiently. In general, the higher the ORP value, the healthier the lake or river is. However, even in healthy lakes and rivers, there is less oxygen (and therefore lower ORP values) as you get closer to the bottom sediments. This is because there are many bacteria working hard in the sediments to decompose dead tissue, and they use up a lot of the available oxygen.

Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water

[98] https://www.gov.nt.ca/ecc/sites/ecc/files/oxidation-reduction_potential.pdf

when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. The WHO (World Health Organization) establishes that the turbidity of drinking water shouldn't be more than 5 nephelometric turbidity units NTU and should ideally be below 1 NTU. Generally, the measured turbidity of the surface water features was all below 5 NTU apart from sampling points SW11 (Tchihinhi stream) and Lumeje rivers recorded during the dry season and sampling points SW01 (Sambuamba river), SW02 (Caiaza river), SW10 (Cassai River), SW11 (tributary to the Cassai River), SW14, SW15 (Lumeje river) and SW16 (tributary of the Tchiumbwe river) during the wet season. It should be noted that samples were collected directly from the rivers and streams without any treatment and confirms the field observations that river water quality was excellent from a turbidity perspective as the waters appeared clear and with limited suspended sediment load. Considering the high erodibility of the underlying soils this is surprising and indicates that the wetland systems surrounding the surface water features are effectively acting as water filtration buffers and aquatic and terrestrial plant life is successful in limiting riverbank erosion.

A total of nine (9) surface water samples during the dry seasons and seventeen (17) surface water samples during the wet season were collected and submitted for a wide range of laboratory analyses. Field parameters are presented in

Table 8-13: and Table 8-14: . Additionally, a summary of the results is presented in Table 8-13 and Table 8-14.

Generally, very low concentrations of dissolved metals were detected during both the dry and wet seasons. During the dry season only dissolved iron concentrations in six of the nine samples during the dry season and 12 of the 17 samples during the wet season exceeding the Angola Class A1 drinking water standard of 100 µg/l. No iron screening values for surface water features were available in the Angolan standards. The US EPA drinking water guideline for iron is 14 000 µg/l and the detected concentrations are well below this screening value, apart from sample SW11 with a concentration of 18 957 ug/l, obtained during the wet season. Sample SW12 shows a higher iron concentration (12 144 ug/l) with reference to the low overall iron concentrations observed.

Anaerobic groundwaters[99] may contain iron (II) at concentrations up to several milligrams per litre without discoloration or turbidity in the water when directly pumped from a well. Taste is not usually noticeable at iron concentrations below 0.3 mg/litre, although turbidity and colour may develop in piped systems at levels above 0.05–0.1 mg/litre. Laundry and sanitary ware will stain at iron concentrations above 0.3 mg/litre.

[99] https://cdn.who.int/media/docs/default-source/wash-documents/wash-chemicals/iron-bd.pdf?sfvrsn=8bde1f09_4

The recommended level of iron in water used for concrete mixing, based on the provided sources, is within the range of 2-2.5 mg/L[100]. Groundwater sources with iron concentrations within this range are considered safe for concrete mixing and curing work. This level of iron content in water is observed to have a positive impact on the compressive strength of concrete. Only the concentrations of iron detected in SW12 and SW14 exceed this suggested limit.

Other metals that were detected include aluminium, barium, manganese, selenium, and zinc but mostly well below WHO or Angolan drinking water standards. Higher metal concentrations of aluminium and manganese are observed at sample point SW11 and SW12 (manganese only), obtained during the wet season.

Low concentrations of minerals (calcium, potassium, and sodium) were detected in all the sampled waters.

No sulphate was detected in any samples during the dry and wet seasons. Chloride concentrations were only recorded at sample points SW01, SW08, SW11, SW12, and SW16 during the wet season. Only three samples contained measurable concentrations of nitrate (NO_3) during the dry season and four samples during the wet season and only one sample had a trace concentration of phosphate during both the dry and wet seasons. Furthermore, no oil and grease were detected in any water sample. Laboratory results confirm that the sampled surface water exhibited excellent quality resembling drinking water quality.

[100] Assessment of Mechanical Properties of Concrete When Groundwater With Different Ferric Iron (Fe 3+) Concentration is Used for Mixing and Curing: a Case Study in Sylhet, Bangladesh

Table 8-11 : Water Quality Field Parameters – Dry Season October 2023

ID	Location	Latitude	Longitude	pH	Temp (°C)	EC (µS/cm)	TDS (mg/l)	DO (mg/l)	ORP (mV)	Turbidity (NTU)
Angola Water Quality Standards Human Consumption				6.5-8.5	Max 22	1000	25	NV	NV	NV
World Health Organisation Drinking Water Criteria				6.5 – 8.5	NV	2500	300	NV	NV	NV
SW01	X5 River	09.707519	20.488736	4.58	24.85	8	4	5.04	294	0.73
SW02	Luachimo River	10.252755	20.246084	4.87	22.66	7	4	6.37	209.9	0.51
SW03	X3 River	10.460881	20.159496	5	22.91	16	8	2.15	237	2.44
SW04	Muxie River	10.502315	20.169360	5.19	23	10	5	4.83	235.2	0.75
SW05	Luachimo River	10.644115	20.206230	5.7	23.08	10	5	6.6	229.6	0.36
SW06	X2 River	10.770321	20.241784	5.26	23.23	11	6	4.39	233.7	2.11
SW07	X1 River	10.888195	20.207324	5.27	24.39	10	5	6.13	250.2	2.11
SW08	Tchiumbwe River	11.021371	20.202954	6.6	23.55	23	11	7.38	140.3	1.75
SW09	Cassai River	11.213170	20.201957	6.9	24.43	29	15	7.38	153.6	2.27
SW10	Drainage line	11.243835	20.188812	5.27	25.42	22	11	4.28	179.9	0.49
SW11	Tchihinhi Stream	11.341167	20.173192	5.37	20.99	25	12	1.60	172	75.8
SW12	Luxia River	11.359191	20.173313	6.46	23.81	19	10	7.43	144.1	1.05
SW13	Lumeje River	11.608404	20.013501	6.62	27*	25	13	6.09	150.6	6.28
BH07	Luele Borehole	10.766051	20.235443	4.82	27*	26	13	5.45	313	0.55

Notes: - No reading taken

EC – Electrical Conductivity

DO – Dissolved Oxygen

ORP – Oxidation Reduction Potential * - Reading taken from transported sample and therefore affected by ambient temperature

Table 8-12: Water Quality Field Parameters – Wet Season March 2024

ID	Location	Latitude	Longitude	pH	Temp (°C)	EC (µS/cm)	TDS (mg/l)	DO (mg/l)	ORP (mV)	Turbidity (NTU)
Angola Water Quality Standards Human Consumption				**6.5-8.5**	**Max 22**	**1000**	**25**	**NV**	**NV**	**NV**
World Health Organisation Drinking Water Limits				**6.5 – 8.5**	**NV**	**2500**	**300**	**NV**	**NV**	**NV**
SW01	SAMSW01/ 256+300	-9.708586	20.492106	4.69	25.65	4	2	6.28	225.8	7.28
SW02	LAUSW02 / 189+500	-10.252175	20.250581	5.48	24.96	4	2	7.23	151.7	6.36
SW03	DRASW03 / 171+400	-10.394864	20.176950	5.03	26.29	6	3	5.11	258.3	0.44
SW04	MUESW04 / 163+800	-10.460883	20.162964	4.96	25.69	9	4	5.78	289.1	0.62
SW05	MUXSW05 / 159+400	-10.500947	20.171314	5.06	24.38	5	3	6.07	241.9	0.59
SW06	LUESW06 / 143+000	-10.644225	20.206158	5.42	27.87	4	2	7.49	246.1	0.61
SW07	LUESW07 / 128+150	-10.766475	20.242939	4.55	25.56	26	13	2.58	255.7	2.58
SW08	MOMSW08 / 113+300	-10.888183	20.207308	5.23	25.22	5	3	5.47	235.7	1.28
SW09	CHISW09 / 97+000	-11.021442	20.202967	6.54	25.43	7	4	6.03	159.4	1.60
SW10	CASSW10 / 73+900	-11.215942	20.206061	6.56	27.32	12	6	5.89	86.6	13.60
SW11	DLSW11 / 70+700	-11.240958	20.192561	6.29	24.65	16	8	6.70	124.1	6.74
SW12	TCHSW12 / 58+600	-11.348425	20.175425	5.76	23.69	9	4	7.30	273.2	3.91
SW13	LUXSW13 / 57+400	-11.358458	20.174878	6.29	26.21	7	4	7.08	226.3	1.99
SW14	DRAINSW14 / 38+200	-11.488744	20.110717	6.24	25.51	54	27	6.16	12.4	7.66

ID	Location	Latitude	Longitude	pH	Temp (°C)	EC (µS/cm)	TDS (mg/l)	DO (mg/l)	ORP (mV)	Turbidity (NTU)
Angola Water Quality Standards Human Consumption				**6.5-8.5**	**Max 22**	**1000**	**25**	**NV**	**NV**	**NV**
World Health Organisation Drinking Water Limits				**6.5 – 8.5**	**NV**	**2500**	**300**	**NV**	**NV**	**NV**
SW15	LUMSW15 / 17+500	-11.616183	19.984467	6.69	26.64	66	36	6.80	58.3	7.22
SW16	CQSW16 / Cassai Quarry	-11.011092	20.234683	5.17	24.38	7	4	8.64	147.5	31.10
SW17	GRISW17 / Griner Quarry	-10.507592	20.206158	5.8	26.83	3	2	7.76	197.2	0.43
BH05	SLBH05 / Cassamba	-10.396578	20.172022	4.96	25.69	7	4	5.78	289.1	0.62
BH06	SLBH06 / Muxie	-10.493797	20.166869	4.91	25.08	37	19	6.62	281.8	0.11
BH09	SLBH09 / Satxitende	-10.935803	20.199450	4.54	26.54	11	6	4.86	274.1	0.33
BH12	CAMBH12 / Camanongue	-11.434331	20.174192	4.61	23.92	16	8	6.88	316.5	0.15

Notes: - No reading taken

EC – Electrical Conductivity

DO – Dissolved Oxygen

ORP – Oxidation Reduction Potential

Table 8-13: Laboratory Results for Water Samples – Dry Season October 2023

Chemical		Sample Location											Screening Values			
		LUELE BH07	BAIRROBH	SW01	SW02	X3	SW04	SW05	SW08	SW09	SW12	SW13	Angola Drinking Water Class A1	Angola Surface Water Objective	WHO [(a)]	US EPA [(b)]
Surface Water (S), Groundwater (GW)	Units	GW	GW	S	S	S	S	S	S	S	S	S				
Total Metals																
Aluminium	µg/l	45	<20	50	45	80	36	36	42	62	51	248	NV	NV	NV	
Arsenic	µg/l	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	100	100	10	0.052
Barium	µg/l	<3	<3	<3	<3	<3	<3	5	19	57	15	42	100	NV	1300	380
Cadmium	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	10		
Chromium	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	50	50		
Cobalt	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NV	NV		
Copper	µg/l	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	20	100		
Iron	µg/l	23	<20	67	139	324	93	60	245	182	165	513	100	NV	NV	14 000
Dissolved Magnesium	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NV	NV		
Manganese	µg/l	6	<2	9	<2	3	<2	<2	<2	<2	<2	3	50	NV	0.1	0.043
Molybdenum	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NV	NV		
Selenium	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10	NV		
Zinc	µg/l	6	<3	<3	<3	<3	<3	4	<3	6	<3	<3	500	500	NV	600
Dissolved Uranium	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NV	NV		
Cations and Anions																
Dissolved Calcium	mg/l	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.7	0.8	0.6	0.6	NV	NV	NV	NV
Dissolved Potassium	mg/l	<0.1	<0.1	<0.1	0.2	0.2	0.5	0.6	1.4	2.3	1	1.5	NV	NV		
Dissolved Sodium	mg/l	<0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.5	0.5	0.4	0.3	NV	NV	NV	NV
Sulphate as SO4	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	150	250	NV	250
Chloride	mg/l	0.5	0.5	0.4	0.5	0.5	0.6	0.5	0.6	0.9	0.7	<0.3	200	250	NV	NV
Nitrate as NO3	mg/l	2	<0.2	0.5	<0.2	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	25	8.8a	50	NV
Nitrate as NO2	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	25	8.8a	NV	NV

Chemical		Sample Location											Screening Values			
		LUELE BH07	BAIRROBH	SW01	SW02	X3	SW04	SW05	SW08	SW09	SW12	SW13	Angola Drinking Water Class A1	Angola Surface Water Objective	WHO (a)	US EPA (b)
Surface Water (S), Groundwater (GW)	Units	GW	GW	S	S	S	S	S	S	S	S	S				
Ortho Phosphate as PO4	mg/l	0.1	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.4	1		
Ammoniacal Nitrogen as NH3	mg/l	<0.030	<0.030	<0.030	<0.030	0.038	<0.030	<0.030	0.066	0.066	<0.030	<0.030	NV	1		
Ammoniacal Nitrogen as NH4	mg/l	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	0.07	0.07	<0.03	<0.03	NV	1	NV	NV
Total Alkalinity as CaCO3	mg/l	6	10	6	6	6	6	10	12	12	10	16	NV	NV		
Organics																
Total Oil and Grease	mg/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NV	NV		

Table 8-14: Laboratory Results for Water Samples – Wet Season March 2024

Chemical		Sample Location																					Screening Values			
		SW01	SW02	SW03	SW04	SW05	SW06	SW07	SW08	SW09	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW17	BH05	BH06	BH09	BH12	Angola Drinking Water Class A1	Angola Surface Water Objective	WHO (a)	US EPA (b)
Surface Water (S), Groundwater (GW)	Units	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	GW	GW	GW	GW				
Total Metals																										
Aluminium	µg/l	506	340	26	60	45	41	60	55	55	197	299	2069	266	53	306	570	35	<20	20	71	22	NV	NV	NV	NV
Arsenic	µg/l	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	100	100	10	0.052
Barium	µg/l	<3	<3	<3	<3	<3	4	<3	4	12	51	20	29	18	10	29	4	3	3	5	<3	8	100	NV	1300	380
Cadmium	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	10	NV	NV
Chromium	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	50	50	NV	NV
Cobalt	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	3	2	<2	<2	<2	<2	<2	<2	<2	<2	NV	NV	NV	NV
Copper	µg/l	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	50	11	7	<7	20	100	NV	NV
Iron	µg/l	675	409	74	1225	51	63	134	96	383	500	442	12144	1060	18957	612	1908	90	<20	<20	<20	<20	100	NV	NV	14 000
Lead	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NV	NV	NV	NV
Manganese	µg/l	13	8	4	8	4	5	6	4	4	6	7	132	115	48	7	30	5	<2	6	<2	<2	50	NV	100	0.043
Molybdenum	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NV	NV	NV	NV
Selenium	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	3	5	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10	NV	NV	NV
Zinc	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	23	5	7	11	5	<3	<3	<3	49	5	<3	<3	500	500	NV	600
Dissolved Uranium	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NV	NV	NV	NV
Cations and Anions																										
Dissolved Calcium	mg/l	0.2	0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.4	0.8	1.1	0.3	0.5	0.6	0.6	0.5	<0.2	0.2	0.3	0.3	<0.2	NV	NV	NV	NV
Dissolved Magnesium	mg/l	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.3	0.7	0.2	0.2	0.2	0.2	0.3	<0.1	<0.1	0.2	<0.1	<0.1	NV	NV	NV	NV
Dissolved Potassium	mg/l	0.1	0.1	0.3	0.1	0.3	0.3	0.1	0.3	0.7	1.9	0.8	0.8	0.7	<0.1	1	0.3	0.3	<0.1	4.2	<0.1	0.1	NV	NV	NV	NV
Dissolved Sodium	mg/l	0.2	0.3	<0.1	0.3	0.2	0.3	<0.1	0.3	0.3	0.7	0.9	0.7	0.4	0.6	0.3	0.4	0.2	0.1	3.2	0.3	0.1	NV	NV	NV	NV
Sulphate as SO_4	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	150	250	NV	250
Chloride	mg/l	0.6	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	<0.3	<0.3	0.4	0.5	<0.3	<0.3	<0.3	0.9	<0.3	<0.3	1.2	<0.3	0.7	200	250	NV	NV
Nitrate as NO_3	mg/l	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.7	<0.2	11.9	1	<0.2	25	8.8[a]	50	NV
Nitrate as NO_2	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	25	8.8[a]	NV	NV
Ortho Phosphate as PO_4	mg/l	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.09	<0.06	<0.06	<0.06	<0.06	<0.06	0.4	1	NV	NV
Ammoniacal Nitrogen as NH_3	mg/l	<0.030	<0.030	0.038	0.094	<0.030	<0.030	<0.030	<0.030	<0.030	0.132	0.038	<0.030	<0.030	<0.030	<0.030	0.123	<0.030	0.113	<0.030	<0.030	0.113	NV	1	NV	NV
Ammoniacal Nitrogen as NH_4	mg/l	<0.03	<0.03	0.04	0.1	<0.03	<0.03	<0.03	<0.03	<0.03	0.14	0.04	<0.03	<0.03	0.03	<0.03	0.13	<0.03	0.12	<0.03	<0.03	0.12	NV	1	NV	NV
Total Alkalinity as $CaCO_3$	mg/l	11	11	11	10	11	11	13	10	20	24	23	16	17	20	16	21	16	10	11	10	13	NV	NV	NV	NV
Organics																										
Total Oil and Grease	mg/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NV	NV	NV	NV

8.4 Groundwater

8.4.1 Area of influence

The groundwater AoI during the project construction phase will encompass aquifers:

- crossed by the right-of-way
- affected by project groundwater abstraction for the infrastructure and other construction activities
- that may be affected by planned discharges, spills and leaks of fuels and chemicals by the Project.

During the operational phase, the AoI will include aquifers crossed by the railway as well as aquifers utilised for longer term water supply to the project, for example at stations that will rely on groundwater sources. Although the project corridor will cross large aquifer systems its direct and indirect impacts are considered to be limited to no more than 1 km from the railway. As groundwater is primarily influenced by geological formations the expected AOI for geology and aquifers are considered to be similar.

8.4.2 Hydrogeology

The typical water infrastructure of Angola includes fields of groundwater boreholes, water supply schemes, dams, river water works, inter-basins and transfer channels. The estimates of renewable groundwater water resources in Angola points to about 58 km^3/year. Although there are operational boreholes all over the country, groundwater reserves are not generally developed significantly due to easy availability of surface water. The most important aquifers are found in sedimentary deposits, whose depth vary between 10 and 30 m, around Huambo; between 5 and 30 m in the coastal areas and up to 200 m in the semi-arid areas of southern Cunene River basin.

The boreholes are designed primarily to meet the household needs. The aquifers recharge, in the pastoralist dominated semi-arid region in Angola is very low. According to results of groundwater models, prepared in 1996, the aquifers are vulnerable to overexploitation (LNEC, 1996). Aquifers recharge decreases, generally from North to South and from East to West of the Cunene River basin. The aquifer recharge is also influenced by the favourable hydrological properties of certain geological formations in the area, which provide more complexity to the general trend.

Most of urban areas receive supply from surface water sources, but the provincial capitals of the provinces of Malanje, Benguela, Lubango and Namibe, as well as the urban areas of Tombwa and Lobito, depend on groundwater, to a greater or lesser extent. According to data from the National Strategic Program for water 2013-2017, the southern and southwest parts of Angola have the majority of available groundwater information. This information indicates that many boreholes have been drilled and registered in these areas. In the remaining provinces, there is inadequate information on groundwater sources (boreholes). An important network on groundwater is located in the provinces of Cunene (40%), Namibe (30%) and Huíla (15%) for a total of 85%, and also in Malanje (5%) Benguela (7%) and Cabinda (3%).

In general, the use of groundwater is concentrated in coastal areas and in southern Angola, where conditions are more arid and surface water available are on a smaller scale. In rural areas with higher incidence, particularly of groundwater obtained depend

on the yield of bore holes, hand-dug wells and springs. It is common for farmers and livestock keepers, to build their own boreholes.

Sparse geohydrological data was available, as no project-specific drilling had occurred during initial design phases. OEC provided only a high-level geological summary ("*Aspectos Geológicos Geotécnicos*," prepared by Intertechne), with detailed investigations pending. Proposed groundwater abstraction points were undefined, and construction camp locations, anticipated as primary abstraction sites, were known only at a corridor scale, insufficient for site-specific risk profiling (e.g., proximity to aquifers or vulnerability to contamination).

The ESIA recommends post-drilling updates to the impact assessment once exact camp locations and borehole data are confirmed. A detailed Conceptual Site Model (CSM) could not be developed due to the absence of government borehole registries (e.g., no access to Angolan or regional databases) and project-specific aquifer data. Instead, a high-level assessment was undertaken using published literature and public geological maps.

The expected aquifers encountered in the project area has been summarised in Table 8-15 . The aquifer regions have been graphically represented in Figure 8-33.

Table 8-15: Geohydrological Aquifer Description (British Geological Society)

Type of Aquifer	Geological Formations and Aquifer Lithology	Productivity	Aquifer properties and groundwater quality
Quaternary Unconsolidated Aquifers	Alluvium - Quaternary	Variable: Low to High	Aquifer productivity depends on the aquifer lithology (whether dominated by permeable sands and gravels or low permeability fine-grained deposits), thickness and lateral (areal) extent. At their most productive, alluvial sediments in river valleys form the best aquifers in Angola, with recorded borehole yields of 15 to 50 l/s (DNA, 2005)
Sedimentary Aquifers - Intergranular flow	Kalahari Group - Tertiary–Quaternary	Moderate to High	Thought to form a moderate to high productivity aquifer. The water table in the Kalahari Group is shallower in the north, and becomes deeper towards the south, where the Kalahari Group is typically completely dry (SADC 2002)
Sedimentary Aquifers - Intergranular and Fracture flow	Unnamed small aquifers along the coast - Cretaceous–Tertiary	Moderate	Argillaceous sandstones along the coast have proved to be moderately productive aquifers
	Karoo Supergroup (inland) - Carboniferous–Jurassic	Moderate	Groundwater can be relatively highly mineralised

Type of Aquifer	Geological Formations and Aquifer Lithology	Productivity	Aquifer properties and groundwater quality
Basement Aquifers	Crystalline basement - Precambrian	Usually Low, sometimes Moderate	Basement rocks form local aquifers, generally with low productivity but sometimes up to moderate productivity. Groundwater is only found where the rocks are fractured and/or weathered. Different lithologies within the basement have different hydrogeological properties. In general, the most common yields of boreholes in granites and gneisses are less than 1 l/s, especially where boreholes are less than approximately 50 m deep (DNA, 2005) The basic rocks in Angola such as gabbros and norites are probably the best aquifers, and in the hydrogeological map of Angola their productivities are often indicated as being 3-5 l / s with a drill success rate of 70-80% (DNA, 2005) Basic intrusive rocks are found both in the north and south of the country One study showed that borehole yield was directly related to the direction of tectonic structures (fracture orientation) For example, where fractures are in a NE-SW direction, yields are less than 3 m^3/hour; and where fractures are in a N-S direction, yields are more than 8.5 m^3/hour (United Nations, 1989) The best groundwater potential may be in zones of quartz veins and basic rocks; contact zones between crystalline rocks of different texture and composition; zones of fractured granitogneiss; and contact zones between metavolcanic and quartz-schist rocks

(Source: https://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Angola)

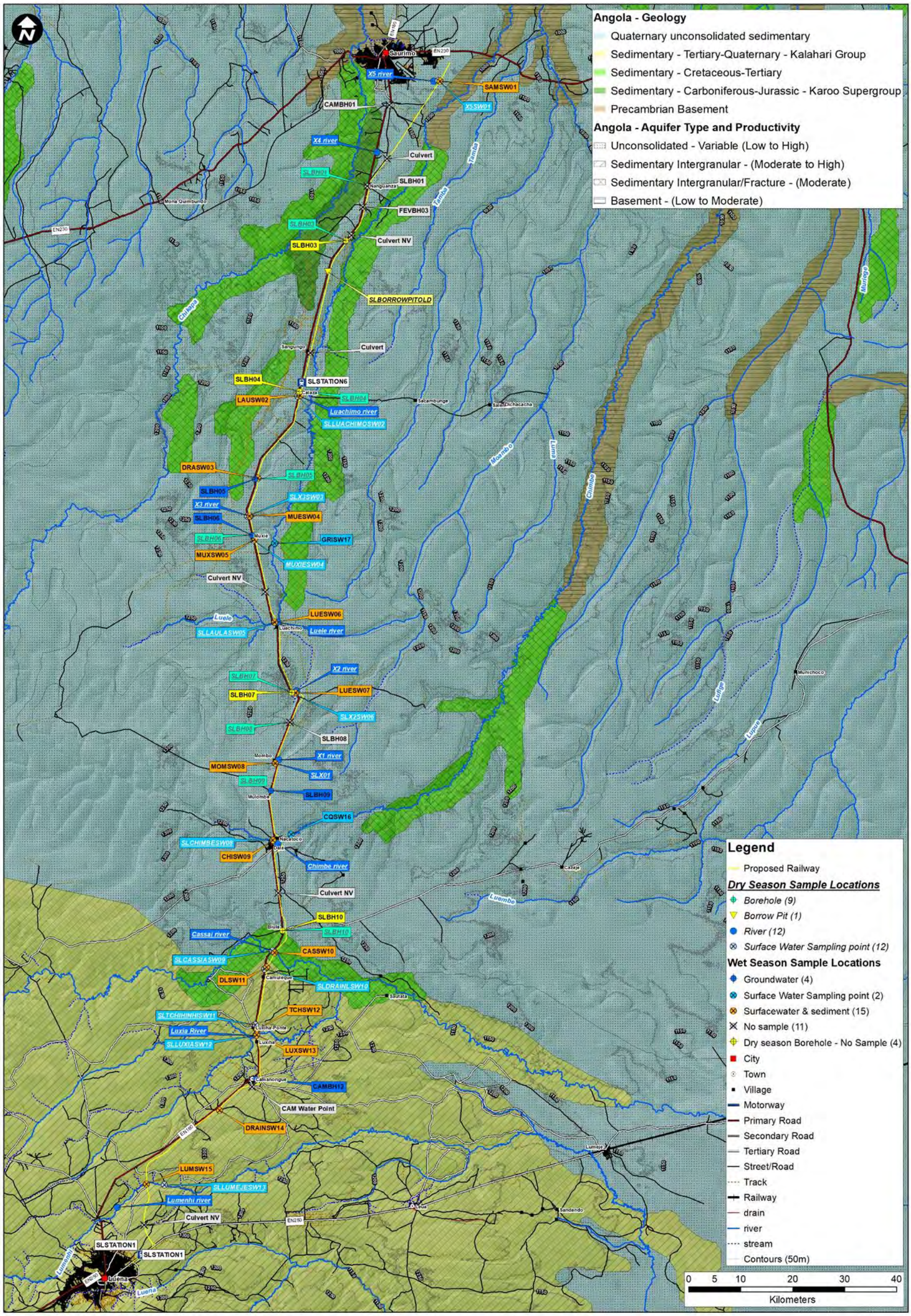


Figure 8-33: Geological and aquifer classification map for the project area

8.4.3 Boreholes and groundwater abstraction

At the time of writing this report, the preliminary design indicated that boreholes will be drilled at the two main camps to meet the project demands. It is also proposed that production boreholes will be required for some stations where connection to municipal water networks is not possible. To ensure the long-term sustainable use of the aquifers, the Contractor will implement hydraulic pump testing of all proposed wells.

Local communities and rural land occupiers are also dependent on groundwater as well a source of water and care should be taken that Project related groundwater abstraction does not negatively influence the ability of local residents to abstract groundwater or negatively impact sensitive ecological receptors.

Sampling methodology

The location of identified boreholes were registered and where possible groundwater samples were collected. Table 6 below shows the details of the sampled boreholes.

Table 8-16: Geohydrological sampling locations

Aquifer Type	Latitude	Longitude	Description	Sampling Point
Unconsolidated	-10.766051	20.235443	Luele borehole	BH07
Unconsolidated	-10.396578	20.172022	Cassamba borehole	SLBH05
Unconsolidated	-10.493797	20.166869	Muxie borehole	SLBH06
Unconsolidated	-10.935803	20.199450	Satxitende borehole	SLBH09
Sedimentary/Intergranular	-11.434331	20.174192	Camanongue borehole	CAMBH12

Considering that the majority of the project corridor is underlain by these two main aquifer types it was considered adequate for the baseline study considering the limited number of available sampling points.

Groundwater samples were collected directly from water faucets connected to reservoir tanks fed by boreholes to represent Point of Use (POU) samples. As the pump infrastructure is protected it was not possible to collect water samples directly from the boreholes. It should also be noted that a total of twelve (12) boreholes were identified but that water samples could only be collected from five locations as borehole infrastructure was not operational and therefore no water samples could be collected at these locations.

During the wet season study an additional five boreholes were located along the N180, assumed to have been installed by the local municipality. Most boreholes were not equipped with pumps in functioning order which resulted in local residents having to collect water from nearby streams and rivers often located some distance from the villages. The exact reason was not known but from limited local consultations the borehole pumps were not functioning. For most boreholes, the solar pumps were housed in concrete blocks and direct access to the pumps was not possible. However, at three of the five identified locations, access was possible and depth to groundwater readings could be collected, and the data is presented in Table 8-17 below.

Table 8-17: Depth to groundwater at sampled boreholes

Borehole number	Village	Depth to groundwater (m bgl)
FEVBH03	Fevereiro	27.3
SLBH01	Nanguanza	18
CAMBH01	Camundambala	31.8

The depth to groundwater in abstraction boreholes indicates that regional groundwater levels within the underlying lithologies occur at depths of greater than 18 m bgl. However, near surface water features shallow groundwater levels were encountered in wetland seeps and embankments. The occurrence of shallow groundwater near surface water features could be as a result of valley incision that resulted in surface water feature elevations to be near the depth of the groundwater levels and thereby connecting these features. Not enough data is currently available to accurately assess whether perched groundwater levels exist near surface water levels or if surface water and groundwater levels intersect in incised valleys and depressions were surface water features are located.

8.4.4 Groundwater quality

As the project is located in Angola it was deemed necessary to include local Angolan standards as well as the internationally accepted World Health Organisation (WHO) standards. For this reason, both standards were considered when comparing results against.

During the dry season study, groundwater borehole parameters could be obtained from one borehole (BH07) located in the village of Luele and is summarised in Table 8-11. The water pH was acidic at 4.82 but all other parameters were within the Angolan drinking water standards (A1). During the wet season, four (4) groundwater samples (i.e. BH05, BH06, BH09 and BH12) could be obtained and is summarised in Table 8-12. The pH was acidic; however all other parameters were within the Angolan drinking water standards (A1).

Water samples for BH05, BH06, BH07, BH09 and BH12 were submitted for laboratory analyses. Laboratory analyses indicated that the borehole water samples were of good water quality and meets the Angolan drinking water standards (refer to Table 8-14:).None of the water samples from boreholes demonstrated exceedances to the WHO standards.

Low concentrations of metals were detected in samples, BH05, BH06, BH07, BH09 and BH12 but none exceeded the applicable WHO standards where available. As for the groundwater samples, low mineral content was measured with below detection to trace concentrations of calcium, potassium and sodium detected. Samples BH07, BH06 and BH09, contained low concentrations of nitrate that did not exceed the Angola Drinking water criterion. Sample HB07 contained low concentration of phosphate that did not exceed the Angola Drinking water criterion.

No detectable concentrations of oil & grease were detected in the analysed samples.

The infield water quality parameters, visual observations and laboratory results indicate that the sampled borehole water quality is generally of excellent quality.

8.5 Microbial testing

In terms of microbial, to assess the likely microbial impact to surface water and groundwater several in-field microbial tests were undertaken. In total 17 surface water features and four borehole samples were collected and analysed. In-field testing was conducted as the analyses of microbial elements by a laboratory require that samples are received at the laboratory within 24 hours of sampling. Due to the remote location of the project site in-field testing for the presence of faecal coliforms and E.coli was undertaken.

The results in Table 8-18 indicate that microbial impacts are widespread across the hydrological features as faecal coliforms were detected in all surface waters using the Aqua Screen test and E.coli detected in 4 of the sampled surface waters. This is not surprising as all the sampled surface waters are utilised by local residents for all domestic purposes (drinking, bathing, washing, irrigation etc).

In contrast to the surface water samples the groundwater samples were generally not impacted by microbial impacts as only one sample (BH05) had a coliform colony count of 4 which exceeds the recommended guideline value of no more than 2 colonies. No faecal coliforms were detected utilising the Aqua Screen tests in any of the borehole samples. Groundwater therefore appears to be less impacted than surface water features as the underlying lithologies inhibit migration of microbial impacts from surface water to groundwater.

In summary, the infield water quality parameters, visual observations and laboratory results indicate that the surface water and groundwater quality is generally of excellent quality, barring microbial impacts to surface water, along the project corridor. As indicated iron levels all fall below the maximum allowable referred to in the US EPA values and therefore safe to drink.

Table 8-18 Microbial Testing Results – Wet Season March 2024

ID	Location	Latitude	Longitude	*Coliform count*	*E.coli*	*Coliforms present**
			Number of Colonies			
SW01	SAMSW01/ 256+300	-9.708586	20.492106	>20	0	Yes
SW02	LAUSW02 / 189+500	-10.252175	20.250581	0	0	Yes
SW03	DRASW03 / 171+400	-10.394864	20.176950	17	6	Yes
SW05	MUXSW05 / 159+400	-10.500947	20.171314	21	0	Yes
SW06	LUESW06 / 143+000	-10.644225	20.206158	4	0	Yes
SW07	LUESW07 / 128+150	-10.766475	20.242939	33	0	Yes
SW08	MOMSW08 / 113+300	-10.888183	20.207308	10	0	Yes
SW09	CHISW09 / 97+000	-11.021442	20.202967	4	0	Yes

ID	Location	Latitude	Longitude	*Coliform count*	*E.coli*	*Coliforms present**
Number of Colonies						
SW10	CASSW10 / 73+900	-11.215942	20.206061	0	0	Yes
SW11	DLSW11 / 70+700	-11.240958	20.192561	54	1	Yes
SW12	TCHSW12 / 58+600	-11.348425	20.175425	>100	0	Yes
SW13	LUXSW13 / 57+400	-11.358458	20.174878	>100	2	Yes
SW14	DRAINSW14 / 38+200	-11.488744	20.110717	18	0	Yes
SW15	LUMSW15 / 17+500	-11.616183	19.984467	19	0	Yes
SW16	CQSW16 / Cassai Quarry	-11.011092	20.234683	16	4	Yes
SW17	GRISW17 / Griner Quarry	-10.507592	20.206158	8	0	Yes
BH05	SLBH05 / Cassamba	-10.396578	20.172022	4	0	No
BH06	SLBH06 / Muxie	-10.493797	20.166869	0	0	No
BH09	SLBH09 / Satxitende	-10.935803	20.199450	0	0	No
BH12	CAMBH12 / Camanongue	-11.434331	20.174192	0	0	No

Notes: * - Tests undertaken utilising Aqua Screen Vials

8.6 Sediment quality

To assess the sediment quality at the sampled surface water locations nine (9) sediment samples were collected during the dry season and 15 samples were collected during the wet season with the aid of a hand auger and submitted for a wide range of analyses with the results summarised in Table 8-19 and

Table 8-20 for both dry season and wet season.

As was the case for the sampled surface water samples the highest concentration of metals was iron and aluminium in all the sediment samples indicating that the underlying sediment is a potential source of these metals. Iron concentrations ranged between 722 mg/kg to a high of 28 170 mg/kg during the dry season and 241 mg/kg to a high of 16 940 mg/kg during the wet season. Aluminium concentrations ranged between 1,472 mg/kg and a high of 10,740 mg/kg during the dry season and between 1 283 mg/kg and a high of 20 200 mg/kg during the wet season. Similar results were obtained for both the dry and wet season results.

Low metal concentrations of arsenic, barium, chromium, cobalt, copper, lead, manganese, and molybdenum were detected in the samples. Lead was detected in five of the nine samples but at concentrations below the TEC screening value indicating no risk.

Low concentrations of barium were also detected in all the samples, but no TEC screening values were available for this metal. Chromium was also detected in all the samples with only the concentration in one sample (SW12 – Luxia River) exceeding the TEC screening value. Chromium is a common element in the Earth's crust with an average concentration of 100 mg/kg[101] . In soils and sediments, geogenic chromium occurs at various concentrations from 10 to 200 mg/kg, while in serpentine soils it can reach up to 6 wt.%. The main geogenic source of chromium in the environment are ophiolitic rocks and, specifically, their alteration derivatives such as serpentinite, consisting of serpentine, Cr-chlorite, talc, etc., and their weathering products.

Calcium was only detected in sediment sample SW12 during the dry season and LUX-13 during the wet season. Magnesium concentrations were mostly below the detection limit, however higher concentrations were observed at sample points CAS-10, DRI-11 and LUX-13, with reference to the other sample sites.

No detectable concentrations of cadmium, selenium and uranium were detected in any of the samples.

From an inorganic perspective no detectable concentrations of nitrate were detected in any of the samples whereas low concentrations of ammonia were detected in four of the nine samples during the dry season and two samples during the wet season. Phosphate was only detected in one sediment sample (SW05) during the dry season. Wetlands naturally remove contaminants such as nitrate and phosphate and the general absence of these compounds in surface water and sediment indicates that the wetlands surrounding the surface water features are acting as a buffer to potential contamination.

A detection of oil & grease was only identified in one sediment sample (SW02 – Luachimo river) at a concentration of 118 mg/kg during the dry season and one sediment sample (CHI-09) at a concentration of 148 mg/kg during the wet season. At these sampling locations it is therefore evident that human activities have led to some sediment impact by oil and greases. These rivers and streams are the main source of water for local inhabitants and washing of cooking utensils, clothing, cars and bicycles can lead to

[101] Nerantzis Kazakis, Nikolaos Kantiranis, Kyriaki Kalaitzidou, Efthimia Kaprara, Manassis Mitrakas, Robert Frei, George Vargemezis, Dimitrios Vogiatzis, Anastasios Zouboulis, Anestis Filippidis, Environmentally available exavalent chromium in soils and sediments impacted by dispersed fly ash in Sarigkiol basin (Northern Greece), Environmental Pollution, Volume 235, 2018, Pages 632-641

organic contamination over time. However, results show that the sediments have not been highly impacted by organic contamination arising from the intense human activities undertaken in the surface water features.

Table 8-19 Laboratory Results for Sediment Samples – Dry Season October 2023

Chemical	Units	Sample Location									Screening Value US EPA TEC*
		SW01	SW02	SW03	SW04	SW05	SW08	SW09	SW12	SW13	
Sediment (SD)		SD	SD	SD	SD	SD	SD	SD	SD	SD	
Aluminium	mg/kg	4286	10740	4043	2150	7440	1924	1472	9784	2768	NV
Arsenic	mg/kg	0.8	1.6	0.9	0.9	1.4	<0.5	<0.5	3.3	0.9	9.79
Barium	mg/kg	1	34	11	2	20	12	6	55	32	NV
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.99
Calcium	mg/kg	<500	<500	<500	<500	<500	<500	<500	794	<500	NV
Chromium	mg/kg	8.5	18.9	36.2	21.6	31.7	32.9	13.6	59	7.6	43.4
Cobalt	mg/kg	0.5	1.6	2.3	<0.5	0.7	5	0.7	3.1	4.7	NV
Copper	mg/kg	5	7	21	7	11	14	2	12	3	31.6
Iron	mg/kg	722	8413	28170	7997	1162	13720	1443	19520	12030	NV
Lead	mg/kg	7	11	<5	<5	17	<5	<5	17	7	35.8
Magnesium	mg/kg	<25	177	164	34	48	93	60	134	<25	NV
Manganese	mg/kg	7	17	59	10	10	84	17	18	318	NV
Molybdenum	mg/kg	<0.1	0.2	0.2	0.2	0.5	0.1	0.2	0.8	<0.1	NV
Potassium	mg/kg	13	382	63	26	68	59	65	184	23	NV
Selenium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	NV
Sodium	mg/kg	37	67	186	30	51	61	44	67	78	NV

Chemical	Units	Sample Location									Screening Value US EPA TEC*
		SW01	SW02	SW03	SW04	SW05	SW08	SW09	SW12	SW13	
Sediment (SD)		SD	SD	SD	SD	SD	SD	SD	SD	SD	
Uranium	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	NV
Zinc	mg/kg	<5	10	8	<5	<5	15	<5	6	7	121
Sulphate as SO4 (2:1 Extract)	g/l	0.0018	<0.0015	<0.0015	0.0023	0.0092	<0.0015	<0.0015	<0.0015	<0.0015	NV
Chloride	mg/kg	2	4	<2	4	10	5	5	3	4	NV
Nitrate as NO3	mg/kg	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	NV
Nitrate as NO2	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV
Ortho Phosphate as PO4	mg/kg	<0.3	<0.3	<0.3	<0.3	3.6	<0.3	<0.3	<0.3	<0.3	NV
Ammoniacal Nitrogen as NH3	mg/kg	<0.6	4	<0.6	1.2	<0.6	<0.6	1	<0.6	1.1	NV
Ammoniacal Nitrogen as NH4	mg/kg	<0.6	4.2	<0.6	1.4	<0.6	<0.6	1	<0.6	1.1	NV

Organics	mg/kg										
Fats, Oil and Grease	mg/kg	<30	118	<30	<30	<30	<30	<30	<30	<30	NV

Notes: * Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems – Volume III, Threshold Effect Concentrations, Consensus based TEC

Table 8-20 Laboratory Results for Sediment Samples – Wet Season March 2024

Chemical	Units	Sample Location															Screening Value US EPA
		SAM-01	LAU-02	DRA-03	MUELE-04	MUXIE-05	LUELE-06	LUE-07	MOM-08	CHI-09	CAS-10	DRI-11	TCH-12	LUX-13	DRAIN-14	LUM-15	TEC*
Sediment (SD)		SD	SD	SD							SD	SD	SD	SD	SD	SD	
Aluminium	mg/kg	3142	3233	5590	14000	3367	1602	9612	1605	1283	8918	8430	10090	5242	20200	5448	NV
Arsenic	mg/kg	0.7	0.8	0.6	0.7	0.6	0.9	0.8	0.6	0.8	1.7	1.3	0.9	0.6	6.5	<0.5	9.79
Barium	mg/kg	2	2	4	7	4	4	4	2	16	98	49	17	20	19	3	NV
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.99
Calcium	mg/kg	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	1513	<500	<500	NV
Chromium	mg/kg	10.9	13.8	7.6	17.1	10.2	17.9	16	10.3	18.5	15.1	15.8	14.7	12.7	18.6	6	43.4
Cobalt	mg/kg	0.9	0.7	<0.5	<0.5	<0.5	0.7	<0.5	0.7	3.8	4.8	8	1.3	3.8	<0.5	<0.5	NV
Copper	mg/kg	3	1	2	7	<1	2	3	5	13	9	10	12	5	20	3	31.6
Iron	mg/kg	3958	7922	241	2397	4417	5820	659	11350	11940	12140	16940	11160	2260	4141	494	NV
Lead	mg/kg	<5	<5	<5	<5	<5	<5	5	<5	<5	12	8	<5	7	18	<5	35.8

Chemical	Units	Sample Location															Screening Value US EPA
		SAM-01	LAU-02	DRA-03	MUELE-04	MUXIE-05	LUELE-06	LUE-07	MOM-08	CHI-09	CAS-10	DRI-11	TCH-12	LUX-13	DRAIN-14	LUM-15	TEC*
Sediment (SD)		SD	SD	SD							SD	SD	SD	SD	SD	SD	
Magnesium	mg/kg	<25	<25	<25	56	<25	<25	<25	<25	93	230	185	55	131	53	<25	NV
Manganese	mg/kg	15	23	2	4	7	20	2	26	70	93	272	26	46	4	5	NV
Molybdenum	mg/kg	0.3	0.4	<0.1	0.2	0.4	0.4	0.2	<0.1	<0.1	0.2	0.2	0.4	0.1	0.2	<0.1	NV
Potassium	mg/kg	18	13	22	50	20	16	35	5	40	217	123	56	171	76	17	NV
Selenium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	NV
Sodium	mg/kg	18	24	16	29	25	29	22	24	31	43	31	46	29	32	17	NV
Uranium	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NV
Zinc	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	12	19	21	6	6	<5	<5	121
Sulphate as SO_4 (2:1 Extract)	g/l	0.0019	0.0022	0.0172	NDP	0.005	<0.0015	0.0031	0.0035	0.0018	0.0026	0.0043	<0.0015	0.0031	<0.0015	<0.0015	NV
Chloride	mg/kg	3	9	3	15	5	7	8	3	5	21	28	7	15	10	10	NV
Nitrate as NO_3	mg/kg	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	NV
Nitrate as NO_2	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV

Chemical	Units	Sample Location															Screening Value US EPA
		SAM-01	LAU-02	DRA-03	MUELE-04	MUXIE-05	LUELE-06	LUE-07	MOM-08	CHI-09	CAS-10	DRI-11	TCH-12	LUX-13	DRAIN-14	LUM-15	TEC*
Sediment (SD)		SD	SD	SD							SD	SD	SD	SD	SD	SD	
Ortho Phosphate as PO_4	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	NV
Ammoniacal Nitrogen as NH_3	mg/kg	1.7	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	13.9	<0.6	NV
Ammoniacal Nitrogen as NH_4	mg/kg	1.9	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	14.6	<0.6	NV
Organics																	
Fats, Oil and Grease	mg/kg	<30	<30	<30	<30	<30	<30	<30	<30	148	<30	<30	<30	<30	<30	<30	NV

8.7 Hydrochemical water facies

A study conducted by Gibbs (Gibbs, 1970) formulated his Gibb's diagrams that represent the Sodium/Calcium ratio (Na^+:(Na^++Ca^{2+})) and Chloride/Bicarbonate ratio (Cl^-:(Cl^-+ HCO_3^-)) as a function of TDS and is widely employed to understand the functional sources of dissolved chemical constituents, such as precipitation-dominance, rock-dominance and evaporation dominance for surface water and groundwater (Gibbs, 1970). The Gibb's plot is presented in Figure 8-34.

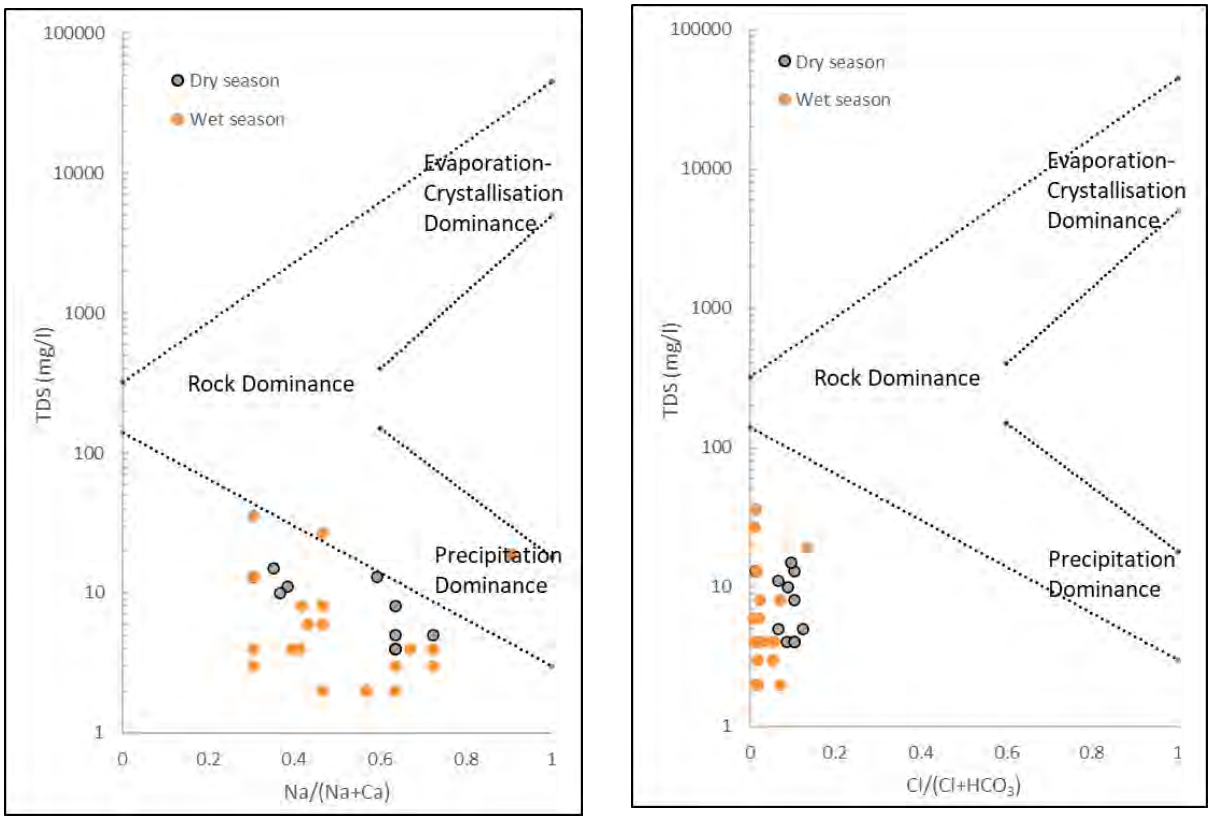


Figure 8-34: Gibb's diagram for the samples obtained during the dry and wet season studies.

Assessing the potential dominant water quality sources, shown in Figure 8-34 indicates the water quality is driven by precipitation driving factors, rather than rock mineralisation, evaporation or crystallisation. The driving factors for these samples are charactered by the very low TDS concentrations, ranging from 2 mg/l to 36 mg/l. From the Gibb's assessment rainfall and potentially low mineralised rock (soil) characterise the water chemistry.

Hydrochemical facies are classified based on the dominant ions. A visualisation of the relative mineral composition of the samples in the Piper diagram (Refer to Figure 8-35) shows the comparison of the water chemical signatures for the water samples obtained during the dry and wet seasons.

As water flows through an aquifer, it adopts a diagnostic chemical composite because of interaction with the lithologic framework. The term hydrochemical facies refers to bodies

of water (typically groundwater), within an aquifer or rock dominant surface water system, that differ in their chemical composition. The facies are a function of the lithology, solution kinetics and flow patterns of the aquifer (Back, 1960 and 1966 as cited in Fetter, 2001) and can assist in determining the water signatures as well as groundwater and surface water interaction (similar signatures).

The water samples are characterised by Sodium-Calcium-bicarbonate (Na-Ca-HCO3) dominant ions indicating freshly recharged (from rainfall) water with low mineralisation. The bicarbonate anion originating either from decomposing organic material or/and from rainwater. As the main bicarbonate sources are from rainwater, decomposing organic material and atmospheric CO_2 it rather reflects fresh or recently precipitated waters. Both surface water and groundwater show the same hydrochemical water facies, indicating the possibility of groundwater-surface water interaction, however, the low mineralised rock/soils charactering the area can also be attributed to the similar water signature.

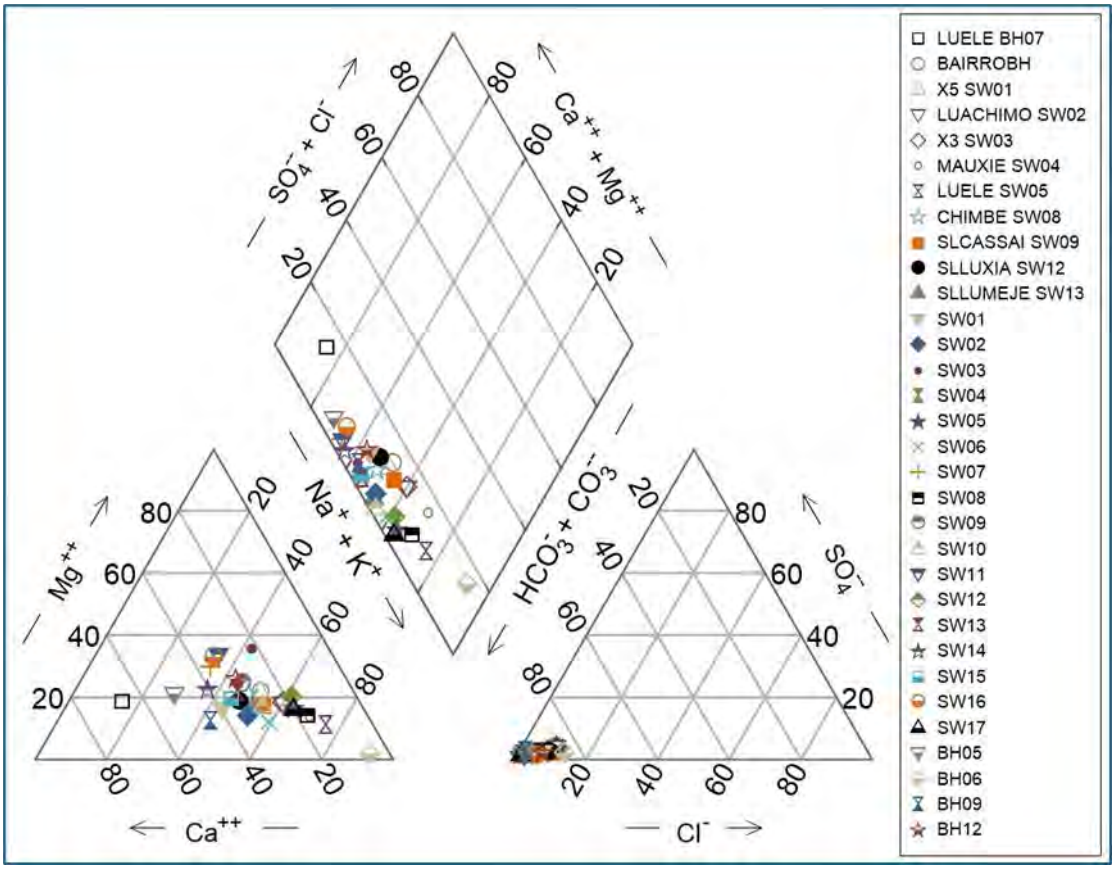


Figure 8-35: Piper diagram for the samples obtained during the dry and wet seasons

8.8 Stable isotope analyses

A total of 11 stable isotope samples were retrieved during the wet season assessment, consisting of both groundwater and surface water. A summary of the isotope results is shown in Table 8-21. Isotope sampling provide a means of indicating of groundwater and surface water interaction is taking place, groundwater is driven by rainfall or if these water bodies act independently from each other.

Table 8-21 Summary of the stable isotope results

Sample Identification	Type	Date	d D (deuterium)	d18O (oxygen)
			(‰)	(‰)
MUXSW06 (SW06)	Surface water	05/03/2024	-27.0	-5.17
SAMSW01 (SW01)	Surface water	04/03/2024	-24.2	-4.66
LAUSW02 (SW02)	Surface water	04/03/2024	-25.4	-4.79
LUESW06 (SW06)	Surface water	05/03/2024	-28.3	-5.09
LUMSW15 (SW15)	Surface water	08/03/2024	-29.6	-5.18
LUXSW13 (SW13)	Surface water	07/03/2024	-29.9	-5.16
MUESW04 (SW04)	Surface water	05/03/2024	-26.7	-4.99
CAMBH12 (BH12)	Groundwater	07/03/2024	-35.1	-5.95
CASBH05 (BH05)	Groundwater	07/03/2024	-23.3	-4.57
MUXBH06 (BH06)	Groundwater	05/03/2024	-26.9	-5.19
SATBH09 (BH09)	Groundwater	202403/06	-27.6	-5.22

The samples were plotted against the global meteoric water line, which represents standard rainfall composition as illustrated in Figure 8-36. The stable isotope results show one cluster/grouping with both surface water and groundwater samples and one outlier sample (borehole sample CAMBH12) with a slightly more depleted signature.

The surface waters and groundwater both show similar isotope signatures. The negative deuterium and oxygen-18 values indicate a light isotope signature, rather than a heavier isotope signature.

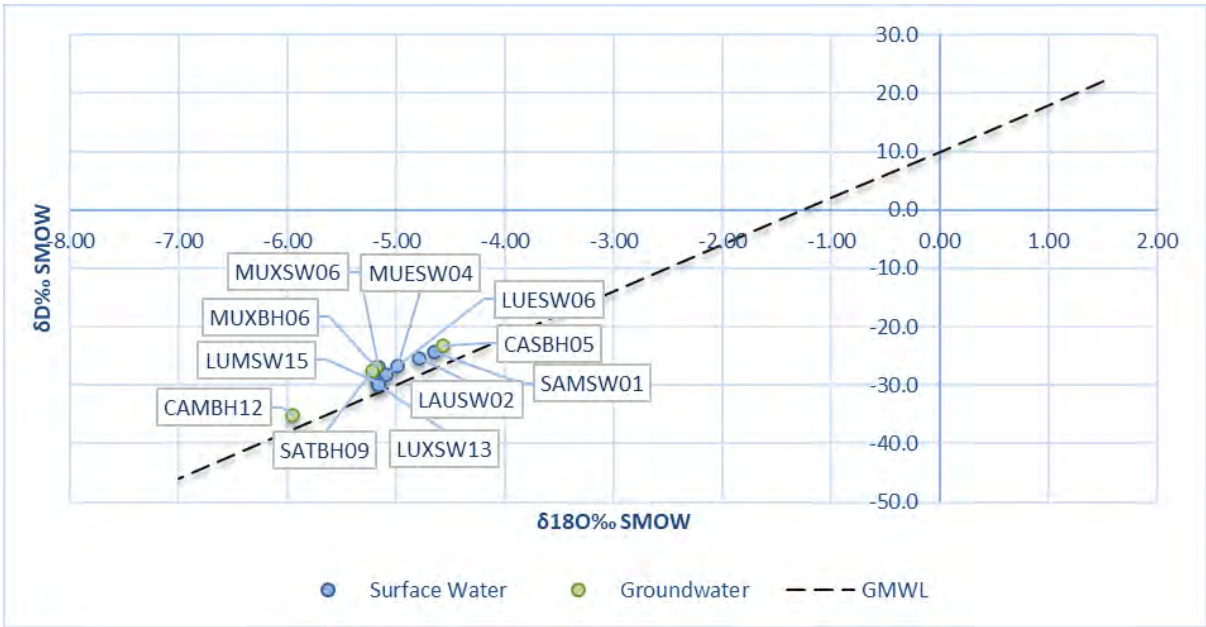


Figure 8-36 Stable isotope data relative to Global Meteoric Water Line (Craig, 1961[13]).

The groundwater and surface water plot (Figure 8-36 above) close to the Global Meteoric Water Line (GMWL). Water composition falling on the meteoric water line is assumed to have originated from the atmosphere and to be unaffected by other isotopic processes. Evaporation from open water and exchange with rock minerals are two of more commonly observed processes causing deviations from meteoric water line (Domenico and Schwartz 1990[14]). The source of groundwater is expected to be from rainfall infiltration or recharge.

Groundwater recharge is depending on seasonal precipitation inputs as well as on soil moisture conditions, and recharge is generally highest during the wet season. However often groundwater isotope values are found which are very close to the weighted average annual precipitation value, as observed in these groundwater samples. This is caused by the attenuation of the seasonal varying precipitation input values and a mixing of different precipitation sources during the passage through the unsaturated zone. The attenuation of the precipitation signal is ruled by the characteristics of the soil water movement and therefore by the geometry of the unsaturated zone with slow (porous soil matrix) and fast (macro pores and fissures) flow lines. Since the groundwater and surface water shows a similar isotope signature, groundwater is driven by precipitation, similar to the surface water. Groundwater recharge is expected to be high with high hydraulic conductivity associated with the aquifer system. Therefore, rainfall infiltrates the aquifer system fast.

Groundwater and surface water interaction can potentially also occur, since the groundwater and surface water samples have the same isotope signatures. Surface water is potentially driving the groundwater signature, rather than the groundwater influencing the surface water. Any impacts relating to the surface water could impact on the groundwater directly.

In terms of surface and ground water interactions, surface water is potentially driving the groundwater signature, rather than the groundwater influencing the surface water. Any impacts relating to the surface water could impact on the groundwater directly. Groundwater recharge is depending on seasonal precipitation inputs as well as on soil moisture conditions, and recharge is generally highest during the wet season.

8.9 Waste

According to PESGRU estimative, in Angola, the waste generation per capita is around 4 kg (inhab/day) on average. Table 8-22 shows that Angolan access to adequate waste and sanitation facilities. Majority of households in rural areas have very limited access to sanitation facilities and garbage disposal.

Table 8-22: Angola 2014 Census results of access to adequate waste and sanitation facilities

Resource	National % of population	Urban % of population	Rural % of population
Proportion of households with access to adequate sanitary facilities	60.0	81.0	25.9
Proportion of households that deposits garbage in an appropriate place	26.3	37.5	8.8

Moxico Province

In the Province of Moxico, the decentralization of financial management to Municipal Administrations has not resolved the inefficiencies in waste management. Contributing factors include the limited number of registered waste operators, insufficient collection equipment, and a lack of sustainable waste treatment/disposal alternatives. Based on information obtained from the municipal administration, waste treatment/disposal practices in the municipality currently involve the incineration of waste. This method has been adopted as a temporary measure due to the absence of a designated municipal landfill facility for waste disposal.

Projections from the Strategic Plan for Urban Waste Management (PESGRU) indicate a substantial increase in waste generation by 2025, with an anticipated per capita growth of approximately 76%. Consequently, per capita waste generation is expected to reach 0.44 kg/person in Moxico, leading to a significant rise in the total volume of waste produced (Source: MOSAIKO).

Locally, it is common to verify the collection of plastic waste such as PET bottles, which leads to economic opportunities for numerous families whether for resale or reuse (using bottles to resell juices or honey produced by local communities). In certain areas of the province, organic waste is utilised as a fertilizer, enhancing the fertility and overall production capacity of agricultural land. This practice is particularly beneficial for family farming, which represents a foundational component of the region's economy.

Lunda Sul Province

In Lunda Sul province, waste management is primarily conducted at the municipal level by the Municipal Basic Sanitation Department. Similar to the situation in Moxico, there is a limited number of authorized waste operators equipped with the necessary resources to effectively manage waste. Currently, waste is typically transported to an open-air dump site where it is incinerated. In Saurimo, there are environmental protection associations, including cooperatives and waste collectors, actively engaged in the collection of recyclable materials, particularly PET plastics. These collected recyclables are transported to Luanda for sale to recycling facilities.

In Saurimo and Luena the municipal solid waste management system were reported to be in place and functioning accordingly. However, based on site visit, there were evidence of solid waste dumped alongside a road outside Saurimo town (Figure 8-37). Both towns used dumpsites for the disposal of municipal waste and there was no sanitary landfill recorded in the project area during the time of the ESIA.

Figure 8-37 Waste dumping in project area near Saurimo town

In the main towns of Luena and Saurimo indoor plumbing and sewerage management seem to be fully functioning. It seems to be a combination between septic tanks and a sewerage system from remnants of previous attempts of proper infrastructure development derailed by the war.

In the areas outside of Luena and Saurimo indoor plumbing seem to be a luxury very few has access to. The basic facilities like toilets and running water is limited to some pit latrines and communal water points for collecting water. These practices further have the implications of polluting the water sources used by the people in these areas.

Providing sufficient ablution facilities during for workers during construction would be crucial for this Project.

8.10 Noise and vibration

8.10.1 Area of Influence Boundary

The AoI for construction noise was set at a 300 m radius around fixed points (stations, power plant etc.) and 300 m linear either side of the rail. This is based on review of aerial mapping, and the closest receptors identified during the baseline survey exercise, noting where the receptors are taking into consideration noise emission levels that would be likely to reach the areas. The AoI for construction vibration has been set to 50 m either side of construction areas.

8.10.2 Methodology

8.10.2.1 Baseline noise survey

A baseline noise survey was conducted in April 2024 to assess the existing noise level along the alignment, as a reference for assessing future operational noise impacts of the project, and not for determining whether the current ambient noise levels exceed guideline limits. The baseline noise survey was undertaken in accordance with IFC PS1 (Paragraph 7), aligned to national regulatory requirements; however, as Angola currently has no national noise standards or prescribed limits, no comparison between the baseline measurements and guideline limits was conducted. As such, the baseline noise survey data serves solely as a refence point for evaluating potential noise impacts during the project operational phase.

The baseline survey has been carried out on an attended basis. While this may result in a reduced sample set when compared to longer-term, unattended monitoring, this was a limitation of the site conditions where safe and secure locations for equipment installation were not readily available. To minimise uncertainty within the measurement data, the survey measurements have been carried out using Class 1 sound level meters, with measurements undertaken during prevailing weather conditions. Notwithstanding this, the baseline monitoring has been utilised to provide context, with the assessment of impacts determined by an absolute threshold. It is recommended additional monitoring is undertaken at detailed design to confirm design targets for fixed plant noise, where necessary. The additional monitoring will need to be undertaken particularly in locations where retained sensitive receptors are identified close to the alignment, camps, or other noise-generating activities. This additional monitoring will be targeted, receptor-based, and proportionate to risk, and the results will be used to refine mitigation measures and construction phase monitoring requirements within the C-ESMP.

Attended noise monitoring was undertaken for 1 hour per location during daytime hours (representative of construction hours and proposed rail operations), where the field consultants noted down the noise sources contributing to the noise environment. The noise monitoring equipment at all positions was located at least 3.5m from any significant reflective surfaces, other than the ground. All measurements were taken with the microphone situated approximately 1.5 m above the local ground level.

At the time of writing the report, the information did not indicate night time operations of trains. Additionally, construction works are assumed to be restricted to daytime periods, therefore, no night time measured were considered to be relevant to the assessment. If the proposed hours of operation for either construction or train movements, then further baseline would be undertaken at detailed design by the operator/contractor to confirm night time levels. Where the location of fixed plant or alignment change, additional monitoring may be required. The measurements undertaken in this report are representative of the layout and project at the stage of writing.

The weather conditions were conducive for noise monitoring throughout the duration of the noise measurements i.e., low wind speeds (below 5 m/s-1) and no precipitation.

8.10.2.1.1 Monitoring locations

The assessment initially included 20 monitoring locations/points (MP) that were closest to sensitive receptors along the alignment route. However, data from three monitoring locations (MP7, MP18 and MP20) were considered unreliable because the noise levels at these monitoring points were affected by unusual noise sources that do not reflect the typical noise conditions (i.e. short-term localised machinery which would not be there on a permanent basis). Therefore, the final assessment and report has excluded MP7, MP18 and MP20 and will only include data from the remaining 17 monitoring locations, as these locations provide a more accurate representation of the typical acoustic environment along the alignment. A summary of the monitoring locations is provided in Table 8-23.

Table 8-23: Noise monitoring locations along proposed Luena – Saurimo Railway alignment

Reference*	Coordinates (EPSG: 3857)	
	X	Y
MP1	2281109	-1081040
MP2	2282020	-1083587
MP3	2271282	-1090705
MP4	2266593	-1110240
MP5	2259963	-1125321
MP6	2254235	-1146822
MP8	2249530	-1192756
MP9	2252774	-1205713
MP10	2252271	-1211411
MP11	2248182	-1235490

Reference*	Coordinates (EPSG: 3857)	
	X	Y
MP12	2249532	-1236659
MP13	2250423	-1252719
MP14	2247251	-1261760
MP15	2245757	-1272645
MP16	2245475	-1281099
MP17	2228645	-1294464
MP19	2222360	-1317571

Note: MP7, MP18 and MP20 removed due to unrepresentative noise sources observed during the monitoring period.

Note: Noise monitoring locations were selected based on the proximity between the proposed Project facilities and the closest sensitive receptors (i.e., dwellings, schools, hospitals etc.), land use, proximity to major noise sources and in compliance with relevant noise standards.

Micro-siting was undertaken in field to identify the most suitable on-the ground monitoring locations for the placement of the monitoring equipment. This involved assessing the site to position the noise equipment in an open area, free from obstructions and at the correct height and distance from the ground, obstacles and reflective surfaces.

At locations where it was not possible to monitor directly adjacent to noise sensitive receptors due to accessibility or local constraints like terrain, obstacles or where receptors were found to be unoccupied, measurements were undertaken at alternative monitoring locations. The alternative locations were considered representative of the closest occupied receptors and suitable to represent the noise levels and sources incident upon each receptor location were selected. Additionally, the alternative locations selected were deemed representative of the noise environment of the original monitoring locations. The specific geographical coordinates of the position were noted and locations updated along with the spatial system used.

Each baseline noise monitoring location selected was within an officially recognised administrative area.

A desktop study and a site survey has been undertaken to identify potential monitoring location representative of the closest receptors to the proposed Project

Regarding noise background at the proposed locations for railway stations, a summary of the noise monitoring locations that are representative of the stations are provided in Table 8-24.

Table 8-24: Railway Stations monitoring locations

Location	Surveyor Observations
MP2	Station 8 - Saurimo
MP4	Station 7 - Saquembue
MP6	Station 6 - Caiaza

Location	Surveyor Observations
MP9	Station 5 - Luele
MP12	Station 4 - Dala
MP16	Station 3 - Camanongue
MP17	Station 2 - Ndongue
MP19	Station 1 - Luena

8.10.2.2 Monitoring equipment

The surveys were carried out using Class 1 sound level meters conforming to the requirements of IEC 61672-1:2013. At each monitoring location, the sound level meters were field calibrated at the start and end of each measurement period using a calibrator conforming to the requirements of IEC 60942:2018. No significant drift in the calibration was recorded (i.e. within a +/- 0.5 dB tolerance). The sound level meters at all monitoring locations were placed at least 3.5 m away from any significant reflective surfaces, other than the ground. All measurements were taken with the microphone situated approximately 1.5 m above the local ground level

The noise measurement equipment utilised in the survey is summarised in Table 8-25. Calibration certificates are available upon request.

Table 8-25 Noise Survey Equipment

Equipment	Make/Model	Serial Number	Calibration Date
Sound level meter	Svantek 971	124681	02/02/23
	Svantek 971	131649	02/02/23
Calibrator	Rion NC-75	34667811	21/12/23
	Rion NC-75	34257025	30/01/24

In the absence of Angola national standards, the assessment criteria used is derived from relevant international standards mainly IFC Environmental Noise Guidelines, World Bank EHS Guidelines and British Standards (BS 5228-2:2009+A1:2014). The criteria define acceptable noise levels during daytime and nighttime hours, of which daytime hours are between 06:00 to 22:00, and nighttime hours are between 22:00 to 06:00. The assessment made refence to the BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites'. The noise guidelines set out techniques for predicting and assessing noise levels to mitigate impacts from construction activities and plant operation. Additionally, it includes example thresholds to determine the significance of noise effects. Since construction noise are temporary in nature, higher noise threshold levels are often adopted.

8.10.2.3 Vibrations criteria and guidelines

In the absence of Angola national standards relating to vibration, relevant applicable international standards have been considered. In this case, the BS 5228-2:2009+A1:2014 guidelines were considered in assessing the significance of vibration

effects on humans and infrastructure. Annex B of the BS 5228-2:2009+A1:2014 provides guideline on the vibration criteria presented in terms of Peak Particle Velocity (PPV) vibration levels (see Table 8-26).

Table 8-26: Guidance on effects of vibration levels perceptible to Humans

Vibration level (PPV)	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level

Table 8-27 provides guidelines for transient vibration mainly for short-term vibrations in low-rise buildings and other structures. Where continuous vibrations are expected to cause resonance (amplified vibrations) especially at lower frequencies, leading to dynamic magnification, the acceptable guide values might need to be reduced by 50% to prevent superficial damage to buildings and other structures caused by short-duration and non-continuous vibrations. Although minor damage to buildings can occur at vibration level greater than twice the guide values.

Table 8-27: Transient vibration guide values for cosmetic damage in structures

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	5 0 mm/s at 4 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

The guide values in Table 8-27 predominantly relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values might need to be reduced by up to 50%.

Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 8-27, and major damage to a building structure may occur at values greater than four times the tabulated values.

Annex E of the standard gives empirical formulae for the prediction of the resultant PPV vibration levels for various types of construction work.

8.10.2.4 Acoustics criteria and guidelines

The acoustic criteria relevant to the assessment are set out in Table 8-28 and Table 8-29**.** These have been derived from relevant international standards as there are no specific national standards. Unless otherwise stated, daytime refers to the hours between 06:00 and 22:00, with night-time between 22:00 and 06:00, and that the criteria should apply externally.

Techniques from the BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Noise' were utilised to predict and assess the likely noise impacts from construction works, based on information on the type and number of plant items being used, their location, and the length of time they are in operation. In addition, the IFC environmental noise guidelines limits were used to address impacts of noise beyond the property boundary of the facilities.

Table 8-28: Noise Level Guidelines (BS 5228-1:2009+A1:2014)

Assessment category and threshold value period	Threshold value, $L_{Aeq,T}$ (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends [D]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

[A] Category A used when ambient noise levels (when rounded to the nearest 5dB(A)) are less than these values

[B] Category B used when ambient noise levels (when rounded to the nearest 5dB(A)) are the same as category A values.

[C] Category C used when the ambient noise levels (when rounded to the nearest 5dB(A)) are higher than category A values.

[D] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays 07:00 – 23:00 Sundays.

Notes

[Note 1] A significant effect has been deemed to occur if the LAeq noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level

[Note 2] If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total LAeq,T noise level for the period increases by more than 3dB due to site noise.

[Note 3] Applied to residential receptors only.

Table 8-29: Noise Level Guidelines (IFC)

Receptor	One hour L_{Aeq} (dB) [1]	
	Day (07:00-22:00)	Night (22:00-07:00)
Residential; institutional; educational [2]	55	45
Industrial; commercial	70	70

[1] Guideline values are for noise levels measured out of doors

[2] For acceptable indoor noise levels for residential, institutional and educational settings, refer to *Guidelines for Community Noise, World Health Organisation (WHO), 1999*.

Construction is temporary in nature, and therefore a higher threshold is commonly adopted for the assessment of impacts. Thresholds set out in BS 5228-1:2009+A1:2014 adopted as lower bound threshold for the onset of adverse impacts, to be achieved where practicable.

8.10.3 Baseline noise and vibration environment

The existing vibration environment was not quantified and no discernible sources of vibration were observed during the field survey. In addition, vibration assessments are typically conducted against absolute criteria, rather than comparison to background.

For the purpose of the baseline noise levels, the weather conditions were noted to be conducive for noise monitoring throughout the duration of the noise measurements i.e., low wind speeds (below 5 m/s^{-1}) and no precipitation. The baseline measured results are provided below.

8.10.3.1 Measured noise levels

A summary of the measured noise levels in each of the monitoring locations are provided in Table 8-30 below.

Table 8-30: Noise measurement summary along the railway line

Location	Start Date	Start Time	End Time	$L_{AFmax,T}$ (dB)	$L_{Aeq,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
MP1	26/04/2024	08:55	09:55	70.6	47.2	49.2	39.4
MP2	26/04/2024	11:10	12:10	72.1	43.8	43.9	34.0
MP3	26/04/2024	11:34	12:34	82.3	59.3	58.9	39.1
MP4	26/04/2024	13:11	14:11	77.9	51.6	49.8	36.1
MP5	26/04/2024	13:36	14:36	75.5	50.1	45.0	29.3
MP6	26/04/2024	15:29	16:29	84.1	55.3	52.0	39.1
MP8	27/04/2024	10:18	11:18	74.9	46.7	47.7	36.7
MP9	27/04/2024	12:10	13:10	68.8	45.7	47.4	36.1
MP10	27/04/2024	13:55	14:55	85.3	56.1	47.0	34.4
MP11	29/04/2024	11:11	12:11	76.6	50.1	51.9	39.2

Location	Start Date	Start Time	End Time	$L_{AFmax,T}$ (dB)	$L_{Aeq,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
MP12	28/04/2024	13:41	14:41	74.6	43.7	44.9	30.9
MP13	28/04/2024	15:13	16:13	77.4	49.3	47.9	34.3
MP14	28/04/2024	12:07	13:07	74.9	47.6	47.2	36.7
MP15	28/04/2024	12:43	13:43	76.8	49.3	48.3	34.6
MP16	28/04/2024	10:42	11:42	66.1	47.2	49.2	39.7
MP17	28/04/2024	10:42	11:42	75.0	52.7	53.2	35.7
MP19	28/04/2024	08:37	09:37	66.4	49.5	53.0	39.4

Note: LAeq,T results are the logarithmic average of LAeq,15min samples. LA10,T and LA90,T are the arithmetic average of LA10,15min and LA90,15min samples.

The dominant noise sources audible at each monitoring location during the survey were noted as follows.

Table 8-31: Monitoring observations

Location	Surveyor Observations
MP1	The audible noise sources were windblown foliage, insect sounds, human interactions, livestock movements, vehicular movements, and construction noise from a house in the area
MP2	The noise environment was dominated by windblown foliage, human interactions and vehicular movements on an access road in the vicinity of the monitoring point, livestock movements, and bird song
MP3	Dominant noise sources were windblown foliage, insect sounds, livestock movements, human interactions, vehicular movement on the EN180 road
MP4	The dominant noise sources were vehicular movement, human interactions, livestock movements, and farming activities 50 meters from the monitoring point
MP5	The audible noise sources were windblown foliage, human interactions, insect sounds, birdsong and vehicular movements
MP6	The dominant noise sources were windblown foliage, insect sounds, livestock movements, human interactions, and vehicular movements along EN180
MP8	The noise environment was dominated by livestock movement, vehicular movements, human interactions, windblown foliage, and insect sounds
MP9	Audible noise sources were human interactions at the marketplace, vehicular movements, windblown foliage, and livestock movements
MP10	Dominant noise sources were vehicular movements, sounds from a school at a distance, human interactions, windblown foliage, insect sounds and livestock movements
MP11	The dominant noise sources included windblown foliage, insect sounds, livestock movements, human interactions, and vehicular movements
MP12	The dominant noise sources were human interactions, windblown foliage, insect sounds, vehicular movements, livestock movements
MP13	The audible noise sources were windblown foliage, insect sounds, vehicular movements, livestock movements, and human interactions
MP14	The noise environment was dominated by vehicular movements, human interactions, and livestock movements
MP15	The audible noise sources were windblown foliage, human interactions, insect sounds, and vehicular movements

Location	Surveyor Observations
MP16	The noise environment was dominated by vehicular movements, livestock movements, and bird song
MP17	The audible noise sources were human interactions, windblown foliage, birdsong, insect sounds, and vehicular movements
MP19	The dominant noise sources were vehicular movements, human interactions, windblown foliage, bird song, insect sounds

8.10.4 Vibration environment

The existing vibration environment has not been quantified and no distinguishable vibration sources were observed during the field survey. In addition, vibration assessments are typically conducted against absolute criteria, rather than comparison to background. Therefore, the construction vibration predictions within the ESIA were based on conservative empirical data derived from comparable construction activities. Moreover, at the time of writing specific construction methodologies, plant types, and final locations were not available. The construction vibration predictions will be reviewed and refined during the detailed design phase once equipment, construction methodologies and work locations are confirmed.

8.11 Air quality

8.11.1 Area of influence

The Project AoI for the demolition during demobilisation, earthworks and construction activities is defined as up to 250 m from the Project site boundary. For trackout activities, up to 250 m from the road connecting to each station will be considered and its AoI is defined as up to 50 m from the edge of those roads, as per the IAQM guidance. During the operational phase of the Project, the project AoI will be defined as the area with human receptors along the railway included in the study at location where the greatest changes in the railway emissions from the proposed diesel locomotives were predicted due to the operation phase. As emissions from diesel locomotive vary along the railway and locations with the greatest predicted changes in railway emissions represent areas with the most significant potential impacts on air quality, defining the project AoI at these critical locations ensures that all human receptors potentially affected by the diesel locomotive are properly considered.

8.11.2 Methodology

8.11.2.1 Air quality parameters

Based on the potential impacts and considering the nature of the Project, the following air quality parameters were considered the most relevant for the construction and operation phase:

- Particulate matter (PM), including PM_{10} and $PM_{2.5}$
- Nitrogen Dioxide (NO_2)
- Ozone (O_3)
- Volatile Organic Compounds (VOCs)
- Sulphur Dioxide (SO_2)

- Carbon Monoxide (CO).

8.11.2.2 *Baseline monitoring survey*

Monitoring was carried out at locations selected to represent exposure to potential construction and operation emissions from the project. The grid references of receptors are listed in Table 8-32 below. The same location was chosen for both 1-hour (short-term) and monthly (long-term) monitoring.

Diffusion tube monitoring was undertaken between the period 24th April 2024 to 23rd May 2024. Approximately 1 hour of dust and carbon monoxide monitoring per site was carried out between the period of 26th April 2024 to 29th April 2024. The same monitoring locations were used for both short-term monitoring and long-term diffusion tube monitoring.

Table 8-32 Monitoring locations

Location Reference	Grid References	Receptor Name/ Location	Description
MP1	9.665117°S 20.491292°E	Saurimo	Roadside, in Saurimo village,
MP2	9.688056°S 20.499167°E	Saurimo	Background, in close proximity to proposed support Camp and Station 8
MP3	9.749016°S 20.405163°E	Saurimo	Residential area, between two communities close proximity to Railway RoW
MP4	9.923468°S 20.361151°E	Saurimo	Residential area close to proposed Station 7
MP5	10.056888°S 20.301593°E	Saurimo	Residential area close proximity to Railway RoW
MP6	10.246537°S 20.248452°E	Saurimo	Residential area, close proximity proposed Station 6 and Caiaza main camp
MP7	10.454444°S 20.158333°E	Saurimo	Residential area close proximity to Railway RoW
MP8	10.653205°S 20.209088°E	Saurimo	Residential area, in close proximity to RoW
MP9	10.767165°S 20.237013°E	Saurimo	Residential area at Maurilo town, in close proximity to proposed Station 5
MP10	10.81785°S 20.232035°E	Saurimo	Residential area close proximity to Railway RoW

Location Reference	Grid References	Receptor Name/ Location	Description
MP11	11.029832°S 20.195763°E	Saurimo	Residential area at Dala town, close proximity to Railway RoW
MP12	11.040139°S 20.207890°E	Dala and Camanongue	Residential area close proximity to Dala Station 4
MP13	11.181704°S 20.215894°E	Dala and Camanongue	Residential area close proximity to Railway RoW
MP14	11.261368°S 20.187399°E	Dala and Camanongue	Residential area close proximity to Railway RoW
MP15	11.350084°S 20.171273°E	Dala and Camanongue	Residential area close proximity to the RoW
MP16	11.431698°S 20.171445°E	Dala and Camanongue	Residential area in Camanongue town, close proximity to Station 3
MP17	11.550385°S 20.020242°E	Dala and Camanongue	Residential area close proximity to Station 2
MP19	11.753275°S 19.957851°E	Dala and Camanongue	Residential area close proximity to proposed Station 1 and Luena support camp
MP20	11.791389°S 19.914167°E	Luena	Residential area in Luena town

Sampling points were selected based on the British Standard European Norm Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 3: Guide to selection, use and maintenance (BS EN 13528-3:2003). As all monitoring locations are situated near residential areas, they are considered as highly sensitive human receptors to air quality. The following techniques were used during monitoring periods:

- sampling points were at least 1 m away from buildings or other major obstructions to avoid local perturbation effects
- the measuring height was between 1,5 m and 4,0 m. Heights > 2.5 m will discourage theft and vandalism of the diffusion tubes
- the immediate vicinity of trees, bushes, etc. were avoided to minimise the influence of the local environment and to minimize effects from insects.

8.11.2.3 Equipment

Ambient concentrations of nitrogen dioxide, ozone and sulphur dioxide were sampled using passive diffusion tubes, transported, deployed and analysed in accordance with BS EN 13528 :2002. Diffusion tubes were supplied and analysed by an accredited laboratory in the UK.

Travel (field) blanks were deployed onsite for quality control and quality assurance (QA/QC) purposes and were analysed at an accredited. The laboratory blanks were maintained as per the QA/QC standards.

Particulate matter was monitored using a TSI 'DustTrak' nephelometer optical particle monitor which can measure indicative concentrations of PM_{10} and $PM_{2.5}$, particulate matter simultaneously. The TSI DustTrak is not a 'reference equivalent' method for the determination of airborne particulates; however, it provides indicative continuous data that may capture short-term events and may be fitted with an in-line filter which can be analysed gravimetrically in the laboratory and the results used to adjust the optically based data. These instruments are powered by batteries do not require an external power supply.

8.11.2.4 Limitations and assumptions

These data represent a limited dataset, of day-time measurements and are therefore likely to be broadly representative of the 24-hour mean guideline but are likely to overestimate the annual mean. The periods monitored are substantially less than a full year and therefore are not appropriate for formal comparison with the WHO annual mean guideline, nevertheless the data represent evidence that the existing, 'baseline' concentrations of PM_{10}, $PM_{2.5}$ particulate matter are consistent with the expected range for rural background in Angola.

Air quality and the concentrations of some pollutants can exhibit natural seasonal variation, e.g. sunlight intensity strongly affects ozone formation and concentrations of airborne particulate matter may be greater during periods of dry weather.

8.11.3 Air quality guidelines and standards

Air quality assessment was undertaken with reference to relevant international and national air quality guidelines and standards for the protection of human health. Consequently, guidelines and standards for ecological receptors are not applicable, as monitoring did not target ecological or habitat receptors.

8.11.3.1 World Health Organisation (WHO) Air Quality Guidelines, 2000 & 2005

The WHO air quality Guidelines have been widely used as a reference tool to assist decision makers around the world in setting air quality standards and goals. The WHO Air Quality Guidelines Global Update, 2005 provides global recommendations on important air pollutants that pose health concerns, including thresholds and restrictions.

The Guidelines apply worldwide to both outdoor and indoor environments and are based on expert evaluation of current scientific evidence.

The International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) General Guidelines reproduce the 2005 WHO Guidelines as recommended criteria for air quality, in the absence of national standards. The relevant 2005 WHO Guidelines levels and interim targets are shown in Table 8-33, below.

Table 8-33: Relevant WHO Air Quality Guidelines 2005 & interim targets

Pollutant	Averaging time	Interim target			Air Quality Guideline
Particulate matter, $PM_{2.5}$, µg/m³	Annual	35	25	15	10
	24-hour[a]	75	50	37.5	25
Particulate matter, PM_{10}, µg/m³	Annual	70	50	30	20
	24-hour[a]	150	100	75	50
Ozone, O_3, µg/m³	8-hour[a]	160	-	-	100
Nitrogen Dioxide, µg/m³	Annual	-	-	-	40
	1-hour	-	-	-	200
Sulphur Dioxide, µg/m³	24-hour[a]	125	50	-	20
	10-minute	-	-	-	500

[a] 99th percentile (i.e. 3–4 exceedance days per year).

[a] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

8.11.3.2 World Health Organisation (WHO) Air Quality Guidelines, 2021

WHO published revised air quality guidelines for pollutants in ambient air in September 2021. The new AQGs for particulate matter (PM) and nitrogen dioxide (NO_2) are substantially lower than the previous (2005) guidelines and are widely exceeded in many urban and other locations around the world. Interim targets are provided as achievable 'milestones' on the journey to meeting the guidelines.

The relevant 2021 WHO Guidelines levels and interim targets are shown in Table 8-34.

Table 8-34: Relevant WHO Air Quality Guidelines 2021 & interim targets

Pollutant	Averaging time	Interim target				Air Quality Guideline
		1	2	3	4	
Particulate matter, $PM_{2.5}$, µg/m³	Annual	35	25	15	10	5
	24-hour[a]	75	50	37.5	25	15
Particulate matter, PM_{10}, µg/m³	Annual	70	50	30	20	15
	24-hour[a]	150	100	75	50	45
Ozone, O_3, µg/m³	8-hour[a]	100	70	-	-	60
	Annual	160	120	-	-	100
Nitrogen Dioxide, µg/m³	Annual	40	30	20	-	10
	24-hour[a]	120	50	-	-	25
Sulphur Dioxide, µg/m³	24-hour[a]	125	50	-	-	40
Carbon Monoxide, CO, mg/m³	24-hour[a]	7	-	-	-	4

[a] 99th percentile (i.e. 3–4 exceedance days per year).

[a] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

8.11.3.3 National Environmental Management: Air Quality Act of South Africa, 2004

Angola is a member of the Southern African Development Community (SADC). Although SADC does not have a unified or region-wide air quality standard that applies across all its member states, it encourages regional cooperation in environmental policies, including air quality management, among its member states. Since Angola does not have its own specific national air quality standards, the National Environmental Management: Air Quality Act (2004) adopted in South Africa, one of the key SADC member states, are used as a reference to assess the air quality in Angola. The South African standards (Air Quality Act) (hereafter referred to as SA AQA) are aligned with international guidelines and suitable for evaluating and managing air quality in Angola.

8.11.3.4 Standards Comparison and Selection

A comparison of the SA AQA and WHO Guidelines is presented in Table 8-35 below. Ambient Air Quality Standards (AAQS) has been derived from the national and WHO guidelines to derive Project assessment criteria. The lowest of the criteria over an appropriate averaging period will normally be selected for a conservative assessment, however in the case of $PM_{2.5}$ particulate matter, the WHO 2021 Interim Targets 2 (WHO IT2) Guidelines are proposed, and Interim Target 4 (WHO IT4) for PM_{10}, because of the significant contribution of natural sources of these pollutants (refer to Section 2 for explanation of the 2005, 2021 and interim WHO Guideline levels).

No specific air quality standards are introduced by Southern Africa Development Community and Angola. The air quality standards adopted in South Africa is applied as a benchmark in the study for comparing the baseline results and for assessing the air quality. In addition, as there is no specific limits for VOC referenced in the WHO guidelines and South African standards, therefore total VOC limits from East Africa Community guidelines is used as a reference.

Table 8-35: Comparison of Ambient Air Quality Standards

Pollutant	Averaging Period	Air Quality Standard - Ambient Air Concentration, µg/m³			Project Assessment Criteria, µg/m³
		SA AQA	WHO 2000/2005	WHO 2021	
Nitrogen dioxide, NO_2	Annual	40	40	10	10
	1 month	150	-	-	150
	24 hr	188	-	25	25
	1 hr	200	200	200	200
	Instant Peak	940	-	-	940
Carbon monoxide, CO (mg/m³)	8 hr	10	10	-	10
	1 hr	30	30	-	30
	24 hr	-	-	4	4
	15 min	-	100	-	100
Particulate matter, PM_{10}	Annual	40	20	15	20 (WHO IT4)
	24 hr	75	50	45	50 (WHO IT4)
Fine particulate matter, $PM_{2.5}$	Annual	-	10	5	25 (WHO IT2)
	24 hr	-	25	15	50 (WHO IT2)
Ozone, O_3	Peak season	-	-	60	60
	8 hr	120	100	100	100
	1 hr	226	-	-	226
Sulphur Dioxide, SO_2	Annual	50	-	-	50
	24 hr	125	20	40	20
	1 hr	350	-	-	350
	10 min	500	500	500	500
Total Volatile Organic Carbon, VOC (mg/m³)*	8 hr	-	-	-	6

Note*: There is no specific SA AQA and WHO guideline for Total VOCs (TVOC). The 8-hour average TVOC limit (6mg/m³) extracted from the East African Community Standard (EAC) is used as a reference for the assessment.

8.11.4 Measured air quality results

8.11.4.1 MP1 – Saurimo

The weather during sampling at MP1 – Saurimo on 24th April 2024 was sunny with clear skies and humid air. Cooking using fossil fuels outside houses and presence of smoke and ash from burning natural vegetation were observed during sampling. VOC tube was not placed on 24th April 2024 because the clamp was not available on the sampling day. The weather during the VOC sampling on 25th April 2024 was sunny with clear skies and cool air. Cooking using fossil fuels outside house was observed. The surrounding environment consisted of exposed soils with some vegetation.

Air quality monitoring results at MP1 - Saurimo have been presented in Table 8-36.

Table 8-36:Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP1 – Saurimo

	MP1 – Saurimo	National and international standards
O_3, µg/m^3	132.2 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.8 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	4.54 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	2.15 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	9 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	5 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.1 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 26th April 2024, time 11:29-12:29. CO monitoring was undertaken on 26th April 2024, time 08:38-09:38. Diffusion tube monitoring was carried out between 24th April 2024 to 20th May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of ozone (O_3) exceeded the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of carbon monoxide (CO) were occasionally detected, but the results are within the WHO guideline and National Environmental Management: Air Quality Act of South Africa (SA AQA), and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.2 MP2 - Saurimo

During the site visit, the weather was sunny with clear skies and humid air. Presence of smoke and ash from burning natural vegetation was observed during sampling. Initial monitoring point was moved because of the presence of long grasses and trees, which was considered to be not a feasible monitoring point. The surrounding environment

consisted mostly of vegetation with some exposed soils. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP2 – Saurimo have been presented in Table 8-37.

Table 8-37: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP2 – Saurimo

	MP2 – Saurimo	National and international standards
O_3, µg/m^3	85.71 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	3.88 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	253 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	252 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.04 (monthly average)	**8hr: 6 (EAC)**

Note: Dust monitoring was undertaken on 26th April 2024, time 10:56-11:56.
CO monitoring was undertaken on 26th April 2024, time 11:05-12:05.
Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

The concentration of CO and SO_2 are also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.3 MP3 - Saurimo

During the site visit, weather conditions were recorded as sunny with clear skies and humid air. During sampling, no signs of any pollution sources were observed within the vicinity. Initial monitoring point was moved because of the presence of houses, and cooking kitchens that use fossil fuels and trees, which was considered to be not a feasible monitoring point. The surrounding environment consisted of vegetation with some exposed soils.

Air quality monitoring results at MP3 - Saurimo have been presented in Table 8-38

Table 8-38: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP3 – Saurimo

	MP3 – Saurimo	National and international standards
O_3, µg/m^3	139.9 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	1.4 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	5.98 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	5 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	4 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.01 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 26th April 2024, time 13:25-14:25. CO monitoring was undertaken on 26th April 2024, time 11:38-12:38. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.4 MP4 - Saurimo

During the site visit, weather conditions were recorded as sunny with clear skies and humid air. Cooking using fossil fuels outside houses was observed and community has dug up waste holes in the ground where waste is burnt. Initial monitoring point was moved because of the presence of houses, and cooking kitchens that use fossil fuels and trees, which was considered to be not a feasible monitoring point. The surrounding environment consisted mostly of exposed soils. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP4 – Saurimo have been presented in Table 8-39.

Table 8-39: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP4 – Saurimo

	MP4 – Saurimo	National and international standards
O_3, µg/m^3	90.26 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	4.78 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	331 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	330 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.05 (monthly average)	**8hr: 6 (EAC)**

Note: Dust monitoring was undertaken on 26th April 2024, time 13:04-14:04.
CO monitoring was undertaken on 26th April 2024, time 13:13-14:13.
Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

The concentration of CO and SO_2 are also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.5 MP5 - Saurimo

During the site visit, weather conditions were recorded as sunny with clear skies and humid air. Cooking using fossil fuels (wood) outside houses was observed during sampling. The surrounding environment consisted of vegetation with some exposed soils.

Air quality monitoring results at MP5 – Saurimo have been presented in Table 8-40.

Table 8-40: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP5 – Saurimo

	MP5 – Saurimo	National and international standards
O_3, µg/m^3	89.42 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	1.1 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	5.34 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	14 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	13 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.85 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 26th April 2024, time 15:27-16:27. CO monitoring was undertaken on 26th April 2024, time 13:39-14:39. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.6 MP6 - Saurimo

During the site visit, weather conditions were recorded as sunny with clear skies and humid air. General plastic litter in the vicinity and cooking using fossil fuels (wood) outside houses were observed during sampling. It was noted that construction material was about 50 m away from the monitoring point. The surrounding environment consisted of vegetation with some exposed soils, and several houses nearby.

Air quality monitoring results at MP6 - Saurimo have been presented in Table 8-41.

Table 8-41: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP6 – Saurimo

	MP6 – Saurimo	National and international standards
O_3, µg/m^3	116.7 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	1.4 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	6.24 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	2.32 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	20 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	17 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.05 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 26th April 2024, time 17:19-18:19. CO monitoring was undertaken on 26th April 2024, time 15:32-16:32. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.7 MP7 - Saurimo

During the site visit, weather conditions were noted as sunny with clear skies and humid air. Initial monitoring point was moved because of the presence of long grass and shrubs of natural vegetation, which was considered to be not a feasible monitoring point. General plastic litter in the vicinity and cooking using fossil fuels (wood) outside houses were observed during sampling. The surrounding environment consisted mostly of vegetation with exposed soils. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP7 - Saurimo have been presented in Table 8-42.

Table 8-42: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP7 – Saurimo

	MP7 – Saurimo	National and international standards
O_3, µg/m^3	67.93 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	6.5 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	251 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	250 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.09 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 26th April 2024, time 15:16-16:16. CO monitoring was undertaken on 26th April 2024, time 15:26-16:26. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 marginally exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

The concentration of CO and SO_2 are also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.8 MP8 – Saurimo

During the site visit, weather conditions were noted as sunny with clear skies and humid air. General plastic litter in the vicinity and cooking using fossil fuels outside houses were observed during sampling. Community has dug up waste holes in the ground where waste is burnt. The surrounding environment consisted of vegetation with some exposed soils.

Air quality monitoring results at MP8 - Saurimo have been presented in Table 8-43

Table 8-43: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP8 – Saurimo

	MP8 – Saurimo	National and international standards
O_3, µg/m^3	115.6 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	1.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	6.99 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	1.86 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	33 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	27 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.08 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 27th April 2024, time 12:08-13:08. CO monitoring was undertaken on 27th April 2024, time 10:22-11:22. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.9 MP9 – Saurimo

During the site visit, weather conditions were noted as sunny with clear skies and humid air. Cooking using fossil fuels outside houses was observed during sampling. Initial monitoring point was moved because of restricted accessibility and since the monitoring point was near a marketplace and school, there is fear of potential damage or theft. Therefore, it was not a feasible monitoring point. The surrounding environment consisted of some houses and some exposed soils.

Air quality monitoring results at MP9 - Saurimo have been presented in Table 8-44.

Table 8-44: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP9 – Saurimo

	MP9 – Saurimo	National and international standards
O_3, µg/m^3	74.58 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.9 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	6.92 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	17 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	16 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.04 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 27th April 2024, time 14:01-15:01. CO monitoring was undertaken on 27th April 2024, time 12:14-13:14. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.10 MP10 – Saurimo

During the site visit, weather conditions were noted as sunny with clear skies and humid air. Cooking using fossil fuels outside houses and area with patches of burnt material were observed during sampling. Initial monitoring point was moved because it was on a school open field and fear of potential damage by school children. Additionally, the headmen of the village mentioned that the pole should be placed within the vicinity of his household because the village has different political party members and it would be possible that the opposing parties may damage the pole. Therefore, it was not a feasible monitoring point. The surrounding environment consisted of some houses and some exposed soils.

Air quality monitoring results at MP10 - Saurimo have been presented in Table 8-45.

Table 8-45: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP10 – Saurimo

	MP10 – Saurimo	National and international standards
O_3, µg/m^3	55.14 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	1.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	8.05 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	1.72 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	38 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	36 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.15 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 27th April 2024, time 15:46-16:46. CO monitoring was undertaken on 27th April 2024, time 13:59-14:59. Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations, however the measured PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 did not exceed the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA Standard, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.11 MP11 – Saurimo

During the site visit, weather conditions were noted as sunny with clear skies and humid air. Initial monitoring point was moved because of restricted accessibility, which was considered to be not a feasible monitoring point. General plastic litter in the vicinity and cooking using fossil fuels outside houses were observed during sampling. The surrounding environment consisted of exposed soils with some vegetation, and some houses nearby. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP11 - Saurimo have been presented in Table 8-46.

Table 8-46: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP11 – Saurimo

	MP11 – Saurimo	National and international standards
O_3, µg/m^3	66.96 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.1 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	6.33 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	255 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	254 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.1 (monthly average)	**8hr: 6 (EAC)**

Note: Dust monitoring was undertaken on 29th April 2024, time 11:00-12:00.
CO monitoring was undertaken on 29th April 2024, time 11:09-12:09.
Diffusion tube monitoring was carried out between 25th April 2024 to 21st May 2024.

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual

average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 marginally exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Saurimo, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Saurimo.

The concentration of SO_2 is within its respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Saurimo.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Saurimo.

8.11.4.12 MP12 – Dala and Camanongue

Air quality monitoring was carried out in seven monitoring locations within Dala and Camanongue. During the site visit for MP12 - Dala and Camanongue, the weather conditions were noted as sunny with clear skies. The surrounding environment consisted mostly of exposed soils with some vegetation. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP12 - Dala and Camanongue have been presented in Table 8-47.

Table 8-47: Measured O3, CO, NO2, SO2, PM10, PM2.5, VOC concentrations at MP12 – Dala and Camanongue

	MP12 – Dala and Camanongue	National and international standards
O3, µg/m3	N/A	Peak Season: 60 (WHO)
CO, mg/m3	0.0 (1-hour average)	1-hr: 30 (SA AQA, WHO)
NO2, µg/m3	3.3 (monthly average)	Monthly: 150 (SA AQA) Annual: 10 (WHO)
SO2, µg/m3	N/A	24-hr: 20 (WHO), 125 (SA AQA)
PM10, µg/m3	248 (1-hour average)	24-hr: 50 (WHO IT4)
PM2.5, µg/m3	247 (1-hour average)	24-hr: 50 (WHO IT2)
VOC mg/m3	0.13 (monthly average)	8hr: 6 (EAC)
Note: Dust monitoring was undertaken on 28th April 2024, time 13:31-14:31.		

CO monitoring was undertaken on 28th April 2024, time 13:40-14:40. Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024. N/A: Baseline data were not available as tubes were missing.

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM10 concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, PM2.5 concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O3 and SO2 were not available as tubes were missing.

Results show NO2 concentration is within the annual and monthly project criterion.

The concentration of CO was also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.13 MP13 – Dala and Camanongue

During the site visit, weather conditions were noted as sunny. The surrounding environment consisted mostly of exposed soils with some vegetation. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP13 - Dala and Camanongue have been presented in Table 8-48.

Table 8-48: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP13 – Dala and Camanongue

	MP13 – Dala and Camanongue	National and international standards
O_3, µg/m^3	67.33 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	3.62 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	246 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	246 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.18 (monthly average)	**8hr: 6 (EAC)**

Note: Dust monitoring was undertaken on 28th April 2024, time 15:04-16:04. CO monitoring was undertaken on 28th April 2024, time 15:19-16:19. Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024.

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 marginally exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Dala and Camanongue, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

The concentration of CO and SO_2 are also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.14 MP14 – Dala and Camanongue

During the site visit, weather conditions were noted as sunny with clear skies. The surrounding environment consisted mostly of exposed soils with some vegetation. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP14 - Dala and Camanongue have been presented in Table 8-49.

Table 8-49: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP14 – Dala and Camanongue

	MP14 – Dala and Camanongue	National and international standards
O_3, µg/m^3	58.64 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.3 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	6.24 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.77 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	251 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	250 (1-hour average)	**24-hr: 50 (WHO IT2)**

VOC mg/m^3	0.01 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 28th April 2024, time 11:59-12:59. CO monitoring was undertaken on 28th April 2024, time 12:08-13:08. Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 did not exceed the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

The concentration of SO_2 is also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.15 MP15 – Dala and Camanongue

During the site visit, weather conditions were noted as sunny with clear skies. The surrounding environment consisted mostly of exposed soils with some vegetation. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP15 - Dala and Camanongue have been presented in Table 8-50.

Table 8-50: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP15 – Dala and Camanongue

	MP15 – Dala and Camanongue	National and international standards
O_3, µg/m^3	62.48 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	5.69 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**

	MP15 – Dala and Camanongue	National and international standards
PM_{10}, µg/m^3	250 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	249 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.03 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 28th April 2024, time 16:32-17:32. CO monitoring was undertaken on 28th April 2024, time 16:41-17:41. Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 marginally exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Dala and Camanongue, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

The concentration of CO and SO_2 are also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.16 MP16 – Dala and Camanongue

During the site visit, weather conditions were noted as sunny with clear skies. The surrounding environment consisted mostly of vegetation with some exposed soils. This has the potential to contribute to higher PM concentrations due to the exposed soils in remote area of rural Angola.

Air quality monitoring results at MP16 - Dala and Camanongue have been presented in Table 8-51.

Table 8-51: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP16 – Dala and Camanongue

	MP16 – Dala and Camanongue	National and international standards
O_3, µg/m^3	80.33 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.3 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	N/A	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	2.43 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	259 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	256 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.18 (monthly average)	**8hr: 6 (EAC)**

Note: Dust monitoring was undertaken on 28th April 2024, time 10:33-11:33.
CO monitoring was undertaken on 28th April 2024, time 10:44-11:44.
Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024.
N/A: Baseline data was not available as tube was missing.

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Dala and Camanongue, especially during drier, sunnier periods.

The concentrations of NO_2 were not available as tube was missing.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

The concentration of SO_2 is also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.17 *MP17 – Dala and Camanongue*

During the site visit, weather conditions were noted as sunny with clear skies. The surrounding environment had exposed soils and also had agricultural areas nearby.

Air quality monitoring results at MP17 - Dala and Camanongue have been presented in Table 8-52.

Table 8-52: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP17 – Dala and Camanongue

	MP17 – Dala and Camanongue	National and international standards
O_3, µg/m^3	76.73 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.7 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	3.74 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	15 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	14 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.05 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 28th April 2024, time 12:33-13:33. CO monitoring was undertaken on 28th April 2024, time 10:46-11:46. Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Dala and Camanongue, especially during drier, sunnier periods.

Results show NO_2 concentration is within the annual and monthly project criterion.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

The concentration of SO_2 is also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.18 *MP19 – Dala and Camanongue*

During the site visit, weather conditions were noted as sunny with clear skies. The surrounding environment had exposed soils and some houses.

Air quality monitoring results at MP19 - Dala and Camanongue have been presented in Table 8-53.

Table 8-53: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP19 – Dala and Camanongue

	MP19 – Dala and Camanongue	National and international standards
O_3, µg/m^3	71.28 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.3 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	N/A	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.77 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	22 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	20 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.06 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 28th April 2024, time 10:29-11:29. CO monitoring was undertaken on 28th April 2024, time 08:42-09:42. Diffusion tube monitoring was carried out between 27th April 2024 to 22nd May 2024. N/A: Baseline data was not available as tube was missing		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} and $PM_{2.5}$ concentrations measured are within the project criterion (WHO) 24 hour mean.

The concentrations of O_3 exceeded the WHO 'peak season' guidelines, though the periods are not strictly comparable and would be typical for remote regions in Dala and Camanongue, especially during drier, sunnier periods.

The concentrations of NO_2 were not available as tube was missing.

Low concentrations of CO were occasionally detected, but the results are within the WHO guideline and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

The concentration of SO_2 is also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Dala and Camanongue.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Dala and Camanongue.

8.11.4.19 MP20 – Luena

Air quality monitoring was carried out in one monitoring location within Luena. During the site visit, weather conditions were noted as sunny with clear skies. The surrounding environment consisted mostly of vegetation with some exposed soils. Construction vehicles were observed in the vicinity. This has the potential to contribute to higher PM concentrations due to the movement of construction vehicles and the exposed soils.

Air quality monitoring results at MP20 - Luena have been presented in Table 8-54.

Table 8-54: Measured O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC concentrations at MP20 – Luena

	MP20 - Luena	National and international standards
O_3, µg/m^3	54.7 (monthly average)	**Peak Season: 60 (WHO)**
CO, mg/m^3	0.0 (1-hour average)	**1-hr: 30 (SA AQA, WHO)**
NO_2, µg/m^3	10.23 (monthly average)	**Monthly: 150 (SA AQA)** **Annual: 10 (WHO)**
SO_2, µg/m^3	<1.7 (monthly average)	**24-hr: 20 (WHO), 125 (SA AQA)**
PM_{10}, µg/m^3	264 (1-hour average)	**24-hr: 50 (WHO IT4)**
$PM_{2.5}$, µg/m^3	263 (1-hour average)	**24-hr: 50 (WHO IT2)**
VOC mg/m^3	0.08 (monthly average)	**8hr: 6 (EAC)**
Note: Dust monitoring was undertaken on 28th April 2024, time 08:20-09:20. CO monitoring was undertaken on 28th April 2024, time 08:30-09:30. Diffusion tube monitoring was carried out between 28th April 2024 to 23rd May 2024.		

As PM monitoring was only carried out for a short period, these measurements only provide a snapshot of PM concentrations. The PM_{10} concentrations exceed the criterion for WHO 24-hour and annual average concentrations during the sampled period. Additionally, $PM_{2.5}$ concentrations measured above both the WHO 24-hour and annual average concentrations. As monitoring was only carried out for approximately one hour, the results are likely to be an overestimate on 24-hour and annual mean concentrations.

The concentrations of O_3 did not exceed the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable.

Results show NO_2 concentration exceeded the annual project criterion and within the monthly project criterion. As monitoring was only carried out for approximately one month, the results are likely to be an overestimate on annual mean concentrations

The concentration of CO and SO_2 are also within their respective WHO guidelines and SA AQA, and consistent with expectations for a rural background location in Luena.

As there is no specific SA AQA and WHO guideline for VOC, the concentration of VOC is within its respective East African Community Standard, which is consistent with expectations for a rural background location in Luena.

8.11.4.20 Overall baseline air quality

Overall, the monitoring programme reports the concentrations of baseline CO, SO_2 and VOC were within the relevant guidelines. Exceedances of PM_{10} and $PM_{2.5}$ concentrations were recorded at 10 monitoring locations. Within Saurimo, the measured PM_{10} and $PM_{2.5}$ concentrations at more than half of the monitoring locations would be within the WHO 24-hour guideline and the annual mean Interim Targets, though there are exceedances at 4 monitoring locations. Also, there were PM_{10} and $PM_{2.5}$ concentrations exceedances at most of the monitoring locations within Dala and Camanongue and the only monitoring location within Luena. NO_2 concentration at the only monitoring location within Luena exceeded the annual project criterion. Exceedances of O_3 concentrations were also recorded at majority of the monitoring locations, except one monitoring location with Dala and Camanongue and the only monitoring location within Luena.

8.11.4.21 Trends and sensitivity to change

Air quality and the concentrations of some pollutants can exhibit natural seasonal variation, e.g. sunlight intensity strongly affects ozone formation and concentrations of airborne particulate matter may be greater during periods of dry weather.

This baseline assessment draws on data from one limited site-specific monitoring campaign carried out in 2024. There is no historical air quality data in the areas of influence from which to draw conclusions about existing trends that may continue; nor have any trends in development or activity that could be used to project future changes in air quality been identified.

8.12 Greenhouse gas emissions

8.12.1 Area of influence

The sensitive receptor for Greenhouse gas (GHG) emissions is at a global scale as these emissions affect the overall global climate, which is considered highly sensitive to GHG fluctuations.

By proxy, the sensitive receptor can also be extended to Angola's Nationally Determined Contributions, which is aligned with the goals of the 2015 Paris Agreement, to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C (NDC, 2022; UNCC,2015).

Separate assessments reports on greenhouse gases emission (GHG) and climate change risk assessment (CCRA) are provided in Appendix 15 of this ESIA Report. The report provides further details including methodology, findings and recommendations.

8.12.2 Methodology

The Proposed Development has the potential to affect the climate by the addition and avoidance of GHG emissions in comparison to the baseline and future baseline scenario.

The scope of the GHG assessment includes the addition of GHG emissions directly from construction, operational and decommissioning activities undertaken within the Site boundary.

It also extends to include emissions that would occur outside the Site boundary, but related to the activities of the Proposed Development including those from:

- The extraction, manufacture, and transportation of materials to the construction site (construction and operation);
- The transportation of workers to Site (construction and operation); and
- Off-site transport and disposal of waste materials (construction, operation and decommissioning).

The assessment (presented in chapter 10.8) also considers the GHG savings from the Proposed Development as a result of displacing passenger travel and transport of freight by combustion vehicles.

8.12.2.1 Guidelines and standards

The assessment of the GHG emissions arising from the proposed development was carried out in accordance with:

- The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (2004)
- The Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022)
- Royal Institute of Chartered Surveyors (RICS) Whole life carbon assessment for the built environment (2023).

The assessment has quantified applicable Kyoto Protocol GHGs as measured in tonnes of carbon dioxide equivalence (tCO_2e), where equivalence means having the same warming effect as CO_2 over 100 years. The seven Kyoto Protocol gas groups assessed were carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and perfluorocarbons (PFCs). In essence, emissions have then been quantified by applying the most relevant and up-to date emission factors. The global warming potential (GWP) of each gas is presented in Table 8-55.

Table 8-55: Kyoto Protocol GHGs and their global warming potential (GWP)

Greenhouse gas/group	Chemical formula	GWP (CO_2e)
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
Hydrofluorocarbons	HFCs	Depends on specific gas
Sulphur hexafluoride	SF_6	23,500
Perfluorocarbons	PFCs	Depends on specific gas
Nitrogen Trifluoride	NF_3	16,100

8.12.2.2 Data

Data associated with the activities contributing to the construction and operation of the project were provided by the Client. Where it was not possible to provide this data, since

this assessment represents a forecast of emissions and some information may not yet be known, secondary data (such as estimates, extrapolations, benchmarks, and proxy data such as distance travelled) have been used.

The secondary data included government publications, independent agencies, and scientific research journals. However, it should be noted that the quality and accuracy of such emission data can vary significantly. Data can differ depending on the research body and/or underlying methodologies applied. It is, therefore, good practice to apply emission factors only from reputable sources.

8.12.3 Baseline GHG emissions

The current baseline conditions including the existing GHG emissions, before the construction and operation of the project can be considered as nil. Given the minimal development or activity on this area presently, the baseline GHG emissions can be considered nil. Conversely, carbon is likely to be stored within vegetation and soil in this area and it can be considered a carbon sink.

With regards to the national GHG context, Angola's GHG emissions have been calculated for 2015 as part of their baseline calculations for their National Determined Contribution (NDC). It was estimated that the national emissions for 2015 were 99,992.2 ktCO2e, of which emissions from energy comprised 18,115.6 ktCO2e (18%).

As part of its National Determined Contribution (NDC) submitted in 2021 Angola has set an unconditional target to achieve 14% GHG emissions reduction by 2025 relative to an emissions baseline of 2015. It has also stated an additional targeted contribution, based on the provision of international support and funding, of a further 10% reduction by 2025 (Government of Angola, 2021) [102]..

[102] Government of Angola (2021) Nationally Determined Contribution of Angola, https://unfccc.int/sites/default/files/NDC/2022-06/NDC%20Angola.pdf

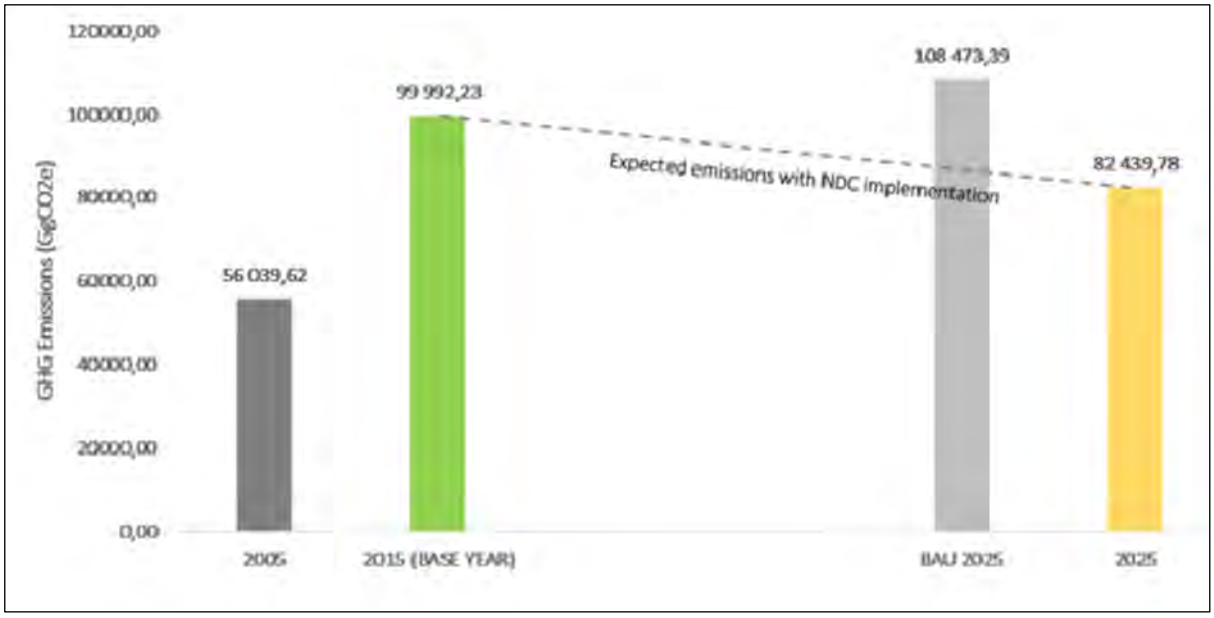


Figure 8-38: Angola's GHG reduction ambition, taken from Angola's NDC 2021

Angola's NDC further provides provisional figures for 2030. The unconditional and conditional targeted carbon reduction across all sectors can be seen in Table 8-56 below. Emissions from transport are included within the conditional targets category only, with a reduction potential of 6,590 tCO_2e in 2025 and 13,180 tCO_2e in 2030. The increase in reduction potential from 2025-2030 is due to an increase in natural gas buses from 2000 in 2025, to 4000 in 2030. Currently, there are no rail specific targets as part of Angola's unconditional and conditional contributions.

Table 8-56: Angola's targeted GHG emissions reductions (compared to a baseline of 2015)

	Unconditional targets (tCO2e)		Conditional targets (tCO2e)	
	2025	2030	2025	2030
Across all sectors	15,754,100	23,329,000	26,542,200	39,717,010

Separate assessments reports on greenhouse gases emission (GHG) and climate change risk assessment (CCRA) are provided in Appendix 15 of this ESIA Report. The report provides further details including methodology, findings and recommendations.

8.13 Landscape and visual

8.13.1 Area of influence

The area of influence has been determined through a combination of desk-based analysis and field investigation. The AoI for the landscape and visual baseline include the corridor along the full length of the railway line and extends to areas where the railway

line can be seen from and where it alters the existing landscape character. This includes an immediate corridor on of 30 m on either side of the alignment and viewpoints from where the railway line, stations, camps and quarries are visible varying from 1 to 5 km to also capture longer distance visibility of Project associated permanent infrastructure.

8.13.2 Methodology

The landscape and visual baseline was developed through a desktop review of secondary data, supported by site visits in March 2024, September 2025 and November 2025. During the site visit, representative photographs and viewpoints were recorded. Additionally, the site visit was undertaken to identify landscape features, land use patterns, vegetation cover, settlement characteristics and key viewpoints.

The baseline assessment aims to characterise the existing landscape character, visual qualities and sensitive receptors within the defined AoI before introducing the project. This includes identifying elements, features and aesthetic or perceptual factors that contribute to the overall landscape and visual character.

Given the linear nature of the railway project traversing diverse landscapes and visual features, the landscape and visual baseline is structured into sectional areas to reflect spatial variability of the landscapes and local variations. The sectional areas for assessment are based on the following factors:

- where there is clear change in landscape characteristics or type
- areas where key project infrastructures are planned
- areas transitioning into a designated conservation area
- where the is a shift in settlement patterns (urban to rural)
- where there is presence of sensitive receptors
- where there are significant changes in visual receptor density or sensitivity

A sectional approach to define the baseline environment was selected because these are sections where the landscape changes character or where project features could cause notable visual/landscape impacts. The delineation of sections allows for a more precise and defensible description of baseline conditions, ensuring that areas with higher visual sensitivity or greater potential for landscape change are clearly identified.

8.13.2.1 Limitations

The landscape and visual assessment has been undertaken based on a desktop literature review and a series of site-derived photographs. A comprehensive field survey, including systematic visual receptor verification and seasonal observations, has not been conducted at this stage. The following key limitations therefore apply:

- No Verified Zone of Theoretical Visibility (ZTV) was undertaken. Consequently, the identification of visual receptors is limited to those observed during the site visit, within the available photographs or documented in secondary sources.
- The assessment is based solely on observed views from photographs taken and existing literature for the areas where available

- The assessment does not constitute a full Landscape and Visual Impact Assessment (LVIA) as defined by best practice guidelines such as the Guidelines for Landscape and Visual Impact Assessment, 3rd Edition - GLVIA3
- Without a formal viewpoint selection process supported by visibility modelling or stakeholder input, the selected photographic viewpoints may not represent the most sensitive or most frequently experienced views within the study area
- The assessment did not include photomontages or visual simulations illustrating how the proposed railway infrastructure would appear within the existing landscape. As a result, the evaluation of visual change relies on professional judgement rather than visual representation
- The visual impact assessment is primarily qualitative and descriptive
- All identified potential impacts are considered preliminary.

8.13.3 Landscape and visual character

8.13.3.1 Project corridor

The Luena-Saurimo Project area is located within the Eastern portion of the Republic of Angola, in a morphological domain called the Eastern Plateau of Angola, where most of its landscape is dominated by elongated, flat-topped hills, between the altitudes of 1,350 m.a.s.l in Luena, and 1,080 m.a.s.l in Saurimo characterising a gentle dip towards the north.

The landscape between Luena (Moxico Province) and Saurimo (Lunda-Sul Province) is largely rural with established municipal centres, communities and settlements along the corridor. The landscape is dominated by savannah, Miombo woodland, seasonal wetlands, some forested areas, and river valleys (11 rivers crossed by the proposed railway line), with ongoing infrastructure development projects such as EN180 highway, power transmission line and fibre optic/telecom cables reshaping accessibility and overall landscape. The terrain is moderately hilly with patches of dense vegetation. The savannah and woodland are characterized by scattered hills, long term anthropogenic disturbances hence degradation, fertile soils in the valleys that supports subsistence farming and some areas are prone to seasonal flooding during rainy season. The open areas are dominated by grassland/shrublands.

The proposed railway line crosses two major basins namely the Zambezi Basin (ZB), shared with 7 Southern Africa Development Community (SADC) countries, in the southern parts of the project area between the towns of Luena and Camanongue and the Congo Basin (CB), shared with 10 countries of Central Africa, further north up to the town of Saurimo (refer to Figure 8-39). The railway line crosses several perennial rivers, water courses and drainage lines as well as numerous wetlands and floodplains. The rivers are of high importance to both ecosystems, but also human populations as local communities are highly dependent on these features as a source of water and for agricultural activities.

8.13.3.2 Wider project AoI overview

Angola’s general topography depicts coastal lowlands lying below 200 m altitude occupying 05% of the country land surface, stepped and mountainous escarpment rising

to 1,000 m occupying 23% of land, extensive interior plateau of 1,000 – 1,500 m occupying 65% of land.

Angola has a distinct topography, ranging from the western coastal lowlands below 200 meters above sea level (m.a.s.l) that occupy a band between 10 and 150 km in width and cover 5% of the country, to areas above 1,500 m.a.s.l that cover 7% of the country (Huntley, 2019). Adjacent to the coastal lowlands, the western mountainous escarpment rises to 1,000 masl and covers 23% of Angola (Huntley, 2019). The interior plateau is 1,000–1,500 masl and covers over half (65%) of Angola and the remaining 07% of the country lies above 1,500 m with the highest point being Mount Moco at 2,620 m.a.s.l (Figure 8-39) (Huntley, 2019). Angola has 12 main landscape groups, with which its ecoregions are closely aligned and are underpinned by dynamic geological processes (Huntley, 2023). The central highlands of the Bié Plateau are the source water for major drainage basins including the Cuanza, Congo, Zambezi and Okavango. The highland river systems are surrounded by miombo woodlands, tropical and subtropical grasslands, tree and shrub savannas (Goyder et al., 2018). The river valleys are characterised by seepages, oxbow lakes, wet grasslands and peatland deposits (Goyder et al., 2018; Lourenco et al., 2022b).

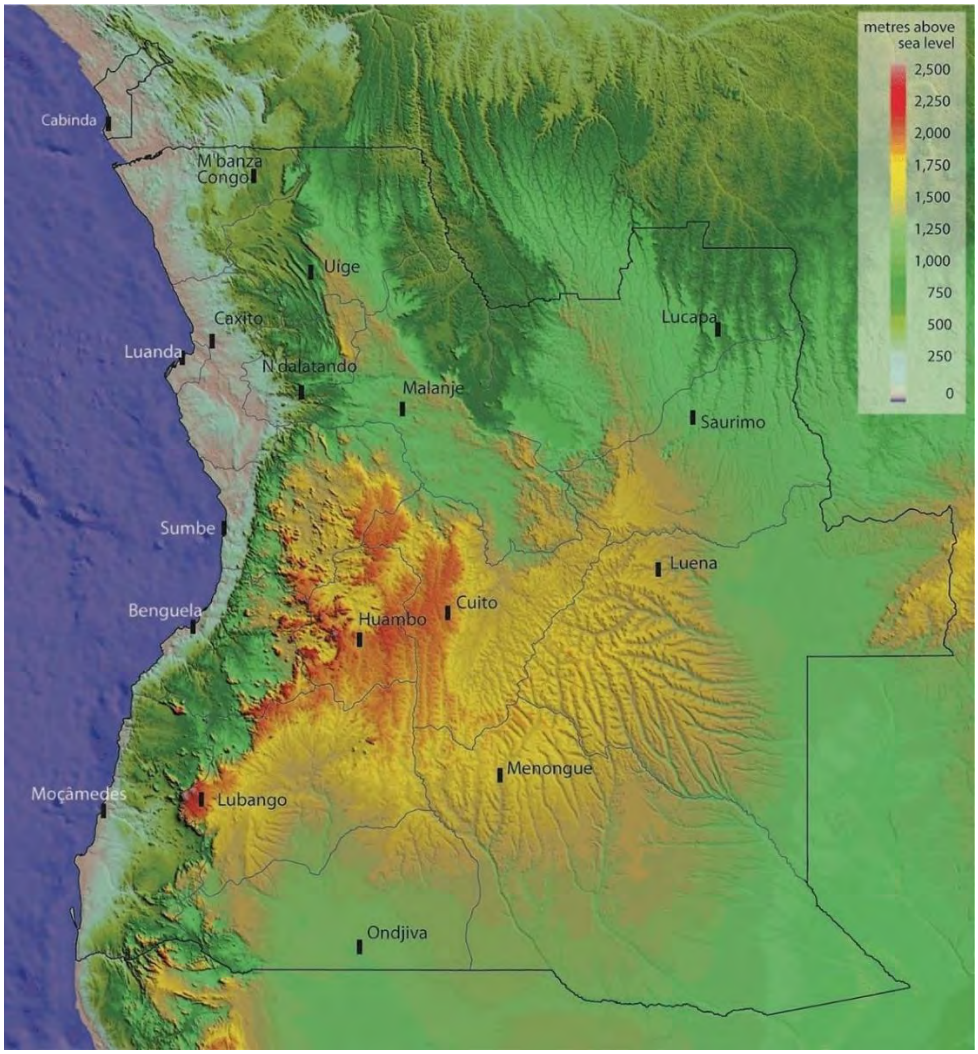


Figure 8-39 Angola's general topography (Huntley, 2023)

8.13.3.3 *Luena station*

The landscape is characterised by flat topography, with a predominantly open semi-modified rural environment. The major land cover that exists consist of distributed grassland and shrubs. Vegetation in the areas is generally sparse and low, indicating either vegetation regrowth or cleared vegetation.

An existing single track railway line, overhead transmission and road runs through the landscape which represents a prominent feature within the visual environment. The presence of the prominent features suggests that the landscape has been functionally modified to provide utility services. A few isolated farmsteads are present, which indicate that the area is somewhat remote, habitation is limited, with no larger settlements.

The visual environment is open and visually exposed, with minimal obstruction to views across the landscape. Due to the limited vegetation cover it can be assumed that the area does not have natural visual screening. The terrain has no prominent hills, significant natural landform features such as trees, watercourses. This flat topography contributes to long-distance visibility.

The visual receptors would likely include road users, farmers and facilities. The absence of visible residential dwellings in the immediate foreground suggests that permanent residential receptors may be limited within close proximity.

In conclusion, the area has a capacity to absorb a new railway line without causing major loss of character or significant impacts on amenity. However, this is contingent on the careful consideration of the detailed design that will be to avoid creating an incongruously dominant new feature.

Figure 8-40: Luena station viewpoints

Source: OEC, 2025

8.13.3.4 *Caiza station*

The landscape is characterised is gently undulating with a predominantly open naturally rural environment. Field patterns are typically irregular, and field boundaries are usually defined by changes land cover type. The major land cover that exists consist of distributed grassland, shrubs and trees and thus has some natural scenic value.

An existing road runs through the landscape which represents a prominent feature within the visual environment. The presence of the prominent feature suggests that the landscape has been functionally modified to provide utility services. There is no indication of homestead or habitation, which indicates a very remote area.

The visual environment has prominent natural features including high trees and large shrubs which contribute to natural visual screening.

The visual receptors would likely include road users. The absence of visible residential dwellings in the immediate foreground suggests that there are no permanent residential receptors within close proximity.

In conclusion, the area has a theoretical capacity to absorb a new railway line as the natural screening currently reduces long-distance visibility and the absence of residential receptors indicate low visual receptor sensitivity. However, this is contingent on the careful consideration of the detailed design that will be to avoid creating an incongruously dominant new feature.

Figure 8-41: Caiza station viewpoints

Source: OEC, 2025

8.13.3.5 Ndongue and Saquembue stations

The location in which the Ndongue and Saquembue stations will be constructed share similar landscape and visual characteristic. The landscape is characterised is gently undulating with a predominantly open naturally rural environment. Field patterns are typically irregular, and field boundaries are defined by changes land cover type. The major land cover that exists consist of distributed grassland, shrubs and trees and thus has some natural scenic value.

An existing road runs through the landscape which represents a prominent feature within the visual environment. The presence of the prominent feature suggests that the landscape has been functionally modified to provide utility services. Informal dirt tracks and footpaths are visible throughout surrounding land, likely created by repeated human or livestock movement, indicating that the land is actively used, however there is no indication of homestead or habitation.

The visual environment has prominent natural features including high trees and large shrubs which contribute to natural visual screening.

The visual receptors would likely include road users and occasional land users utilising the informal paths The absence of visible residential dwellings in the immediate foreground suggests that there are no permanent residential receptors within close proximity.

In conclusion, the area has a theoretical capacity to absorb a new railway line as the natural screening currently reduces long-distance visibility and the absence of residential receptors indicate low visual receptor sensitivity. However, this is contingent on the careful consideration of the detailed design that will be to avoid creating an incongruously dominant new feature.

Figure 8-42: Ndongue station viewpoints

Figure 8-43: Saquembue station viewpoints

Source: OEC, 2025

8.13.3.6 Saurimo station

The landscape is characterised by flat topography, with a predominantly open natural environment. The major land cover that exists consist of distributed low-lying grassland, vegetation and scattered shrubs, forming a continuous and largely uninterrupted and intact land cover across the visible extent of the landscape. Vegetation in the areas is generally sparse and low, indicating either vegetation regrowth or cleared vegetation or possibly used for low intensity grazing.

An existing road runs through the landscape which represents a prominent built feature within the visual environment. The presence of the prominent features suggests that the landscape has been functionally modified to provide utility services. There is no indication of permanent or informal settlements, which indicate that the area is somewhat remote with no habitation.

The visual environment is open and visually exposed, with no obstruction to views across the landscape. This flat topography contributes to long-distance visibility Due to the flat to gently undulating terrains, limited prominent features such as hills or large trees/forest, it can be assumed that the area does not have natural visual screening.

The visual receptors would likely include road users. The absence of visible residential dwellings in the immediate foreground suggests that permanent residential receptors may be limited within close proximity. Therefore, low visual receptor sensitivity in terms of visual amenity.

In conclusion, the area may be sensitive to new linear infrastructure because changes would be easily perceived, even at distance or significant impacts on amenity. However, this is contingent on the careful consideration of the detailed design that will be to avoid creating an incongruously dominant new feature.

Figure 8-44: Saurimo station viewpoints

Source: OEC, 2025

8.13.3.7 Camanongue station

The landscape is characterised by flat topography, with woody vegetation and an open natural environment. The major land cover that exists consist of a mixture of distributed low-lying grassland, vegetation and scattered shrubs, forming a semi-natural mosaic land cover across the visible extent of the landscape. Vegetation in the areas is generally sparse and low, indicating either vegetation regrowth or cleared vegetation.

An existing gravel road runs through the landscape, leading to small scale residential settlements. The settlements represent a prominent built feature within the visual environment.

The visual environment is open and visually exposed, with obstruction to views across the landscape by the built houses. However, these houses are clustered together, which has minimum effect to long-distance visibility Due to the flat to gently undulating terrains, limited prominent features such as hills or large trees/forest, it can be assumed that the area does not have natural visual screening.

The visual receptors would likely include road users and residents, indicating high visual receptor sensitivity.

In conclusion, the area may be sensitive to new linear infrastructure because changes would be easily perceived, even at distance or significant impacts on amenity. However, the existing presence of the road and houses suggests that the landscape already accommodates some level of infrastructure, which can increase its potential capacity to absorb additional development, this is contingent on careful consideration of the detailed design.

Figure 8-45: Camanongue station viewpoints

Source: OEC, 2025

8.13.3.8 Dala station

The landscape is characterised by flat topography, with woody vegetation and an open natural environment. The major land cover that exists consist of a mixture of distributed low-lying grassland, vegetation, trees and scattered shrubs, forming a semi-natural mosaic land cover across the visible extent of the landscape. Vegetation in the areas is generally sparse and low, indicating cleared vegetation or low grazing zones.

An existing gravel road runs through the landscape, leading to medium scale residential settlements and a water tower. The presence of these built features suggest that the landscape has been modified. Informal dirt tracks and footpaths are visible throughout surrounding land, likely created by repeated human or livestock movement, indicating that the land is actively used.

The visual environment is a mixture of open and visually exposed landscapes with obstruction to views across the landscape by the built houses, water tower and natural features including high trees and large shrubs which contribute to natural visual screening and limits long-distance visibility.

The visual receptors would likely include road users, occasional land users and residents, indicating a high visual receptor sensitivity.

In conclusion, the area has a capacity to absorb a new railway line without causing major loss of character or significant impacts on amenity due to natural screening and the existing presence of built structures, suggesting that the landscape already accommodates some level of infrastructure, which can increase its potential capacity to absorb additional development, this is contingent on careful consideration of the detailed design.

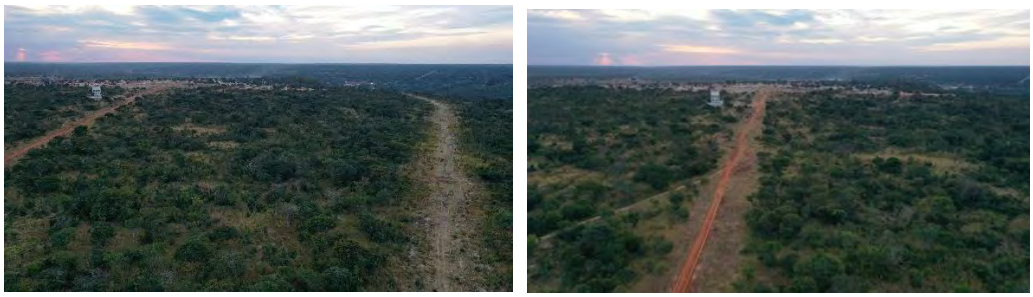


Figure 8-46: Dala station viewpoints

Source: OEC, 2025

8.13.3.9 Rivers

The proposed railway line crosses 11 rivers, namely: River Caiza, River Cassai, River Luachimo, River Lumeje, River Luxia, River Mombo, River Riacho, River Sambuamba, River Tchihinhi and River Tchiumbwe. At river crossings the landscape character changes from open savannah to woodland to a more visually contained riparian environment.

Although the areas have been partially modified by human activity, the landscapes in the proposed river crossing locations retain a predominantly natural character with vegetation

including trees, shrubs and tall grass concentrated along the rivers and throughout the wider area, contributing to the scenic quality and distinct sense of place.

The Tchiumbwe River crossing, located near the Dala waterfalls and hydropower plant, features one of the most prominent structures along the alignment: a railway bridge approximately 300 m northeast of the waterfalls, rising about 100 m from foundation to deck, making it the tallest bridge on the route. Further along, the Luachimo River area presents an expansive landscape of seasonal swamps and savannah grassland. Although these areas possess distinctive natural features, the railway structures are expected to integrate into the existing corridor, with any landscape or visual changes remaining localised.

The rivers are likely to be used by local communities for livestock, irrigation and household use. Therefore, sensitive receptors include communities who use the water for various purpose. Additionally, receptor includes road users where rivers coincide with river crossings.

The proposed railway development will introduce an additional structural infrastructure alongside existing features and bridges on the EN180; however, given the already modified corridor, major landscape or visual impacts are not anticipated.

Figure 8-47: River Caiza viewpoints

Figure 8-48: River Cassai viewpoints

Figure 8-49: River Luachimo viewpoints

Figure 8-50: River Luele viewpoints

Figure 8-51: River Lumeje viewpoints

Figure 8-52: River Luxia viewpoints

Figure 8-53: River Mombo viewpoints

Figure 8-54: River Riacho viewpoints

Figure 8-55: River Sambuamba viewpoints

Figure 8-56: River Tchihinhi viewpoints

Figure 8-57: River Tchiumbwe viewpoints

Source: OEC, 2025

9 BIODIVERSITY BASELINE

9.1 Biodiversity Area of Influence

Under IFC PS 1 the AoI must be delineated and should be considered to encompass, as appropriate:

- the primary project site(s) and related facilities that the client (including its contractors) develops or controls, such as power transmission corridors, pipelines, canals, tunnels, relocation, and access roads, borrow and disposal areas, construction camps
- associated facilities that are not funded as part of the project (funding may be provided separately by the client or by third parties including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the Project
- areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken
- areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The AoI does not include potential impacts that would occur without the Project or independently of the Project.

The AoI of the project is defined as a basis for identifying the boundaries for baseline data gathering by taking into consideration the spatial extent of potential direct and indirect impacts of the project. Direct impacts of the project are typically located within a smaller area around the Project activities (i.e., in the direct AoI). For this Project the direct area of influence is a 1 km buffer, either side of the planned railway track. This was the area of assessment for the Project.

Indirect impacts typically extend across a wider area and often relate to the socioeconomic sphere of influence of the project. A development project can indirectly affect various ecosystem services including water purification, climate regulation, soil fertility, and pollination. It can disrupt wildlife migration routes, assemblages, and breeding grounds, potentially leading to population declines. The extraction of timber, non-timber forest products, and aggregates can result in habitat degradation, reduced biodiversity, and increased erosion. Additionally, cultural and recreational services provided by natural landscapes may be diminished, impacting local communities and their traditional practices.

For the indirect impacts a 20 km indirect AoI has been utilized. The assessment zone was considered to enable identification of sensitive receptors and potential direct and indirect impacts of the project. The assessment includes a footprint of all project aspects including a quarry at Biula, which is approximately 18 km from the railway alignment. Any habitat located beyond the 20 km AoI from the proposed railway track is unlikely to be impacted by the development based on similar projects and professional experience. As such, the 20 km AoI is considered sufficient for this assessment and is referred to as the AoI from hereon.

9.2 Methodology

9.2.1 Desktop methodology

Desktop-based methods consisted of a document and database review of available information, including the Integrated Biodiversity Assessment Tool (IBAT). The Integrated Biodiversity Assessment Tool (IBAT) provides access to critical information on biodiversity priority sites to inform risk management and decision-making processes that address potential biodiversity impacts. This tool is a developed through a partnership of Birdlife International, Conservation International, IUCN and United Nations Environment World Conservation Monitoring Centre (UNEP-WCMC). The data for the area was acquired and has been incorporated into the reporting process. In addition to IBAT, statistics, and other data from private, federal, provincial, regional, and local sources. This search was completed to identify, extract, and compile available information that may influence the development and its impact on the biodiversity of the AoI.

A variety of datasets have been considered and reviewed to provide a suitable description of the project area, whilst also considering the surrounding areas. Table 9-1 presents an overview of datasets which were considered for this the desktop assessment but are not further elaborated on due to limited relevance. A comment has been provided for each dataset to describe the data and the relevance in the context of the Project.

Table 9-1: Datasets considered for the description of the project area and corresponding comments

Dataset	Comment
Global Critical Habitat Screening Layer (UNEP-WCMC (2017))	This screening layer presents the global spatial distribution of likely or potential Critical Habitat (CH), as defined by the IFC PS6 criteria. The project area does not traverse any likely CH
Protected Areas (IUCN and UNEP-WCMC (2023))	This dataset displays areas that are legally protected according to various designations and managed to achieve conservation objectives. The project area does not traverse any listed protected area. The nearest protected area is the Cameia National Park, located approximately ~60 km west of the project area (Figure 9-5)
RAMSAR (IUCN and UNEP-WCMC (2016))	The nearest RAMSAR site is located in Luanda, referred to as the Angola accession site
Biosphere Reserve (IUCN and UNEP-WCMC (2016))	No Biosphere Reserves are listed for Angola
Biodiversity Hotspots	A biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction. No hotspots are located proximal to the project area
Alliance for Zero Extinction (AZE) sites (2010)	This dataset displays critical sites for conservation that contain endangered species with limited ranges and populations found nowhere else on the planet. No AZE sites are located proximal to the Project area
Endemic Bird Areas (EBA) (Stattersfield et al., 1998)	This dataset displays areas where the geographic range of two or more endemic bird species overlaps. No EBAs are proximal to the project corridor. EBAs are located in the western region of the country
Important Bird & Biodiversity Areas (IBA) (BirdLife International, 2014)	This dataset displays areas that play a key role in the protection of birds and biodiversity, whose identification is part of a global project, curated by BirdLife International. The nearest IBA is the Cameia National Park

9.2.2 Terrestrial ecology survey methodology

9.2.2.1 Botanical studies

Homogenous vegetation units were subjectively identified using satellite imagery, existing land cover maps and a Shuttle Radar Topography Mission Digital Elevation Model (SRTM DEM). The floristic diversity and search for flora Species of Conservation Concern (SCC) were conducted through timed meanders within representative habitat units delineated before and during the site survey. The timed random meander method is a highly efficient method for conducting floristic analysis specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost effective and highly suited for compiling flora species lists and therefore gives a rapid indication of flora diversity. The timed random meander search was performed based on the original technique described by Goff et al. (1982). Suitable habitat for SCC was identified according to Raimondo et al. (2009) and targeted as part of the timed random meanders.

9.2.2.2 Floristic habitat delineation

The data obtained during the fieldwork was used to manually adjust the preliminary habitat units mapped using satellite imagery (Google Corporation), existing land cover data for the area and more importantly, georeferenced ground-level photography and extensive field notes from transects obtained during the fieldwork surveys. The resulting habitat delineation will be intended for use at a scale of 1:50000.

9.2.2.3 Mammals

The following methods are the standard operating procedure for mammal surveys and were applied during this assessment.

9.2.2.3.1 Likelihood of Occurrence

There is a high likelihood that not all mammal species known to occur within the AoI, and surrounding areas were located during the survey. Therefore, a 'Likelihood of Occurrence' (LOO) and a 'SCC' review was applied to any potential omissions in the data set. For the LOO analysis, a full summary of Red-List mammals, as well as other SCC was tabulated, with a simple likelihood applied. The relevant species of special consideration or SCC was addressed separately based on the data collected during the fieldwork studies, in context of the development and the effects that these may have on both the ecology and spatial distribution of the species.

9.2.2.3.2 Spoor tracking

Spoor tracking is considered to be the world's oldest science, enabling detailed sampling of mammalian species without the need for trapping or direct observation. All spoor, including footprints, den sites, burrows, hairs, scrapings, and diggings was recorded and documented by detailed geo-referenced photography. Spoor tracking took place during general fieldwork, during specific timed spoor tracking drives/transects and at carefully chosen locations such as roads and other areas with highly trackable substrates.

9.2.2.3.3 Scat and pellets

Small predator scats and owl pellets have been used to identify rodent populations present within the AoI. The method relies on the use of undigested or regurgitated jawbones, which are compared against reference material at the University of Pretoria to identify rodent species.

9.2.2.3.4 Nocturnal and day-time surveys

Nocturnal Surveys: This technique is an essential tool in mammalian sampling, simply because most of the target species are only active after dark. High power spotlights are used from the vehicle to illuminate nocturnal species. Some mammal species can be located using vocalisations.

Day Time Direct Observations: All mammals observed during the sampling period, their geographic coordinates and the surrounding habitat were recorded. This data was used to supplement the overall habitat analysis to give context to the area. Animals were encountered through driving, normal routine movement through the AoI, and through active searching of refugia.

Further to both the nocturnal and diurnal (day) time surveys, (1) camera trapping, (2) point survey counts, and (3) funnels and pitfall traps were originally proposed as possible methods to incorporate when sampling fauna within the AoI. However, given the time limitations associated with this project, we were unable to implement any of these methods during the course of the seasonal surveys.

9.2.2.3.5 Survey limitations

Camera trapping, point survey counts, and funnels/pitfall traps were proposed as possible methods but were not implemented due safety concerns of moving in an area that was not yet demined at the time of the ESIA. In addition, safety concerns did not allow for the implementation of night-time surveys during both the dry and wet season surveys. The use of these methods for future targeted biodiversity surveys will improve the likelihood of detecting fauna species facilitating the accurate quantification of the fauna diversity present on site.

9.2.2.4 Avifauna studies

9.2.2.4.1 Walked transects

Walked transects were conducted at various locations along the proposed railway corridor within the 1 km buffer. The length of each transects (average: 628 m; range: ~214 m – 1642 m) differed slightly depending on accessibility. The aim of the transects was to gather data on the diversity and relative abundance of birds on site, particularly regarding smaller passerines. The following data were collected at each surveying location:

- the species (identification) of each bird observed or heard
- the number of individuals observed for each species.

9.2.2.4.2 Survey limitations

The methodology focused on diurnal and opportunistic observations. Nocturnal surveys and advanced methods such as point counts or mist-netting were not conducted.

9.2.2.4.3 Ad hoc surveys

To obtain a more complete inventory of bird species present (apart from those observed during the point counts), all bird species observed while moving along the proposed route were identified and noted. Particular attention was also paid to suitable roosting, foraging and nesting habitat for threatened or near-threatened species. Besides visual observations, bird species will also be identified by means of their calls and other signs such as nests, discarded eggshells and feathers.

9.2.2.5 Herpetofauna

9.2.2.5.1 Active searching

Reptiles were searched for on foot within the AoI during the day. Active searching for reptiles entailed the following:

- photographing active reptiles from a distance with a telephoto lens
- lifting up and searching under debris or rocks (rocks were returned to their original positions)
- scanning for any signs of reptiles such as shed skins, the positive identification of which was taken as an observation of that species
- catching any observed active reptile by hand. All captured reptiles were photographed and released unharmed.

Only one reptile species was recorded during the survey. A more comprehensive assessment of herpetofaunal diversity would require additional sampling methods such as pitfall trapping and nighttime surveys. Therefore, the limitations stated for mammal surveys (section 9.2.2.3.5) applies to herpetofauna.

Figure 9-1 overleaf depicts the survey Points of Interest (POI).

Figure 9-1: Map depicting the surveyed Points of Interest (POI)

9.2.3 Freshwater ecology survey methodology

The hydrological settings of the proposed development were defined. This includes the catchment sizes, runoff potential, elevation profiles as well as other general characteristics of the freshwater associated environmental components such as:

- wetlands
- swamps
- rivers
- streams
- drainage areas/lines
- locations sampled are further presented in the sections below.

9.2.3.1 Water quality

Water quality was measured in situ using a calibrated handheld water quality meter. The constituents considered that were measured included: pH, conductivity (µS/cm), temperature (°C) and Dissolved Oxygen (DO) in percent saturation (mg/l and %). Water quality analysis is typically conducted at each sampling site along the watercourses in the project area which contain water.

9.2.3.2 Riverine habitat sensitivity

Due to the extent of the 20 km buffer, a digital elevation model was used to identify freshwater sensitive habitats. Sensitivity is directly proportional with water availability.

9.2.3.3 Integrated Habitat Assessment System (IHAS)

The quality of the instream and riparian habitat influences the structure and function of the aquatic community in a stream; therefore, the assessment of the habitat is critical to any assessment of ecological integrity. The Integrated Habitat Assessment System (IHAS, version 2) was applied at selected sampling sites to assess the availability of habitat biotopes for macroinvertebrates. The IHAS was developed specifically for use with the SASS5 index and rapid biological assessment protocols in South Africa (McMillan, 1998). The index considers sampling habitat and stream characteristics. The sampling habitat is broken down into three sub-sections namely Stones-In-Current (SIC), Vegetation (VEG), Gravel Sand & Mud (GSM) and other habitat/ general. It is presently thought that a total IHAS score of over 65% represents good habitat conditions, a score over 55% indicates adequate/fair habitat conditions and a score below 55% indicates poor habitat (McMillan, 1998) (Table 9-2).

Table 9-2: Integrated Habitat Assessment System Scoring Guidelines.

IHAS Score	Description
> 65%	Good (Diverse)
55-65%	Adequate (Moderately diverse)
< 55%	Poor (Low diversity)

9.2.3.4 *Aquatic macroinvertebrate*

In order to define the sensitivity of the aquatic environment and provide realistic site-specific potential impacts, it is proposed that sessile aquatic macroinvertebrates are sampled in a standard aquatic invertebrate assessment similar to that provide in the South African Scoring System (SASS) (Dickens and Graham, 2002). It is proposed that sampling points align with the extent of the proposed developmental area but are focused in areas surrounding proposed crossings, nursery locations and other major infrastructure.

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (*Barbour et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (*Barbour et al*., 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of monitoring the health of an aquatic ecosystem.

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. Field sampling is easy and since the communities are heterogeneous and several phyla are usually represented, response to environmental impacts is normally detectable in terms of the community as a whole (Hellawell, 1977). The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution; these sensitivities range from highly tolerant families to highly sensitive families. Taxa were divided into three sensitivity categories according to Gerber and Gabriel (2002): highly tolerant taxa (Intolerance Rating 1-5), moderately tolerant taxa (Intolerance Rating 6 - 10) and intolerant taxa (Intolerance Rating 11 - 15). SASS results are expressed both as an index score (SASS score) and the Average Score Per Taxon (ASPT value). Sampled macroinvertebrates were identified using “A Field Guide to Freshwater Macroinvertebrates of Southern Africa” (Fry, 2022). Identification of organisms was made to family level (Thirion et al., 1995; Gerber and Gabriel, 2002).

9.2.3.5 *Ichthyofauna characteristics*

The expected fish species data was obtained from Skelton (2019). Using the country wide species list, species were added or removed according to the zoogeographical regions stipulated in Skelton, (2001) and *Abell et al.* (2008). Thereafter, the International Union for the Conservation of Nature (IUCN, 2020) spatial distribution data were extracted (clipped) using GIS for the project area. These studies suggest fish community affinities between the Kwanza River and Cunene River Basins. Considering this, fish species found in both river basins were included in the expected species list. Although it is likely that there were erroneous species included in the overall expected fish species list, the inclusion of these species will produce a robust and extensive assessment of the region’s freshwater fishes.

Collection techniques of fish within selected sites are dependent on habitat and included methods such as electroshocking with an Haltech electro-fisher, seine and fyke nets, cast nets, angling and underwater action camera (Go-Pro). Fish were identified in the field using Skelton (2001), iNaturalist, and GBIF. Selected specimens were photographed and released at the point of capture. Qualitative data were collected at each site to establish fish diversity and abundances of the aquatic systems. Fish habitat preferences were determined through assessment of various drivers. Examples of fishing methods applied during the survey can be seen in (Figure 9-2Figure 9-2: Different fishing methods applied during the survey (Photos taken by TBC, November 2023) below. It should be noted that, sampling was limited due to time constraints, safety concerns, and flooding conditions (fast deep waters not wadable). Therefore, only vegetation margins were sampled and should be interpreted accordingly and with caution.

Figure 9-2: Different fishing methods applied during the survey (Photos taken by TBC, November 2023)

9.2.4 Methodology for QGIS Multispectral Analysis

The following was undertaken to identify and delineated habitat classes.

Data Acquisition: Obtain multispectral imagery from satellite providers like Landsat or Sentinel. Ensure the imagery includes necessary spectral bands relevant to your analysis, such as RGB, Near-Infrared (NIR), and Short-Wave Infrared (SWIR). These bands are crucial for various types of environmental and land cover analysis.

Band Combination: Utilize the "Raster Calculator" to create custom band combinations or indices, such as the Normalized Difference Vegetation Index (NDVI), calculated as (NIR - Red) / (NIR + Red). Save the results as new raster layers. These indices help

highlight specific features or conditions in the study area, providing valuable insights for further analysis.

Visualization: Apply false colour composites by assigning different bands to RGB channels, such as NIR to Red, Red to Green, and Green to Blue, for enhanced visualization of specific features. Adjust the symbology and stretch histogram to enhance the contrast and visibility of these features, making it easier to interpret the data.

Classification: Perform supervised or unsupervised classification using tools like the "Semi-Automatic Classification Plugin" (SCP). For supervised classification, select training samples for each land cover class and classify the image based on these samples. For unsupervised classification, set the desired number of classes and classify the image accordingly. This step categorizes the imagery into distinct land cover types, facilitating detailed analysis.

Accuracy Assessment: Collect ground truth data to assess the accuracy of the classification. Create a confusion matrix to evaluate the classification's performance and calculate accuracy metrics such as overall accuracy, producer's accuracy, user's accuracy, and the kappa coefficient. This accuracy assessment ensures that the classification results are reliable and can be used confidently for further analysis.

Throughout this process, site data that is generated is instrumental in calibrating the model. Ground truth data is used to refine and validate the classification and analysis, ensuring that the model accurately represents real-world conditions. This calibration step is crucial for enhancing the reliability and accuracy of the multispectral analysis conducted in QGIS.

9.3 Ecoregions

9.3.1 Terrestrial ecoregions

The railway line traverses one terrestrial bioregion namely the Greater African Subequatorial Savannas & Mixed Woodlands (AT11)[103] and the planned Luena Saurimo Railway project is fully within the Angolan Wet Miombo Woodlands ecoregion[104].

The Angolan Miombo woodlands ecoregion is primarily located in the southern African country of Angola. This expansive ecoregion traverses across the central and southern regions of Angola and is characterized by its unique vegetation type known as Miombo woodlands. These woodlands consist predominantly of deciduous trees, such as Brachystegia and Julbernardia species, interspersed with grasslands. The Angolan Miombo woodlands ecoregion supports a diverse range of fauna, and an array of bird species. This ecoregion plays a vital role in the conservation of Angola's biodiversity and ecosystem services (*Burgess et al*. 1998; Huntley et al., 2023).

[103] (https://www.oneearth.org/navigator/Angolan Miombo woodlands).

[104] https://www.oneearth.org/ecoregions/angolan-wet-miombo-woodlands/

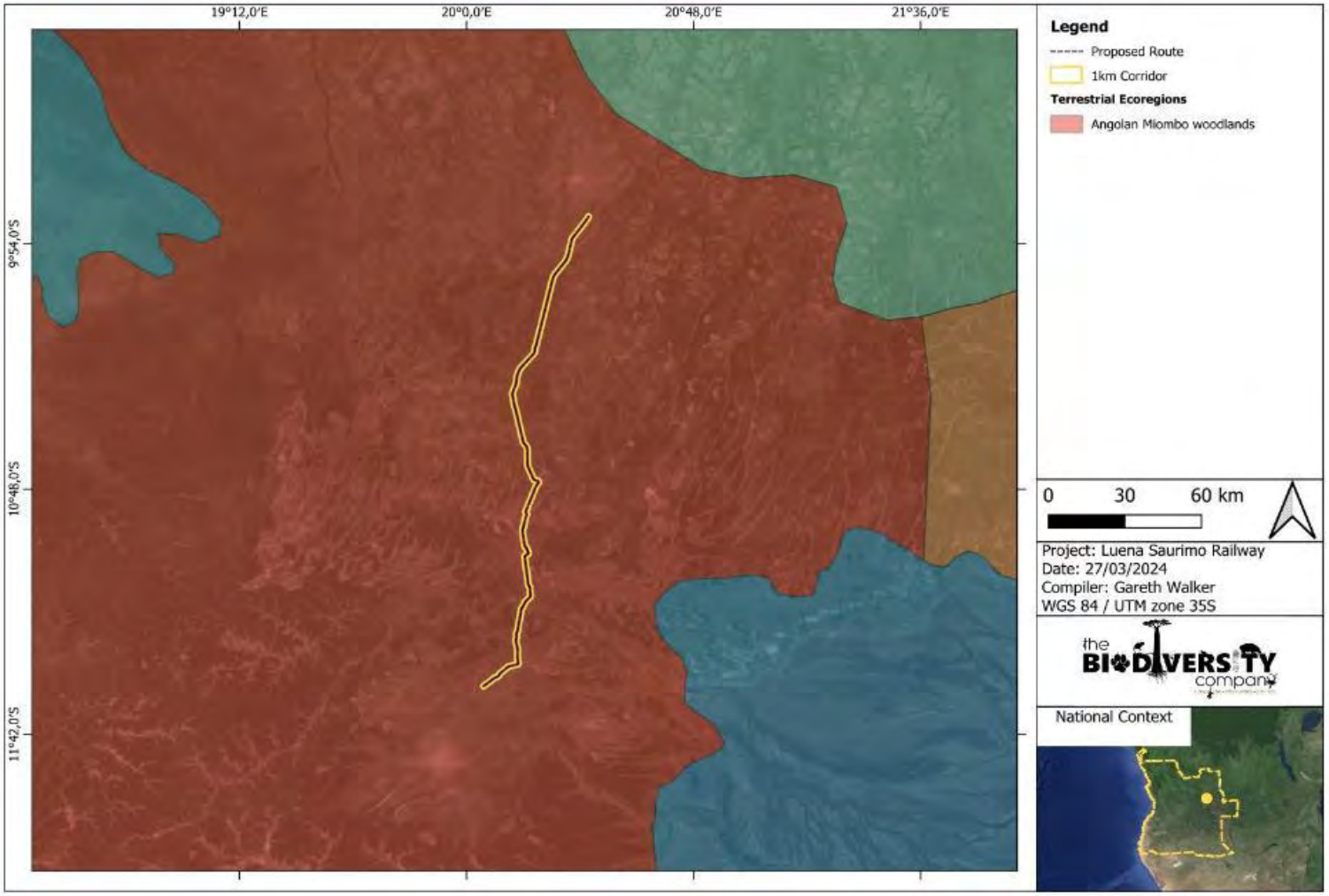


Figure 9-3: The location of the project area within the terrestrial Angolan Miombo woodland ecoregion (OneEarth 2024)

9.3.2 Freshwater ecoregion

The project area falls predominantly within the Kasai Ecoregion with a small portion within the Zambezian Headwater Ecoregion (FEOW, 2008). The Kasai Ecoregion largely follows the boundaries of the catchment of the Kasai River, which encompasses a vast area (900 000 km^2) within southwestern Democratic Republic of Congo (DRC) and the northeast corner of Angola. The Zambezi Headwater ecoregion extends from the Okavango catchment in the west to the headwaters of the Kafue River in the east and includes the headwaters of the Upper Zambezi River. Most of the rivers drain the interior of Angola, but parts of the upper Zambezi and the upper Kafue flow through northern Zambia. The headwaters of the Zambezi share a common watershed divide with the Congo River Basin to the northeast, and with the headwaters of the Cuanza and other westward draining rivers of Angola to the northwest.

According to FEOW (2008), the Kasai ecoregion largely follows the boundaries of the catchment of the Kasai River. The many falls and rapids along the course of the Kasai River and its tributaries restrict the movement of fish and this may explain the high level of endemism in this ecoregion. Rapids have prevented the dispersal of species to the lower reaches of rivers as well as headwater colonization by potentially competing species. A few of the uppermost tributaries of the Kasai are included within the Zambezian Headwaters ecoregion due to their historic connection with the rivers of that ecoregion and the Zambezian affinity of their fauna. Regarding endemic species, Angolan tributaries on the Lunda Plateau harbour an impressive array of endemic fishes, including the dwarf distichodontid *Dundocharax bidentatus* and one or more poeciliids, cyprinids, mormyrids and cichlids (FEOW, 2008). The Fwa River, a short (20 km) tributary of the Lubi located in the middle of the ecoregion, also possesses five endemic cichlid species. Two of the endemic cichlids (*Cyclopharynx fwae* and *C. schwetzi*) belong to a genus only found in the Fwa. The Fwa's stable environment might have facilitated speciation. Other species in rapids of the lower Kasai River, specialised fish assemblages known only from a few historical specimens include the cichlids *Steatocranus rouxi* and *Teleogramma monogramma*. Interestingly, these taxa often have their closest relatives in Pool Malebo and the rapids of the Lower Congo, but not in other parts of the Kasai drainage. These reports of endemic species refer to locations outside of the Project's AoI.

Presently the Zambezian Headwaters share a number of species with the southern tributaries of the Congo River; hence, some of the most upstream portions of these Congo headwaters have been included in the Upper Zambezian Headwaters ecoregion. The capture of the Upper Zambezi and Kafue by the Middle Zambezi in the Plio-Pleistocene had little effect on the nature of the fauna of this ecoregion, as Kafue Gorge and Victoria Falls presented impassable barriers to the upstream migration of fish. Five species of fish, *Paramormyrops jacksoni*, *Parakneria fortuita*, *Hypsopanchax jubbi*, *Barbus bellcrossi*, and *Schilbe yangambianus*, are endemic to the headwaters of these rivers. The level of biological investigation in this ecoregion is low. Angola is very poorly known biologically, and a substantial amount of further investigation is needed in this ecoregion before an adequate evaluation of biological distinctiveness can be made (FEOW, 2008).

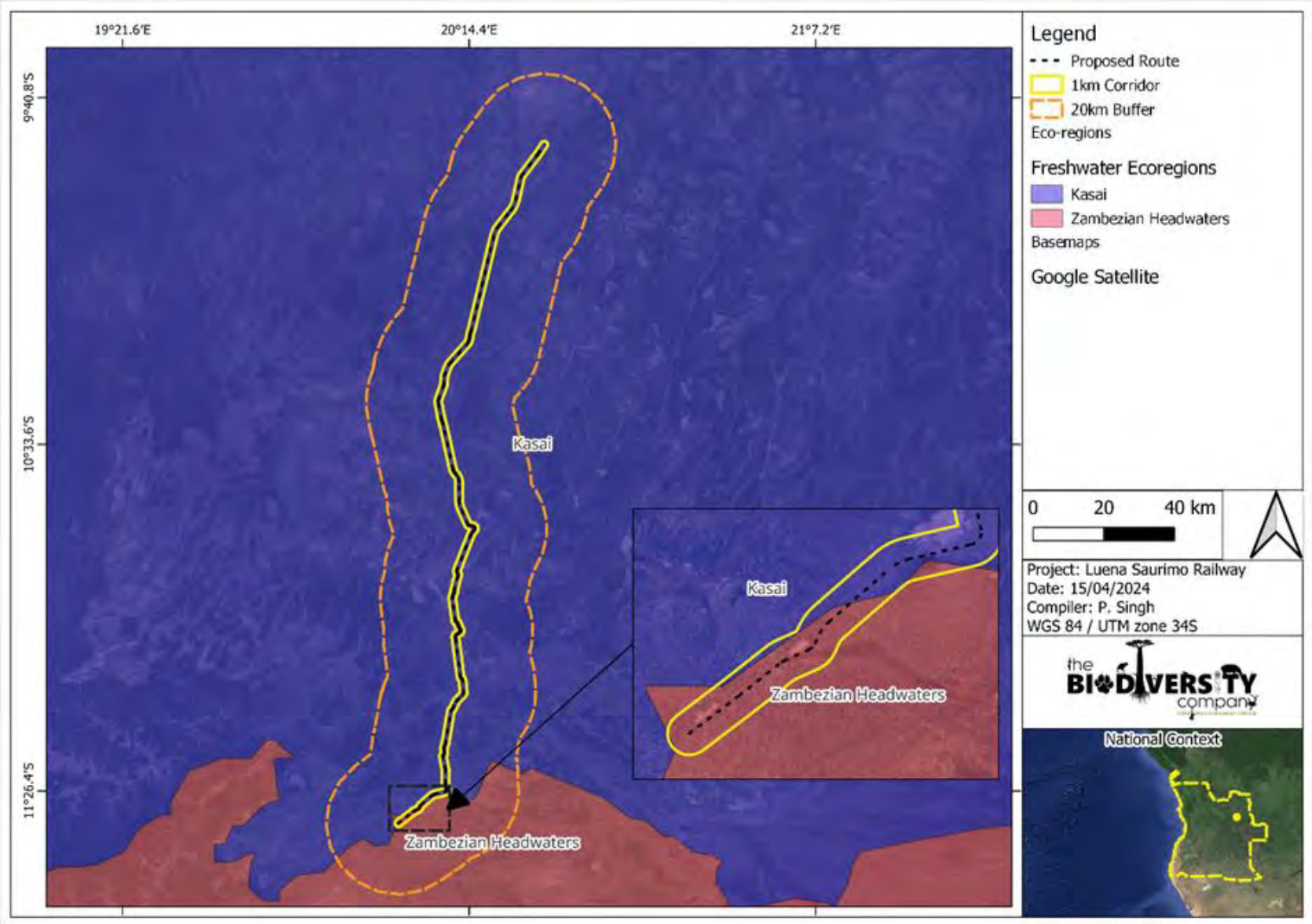


Figure 9-4: The project area falls within the Kasai and Zambezian Headwaters Freshwater Ecoregion (FEOW, 2008).

9.4 Protected areas

Cameia National Park (Parque Nacional da Cameia), situated in the Moxico province of Angola and approximately 1100 meters above sea level, encompasses an area of 14,450 square kilometres. This protected area shares its name with the nearby Cameia municipality. The park's northern boundary is defined by the Cameia-Luacano road, while the southern section of the eastern boundary is formed by the Chifumage River. To the southwest, the Lumeje and Luena rivers mark the park's boundary. This boundary is more than 50 km away from the Project's corridor, hence outside of the Project's direct AoI. The International Biodiversity Assessment Tool (IBAT) database similarly does not indicate a protected area to be within 50 km from the project.

The park predominantly comprises seasonally flooded plains that are part of the Zambezi River basin. The northern part of the park drains into the Chifumage River. Additionally, there are extensive miombo woodlands, reminiscent of those found in the Zambezi basin in western Zambia.

Beyond the park's boundaries are two lakes, Lago Cameia and Lago Dilolo, the latter being the largest lake in Angola. Both lakes feature extensive reedbeds and grassy swamps, creating a habitat that supports a diverse population of aquatic birds.

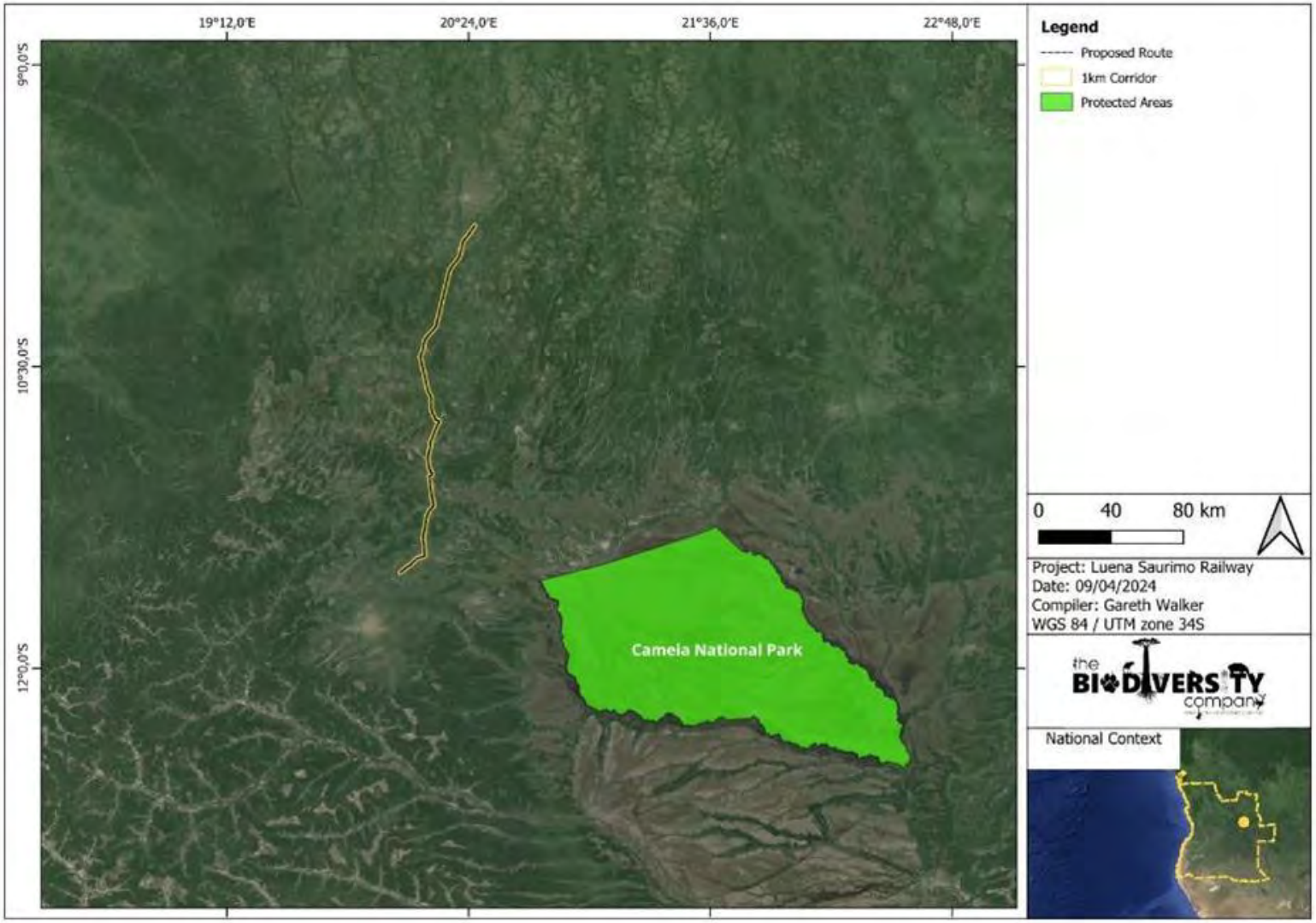


Figure 9-5: The project area in relation to the Cameia National Park

Cameia NP is home to various avifauna species such as: White-throated Francolin (*dewittei*), Wattled Crane, Forbes's Plover, Margaret's Batis (*kathleenae*), Grey-olive Greenbul (*schoutedeni*), Rufous-naped Lark (*kabalii/gomesi*), Angola Lark (antonii), Chirping Cisticola (congo), Cloud Cisticola (*anselli*), Dambo Cisticola (*dambo*), Southern Hyliota (*inornata*), Congo Moor Chat and Grimwood's Longclaw, as well as Böhm's Spinetail, Grey Go-away-bird (*molybdophanes*), Southern Ground Hornbill, Meyer's Parrot (*matschiei*), Black-fronted Bushshrike (*manningi*), Brubru (*nigritemporalis*), Desert Cisticola (*traylori*), Tawny-flanked Prinia (*kasokae*), Yellow-breasted Apalis (neglecta), African Thrush (*stormsi*), Familiar Chat (*modesta*), Collared Sunbird *(garguensis*), Purple-banded Sunbird (*microrhynchus*) and Black-and-white Mannikin (*woltersi*). Consequently, Cameia NP has been identified as an Important Bird Area (IBA) and Key Biodiversity Area (KBA) in Africa and Dean (2001) summarised a total of 144 species within Cameia NP.

9.4.1 Endemic Bird Areas (EBAs)

While numerous bird species have widespread distributions, a significant portion, totalling over 2,500, are endemic to and confined within areas covering less than 5 million hectares, referred to as restricted-range species. BirdLife International has undertaken the comprehensive task of mapping each restricted-range species by utilizing geo-referenced locality records. This meticulous effort has led to the identification of specific regions across the globe, known as "Endemic Bird Areas" (EBAs), where the ranges of two or more of these species intersect.

It is noteworthy that half of all restricted-range species are currently classified as globally threatened or near-threatened, while the other half remain susceptible to habitat loss or degradation. Moreover, the majority of EBAs play a vital role in the conservation of restricted-range species belonging to other animal and plant groups. These distinctive landscapes hosting these avian species occupy a mere 4.5% of the Earth's land surface, emphasizing their utmost importance in the realm of large-scale ecosystem conservation efforts.

In terms of geographical characteristics, EBAs often manifest as islands or mountain ranges and exhibit substantial variability in size, spanning from a few hundred hectares to more than 10,000,000 hectares. EBAs also display variations in the number of restricted-range species they harbour, ranging from as few as two to as many as 80. While EBAs can be found worldwide, the majority, approximately 77%, are situated in tropical and subtropical regions.

Most of the habitat across Angola is comprised of Angolan scarp savanna and woodlands. It also includes areas of Angolan wet miombo woodlands. This region has no Intact Forest. The area has a predominantly equatorial climate with dry winters. It is part of the Tropical and Subtropical Grasslands, Savannas and Shrublands biome. The proposed development does not overlap with the EBA identified in Angola (Figure 9-6).

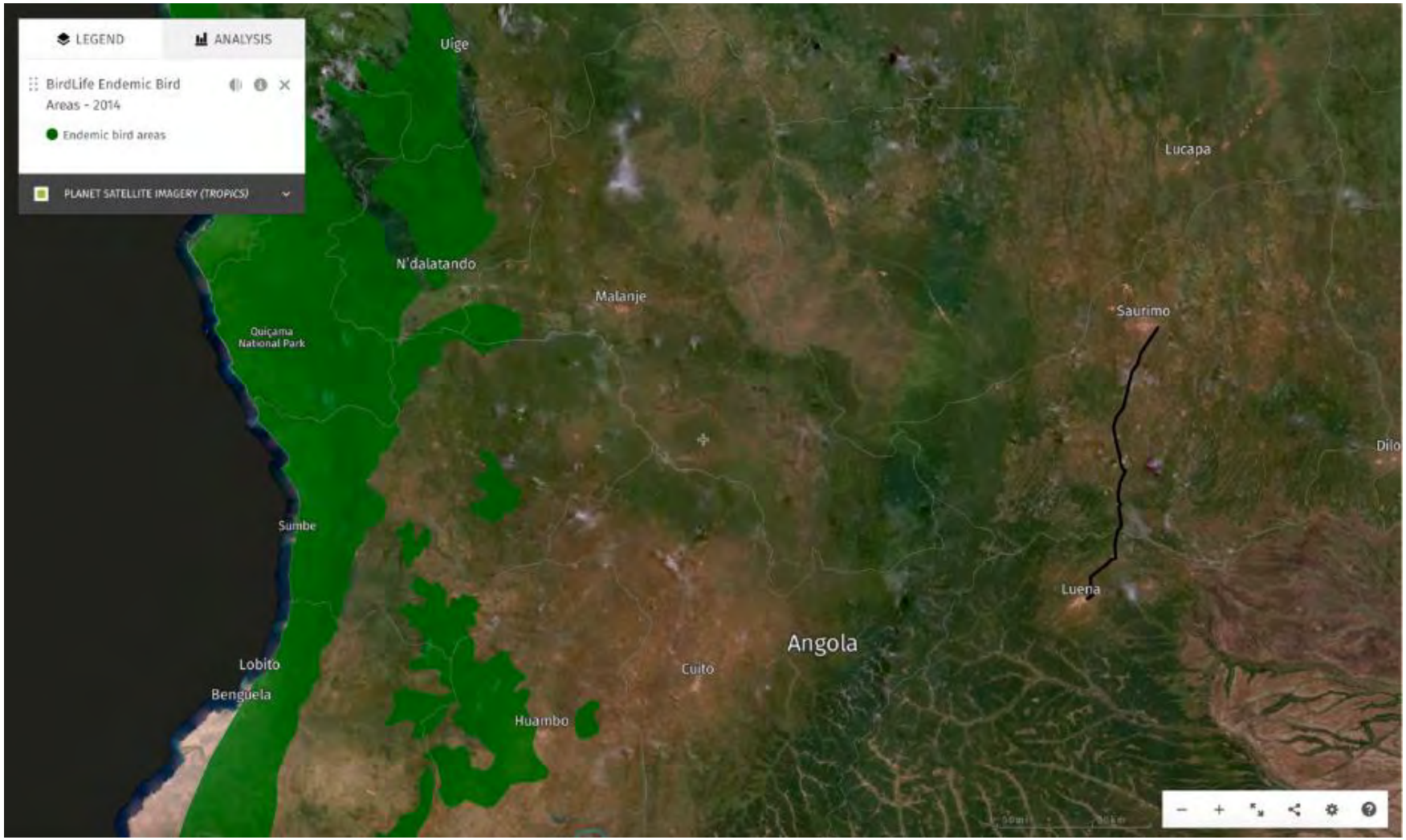


Figure 9-6: The project area in relation to the EBA (Global Forest Watch, 2025)

9.5 Land cover

Land cover mapping was aligned to the extent possible to the Copernicus landcover classes, and derived from analysing Sentinel 2 multi-spectral imagery. The imagery dated from 8 September 2023, which coincides with the initial flush of greening of vegetation, facilitating a better distinction between vegetation cover types. At the same time, this imagery was still clear of cloud formations that typically obscure data. Training points used for the classification of remote-sensing data included interpretations from Google Earth imagery, and site observations. The full set of these land-cover (and landuse) maps is presented within Appendix 03. Without further ground-truthing possible at the time of the survey, secondary vegetation, e.g. old fields now covered with high shrubby or mixed woodland vegetation could not be distinguished from primary vegetation with similar structure, nor could different types of habitats within the land cover classes be mapped out. Using the precautionary approach, land-cover classes were thus presumed to be either natural or modified, even if some of the natural habitats may be in a poor ecological state. Land-cover classification will be improved after observations from the anticipated RAP investigations have been completed.

Of the approximately 52,750 ha within the 1 km AoI buffer, 71.6% is presumed to be natural habitat, and 28.4% is confirmed modified habitat (see Table 9-3 for a breakdown). Presuming that the rail and associated temporary and permanent infrastructure will transform approximately 475 ha across the 260 km length, then within the AoI possibly 1% of the presumed natural habitat (± 380 ha) may be transformed, with up to 0.6% of the modified habitat (± 90 ha).

Table 9-3: The land cover classes for the project AoI and their approximate extent

Land cover	Type	Area (ha)	Area (%)
Built-up	Modified	1669.78	3.17
Croplands	Modified	13312.66	25.24
Open, sparsely vegetated areas or bare land	Natural	2215.50	4.20
Forest/Woodland	Natural	1812.20	3.44
Shrubland	Natural	24764.21	46.95
Water	Natural	227.78	0.43
Wetlands	Natural	2028.48	3.85
Grasslands/Herbaceous	Natural	6719.39	12.74
Total		**52,750.00**	**100**

Note: the extent of measurable open water, wetlands and floodplains may vary depending on the season of capture of the remote sensing data, combined with the rainfall received prior to the capture of remote sensing data.

The landcover classes can be briefly described as follows:

- Confirmed modified habitat:
  - Built-up areas: these included roads, settlements and related structures as well as larger urban areas

- Croplands: these included annual crops, perennial crops as well as orchards. Where from historic imagery and site insights fallow lands could be distinguished from grassland and/or shrubland, this was included into this landcover class

- Presumed natural habitat, but in various states of ecological integrity (see Section 9.5.1):
  - Open, sparsely vegetated areas or bare land: this land cover consisted mostly of periodically inundated floodplains, as these areas were typically found adjacent to wetlands and/or rivers
  - Forest/Woodland vegetation consisted of mosaics of open (15-40%) broadleaved deciduous forest/woodland and closed to open (>15%) mixed broadleaved deciduous forest
  - Shrubland included closed to open shrubland, which could also have included some secondary fallow fields (often referred to as “farmbush”), as well as savanna-like patchy mosaics of low forest, grassland and thicket
  - Grassland/herbaceous vegetation included a variety of more expansive grasslands, but could have also included swamp grasslands, which would qualify as seasonal wetlands
  - Water environs in the AoI were mostly perennial rivers, whilst wetlands included floodplains and other seasonally or permanently wet depressions. Both these land-cover classifications were further informed by the surface water investigation.

9.5.1 Current land use and disturbance

Vegetation and habitat types within the project area are impacted by alien infestation, crop and livestock subsistence farming, mining and infrastructure development, construction, and slash-and-burn practices (Figure 9-7).

Figure 9-7: Current impacts on the vegetation and habitat types within the project area (e.g., subsistence farming, construction, infrastructure development, and slash-and-burn

9.6 Threatened Fauna and Flora in Angola

According to the International Union for Conservation of Nature (IUCN, 2016), Angola contains a total of 172 threatened species (Table 9-4). The numbers of flora and fauna within each IUCN category for Angola is depicted in Table 9-5.The full IUCN red list is appended in Appendix 16.1.2.

Table 9-4: IUCN threatened species in Angola ranked taxonomically.

Mammals	Birds	Reptiles*	Amphibians*	Fish*	Molluscs*	Other Inverts*	Plants*	Total*
22	33	7	0	56	7	4	43	172

*These groups have not yet been completely assessed, and their figures should be interpreted as species that are known to be threatened to date.

Table 9-5: Number of fauna and flora species in each IUCN Red List category for Angola

	CR	EN	VU	Subtotal	NT	DD	LC	Total
Flora	4	19	46	**69**	37	78	1,406	**1,590**
Fauna	24	52	84	**160**	66	213	2,943	**3,382**

9.7 Terrestrial ecology

9.7.1 Desktop findings

9.7.1.1 Vegetation types

This section is divided into a description of the relevant vegetation types expected under natural conditions and the expected flora species.

Angolan Wet Miombo Woodlands

These woodlands, savannas and grasslands typically receive more than 1000 mm of rain per year and occur at elevations ranging from ~900 m to ~1500 m above mean sea level. *Brachystegia spiciformis* occurs in varying densities and robustness throughout the miombo woodland, with other species (i.e., *B. floribunda, B. glaberrima, B. longifolia, B. wangermeeana, and B. gossweileri)* occurring at varying densities depending on the underlying soil characteristics. Julbernardia paniculata is also widespread across the Angolan miombo, along with *Burkea, Cryptosepalum, Guibourtia*, and Pterocarpus. The wet miombo consists of a mosaic of woodlands, grasslands, and savannas with a continuous grass cover, even under a thin cover of woodland canopy, where the grass

biomass may be too sparse to support fire penetration in most seasons. Shrubs and short trees of wet miombo include *Diplorhynchus condylocarpon, Baphia massaiensis*, and *Copaifera baumiana*. On the edges of drainage-line grasslands, species of *Monotes*, Protea, and *Uapaca* occur as short trees. Grasses include species of Andropogon, *Digitaria, Elionurus, Eragrostis, Hyparrhenia, Loudetia, Monocymbium, Setaria*, and Panicum – becoming prominent under woodland (Huntley, 2023).

Angolan Dry Miombo Woodlands

These woodlands occur on the deep, heavily leached Kalahari sands of southeast Angola, where the gently undulating landscape with broad valleys is drained by waters from the Longa, Cuito and Cuando basins, descending from ~1200 to ~1000 m. The deciduous woodland canopies occur at 8 to 15 m in height. The floristic composition dry miombo woodlands is less rich than wet miombo, with *Brachystegia bakerana* and *Burkea africana* being prominent, along with *Julbernardia paniculata, Guibourtia coleosperma, Dialium engleranum, Schinziophyton rautanenii,* and *Cryptosepalum exfoliatum*. The catenal series of broad valleys between occurring between the rises (i.e., ancient dunes) are seasonally waterlogged and carry grasslands of Loudetia, Trachypogon, Eragrostis, and *Monocymbium.* On the open margins of the *catenas*, communities of *geoxyles* are found, and include *Brachystegia russelliae,* B. *bakerana*, *Parinari capense* and *Chamaeclitandra henriquesiana* (Huntley, 2023).

Expected flora species

The IBAT indicates that 251 species of indigenous plants are expected to occur within the development area and surrounding landscape (this list will be made available upon request). The database indicates that a total of fourteen (14) SCC are expected to occur within both the direct and indirect AoI. These include two (2) Critical (CR), three (3) Endangered (EN), three (3) Vulnerable (VU), and six (6) Near Threatened or Lower Risk/Near Threatened (NT OR LR/NT) species (

Table 9-6). The IBAT data is attached as Appendix 16.1.3.

Table 9-6: SCC flora species that may occur within the Area of Influence according to the IBAT database

Family	Species	IUCN Red List	Likelihood Of Occurrence	Observed During Surveys	Comments
LYTHRACEAE	*Rotala robynsiana*	CR	Moderate	No	Not detected; habitat present but species rare
XYRIDACEAE	*Xyris exigua*	CR	Low	No	Not detected; habitat present but species rare
EUPHORBIACEAE	*Croton gossweileri*	EN	Low	No	Not detected; low likelihood due to limited suitable habitat.
ORCHIDACEAE	*Disa aequiloba*	EN	Moderate	No	Not detected; moderate likelihood due to suitable habitat in AoI
LENTIBULARIACEAE	*Genlisea angolensis*	EN	Moderate	No	Not detected; habitat present but species rare
CHRYSOBALANACEAE	*Magnistipula butayei subsp. youngii*	EN	Low	No	Not detected; low likelihood due to limited suitable habitat
DROSERACEAE	*Drosera bequaertii*	VU	Low	No	Not detected; low likelihood due to limited suitable habitat
PODOSTEMACEAE	*Inversodicraea cristata*	VU	Low	No	Not detected; low likelihood due to limited suitable habitat
LYTHRACEAE	*Rotala smithii*	VU	Moderate	No	Not detected; moderate likelihood due to suitable habitat in AoI
PRIMULACEAE	*Anagallis elegantula*	NT OR LR/NT	Moderate	No	Not detected; moderate likelihood due to suitable habitat in AoI
PRIMULACEAE	*Anagallis kochii*	NT OR LR/NT	Moderate	No	Not detected; moderate likelihood due to suitable habitat in AoI
FABACEAE	*Daniellia alsteeniana*	NT OR LR/NT	Low	No	Not detected; moderate likelihood due to suitable habitat in AoI

Family	Species	IUCN Red List	Likelihood Of Occurrence	Observed During Surveys	Comments
LYTHRACEAE	*Rotala gerardii*	NT OR LR/NT	Low	No	Not detected; low likelihood due to limited suitable habitat
LENTIBULARIACEAE	*Utricularia bracteata*	NT OR LR/NT	Moderate	No	Not detected; moderate likelihood due to suitable habitat in AoI
XYRIDACEAE	*Xyris angustifolia*	NT OR LR/NT	Low	No	Not detected; low likelihood due to limited suitable habitat

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT= Near Threatened, LR/NT=Lower risk but near threatened.

9.7.1.2 *Faunal assessment*

Herpetofauna

Based on the IBAT database 146 herpetofauna species are expected to occur within the indirect AoI. Of these, one (1) reptilian SCC (NT OR LR/NT) is expected to occur within the indirect AoI (Table 9-7).

Table 9-7: Herpetofauna SCC expected in the AoI

Family	Species	Common name	IUCN	Habitat	Likelihood Of Occurrence	Observed During Surveys	Comments
PYTHONIDAE	*Python sebae*	Central African Rock Python	NT OR LR/NT	Forest, Savanna, Shrubland, Grassland, Rocky Areas	High	No	Not detected; high likelihood due to suitable habitat and regional records

NT= Near Threatened, LR/NT=Lower risk but near threatened.

Mammals

The IBAT Mammal database lists a total of 130 mammalian species expected to occur within and around the development area. Of these, fourteen (14) SCCs are expected to occur within the indirect AoI, including two (2) CR, one (1) EN, five (5) VU, and seven (6) NT OR LR/NT species (Table 9-8). No indigenous mammals were observed during the survey, and hence only likelihood of occurrence is indicated.

Avifauna

The IBAT database lists over 350 species potentially present as indicated from historical records and/or distribution models by IUCN, of which only thirteen (13) SCC (Table 9-9). The latter include two (2) CR, five (5) EN, three (3) VU, and three (3) NT OR LR/NT species, Of the NT species, one (Mountain Pipit) is considered to be range-restricted.

Table 9-8: Mammal SCC expected in the project area

Family	Species	Common Name	IUCN	Habitat	Likelihood Of Occurrence
RHINOCEROTIDAE	*Diceros bicornis* (and any subspecies)	Black Rhino (and any subspecies)	CR	Savanna, Shrubland, Desert	Unlikely – considered extinct in Angola
MANIDAE	*Phataginus tricuspis*	White-bellied Pangolin	EN	Forest, Savanna, Artificial/Terrestrial	High
FELIDAE	*Acinonyx jubatus*	Cheetah	VU	Open Savanna, Open Shrubland, Grassland, Wetlands (inland)	Unlikely
CERCOPITHECIDAE	*Colobus angolensis* (also listed as *Colobus angolensis* ssp. *angolensis*)	Angolan Colobus	VU	Forest	Moderate
FELIDAE	*Panthera leo*	Lion	VU	Forest, Savanna, Shrubland, Grassland, Desert	Unlikely
FELIDAE	*Panthera pardus*	Leopard	VU	Forest, Savanna, Shrubland, Grassland, Rocky areas	Moderate
MUSTELIDAE	*Aonyx capensis*	African Clawless Otter	NT OR LR/NT	Forest, Grassland, Wetlands (inland)	High
BOVIDAE	*Cephalophus dorsalis*	Bay Duiker	NT OR LR/NT	Forest, Artificial/Terrestrial	High
BOVIDAE	*Cephalophus sylvicultor*	Yellow-backed Duiker	NT OR LR/NT	Forest, Savanna, Shrubland, Artificial/Terrestrial	High
PTEROPODIDAE	*Eidolon helvum*	African Straw-coloured Fruit-bat	NT OR LR/NT	Forest, Savanna, Artificial/Terrestrial	High
MUSTELIDAE	*Hydrictis maculicollis*	Spotted-necked Otter	NT OR LR/NT	Forest, Wetlands (inland), Marine Neritic, Marine Intertidal	High
BOVIDAE	*Kobus vardonii*	Puku	NT OR LR/NT	Savanna, Grassland, Wetlands (inland)	Moderate

Table 9-9: Avifauna SCC expected in the project area

Family	Species	Common Name	IUCN	Habitat	Likelihood Of Occurrence	Observed During Surveys	Comments
ACCIPITRIDAE	*Gyps africanus*	White-backed Vulture	CR	Forest, Savanna, Shrubland, Grassland, Desert, Artificial/Terrestrial	Moderate	No	Not detected; moderate likelihood due to suitable habitat and regional records.
ACCIPITRIDAE	*Necrosyrtes monachus*	Hooded Vulture	CR	Forest, Savanna, Shrubland, Grassland, Wetlands (inland), Desert, Artificial/Terrestrial	Moderate	No	Not detected; moderate likelihood due to suitable habitat and regional records.
ACCIPITRIDAE	*Polemaetus bellicosus*	Martial Eagle	EN	Forest, Savanna, Shrubland, Grassland, Wetlands (inland)	High	No	Not detected; high likelihood due to suitable habitat and regional records.
ACCIPITRIDAE	*Torgos tracheliotos*	Lappet-faced Vulture	EN	Forest, Savanna, Shrubland, Grassland, Desert	Moderate	No	Not detected; moderate likelihood due to suitable habitat and regional records.
ACCIPITRIDAE	*Terathopius ecaudatus*	Bateleur	EN	Forest, Savanna, Shrubland, Grassland	Confirmed	Yes	Detected during survey; suitable habitat present.
ACCIPITRIDAE	*Aquila nipalensis*	Steppe Eagle	EN	Forest, Savanna, Grassland, Desert Rocky areas (e.g. inland cliffs, mountains)	High	No	Not detected; high likelihood due to suitable habitat and regional records.
SAGITTARIIDAE	*Sagittarius serpentarius*	Secretary bird	EN	Open Savanna or Shrubland, Grassland, Artificial/Terrestrial	Low	No	Not detected; low likelihood due to limited suitable habitat.
BUCEROTIDAE	*Bucorvus leadbeateri*	Southern Ground-hornbill	VU	Forest, Savanna, Shrubland, Grassland,	Moderate	No	Not detected; moderate likelihood due to suitable

Family	Species	Common Name	IUCN	Habitat	Likelihood Of Occurrence	Observed During Surveys	Comments
				Wetlands (inland), Artificial/Terrestrial			habitat and regional records.
GRUIDAE	*Bugeranus carunculatus*	Wattled Crane	VU	Grassland, Wetlands (inland), Artificial/Terrestrial, Artificial/Aquatic & Marine	Moderate	No	Not detected; moderate likelihood due to suitable habitat and regional records.
FALCONIDAE	*Falco vespertinus*	Red-footed Falcon	VU	Forest, Savanna, Shrubland, Grassland, Wetlands (inland), Artificial/Terrestrial	Confirmed	Yes	Detected during survey; suitable habitat present.
MOTACILLIDAE	*Anthus hoeschi*	Mountain Pipit	NT OR LR/NT	Shrubland, Grassland	Low	No	Not detected; low likelihood due to limited suitable habitat.
SCOLOPACIDAE	*Gallinago media*	Great Snipe	NT OR LR/NT	Savanna, Shrubland, Grassland, Wetlands (inland), Artificial/Terrestrial	High	No	Not detected; high likelihood due to suitable habitat and regional records.
OTIDIDAE	*Neotis denhami*	Denham's Bustard	NT OR LR/NT	Savanna, Shrubland, Grassland, Artificial/Terrestrial	Low	No	Not detected; low likelihood due to limited suitable habitat.

9.7.2 Field findings

The following sections provide results from two seasonal surveys (dry and wet seasons) that were conducted for the proposed development. The first, conducted from the 2nd to the 8th of October 2023 constitutes a dry season survey; the second, conducted from the 10th to the 20th of March 2024 constitutes a wet season survey. Flora assessment

This section is divided into four sub-sections:

- vegetation/habitat units
- indigenous flora
- Species of Conservation Concern (SCC)
- Invasive Alien Plants (IAPs).

Vegetation/habitat units

According to the field verification, six (6) main vegetation/habitat units occur within the AoI. These habitats were identified based on vegetation characteristics such as dominant species and vegetation structure. It is, however, important to note that delineation of vegetation/habitat units beyond the 1 km development corridor were completed at a desktop level without any supporting ground-truth evidence. The vegetation/habitat units identified are listed in (Table 9-10), and correspond broadly with the land cover classes identified in Section 9.5 above. Their approximate extent is mapped in Figure 9-8, Figure 9-9 and Figure 9-10.

Table 9-10: Vegetation/habitat units identified within the AoI

Vegetation unit	IFC Habitat	Approximate extent in AoI	Disturbance level	Habitat condition	Ecosystem services
Aquatic areas (including rivers, dams, and wetlands) (Land cover classes water, wetlands and open bare land)	Natural	± 4471.8 ha (± 8.5%)	Low to Very High	Good to poor	Freshwater supply, biodiversity support, fisheries, flood regulation, erosion control, water filtration, recreational opportunities, transportation routes, hydropower generation, cultural significance, and aesthetic and educational value
Angolan Miombo Woodlands (Land cover class Forest/Woodland)	Natural	Combined: ± 1812.2 ha (± 3.4 %)	Moderate to High	Slightly degraded to Very poor	Carbon sequestration, water regulation, timber and non-timber forest products, Erosion control, cultural significance, tourism potential, climate regulation, soil fertility maintenance, pollination support, food production and natural resource regulation
Forests (Land cover class Forest/Woodland)	Natural		Moderate to High	Slightly degraded to Poor	Carbon sequestration, water regulation, timber and non-timber forest products, Erosion control, cultural significance, tourism potential, climate regulation, soil fertility maintenance, pollination support, food production and natural resource regulation
Savannas and Grasslands (Land cover class Shrubland and Grasslands/Herbaceous)	Natural	± 31486.6 ha (± 59.7%)	Moderate to High	Slightly degraded to Very poor	Carbon sequestration, water regulation, timber and non-timber forest products, cultural significance, tourism potential, climate regulation, soil fertility maintenance, pollination support, food production and natural resource regulation
Agricultural/Croplands (Land cover class Croplands)	Modified	± 13312.7 ha (± 25.2%)	N/A	N/A	Food production, water filtration, soil fertility maintenance, pollination support, genetic diversity conservation, carbon sequestration, cultural significance, employment generation, opportunities for recreation and tourism, and habitat provision for biodiversity
Modified/Degraded Habitats (Land cover class Built-up)	Modified	± 1669.8 ha (± 3.2 %)	N/A	N/A	Food production, water infiltration

Aquatic Habitats

This habitat unit collectively includes all bodies of water (i.e., rivers, wetlands, swamp forest and dams). The dominant species found in this habitat are *Voacanga africana*, Ficus sycomorus subsp. sycomorus, Phragmites australis, Typha capensis, Acalypha *ornata, Millettia versicolor* and *Cyperus papyrus*. Although portions of this habitat unit have been degraded, most of the aquatic habitats are intact and have the capability to support a high diversity of terrestrial fauna flora. Further, aquatic habitats are integral for community members residing within the AoI who use these habitats to hunt and fish, obtain drinking water, clean themselves and their clothing, and process agricultural food items. Because of this, aquatic areas naturally have a higher ecological sensitivity and should – as best as possible - be conserved and maintained.

Angolan Miombo Woodlands

Angolan Miombo woodland is distinguished from other African savanna, woodland, and forest formations by the dominance of tree species in the family *Fabacea,* subfamily Caesalpinioideae, particularly in the *genera Brachystegia, Julbernardia*, and *Isoberlinia.* Large trees widespread in the Angolan Miombo include *Brachystegia junciformis*, *Julbernardia paniculata, Copaifera baumiana*, B. *floribundum*, B. boehmii, B. *gossweileri,* and *B. wangermeeana.* Most Miombo woody species shed their leaves in the dry season. A few weeks before the onset of the rains, the trees flush again. Various large areas of woodland vegetation within the project area have been modified for agriculture, creating a highly fragmented network of woodland habitat units. However, as illustrated above, many woodland areas still exist predominantly in naturalized form facilitating ecosystem services (as previously discussed) and promoting the existence of high fauna and flora diversity.

Forests

The dominant species within this habitat type are *Spondias mombin, Sterculia dawei, Adansonia digitata* (locally protected species)*, Ceiba pentandra, Chromolaena odorata* (alien invasive)*, Mangifera indica* (exotic, cultivated)*, Psidium guajava* (alien invasive)*, Albizia adianthifolia, Millettia versicolor, Albizia zygia, Ricinodendron heudelotii* and *Griffonia speciosa*. The condition of the forests differs markedly. All the forests have had some degree of past logging and/or poaching (as depicted above). Many large areas within the project area have been cleared and burnt for agricultural use, creating a highly fragmented network of forest islands. Having said this, some of these islands still host a natural complex of mostly indigenous species.

Savanna and Grasslands

The dominant species found within this habitat type are *Terminalia brachystemma, Psorospermum febrifugum, Leucaena leucocephala* (alien invasive), *Erythrina abyssinica, Albizia adianthifolia, Diplorhynchus condylocarpon, Peltophorum africanum, Hyparrhenia diplandra, Sorghum bicolor, Annona senegalensis, Piliostigma thonningii* and *Cochlospermum angolense*. This habitat has also been well utilised, and many parts have been completely cleared for subsistence farming. However, many areas are large intact and occur in a mostly naturalized, unmodified state.

Agricultural Areas

These are areas where the natural, historical vegetation has been cleared and planted with a variety of crops (Cassava, Sweet potato, Maize, and bananas). Further, livestock and aquaculture farming have further contributed to the transformation of the land.

Modified Habitat

This habitat has been transformed either through building roads, infrastructure, clearing or mining. There is very little natural vegetation present. Impact and degradation in these areas is high.

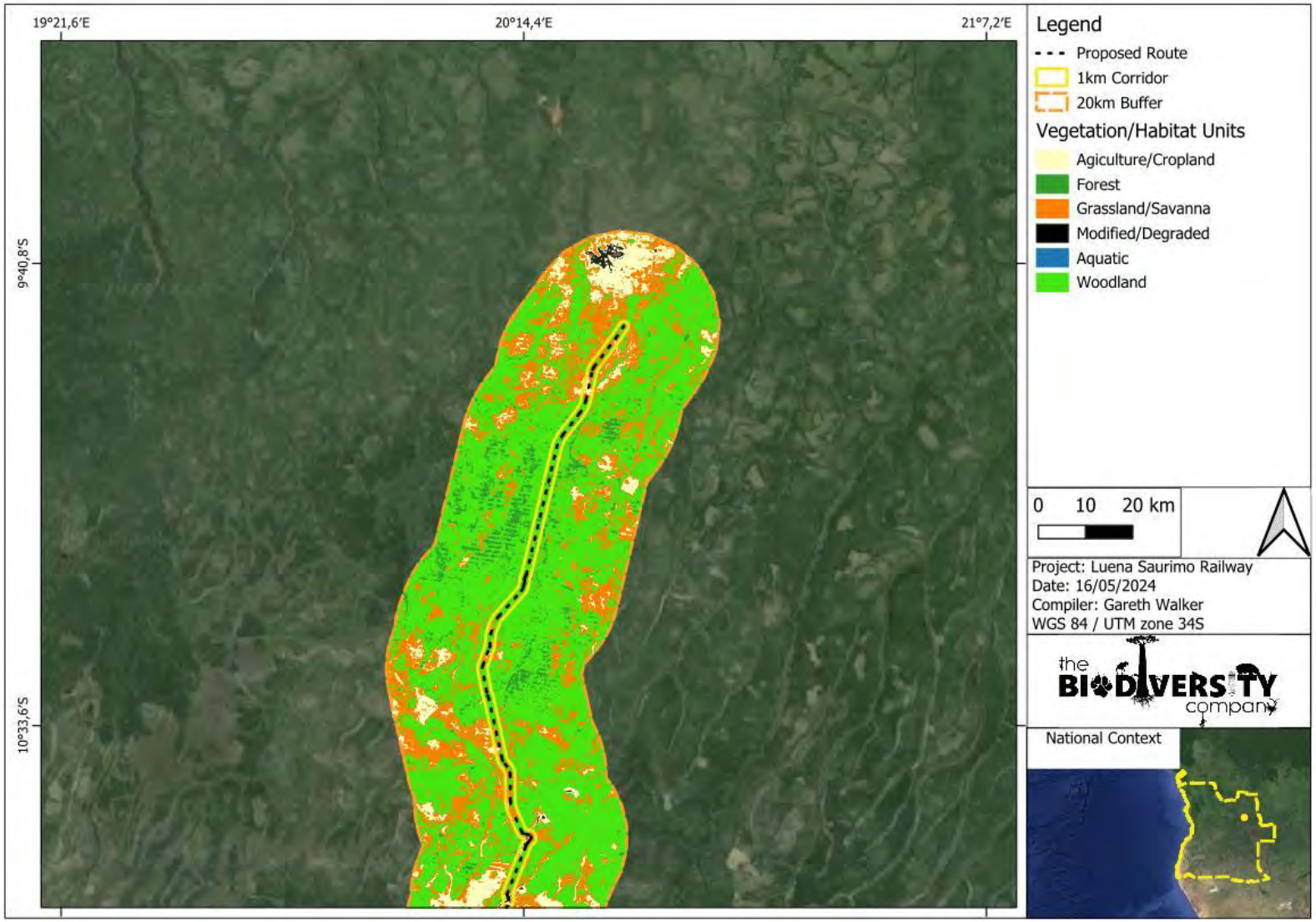


Figure 9-8: Vegetation types on and around the AoI – northern section

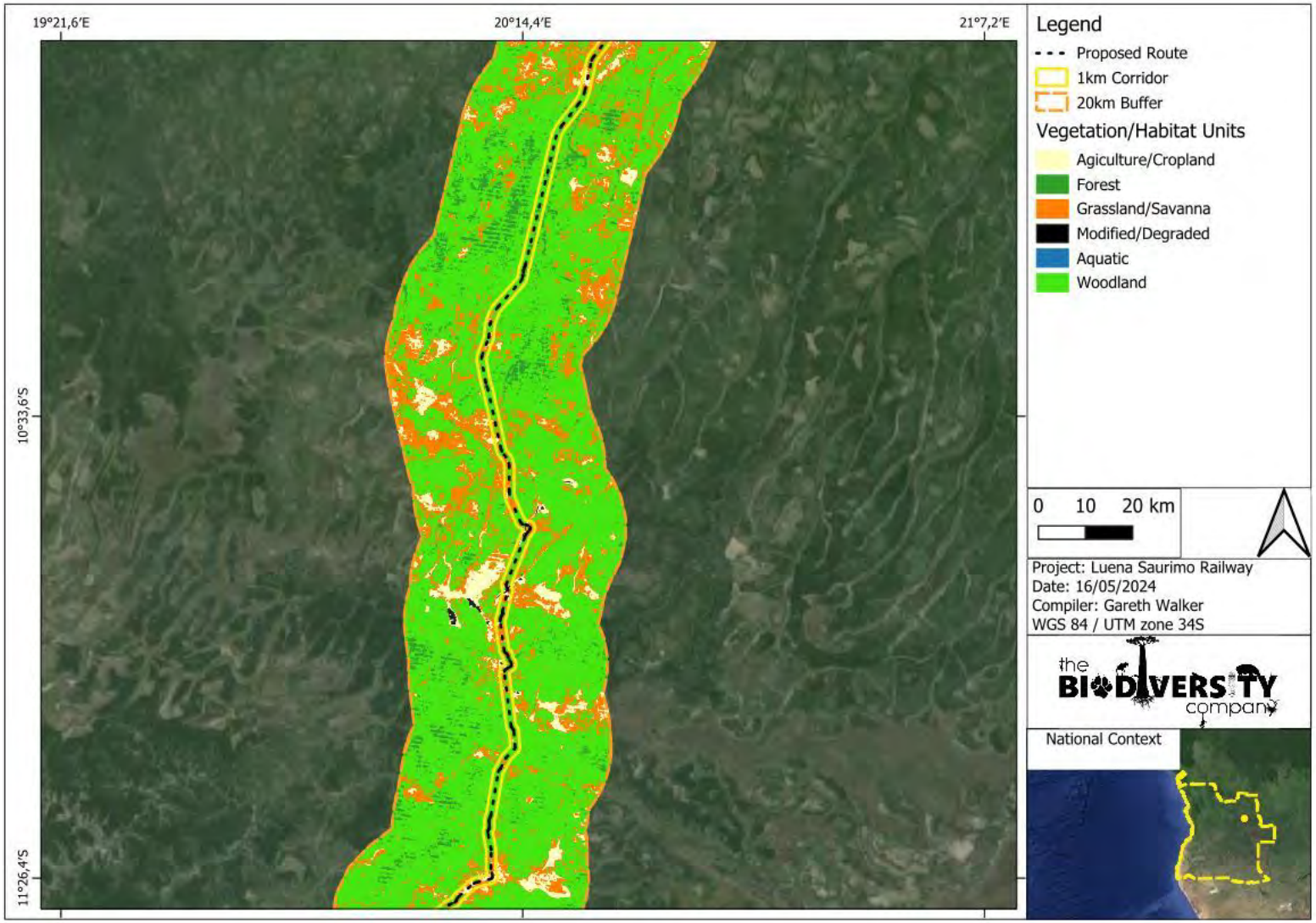


Figure 9-9: Vegetation types on and around the AoI – central section

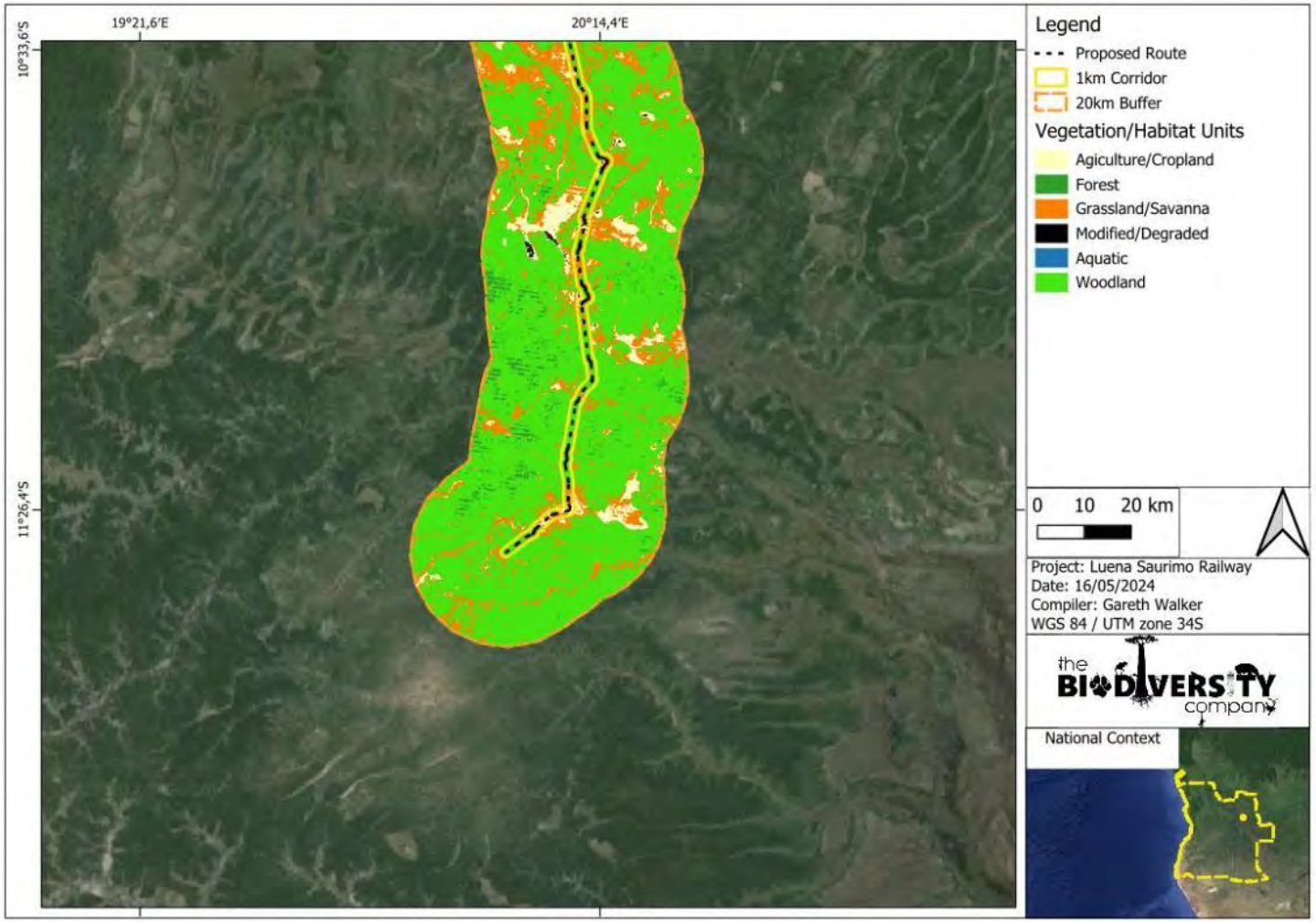


Figure 9-10: Vegetation types on and around the AoI – southern section.

Indigenous Flora

No flora SCC were detected within the AoI. Several of the species recorded are indicator taxa of the vegetation types described in section 9.7.1.1 of this report. Photographs illustrating examples of some of the species recorded within the AoI are provided below.

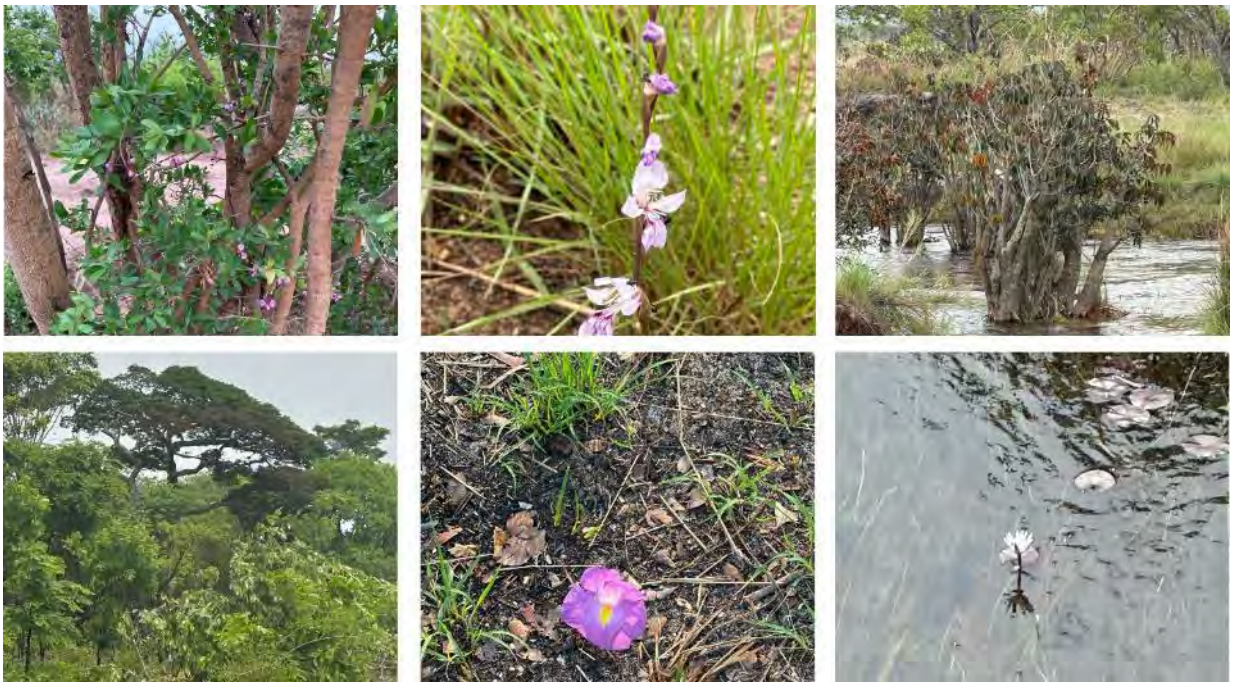


Figure 9-11: Photographs depicting examples of some indigenous plant species found within the assessment area

Invasive Alien Plants

Invasive Alien Plants (IAPs) tend to dominate or replace indigenous flora, thereby transforming the structure, composition and functioning of ecosystems. Therefore, it is important that these plants are controlled by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species.

A total of 42 alien and/or invasive plant (AIP) species were recorded in and around the development area. Most of these were recorded in the urban, peri-urban and in areas impacted by infrastructure development, croplands and derived semi-natural pastures and old fields. The list of the exotic species is detailed in Table 9-11. Some of these species are widely cultivated but are of low concern, others have become naturalised and may cause local weed nuisance (e.g. competition with crops), whilst invasive species have the potential to do significant harm to local ecosystem and ecosystem functionality of left unchecked. This invasiveness has been included in the table below.

Table 9-11: List of the alien plant species observed, indicating invasive status

Species	Invasiveness	Species	Invasiveness
Spondias mombin	Naturalised, cultivated	*Tagetes minuta*	Invasive
Tithonia diversifolia	Invasive	*Richardia brasiliensis*	Naturalised
Ricinus communis	Invasive	*Musa × paradisiaca*	Naturalised, cultivated
Mangifera indica	Naturalised, cultivated	*Boerhavia diffusa*	Naturalised
Psidium guajava	Naturalised, cultivated	*Albizia lebbeck*	Exotic/Naturalised
Calotropis gigantea	Invasive	*Sida acuta*	Invasive
Carica papaya	Naturalised, cultivated	*Leea guineensis*	Exotic/Naturalised
Leucaena leucocephala	Invasive	*Emilia fosbergii*	Naturalised
Chromolaena odorata	Invasive	*Gomphrena celosioides*	Naturalised
Tridax procumbens	Invasive	*Mimosa pudica*	Invasive
Caesalpinia pulcherrima	Naturalised, cultivated	*Mimosa pigra*	Invasive
Terminalia catappa	Naturalised, cultivated	*Mimosa diplotricha*	Invasive
Manihot esculenta	Naturalised, cultivated	*Senna spectabilis*	Invasive
Canna indica	Invasive	*Nicandra physalodes*	Invasive
Mitracarpus hirtus	Naturalised	*Amaranthus viridis*	Naturalised
Bidens pilosa	Invasive	*Dysphania ambrosioides*	Naturalised
Cascabela thevetia	Invasive	*Parthenium hysterophorus*	Invasive
Persea americana	Naturalised, cultivated	*Mesosphaerum suaveolens*	Invasive
Mirabilis jalapa	Invasive	*Emilia sonchifolia*	Naturalised
Lantana camara	Invasive	*Melia azedarach*	Invasive
Bambusa vulgaris	Naturalised	*Solanum mauritianum*	Invasive

9.7.2.1 *Faunal assessment*

Herpetofauna

A single (1) reptile species was recorded within the development area. It is not classified as an SCC. It is possible that more species may occur within the AoI, however obtaining an accurate estimate of herpetofauna diversity will require extensive sampling procedures (e.g., pitfall trapping, nighttime surveys, etc.) over extended periods of time that were unfortunately beyond the scope of this assessment.

Table 9-12: Herpetofauna recorded from the assessment area.

Family	Species	Common Name	IUCN
Reptiles			
Colubridae	*Dasypeltis palmarum*	Palm Egg Eater	LC

Figure 9-12: Photograph illustrating the single herpetofauna species (*Dasypeltis palmarum* – Palm Egg Eater) recorded within the assessment area

Mammals

A total of five (5) mammal species were recorded within the project area during the survey period (Table 9-13 and Figure 9-13). Of these, one (1) is considered an SCC (i.e., *Aonyx capensis* – Cape Clawless Otter).

Table 9-13: Mammal species recorded within the project area during the survey periods.

LC = Least Concern

Family	Species	Common Name	IUCN
Bovidae	*Philantomba monticola*	Blue Duiker	LC
Bovidae	*Duiker spp. (Unknown)*	*	*
Herpestidae	*Atilax paludinosus*	Marsh Mongoose	LC
Mustelidae	*Aonyx capensis*	Cape Clawless Otter	NT
Viverridae	*Civettictis civetta*	African Civet	LC

Figure 9-13: Photographs depicting tracks and signs of fauna species known to occur within the assessment area

9.7.2.2 Avifauna

A total of one hundred and seven (107) avifauna species were recorded within the project area during the survey period (Table 9-14). It is highly likely that additional avifauna species will be recorded from the project area through extensive sampling. Two SCC (Bateleur - *Terathopius ecaudatus* and Red-footed Falcon - *Falco vespertinus*) were recorded within the Project area.

Table 9-14: Avifauna species recorded within the project area during the survey periods

Common Name	Scientific Name	Regional	IUCN	Congregatory	Migratory
African Palm Swift	*Cypsiurus parvus*	LC	LC		
African Pied Wagtail	*Motacilla aguimp*	LC	LC		
African Stonechat	*Saxicola torquatus*	LC	LC		Resident and local migrant
Amethyst Sunbird	*Chalcomitra amethystina*	LC	LC		
Amur Falcon	*Falco amurensis*	LC	LC	In massive numbers 1000+ sometimes	Palearctic winter Migrant
Angolan Batis	*Batis minulla*	LC	LC		
Angolan Swallow	*Hirundo angolensis*	LC	LC		Partial local migrant
Arrow-marked Babbler	*Turdoides jardineii*	LC	LC		
Ashy Flycatcher	*Muscicapa caerulescens*	LC	LC		
Bateleur	*Terathopius ecaudatus*	NT	EN		
Black Crake	*Zapornia flavirostra*	LC	LC		
Black Cuckooshrike	*Campephaga flava*	LC	LC		Resident and intra-African migrant
Black Saw-wing	*Psalidoprocne pristoptera*	LC	LC		Resident and intra-African migrant
Black-and-rufous Swallow	*Hirundo nigrorufa*	LC	LC	Up to 20 in non-breeding season	Partial local migrant
Black-backed Puffback	*Dryoscopus cubla*	LC	LC		
Black-collared Barbet	*Lybius torquatus*	LC	LC		
Black-crowned Tchagra	*Tchagra senegalus*	LC	LC		
Black-headed Oriole	*Oriolus larvatus*	LC	LC		

Common Name	Scientific Name	Regional	IUCN	Congregatory	Migratory
Black-winged Red Bishop	*Euplectes hordeaceus*	LC	LC		
Blue-cheeked Bee-eater	*Merops persicus*	LC	LC	Yes	Palearctic winter visitor
Broad-billed Roller	*Eurystomus glaucurus*	LC	LC	Yes	Seasonal breeding migrant
Bronze Mannikin	*Spermestes cucullata*	LC	LC		
Brown Snake Eagle	*Circaetus cinereus*	LC	LC		
Brown-crowned Tchagra	*Tchagra australis*	LC	LC		
Cape Crow	*Corvus capensis*	LC	LC		
Cape Starling	*Lamprotornis nitens*	LC	LC		
Cape Wagtail	*Motacilla capensis*	LC	LC		
Cardinal Woodpecker	*Dendropicos fuscescens*	LC	LC		
Collared Sunbird	*Hedydipna collaris*	LC	LC		
Common Greenshank	*Tringa nebularia*	LC	LC	Yes	Palearctic visitor
Common Waxbill	*Estrilda astrild*	LC	LC		
Copper Sunbird	*Cinnyris cupreus*	LC	LC		
Crowned Hornbill	*Lophoceros alboterminatus*	LC	LC		
Dark-capped Bulbul	*Pycnonotus tricolor*	LC	LC		
Dusky Indigobird	*Vidua funerea*	LC	LC		
Dusky Sunbird	*Cinnyris fuscus*	LC	LC		
Emerald-spotted Wood Dove	*Turtur chalcospilos*	LC	LC		

Common Name	Scientific Name	Regional	IUCN	Congregatory	Migratory
Eurasian Hobby	*Falco subbuteo*	LC	LC		
European Bee-eater	*Merops apiaster*	LC	LC	Yes	Breeding intra-Africa and Palearctic winter visitor
Fan-tailed Widowbird	*Euplectes axillaris*	LC	LC		
Flappet Lark	*Mirafra rufocinnamomea*	LC	LC		
Fork-tailed Drongo	*Dicrurus adsimilis*	LC	LC		
Green Twinspot	*Mandingoa nitidula*	LC	LC		
Green-headed Sunbird	*Cyanomitra verticalis*	LC	LC		
Green-winged Pytilia	*Pytilia melba*	LC	LC		
Grey Kestrel	*Falco ardosiaceus*	LC	LC		
Grey-backed Camaroptera	*Camaroptera brevicaudata*	LC	LC		
Grey-rumped Swallow	*Pseudhirundo griseopyga*	LC	LC		
House Sparrow	*Passer domesticus*	LC	LC		
Icterine Warbler	*Hippolais icterina*	LC	LC		Palearctic migrant
Jacobin Cuckoo	*Clamator jacobinus*	LC	LC		Intra-African migrant
Klaas's Cuckoo	*Chrysococcyx klaas*	LC	LC		Intra-African migrant
Lesser Striped Swallow	*Cecropis abyssinica*	LC	LC		
Levaillant's Cisticola	*Cisticola tinniens*	LC	LC		
Levaillant's Cuckoo	*Clamator levaillantii*	LC	LC		Intra-African migrant
Little Bee-eater	*Merops pusillus*	LC	LC		

Common Name	Scientific Name	Regional	IUCN	Congregatory	Migratory
Little Swift	*Apus affinis*	LC	LC	Yes	Partial Migrant
Long-legged Pipit	*Anthus pallidiventris*	LC	LC		
Long-tailed Paradise Whydah	*Vidua paradisaea*	LC	LC		
Long-tailed Widowbird	*Euplectes progne*	LC	LC		
Mosque Swallow	*Cecropis senegalensis*	LC	LC		Partial Intra-African migrant
Neddicky	*Cisticola fulvicapilla*	LC	LC		
Northern Fiscal	*Lanius humeralis*	LC	LC		
Northern Grey-headed Sparrow	*Passer griseus*	LC	LC		
Orange-breasted Bushshrike	*Chlorophoneus sulfureopectus*	LC	LC		
Orange-cheeked Waxbill	*Estrilda melpoda*	LC	LC		
Pearl-breasted Swallow	*Hirundo dimidiata*	LC	LC		Intra-African migrant
Pied Crow	*Corvus albus*	LC	LC		
Pin-tailed Whydah	*Vidua macroura*	LC	LC		
Purple Heron	*Ardea purpurea*	LC	LC		
Purple-banded Sunbird	*Cinnyris bifasciatus*	LC	LC		
Rattling Cisticola	*Cisticola chiniana*	LC	LC		
Red-billed Firefinch	*Lagonosticta senegala*	LC	LC		
Red-billed Quelea	*Quelea quelea*	LC	LC		
Red-collared Widowbird	*Euplectes ardens*	LC	LC		

Common Name	Scientific Name	Regional	IUCN	Congregatory	Migratory
Red-crested Korhaan	*Lophotis ruficrista*	LC	LC		
Red-eyed Dove	*Streptopelia semitorquata*	LC	LC		
Red-faced Mousebird	*Urocolius indicus*	LC	LC		
Red-footed Falcon	*Falco vespertinus*	LC	VU	Yes	Palearctic winter migrant
Red-necked Spurfowl	*Pternistis afer*	LC	LC		
Ring-necked Dove	*Streptopelia capicola*	LC	LC		
Rock Dove	*Columba livia*	LC	LC		
Scarlet-chested Sunbird	*Chalcomitra senegalensis*	LC	LC		
Sooty Chat	*Myrmecocichla nigra*	LC	LC		
Southern Black Flycatcher	*Melaenornis pammelaina*	LC	LC		
Southern Masked Weaver	*Ploceus velatus*	LC	LC		
Speckled Mousebird	*Colius striatus*	LC	LC		
Stout Cisticola	*Cisticola robustus*	LC	LC		
Tawny-flanked Prinia	*Prinia subflava*	LC	LC		
Tropical Boubou	*Laniarius major*	LC	LC		
Variable Sunbird	*Cinnyris venustus*	LC	LC		
Village Weaver	*Ploceus cucullatus*	LC	LC		
Violet-eared Waxbill	*Granatina granatina*	LC	LC		
Wahlberg's Eagle	*Hieraaetus wahlbergi*	LC	LC		
Wailing Cisticola	*Cisticola lais*	LC	LC		

Common Name	Scientific Name	Regional	IUCN	Congregatory	Migratory
Western Cattle Egret	*Bubulcus ibis*	LC	LC		
Western Violet-backed Sunbird	*Anthreptes longuemarei*	LC	LC		
White-browed Coucal	*Centropus superciliosus*	LC	LC		
White-browed Scrub Robin	*Cercotrichas leucophrys*	LC	LC		
Yellow-billed Kite	*Milvus aegyptius*	LC	LC		
Yellow-breasted Apalis	*Apalis flavida*	LC	LC		
Yellow-fronted Canary	*Crithagra mozambica*	LC	LC		
Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*	LC	LC		
Yellow-mantled Widowbird	*Euplectes macroura*	LC	LC		
Yellow-rumped Tinkerbird	*Pogoniulus bilineatus*	LC	LC		
Yellow-throated Leaflove	*Atimastillas flavicollis*	LC	LC		
Zitting Cisticola	*Cisticola juncidis*	LC	LC		

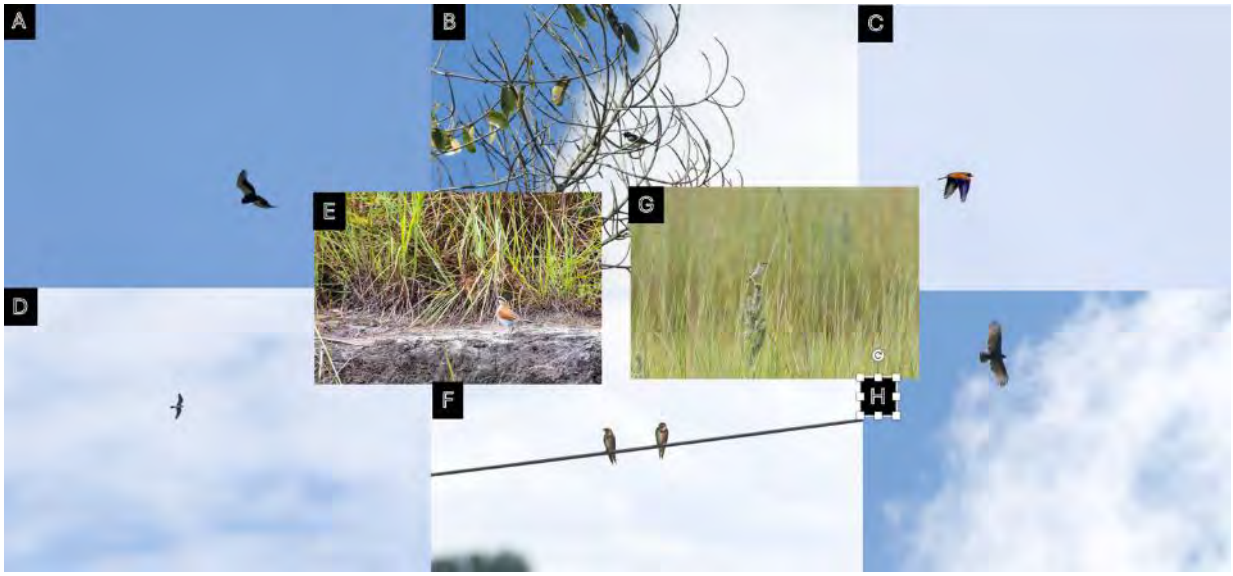


Figure 9-14: Photographs illustrating avifauna species observed within the AoI: A) Bateleur, B) Western Violet-backed Sunbird, C) Board-billed Roller, D) Red-footed Falcon, E) Black-crowned Tchagra, F) Angolan Swallow, G) Stout Cisticola and H) Brown Snake Eagle.

9.7.3 Summary of findings on the existing terrestrial ecology in the project AoI

In the current layout designs, most infrastructure is planned for placement in Woodland areas and Savannas and Grasslands habitats. Despite the recurring impact of anthropogenic fires on the latter habitat, its substantial grass coverage plays a crucial role in local hydrology. During the rainy season, the high grass density leads to the generation of significant run-off volumes. This water flows into the lower lying forests and Riparian areas. The presence of this habitat significantly retards water run-off, compelling water to infiltrate through the predominantly sandy substrate beneath, ensuring a consistent water supply to downstream habitats.

This buffering capacity is essential, as it prevents the gradual erosion of forest habitat edges caused by rainy season run-off. Furthermore, the grass cover's ability to facilitate water penetration into the soil is pivotal for maintaining a steady sub-surface and underground water supply to Tropical flooded forests, peat forests, permanent lowland rivers, and seasonal floodplain marshes. It is therefore imperative to adhere to industry best practices in storm water management to safeguard these critical ecological processes.

9.8 Freshwater ecology

A total of 11 sampling sites were selected for the freshwater assessment. The first survey, conducted from the 2nd to the 8th of October 2023 constituted a dry season survey; and the second, conducted from the 10th to the 20th of March 2024 constituted a wet season survey, with emphasis placed on the systems within the project area. Some sites were not sampled due a combination of time limitations, seasonal limitations and access restrictions. Water quality was assessed at all sites, whilst IHAS, SASS5 and Ichthyofaunal Assemblages were only assessed at OAE 4, OAE 8 and OAE 9. (Table 9-15 and Figure 9-15) illustrate the sampling sites for the study. Table 9-16 presents the results summary of the sampling sites for the study and associated Global Positioning System (GPS) coordinates (proposed crossing location). The project area is characterized by a number

of floodplain wetlands with an active river channel. Sampling sites were chosen based on the 11 crossing points. Where possible/feasible, the nearest representative sampling location(s) were assessed in instances where the exact bridge locations were not accessible.

Table 9-15: Dates and locations of the aquatic survey

Survey	Upstream View	Downstream View
	OAE 1 - Lumeje River	
Oct-23	-	-
Mar-24	-	-
GPS	11°36'54.55"S, 19°59'5.25"E	
	OAE 2 - Luxia River	
Oct-23	-	-
Mar-24	-	-
GPS	11°21'30.73"S, 20°10'28.74"E	
	OAE 3 – Tchihinhi River	
Oct-23	-	-
Mar-24		
GPS	11°20'52.76"S, 20°10'31.35"E	

Survey	Upstream View	Downstream View
	OAE 4 - Kasai River	
Oct-23		
Mar-24		
GPS	11°12'56.53"S, 20°12'20.75"E	
	OAE 5 - Tchiumbwe River	
Oct-23	-	
Mar-24	-	-
GPS	11° 1'27.67"S, 20°12'52.48"E	

Survey	Upstream View	Downstream View
	OAE 6 - Mombo River	
Oct-23	-	-
Mar-24		
GPS	10°53'6.31"S, 20°12'34.72"E	
	OAE 7 - Luele River	
Oct-23	-	-
Mar-24	-	-
GPS	10°45'59.99"S, 20°14'32.94"E	
	OAE 8 - Luachimo River	
Oct-23		

Survey	Upstream View	Downstream View
Mar-24		
GPS	10°38'28.98"S, 20°12'38.05"E	
	OAE 9 - Maurilio River	
Oct-23		
Mar-24	-	-
GPS	10°27'39.31"S, 20° 9'47.02"E	
	Unplanned crossing - Wetland	
Oct-23		

Survey	Upstream View	Downstream View
Mar-24		
GPS	10°23'43.48"S, 20°10'36.33"E	
	OAE 10 -Caiaza River	
Oct-23		
Mar-24		
GPS	10°15'7.93"S, 20°15'0.82"E	

Survey	Upstream View	Downstream View
	OAE 11 - Sambuamba River	
Oct-23		
Mar-24		
GPS	9°42'31.01"S 20°29'30.59"E	

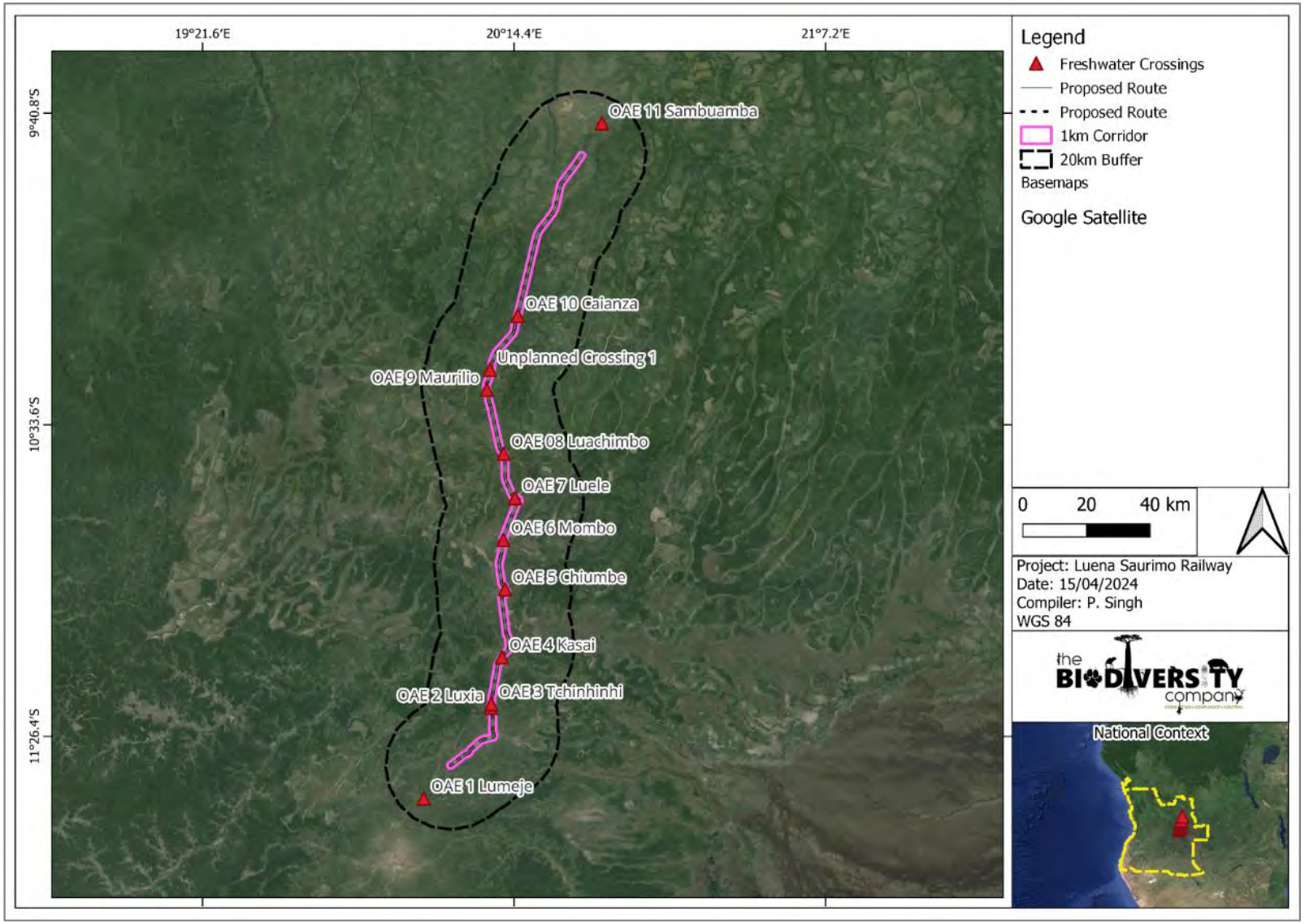


Figure 9-15: Locality map of the sampling sites within the AoI

9.8.1 In-situ water quality for aquatic ecosystem conditions

In-situ water quality analysis is typically conducted at each sampling site along the watercourses in the project area which contained water. These results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996), and Chapman & Kimstach (1996). The floodplains and rivers displayed water quality that would be suitable for most aquatic biota except those that are sensitive to pH and dissolved oxygen. The sub-optimal water quality may be due to interactions and reactions with the floodplain wetland.

Table 9-16: Baseline in-situ water quality results for the project area

Site	Watercourse	pH	Conductivity (µS/cm)	Dissolved oxygen (mg/l)	Temperature (°C)
Limits		6.5-9.0***	500A	> 6.0**	5-30*
OAE 1	Lumeje	6.62	25	6.09	27.0
OAE 2	Luxia	6.46	10	7.43	23.8
OAE 3	Tchihinhi	5.37	25	75.8	20.9
OAE 4	Kasai	6.9	29	7.38	24.3
OAE 5	Chiumbe	6.60	23	1.75	23.5
OAE 6	Mombo	5.27	10	6.13	24.4-
OAE 7	Luele	4.82	26	5.45	27.1
OAE 8	Luachimo	5.70	10	6.6	23.1
OAE 9	Maurilio	5.00	16	2.15	22.9
OAE 10	Caiaza	4.87	7	6.37	22.6
OAE 11	Sambuamba	-	-	-	-
Levels exceeding recommended guideline levels are indicated in red.					
* TWQR – Target Water Quality Range (DWAF, 1996) ** Chapman and Kimstach (1996) A – Planning level water quality RSA (DWA, 2011a)					

Water quality perturbations were recorded in the project area. This is on account of the recorded depressed dissolved oxygen level and slightly acidic pH levels at some systems. The depressed levels of dissolved oxygen can be attributed to sites with wetland characteristics and floods observed during the survey. Flood events assist in lowering

dissolved oxygen levels within rivers due increased chemical and biological oxygen demand associated with increased rainfall and surface runoff which increase the pollutant loads (organics and chemical) in local rivers. Additionally, Wetland systems are known to have naturally depressed dissolved oxygen levels due to the gentle gradient and natural absence of stones habitat that helps aerate the water and high organic waste associated with dense wetland vegetation. The breakdown of organic waste within water bodies results in oxidative decomposition of the waste by micro-organisms which may result in depletion of dissolved oxygen levels. This scenario is described as increased biological oxygen demand (BOD) of micro-organisms.

9.8.2 Integrated Habitat Assessment System (IHAS)

The IHAS index was developed by McMillan (1998) for use in conjunction with the SASS5 protocol. IHAS was conducted to link suitable habitat availability and macroinvertebrate communities. The IHAS results for the survey are presented in (Table 9-17). Habitat diversity and subsequent availability was considered 'Adequate' along the Kasai River (OAE 4), and 'Good' at along the Luachimo River (OAE 8) and Maurilio River (OAE 9). This indicated that habitat would not be a limiting factor to macroinvertebrate communities within these systems, as suitable habitat availability was moderately diverse to diverse.

Table 9-17: IHAS water quality results for the project area

Site	OAE 4 Kasai River	OAE 8 Luachimo River	Maurilio River
Score	63	70	68
Suitability	**Adequate**	**Good**	**Good**

9.8.3 Aquatic macroinvertebrates

The SASS5 aquatic macroinvertebrate results are presented in

Table 9-18. Due to time constraints, three (3) river crossings were assessed. Due to

System	Kasai River	Luachimo River	Maurilio River
Site	OAE 4	OAE 8	OAE 9
SASS5 Score	127	146	106
No. of Taxa	16	24	22
ASPT*	7.9	6.1	4.8
Macroinvertebrate Diversity	High	High	High
Ecological condition**	Largely natural	Largely Natural	Moderately Modified

similarities within the catchment and Angolan waters being understudied, the three (3) assessed rivers may (with caution) be deemed representative of the unassessed crossings for the 2023-2024 assessment. Based on the ASPT scores the aquatic macroinvertebrate communities for the sampled reaches comprised primarily of sensitive

taxa (Intolerance Rating ≥ 10) within the Kasai (OAE 4) and Luachimo (OAE 8) rivers and of moderately tolerant taxa (Intolerance Rating 5 - 10) within the Maurilio River (OAE 9).

Site OAE 4 presented a SASS5 score of 127 and an ASPT of 7.9 based on a high diversity of taxa, with five (5) sensitive taxa present (Perlidae, Dicercomyzidae, Oligoneuridae, Prosopistomatidae and Lepidostomatidae). OAE 8 presented a SASS5 score of 146 and an ASPT of 6.1 based on a high diversity of taxa, with four (4) sensitive taxa present (Perlidae, Dicercomyzidae, Oligoneuridae, and Lepidostomatidae). OAE 9 presented a SASS5 score of 106 and an ASPT of 4.8 based on a high diversity of taxa, with one (1) sensitive taxon present (Scirtidae).

Table 9-18: Macroinvertebrate assessment results recorded during the survey

System	Kasai River	Luachimo River	Maurilio River
Site	OAE 4	OAE 8	OAE 9
SASS5 Score	127	146	106
No. of Taxa	16	24	22
ASPT*	7.9	6.1	4.8
Macroinvertebrate Diversity	High	High	High
Ecological condition**	Largely natural	Largely Natural	Moderately Modified

9.8.3.1 *Ichthyofaunal assemblage*

Based on the available IUCN database and Skelton (2019), a total of160 fish species are expected in the Kasai and Zambezian Headwaters ecoregions. According to FEOW (2008), biological studies and associated knowledge in Angola is still in its infancy and therefore a substantial amount of further investigation is needed in this ecoregion before an adequate evaluation of biological distinctiveness can be made. The expected species are presented in Table 9-20. As noted in the table the following fish species: *Oreochromis lepidurus* (EN), *Oreochromis macrochir* (VU) and *Marcusenius cuangoanus* (VU) are red listed species (IUCN, 2024) and expected for the local catchment areas. Green highlighted species are endemic to these ecoregions. The listing of this species can be attributed to the loss of habitat through anthropogenic activities, which in some cases is compounded by endemism of the species as a result of natural migration barriers (rapids and falls). These fish, together with species listed as data deficient or not evaluated are considered to be Species of Conservation Concern (SCC) based on the absence of suitable distribution data. Congregatory and migratory behaviours of these SCCs have been indicated in Table 9-20 based on available information (Skelton, 2001; Skelton, 2019; and IUCN, 2024).

The aquatic biodiversity of the Zambezi and Congo basins is considered moderate, and range restricted (Figure 9-16) (Darwall *et al*. 2008). The fish species within these systems are poorly studied restricting available accounts on species composition and distribution.

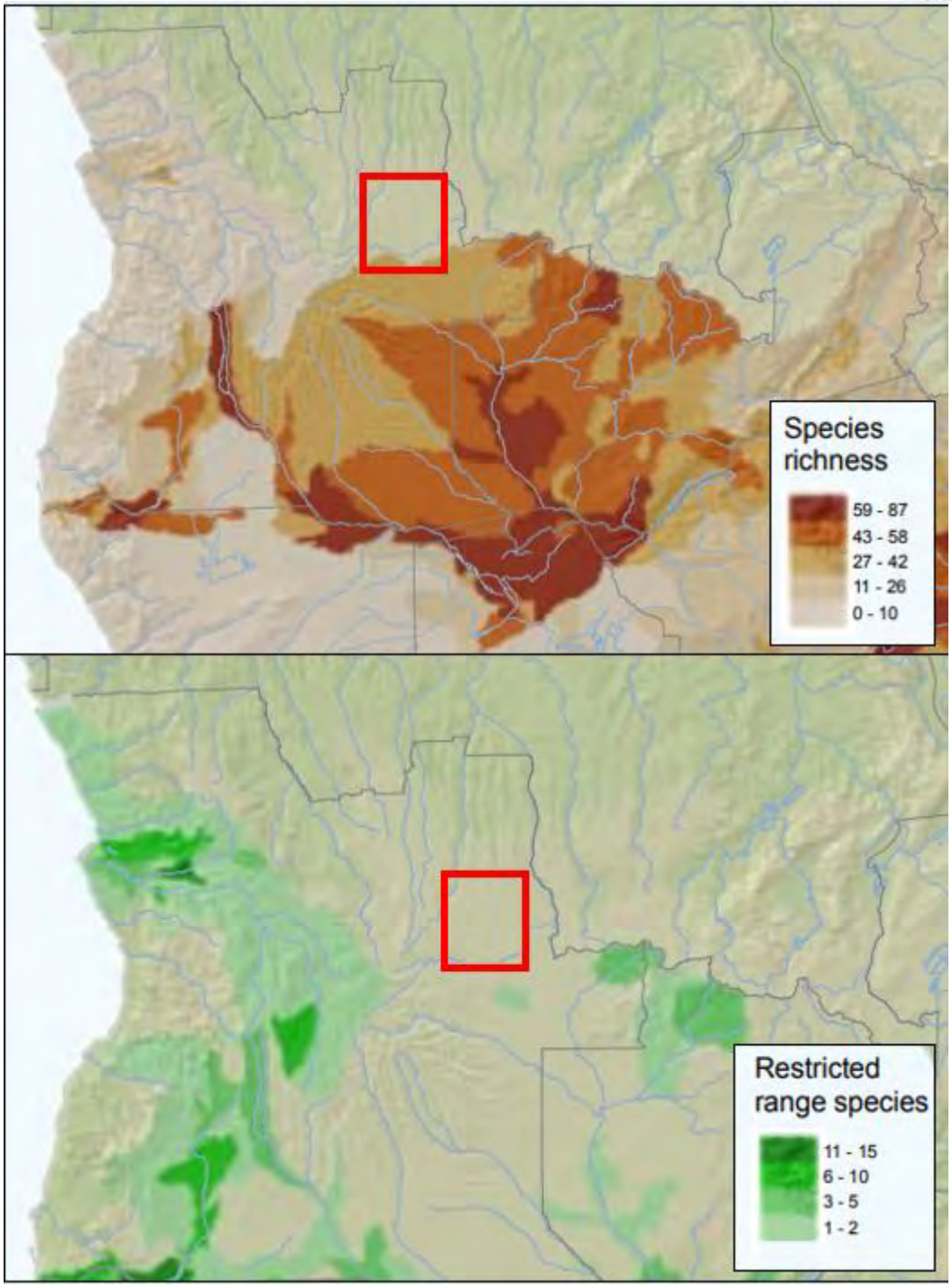


Figure 9-16: Ichthyofaunal Species Richness and Range of Restricted Species (Darwall *et al.* 2008). Red Square Represents Project Area

Table 9-19 Expected and sampled fish species in the AoI (IUCN, 2024)

Scientific name	IUCN status (IUCN, 2024)	Congregatory (C) and/or Migratory (M) Species	Sampled In Direct AoI
Alestes macropthalmus	LC		
Amphilius lentiginosus	DD	M	
Atopochilus macrocephalus	DD		
Brycinus grandisquamis	LC		
Brycinus humilis	DD		
Brycinus imberi	LC		
Brycinus kingsleyae	LC		
Brycinus lateralis	LC		
Bryconaethiops microstoma	LC		Yes
Campylomormyrus alces	LC		
Campylomormyrus cassaicus	DD		
Campylomormyrus elephas	LC		
Campylomormyrus luapulaensis	DD		
Campylomormyrus numenius	LC		
Campylomormyrus rhynchophorus	LC		
Campylomormyrus tshokwe	LC		
Channallabes apus	LC		
Chiloglanis angolensis	DD		Yes
Chiloglanis lukugae	LC		
Chiloglanis micropogon	NE		
Chrysichthys cranchii	LC		
Chrysichthys delhezi	LC		
Chrysichthys macropterus	DD		
Clariallabes heterocephalus	LC		
Clariallabes variabilis	LC		
Clarias angolensis	LC		Yes
Clarias buthupogon	LC		
Clarias dumerilii	LC		
Clarias gariepinus	LC		
Clarias liocephalus	LC		
Clarias ngamensis	LC		
Clarias nigromarmoratus	LC		
Clarias platycephalus	LC		
Clarias stappersii	LC		
Clarias theodorae	LC		Yes
Congoglanis alula	LC		
Congoglanis howesi	NE	C	
Coptodon rendalli	LC		Yes

Scientific name	IUCN status (IUCN, 2024)	Congregatory (C) and/or Migratory (M) Species	Sampled In Direct AoI
Ctenopoma multispine	LC		Yes
Cyphomyrus psittacus	LC		
Distichodus fasciolatus	LC		
Distichodus lusosso	LC		
Distichodus maculatus	LC		
Distichodus notospilus	LC		
Distichodus sexfasciatus	LC		
Dundocharax bidentatus	DD		
Enteromius afrovernayi	LC		
Enteromius ansorgii	LC		
Enteromius breviceps	LC		Yes
Enteromius brevidorsalis	LC		Yes
Enteromius brevilateralis	DD		
Enteromius caudosignatus	DD		
Enteromius chicapaensis	LC		
Enteromius chiumbeensis	LC		
Enteromius eutaenia	LC		
Enteromius fasciolatus	LC		
Enteromius haasianus	LC		
Enteromius holotaenia	LC		
Enteromius kessleri	LC		
Enteromius lineomaculatus	LC		
Enteromius lujae	DD		
Enteromius machadoi	DD		
Enteromius mattozi	LC		
Enteromius mediosquamatus	DD		
Enteromius miolepis	LC		
Enteromius multilineatus	LC		Yes
Enteromius paludinosus	LC		
Enteromius petchkovski	NE		
Enteromius poechii	LC		
Enteromius radiatus	LC		
Enteromius rousellei	NE		
Enteromius trimaculatus	LC		
Enteromius unitaeniatus	LC		
Euchilichthys astatodon	LC		
Euchilichthys royauxi	LC		
Garra dembeensis	LC		
Gnathonemus barbatus	DD		
Gnathonemus petersii	LC		

Scientific name	IUCN status (IUCN, 2024)	Congregatory (C) and/or Migratory (M) Species	Sampled In Direct AoI
Hemichromis elongatus	LC		Yes
Hepsetus cuvieri	LC		
Heterobranchus longifilis	LC		
Hydrocynus vittatus	LC		
Hypsopanchax jubbi	LC		
Kneria angolensis	LC		
Kneria ansorgii	DD		
Kneria polli	LC		
Labeo annectens	LC		
Labeo ansorgii	LC		
Labeo chariensis	LC		
Labeo cylindricus	LC		
Labeo greeni	LC		
Labeo lineatus	LC		
Labeo longipinnis	LC		
Labeo macrostoma	LC		
Labeo parvus	LC		
Labeo velifer	NE		
Labeo weeksii	LC		
Labeobarbus caudovittatus	LC		
Labeobarbus codringtonii	LC		
Labeobarbus jubbi	DD		
Labeobarbus macrolepidotus	LC		
Labeobarbus marequensis	LC		
Labeobarbus nanningsi	DD		
Malapterurus monsembeensis	LC		
Marcusenius altisambesi	LC		
Marcusenius angolensis	LC		
Marcusenius cuangoanus	VU	M	
Marcusenius dundoensis	DD		
Marcusenius moorii	LC		
Marcusenius stanleyanus	LC		
Micralestes acutidens	LC		
Micralestes humilis	LC		
Micropanchax hutereaui	LC		
Micropanchax johnstonii	LC		
Micropanchax katangae	LC		
Micropanchax luluae	NE		Yes
Micropanchax macrurus	LC		
Micropanchax mediolateralis	LC		

Scientific name	IUCN status (IUCN, 2024)	Congregatory (C) and/or Migratory (M) Species	Sampled In Direct AoI
Micropanchax nigrolateralis	DD		
Mormyrops anguilloides	LC		
Mormyrops attenuatus	LC		
Mormyrus caballus	LC		
Mormyrus rume	NE		
Nannocharax angolensis	LC		
Nannocharax lineostriatus	DD		
Nannocharax macropterus	LC		Yes
Nannocharax procatopus	LC		
Odaxothrissa ansorgii	LC		
Opsaridium zambezense	LC		Yes
Oreochromis lepidurus	EN		
Oreochromis macrochir	VU		
Oreochromis schwebischi	LC		
Parakneria fortuita	DD		
Parakneria vilhenae	DD		
Paramormyrops jacksoni	DD		
Parauchenoglanis ngamensis	LC		
Pellonula vorax	LC		
Pelmatolapia cabrae	LC		
Petrocephalus christyi	LC		
Petrocephalus micropthalmus	LC		
Petrocephalus simus	LC		
Phractura macrura	DD		
Phractura scaphyrhynchura	LC		
Platyclarias machadoi	DD		
Pollimyrus brevis	LC		
Pollimyrus tumifrons	LC		
Polypterus ornatipinnis	LC		
Protopterus aethiopicus	DD		
Protopterus dolloi	LC		
Pseudocrenilabrus philander	LC		Yes
Raiamas christyi	LC		
Sargochromis thysi	LC		
Schilbe grenfelli	LC		
Schilbe intermedium	LC		
Schilbe yangambianus	LC		Yes
Serranochromis angusticeps	LC		
Serranochromis macrocephalus	LC		
Serranochromis robustus jallae	LC		

Scientific name	IUCN status (IUCN, 2024)	Congregatory (C) and/or Migratory (M) Species	Sampled In Direct AoI
Serranochromis thumbergi	LC		
Synodontis longirostris	LC		
Synodontis nigromaculatus	LC		
Synodontis ornatipinnis	LC		
Tilapia ruweti	LC		
Tilapia sparrmanii	LC		
Zaireichthys dorae	DD		
Zaireichthys flavomaculatus	DD		

CR – Critically Endangered; EN – Endangered; VU: Vulnerable; NT – Near Threatened; LC - Least Concern; NE – Not Evaluated; DD – Data Deficient Endemic species

Due to the poor level of fish exploration within the Kasai and Zambezi Headwater Basins, many of the captured species are likely undescribed, with the potential of high conservation value species occurring in the general area. The table above presents 166 fish species recorded in the IUCN database that are expected to be within the basin headwaters. Out of these, 8 are currently known to be endemic (highlighted in green), and only *Schilbe yangambianus* was the only endemic fish species confirmed in the direct AoI. Overall, the fish species observed in the area is diverse, important, and sensitive. The level of taxonomic uncertainly would therefore be considered significant and additional assessments are recommended.

9.8.4 Summary of findings on the existing freshwater ecology in the project AoI

The project area presented different hydrological settings in terms of biotic and abiotic components. Water quality perturbations were recorded in the project area. This is on account of the recorded depressed dissolved oxygen level and slightly acidic pH levels at some systems. The depressed levels of dissolved oxygen can be attributed to sites with wetland characteristics and floods observed during the survey. Flood events assist in lowering dissolved oxygen levels within rivers due increased chemical and biological oxygen demand associated with increased rainfall and surface runoff which increase the pollutant loads (organics and chemical) in local rivers. Additionally, Wetland systems are known to have naturally depressed dissolved oxygen levels due to the gentle gradient and natural absence of stones habitat that helps aerate the water and high organic waste associated with dense wetland vegetation. The breakdown of organic waste within water bodies results in oxidative decomposition of the waste by micro-organisms which may result in depletion of dissolved oxygen levels. This scenario is described as increased biological oxygen demand (BOD) of micro-organisms.

A variety of aquatic habitats were present within the project area, this included small forest streams (drainage lines), larger river systems, swamps, and wetlands (floodplains, un-channelled valley-bottoms), with open and closed vegetation canopy cover and different flow characteristics. The high flows were noted during the survey, due to heavy rainfall, which was expected in the high flow season. Therefore, flow characteristics were dominated by fast-deep velocity-depth classes, followed by slow-deep pools and dominated by high to very high turbidity during the wet season. The project area was dominated by floodplains with modified instream and riparian habitat; therefore, a loss

and change of natural habitat and biota may have occurred at existing crossings but the basic ecosystem functions are still predominantly unchanged. According to the IHAS results, an adequate diversity of habitat was available to support diverse macroinvertebrate communities at the sites assessed. SASS5 and ASPT scores indicated moderately modified to largely natural conditions at the sites assessed. Sensitive macroinvertebrate taxa were present hence indicative of negligible responses to existing modifications. The presence of sensitive taxa requires mitigation measures that would ensure reduced disturbance to the aquatic environment during the construction and operational phases.

A total of 15 different fish species were observed and captured during the study. Novel species include several species of each of these genera: *Enteromius sp., Clarias sp., Labeo sp., Labeobarbus sp*. etc. There were presence of unique species requiring additional studies. Therefore, the ichthyofaunal biodiversity was considered moderate within the Project Area.

The instream habitats and some flooded reed banks of the sampled rivers provide crucial nursing and spawning habitats for fish during the wet season (as observed during the survey). This was confirmed through the sampling of juvenile fish in the flooded habitats. The proposed Luena-Saurimo Railway Project and associated infrastructure will have an impact on these systems ranging from high to moderately high during construction, operation, and decommissioning phase prior to mitigation. Furthermore, most of the aquatic systems in the AoI are already impacted by crossings and anthropogenic activities, therefore with the application of prescribed mitigation measures and recommendations these impacts can be reduced to moderate for the construction and decommissioning phases and low for operational phase.

9.9 Ecological sensitivity

Six (6) different habitat units were delineated within the assessment area (see Table 9-20). These habitat types are primarily based on vegetation parameters including dominant species and vegetation structure, and faunal habitats can be inferred based on these delineations. Descriptions of each of these habitat types can be seen in Section 9.7.2.1. All habitats within the AoI were allocated a sensitivity category. The sensitivities of the habitat types delineated are illustrated in Figure 9-17. Much of the project area comprises large areas of intact indigenous vegetation. There are however signs of past disturbance. Despite the disturbances present, there is still suitable habitat for a variety of plant species (which could include SCCs and Angolan Red Listed species). Alarmingly, there were very few signs of faunal species. It is thought that most of the larger faunal species have been hunted out, except for the smaller more cryptic mammals. Hunting is likely being conducted for food and also trade of animals, including parts.

Table 9-20: Summary of habitat sensitivity within the field assessment area of the proposed development

Habitat	Sensitivity	Reasoning
Agriculture/cropland	Low	These are modified habitat types with impaired ecological function and typified by pioneer, cultivated and alien/invasive flora species. Remnant individuals of taller high conservation value timber species are scattered throughout the habitat type
Forest	Medium	Although this habitat type is represented, in part, by areas with a high intact canopy with numerous emergent species, large tracts have been cleared leaving this habitat type in a partially modified state. Furthermore, large areas of intact forest occurred beyond the scope of our survey area and have subsequently been analysed from a desktop perspective only
Grassland/Savanna	Medium	No SCC were detected within this habitat type. However, most of the grassland/savanna habitats that were assessed appeared to be fairly intact and have the potential to contribute to ecosystem services. Moreover, the naturalized state of most grassland/savanna habitats are likely to facilitate a high diversity of fauna and flora species
Modified/Degraded	Very Low	Modified habitat, where very little natural habitat is left
Aquatic	High	Although not detected, aquatic habitat units, which include dams, rivers, and wetlands, have the potential to support fauna and flora SCCs. Most of the aquatic habitats that were covered during the survey were in an overall good ecological condition with a high flora and fauna diversity occurring throughout
Woodland	Medium	Many woodland areas that were covered during the survey still exist predominantly in naturalized form facilitating ecosystem services and promoting the existence of high fauna and flora diversity

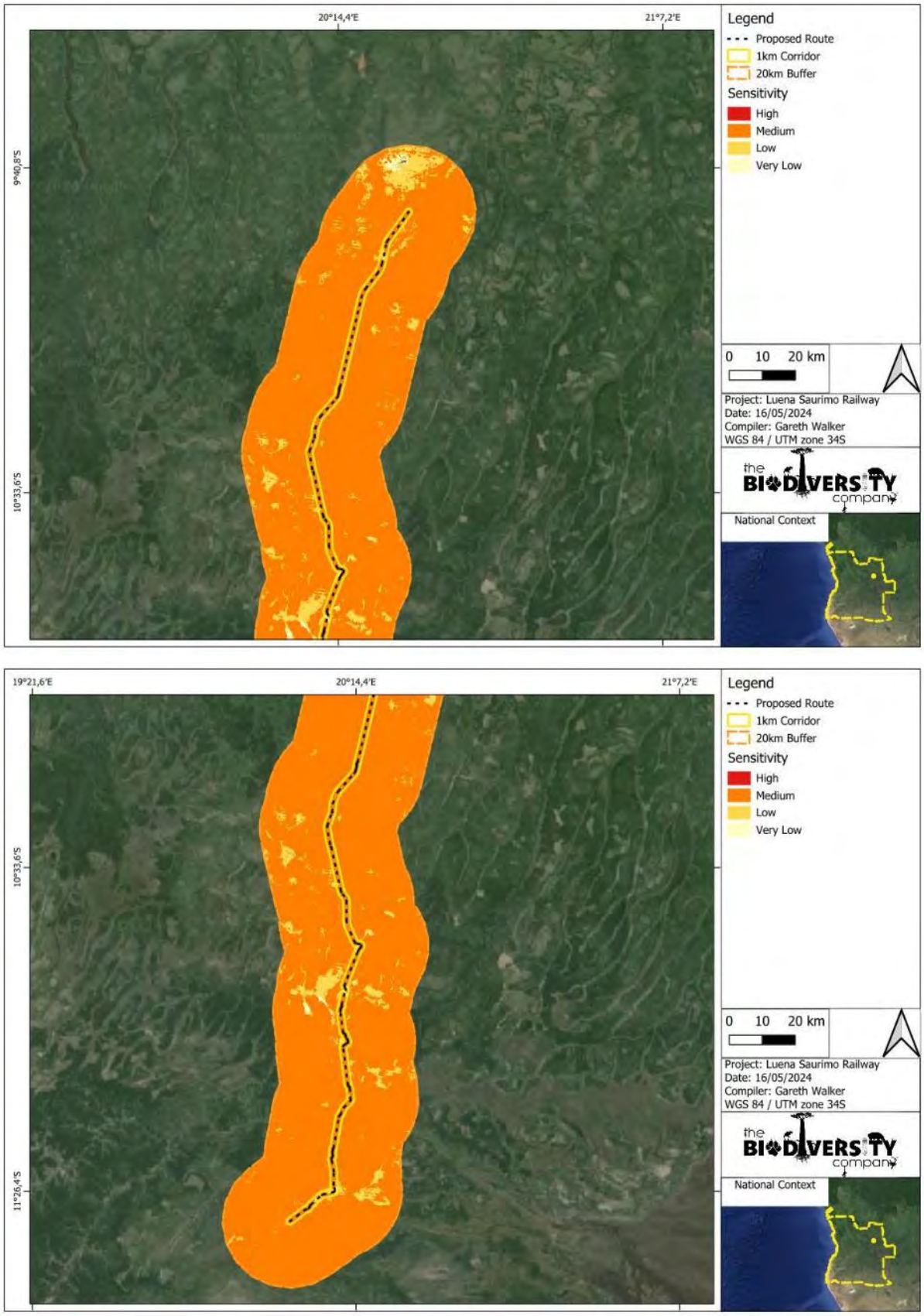


Figure 9-17: Map illustrating habitat sensitivity within the AoI.

9.9.1 Freshwater sensitive habitats

The freshwater habitats have been identified and mapped in the below figures (Figure 9-18–Figure 9-23). Due to the extent of the 20 km Indirect AoI, a digital elevation model was used to identify freshwater sensitive habitats. Sensitivity is directly proportional with water availability, and it ranges from low to high for this wider Indirect AoI. Some of the river crossings proposed to be traversed by the project infrastructure are predominantly classified as high sensitivity. These fall within the direct AoI between KM56+500 -Km 59+000, KM72+500 to KM74+500, KM 96+500 to KM97-500, KM142+500 to KM144+500 and KM 189+000 to KM190+500. When any development takes place over these areas, careful monitoring needs to be allocated to ensure that the mitigation actions are working and additional actions are implemented where necessary.

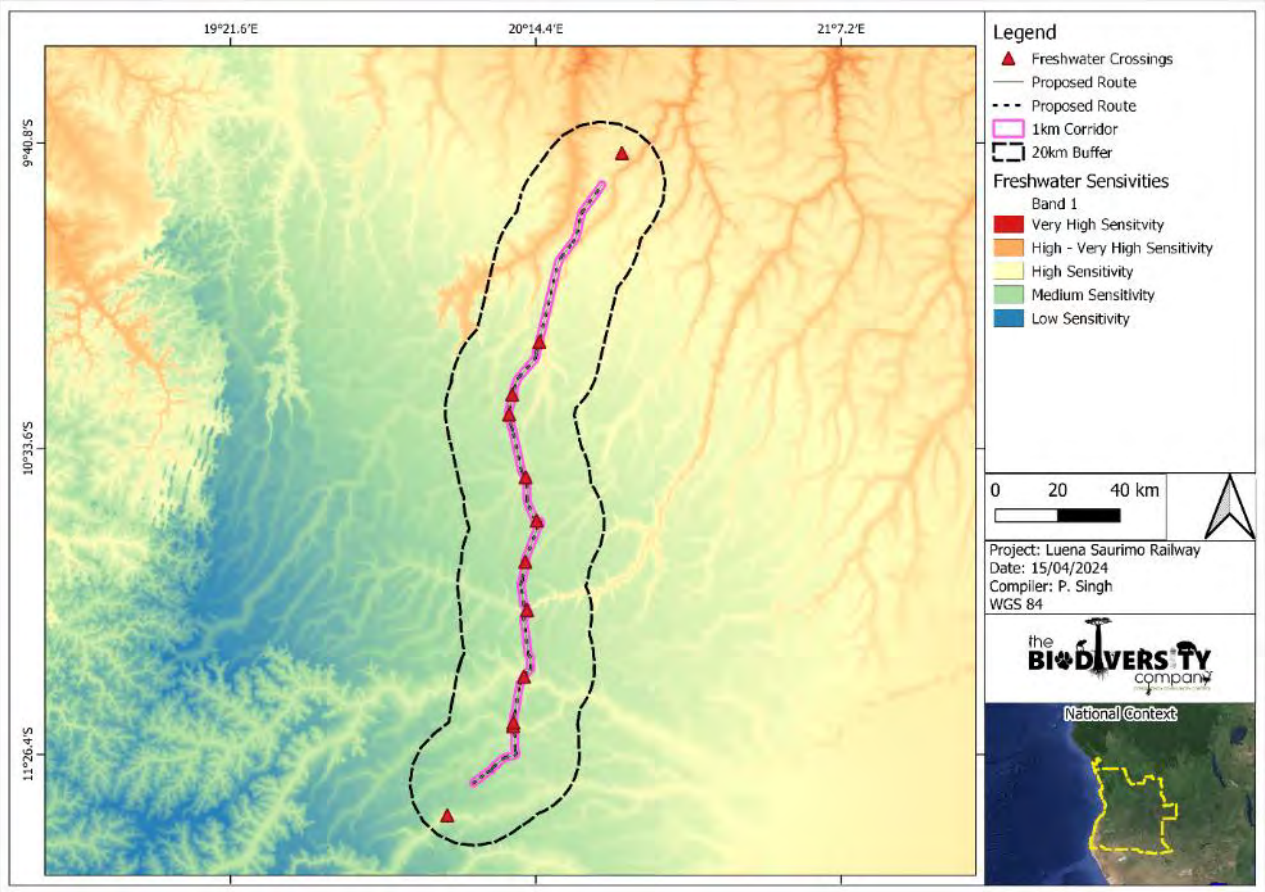


Figure 9-18: Map illustrating freshwater sensitive areas

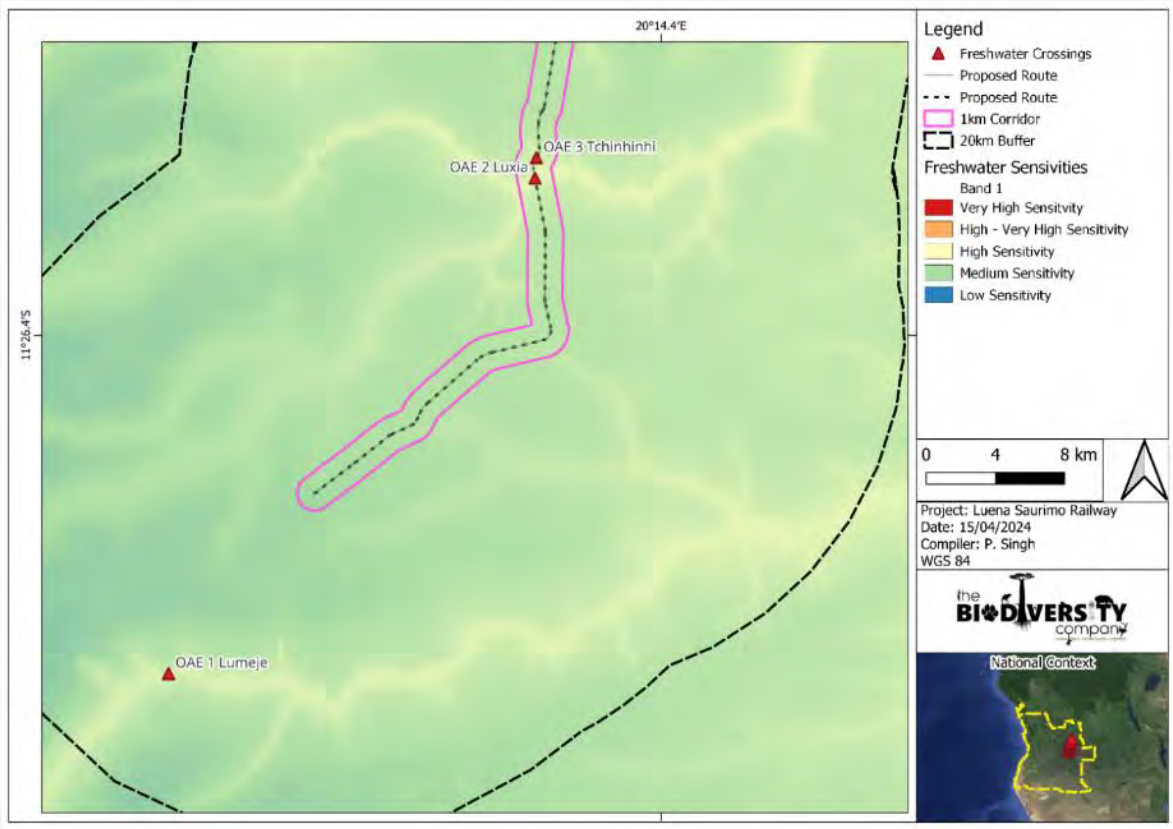


Figure 9-19: Map illustrating sensitive areas associated with crossings 1-3

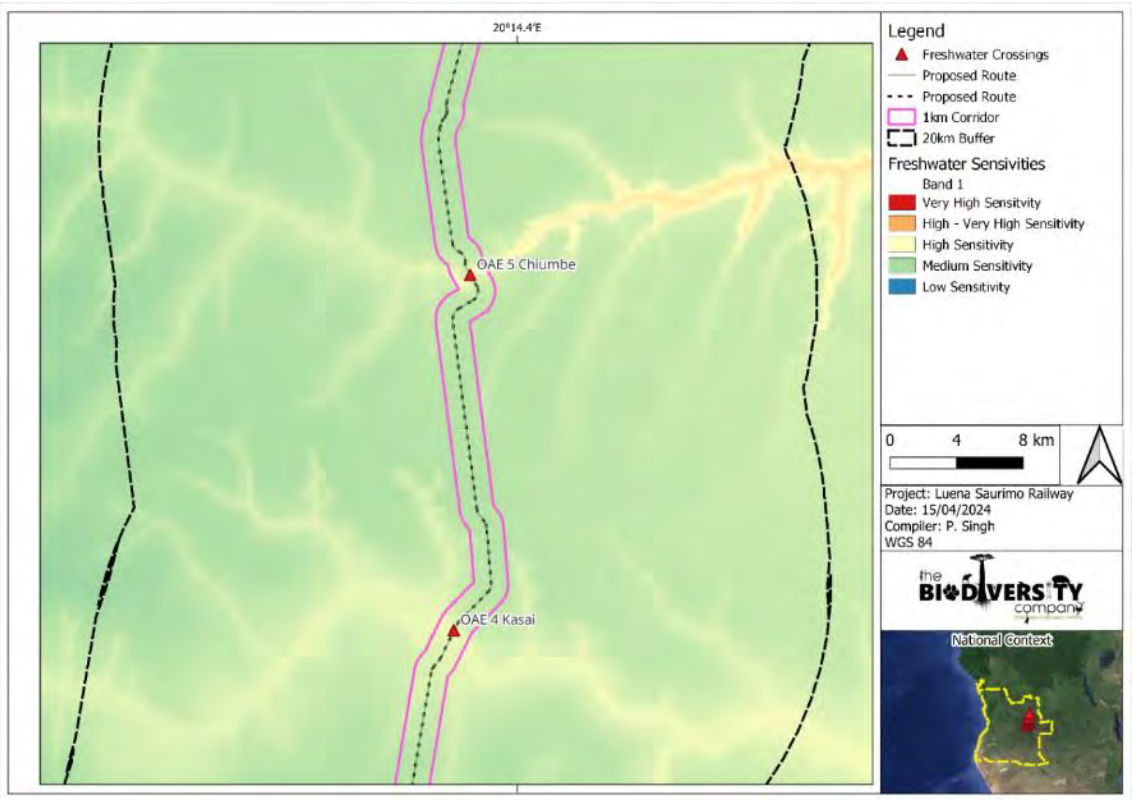


Figure 9-20: Map illustrating sensitive areas associated with crossings 4-5

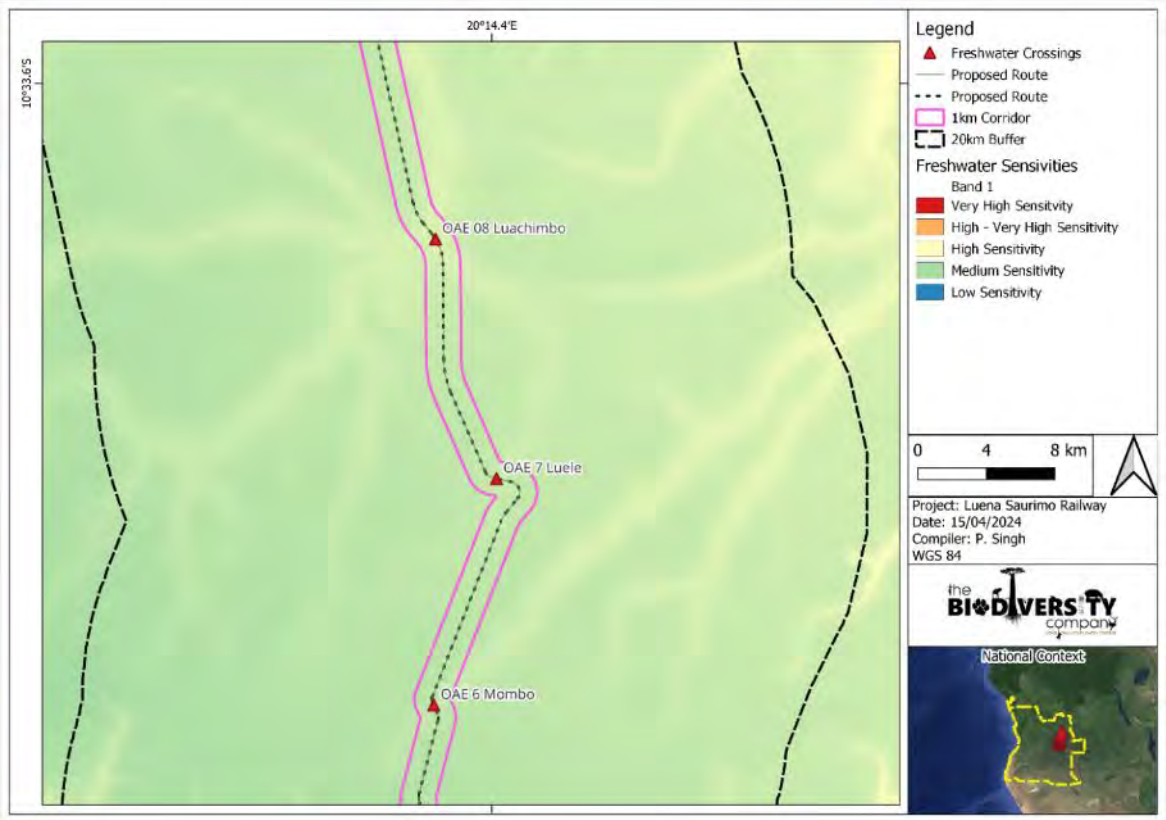


Figure 9-21: Map illustrating sensitive areas associated with crossings 6-8

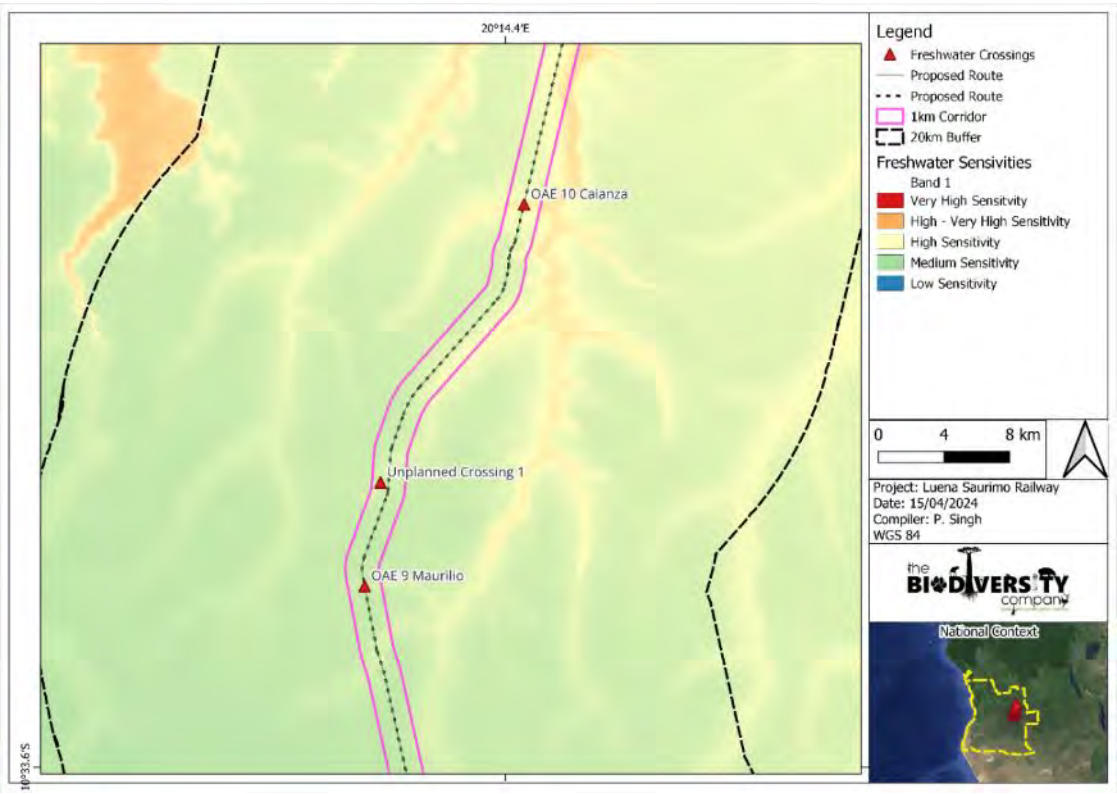


Figure 9-22: Map illustrating sensitive areas associated with crossings 9-10 and an unplanned crossing.

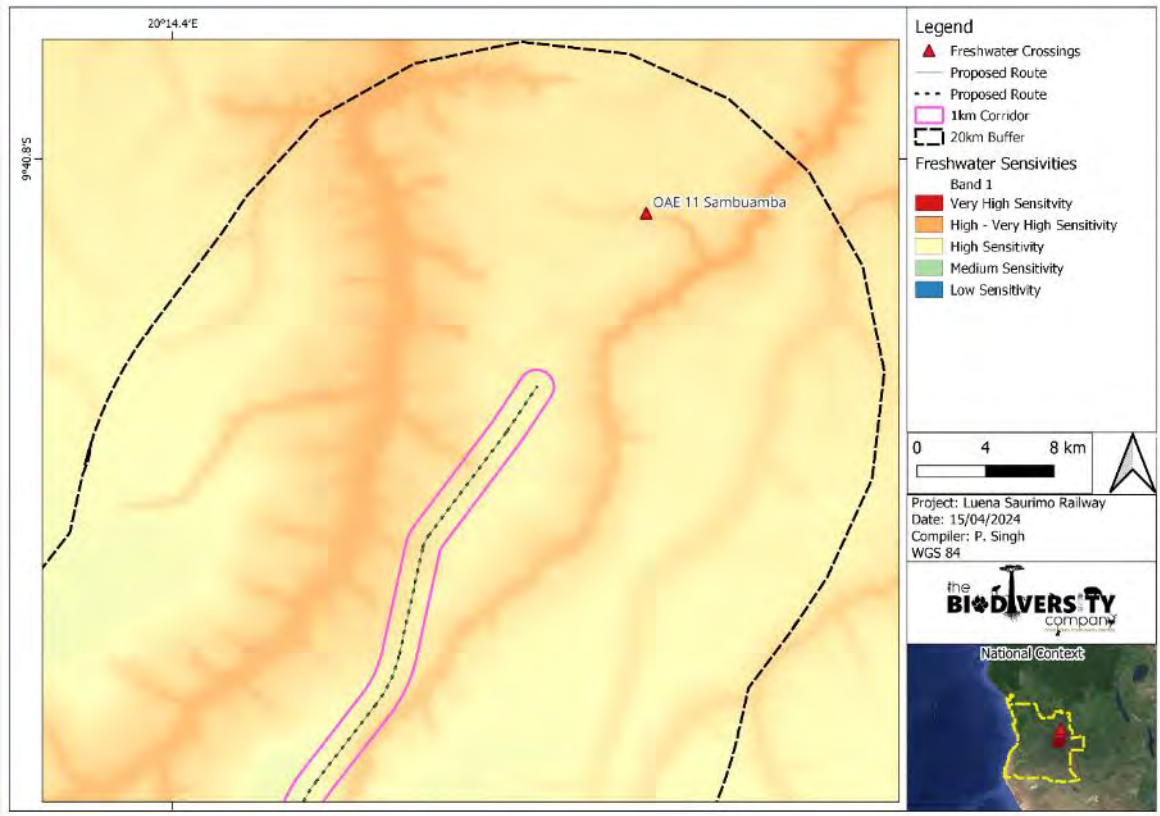


Figure 9-23: Map illustrating sensitive areas at Saurimo[105]

[105] OAE 11 is not a river crossing that the railway will traverse. This is reference to a sample point visited by the aquatic biodiversity specialist as a location upstream of the project.

9.10 Critical Habitat Screening Assessment

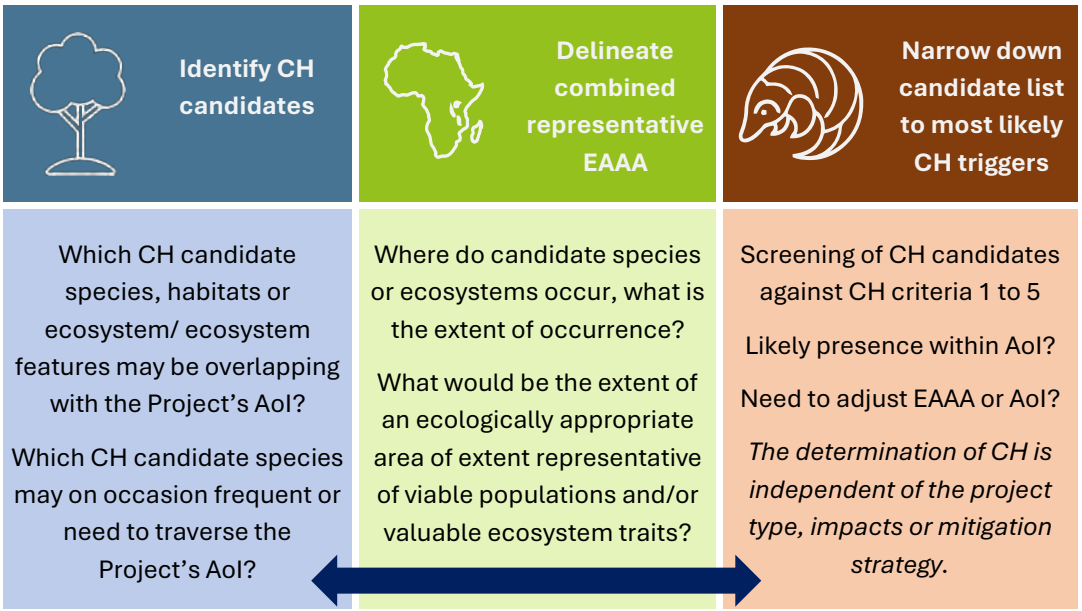
Angola endured a war of independence from 1961-1974 followed by nearly three decades of civil conflict between 1975 and 2002, during which wildlife populations were severely depleted through intensive hunting, bushmeat trade and the breakdown of environmental governance (Huntley, 2017; USAID, 2008). Many large and medium-sized mammals and other vulnerable taxa were locally extirpated from otherwise intact or near intact habitats, leaving areas with "healthy habitat without animals to inhabit it" in the immediate post-war period (USAID, 2008). At the same time, the wars greatly restricted scientific access to most of the country, so a large proportion of published species records comes from pre-independence expeditions, museum collections and scattered historical surveys (Huntley et al., 2019; Beja et al., 2019). For several taxonomic groups, especially amphibians and reptiles, recent syntheses highlight that many records are based on historical collections, that some type of material has been lost or destroyed, and that distribution maps compiled for Angola may remain incomplete or taxonomically outdated in places (Marques et al., 2018; Huntley et al., 2019).

Consequently, the presence of a species in historical literature or in global databases (e.g. GBIF, IUCN Red List, IBAT) for a given province or region indicates documented occurrence at some point in the past, but does not necessarily confirm that viable populations persist today (particularly for heavily hunted or conflict-sensitive specie) though some listings may reflect more recent data. Conversely, the long period without surveys means that some species now present may still be under-recorded or only recently detected by post-war assessments (Huntley et al., 2019; Beja et al., 2019; Marques et al., 2018). In this Critical Habitat screening, all secondary data have therefore been treated with caution. Historical records (mostly pre-1975) and pre-ceasefire records (pre-2002) are distinguished from recent post-war data where available, and species' likelihood of current occurrence has been evaluated using a combination of: (i) temporal context of records, (ii) current habitat condition and accessibility, and (iii) expert judgement on hunting pressure and other threats in the project's area of influence. This approach recognises that some species listed for the wider region or province may have been depleted or extirpated during the wars and their aftermath, while apparent absences may reflect survey gaps rather than true absence.

As the survey carried out was restricted by access due to the potential for unexploded ordnances remaining in the active (which again prevent the return of many indigenous fauna species to the area), a critical habitat screening assessment as outline below was still deemed necessary to evaluate the historic records of potential critical habitat-triggering species vs current likelihood of such species being present, and if present, in significant enough numbers to potentially trigger critical habitat.

9.10.1 Methodology

Following the IFC Guidance Notes for PS6 (2019), but adapted for the screening assessment prior to conducting comprehensive baseline surveys, an iterative approach to determine the likelihood of Critical Habitat (CH) along the Project AoI (or immediate surroundings) was followed. This looked at both the Project AoI but also a wider ecologically appropriate area of assessment (EAAA), summarised as follows:



Note: Whilst the Project AoI had been set at a 1 km buffer for the ESIA, using the precautionary approach, for the CHSA the AoI was increased to a 5 km buffer to be more representative of ecological processes within rivers and wetlands crossed.

The Critical Habitat criteria as outlined in the IFC PS6 Guidance Notes (2019), are summarised in Table 9-21. The Red List Categories are according to the IUCN Red List Categories and Criteria V3.1 (2012[106]). Four of the five criteria are defined by quantitative thresholds (Criteria 1-4) and one criterion by a qualitative threshold (Criterion 5). Candidate features were screened against these criteria and thresholds to determine critical habitat features.

Table 9-21: **Critical Habitat Criteria as summarised from the IFC PS6 Guidance Notes (2019)**

Criteria	Critical habitat thresholds and guidance
1 Critically Endangered (CR) / Endangered (EN) Species	Thresholds: • Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥0.5% of the global population AND ≥5 reproductive units of a CR or EN species). • Areas that support globally important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds under C1a). • As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species. Guidance: • Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1.

[106] IUCN categories: Critically Endangered (CR): taxon considered to be facing an extremely high risk of extinction in the wild; Endangered (EN): taxon considered to be facing a very high risk of extinction in the wild; Vulnerable (VU): taxon considered to be facing a high risk of extinction in the wild; Data Deficient (DD): taxon is DD when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.

Criteria	Critical habitat thresholds and guidance
	• The inclusion of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals. *Indigenous DD species were screened following the precautionary principle.*
2 Endemic/ Restricted Range Species	Threshold: • Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species. Guidance: • The term endemic is defined as restricted-range and restricted-range refers to a limited extent of occurrence (EOO). • For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO <50,000 km² • For marine systems, restricted-range species are provisionally being considered those with an EOO <100,000 km². • For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of ≤500 km linear geographic span (i.e., the distance between occupied locations furthest apart). • Where information is available, EOO information can be refined by the area of occupancy (AOO), which represents the area of suitable habitat currently occupied by a taxon.
3 Migratory/ Congregatory Species	Threshold: • Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. • Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress. Guidance: • Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). • Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis
4 Highly Threatened and/or Unique Ecosystems	Thresholds: • Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. • Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning. Guidance: • The IUCN is developing a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species. The client should use the Red List of Ecosystems where formal IUCN assessments have been performed. • Where formal IUCN assessments have not been performed, the client may use assessments using systematic methods at the national/ regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally recognised NGOs).
5 Key Evolutionary Processes	Guidance: • This criterion is defined by the physical features of a landscape that might be associated with particular evolutionary processes; and/or • Subpopulations of species that are phylogenetically or morphologically distinct and may be of special conservation concern given their distinct evolutionary history.

Accordingly, the CHSA was initiated with a review of available databases (as outlined in Section 9.7 to 9.9 above), delineating a preliminary EAAA (described below), and refined by additional information that may be available on CH candidates most likely within the AoI. Collated information was evaluated by insights gained from the site survey, and has been used to primarily determine if there is a likelihood for CH candidates to be present based on a high-level determination of suitable habitat and/or direct sightings.

9.10.1.1 Methods used for Criteria 1 to 3

The IFC thresholds for Criteria 1 to 3 are based on percentages of global and national population sizes, combined with the minimum numbers of reproductive units. There are often instances where a species' population is largely unknown, and in these cases the first three criteria could, where scientifically verifiable[107], be assessed with percentages of global distribution ranges.

The list of candidate species to be assessed against Criteria 1 to 3 was derived IBAT as well as field observations. The species evaluated against Criterion 1c also included all indigenous data deficient (DD) species potentially present, as these be threatened, pending more in-depth scientific studies. This would be the most practical way to address current uncertainties regarding such species. Only DD species with a narrow distribution range and/or high likelihood of being abundant in the AoI (as used for the CHSA) were included in the results.

For each candidate species, the following information as available was obtained and further determined to the extent possible:

- species habitat preference
- the geographical ranges and distribution maps of species in relation to the EAAA
- habitat types within the EAAA
- estimates of population size at global and national levels
- estimates of population density at global and national levels
- area of occupancy (AOO) at global and national levels
- reproductive units of a species at global and national levels (i.e. number of breeding pairs)

These outputs were then screened against the significance thresholds that define critical habitat outlined above. For CR, EN, VU or endemic species, for which population distribution is not well understood, an assessment of the importance of the broader landscape was made based on high-level literature reviews, and professional judgement from the baseline surveys.

9.10.1.2 Methods used for Criterion 4

IFC Guidance Note 6 (IFC, 2019) indicates that the CHA should use the Red List of Ecosystems (Keith et al., 2024) where formal IUCN assessments have been performed. However, where formal IUCN assessments have not been performed, the CHA may use

[107] It must be noted that for many Angolan endemic species but also other indigenous species, there is limited information available on the actual area of occurrence (AOO as per IUCN) or population status. Such data for Angola specifically is mostly lacking. Using the modelled extent of occurrence (EOO as per IUCN) to determine the potential fraction of a species' population within a Project-impacted area can be highly misleading, unless the species is range-restricted or detailed surveys can be undertaken to measure the actual extent of suitable habitat present in the area assessed.

assessments using systematic methods at the national/regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally recognized NGOs) (GN79: IFC, 2019).

The IUCN Red List of Ecosystems follows a similar approach to the IUCN Red List of Threatened Species (Keith et al., 2024; IFC, 2019). The IUCN Red List of Ecosystems uses broad criteria to assess globally threatened ecosystems:

A: Reduction in geographic distribution, especially over the past 50 years

B: Restricted geographic distribution:

- Condition 1: Restricted distribution,
- Condition 2: Evidence of ongoing or future decline, threat or few locations:
    - B1: Small EOO AND threats
    - B2: Small AOO AND threats
    - B3: Very small number of locations (generally fewer than 5) AND prone to the effects of human activities or stochastic events within a very short time period, which could lead to collapse or a more severe threat category of this ecosystem

C: Environmental degradation. Observed or predicted decline relative to the amount of decline required until collapse.

D: Biotic disruption. Observed or predicted decline relative to the amount of decline required until collapse.

E: probability of collapse. Applied using a process-based ecosystem simulation model:

- CR ≥ 50% in 50 years
- EN ≥ 20% in 50 years
- VU ≥ 10% in 100 years

However, the IUCN Red list of Ecosystems is still under development, and no formal assessments have been undertaken for terrestrial or aquatic habitats within Angola. At a broader scale the conservation status of the ecoregions within which the AoI is situated (as defined by OneEarth 2024) was considered under this category.

9.10.1.3 Criterion 5

Guidance Note 6 (IFC, 2019) identifies two key factors defining the presence of key evolutionary processes: the physical features of a landscape or seascape, and subpopulations of species that are phylogenetically or morphologically distinct. Such areas may typically have either or a combination of geographically isolation (currently or historically), high levels of endemicity and spatially highly heterogeneous.

While Criterion 4 considers the ecosystem itself, Criterion 5 is defined by the physical features of a landscape that might be associated with particular ecological and evolutionary processes. In the majority of cases, this criterion will be triggered in areas that have been previously investigated and are already known or suspected to be associated with unique evolutionary processes (IFC, 2012). While systematic methods to measure and prioritise evolutionary processes in a landscape do exist, they are typically beyond a reasonable expectation of studies conducted by the private sector (GN83: IFC, 2019). Examples of spatial features associated with evolutionary processes include:

- Landscapes with high spatial heterogeneity that are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify;
- Environmental gradients, also known as ecotones, which produce transitional habitat, which has been associated with the process of speciation and high species and genetic diversity;
- Edaphic interfaces: specific juxtapositions of soil types (for example, serpentine outcrops, limestone, and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism;
- Connectivity between habitats (for example, biological corridors) that ensure species migration and gene flow; and
- Sites of demonstrated importance to climate change adaptation for either species or ecosystems

9.10.1.4 Notes and Limitations

The spatial and temporal extents of this CHSA as described were deemed appropriate for a screening assessment. A total assessment of all probable alternatives, seasonal variations or circumstances that may exist for the AoI was not undertaken as part of the screening. No fixed assumptions on CH should be made unless opinions are specifically indicated and provided.

The above is considerably dependent on specialist knowledge of the area in question and opinion between specialists may vary.

Due to limitations in available groundtruthed data relating to species and their population sizes and habitats within the EAAA, as well as intermittent or absent global population or distribution data for many species, it was not possible to quantitively assess all biodiversity features against the thresholds for CH. Therefore, a precautionary approach was used for species based on the following categories:

- **Qualifying**: reasonable evidence that the species is present in the AoI and meets or approaches the threshold.
- **Potentially qualifying**: Insufficient evidence to confirm qualification but there are e.g. suitable habitat or other aspects that may suggest qualification.
- **Unlikely**: reasonable evidence that the species does not meet the threshold.
- **Not qualifying**: Available information is clear enough to conclude that the species does not meet the threshold.
- **Priority Biodiversity Features (PBF)**: where such are likely present within the EAAA but do not trigger CH, these were still indicated to the extent possible, as they are important for local and possibly global conservation goals.

Biodiversity values that were assessed as “qualifying” and “potentially qualifying” were screened in and listed below. Biodiversity values that were assessed as “unlikely” and “not qualifying”, we considered as reasonably confident to be screened out and were not elaborated on further.

The most recent gazetted list of threatened species dates from 2018 (Decreto Executivo n.° 252/18), and this was used to amend the threat status where it is indicated as more severe than the global IUCN rating. It is presumed that all indigenous threatened species listed in this document, and CITES-listed species should be considered locally protected.

9.10.2 Ecologically Appropriate Area of Assessment

The scale at which a critical habitat assessment is conducted depends on underlying ecological processes for the ecosystems, habitat(s) and species potentially, and is not limited to the footprint of the project nor the potential Project's AoI. Rather, the Ecologically Appropriate Area of Assessment (EAAA) needs to be determined, as defined in the IFC PS6 Guidance Notes (2019):

'GN59. The project should identify an ecologically appropriate area of analysis to determine the presence of critical habitat for each species with regular occurrence in the project's area of influence, or ecosystem, covered by Criteria 1-4. … define the boundaries of this area taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project's area of influence) and the ecological patterns, processes, features, and functions that are necessary for maintaining them… use this area of analysis to assess applicability of the critical habitat criteria and thresholds to determine critical habitat for the species and/or ecosystems concerned. Critical habitats boundaries should be equivalent in scale to areas mapped for practical site-based conservation management activities. For some wide-ranging species, critical habitat may be informed by areas of aggregation, recruitment, or other specific habitat features of importance to the species.'

The EAAA was delineated to include all habitats similar to those found within the project AoI, taking into consideration local ecosystem dynamics, species distribution and habitat needs, and the extent of area practically manageable. As potential critical habitat triggers include freshwater plants, and species using wetland (and stream) habitats as key resource and movement corridor, the extent of local watersheds, capped at approximately 50 km downstream of the AoI boundary, was concluded representative of habitat requirements and/or viable populations of SCCs potentially present or migrating/congregating locally. This also took into consideration the potential habitat similarity of protected and/or key biodiversity areas (KBA), and the most recent global CH screening layer (Dunnett et al., 2025) within and further than 50 km away from the AoI to confirm that a further extension of the EAAA to include such was not necessary (habitats in the AoI not that similar to be important for species triggering the relevant KBAs). The EAAA contains woodlands, active and abandoned agricultural fields, various types of wetlands and aquatic habitat, as well as mosaics of forest, more open savanna, grasslands and urbanised areas. The EAAA is shown in Figure 9-24.

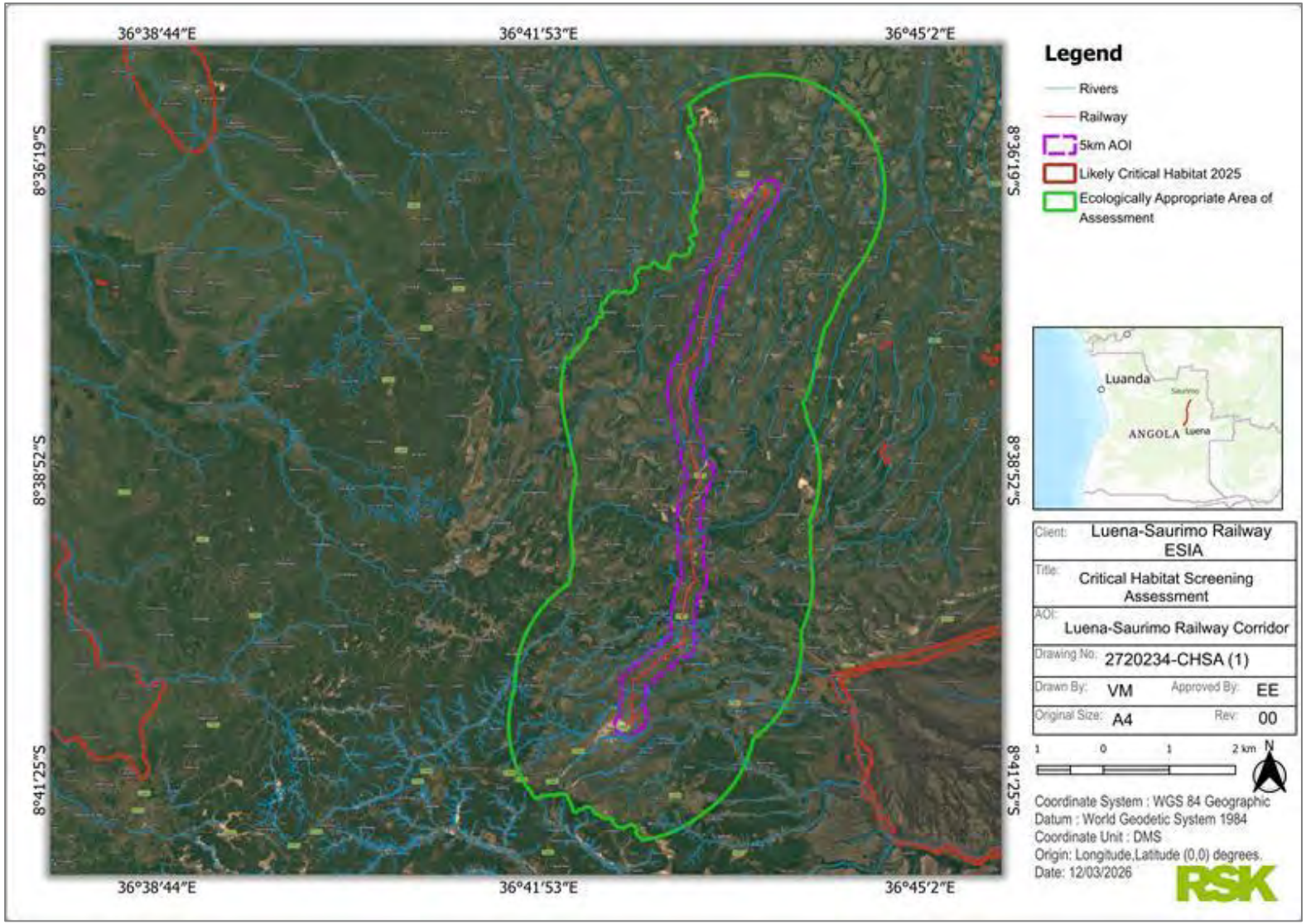


Figure 9-24: The Luena Saurimo Railway corridor in relation to the EAAA investigated

9.10.3 Results

9.10.3.1 Criterion 1: Critically endangered and endangered species

The species listed in Table 9-22 have been confirmed or could potentially occur within the EAAA and AoI at numbers high enough to trigger critical habitat under Criterion 1. Using the precautionary basis, where too little is known about population numbers, but species presence was confirmed or would be highly likely, such species were included in the list.

No species could be confirmed to trigger CH under Criterion 1.

9.10.3.2 Criterion 2: Endemic and restricted range species

The species listed in Table 9-23 have been confirmed or could potentially occur within the EAAA and AoI at numbers high enough to trigger critical habitat under Criterion 2. Using the precautionary basis, where too little is known about population numbers, but species presence was confirmed or highly likely, such species were included in the list.

The restricted range fish *Chiloglanis angolensis* was confirmed, which may be a new distribution record. Similarly, is it possible that several range-restricted fish and plant species may be present – all within streams and wetlands. This will at east require streams to be treated as no-go area unless more studies on the abundance of this species can be undertaken.

9.10.3.3 Criterion 3: Migratory and congregatory species

The species listed in Table 9-24 could potentially occur within the EAAA and AoI, and if regularly occurring during suitable seasons and then in significant numbers could trigger critical habitat under Criterion 3. For species where too little is known about population numbers, but presence was either confirmed or highly likely to be present in high numbers at least on occasion, such species were included in the list.

The Amur Falcon (*Falco amurensis*) is one congregatory and migratory species confirmed in such abundance that it possibly does trigger CH, but rail impact should likely be insignificant.

9.10.3.4 Criterion 4: Highly threatened and / or unique ecosystems

No habitat within the AoI could be identified as definitely meeting these criteria. However, using the cautionary approach, the following should be considered as having a high conservation and/or ecosystem services value, and destruction or disturbances should be avoided or minimised to the extent possible with suitable engineering designs (which will also contribute significantly to the rail's long-term resilience against extreme climatic/flooding events):

- Floodplains with channelled valley-bottom wetlands (rivers)

9.10.3.5 Criterion 5: Areas associated with key evolutionary processes

No habitat within the AoI could be identified as definitely meeting these criteria.

Table 9-22 Potential species that could trigger IFC threshold 1a, 1b or 1c

Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
Fish						
Type of Elephant-fish	*Marcusenius cuangoanus*	VU	NE	Unlikely	Not qualifying	Known from the Kwango/Cuango River basin, which is outside the EAAA
Type of Cichlid	*Oreochromis lepidurus*	EN	NE	Unlikely	Not qualifying	Known from the Boma area of the lower Congo River, which is outside the EAAA
Herpetofauna						
-	-	-	-	-		
Birds						
Hooded Vulture	*Necrosyrtes monachus*	CR	NE	Possible	Not qualifying	Presence occasional and opportunistic, no known breeding in area
White-headed Vulture	*Trigonoceps occipitalis*	CR	NE	Possible	Not qualifying	Presence occasional and opportunistic, no known breeding in area
Steppe Eagle	*Aquila nipalensis*	EN	NE	Possible	Unlikely	Presence very low and opportunistic, no known breeding in area
Martial Eagle	*Polemaetus bellicosus*	EN	NE	Possible	Unlikely	Presence very low and opportunistic, no known breeding in area
Secretarybird	*Sagittarius serpentarius*	EN	NE	Unlikely	Not qualifying	Very limited suitable habitat
Bateleur	*Terathopius ecaudatus*	EN	NE	**Confirmed**	Not qualifying	Local abundance very low and opportunistic, no known breeding area
Lappet-faced Vulture	*Torgos tracheliotos*	EN	NE	Possible	Not qualifying	Presence occasional and opportunistic, no known breeding in area

Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
Southern Ground-hornbill	*Bucorvus leadbeateri*	VU	NE	Possible	Unlikely	Historic records, no known breeding in area and/or low abundance
Wattled Crane	*Bugeranus carunculatus*	VU	NE	Possible	Unlikely	Historic records, no known breeding in area and/or low abundance
Red-footed Falcon	*Falco vespertinus*	VU	NE	**Confirmed**	Not qualifying	Local abundance very low and opportunistic, no known breeding area
Mammals						
Black Rhino (and any subspecies)	*Diceros bicornis*	CR	EX	No	Not qualifying	Considered extinct in Angola
White-bellied Pangolin	*Phataginus tricuspis*	EN	EN	Possible	Not qualifying	Local abundance anticipated very low due to habitat patchiness and low resources
Cheetah	*Acinonyx jubatus*	VU	EN	Unlikely	Not qualifying	Very limited to no suitable habitat
Angolan Colobus	*Colobus angolensis* ssp. *angolensis*)	VU	EN	Possible	Not qualifying	Local abundance anticipated very low due to habitat patchiness and low resources
Lion	*Panthera leo*	VU	EN	Unlikely	Not qualifying	Lions in Angola only known from few protected areas outside the EAAA
Leopard	*Panthera pardus*	VU	EN	Possible	Not qualifying	Local abundance anticipated very low due to low (food) resources
Plants	**Growth form**					
Bulbostylis trabeculata	Wetland sedge	DD	NE	Possible (wetlands)	PBF	If present likely too few to trigger CH, but treat confirmed occurrences as no-go area

Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
Genlisea angolensis	Aquatic herb	EN	NE	Possible (swampy grassland and wetlands)	PBF	If present likely too few to trigger CH, but treat confirmed occurrences as no-go area
Rotala robynsiana	Aquatic herb	CR	NE	Possible (wetlands)	PBF	If present likely too few to trigger CH, but treat confirmed occurrences as no-go area
Xyris exigua	Aquatic herb	CR	NE	Possible (wetlands)	PBF	If present likely too few to trigger CH, but treat confirmed occurrences as no-go area
Croton gossweileri	Shrub or small tree	EN	NE	Possible (riparian woodland)	PBF	If present likely too few to trigger CH, but could occur in small patches that should then be treated as no-go area
Disa aequiloba	Orchid	EN	NE	Possible (swampy grassland and wetlands)	PBF	If present likely too few to trigger CH, but could occur in small patches that should then be treated as no-go area

Table 9-23 Potential species that could trigger IFC thresholds for Criterion 2

Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
Birds						
Mountain Pipit	*Anthus hoeschi*	NT OR LR/NT	NE	possible	PBF	If present likely too few to trigger CH, but suitable habitat may be present (poorly understood outside its high-altitude breeding preference)
Fish						
-	*Amphilius lentiginosus*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
Gorgeous Barb	*Barbus bellcrossi*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
Angolan Catfish	*Chiloglanis angolensis*	DD	NE	**Confirmed**	Potentially qualifying	Observation potentially a new distribution – previously only recorded from Kwango/Cuango River basin outside the EAAA
-	*Dundocharax bidentatus*	DD	NE	Possible	PBF	Only known from the type locality Lucoge River, Kasai River system
-	*Enteromius caudosignatus*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Marcusenius dundoensis*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Opsaridium maculicauda*	DD	NE	Possible	PBF	Only known from the type locality Lucoge River, Kasai River system
-	*Parakneria fortuita*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area

Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
-	*Paramormyrops jacksoni*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Steatocranus rouxi*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Cyclopharynx fwae*	LC	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Cyclopharynx schwetzi*	LC	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Hypsopanchax jubbi*	LC	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
Yangami Butterbarbel	*Schilbe yangambianus*	LC	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area
-	*Teleogramma monogramma*	VU	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area

Table 9-24 Potential species that could trigger IFC thresholds for Criterion 3

Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
Birds						
Amur Falcon	*Falco amurensis*	LC	LC	**Confirmed**	**Potentially qualifying**	Migratory: Observed in massive numbers often exceeding 1000, **thus possibly meeting the 1% threshold** Uncertainty if this is a regular occurrence
Black-and-rufous Swallow	*Hirundo nigrorufa*	LC	LC	**Confirmed**	Not qualifying	Migratory – up to 20 in observed flocks, overall abundance below threshold
African Stonechat	Saxicola torquatus	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Angolan Swallow	*Hirundo angolensis*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Black Cuckooshrike	*Campephaga flava*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Black Saw-wing	*Psalidoprocne pristoptera*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Blue-cheeked Bee-eater	*Merops persicus*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Broad-billed Roller	*Eurystomus glaucurus*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Common Greenshank	*Tringa nebularia*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
European Bee-eater	*Merops apiaster*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold

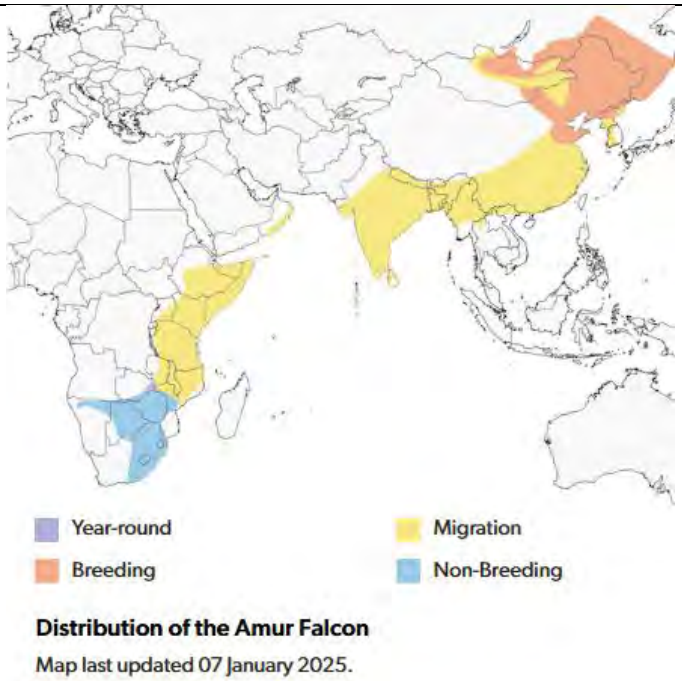
Common name	Scientific name	IUCN Red List Status	Angola threat status	Presence in the AoI	Ch trigger?	Notes
Icterine Warbler	*Hippolais icterina*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Jacobin Cuckoo	*Clamator jacobinus*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Klaas's Cuckoo	*Chrysococcyx klaas*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Levaillant's Cuckoo	*Clamator levaillantii*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Little Swift	*Apus affinis*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Mosque Swallow	*Cecropis senegalensis*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Pearl-breasted Swallow	*Hirundo dimidiata*	LC	LC	**Confirmed**	Not qualifying	Observed abundance below threshold
Red-footed Falcon	*Falco vespertinus*	LC	VU	**Confirmed**	Not qualifying	Observed abundance below threshold
Fish						
-	*Amphilius lentiginosus*	DD	NE	Possible	PBF	If present likely too few to trigger CH, but treat potential habitats as no-go area

9.10.3.6 Information on potential CH-triggers identified

As shown in above tables, two species could potentially trigger Critical Habitat:

- Amur Falcon (*Falco amurensis*)
- Angolan Catfish (*Chiloglanis angolensis*)

These species are explored in more detail below, with implications on and by the proposed Project.

Species	*Falco amurensis* Amur Falcon	 The currently known geographic range of the Amur Falcon, as shown by Birds of the World (2025).
Status (IUCN Red List of Threatened Species)	LC Congregatory and migratory	
Critical Habitat Criteria	Criterion 3	
Qualifying	Potential	
Population size	200,000-667,000	
EOO (km²)	3450000	
Justification	The last assessment of this species was in 2021 (IUCN, 2025), by which time it non-breeding congregations were not known from the upper Zambezi River catchment nor upper Kasai catchment, in which this species was observed during the baseline survey (i.e. central portion of the rail, where grasslands and open savanna are more extensive (see Section 9.7.2). As can be seen by the wide-ranging discrepancies around anticipated global population (done in 2009), if taking the worst-case scenario of only 200,000 birds remaining, then 2000 birds possibly observed during the survey could meet the lowest threshold for congregatory species, and this the potential CH qualifier is indicated using the most conservative approach. In its overwintering range (including the AoI), this species prefers savannas and grasslands, roosting (often in large numbers) in clumps of trees. It feeds mainly on insects, which would be abundant in open grassy wetlands and open savannas. Amphibians or small birds are occasional prey. Arrival after breeding is from late November/December, and migration back to breeding areas generally starts around late February/March. Information: https://datazone.birdlife.org/search?search=falco%20amurensis and https://birdsoftheworld.org/bow/species/amufal1/cur/introduction	
Implications for Project	This species has been spotted >600 km from its nearest known seasonal distribution, which shows a previously unknown or occasional range expansion. It is possible that overall population numbers may then be	

	>200,000, which would mean that observed occurrences in the AoI would then be below the CH threshold. Retaining wetland functionality through sufficient drainage installations, whilst keeping the active rail servitude free of tree-clumps would be key mitigation. Overall, with mitigation the likely impact on this species should be negligible, and no offset will be required. However, monitoring of movement patterns during construction and first five years of operation is recommended to determine if adaptive management will be required.

Species	*Chiloglanis angolensis* Angolan Catfish	
Status (IUCN Red List of Threatened Species)	DD	
Critical Habitat Criteria	Criterion 2	
Qualifying	Potential	
Population size	Not known	The currently known geographic range of the Angolan catfish, as shown by IUCN (2025).
EOO (km²)	Not known	
Justification	The last assessment of this species was in 2009 (IUCN, 2025), by which time it was not known from the Kasai River catchment, in which it was observed during the baseline survey. Given the previous disconnected locations and the new observation, the actual range of this fish could be much wider than previously anticipated. Currently this species is known exclusively from Angola, which is why – using the precautionary principle – it is indicated as potentially triggering CH. This will include the wetlands and streams of the Kasai River system. This species is also adapted to rocky rapids, but in general is a benthopelagic species (in open water and feeding on bottom of waters), thriving in freshwater environs with slow-moving and even stagnant water. Muddy and sandy substrates in rivers provide resources for feeding (detritus, algae and small invertebrates) and spawning. Information from IUCN (2025) and https://www.marinelifeid.com/identification/chiloglanis-angolensis/	
Implications for Project	This species was observed > 100 km from its nearest known distribution, which underscores the knowledge gaps on this species. It may thus have a bigger range than currently known, which may more its occurrence in the AoI to below the CH threshold. Installing sufficient drainage structures and bridges to retain all wetland and stream connectivity (i.e. not concentrating water and spanning the width of	

	wetland ecosystems) – especially catering for the connectivity of seasonal elevated water levels will be the most important mitigation to allow for free movement and possible migration of this (and other) fish species. A rapid response plan for accidental hydrocarbon spill will be essential. If above mitigations are implemented, impact on this fish species will be negligible, and no offset or detailed biodiversity action plan will be required.

10 IMPACTS IDENTIFICATION AND ASSESSMENT

This chapter presents identification and assessment of the environmental and social impacts and risks associated with construction operation and maintenance phases of the proposed Luena-Saurimo railway Project.

10.1 Impacts identification and assessment process

10.1.1 Impact identification process

Potential environmental, socio-economic and cultural impacts of the Project were identified and assessed by using the following techniques:

- use of impacts/aspects identification matrices
- identification of project components/activities causing impacts (Chapter 3)
- establishing affected environmental and social aspects (VECs). The VECs that may potentially be affected by the Project included in this assessment incudes but not limited to air quality, noise, surface water, groundwater, soils, biodiversity, community health and safety, local economy, employment and livelihoods, transportation and traffic as well as cultural heritage
- determining how project activities interact with the VECs to assist in potential environmental and social impacts identification as per process in Figure 10-1
- review of issues and concerns raised by stakeholders
- recognition of an element of legislation, policy, regulatory requirements, official government decisions/directives or international requirements
- expert judgement and experience with similar Projects.

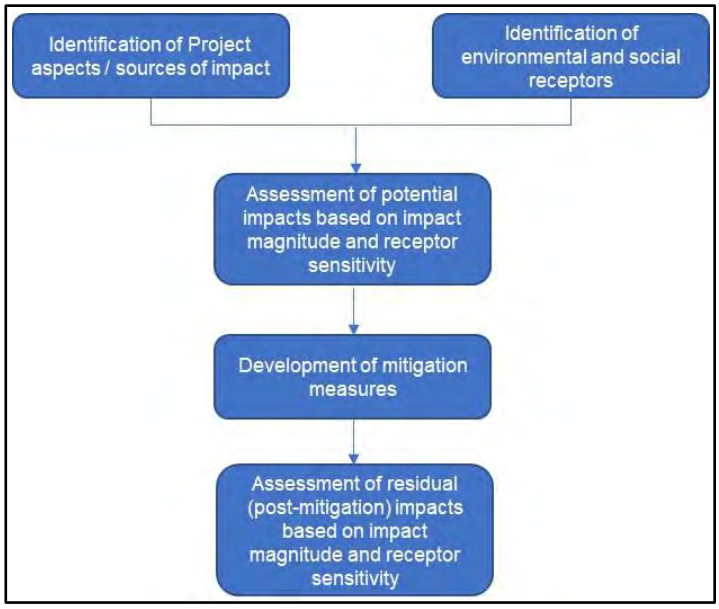


Figure 10-1: Impacts identification process

10.1.2 Impacts assessment

10.1.2.1 Nature of impact

Potential impacts identified are rated in terms of a range of impact criteria, as follows:

- positive impacts are impacts that are beneficial to the environmental or social receptor
- negative impacts are impacts that are detrimental to the environmental or social receptor.

Direct or indirect impact:

- direct impacts are impacts caused by a Project action, which occur at the same time and location as the activity
- indirect impacts are impacts caused by a Project action, but which occur later in time or are farther removed in distance but can be reasonably foreseen. Indirect impacts may include impacts related to induced changes in the pattern of use of the marine area, or related effects on air and water and other natural systems, including ecosystems.

Impact duration:

- short-term (temporary): impacts of less than 1 year in duration
- medium-term: impacts between 1 and 10 years in duration
- long-term (permanent): impacts of more than 10 years in duration.

Impact reversibility:

- an impact is reversible when there is a possibility that the affected environmental factor will return to conditions similar to those it had before the impact occurred
- an impact is irreversible when the possibility of the affected environmental factor returning to conditions similar to those it presented before the impact of the impact does not exist or is negligible.

Impact scale:

- an impact is local when the effects on the environmental factor in question are restricted to a local extent; for the socioeconomic environment, spatial coverage is local when the impact is restricted to a municipality
- an impact is regional when the effects on the environmental factor in question reaches a regional extent; for the socioeconomic environment, spatial coverage is regional when the impact affects more than one municipality
- an impact is national or international when the effects on the environmental factor in question have a national, continental or global character; for the socioeconomic environment, coverage is supra regional when the impact affects more than one municipality and is national, continental or global.

Cumulative impacts

- cumulative impacts are the additive impacts resulting from the impacts associated with the project, when considered in combination with any other development activity proposed within the anticipated area of impact at the same time.

10.1.2.2 Impact Magnitude

Significance is a function of the impact magnitude and importance of the receptor. It must be noted that impact magnitude and receptor importance are defined qualitatively or quantitatively, depending on the methodology and nuances of the individual technical assessment topics.

The magnitude of a predicted impact is defined as the extent of change which may be expected as a result of a range of factors including:

- the anticipated geographic area that may be affected
- the duration and frequency of an impact
- the degree of environmental or socio-economic change and/or level of community concern.

Table 10.1 sets out indicative guidance for the consideration of potential impact magnitude

Table 10-1: Guidance on characterisation of potential impacts

Definition	Indicative description of impact*
No effect	No measurable change from background levels (ecosystem, population, natural resources). Imperceptible or negligible Social, economic or cultural impact is 'imperceptible' or unlikely to be noticed
Low	Small change but nonetheless measurable relative to background levels. Highly localised to immediate vicinity of (e.g., within an order of 500 m or other reasonable buffer depending on the resource affected). Short term. Not expected to contribute to cumulative effects
Minor	Measurable change relative to background levels. Changes might be noticeable but fall within the range of normal variation Impacts felt at local level and/or a group of individuals of a population at a localised area and/or over a short period (one generation or less). Short term. Impact is not expected to contribute to cumulative effects Changes in social, economic or cultural dynamics with minor and temporary effect on any given sector performance and/or population wellbeing. Limited impact to archaeological, cultural or natural resources. Unlikely to result in concerns being raised by governmental bodies or stakeholders Can be positive or negative. Mitigation measures for negative impacts, if required, can be readily implemented
Medium	Large change relative to background levels (ecosystem, population, natural resources), and likely to contribute to cumulative effect. Changes exceed the range of natural variation Impacts may be felt at regional level and/or affect a portion of the population or species over one or more generations but does not change the integrity of the population. Impacts may be medium to long term Changes in social, economic or cultural dynamics with moderate and noticeable adverse effect on any given sector performance and/or population wellbeing Involved damage to archaeological, cultural or natural resources of local importance. Such impact may result in concerns being raised by governmental bodies or stakeholders

Definition	Indicative description of impact*
	Can be positive or negative. Negative impact can be minimised or avoided by application of specific mitigation measures. After mitigation, residual impacts may require monitoring
High	Substantial change to the baseline and long term (>5 years) changes in an ecosystem. Changes are well outside the range of natural variation and assisted rehabilitation might be required. May affect the whole population or species causing a change in abundance and/or distribution, or the size of genetic pool such that natural recruitment would not return to that population, or any population of species dependent upon it Impacts may be widespread. Impact may be a major contributor to cumulative effects Changes in social, economic or cultural dynamics with major adverse effect on any given sector performance and/or population wellbeing. Involves damage or permanent loss to archaeological, cultural or natural resources of international/national importance. Such impacts may result in immediate intervention by governmental bodies and stakeholders Can be positive or negative. Negative impact may be difficult to mitigate and/or irreversible

Notes: *These descriptions are for guidance only. Professional judgement may be applied in specific circumstances out with these guide descriptions.

10.1.2.3 Receptor Sensitivity

Receptor sensitivity criteria will be applied, taking into account the following key factors:

- relevant legislative or policy standards or guidelines
- the relative value or importance of the receptor at local, national or international level; the importance of a receptor may relate to biodiversity, ecosystem services, cultural or economic significance
- the vulnerability of a receptor, its capacity to absorb change and its ability to recover from an impact.

Table 10-2: Receptor Value/Sensitivity – Indicative Criteria

Definition	Indicative description*
Not sensitive	Resilient to Project activities. The receptor is resistant to change or is of little environmental or social value
Low	Receptors with limited value or importance attached to them, even at local level. Easily adaptable to change, or likely to recover immediately (within days/weeks)
Medium	Receptors of importance at a local or national level. The receptor has moderate capacity to absorb change without significantly altering its present character and/or recovery likely within 1 to 2 years of cessation of activities or highly localised medium-term recovery (2 to 5 years)
High	Receptors of importance at national level. The receptor has low capacity to absorb change without fundamentally altering its present character, is of high environmental or social value. Species of potential conservation significance. and/or recovery likely 5 to 10 years following cessation of activity, or that cannot easily be recovered
Note: *these descriptions are for guidance only. Professional judgement may be applied in specific circumstances with these guide descriptions.	

10.1.2.4 Impact Significance

The magnitude of impact and sensitivity of receptor is then combined to determine the predicted significance of any impacts, as shown in Table 10-3

		Sensitivity				
		Not Sensitive	Low	Medium	High	Very high
Magnitude	No effect	No effect	No effect	No effect	No effect	No effect
	Slight	Negligible	Negligible	Minor	Minor	Minor
	Minor	Negligible	Minor	Minor	Moderate	Moderate
	Medium	Minor	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major

10.1.2.5 Environmental Risk

In addition to the factors discussed above, when considering unplanned events, the likelihood of an event occurring also requires consideration. In this case, the likelihood indicative criteria listed in Table 10-4.

The sensitivity and magnitude of the impact is then combined to determine the risk estimation/residual impact probability. These are envisioned unavoidable problems that may remain despite all practical and feasible mitigation measures implemented. Table 10-5 will be applied to provide predicted rating/estimation of the residual impacts.

Table 10-4: Impact Significance Matrix

Definition	Indicative description*
Remote	Never occurred during Project activities but has been known to occur
Unlikely	Has occurred in Project activities in the past but as an isolated incident under exceptional circumstances
Occasional	Has occurred on more than one occasion during Project activities in the past
Likely	Occurs regularly during Project activities
Note: * these descriptions are for guidance only. Professional judgement may be applied in specific circumstances with these guide descriptions.	

		Sensitivity			
		Not Sensitive	Low	Medium	High
Magnitude	No effect	No effect	No effect	No effect	No effect
	Slight	Negligible	Negligible	Minor	Minor
	Minor	Negligible	Minor	Minor	Moderate
	Medium	Minor	Minor	Moderate	Moderate
	High	Minor	Moderate	Moderate	Major

10.1.3 Mitigation hierarchy adopted

Given Project's commitment to international standards for sustainability, the overall mitigation hierarchy adopted has been aligned with IFC proposed guidelines whereby:

- impacts avoidance through application of best engineering practices, access roads, power supply and water supply infrastructure design alternatives considerations. Avoidance will be the most preferred and a priority option
- minimizing adverse impacts resulting from construction, operation and maintenance activities of the host sites and infrastructure in cases where avoidance is impossible, appropriate mitigation measures and/or commitments will be drawn for each impact
- in-situ restoration/compensation of the residual impacts & affected areas/communities
- offsetting residual impacts as the least option
- social impacts assessment.

The significance assessment of identified impacts is provided separately in Appendix 16.

10.1.4 Human rights risk assessment, greenhouse gas emissions and climate change risk assessment

Different approaches have been used in assessing risks associated with human rights, climate change and greenhouse gas emissions. The full assessment for each item is provided in a separate standalone report in Appendix 14 (Human Rights) and Appendix 15 (Climate change and greenhouse gas emissions).

10.2 Socio-economic impacts

This chapter will focus on the impacts identified as part of the socio-economic assessment.

10.2.1 Description of potential impacts

A social impact is something that is experienced or felt, in a perceptual or corporeal sense at the level of an individual, social unit (family/household/community) or community/society (Vanclay *et al*, 2015). A perceived impact is something that is believed to be a potential impact rather than something that has been established as being an actual impact. Note that perceived impacts affect how people feel about the project and how they feel and behave generally, thus for stakeholders their perception is their reality.

Considering the statement above, it must be considered that some social impacts will not be discussed in detail and that the focus will be on the most severe impacts. Nevertheless, it must be considered that the social environment is dynamic and adapts to change. The focus should be on the active management of social impacts rather than on the prediction and once-off mitigation thereof. Successful mitigation and management of social impacts require long-term commitment and involvement and should form part of the strategic planning and management of the project until decommissioning. Suggestions for the management of social impacts are included in the report. The implementation of the relevant management suggestions should start as soon as possible since the social impacts of the project started when the project was announced. Another important consideration in this project is the social context in which it will be executed. Impacts are assessed from a community perspective, and where it will influence a specific group of stakeholders it will be indicated as such. An attempt was made to simplify the impact assessment and to focus on aspects that can aid the decision-making process.

Social impacts are the result of social change, and to fully understand the potential impacts it is important to know the impact pathways. A social change process is a discreet, observable, and describable process that changes the characteristics of a society, taking place regardless of the societal context (that is, independent of specific groups, religions etc.). Social change processes can be measured objectively. The way in which social change processes are perceived, given meaning, or valued, depend on the social context in which various societal groups act. Some groups in society can adapt quickly and exploit the opportunities of a new situation. Others (e.g. vulnerable groups) are less able to adapt and will bear most of the negative consequences of change. These social change processes may, in certain circumstances and depending on the context, lead to the experience of social impacts. Social impacts are therefore completely context dependent (Vanclay, 2003). More equally important text, along with some bullet points:

This section describes and assesses the specific social impacts that will be associated with the proposed construction of the Luena-Saurimo railway line. When the mitigation and management of social impacts are considered, one must consider that social impacts occur in communities surrounding the proposed project, and although the project proponent may be the catalyst for some impacts, there may be several external factors contributing to the impact. Many of these factors are outside the control of the project proponent. The proponent cannot mitigate many of the social impacts alone, and partnerships with local government and Non-Profit Organisations are often required.

Social impacts must be managed in the long term. This complex process requires insight in the social environment and community dynamics. The social environment adapts to change quickly, and social impacts therefore evolve and change throughout the project cycle. This impact assessment is focussed on construction and operation impacts. Closure or decommissioning of the railway line once established will cause significant social impacts, but due to the changes in the social environment over time it is almost impossible to predict and assess those impacts with an appropriate level of accuracy at present. Should the railway line be decommissioned, a social impact assessment specific to closure must be conducted.

Sources of social impacts are often not as clear-cut as those in the biophysical environment. The following actions that can lead to social impacts have been identified:

- activities and processes that can lead to social impacts before and during construction:
    - land acquisition and resettlement
    - change of land use
    - influx of staff and moving equipment to the project area
    - site clearing
    - construction of the railway, stations and associated infrastructure
    - temporary camp for workers
    - creation of direct and indirect jobs
    - trail runs of trains
- activities that can lead to social impacts during operations:
    - land-use change of areas initially dedicated to other uses, particularly agriculture
    - noise and vibrations caused by train
    - generation of dust from trains
    - waste from trains, stations and depots
    - track maintenance
    - accessibility (improved connectivity)
    - creation of direct and indirect jobs
    - water usage and pollution
    - accidents and incidents
    - economic benefits

Mitigation measures are context specific and the mitigation measures in this report should be viewed as guidelines.

The following table summarizes the themes identified and adapted through the evaluation of the baseline studies and stakeholder consultation. The analysis showed that social impacts and mitigation measures during construction and operation were very similar. To avoid repetition, they have been presented together in Table 10. 1 below.

Table 10. 1: Themes and associated impacts

Topic	Associated Social Impact
Economy	Skills development
	Gains in the local and national economy
	Financial affordability of services to local people
	Increase in mobility and accessibility
	Direct employment opportunities at the Project
	Gender inequalities in direct employment opportunities
	Indirect employment opportunities through increased demand for goods and services
	Induced employment effects through increased purchasing power in community
	Risk of local inflation, potentially driving inequality
	Negative impacts on traditional livelihoods
Community health and safety	Increases in anti-social behaviour, criminality, sexually transmitted infections and other social challenges linked to in-migration
	Noise, dust and vibrations impacting the health of the population
	Damage to housing and other community infrastructure from vibrations
	Pressure on community services (e.g. housing, sanitation facilities and waste management, and health facilities)
	Impacts on quality and quantity of surface and ground water sources
	Pedestrian safety: Need for signage, audible warnings, and safety education for children. Fences near villages
Resettlement and displacement	Impacts on livelihoods – economic displacement: agricultural fields may need to be relocated, loss of access to rivers and services
	Resettlement and impact on property rights: concerns about compensation for households located close to the railway
	Potential for disproportionate negative impacts on women
	Pressure on agricultural livelihoods and food security for those impacted by land acquisition and resettlement
	Community tensions over land acquisition and compensation
	Livelihoods risks associated with use of cash compensation
Demography and social fabric	Community cohesion: potential conflicts due to competition for jobs and benefits

Topic	Associated Social Impact
	Gender impacts: Women may receive fewer opportunities or lose existing opportunities
	Blocking access from fields/between villages
	Impacts on vulnerable groups: Elderly and disabled people may not be included in some benefits
	Expectations of people about the project: High expectations from the community
	Presence of migrant workers: Connectivity issues, lack of services for workers, impact on women and girls
Governance	Low levels of trust in government
	Weakening of traditional hierarchies and governance structures
	Potential increases in corruption and inequality in communities
Culture	Grave relocations
	Loss of medicinal plants
	Deterioration of non-tangible cultural heritage due to influx
	Damage to physical cultural heritage assets
Occupational health and safety	Types of hazards potentially associated with the project
	Risk assessment
	Health and safety management system

10.2.2 Economy

The project area is currently difficult to access and there are limited employment and other economic opportunities. The Project will cause several positive economic impacts but can also potentially cause negative impacts.

10.2.2.1 Skills development and knowledge transfer opportunities

Construction phase

The project is likely to create skills development through employment of local individuals within the community opportunities and capacity transfer during the construction of the railway line. These opportunities could be formal, through on-the-job training, the contractor or subcontractor, or informal, when skills are transferred between community members thereby improving the competencies and expertise of the workforce. Such training initiatives serve to enhance the capabilities of employed individuals, subsequently fortifying their prospects for future employment opportunities.

The magnitude of the impact is considered high and significance moderate.

Mitigation measures

- skills development plans must be a contractual requirement. These plans must be focussed on skills that the project needs, and that are also transferable. Support must be given to people after the training to ensure that their newly acquired skills can be implemented

- fostering on-the job training and collaboration with the existing vocational training centres or through OEC's internship/graduate recruitment and development scheme
- attaching non-skilled workers with the semi-skilled and/or skilled ones to facilitate skills and knowledge transfer on the job
- priority to communities within the Project area in the employment and skills development
- establishing mentorship or apprenticeship programs wherein experienced professionals within the Project provide guidance and support to newly employed locals.

The residual impacts are expected to be positive, reflecting the increasing in long-term skills development, sustained local economic stimulation and improved livelihood security.

Operation and maintenance phase

Continued skills development during the operational phase through the employment of local residents during the operation of the railway line. The magnitude is considered as moderate and the significance moderate.

Enhancement measures

- the project needs to retain local labour where feasible for the operation and maintenance works of the railway Infrastructure and facilities
- developing structured training programs that align with the local needs
- introducing initiatives aimed at capacity building within the local community, including collaborating with educational institutions or vocational training centres to offer specialized courses that cater to the skill demands of the Project
- establishing mentorship or apprenticeship programs wherein experienced professionals within the Project provide guidance and support to newly employed locals.

The residual impacts are expected to be positive, reflecting the increasing in long-term skills development, sustained local economic stimulation and improved livelihood security.

10.2.2.2 Direct local employment opportunities

Construction phase

The project will contribute to direct and indirect employment opportunities to local communities during mobilisation, early works and construction activities of the proposed railway line infrastructure, facilities and utilities. These activities will require a sufficient workforce of which many will be recruited from the local communities along the railway line. Workers with varying skills levels (skilled, semi-skilled and unskilled) will be needed, hence providing income generation opportunities for communities leading to increased household income and living standards. A peak of 1,000 employees is expected whereby indicatively it will constitute 15% skilled, 60% semi-skilled and 25% unskilled. It is currently estimated that 80% of the workforce will be from the Project area with 93% being Angolan nationals for the entire Project (construction and operation).

The railway line Project may also provide indirect and induced employment opportunities in e.g., the local service sector creating additional employment during the mobilisation and construction phase.

The magnitude of the impact is considered as high and the significance high.

Enhancement measures

- ensure fair and transparent recruitment processes, policies and plans that prioritise local hiring from existing local communities
- local content optimisation and integration in all project activities and supply chain
- mainstreaming gender-related considerations including equal employment opportunities throughout Project activities and supply chain
- consideration of vulnerable and marginalised groups in the employment opportunities implement training programs to upskill local workers, ensuring they qualify for various roles within the railway Project
- communicate the availability of jobs to the community in a mutually agreed and accessible manner through advertisement of the available opportunities to the wider public and encouraging local communities to take up the opportunities. Ensure that communication include women
- implementing an accessible and transparent worker grievance mechanism to provide a platform for workers to submit complaints and comments regarding labour and working conditions

The residual impacts are expected to be positive, reflecting the increasing in employment opportunities, sustained local economic stimulation and improved livelihood security.

Operation and maintenance phase

Direct employment opportunities at stations and manning the locomotives can lead to increased income levels for local communities, fostering economic growth and stability during the operation and maintenance phase. There will be landscaping, mechanical and structural related job opportunities for maintenance of the infrastructure and equipment. The magnitude is considered high and long term and impact assessed as moderate significance.

Enhancement measures

- ensure fair and transparent recruitment processes that prioritise local hiring
- implement training programs to upskill local workers, ensuring they qualify for various roles within the railway Project
- advertisement of the available opportunities to the wider public and encouraging local communities to take up the opportunities
- mainstreaming gender-related considerations including equal employment opportunities throughout Project activities and supply chain

The residual impacts are expected to be positive, reflecting the increasing in long-term employment opportunities, sustained local economic stimulation and improved livelihood security.

10.2.2.3 Indirect employment opportunities

Construction phase

Indirect employment opportunities through increased demand for goods and services and induced employment effects through increased purchasing power in the community. The magnitude of the impact is considered as moderate and the significance moderate.

Mitigation measures

- the project proponent should ensure a fair number of secondary economic opportunities are given to local contractors. Services and goods must be procured locally as far as reasonably possible. Aspects of this positive impact will occur by default when the construction force lives locally and they utilise local services and support local shops.

The residual impacts are expected to be positive, reflecting the increasing in indirect employment opportunities, sustained local economic stimulation and improved livelihood security.

Operation and maintenance phase

The railway project can stimulate local economies by increasing demand for goods and services, benefiting local businesses such as retail stores, restaurants, and suppliers. The magnitude of the impact is considered as moderate and the significance moderate.

Enhancement measures

- encourage procurement of goods and services from local businesses to support the local economy.
- provide training and support for local businesses to help them meet the demands generated by the railway Project.

The residual impacts are expected to be positive, reflecting the increasing in indirect employment opportunities, sustained local economic stimulation and improved livelihood security.

10.2.2.4 Risk of inequitable access to employment and income-generating opportunities

Construction phase

Social and cultural norms prevalent within Moxico and Lunda Sul Provinces might act as barriers hindering certain members, particularly women and other vulnerable populations, from fairly participating in the employment initiatives offered by the Project. This situation has the potential to perpetuate gender and economic disparities within these communities. Women tend to be responsible for generating income, from informal trading or cultivation providing for household food security, raising children, and caring for the sick and elderly. It is highly likely that women will not benefit as much as men from employment opportunities. Precautions need to be integrated into the project to address gender inequality in direct employment benefits. Women may not qualify for jobs based on their gender or excluded from opportunities due to their household and childcare duties.

The magnitude of the impact is medium and the significance of impact is moderate.

Mitigation measures

- the contractor should put measures in place to ensure the most effective local employment strategy is deployed. The strategy must include desirable targets for gender equality targets

- establishing and enforcing policies and plans that promote diversity and inclusivity within the employment framework
- equip women with the necessary skills to qualify for a broader range of employment opportunities within the project
- create a supportive and flexible work environment that accommodates the needs of women, including provisions for childcare, flexible working hours, and safe work conditions.

After the implementation of mitigation measures and the improvement of gender inclusivity relative to the baseline, as a result of the Project development, minor residual impacts are still anticipated due to entrenched socio-cultural roles, responsibilities and limited skillsets.

Operation and maintenance phase

Women may face barriers to employment in the railway project due to gender biases, leading to unequal representation in the workforce and limiting economic opportunities for women. The magnitude of the impact is medium and the significance of impact is moderate.

Mitigation measures

- the operator should put measures in place to ensure the most effective local employment strategy is deployed. The strategy must include targets for gender equality target, particularly in both skilled and unskilled roles
- provide specialised training and skills development programs for women to equip them with the necessary skills to qualify for a broader range of employment opportunities within the project
- create a supportive and flexible work environment that accommodates the needs of women, including provisions for childcare, flexible working hours, and safe work conditions

After the implementation of mitigation measures and the improvement of gender inclusivity relative to the baseline, as a result of the Project development, minor residual impacts are still anticipated due to entrenched socio-cultural roles and women's limited skillsets.

10.2.2.5 Local inflation risks

Construction phase

Risk to local inflation, especially if the cost of living goes up and there is a change in local supply and demand. This can cause an increase in inequality between people that are employed by the project, and people relying on subsistence farming. The magnitude of the impact is medium and the significance of impact is moderate.

Mitigation measures

- project construction workers will be accommodated in the planned five construction camps to avoid/minimize housing over-demand within local communities and mitigate potential inflationary risks on the housing markets
- arrange dedicated transport for workers living outside the Project camps, preventing the potential inflation impacts on local public transport
- encourage local production of goods to increase supply and stabilise prices
- continuous monitoring of the population influx and local infrastructure capabilities

- in the event that substantial project-induced inflation is reported as a major (frequent) grievance, the Project will consider alternative and duly qualified suppliers based outside of the project-affected communities.

After the implementation of mitigation measures reducing the risk of project induced inflation. The residual impact is expected to be minor as the increase on prices may still occur during peak construction as demand increases.

Operation and maintenance phase

The influx of workers and the increased demand for goods and services can drive up prices for necessities such as food, housing, and transportation, making it difficult for local residents to afford these essentials. However, local inflation from railway operation and maintenance activities is expected to be low with exceptional areas like Saurimo main station surrounding areas. Overall, the project is expected to contribute to controlling inflation and lowering prices of key products such as petroleum products and other goods and services that were initially transported by road from Luanda and other Provinces. The magnitude of the impact is low and the significance of impact is low.

Mitigation measures

- encourage local production of goods to increase supply and stabilise prices
- prioritise sourcing good and services from local suppliers and contractors

After implementation of mitigations, the residual impact is expected to be very low as the Project will potentially contribute positively to inflation control during operation phase

10.2.2.6 Improved mobility, accessibility and Port connectivity

Operation and maintenance phase

Increase in mobility and accessibility during the operation and maintenance phase. People will have easier access to urban areas, access to more markets, employment, safe and secure transport system for goods, services and products from Luanda, Benguela Port and enhanced mobility and connectivity of the communities. Large scale mining operations e.g., Catoca Mining and other planned large scale investments in agriculture and mining within Lunda Sul will benefit from seamless connectivity and reliable transport for cargo and other goods. This will have positive economic impacts on the communities. The magnitude of the impact is high, and the significance of the impact is high.

Mitigation measures

- implementing routine and periodic maintenance activities of the railway infrastructure for continuous and reliable service provision throughout the year
- review of fares for both passengers and freight to a rate similar or cheaper with other available transport means
- continuous key stakeholders engagement and communications including grievances redress mechanism
- develop a partnership model with the operator and communities to establish a community-based feeder transportation service program to enhance access to the proposed stations. The program will utilise local community vehicles (minivans, three-wheelers etc.,) to provide connections from community hubs directly to the train station at synchronised train timetables

- all stations and trains must be accessible to people with restricted mobility using ramps, handrails, accessible train carriages, wide entrances amongst others. Special rates for the elderly and people with special needs, travel cards or local discounts must be considered.

Positive residual impacts are expected with the of operation or the railway line and improved and upgraded access roads which will enhance connectivity.

10.2.2.7 *Affordability of the railway transport for passengers and cargo*

Construction phase

The increased need for goods and services during the construction of the railway line may cause affordability issues for local residents. Induced employment effects related to an increase in purchasing power of construction workers can lead to an increase in costs for goods and services over the 5 years construction period. The magnitude of the impact is medium and the significance of the impact is moderate.

Mitigation measures

- encourage local sourcing, contract local suppliers for goods and services required during the construction phase. This helps to stimulate the local economy and reduce the impact of increased demand

After the implementation of mitigation measures reducing the risk of project induced inflation. The residual impact is expected to be minor as the increase on prices may still occur during peak construction as demand increases.

Operation and maintenance phase

Some local people are concerned about the financial affordability of the railway service. Locals are willing to pay for tickets, but the costs must be kept as low as possible. The magnitude of the impact is medium and the significance of the impact is moderate.

Mitigation measures

- operator to review ticket fairs and comparisons with other modalities along the railway corridor to optimise community/users' affordability of the ticket prices to being similar or less than alternative transport methods
- continuous key stakeholders engagement and communications including grievances redress mechanism

After mitigation measures, the residual impact is anticipated to be minor.

10.2.2.8 *Improved livelihoods, local economy and empowerment*

Construction phase

Demand for livestock and local produce due to increased demand for food for labour force. This can be a positive impact for residents who will be able to adapt and increase their productivity. One significant way livelihoods will improve is through the ability to diversify livelihoods through e.g. employment opportunities and various income generating opportunities. By diversifying livelihoods into e.g. employment, households along the railway corridor can secure a supplementary source of income that can act as a buffer against vulnerabilities such as a failed harvest, ultimately improving their economic and livelihoods status.

The magnitude of the impact is high and the significance of the impact is high.

Enhancement measures

- encouraging the creation of local supply chains by facilitating connections between the Project construction activities and local businesses
- the Project will actively support local businesses by procuring goods and services from nearby enterprises. This practice stimulates economic growth within the community, benefiting entrepreneurs and bolstering the local economy
- include local procurement policies and commitments to sourcing produce from local farmers within project area and vicinity of the worker accommodation camps
- implementation of livelihood restoration programs (LRP) such as capacity building, – provide training programs for local farmers to increase productivity and efficiency. This could include modern farming techniques, pest control, and sustainable practices.
- implement Luena-Saurimo project LRP sub-programs as 'open-access' to provide the host community with the opportunity to upgrade skills within e.g., agriculture and small businesses.

The residual impacts are expected to be positive, reflecting the increasing in community economic benefits, sustained local economic stimulation and improved livelihood security as a result of farm produce, livestock selling and local enterprises.

Operation phase

During operation and maintenance, indirect economic empowerment for farmers and livestock keepers can occur due to the increased demand for produce due to improved mobility, accessibility and employment opportunities. In a broader context, these initiatives will collectively contribute to the municipalities (Moxico, Camanongue, Dala and Saurimo) local economic growth. This positive impact will extend beyond the immediate project area, creating a ripple effect that benefits the entire region.

The magnitude of the impact is high and the significance of the impact is high.

Enhancement measures

The following measures can be implemented to create a sustainable and inclusive environment that extends beyond immediate Project related impacts:

- encouraging the creation of local supply chains by facilitating connections between the Project and local businesses
- promoting sustainability and economic resilience within the community
- incorporating social responsibility measures, such as community development funds or initiatives, to contribute to the overall well-being of the community
- skills development, training and capacity-building programs will be conducted as part of the implementation of the RAP and LRP to enhance the skills of the local workforce, making them more competitive and better prepared for employment opportunities within and beyond the Project
- conducting a comprehensive economic analysis to identify sectors that can support job creation beyond the Project's direct employment opportunities.

The residual impacts are expected to be positive, reflecting the increasing in community economic benefits, sustained local economic stimulation and improved livelihood security as a result of livestock selling.

10.2.3 Community health and safety

The construction and operation of the Luena-Saurimo railway could impact the health and safety of local communities.

10.2.3.1 Exposure to diseases transmission

Construction phase

The Project area will experience increased population from influx, presence of five construction camps, services providers, vendors and enterprises. The interaction will likely expose both communities, construction workers and supply chain to the risks of various diseases transmission. HIV/AIDS and other sexually-transmitted diseases prevalence relevant to the Project involves factors like alcohol and drug abuse, transactional sex, and migratory labour, exacerbated by contractors bringing materials from other Provinces and creating "hot spots" for sex work, increasing disease spread. Additionally, these activities pose a risk of spreading other communicable diseases along transportation routes. Diseases will have an impact not only on workers but also on the to the communities surrounding the railway line.

In-migration triggers a dramatic rise in the “four M’s”: men, money, movement (influx), and mixing (i.e., the interaction between high and low disease prevalence groups). These factors are the conditions necessary to produce a surge in sexually transmitted diseases. Other drivers of the HIV epidemic that may be relevant for the Project include high levels of alcohol and drug abuse, transactional and commercial sex, sexual and gender-based violence, migratory labour, poverty, income disparities and unequal access to prevention, treatment and care. Another important consideration is the impact of contractors bringing in materials from other provinces, especially during the construction phase. The truck drivers are often required to stop overnight. The truck stops become “hot spots” with a considerable pull factor luring people with economic opportunities, including sex work. It is difficult to manage these transient factors, but it does contribute to the spread of the disease amongst transportation routes, and it is therefore important to consider the impact. Apart from sexually transmitted diseases, there is also a risk of spreading other communicable diseases.

Further, local food vendors servicing the railway workforce can contribute to the transmission of foodborne diseases in case of poor hygiene in food handling practices. Due to the absence of reliable water supply, welfare facilities and sanitation systems in most communities along the railway line, makes the community more susceptible to the spread communicable diseases. The healthcare system within the communities on the other hand is not fully equipped to address a widespread outbreak.

The magnitude of the impact is high and the significance of the impact is major.

Mitigation measures

- implementation of the Community Health and Safety Plan that will include measures to avoid or minimise exposure to diseases transmission to both workers and surrounding communities.
- extend the workplace programme for HIV beyond the company’s operations, and include all contractors, suppliers, transportation companies and local communities. Make it a contractual requirement. The spread of HIV along transportation routes (roads and railways) is well documented, so this component

of the Project (transportation of all goods and services to and from the project site) needs special attention

  - select suppliers who have in-house HIV programmes and policies in place
  - develop tailored behaviour change communication (BCC) materials such as mirror hanger messages and bumper stickers
  - include condoms in the road safety kit
  - work with truck company managers to ensure that their drivers receive adequate HIV training

- sensitise the community on communicable diseases through health education and awareness programs about disease transmission and encourage food vendors to uphold hygienic food handling practices and carry out periodic medical examinations.
- free voluntary counselling sessions/programs for HIV/AIDS and STDs will be encouraged and provided to the community
- collaborate with existing programs at the municipalities or initiating and implementing targeted reproductive health education programs, specifically focusing on young girls, women and adolescents in schools
- toolbox talks should include talks about the impact of promiscuous behaviour
- the project proponent should develop an in-house infectious diseases strategy applicable to all contractors and sub-contractors to address health issues within the workforce and align the strategy with a community HIV strategy implemented by a non-profit organisation. Local schools and communities living in traditional areas close to the project must be included in the strategy. The strategy should include voluntary counselling and testing and training of peer educators
- a workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration
- provide clinics and medical services for construction staff that will:
  - provide surveillance and active screening and treatment for all workers
  - conduct immunization programs for workers in local communities to improve health, and guard against any infections and providing other services where they are not available regionally
  - provide treatment through standard case management in on site and public healthcare facilities
  - confidentiality and appropriate care concerning migrant workers is always applied
- preventing illness amongst workers in local communities by undertaking further education initiatives training health workers in disease treatment
- develop a disease prevention strategy incorporated in the Community Health and Safety Plan for vector borne diseases (mosquito and other arthropod borne diseases) in close collaboration with the community health authorities that will include actions to:
  - control the sanitary conditions within camps and at mobile toilets placed near active construction zones
  - prevent any larval and adult mosquitoes and breeding habitats close to human settlements. These can be eliminated by removing any unusable impounded water
  - displace standing water by increasing the water velocity in natural and artificial channels
  - apply residual insecticide to structures
  - implement a vector control awareness program

  - provide chemoprophylaxis drugs by nonimmune workers as well as collaborating with public health officials to provide medical services
  - prevent bites such as repellent clothing, netting and other barrier
- monitor migrating workforce to prevent any further disease outbreaks
- collaborate with other control and treatment programs in the project area so that the maximum beneficial effects are in place for this project and its communities
- educate the project staff and personnel as well as the residents in surrounding communities on the risks and how to prevent them and also available treatment once they start feeling sick. This can include distribution of appropriate education materials at all levels of the community
- develop collaborative support with authorities to monitor the communities dealing with high-risk seasons to enhance capacity for early detection of the disease
- control the sanitary conditions within camps and at mobile toilets placed near active construction zones.

After implementation of comprehensive mitigations and health management measures reducing the overall risk of increased HIV prevalence and other communicable diseases, residual risks will remain due to factors outside the control of the Project (i.e., existing health system limitations). Therefore, the residual risk is assessed as moderate.

Operation and maintenance phase

During operation phase, higher influx is not envisaged due nature of trains operations and maintenance works requiring minimum workforce as compared to construction phase. Most interaction will be between communities and newcomers due to enhanced accessibility, flow of goods and services between different Provinces. This can expose community to the risks of exposure to communicable diseases, such as respiratory infections, sexually transmitted infections (STIs), and vector-borne diseases, impacting both the workers and local communities. The magnitude of the impact is medium and the significance of the impact is moderate.

Mitigation measures

- encouraging and undertaking free voluntary counselling and testing sessions/programs for HIV/AIDS and STDs at health centres within project area of influence
- implement awareness and education programs about disease prevention and control
- operator is encouraged to initiate collaboration with local/government clinics/health care facilities along the railway corridor to offer extended support to communities where operator has worker health services. The operator may extend limited and/or specific preventative services, health screenings and check-up for communicable diseases. Where complex health cases are identified, patients requiring advance care will be referred to the nearest government hospital or public health facility.

After implementation of comprehensive mitigations and health management measures reducing the overall risk of increased HIV prevalence and other communicable diseases, residual risks will remain due to factors outside the control of the Project (i.e., existing health system limitations). Therefore, the residual risk is assessed as minor.

10.2.3.2 *Increased vulnerability of young girls, women and vulnerable groups to gender-based abuse sexual harassment and violence*

Construction phase

The Project construction activities in all four municipalities including communities adjacent to the five construction camps, have the potential to result in incidents of Gender-Based Violence (GBV) and sexual harassment, adversely impacting the rights of women, vulnerable groups and children, including the right to education. These issues may stem from discriminatory practices and inequality, particularly against women and vulnerable groups. The sensitive receptors of this impact are mainly the women (e.g. involved in supporting services to the Project workforce) and adolescent girls because generally they bear the greatest and most direct costs of gender inequalities. Vulnerable groups, including women, children, the elderly, and those with disabilities, may be particularly affected.

There will be an overall increase of people with more purchasing power/money to spend, especially in evenings and weekends (because of an influx of migrant workers and increased purchasing power of local residents employed by the Project). Vulnerable groups, such as young girls, and women involved in the construction activities or supply chain may face increased risks of sexual predation, leading to teenage pregnancies and the spread of sexually transmitted diseases. Additionally, easier access to alcohol and substances can result in higher rates of abuse, early/unwanted pregnancies and school dropout among adolescents.

Vulnerable people may also be exploited due to their vulnerable nature and the lack of proper means to protect themselves. In some cases, children who are supposed to be at school may be used by the contractor as cheap labour.

The magnitude of the impact is high and the significance of the impact is major.

Mitigation measures

- a construction Gender Action Plan (GAP) should be developed (or integrated in the Community Health and Safety Plan) and rolled-out for execution throughout the supply chain as a contractual requirement. This will include measures that ensure the safety and security of women in the communities along the railway corridor. These measures will include:
    - education and awareness campaigns for the communities
    - training and awareness raising for the workers
    - a code of conduct for community-worker relations
    - a code of conduct for security personnel
    - continuous gender-based violence monitoring activities (including a dedicated grievance mechanism) to be carried out by a female Community Liaison Officer (CLO)
    - in collaboration with local government establish a Gender Help Desk at the construction yard/sites/camps and ensuring adequate and transparent referral mechanisms are in place for reported cases at the community level
    - incorporating Protection against Sexual Exploitation and Abuse (PSEA) requirements in the contractors and sub-contractors' contracts
    - Child Abuse Protection Plan (CAPP) & measures
- review of specific Project components and activities that are known to heighten sexual abuse/harassment/abuse/GBV risks at the community level, e.g.,

employment opportunities, women food vendors, influx, operation of the construction camps/laydown areas

- promote women involvement in all stages of Project activities and ensure that vulnerable people are involved in taking decisions on matters that affect them directly
- effective, on going and culturally appropriate dialogue and continuous engagement with the wider communities and different vulnerable groups such as women, girls and students through the SEP
- promote women involvement in all stages of Project activities and ensure that vulnerable people are involved in taking decisions on matters that affect them directly
- implement comprehensive community and workers sensitisation programs in collaboration with local NGOs focusing on sexual health, consent, and substance abuse prevention, alongside providing accessible healthcare services, including counselling and support for vulnerable groups
- the Contractor has existing Human Resource Policies and Codes of Conduct that establish strict monitoring and reporting mechanisms to prevent and address sexual harassment and substance abuse amongst employees of the Project within the Project area
- develop tailored BCC materials such as mirror hanger messages and bumper stickers to be displayed in camps and within the community centres
- implement toolbox talks about the impact of promiscuous behaviour and vulnerabilities of the residents in surrounding communities and potential.

After implementation of comprehensive mitigations measures reducing the overall risk to young girls cannot be completed eliminated. The residual impact is considered moderate, because to some level of exposure remains due to factors outside the control of the Project, reflecting risks to safety, health, and educational outcomes of young girls.

Operation and maintenance phase

The railway operation and maintenance activities have the potential to escalate gender-related incidents, particularly female workers involved in the project, domestic and sexual violence against women nearby project areas, if there are insufficient measures addressing gender issues. In the absence of robust regulatory and security enforcement measures, women, vulnerable individuals and children are at risk of remaining susceptible to violence.

The magnitude of the impact is moderate and long-term and the significance of the impact is major.

Project's operation and maintenance phase have the potential to escalate such incidents, particularly domestic and sexual violence against women at the household level, if there are insufficient measures addressing gender issues. In the absence of robust regulatory and security enforcement measures, women, vulnerable individuals and children are at risk of remaining susceptible to violence

Mitigation measures

- coordinate with local authorities to enhance infrastructure and public services

After implementation of comprehensive mitigations measures reducing pressure on local resources, vulnerable groups, residual impacts may still be experienced. The residual impacts expected include reduced water access, food, housing and health care during

high demand periods. Therefore, the residual impacts are considered moderate reflecting a reduced but ongoing strain on local resources and services.

10.2.3.3 Community exposure to noise nuisances, elevated dust and vibrations

Project activities, particularly blasting, earthworks and construction traffic could result in noise, dust and vibrations, potentially resulting in increased ambient noise levels and air emissions for adjacent communities, settlements or any other sensitive receptors closer to the construction footprint. From a social perspective it is important that the nuisance factor must also be considered. Vibration could result in damage to buildings, cultural sites and other community infrastructure such as boreholes and wells, especially considering that many people in the area live in traditional mud houses.

Further assessment of the noise and dust emission and vibration exposure including mitigation measures is provided in the Physical Impacts chapter under Noise and Vibrations. Proposed mitigations measures are applicable across all physical, social and cultural and biological receptors affected by Project construction activities.

10.2.3.4 Population influx (job seekers, speculators & enterprises) into Project area and pressure on infrastructure.

Construction phase

Influx of people mainly job seekers, speculators and enterprisers along the Project corridor can negatively impact the local communities, resources and existing infrastructure. The construction activities often create job opportunities, attracting individuals from other areas in search of employment. The promise of jobs and income can lead to an influx of workers and their families. The need for labour, including skilled and unskilled workers, can also result in an influx into the communities. A population influx would put pressure on existing services in the Project area. A key pressure point would be the availability of housing, potentially resulting in overcrowding.

Migrants could also put pressure on the area's already inadequate water and sanitation facilities, and waste management. The population influx would put pressure on existing public health facilities. These facilities are already under-resourced and under-staffed and may not be able to adequately meet the needs of an increased population.

Therefore, the influx of population along the corridor is likely to contribute to the following negative impacts:

- strain on the local resources, such as water, energy and food, potentially leading to shortages and competition for these essential resources
- increased demand for housing, which may lead to overcrowding and inadequate living conditions
- pressure on the existing infrastructure, healthcare facilities and educational institutions, potentially resulting in congestion, overburdened services and a decline in the overall quality of life for both the existing and newly arrived residents
- the social fabric of the local community may be disrupted as newcomers may have different cultural backgrounds, leading to potential social tensions and challenges in community integration.

The significance of the impact is assessed as major though it will be for short term during construction phase, and moderate in magnitude.

Mitigation measures

- updating and implementation of existing OEC's Influx Management and Monitoring Plan (PI-PL-082-OECLS, 23 July 2023) for the Project
- use of worker accommodation for non-local workers, avoid at-gate hiring practices
- engagement and collaboration with the local government authorities and existing community members along the corridor inform them about the potential influx and collaborative mechanisms to address influx issues
- prioritising the hiring of local villagers for construction jobs to reduce the influx of workers from outside the host sites area
- implementation of resource-efficient practices (e.g. water and energy conservation at the camps and construction activities) to ensure that essential resources like water, energy and food are managed sustainably, reducing pressure on local resources
- where feasible, through CSR activities during construction phase, support community/local government initiatives in the expansion and upgrading of public utility infrastructure e.g. water supply to meet increased demand,
- designate a community liaison officer to monitor emerging resource and services pressures
- implement a grievance procedure to report specific resource and services concerns.

After implementation of comprehensive mitigations measures reducing pressure on local resources and services, a degree of pressure is likely to remain as larger populations who become semipermanent will cause pressure, however the residual impacts are expected to be minor.

Operation and maintenance phase

Influx directly related to the operation and maintenance phase workforce will be negligible. Typically, operation phase workers would be (or would become) long-term members of the communities, and so some of the influx-related issues are less relevant. The exception is in relation to any maintenance activities that are required in which case non-local workers may typically come in temporarily, but the numbers of workers involved may not be significant. Population growth that will be triggered by the improved accessibility, mobility and transportation at communities with stations may occur, but - arguably - the requirement to manage this is the responsibility of different levels of government at municipal and Province as part of their regular governance functions.

10.2.3.5 Pollution of water sources

Impacts related to the unexpected contamination of water sources is addressed in section 10.7.

10.2.3.6 Community safety risks and access during construction

Construction phase

The proposed railway line is located closer to EN180 highway to a large extent. The highway is the only means of transport connecting Luena and Saurimo. During construction, there will be movement of people, goods and vehicles related to the construction activities. Ongoing construction traffic can increase the risk of traffic

accidents, especially if proper safety measures are not in place especially in sensitive receptors like schools, health facilities, communes/settlement/neighbourhood centres, markets, municipal centres and along haulage routes where non-motorised movement is prevalent.

There are currently a number of footpaths, community access roads and other main roads linking communities to farms, rivers for water source, worshipping areas, cultural areas like burial areas and connecting to town or other communities. These footpaths are not signposted but play an important role in the social and community structures in terms of connectivity and to transport their agricultural produce and livestock between communities. During construction works local community members will frequently seek to cross over the alignment to access farm lands, water etc. on the other side. It is likely to be difficult to prevent movement across the alignment hence restrictions on access during will impact livelihoods.

The construction of the main camps, support camps, bridges, culverts, stations and embankments will introduce construction zones with heavy machinery, heavy vehicles, altered terrain and construction platforms that present safety risks to community members who may pass through/nearby. The potential results from incidences may include injury, permanent incapacity and even mortality in certain instances. In some cases, people need to take long detours because they cannot cross the rivers. There is a risk that people will use the railway bridges to take short-cuts between villages, which can potentially be lethal.

Mitigation measures

- implementation of construction Traffic Management Plan to ensure the safe flow of traffic
- implementation of the Community Health and Safety Plan
- maintain communities connectivity and accessibility by providing safe access routes/crossings/alternatives for all categories including vulnerable groups thorough assessment of the construction access routes including alternatives and high risk areas avoidance to ensure safety of the community groups at risk
- installing adequate safety barriers, signage and warning systems in construction zones and potential hazards
- enforcing safety protocols for construction transportation activities, such as speed limits and mandatory safety training for drivers and road users
- undertaking community safety awareness and sensitisation campaigns: maintaining open communication and actively engaging with the community, existing schools, health care centres, three-wheelers and other road users for awareness creation and addressing their concerns and issues
- providing mandatory training for construction workers and equipment operators to ensure they follow safety protocols and drive cautiously within construction zones
- maintaining a transparent and accessible community grievance redress mechanism.

After the implementation of mitigation measures, low residual impacts are anticipated with temporary access disruptions. As the Project activities are transient in nature, the expected residual impacts are considered as minor and activities will likely return to their original state prior to construction activities.

10.2.3.7 Severance - accessibility and connectivity during operation phase.

There are currently a number of footpaths, community access roads and other main roads linking villages communities to farms, rivers for water source, worshipping areas, cultural areas like burial areas and connecting to town or and to each other communities. These are critical paths or roads that could be significant for connectivity and land access. The indicative locations/kilometre points (note this is a non-exhaustive list) is provided in Table 10. 2 below. Restrictions on connectivity and accessibility or crossing the alignment will create livelihood impacts beyond communities located closer to the railway line. This is an impact of high magnitude and major significance if communities' movements will be restricted and long-term nature of the impact.

Table 10. 2: Indicative locations for crossings along the railway line (tracks, access roads and main unpaved roads)

Railway Section	Indicative Crossings and Respective KPs		
	Tracks	**Access Roads**	**Main Unpaved Roads**
Section 1	KM= 0+400	KM= 6+250	KM= 9+700
	KM= 4+400	KM= 6+700	
	KM= 4+625	KM= 7+600	
	KM= 5+500	KM= 8+100	
	KM= 6+000	KM= 8+600	
	KM= 6+100	KM= 9+450	
	KM= 6+900	KM= 10+890	
	KM= 7+350	KM= 11+130	
	KM= 7+555	KM= 12+255	
	KM= 8+225	KM= 12+837	
	KM= 8+485	KM= 14+404	
	KM= 8+880	KM= 16+930	
Section 2	KM= 17+300	KM= 17+800	KM= 30+400
	KM= 18+975	KM= 18+300	KM= 49+250
	KM= 19+310	KM= 19+538	
	KM= 20+085	KM= 24+400	
	KM= 21+087	KM= 26+550	
	KM= 23+300	KM= 29+000	
	KM= 24+000	KM= 32+730	
	KM= 24+100	KM= 32+800	
	KM= 25+000	KM= 47+350	
	KM= 26+650	KM= 48+700	
	KM= 27+990	KM= 50+000	
Section 3	KM= 61+100	KM= 58+550	KM= 59+900
	KM= 65+250	KM= 59+100	KM= 69+300
	KM= 67+900	KM= 61+450	KM= 81+650
	KM= 68+000	KM= 62+950	
	KM= 68+600	KM= 64+300	
	KM= 69+600	KM= 64+400	
	KM= 70+300	KM= 64+600	

Railway Section	Indicative Crossings and Respective KPs		
Section 4	KM= 86+400	KM= 89+430	KM= 98+000
	KM= 92+150	KM= 89+450	
	KM= 95+410	KM= 90+595	
	KM= 96+450	KM= 90+300	
	KM= 97+500	KM= 90+500	
	KM= 97+550	KM= 95+500	
Section 5	KM= 100+400	KM= 106+900	KM= 110+000
	KM= 107+550	KM= 107+000	
	KM= 107+800	KM= 107+500	
	KM= 108+650	KM= 107+520	
	KM= 108+900	KM= 109+050	
	KM= 111+900	KM= 110+800	
	KM= 113+300	KM= 113+900	
Section 6	KM= 120+300	KM= 120+970	KM=126+450
	Tracks	**Access Roads**	**Main Unpaved Roads**
	KM= 121+130	KM= 128+500	
	KM= 125+200	KM= 128+800	
Section 7	KM= 134+200	KM= 132+000	KM= 143+900
	KM= 134+500	KM= 138+010	
	KM= 136+900	KM= 138+050	
	KM= 141+800	KM= 141+400	
	KM= 141+850	KM= 141+700	
Section 8	KM= 159+100	KM= 164+400	KM= 156+600
	KM= 160+200	KM= 166+350	
	KM= 160+400	KM= 167+200	
	KM= 161+200	KM= 169+000	
Section 9	KM= 170+200	KM= 170+600	KM= 180+000
	KM= 171+400	KM= 178+900	
	KM= 172+495	KM= 180+100	
	KM= 173+200	KM= 180+200	
	KM= 176+300	KM= 180+300	
Section 10	KM= 190+250	KM= 190+300	KM= 190+100
	KM= 193+450	KM= 193+200	KM= 198+100
	KM= 194+800	KM= 194+300	KM= 198+300
	KM= 193+950	KM= 195+300	KM= 204+200
	KM= 195+400	KM= 195+700	KM= 220+800
	KM= 196+200	KM= 197+800	
Section 11	KM= 225+600	KM= 226+200	KM= 227+900
	KM= 229+600	KM= 226+400	KM= 231+700
	KM= 230+300	KM= 230+700	KM= 239+900
	KM= 230+450	KM= 231+200	KM= 247+000
	KM= 232+100	KM= 231+750	KM= 250+000
	KM= 232+200	KM= 233+100	KM= 250+900
	KM= 234+510	KM= 233+800	KM= 253+100

Railway Section	Indicative Crossings and Respective KPs		
	KM= 236+490	KM= 233+900	KM= 253+800
	KM= 236+600	KM= 234+400	KM= 255+700
Tracks = footpaths and livestock tracks Access roads = minor roads linking villages, farms and other local roads to a major road Major unpaved road = a primary road that is nor surfaced with pavement			

Mitigation measures

- there will be no fencing of the railway during operations as people and animals need to cross freely to ensure continued accessibility and connectivity. It would also be financially unfeasible and the fencing would be at risk of theft or vandalism. There may be a small number of exceptions where some fencing is necessary for safety, security and control purposes, e.g., Saurimo main station
- the preliminary design has integrated provisions for designated community crossings. The Project intends to develop at least one crossing point for vehicles in every community to allow access across the railway line. Pedestrians and livestock can also use these formal crossing points or cross anywhere along the railway line as it will not be fenced (apart from in the odd location by exception)
- community engagements during detailed design process: the actual locations of the crossings in each community will be determined during detailed design. The Project will engage communities along the railway line and investigate where people currently cross in the area to help define suitable crossing point locations
- there will not be formal barriers at crossings due to the risk of damage and / or theft as has happened elsewhere in Angola. Most likely the community crossing points will be just levelled areas where cars, pedestrians, cyclists and motorbikes can cross. However, the characteristics – in addition to locations – of the crossings will be defined during detailed design

After the implementation of mitigation measures, low residual impacts are anticipated with continued access and minimum community accidents and incidents related to trains movements.

10.2.3.8 Safety risks from train movements during trains movements.

There are currently a number of footpaths, community access roads and other main roads linking villages communities to farms, rivers for water source, worshipping areas, cultural areas like burial areas and connecting to town or and to each other communities. These are critical paths or roads that could be significant for connectivity and land access (refer Table 10. 2 above.). After construction, the entire railway line will not be fenced to allow for free community access through provision of safe crossing points etc. There will be frequent movements of people, livestock, vehicles and bicycles crossing at all points along the route, creating a significant community safety risk during trains movements. The people are not used to railways, and in many instances the railway will traverse villages. Children are at risk when playing next to the railway. This is an impact of high magnitude and major significance and long-term nature of the impact.

Mitigation measures

- community safety awareness campaigns: conduct community education programs on railway safety, especially targeting children and parents as well enforcing the use of designated crossings. This endless campaign will be included in the operator's ESMS and/or integrated in the Community Safety

Sensitisation Plan to be implemented starting from a year in advance of start of train operations and then continuously during operations

- distribute informational materials and hold workshops in villages to raise awareness about the dangers of playing near the railway
- the preliminary design has integrated provisions for designated community crossings. The Project intends to develop at least one crossing point for vehicles in every community to allow access across the railway line. Pedestrians and livestock can also use these formal crossing points or cross anywhere along the railway line as it will not be fenced (apart from in the odd location by exception)
- community engagements during detailed design process: the actual locations of the crossings in each community will be determined during detailed design. The Project will engage communities along the railway line and investigate where people currently cross in the area to help define suitable crossing point locations
- preliminary design has integrated railway safety considerations including telecommunication, signage, warning systems etc.

After the implementation of mitigation measures, low residual impacts are anticipated with continued access and minimum community accidents and incidents related to trains movements.

10.2.4 Land acquisition

IFC PS 5 states that: "Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in physical or economic displacement. This occurs in cases of (i) lawful expropriation or temporary or permanent restrictions on land use and (ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail."

In terms of land acquisition and involuntary resettlement, the IFC Performance Standards requires the following:

- project design – consider feasible alternative project designs to avoid or minimise physical and/or economic displacement, while balancing environmental, social, and financial costs and benefits, paying particular attention to impacts on the poor and vulnerable
- compensation and benefits for displaced persons – when displacement cannot be avoided, displaced communities and persons will be offered compensation for loss of assets at full replacement cost and other assistance to help them improve or restore their standards of living or livelihoods as provided in the IFC Performance Standard 5 through development and implementation of the Project RAP and LRP
- community engagement – engage with affected communities, including host communities, through the process of stakeholder engagement as described in the IFC Performance Standards
- grievance mechanism – a grievance mechanism consistent with IFC Performance Standards should be established as early as possible in the project development phase
- resettlement and livelihood restoration planning and implementation – where involuntary resettlement is unavoidable, a census will be carried out to collect

appropriate socio-economic baseline data to identify the persons who will be displaced by the project, determine who will be eligible for compensation and assistance, and discourage ineligible persons, such as opportunistic settlers, from claiming benefits. A cut-off data for eligibility should be determined and information regarding the cut-off date should be well documented and disseminated through the project area.

With the current information, it is recommended that a detailed asset inventory is conducted during preconstruction phase to confirm physical displacement, and resettlement impacts in potentially affected communities described in Section 6.9 of the social baseline.

10.2.4.1 Economic and physical displacement and livelihoods disruptions

Construction phase

Displacement impacts associated with the Project arise primarily from land acquisition and land-use restrictions required during the pre-construction, construction, and operational phases. Based on the current Project design and available information, displacement is expected to be predominantly economic in nature, with limited physical displacement.

The Project's indicative land requirement both permanent and temporary land based on current existing preliminary design and available spatial information have been estimated to support early resettlement planning. Based on preliminary design and field verification, Project-related displacement is expected to be predominantly economic in nature, arising from the permanent and temporary loss of access to agricultural land, crops, trees, and natural resources.

Overall, the indicative permanent land requirement for the Project is estimated at approximately 1,560 ha comprising mainly the entire railway corridor (60m), 8 stations, access roads to stations and passing loops (refer Section 2.7.1.10 in Project Description Chapter). The exact extent of permanent land take at these locations will be confirmed during detailed design and surveys including affected asset inventories.

Temporary land occupation will occur during construction for work areas, camps, and logistics, with impacts expected to be location-specific and time-bound.

Physical displacement is expected to be very limited, with only a small number of households anticipated to require replacement housing. The Project has, through alignment selection and subsequent design refinements, sought to avoid or minimise physical displacement in line with PS5 requirements. Based on RPF fieldwork undertaken in December 2025, physical displacement is expected to be very limited in scale. Initial findings indicate that three residential dwellings may be directly affected, potentially resulting in the physical displacement of three PAHs. Should additional cases of physical displacement be identified through these processes, they will be addressed through the preparation and implementation of RAP-LRPs in accordance with PS5.

Temporarily occupied land will be used for defined periods only and, where feasible, will be reinstated and returned to its prior use following completion of construction activities.

In terms of loss of other assets and structures, the Project may affect a limited number of non-residential structures located within or adjacent to the Project footprint. Based on

RPF fieldwork undertaken in December 20205, these structures include two commercial or vacant buildings and seven temporary farm huts.[108]

The temporary farm huts are primarily associated with agricultural activities and seasonal land use and are not used as permanent residences. Impacts on such structures are therefore expected to result predominantly in economic displacement, including disruption to farming activities, rather than physical displacement.

The proposed Project will lead to economic displacement to a large extent, since many fields will be traversed by the railway track. The Project area is characterised by widespread customary land use, subsistence livelihoods, and high levels of vulnerability, which are central considerations in resettlement planning. As of December 2025, indicatively, at least 33 PACs are likely to be affected by the Project. Economic displacement is expected to be prevalent along the Project corridor and is anticipated to constitute the dominant form of resettlement impact associated with the Project. Multiple PACs are likely to experience loss of access to land and productive resources as a result of both permanent land acquisition for the railway RoW and associated infrastructure, as well as potential temporary land use restrictions during construction. These impacts may affect agricultural activities, access to natural resources, and, in some locations, non-farm livelihood activities.

During construction, some people may also have restricted access to their agricultural fields and their access water sources and ecosystem services (especially medicinal plants – discussed under Ecosystem Services Impacts Section 10.6). Communities are concerned about prompt compensation to rebuild their lives. The sensitivity of livelihoods is high, and magnitude is considered as high and significance major.

Regarding demining, while demining is not considered an Associated Facility under IFC PS1, the developed RPF for Luena-Saurimo recognises that, in line with international good practice, any resettlement-relevant impacts that may arise from enabling or prerequisite activities undertaken within the Project footprint should be considered where such impacts are demonstrably linked to Project development. Information available from ESIA fieldwork indicates that demining activities were conducted using non-intrusive methods in cultivated areas and that direct impacts on crops and farmland were limited. At this stage, the nature and magnitude of any such impacts have not been fully established. Accordingly, a precautionary and verification-based approach will be applied during the preparation of RAP-LRPs.

Mitigation measures

- preliminary design of the railway line, stations locations and layouts have been revised on multiple occasions during ESIA stage to avoid displacement impacts and where avoidance is not feasible, impacts minimisation has been adopted. Refer Chapter 3 (Project Alternatives)
- a Resettlement Policy Framework (RPF) has been developed to guide the management of land acquisition, resettlement, and livelihood restoration impacts associated with the Project, in accordance with Angolan legislations, IFC PS6 and other applicable international standards[109]

[108] The farm huts, *'casas de lavra'*, are small shacks used by farmers as shelters for animals and grain storage and are typically located next to farming land.

[109] See further details in a separate report – Resettlement Policy Framework for Luena-Saurimo Railway Project, RSK Africa (January 2026).

- following finalisation of the detailed design, site-specific Resettlement Action Plans (RAPs) and Livelihoods Restoration Plans (LRPs) will be prepared based on comprehensive socio-economic surveys, asset inventories, and stakeholder engagement. Compensation and assistance will be implemented prior to the commencement of construction in affected areas.
- replacement land is the preferred form of compensation for loss of land, particularly for customary land users, consistent with Angola's national practices. Cash compensation is provided for affected assets and improvements, including crops, trees, and structures, at replacement cost
- livelihood restoration measures will be implemented to address economic displacement and support the restoration of income and food security
- RAPs and LRPs will be implemented on a phased basis, aligned with Project construction sequencing
- ongoing monitoring and adaptive management will be applied
- a community Grievance Redress Mechanism will be implemented to allow community members to promptly raise any grievances related to land acquisition and resettlement with the project proponent

A level of economic displacement will remain as the construction activities may affect agricultural fields providing ecosystem services, therefore full pre-project economic conditions. As a result, although mitigations will significantly reduce the severity of the residual impacts, a minor impact is likely to remain.

Operation and maintenance phase

During the operational and maintenance phase, the activities undertaken are not anticipated to pose a risk as communities would have already been compensated during the construction of the railway line.

10.2.4.2 Inequality in compensation and livelihood restoration interventions

Construction phase

Negative livelihood impacts from land acquisition may be disproportionately felt by women and other vulnerable groups within the affected communities. The process of land acquisition and economic displacement may exacerbate existing economic inequalities, as women often have less access to economic opportunities and resources compared to men. While women are heavily involved in agriculture, compensation payments are generally paid to male heads of households. Male community members are also more likely to find employment at the project therefore concern is for women whose primary source of income is farming who may be left at a disadvantage without alternative means for a livelihood. The sensitivity of livelihoods is high, and magnitude is considered as high and significance major.

Mitigation measures

- integration of the Gender Action Plan (GAP) in the entire resettlement planning and implementation
- implement a Grievance Mechanism to allow community members to promptly raise any grievances related to land acquisition with the project proponent
- ongoing monitoring and adaptive management will be applied

After the implementation of mitigation measures and the improvement of gender inclusivity relative to the baseline, because of the Project development, women are still

likely to experience minor residual livelihood disadvantage/impacts due to entrenched socio-cultural roles and norms.

10.2.4.3 Increased value of land around stations areas

Construction phase

Land acquisition, resettlement and the expected influx of workers from outside the study area could put pressure on the availability of residential land. This could increase the number and value of land transactions (including traditional land tenure). This is mostly expected to impact villages where there will be stations or bigger towns. There may be localised inflationary effects at the stations areas, but these are unlikely to be widespread or severe in the railway corridor context. However, it is unlikely that the level of displacement caused by this form of linear infrastructure, and particularly where land is predominantly allocated under a Traditional Authorities (i.e., customary land tenure system) and market for private land is almost non-existence, it is unlikely that the Project will trigger a major impact on land values.

The magnitude is considered as minor and significance of the impact is assessed as minor.

Mitigation measures

- conduct awareness and education campaigns to educate communities about the land rights, tenure systems and transaction processes
- develop and implement an influx management plan, ensuring that project workers are strictly provided accommodation by the project to avoid increasing pressure on local land markets
- engage traditional authorities, local government, and community groups in decision-making about land allocation and development planning.

After implementation of comprehensive mitigations measures reducing pressure on local resources, a degree of pressure is likely to remain as larger populations who become semipermanent will cause competition for proposed land uses, however the residual impacts are expected to be very minor.

10.2.4.4 Land as catalyst for tensions in communities

Construction phase

The land acquisition and compensation processes could generate tensions among recipients of compensation if there are perceptions of unequal treatment. The process could also generate tensions between recipients of compensation and those who are not entitled to compensation. The magnitude is considered as moderate and significance of the impact is assessed as moderate.

Mitigation measures

- implement a clear, transparent, fair, and well-communicated compensation process that ensures all stakeholders understand the criteria and procedures
- conduct regular and inclusive consultations with all affected community members to address concerns and explain the compensation process
- establish a grievance redress mechanism where individuals can report and resolve issues related to perceived inequalities

- use of community mediation committees to facilitate dialogue and mitigate tensions that arise between different groups regarding compensation
- provide social support services such as funding community-based projects that will benefit the wider community through various options to be considered during LRP implementation.
- ongoing monitoring and adaptive management will be applied

The residual risk of tension within communities remains, as perception of compensation inequality will exist regardless of transparency and implemented mitigation measures, potentially affecting community cohesion and cooperation. Overall, the residual impact is likely to remain minor, as tension cannot be entirely eliminated and the unpredictability of tension rising.

Unplanned events are unpredictable as well as factors, such as politics, remain outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place and any incident that may arise is expected to be limited in duration and scope.

10.2.4.5 Misappropriation of funds

Construction phase

The reliance on cash compensation carries with it the risk of community members not using funds to re-establish their livelihoods and finding themselves in an economically precarious position once the compensation payment has been spent. This can create tensions within families and disrupt the social fabric of communities. The magnitude is considered as high and significance of the impact is assessed as major.

Mitigation measures

- replacement land is the preferred form of compensation for loss of land, particularly for customary land users, consistent with Angola's national practices. Cash compensation is provided for affected assets and improvements, including crops, trees, and structures, at replacement cost
- livelihood restoration measures will be implemented to address economic displacement and support the restoration of income and food security
- implementation of the financial literacy and livelihood support programs for recipients of cash compensation to ensure they effectively use their funds to re-establish their livelihoods
- ongoing monitoring and adaptive management will be applied

Residual risks likely to remain relating to mismanagement or rapidly spending compensation funds includes families becoming economically vulnerable. Although mitigations can reduce the severity, residual impact remains minor.

10.2.5 Demography and social fabric

The primary cause of changes to the demography and social fabric of the study area is expected to be in-migration by individuals seeking economic opportunities. Communities have high expectations about the perceived benefits that the project can bring into the area.

10.2.5.1 Social tension with foreign workforce

Construction phase

A peak of 1,000 employees is expected whereby the labour force will constitute 15% skilled, 60% semiskilled and the remain will be unskilled. Regarding female participation in this Project, it´s important to note that in the skilled and semiskilled spectres, females will be significantly higher than in the site works, an estimate 30% of female to fulfil the Engineer, Planning, Design, Canteen and Cleanings categories.

It is currently estimated that 80% of the workforce will be from the Project area with 93% being Angolan nationals for the entire Project (construction and operation).

Given the lack of skills in the communities, it is expected that a significant percentage of semi-skilled and skilled workers will need to be recruited from elsewhere in Angola. The communities made it clear that they preferred Angolan workers rather than people from other countries, as they have had some bad experiences with foreign workers. This can lead to social tensions that can affect the progress of the project construction. The magnitude of the impact is considered as moderate and the significance of the impact is moderate.

Mitigation measures

- Project recruitment policy includes effective local employment strategy. The strategy must include gender targets
- appoint a Community Liaison Officer (CLO) for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues
- develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances
- a workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration on aspect such as sexual exploitation, respect to religious and traditional matters, hunting, and fishing.

The residual risk of social conflicts remains, as tensions between communities and the project are unpredictable as well as factors, such as politics, remain outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place and any incident that may arise is expected to be limited in duration and scope.

Operation and maintenance phase

Similar to the construction phase, the relatively low level of skills currently available in the communities may require that a significant percentage of semi-skilled and skilled workers will need to be recruited from elsewhere in Angola. Highly specialised skills may be recruited from other countries as necessary. Recruitment practices could also generate tensions within the communities, i.e. between those who have been given employment and those who have not. This would be particularly a risk if there is a perception of a lack of transparency around recruitment decisions. Similarly, recruitment could generate tensions between communities in the immediate vicinity of the project and other nearby communities hoping to benefit from employment opportunities. Careful consideration to

residents along the project corridor is to be integrated to avoid social tensions/conflicts related to workforce. The magnitude of the impact is considered as low and the significance of impact is low.

Mitigation measures

- establish ongoing training and development programs for local community members to increase their skill levels and enhance employability for semi-skilled and skilled positions
- the railway operator should put measures in place to ensure the most effective local employment strategy. The strategy must include gender targets
- the operator shall develop and implement recruitment policies that prioritise hiring from the local communities and Angolan nationals and promote gender equity and unbiased recruitment in the recruitment policies.
- provide support programs for female employees, such as mentorship, career advancement opportunities, and safe working conditions.

The residual risk of social conflicts remains, as tensions between communities and the project are unpredictable as well as factors, such as politics, remain outside the control of the Projects full control. However, the residual impacts are considered to be very minor due to the robust mitigation measures related to labour are in place and any incident/tension that may arise is expected to be limited in duration and scope.

10.2.5.2 Additional pressure on services for positive well-being

Construction phase

The community also expressed concern about the social wellbeing of migrant workers. They feel that there is a lack of social services to address the needs of these workers. One example is the lack of mobile phone reception in many villages, which would prevent migrant workers to stay in touch with their families. Other social services such as constructive recreational activities, infrastructure for religious/spiritual practices or cultural gatherings/celebrations. The magnitude of the impact is considered as moderate and the significance of impact is moderate.

Mitigation measures

- appoint Community Liaison Officers (CLOs for the project to communicate directly with communities. This will ensure communities receive information first hand. This can also be the person that the community can approach regarding project issues
- develop a community-friendly external grievance mechanism in conjunction with the project proponent. It must be accessible and simple and facilitate speedy feedback on any grievance received. The grievance mechanism must address and keep record of community grievances
- a workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration
- consider sport and recreational activities within camps for workers
- establish work schedules that enable workers to participate in religious/spiritual gatherings and events.
- conduct cultural sensitivity training for both migrant workers, construction workers and local community members to promote understanding and reduce potential conflicts.

After implementation of comprehensive mitigations measures reducing pressure on local resources and services, residual impacts may still be experienced. The residual impacts expected include reduced water access, food, housing and health care during high demand periods, lack of adequate recreational facilities that cannot be fully addressed by the project. Therefore, the residual impacts are considered moderate reflecting a reduced but ongoing strain on local resources and services.

10.2.6 Governance

The construction and operations of the railway line could impact official and traditional governance structures in local communities and beyond. These changes would primarily be driven by the potential economic empowerment of members of the community employed at the project (most likely young men), the arrival of migrants seeking economic opportunities, and the flow of revenues to local, provincial and national authorities. Local people expressed that they do not have a lot of faith in the government, as the government often make promises that it does not deliver on.

10.2.6.1 Community tensions from unmet expectations

Construction phase

Extensive consultations conducted with Province governments, municipal administrations, traditional authorities, neighbourhoods, communities and residents from project affected communities underscore a considerable community anticipation for employment prospects linked to the Project construction activities. However, it is imperative to acknowledge that not all individuals will secure employment due to limited vacancies or disparities in requisite skills. Consequently, this discrepancy may provoke dissatisfaction among community members or local authorities.

The influence of traditional authorities over local employment decisions and their involvement in the identification of landowners and the negotiation of compensation for land acquisition and resettlement could become a source of tension and inequality.

The arrival of migrant workers and the economic empowerment of younger community members could challenge traditional hierarchies and power structures. New arrivals may not subscribe to local traditional governance systems. Likewise, the community's youth may seek a greater say in community decision-making if their economic position is strengthened. Potential pressures on traditional power structures could lead to tensions.

The magnitude of the impact is considered as moderate and the significance of impact is moderate.

Mitigation measures

- community and other stakeholders expectations management through continuous stakeholder engagement as per SEP, establishing transparent communication channels to manage community expectations effectively
- engaging in continuous dialogue with the community, explaining the realistic scope of employment prospects and provide insights into the skills and qualifications necessary for various roles
- broadening community participation in project-related benefits beyond direct employment

- developing robust grievance redress mechanisms to address concerns and dissatisfaction within the community regarding employment opportunities, land access and resettlement issues
- implement the SEP for construction. Create forums for regular dialogue between traditional and public authorities, youth and women's representatives, new arrivals, and other community members, as described in the SEP
- disseminate timely and accurate information regarding project progress to stakeholders at the local, provincial and national levels as described in the Stakeholder Engagement Plan

.A residual risk remains that traditional authorities may continue to influence decision in ways that could perpetuate corruption, regardless of the implemented mitigation measures. At the same time the economic empowerment of younger generation and migrant workers may shift power dynamics, potentially challenging traditional authorities and systems. However, the residual impacts are considered minor, as the roles of traditional authorities and the project need to align.

Operation and maintenance phase

The influence of traditional authorities over local employment decisions and compensation negotiations is most prominent during the construction phase when land acquisition, resettlement, and initial hiring take place. Once the project transitions to the operation and maintenance phase, these processes are largely completed, reducing the role of traditional authorities in these areas. The magnitude of the impact is considered as moderate and the significance of the impact is moderate.

Mitigation measures

- involve traditional authorities in the implementation of impact management tools
- develop a Stakeholder Engagement Plan for operation and maintenance phase that includes forums for regular dialogue between traditional and public authorities, youth and women's representatives, new arrivals, and other community members, as described in the Stakeholder Engagement Plan.

A residual risk remains that traditional authorities may continue to influence decision in ways that could perpetuate corruption, regardless of the implemented mitigation measures. At the same time the economic empowerment of younger generation and migrant workers may shift power dynamics, potentially challenging traditional authorities and systems. However, the residual impacts are considered minor, as the role of traditional authorities reduce during operational phase.

10.2.7 Occupational health and safety

The construction of the new railway line that includes stations, bridges, culverts, and vehicle/livestock crossings etc. presents significant Health and Safety (H&S) hazards that must be effectively managed to prevent accidents, injuries, and fatalities. The H&S hazards associated with the project can be broadly categorized as physical, chemical, biological, biomechanical, technological, psychosocial, ergonomic and natural phenomena. Mitigation measures to reduce the risk of these hazards from harming people should be identified and implemented. Ultimately, the H&S objective is to reduce injuries and ill health to both workers and the public, comply with Angolan H&S legislation and LAS, as well as to ensure that the moral and ethical requirements of all interested parties are met.

The Luena-Saurimo railway project will include, amongst others, the following major activities during the construction and operational phases that may cause H&S hazards:

Table 10. 3: Construction and Operational activities that may cause H&S hazards

Construction Activity	Operational Activity
Recruitment and Mobilisation of Personnel	**Recruitment and Mobilisation of Personnel**
Construction of railway embankment and tracks	Rail and infrastructure maintenance
Culverts & drainage	Train operation
Bridge and overpasses	Station operation
Elevated structures	Crossings (vehicle, pedestrian & livestock)
Crossings (vehicles, pedestrians, livestock)	Use of railway access road for emergencies and maintenance
Stations	Supply and storage of fuel
Electrical supply	Electrical supply
Signals and communications	Signals and communications
Stone quarrying	Maintenance workshop for locomotives and stations
Sand mining	
Road and traffic diversions	
Blasting	
Excavation	
De-mining	
Sleeper and concrete batching plants	

10.2.7.1 Injury from physical hazards.

Construction phase

The movement of people, construction materials and goods needed during construction increases the H&S risk for physical injury. Similar to pedestrian safety presented above, collisions involving workers along the construction sites can cause physical injury. In addition, operating equipment and machinery and maintenance activities at the respective workshops can result in physical injury. Physical injury can also affect workers as a result of flying or falling objects (e.g. from blasting at quarries, working at heights), heat or hot objects (e.g. electrical fixtures, welding equipment and water heaters) and lifting heavy objects. Apart from workers at active construction zones or workshops, personnel working at the construction offices can also be exposed to physical hazards in the form of slips, trips and falls, cuts, burns and scratches/bruises.

Physical hazards during construction are considered as high in sensitivity, and high in magnitude because of the large number of workers planned to be engaged over 5 years. Therefore, the significance is assessed as high/major.

Mitigation measures

The Contractor has a H&S management system with the following management plans in place.

Table 10. 4: Management plans to be implemented

Health and Safety Management System	Management Plans in Place for the Project
Incidents	• PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN • PI-PR-012-INCIDENT INVESTIGATION METHODOLGIES ANNEX I_EN • PI-PR-012- INCIDENT INVESTIGATION METHODOLGIES ANNEX II_EN • PI-FR-01201-OECLS_EN work accident statistics report • PI-FR-01202-OECLS_EN incident investigation report • PI-FR-01203-OECLS_EN incident alert form
Safety management	• PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN • PI-PR-008-INSPECTIONS_EN • PI-PR-009-QUALIMETRY_EN • PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN • PI-PR-041-CARGO HANDLING_EN • PI-PR-042-ELECTRICAL INSTALLATIONS AND ELECTRICAL SERVICES_EN • PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN • PI-PR-045-HOT WORKS_EN • PI-PR-046_SIGNALLING AND ISOLATION_EN • PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN • PI-PR-041-CARGO HANDLING_EN • PI-PR-042-ELECTRICAL INSTALLATIONS AND ELECTRICAL SERVICES_EN • PI-PR-049-OECLS -HAZARDOUS WORK PERMIT en • PI-PR-103-WORK AT HEIGHT_EN • PI-PR-102-OECLS_CONFINED ENVIRONMENT SERVICES_EN • PI-FR 10201 OECLS_EN - Confined Space Registration • PI-FR 10202-OECLS_EN - letter of agreement • PI-FR 10203 OECLS _EN registration and scope for authorisation confined space work • PI-FR 10204 OECLS_EN confined space permit

While mitigation measures will significantly reduce severity of incidents, there is a level of exposure to occasional safety related incidents, such as slip and trips and unforeseen events such as falling objects or accidents related to machinery operation or malfunction. The residual risks are likely to be minor because of the effectiveness of mitigations.

Operation and maintenance phase

Physical hazards during operations can occur at maintenance workshops when repairing locomotives and other equipment. This can include burns, crush, falls, bruises and cuts. In addition, there is a collision risk with moving locomotives when workers are manning stations or maintaining the tracks and embankments. This long-term impact is considered as high in sensitivity, moderate in magnitude and high in significance.

Mitigation measures

- the operator is responsible for the preparation of the following management plans:
    - Operational Safety Management System
    - Mainline Operational Plan
- all personnel are to have safety training during induction and participate in regular refresher trainings, webinars.
- operator is to conduct safety inspections as part of their internal monitoring to ensure measures are being implemented and are effectively avoiding risks.

While mitigation measures will significantly reduce severity of incidents, there is a level of exposure to occasional safety related incidents, such as slip and trips and unforeseen events such as falling objects or accidents related to machinery operation or malfunction. The residual risks are likely to be minor because of the effectiveness of mitigations.

10.2.7.2 Deteriorated health from long term exposure to chemicals and emissions.

Construction phase

Emissions during construction phase refers to dust, gasses/vapours, noise and vibrations that are released as a result of a construction activity and/or equipment. Chemicals are hazardous depending on their composition/toxicity by inhalation, ingestion or skin contact. Concerns related to long term exposure to these hazards includes deteriorating hearing, eyesight, frequent pains, respiratory problems, poor digestion and other health effects for workers. The detailed air quality and acoustics studies both assess the potential impacts of emissions a minor as a result of a low number of emission sources and low quantity of projected emissions (please fer to physical impacts in section 10.4). Chemical exposure is also considered as low in magnitude because of the nature of the project will not involve large quantities of highly toxic substances, as well as relatively well-established protocols for the safe handling of chemicals that the Contractor has established. Therefore, this impact is assessed as minor.

Mitigation measures

The Contractor has a H&S management system with the following management plans in place.

Table 10. 5:Management plans to be implemented

Health and Safety Management System	Management Plan in Place
Occupational health	• PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN • PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN • PI-PR-022-OECLS_HEARING CONSERVATION PROGRAM_EN • PI-PR-023-OECLS_ERGONOMIC PROGRAMME_EN • PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN • PI-PR-025-OECLS_SICK LEAVE MONITORING PROGRAMME-SLMP_EN

Health and Safety Management System	Management Plan in Place
	• PI-PR-052-OECLS-GUIDELINES FOR DRAWING UP THE RESPIRATORY PROTECTION
Chemical handling	• PI-PL-105-OECLS_CHEMICALS MANAGEMENT PLAN_EN • PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN • PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN
Emissions	• PI-PL-106-OECLS_AIR QUALITY MANAGEMENT PLAN_EN • PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN • PI-FR 10402 OECLS - AIR QUALITY MONITORING en • PI-FR 10403 OECLS - NOISE MONITORING en • PI-FR 10404 OECLS - VIBRATION MONITORING en (2)

Residual risk including occasional exposure to dust, noise, vibration and chemical exposure may persist, cause minor short-term health effects. However, given the low quantity of exposure, combined with safety protocols, the residual impact is expected to remain minor.

Operation phase

Emissions during operation phase refers to vapours, soot noise and vibrations that are released as a result of running the locomotives. The detailed air quality and acoustics studies both assess the potential impacts of emissions a minor as a result of a low number of locomotives planned per day (please refer to physical impacts in section 10.4). It is not anticipated that large quantities of chemicals will be used during operations, low volumes will be used as cleaning and lubricants at workshops (potential exposure as a result of a spill, leak or explosion is considered as an unplanned event – see section 10.7). Therefore, the magnitude of exposure during operations is considered as low and the potential impact significance as minor.

Mitigation measures

The operator is to maintain the minimal exposure to emissions and chemicals for workers by:

- instituting regular health and safety inspections at stations and workshops
- establishing a procedure for fit to work health checks for personnel
- including health risks in all induction and refresher training.

Residual risk including occasional exposure to dust, noise, vibration and chemical exposure may persist, cause minor short-term health effects. However, given the low quantity of exposure, combined with safety protocols, the residual impact is expected to remain minor.

10.2.7.3 Biological infections and bites.

Construction phase

Like the community health impact of increased burden of disease, the migration of construction workers also creates increased risk of infections/infectious diseases amongst workers. The frequent movement of workers to and from camps, between

camps and during their regular time off for rest increases the risk of diseases transmitted sexually, by air, by vectors and/or by water.

At the camps and along the construction sites, workers will be exposed to bites from various insects and mosquitoes. The socio-economic baseline chapter indicated the presence of malaria in the project area of influence, transmitted through mosquito bites. In addition, there will be other insects like ants, arthropods like centipedes, reptiles like snakes, and others that could bite workers with various degrees of toxins/venom that can cause a reaction. In extreme situations, certain types of venom pose a serious health risk.

The sensitivity of the health of workers is considered as high; however, the magnitude of the impact is considered as medium because the preliminary designs have considered health personnel and medical services at the camps. In addition, there are existing protocols during recruitment that help to screen out infectious diseases during mobilisation and the Contractor has established rules for PPE that will limit worker's exposure to bites. Therefore, the significance of the impact is assessed as moderate.

Mitigation measures

The contractor has established the following mitigation measures:

- PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN
- PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN
- OECLS-AF-PG-GER-002_TRAINING PLAN_EN
- PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN

After implementation of comprehensive mitigations and health management measures reducing the overall risk of increased communicable diseases, residual risks will remain due to factors outside the control of the Project (i.e., existing health system limitations). Therefore, the residual risk is assessed as moderate.

Operation phase

The movement of workers with locomotives and movement of people travelling between Luena and Saurimo also creates increased risk of infections/infectious diseases amongst workers. Diseases transmitted sexually, by air, by vectors and/or by water can easily affect workers at stations and manning the stations. This impact is considered as high in sensitivity because the health of workers can be fatal if not managed effectively. The magnitude is also considered as high because of the frequent movement of people between the town and future in-migration of people. Therefore, the significance of the impact is assessed as major.

Mitigation measures

The operator is to implement the following mitigation measures:

- establish a memorandum of understanding with existing health/medical facilities in the four municipalities for the provision of medical services for project personnel
- train First Aiders to be placed at each station
- implement training for all workers during induction and refresher training

- establish a health monitoring system as an early warning mechanism to identify increased incidences of infections/outbreaks among workers
- include health outbreaks in the operational emergency response plan.

After implementation of comprehensive mitigations and health management measures reducing the overall risk of increased communicable diseases, residual risks will remain due to factors outside the control of the Project (i.e., existing health system limitations). Therefore, the residual risk is assessed as moderate.

10.2.7.4 Deterioration of health due to poor ergonomic equipment and practices

Construction phase

Poorly designed workstations or repetitive tasks can lead to musculoskeletal disorders among workers who typically work with repetitive, awkward posture, forceful motion, stationary positions and equipment. Stress, long working hours, inadequate breaks and a demanding work environment can have a significant impact on workers' mental health and well-being. The significance is assessed as moderate because although the sensitivity of the worker's health is high, the magnitude is considered as moderate.

Mitigation measures

The contractor has established the following management plans:

- PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN
- PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN
- PI-PR-023-OECLS_ERGONOMIC PROGRAMME_EN
- PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN

After implementation of comprehensive mitigations, health and safety measures reducing ergonomic risks, the residual risks are still expected, as some workers may still experience fatigue, minor injuries strains from repetitive works. However, the residual impacts are regarded as minor as they are largely manageable with ongoing health and safety interventions.

Operations and maintenance phase

At the time of the ESIA study, the planned operations were 2 passenger and 2 cargo trains per day. This doesn't pose a significant stressful work schedule that can significantly contribute to ergonomic and well-being concerns. The Operator shall re-assess this impact when the number of trains increases.

The detailed significance assessment of social impacts presented above is provided separately in Appendix 16.2.

10.3 Cultural heritage impact assessment

10.3.1 Tangible Cultural heritage impacts

The project corridor has tangible cultural heritage features which include the following:

- cemeteries in Dala Municipality, Luena municipality, Camanongue Municipal, the neighbourhoods of Sangoma, Biula, Saiassua, Luele, Satxitende, Muieie, Nanguanza, Muamucalanganza, Caiaza, Kanda II, Sacapiasso, Muapezo, Kamuleque, Samucanda and Mussirinjiji
- tombs located in Bairro Kanda II community, Luena municipality, Camanongue Municipal
- rivers and lakes that are regarded as monuments by the locals because of their cultural significance located through Lunda-Sul and Moxico, respectively
- museums located in Nanguanza
- monuments located in Luena
- military exhibition areas in the province of Moxico
- religious and communal buildings, including ruins of churches located in Vila Sede de Camanongue, Jango in Kamuleque neighbourhood.

10.3.1.1 Deterioration of heritage site visual character

There are physical monuments, cemeteries, tombs, religious and communal buildings that are known within the proposed project area that may be potentially impacted by construction activities. The impacts induced from the project activities that may arise include visual deterioration from the emission of dust from the proposed project activities. Although the baseline does not indicate that any of these physical cultural heritage features will be damaged or need to be relocated because of dust pollution, they may be impacted by the increase of dust emissions, affecting their aesthetic appeal.

Table 10.3-1: summaries the identified heritage features located within 350 m of the RoW that have the potential of being impacted by dust emissions as they are in open areas with dense natural vegetation cover and along or in proximity to the EN180 and the construction access roads.

Table 10.3-1: Potential impactable tangible features

ID	Tangible Cultural Heritage Assets (Dala municipality)	Coordinates		Relevance	Distance from the Railway Line
		Latitude	Longitude		
D7	Grave of Nossa Senhora da Viagem	10°47'54.31	20°14'21.97"	High local relevance	180 m
D8	Txiumbwe River Monuments	11° 1'19.82"	20°12'7.42	High national relevance	150 m

Preconstruction and construction phases

The increase in vehicle movements along construction routes and use of equipment within the project area may contribute to pollution, particularly construction vehicles that

are powered by fossil fuels such as diesel and petrol. These vehicles generate air pollutants that can settle on the surfaces of the heritage sites, leading to accumulation of soot, which can alter the visual character of heritage sites and overtime the layers of soot can cause staining and discoloration, especially heritage sites constructed with light coloured materials. During the establishment of camps, stations and access roads, the Contractor's Chance Finds Procedure will document any additional sites of cultural significance to minimise the impact of dust on the structures.

Mitigation measures – Preconstruction and construction phase

Reference to existing management plans:

PI-FR 10402 OECLS - AIR QUALITY MONITORING en

PI-FR 10403 OECLS - NOISE MONITORING en

PI-FR 10404 OECLS - VIBRATION MONITORING en (2)

PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN to be updated to include:

- regular dust suppression with water or installing temporary barriers around construction zones to help manage dust accumulation.

Despite the implementation of mitigation measures, low residual impacts are anticipated with dust and soot deposition on cultural heritage structures. Although heritage sites remain highly sensitive receptors due to their cultural and historical value, the residual impact is considered as minor, as no irreversible staining or discoloration is expected.

Operational and maintenance phases

The introduction of trains within the project area may impact the visual character of heritage sites, particularly sites that are within proximity to the railway line. During train movements, diesel engines emit exhaust fumes that contain soot and other particulate matter, which can settle on the surfaces of heritage sites and accumulate overtime, leading to dark staining and discoloration.

Mitigation measures – operational and maintenance phase

- Initiate a community engagement programme that involves regular cleaning and maintenance, such as pressure washing to help manage dust accumulation.

As emission during the operational phase will be intermittent, the residual impact is considered as negligible – minor. Long-term visual deterioration is unlikely to occur.

10.3.1.2 Access to community heritage sites

The project area has cultural heritage sites such as cemeteries, tombs and ritual areas used for cultural practices. The construction of new access paths may bring both negative and positive impacts in terms of accessibility beyond the RoW. The baseline indicates that the construction of access roads can increase accessibility to heritage sites. However, during construction activities, some existing paths may be temporarily disrupted.

Preconstruction and construction phases

During the construction activities of new access roads, there may be a temporarily disruption on the accessibility to heritage sites by causing temporary road closures, detours and restricted access points. These disruptions can affect the resident's normal routines and limit access to the heritage sites. The locals who travel by foot may experience difficulties navigating around the construction zones, particularly if the pathways are blocked or rerouted. This would mean that the locals would have to use alternative routes that may be longer or reduce the number of visits they take to the heritage sites. Using alternative routes increases their normal travel time, leading to delays and disrupting their planned traditional practices.

Moreover, the construction of new access roads, specialised crossings and the railway will present a potential positive impact, enhancing the accessibility to cultural heritage sites for both tourists and locals within the project area. These access roads can also create direct and faster paths, allowing the elderly and people with disabilities easier accessibility to visit the sites.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN

PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

The above documents will be updated to include the following measures:

- if the community's usual access path to cultural heritage sites must be used for project implementation purposes, alternative paths that do not disrupt the community's routine must be indicated
- select suitable alternative paths that meet community needs, local authorities must be consulted
- local communities must be informed in advance about the approved alternative path
- schedule project activities to avoid interference with the normal flow of people and vehicles
- frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.

Despite the implementation of mitigation measures, low residual impacts are anticipated with temporary access disruptions. As the project activities are transient in nature, the expected residual impacts are considered as minor and will likely return to its original state prior to construction activities.

Operational and maintenance phases

The construction of new access roads, specialised crossings and the railway will present a potential positive impact, enhancing the accessibility to cultural heritage sites for both tourists and locals within the project area and beyond the RoW. These access roads can also create direct and faster paths, allowing the elderly and people with disabilities easier accessibility to visit the sites.

Mitigation measures – operational and maintenance phase

Develop and implement operational management plans related to Traffic Management and Stakeholder Engagement that include the following measures:

- local communities must be informed in advance about the approved alternative paths
- schedule project activities to avoid interference with the normal travel and transport of people and vehicles routes (tuktuk, motorcycles, cars and buses)
- frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.

No negative residual impacts are expected; however, the positive residual impacts of improved and upgraded access roads will enhance connectivity.

10.3.1.3 Disrupted access to touristic heritage sites

The project area has tourism attractions such as the museum, monuments and exhibition areas that may potentially be impacted by the project activities. Although the baseline conditions indicate that accessibility of these tourism attractions may not be permanently impacted, they may however experience a decrease in tourists as well as local students who visit due to the construction activities temporarily restricting access to the sites and affecting their overall experience.

Table 10.3-2 summaries the identified heritage tourism attraction sites located within the project area that have the potential of access being temporarily restricted or disrupted.

Table 10.3-2: Potential impactable cultural heritage sites

ID	Tangible Cultural Heritage Assets (Moxico Municipality)	Coordinates		Relevance	Distance from the Railway Line
		Latitude	Longitude		
S2	Nanguanza Museum	9°53'23.01"	20°21'59.54"	High Provincial relevance	610 m

Preconstruction and construction phases

Construction activities may temporarily disrupt accessibility to heritage sites by causing temporary road closures, detours and restricted access points. Construction activities lead to an increase in vehicle movements along construction routes within the project area, making it difficult for tourists to reach their destinations. Increased vehicle movements lead to increased traffic congestion and detours, causing delays in travel times and requiring tourists to use alternative unfamiliar routes. This leads to confusion and inconvenience, potentially discouraging tourists or students to visit these sites.

Mitigation measures – Preconstruction and construction phase

Reference to existing management plans:

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN

The above documents will be updated to include the following measures:

- alternative paths that do not disrupt the community's routine must be indicated
- select suitable alternative paths that meet community needs, local authorities must be consulted
- schedule project activities to avoid interference with the normal flow of people and vehicles
- maintain continuous dialogue with communities and their representatives throughout the project life cycle
- frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage.

Despite the implementation of mitigation measures, low residual impacts are anticipated with temporary access disruptions. As the project activities are transient in nature, the expected residual impacts are considered as minor and will likely return to its original state prior to construction activities.

Operation and maintenance phases

The construction of new access roads, specialised crossings and the railway will present a potential positive impact, enhancing the accessibility to cultural heritage sites for both tourists and locals within the project area. These access roads can also create direct and faster paths, allowing the elderly and people with disabilities easier accessibility to visit the sites.

No negative residual impacts are expected; however, the positive residual impacts of improved and upgraded access roads will enhance connectivity.

10.3.1.4 Destruction/deterioration of physical heritage structures

The current heritage sites identified in Chapter 7 are not within the direct footprint of the railway track i.e. they are beyond the 60m RoW. Therefore, there is no anticipation that they will need to be removed of be altered physically. Other physical monuments, cemeteries, tombs, religious and communal buildings that are not yet known within the proposed Project RoW and its facilities that may be potentially impacted by construction activities, particularly sites such as old ruins, undiscovered and undermarketed sites that are not visible. At the time of the field surveys, the exact coordinates of the camps and stations were not yet defined. The impacts induced from the project activities that may arise include impacts from vibrations of vehicle movements and equipment use, particularly on un-identified and unmarked heritage sites and underground cultural or archaeological findings that may be impacted at campsite locations, station locations, near river crossings and along the RoW access route to be established.

Pre-construction and construction phases

Construction activities such as rock breaking can produce ground- borne vibration, especially on soft ground and may cause damage at high magnitude. This can impact cultural infrastructure that is relatively old or made of clay or stone, potentially causing damages such as cracks and holes, compromising the structural integrity and its heritage value or causing structures to eventually collapse. Rock breaking will be undertaken in

small, discreet areas (i.e. rock crusher areas) and therefore this impact will not affect all infrastructure near these areas.

Some cemeteries/graves may potentially be unintentionally destructed by vibration that may occur near the sites, as they were not clearly marked as graves, and some were not easily identifiable during the baseline field visit. In addition, vegetation clearance and the establishment of camps can lead to chance finds of unidentified and un-marked sites of cultural and archaeological significance. During the establishment of camps, stations and access roads, the Contractor's Chance Finds Procedure will document any additional sites of cultural significance to minimize the any damage to the structures.

Mitigation measures – Preconstruction and construction phase

Reference to existing management plans

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

PI-PL-107 OECLS-TRAFFIC MANAGEMENT PLAN AND ITS CONSEQUENCES_EN

PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

PI-FR 10402 OECLS - AIR QUALITY MONITORING en

PI-FR 10403 OECLS - NOISE MONITORING en

PI-FR 10404 OECLS - VIBRATION MONITORING en (2)

PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN

The above documents include the following embedded mitigation measures:

- in case of damage, repair damage caused to local communities during construction with the parties involved
- maintain continuous dialogue with communities and their representatives throughout the project life cycle
- ensure that the demining is finalised, and the certificate has been issued
- evaluate the need to create a buffer zone on cultural heritage
- establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access path. This can help identify problems early and take corrective action
- frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage
- in the event of grave relocation within the project area of influence, operations must immediately be interrupted, and traditional and municipal authorities must be notified to facilitate assistance and ensure compliance with cultural heritage legislation.

Anticipated vibration-related consequences are expected, particularly to unmarked graves. However, due to the distance of the known heritage sites from the RoW, the expected residual impacts are considered negligible – minor.

Operational and maintenance phases

The continuous daily movement of the train and maintenance equipment can generate vibrations through the ground, particularly soft ground. Over time, the frequent vibrations can weaken the structural stability of cultural infrastructure that is relatively old or made

of clay or stone, potential causing damages such as cracks, compromising the structural integrity and its heritage value or causing structures to eventually collapse.

Although the train movement can cause structural damage, the proposed Project will have limited vibration impacts, as the magnitude of vibrations are dependent on different aspects, including train type, speed, tracks, foundation, rail joints and train conditions. In essence, the magnitude of vibration is influenced by the conditions and age of the train and its infrastructure. Therefore, given the newly design of the train, it is unlikely to have a significant vibrational impact.

Mitigation measures – operational and maintenance phase

Develop and implement the following management plans: Stakeholder engagement plan, traffic management plan. These documents will include the following measures:

- inform communities about grievance mechanism so they can report issues and concerns
- compensation in case of damage, repair damage caused to local communities during construction with the parties involved
- establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access paths. This can help identify problems early and take corrective action.

Anticipated vibration-related consequences are expected, particularly to unmarked graves. However, due to the distance of the known heritage sites from the RoW, the expected residual impacts are considered negligible – minor.

10.3.1.5 Destruction of native medicinal plants

There are communities within the project area that rely on botanical resources such as native plants for medicinal practices and healthcare. These plants are mostly used in the identified communities of Muamucalanganza, Muieie, Luele, Camanongue Saquembue, Sangoma, Mukuanguaji, Sacapiasso, Migotchi, Samucanda, Sakambudji, Musseringinge, Mumanga, Caiza, and Saissazo, with some plants notably in other vast areas of the project area and beyond. The baseline conditions indicate that these plants may be impacted during the project activities. However, traditional authorities and community members stated that the clearance of the medicinal plants within the project area will not prevent their continued use for medicinal purposes.

Preconstruction and construction phases

Activities such as vegetation clearance can alter the natural habitats where medicinal plants thrive, leading to the disturbance and decline of the plants. Moreover, this can expose areas of invasive plant species that may displace or replace the medicinal plants. Therefore, interfering with traditional practices that involve these plants.

In addition, construction activities can cause soil contamination from chemical and oil spills and runoff. This damages/deteriorates the quality of soil and affecting the ability of medicinal plants to successfully grow.

The proposed communities where campsites will be constructed will become disturbed and will lead to the reduced availability of medicinal plants. This includes the communities of Luele, Camanongue and Caiaza. Moreover, medicinal plants in certain portions of Camanongue and Caiza will be permanently destroyed, as these areas will be turned into

permanent campsite/worker accommodation. The loss of the medicinal plants may potentially erode cultural knowledge of the use of these medicinal plants within these communities.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN

PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN

PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN

The above documents include the following measures:

- frequently involve traditional local and administrative authorities in the decision-making process regarding medicinal plants
- maintain continuous dialogue with communities and their representatives throughout the project life cycle
- relocate medicinal plants
- Identify potential clearance of routes/locations that have medicinal plants and required documentation for the replanting/restoration of impacted areas.

Despite the implementation of mitigation measures, residual impacts are anticipated with the loss of some individual medicinal plants being unavoidable. However, the residual impacts are considered to be minor due to the reversible nature for specific locales and affecting communities directly adjacent to the cleared areas.

Operational and maintenance phases

Activities such as vegetation clearance can alter the natural habitats where medicinal plants thrive, leading to the disturbance and decline of the plants. Moreover, this can expose areas of invasive plant species that may displace or replace the medicinal plants. Therefore, interfering with traditional practices that involve these plants.

In addition, operation of the train and maintenance and cleaning activities that involve the handling of chemical liquids can cause soil contamination from accidental chemical and oil spills or leaks, which can potentially damage/deteriorate the quality of soil and affecting the ability of the plant to successfully grow.

Mitigation measures – Operational and maintenance phase

Develop and implement an invasive species management plan, stakeholder engagement plan for operations

- frequently involve traditional local and administrative authorities in the decision-making process regarding medicinal plants
- maintain continuous dialogue with communities and their representatives throughout the project life cycle

- remove invasive plants during regular maintenance/clearing of vegetation along the embankments and surrounding station locations.

Despite the implementation of mitigation measures, residual impacts are anticipated with the loss of some individual medicinal plants being unavoidable. However, the residual impacts are considered to be minor due to the reversible nature for specific locals and affecting communities directly adjacent to the cleared areas.

10.3.2 Intangible cultural heritage impacts

The project corridor has intangible cultural heritage elements including:

- customary beliefs
- cultural dances celebrations
- oral traditions
- festivals
- rituals
- drawings
- artifacts (such as musical instruments and traditional masks).

10.3.2.1 Disruption of sand drawing ceremonies

The proposed project is within an area where certain cultural events occur. This includes the Sona drawings, where the locals create drawings and geometric figures in the sand as a means of contributing to the preservation of their heritage and knowledge transmission. This cultural significant activity may be potentially impacted by the project, and the emission of dust from the proposed project activities.

Preconstruction and construction phases

The proposed Project transverses through the Lunda Tchokwe communities, where the Sona cultural ceremony occurs. The construction of new access roads, disrupt this ceremony as the roads may be constructed over land where these drawings are placed. Moreover, the activities associated with the access road constructions can restrict access to land or alter the natural landscape and composition of the sand, making it unsuitable for creating their traditional drawings.

In addition, construction activities that create dust, causes the dust in the air to settle on the surface, blurring out some of the drawings. This not only impacts the visual clarity of the drawings but also disrupt the environment these ceremonies occur. Therefore, these traditional ceremonies may need to temporarily relocate to less significant or inappropriate locations, impacting the authenticity and meaning of these ceremonies.

Mitigation measures – Preconstruction and construction phase

- implement dust suppression measures, such as water spraying on roads, install speed limits to avoid greater extent of emissions.

Despite the implementation of mitigation measures, residual impacts are anticipated with the temporary disruption of ceremonies being unavoidable. With regards to the Sona cultural ceremony, the anticipated residual impacts are considered as minor because these ceremonies are site-specific and no long-term loss of heritage value is expected.

Operational and maintenance phase

During the operational and maintenance phase, the activities undertaken are not anticipated to pose a risk or cause any disturbance to the Sona drawing ceremony.

10.3.2.2 Cultural misunderstanding

Communities within the project area have different Bantu/ethnic groups with different cultures, norms and practices that may be potentially impacted by the project activities and its migrant workers. The baseline conditions indicate that the proposed project may generate cultural misunderstandings, in communities located close to the project ROW due to the interaction between workers assigned to the project and local residents.

Preconstruction and construction phases

Overall project activities involving migrant workers can lead to cultural misunderstandings when there is lack of understanding or awareness towards cultural norms and practices, particularly with migrant workers who may not know the cultural beliefs of locals within the project area or when migrant workers carry out their activities with disregard of the culture/traditions within these communities. This may lead to a clash of values, where project activities are seen as being prioritized over cultural preservation.

In addition, language barriers can lead to misunderstanding and misinterpretations about the project intention between the locals and migrant workers, particularly where more migrant workers are assigned to work.

Mitigation measures – Preconstruction and construction phase

Reference to existing management plans:

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

OECLS-AF-PG-GER-002_TRAINING PLAN_EN

PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN

The above management plans include measures to:

- develop training materials to instruct key concepts, local context and foster local understanding among construction workers to avoid social conflicts with local communities
- maintain continuous dialogue with communities and their representatives throughout the project life cycle
- frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage

- inform communities about grievance mechanism so they can report issues and concerns.

Operational and maintenance phases

The constructed permanent main campsites in Camanongue and Caiza will accommodation migrant workers who will be employed during the commissioning phase of the project. These areas will continue experience ongoing negative cultural impacts as a result of language barriers.

Mitigation measures – operational and maintenance phases

- develop training materials to personnel at stations and manning locomotives that provide key concepts, local context and foster local understanding among construction workers to avoid social conflicts with local communities.

The residual risk of minor instance of miscommunication and cultural tension remains, as communities/people's levels of understanding are different and remain outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place and any incident that may arise is not expected to be long-lasting issue.

10.3.2.3 Disruption of cultural, tradition and religious events

Communities within the four municipalities of the project area have different Bantu/ethnic groups with different cultures and traditional practices or events, occurring on specific days, months and years that may be potentially impacted by the prolonged project activities occurring over 60 months. The baseline conditions indicate that the project activities may cause noise pollution that may interfere with cultural or religious events or practices such as the festivals and dance celebrations.

Cultural and traditional practices that maybe impacted include:

- initiation ceremonies
- welcoming dance ceremonies
- festivals
- rituals
- ceremonies of soba (traditional leader)
- conflict resolutions
- traditional marriage festivities
- funeral practices.

Preconstruction and construction phases

During the preconstruction and construction phases, noise pollution from increased vehicle traffic, machinery and construction activities near the communities that engage in cultural and religious events may experience reduced enjoyment and tranquillity. The noise impacts may disrupt ceremonies, rituals or prayers that require a quiet and peaceful environment. The noises from construction activities can drown out music/songs during dance ceremonies and the festivals, overall disrupting the ambience and making it difficult for the locals to hear the key elements of their events.

In addition, construction activities may disrupt accessibility (because of reasons explained in land access impacts). The events may need to be temporarily relocated to less significant or inappropriate locations, impacting the authenticity and meaning of these events.

Moreover, the presence of construction works can impact the regular scheduling of traditional events, diminishing cultural continuity and community engagement, therefore potentially reducing community engagement and participation.

Mitigation measures – Preconstruction and construction phase

Reference to existing management plans

PI-PL-108-OECLS_CULTURAL HERITAGE MANAGEMENT PLAN_EN

PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN

OECLS-AF-PG-GER-002_TRAINING PLAN_EN

PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN

PI-FR 10402 OECLS - AIR QUALITY MONITORING en

PI-FR 10403 OECLS - NOISE MONITORING en

PI-FR 10404 OECLS - VIBRATION MONITORING en (2)

PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN

The above-mentioned management plans have measure to:

- establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access paths. This can help identify problems early and take corrective action
- frequently involve traditional local and administrative authorities in the decision-making process regarding cultural heritage
- maintain continuous dialogue with communities and their representatives throughout the project life cycle.

Despite the implementation of mitigation measures, residual impacts are anticipated with the temporary disruption of ceremonies being unavoidable. The anticipated residual impacts are considered as minor because these ceremonies are site-specific and no long-term loss of heritage value is expected.

Operational and maintenance phases

The movement of trains may cause noise interference, particularly while the train is signalling or stopping at the stations near communities. These noise impacts may cause irritation and interference with significant cultural events.

Moreover, equipment used for maintenance activities across the RoW could potentially disrupt traditional ceremonies and practices.

Mitigation measures – operational and maintenance phase

- establish monitoring programs to track vibration, noise and pollution levels around cemeteries, and cultural heritage access paths. This can help identify problems early and take corrective action.

Despite the implementation of mitigation measures, residual impacts are anticipated with the temporary/minimal disruption of ceremonies being unavoidable. The anticipated residual impacts are considered as minor because these ceremonies are site-specific and no long-term loss of heritage value is expected.

The detailed significance assessment of cultural heritage impacts presented above is provided separately in Appendix 16.3.

10.4 Physical Environment Impact Assessment

10.4.1 Acoustics/noise and vibration

10.4.1.1 Assessment scope

The scoping table below (Table 10.4-1) sets out the key elements considered as part of the impact assessment. Where topic areas have been scoped out, a justification has been provided. This table is considered to be valid at the time of writing however, where further project information is made available, or information/assumptions contained within this report is changed during detailed design further detailed noise assessment work will be required to verify the findings here, including whether key areas should be excluded from the assessment.

Table 10.4-1: Scoping table

Assessment Element / Phase	Scoped In	Scoped Out	Justification
Noise and Vibration			
Construction - Noise	✓		There is the potential for significant noise effects on nearby human receptors resulting from construction activities associated with the Proposed Development, therefore, a construction noise assessment is required.
Construction - Vibration	✓		There is the potential for significant vibration effects on nearby human receptors resulting from construction activities associated with the Proposed Development, therefore, a construction vibration assessment is required.
Construction - Traffic	✓		Potential for significant noise effects on nearby human receptors resulting from construction traffic associated with the Proposed Development, therefore a construction traffic assessment is required.
Construction Blasting - Noise		✓	As the quarries are existing and have not been introduced for this development, it is assumed quarry operations are already permitted. On this basis, blasting noise (including air overpressure) has been scoped out of the assessment.

Assessment Element / Phase	Scoped In	Scoped Out	Justification
Construction Blasting - Vibration		✓	As the quarries are existing and not been introduced for this development, it is assumed quarry operations are already permitted. On this basis, blasting vibration has been scoped out of the assessment.
Operational Noise - Train Movements		✓	The current proposed operations assume there will be a total of 4 train movements per day (comprising 2 passenger trains and 2 freight trains). It is proposed that the same train will complete the two-way movement for both freight and passenger trains, therefore, in any worst-case 1 hour, 1 freight movement and 1 passenger train movement is expected to occur. All operational movements are proposed during the daytime period. Due to the limited number of pass-bys and the time in which it takes for the pass-bys (less than 1 minute per train based on line speeds) to occur in any 1-hour period, it is unlikely to cause a significant effect due to the limited proposed operational movements during the considered time periods. Therefore, operational noise associated with train movements has been scoped out of the assessment. This should be revisited at detailed design once further operational information is provided (see Section 10.4.1.5 for further information)
Operational Vibration – Train Movements		✓	During the movement of trains there is a potential for local vibration to be generated. The magnitude of vibration is dependent on a number of variables including track foundation, track fixings (i.e., isolation), sleeper type, train speed, train type, rail roughness, rail joints crossings and wheel condition. Given the fact that all components will be designed and chosen as a newly built rail line, vibration levels are expected to be low and within acceptable limits. Additionally, vibration can also be influenced by site-specific physical parameters and receptor characteristics, a more detailed operational vibration assessment will be undertaken once detailed design information becomes available. This will include confirming the separation distance between the alignment at the closest sensitive receptors (anticipated to be at least 30 m) and incorporate BPMs to further reduce vibration transmission. Therefore, the purpose of the assessment operational vibration has been provisionally scoped out of the current assessment, and will be re-assessed during detailed design phase, when sufficient data is available to support a quantitative analysis.

Assessment Element / Phase	Scoped In	Scoped Out	Justification
Operational Noise - Idling Noise		✓	The current proposed operations assume there will be a total of 4 train movements per day (comprising 2 passenger trains and 2 freight trains). It is proposed that the same train will complete the two-way movement for both freight and passenger trains, therefore, in any worst-case 1 hour, 1 freight movement and 1 passenger train movement is expected to occur. All operational movements are proposed during the daytime period. Although the train schedule determining expected arrival times is not currently available at this stage in the design, it is anticipated that trains running idle at each station will last no longer than approximately 3 to 5-minutes (based on expert judgement), and therefore, it is unlikely that idling train noise would cause a significant effect due to the limited time idling at the station in any 1-hour daytime assessment period. Therefore, operational noise associated with train movements has been scoped out of the assessment. This should be revisited at detailed design once further operational information is provided (see Section 10.4.1.5 for further information)
Operational Noise - Fixed Plant	✓		Due to limitations surrounding the detailed fixed plant information associated with the stations (i.e., plant selection, location of plant, number of plants etc), a qualitative assessment has been undertaken with the recommendation that a detailed quantitative assessment should be undertaken at detailed design once further information surrounding the plant installation is known. At this stage limit levels will be presented for receptors which are identified around stations (at detailed design).
Operational Noise - Traffic		✓	Due to the low number of vehicles that are expected to be introduced as a result of the Proposed Development (via ad-hoc maintenance), the influence of operational phase vehicle movements is not expected to give rise to significant effects, therefore, operational traffic noise has been scoped out of the assessment.
Commissioning - Noise		✓	The noise from the commissioning phase will be equivalent or lower than the noise from the operational phase, therefore, commissioning noise has been scoped out of the assessment.
Commissioning - Vibration		✓	The noise from the commissioning phase will be equivalent or lower than the noise from the operational phase, therefore, commissioning vibration has been scoped out of the assessment.

Assessment Element / Phase	Scoped In	Scoped Out	Justification
Decommissioning - Noise	✓		There is the potential for significant noise effects on nearby human receptors resulting from decommissioning activities associated with the Proposed Development, therefore, a decommissioning noise assessment is required.
Decommissioning - Vibration	✓		There is the potential for significant vibration effects on nearby human receptors resulting from decommissioning activities associated with the Proposed Development, therefore, a decommissioning vibration assessment is required.

10.4.1.2 Construction noise assessment input

The construction methodology and programme has yet to be defined, and therefore the following has been determined through work on similar projects in order to make an initial judgement of impacts. The construction works are likely to involve the use of a variety of working methods, and operations will vary throughout the construction period. Therefore, noise levels from the works are likely to vary significantly over time as the type of construction activities change.

It should be noted that the linear nature of the works means that noise form construction will be transient and any impacts short in duration before the works themselves move to the next section.

An initial estimate of the expected construction related noise levels over a representative period has been provided using typical plant items and the associated noise emission data from British Standard BS 5228-1:2009+A1:2014 (in the absence of national guidance on construction noise predictions).

For the purpose of predicting the likely noise impacts associated with the construction activities, the following phases of the works have been considered (Table 10.4-2).

Table 10.4-2: Construction activities

Construction Activity1	Construction Hours	Activities	Temporal Use
Early Works (Geotechnical and Mobilization Works)	Standard	Site Clearance and Grubbing Site and Camp Establishment	<2 years
Earthworks and Civils	Standard	Earthworks and Civils	<2 years
Signalling and Telecommunications Works	Standard	Signalling and Telecommunications Works	1-5 Years
Track Works	Standard	Ballast and Track Laying	<2 years

Construction Activity1	Construction Hours	Activities	Temporal Use
		Ballast Distribution Ballast Tamping	
Passenger Stations, Permanent Camps Establishment	Standard	Mechanical and Electrical Installations	1-5 Years

NOTES: [1] Construction of rather than operation, other than specified

There is a potential for noise to be emitted from construction traffic at levels discernible within the study area. The magnitude of noise, and level of impact would be determined by existing traffic noise levels and the number of future vehicles (including type of vehicle and the construction roues being used). At this stage, specific construction vehicle details are yet to be defined and as such assumptions have been made. It is anticipated that construction vehicles will utilise a new unsealed access road to be built parallel to the track and very few instances where the construction vehicles may use the existing EN180 road.

There is the potential for project traffic to change the noise environment in two ways, through:

- an increase in construction traffic on existing roads
- new traffic noise source on the access road (construction and maintenance).

Traffic data is not available for most roads through Angola and therefore the existing traffic information along the local road networks is unavailable. As a result of this it is not possible to undertake a 'typical' quantitative noise assessment of existing road traffic noise. On this basis, traffic associated with the construction phase has been calculated utilising the 'haul road' calculation method as set out in British Standard BS 5228-1:2009+A1:2014, to provide an indication of absolute levels.

The construction traffic flows with regards to material deliveries assume approximately 180 individual HGV movements per day along the access road. This assumes that HGV movements will only be occurring during the daytime periods.

Below outlines the proposed worst-case hour for HGV movements along the existing local road network and the access road to the rail corridor:

- local road network: 15 individual movements
- access road to the site: 10 individual movements.

Access to the rail corridor (through construction and/or operation) will be through a new access road. It is planned that the road will be cleared five meters from the railway alignment and to run in parallel to it. Some vehicle movements will use the existing EN 180 road to access the rail corridor, depending on the vehicle's origin. At this stage the origin of construction and operational maintenance vehicles is unknown (see Section 10.4.1.8 for further information on traffic). It is anticipated that vehicular movements along the access roads during operation will be limited to ad-hoc maintenance requirements along the route. It is not intended to be a publicly accessible highway.

The quantitative assessment for construction traffic is presented in Section 10.4.1.8.

10.4.1.3 Construction vibration assessment input

Construction works comprising activities such as rock breaking can produce ground-borne vibration, which may be felt in nearby properties and may cause damage at high magnitude.

The main source of vibration associated with the proposed development is expected to be attributable to transient rock breaking and rock ripping activities (see Table 10.4-3). This source has therefore been considered as part of the quantitative assessment.

All of the activities are considered to be undertaken during daytime periods only.

The tasks mentioned above, with the exception of compaction, will be undertaken in small, discreet areas and not route wide. In addition, a low-impact compaction method is proposed for ground reinstatement along the alignment and therefore, only the vibration sources in Table 10.4-3 are considered.

Table 10.4-3: Construction activities - vibration

Construction Phase	Activities
Earth Works	Rock breaking and rock ripping
Track Works	Rock breaking and rock ripping

In a similar way to the prediction and the assessment of noise, the vibration levels from each of the above activities are predicted using empirical formulae and the distances to which magnitude bands are exceeded is presented in Section 10.4.1.9.

10.4.1.4 Significance impact criteria

Based on the international standards, the following significance criteria have been adopted for the project. Where moderate to major impacts are identified, this is considered to constitute a significant adverse effect. The sensitivity of receptors is presented in Table 10.4-4. It should be noted that, the sensitivity of receptors remains the same regardless of the location or activity. Therefore, for the purpose of the determination of 'Significance of effects', receptor sensitivity is taken as 'High' only.

Table 10.4-4: Receptor sensitivity - noise

Source	Period
High	Residential properties, educational establishments, hospitals, places of worship, hotels, children's nurseries, nursing homes. This will include those which are isolate receptors and those within community centres/communes and towns
Medium	Commercial premises including offices, halls, public municipal areas, bars and restaurants
Low	Industrial premises

Negligible	All other areas such as those used primarily for agricultural purposes

The magnitude of the impact within this assessment has been described using the following scale:

- high
- moderate
- low
- negligible.

Although the lowest measure of magnitude of effect is defined as 'Negligible', it should be noted that noise and vibration levels may still be audible/perceptible during the construction and operational phases.

The criteria in the table below have been adopted for the assessment of magnitude of impact. Based on the international standards, the following significance criteria have been adopted for the project. Where moderate to major impacts are identified, this is considered to constitute a significant adverse effect:

Table 10.4-5: Adopted significance criteria

Source	Period	Significance			
		Negligible	Minor	Moderate	Major
Construction & decommissioning phases noise	Day	< 55 dB $L_{Aeq,T}$	55 – 65 dB $L_{Aeq,T}$	65 – 75 dB $L_{Aeq,T}$	> 75 dB $L_{Aeq,T}$
Construction & decommissioning phases vibration	Day	< 0.3 mm/s PPV	>0.3-1 mm/s PPV	>1-5 mm/s PPV	> 5 mm/s PPV
Operational Noise – Fixed Plant*	Day	< 55 dB $L_{Aeq,1hr}$, or below background ($L_{90,1hr}$) – whichever is the lower.	<55 dB $L_{Aeq,1hr}$, or 3dB above background ($L_{90,1hr}$) – whichever is the lower.	<55 dB $L_{Aeq,1hr}$, or 3 – 10 dB above background ($L_{90,1hr}$) – whichever is the lower.	<55 $L_{Aeq,1hr}$, or 10 dB above background ($L_{90,1hr}$) – whichever is the lower.

**These represent a cumulative target at each receptor (i.e. accounting for all fixed plant operating and not individual plant item targets)*

The overall significance of an effect is determined by combining the sensitivity of the receptor and magnitude (as presented in Table 10.4-6). The assessment of significance relies on best practice and the relevant published standards and guidance documents as defined above.

The significance of an effect is reported as either 'significant' or 'not significant'. Where impact significance is assessed as 'Negligible' or 'Minor', the overall effect is not

significant. Where the impact significance is assessed as 'Moderate' or 'Major', the overall effect is significant. Where a significant effect is identified, mitigation is to be considered.

Table 10.4-6: Determining significance of effects

Magnitude	Sensitivity of receptor/receiving environment to change			
	High	Medium	Low	Negligible
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

10.4.1.5 Exclusions and assumptions

The following data is unavailable at this point in the design and is therefore considered a limitation of the assessment.

Data exclusions

Sensitive receptors

Although the baseline noise measurements were undertaken at selected receptors, representative of the closest sensitive receptors to the proposed development, detailed receptor information is unavailable at this stage of the project (this includes specific receptor names, use and location). However, through an initial review and guidance form the Social and Environment teams, the closest receptors (those identified as greatest potential for impact) are those identified for monitoring. It should be noted that the sensitive receptors will be verified during detail design or during the RAP. Noise levels from the construction works experienced by a receptor would vary over time as the distances to noise producing plant and the type of construction activity change. The assessment is based on buffered approach where receptors within a specified distance from the alignment will likely be affected by the project. Full detailed list of receptors is to be undertaken during the detailed design phase hence the current assessment is based on distance corrections and conservative assumptions. Further assessment would need to be undertaken at detailed design stage for both construction and operational phases once a full detailed list of sensitive receptors is made available. This assessment shall include the linkage between baseline levels, predicted impacts and applicable criteria. Likewise, quantification of the number of properties that have the potential to be affected by construction phase impacts will be undertaken at later stages.

Construction methodology

Construction activities would involve the use of a variety of working methods, for which an estimate of the expected noise levels over a representative period has been prepared, in accordance with industry best practice. At this stage of the project, the existing basic design has been used for assessment. The detailed design to be undertaken later will provide detailed further information surrounding the construction phase including the confirmed working methods, programme etc. While the basic design has been produced,

the detailed construction methodology including equipment and plants, programme of execution at each railway section will be developed at later stages.

The assessment of construction noise impacts has been based on an assumed programme and period of working, utilising a prediction method which is typically pessimistic in the prediction of noise levels. As a result, it is unlikely that the uncertainty would give rise to impacts of greater significance than that assumed at this stage.

The specific make and model of plant to be used during the construction phase have not yet been identified. Predictions of noise and vibration impacts are therefore based on example sources of similar size and operation to those proposed.

No information regarding the projected vehicle movements required for site material throughout the construction stage has been provided. Therefore, assumptions have been made based on professional judgement to determine movements along the access road and the local road network.

To enable quantitative assessment, while vehicle movements on the road network associated with the construction they may give rise to short-term increases in noise at existing receptors, this will be short-term in nature.

There is currently no information available regarding the existing traffic flows along the local road network, therefore the potential change in noise level from the construction HGV movements cannot be quantified at this stage.

Station Layouts

At this stage the layout of new stations, including source (and magnitude) of noise emissions is not available. These have an important role to play in the operational impacts of station with respect to noise. For the purpose of the assessment, limits have been set using baseline noise monitoring data, to ensure the detailed design of stations and associated noise sources are sympathetic to noise. These are based on project criteria and assume the cumulative impact of all noise sources within the station extents (not a limit per plant item).

Nighttime monitoring

No data measurements were taken during night periods due to the assumption that the construction activities and train operations are restricted to daytime periods. Therefore, nighttime measurements were not relevant at this stage of writing. However, if the proposed hours of either construction or operations at the detailed design fall during the nighttime periods, further baseline would be undertaken at detailed design by the operator/contractor to confirm nighttime levels. Where the location of fixed plant or alignment change, additional monitoring may be required. The measurements undertaken in this report are representative of the layout and project at the stage of writing

Station operations

Operational plant information associated with the stations is unavailable at this stage of the design, therefore, no quantitative assessment of the fixed plant has been undertaken and is a limitation of the assessment.

Based on the above, it is unlikely that the uncertainty would give rise to impacts of greater significance than that assumed at this stage.

Assumptions

It is assumed that noise and vibration impacts associated with construction activities will be temporary and will end after completion of the construction phase. Moreover, the construction of the Project will progress through different locations in a linear manner and will not always be stationary, which reduces the overall significance of noise based on the factor of duration. Therefore, this will lead to the impacts being irregular and unpredictable and will only last for a short period of time and are expected to move or change frequently as the project progresses.

However, it is assumed that long term impacts of noise and vibrations will be felt during operation phase associated with movement of trains, particularly within communities residing along the railway corridor. The predicted noise levels are simply a distance correction between the construction area at reference distances from the proposed construction area this does not account for any intervening buildings that would serve to provide acoustic screening, particularly in towns and villages where areas are densely populated.

Operational train noise

The information provided, in relation to train operations, at the time of preparing this document is limited. However, based on the number of movements alone in a single daytime period, this provides a good indication that there would be no impact on the existing noise environment when considered in accordance with IFC guidance. The IFC guidance for daytime noise considers a time and energy average noise level from operational sources, not an instantaneous event. The current information on train operations, indicates that there will be an elevated train noise at any single receptor as a result of train movements, for no more than 1 minute in an hour, and a maximum of 4 mins in total per day. In simple terms, although these may give rise to an elevated level instantaneously, they will not be sufficient to elevate the noise over a 1 hour assessment period. Therefore, will be negligible and have not been quantified as part of this study, rather have been scoped out of the assessment. However, this should, and conclusion will be reviewed at detailed design phase once the following information is made available:

- 3D alignment
- rail corridor terrain profile
- detailed rail speed profile (section by section)
- station location and station layout
- station use profile (speed and time basis)
- sidings layout
- siding use profile (speed and time basis)
- locomotive detail
- locomotive temporal profile (when trains will run)
- receptor identification database
- cutting, bridge and embankment detailing (including 3D design).

During the preparation of the ESIA, all preliminary design information provided has been considered. Any changes to current assumptions will influence the outcomes of the current assessment. During the development of the detail design, changes to the information provided may impact the assessment and conclusions presented in this

document. A further noise and vibration impact assessment would need to be undertaken once a detail designed is refined.

10.4.1.6 Increased generation of noise from pre/construction activities

Preconstruction and construction

Table 10.4-7 presents the predicted preconstruction and construction noise levels that can potentially occur during the construction phase of the Project. All values are presented as free-field levels and assume soft ground propagation. A copy of the plant lists used within the assessment is provided in Table 2-14 (Chapter 2 Project Description) and attached in Appendix 16.8. These predictions are based on activities assumed to be undertaken on a project such as this and will need to be confirmed at detailed design.

Table 10.4-7: Predicted construction noise levels (dB $L_{Aeq,T}$)

Task	Construction Activity	Noise level (dB LAeq,T) at range of setback distances (m)							
		10	50	75	100	150	200	250	300
1.1	Site Clearance and Grubbing	77	61	60	54	49	46	44	42
1.2	Site and Camp Establishment	70	55	57	47	43	39	37	35
1.3	Access Route Construction	74	58	60	51	46	43	41	39
1.4	Earthworks and Civils	74	58	64	51	46	43	41	39
1.5	Signalling and Telecommunication Works	75	60	63	52	48	44	42	40
1.6	Ballast and Track Laying	75	60	57	52	48	44	42	40
1.7	Track Works	64	48	57	41	36	33	31	29
1.8	Ballast Laying and Distribution	83	68	63	60	56	52	50	48
1.9	Ballast Tamping	81	66	61	58	54	50	48	46
1.10	Rock breaking	74	58	57	51	46	43	41	39
1.11	Quarries Operations	85	70	65	62	58	54	52	50
2.0	Culvert and Bridge Works	78	63	61	55	51	48	45	43
2.1	Ballast production	55	40	65	32	28	25	22	20

Task	Construction Activity	Noise level (dB LAeq,T) at range of setback distances (m)							
		10	50	75	100	150	200	250	300
2.2	Foundations (piling)	72	57	63	49	45	41	39	37
2.3	Foundations (concreting)	69	54	56	46	42	38	36	34
2.4	Steel and Framework	71	56	59	48	44	40	38	36

Based on assumptions, the general construction activities that will be undertaken (Table 10.4-7) create impulsive noise, associated with the use of equipment, signalling, the sudden bursts of loud sounds from earth works and rock breaking activities, particularly during the construction of the access roads, that may cause startling impact. Moreover, intermittent noise will be caused by the continuous use of a plant/equipment while undertaking Project activities (i.e. during ballast tampering). The predicted noise levels are simply a distance correction between the construction area at reference distances from the proposed construction area this does not account for any intervening buildings that would serve to provide acoustic screening, particularly in towns and villages where areas are densely populated.

The assessment results indicate that the predicted noise levels of construction works have the potential to exceed the project criteria at up to 75 m from the considered alignment in line with threshold criteria outlined in BS 5 228,

The duration of the construction activities and the transient nature of the project will mean that these levels will be experienced for very short periods of time. Noise control measures will be implemented; however, the inherent nature of construction means short term impacts are likely and typically accepted.

A further construction assessment would be undertaken by the contractor during detailed design phase once the detailed list of sensitive receptors, and construction methodology is made available.

Mitigation

Construction works are inherently noisy; however, they are typically short term in duration, and for the purpose of linear works such as rail are transient (short term at any one location. Therefore, impacts may be present in the short term, but significance is reduced as a factor of duration. It is recommended that noise from construction works be controlled through good working practices and noise control measures. Typical measures that can be adopted are set out below:

- minimising drop heights of materials i.e. lorry with lifting boom or dumper carefully depositing materials
- maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)
- all plant, equipment and noise control measures applied to plant and equipment should be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practicable. Any plant, equipment or items fitted with noise control equipment found to be defective will not be operated until repaired

- machines in intermittent use will be shut down or throttled down to a minimum during periods between works
- as far as is reasonably practicable, the location and orientation of semi-static equipment will be chosen to minimise the noise impact on sensitive receptors
- where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements
- where safe to do so, noise from reversing alarms will be controlled and limited as far as possible using physical barriers to restrict pedestrian and construction worker movements in zones with numerous turning/reversing construction vehicles, to minimise intrusive sound of tonal alarms
- where night works are required, as far as is practicable programme the work such that separation distances to noise sensitive receptors are maximised
- a programme of community liaison should be carried out, including notification of works and details of the complaints process.

10.4.1.7 Increased generation of noise from operation activities

Operation and maintenance

Noise associated with the operational phase is most likely to arise from

- the movement of the train transporting passengers and cargo along the rail route that passes through the communities. Noise from the train movement can be caused by the train signalling (i.e. horning at the level crossings and as the train is about to halt at the stations). From a social perspective, intermittent and transient increases in noise levels will present short incidences of disturbance that is discussed in the social impacts assessment. However, the noise impact in terms of exceedance of threshold levels was scoped out of the assessment as it has been deemed insignificant
- noise associated with fixed plants i.e. stations. Information surrounding the equipment type, layout, location and quantity is not yet known at this stage in the design. It is recommended that a revised quantitative assessment should be undertaken at detailed design stage once further information regarding the fixed plant is made available. Therefore, in order to provide an indication of impact for the purpose of the ESIA, the derived impact assessment criterion has been used to set as targets for future station and other ancillary plant design. This will assist in plant selection and noise control design

In accordance with the derived project criteria, and assuming receptors are highly sensitive, operational noise should be no greater than a magnitude representing a 'moderate' or 'major' impact. Using the background noise measurements, and methodology presented in Table 10.4-6, design criteria is presented below:

Table 10.4-8: Operational Design Criteria (Fixed Plant)

Design criteria for fixed plant	Station number							
	1	2	3	4	5	6	7	8
Absolute, $L_{Aeq,1hr}$	55	55	55	55	55	55	55	55

Design criteria for fixed plant	Station number							
	1	2	3	4	5	6	7	8
*Derivation from background	42 (39)	39 (36)	43 (40)	34 (31)	39 (36)	42 (39)	39 (36)	37 (34)
Proposed external Design Criteria (lowest)	42	39	43	34	39	42	39	37

* *Derivation is background + 3 dB with the background level presented in brackets. These values should be confirmed at detailed design with a series of longer measurements to capture a greater dataset over a day and night time periods.*

The station fixed plant should be designed to be below the levels presented in Table 10.4-8. This is a cumulative design target to account for contribution from all fixed plant, and not individual plant targets. Assuming these levels are met (or are adjusted according to a greater dataset of background measurements), then impacts form fixed plant noise at stations would be **not significant.**

Mitigations

At this stage the location the required layout/plant and quantities for stations have yet to be confirmed however through intelligent design and plant choice, impacts from fixed plant at stations can be controlled.

The following considerations should be made where mitigation is required:

- sympathetic site layout (i.e. use of structures as barriers, increase plant separation distance from receptors)
- boundary barriers (consideration to the requirements of the height, density, and materials should be made at detailed design phase).
- low noise plant choice
- acoustic enclosures or locate plant internally
- locate flues/exhausts on alternate side to receptors

A quantitative assessment to be done at detailed design stage once more information surrounding the fixed plant is made available, along with a greater detail of background noise data. In terms of operational noise from fixed plant, the design targets have been provided reflective of current preliminary design information to ensure impacts are negligible.

10.4.1.8 Generation of traffic noise impact

Noise will be generated by the movement of vehicles being utilised for the activities listed below:

- transportation of equipment and materials by heavy goods vehicles (HGV)
- transportation of workers
- movement of construction and maintenance vehicles.

The predicted noise levels generated by construction traffic have been calculated for the existing local road network and the proposed access road that will run parallel to the track. Table 10.4-9 presents the predicted free-field hourly traffic noise levels for both road types. The potential impacts associated with traffic are explained below. However, it should be noted that from the baseline, it is assumed that noise along the existing roads (EN180) will not result in a significant impact assuming that receptors are at least 5 m away from the existing road network and the proposed access roads.

Table 10.4-9: Predicted noise from traffic

Number of truck movements per hour	Distance between road and receptor						
	5 m	10 m	25 m	50 m	100 m	150 m	200 m
	Corresponding LAeq,T, dB						
Local road network: 15 movements	66	63	59	56	53	51	50
Access road: 10 movements	64	61	57	54	51	49	48

Truck sound (Lw) = 108 dB(A)

Vehicle speed average (local network) = 24 km/h

Vehicle speed average (access road) = 24 km/h

Angle of view = 180 degrees

Preconstruction and construction

The heavy vehicles used for the transportation of equipment, materials and passengers along the EN180 can potentially emitted intermittent noise when signalling (i.e. hooting or noise from the construction vehicles carrying equipment/abnormal loads passing by at high speed). In addition, the project area has portions of poor/uneven/damaged roads along the EN180 that vehicles will travel over, generating increased noise pollution.

In accordance with BS 5228, the noise levels generated by construction traffic movements along new (access/haul roads) and existing roads will not result in a significant impact assuming that receptors are at least 5 m away from the existing local road network and the proposed access road.

It is recommended that a further construction phase traffic assessment is undertaken at once traffic numbers are better defined and roadside receptors have been identified.

Mitigations

- maintaining smooth surfaces for vehicle movements (irregular surfaces can create greater noise/vibration emissions)
- a programme of community liaison should be carried out, including notification of works and details of the complaints process
- where safe to do so, noise from reversing alarms will be controlled and limited as far as possible using physical barriers and bright warning lights for pedestrians

and construction workers in zones with numerous turning/reversing construction vehicles, to minimise intrusive sound of tonal alarms

Operation and maintenance

Not applicable. Scoped out of the assessment as it has been deemed insignificant.

10.4.1.9 Increase in vibrations from construction activities

Preconstruction and construction

The vibration emission levels generated through the construction phase have been calculated using empirical formulae, based on file data from RSK measurements of similar activities. However, this data should be reviewed and refined once specific construction methods, and locations are identified.

The source input for the vibration calculation exercise is summarised in the table below.

Table 10.4-10: Vibration Source Data (Construction Only)

Construction Phase	Activity	Input Data							Assumptions	Source of data
Earth works - alignment	Rock breaking and rock ripping	Distance from Activity (m)	PPV Vibration Level (mm/s) at Distance (m)						Excavator rock breaker or ripper	OEC Engineering approved assumption
			5	10	20	30	40	50		
Track works - alignment	Rock breaking and rock ripping	Heavy rock hammer (1.5 t)	4.5	3	1.5	0.4	0.35	0.3	Excavator rock breaker or ripper	OEC Engineering approved assumption
		Medium rock hammer (0.6 t)	0.2	0.06	0.02	0.01	-	-		

Rock breaking and ripping has the potential to occur along the alignment where rock obstructions cannot be removed using standard excavation methods. However, the location of such activity will not be defined until work commences. Therefore, the risk of impact is based on generic predictions for the activities and resultant offset distances.

The vibration resulting from rock breaking and ripping is presented in the table below.

Table 10.4-11: Rock Breaking and Ripping – Vibration Predictions

Magnitude[1]	Corresponding Vibration PPV, mms^{-1}	Distance from Activity, m	Significance
Negligible	<0.3	>35	Not significant
Low	0.3–1.00	25-35	Not significant
Medium	1.01–5.00	4–25	Significant
High	>5.00	<4	Significant

The predictions indicate that the project vibration limits may be exceeded where earthworks and track works construction are undertaken within close proximity (approximately 25 m) of sensitive receptors.

At distances above 35 m, people may still perceive vibration from rock breaking activities (based on the hammer weights identified in Table 10.4-10 above), however, levels will not be at a level to cause structural or cosmetic damage.

No account has been taken of any surface, buried utilities or services which may be sensitive to vibration. These will be identified through site specific surveys and assessment at the construction phase.

Given the likely distance between proposed works and existing receptor locations, it is considered that impacts from construction vibration would be **not significant** where receptors are more than 25 m from construction works.

Operation and maintenance

Continuous vibrations, which is likely to continue for many years throughout the project life cycle, can cause the deterioration of infrastructure overtime, particularly old infrastructure such as the ruins located along the ROW, the rural houses made of stone or clay. Although the train movement can cause structural damage, the proposed Project will have limited vibration impacts, as the magnitude of vibrations are dependent on different aspects, including train type, speed, tracks, foundation, rail joints and train conditions. In essence, the magnitude of vibration is influenced by the conditions and age of the train and its infrastructure. Therefore, given the newly design of the train, it will not have a significant vibrational impact.

10.4.1.10 Residual noise and vibration impacts

With the assumptions that are stated in the above assessment, residual impacts from the projects as a result of noise and vibration will be negligible. It is not anticipated that the detailed design will be significantly different to result in significant changes to the impacts. Should the monitoring results undertaken indicate continuous concerns/exceedances with respect to layouts, sensitive receptors and noise emission data points, a separate assessment is recommended during construction phase.

10.4.2 Air quality

In accordance with the IAQM construction dust guidance, the risk of dust and emissions affecting sensitive receptors in the area around the proposed development site was assessed, based on the 'area sensitivity' and the magnitude of emissions from each of the following types of construction activity:

- clearance of vegetation and preparation of the ground
- excavation of materials
- earthworks
- movement of materials
- operation of plant and vehicles over friable surfaces
- demolition from demobilisation (removal of redundant structures/features)
- trackout.

For each activity, the risk of site-derived dust and emissions affecting local sensitive receptors within the respective Project AoI, including residential properties, industrial and commercial buildings, is determined as either negligible, low, medium or high risk. The risk category may differ for each of the activities and depends on the potential emissions magnitude and the sensitivity of the area. The different types of impact considered are:

- the potential dust emission magnitudes for demolition, earthworks, construction and trackout activities, based on information provided by the client. Although there is no preconstruction demolition, demolition during demobilisation is considered in the assessment
- the operation of vehicles, plant and equipment powered by internal combustion engines results in the emission of exhaust gases containing pollutants including NO_x, PM_{10}, $PM_{2.5}$.

10.4.2.1 Increased fugitive dust emissions

Preconstruction and construction phase

Fugitive dust emissions may be caused during the construction phase by earthworks and preparation of the ground, excavation of materials, movement of materials and operation of plant and vehicles over friable surfaces.

A qualitative assessment of fugitive dust impacts was undertaken using the methodology suggested by the Institute of Air Quality Management (IAQM) in 'Guidance on the assessment of dust from demolition and construction' and information available from the project team on the construction phase of the proposed development.

Although the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' (EPUK-IAQM 2017 guidance) jointly published by Environmental Protection UK's (EPUK) and IAQM in 2017 aimed to support planning and development within the UK, this methodology is considered best practice. The assessment has been completed using professional judgment and the IAQM methodology has been adapted where necessary.

The IAQM guidance advises that construction impacts are only likely within 250 m of the boundary of the site. Therefore, receptors within 250 m of the construction works boundary may have the potential to be affected by fugitive dust emissions.

For each activity, the risk of site-derived dust and emissions affecting local sensitive receptors within the respective Project AoI, including residential properties, industrial and commercial buildings, is determined as either negligible, low, medium or high risk. The risk category may differ for each of the activities and depends on the potential emissions magnitude and the sensitivity of the area. Three different types of impact are considered:

- disamenity due to dust deposition and soiling
- the risk of health effects due to an increase in exposure to PM_{10}
- harm to ecological receptors.

The assessment is used to define the appropriate level of mitigation required. The following sections describe the construction dust assessment methodology in further detail.

Step 1: Screen the requirement for assessment

The first step is to screen out the requirement for a construction dust assessment; this is usually a somewhat conservative level of screening. An assessment is usually required where there is: a 'human receptor' within:

- 250 m of the boundary of the site, or
- 50 m of the route used by construction vehicles onto the public highway, up to 250 m from the site entrance(s).

Or an 'ecological receptor':

- 50 m of the boundary of the site, or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).

Step 2: Determine Potential Dust Emission Magnitudes

Demolition (during construction demobilisation)

The dust emission magnitude category for demolition is varied for each site in terms of timing, building type, duration and scale. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total building volume >75,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >12 m above ground level
- **Medium**: Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material, demolition activities 6 m – 12 m above ground level; and
- **Small**: Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <6 m above ground, demolition during wetter months.

Earthworks

The dust emission magnitude category for earthworks is varied for each site in terms of timing, geology, topography and duration. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total site area >110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6m in height
- **Medium**: Total site area 18,000 – 110,000 m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 3 – 6 m in height; and
- **Small**: Total site area < 18,000 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <3 m in height.

Construction

The dust emission magnitude category for construction is varied for each site in terms of timing, building type, duration, and scale. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: Total building volume >75,000 m^3, on site concrete batching, sandblasting
- **Medium**: Total building volume 12,000 – 75,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching; and
- **Small**: Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout

Factors which determine the dust emission magnitude class of track out activities are vehicle size, vehicle speed, vehicle number, geology and duration. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
- **Medium**: 20 – 50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100 m; and
- **Small**: <20 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.

<u>Step 2B: Defining the Sensitivity of the Surrounding Environment</u>

The sensitivity of the area is defined for dust soiling, human health, and ecosystems. The sensitivity of the area considers the following factors:

- the specific sensitivities of receptors in the area
- the proximity and number of those receptors
- in the case of PM_{10}, the local background concentration
- site-specific factors, such as whether here are natural shelters such as trees, to reduce the risk of wind-blown dust.

Table 10.4-12 was used to define the sensitivity of different types of receptors to dust soiling, health effects and ecological effects.

Table 10.4-12: Sensitivity of Individual receptors in the area surrounding the Site

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
High	Users can reasonably expect enjoyment of a high level of amenity. The appearance, aesthetics or value of their property would be diminished by soiling. The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Examples include dwellings, museums and other culturally important collections.	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day) Examples include residential properties, hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	Locations with an international or national designation and the designated features may be affected by dust soiling. Locations where there is a community of a particular dust sensitive species such as vascular species included in the Red Data List.

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
Medium	Users would expect to enjoy a reasonable level of amenity but would not reasonably expect to enjoy the same level of amenity as in their home. The appearance, aesthetics or value of their property could be diminished by soiling. The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples include parks and places of work.	Locations where the people exposed are workers and exposure are over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown. Locations with a national designation where the features may be affected by dust deposition. Example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
Low	The enjoyment of amenity would not reasonably be expected. Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling. There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths and roads.	Locations where human exposure is transient. Indicative examples include public footpaths, playing fields, parks and informal markets.	Locations with a local designation where the features may be affected by dust deposition. Example is a local Nature Reserve with dust sensitive features.

Based on the sensitivities assigned of the different types of receptors surrounding the site and numbers of receptors within certain distances of the site, a sensitivity classification for the area can be defined for each. Table 10.4-13, Table 10.4-14 and Table 10.4-15, indicate the method used to determine the sensitivity of the area for dust soiling, human health and ecological impacts, respectively.

Table 10.4-13: Sensitivity of the area to dust soiling effects on people and property.

Receptor Sensitivity	Number of Receptors	Distances from the Source (m)			
		<20	<50	<100	<250
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

For track out, as per the guidance, it is only considered necessary to consider track out impacts up to 50 m from the edge of the road.

Table 10.4-14: Sensitivity of the area to Human Health Impacts (IAQM construction dust guidance)

Receptor Sensitivity	Annual Mean PM_{10} Conc.	Number of Receptors	Distances from the Source (m)			
			<20	<50	<100	<250
High	>32µg/m³	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	28-32 µg/m³	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	24-28 µg/m³	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<24 µg/m³	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>32µg/m³	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	28-32 µg/m³	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} Conc.	Number of Receptors	Distances from the Source (m)			
			<20	<50	<100	<250
	24-28 μg/m³	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<24 μg/m³	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low

Table 10.4-15: Sensitivity of the area to Ecological Impacts

Receptor Sensitivity	Distances from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Step 2C: Assessing the risk of impacts

The final step is to use both the dust emission magnitude classification with the sensitivity of the area, to determine a potential risk of impacts for each construction activity, before the application of mitigation. Table 10.4-16, Table 10.4-17 and Table 10.4-18 present the matrices used to assign the level of risk for each construction activity.

Table 10.4-16: Risk of Dust Impacts from Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 10.4-17: Risk of Dust Impacts from Earthworks/Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 10.4-18: Risk of Dust Impacts from Track out

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

The potential dust emission magnitudes for demolition, earthworks, construction and trackout activities are summarised in Table 10.4-19, based on information provided by the client. Although there is no preconstruction demolition, demolition during demobilisation is considered in the assessment.

Table 10.4-19: Summary of Dust Emission Magnitudes (without Mitigation)

Activity	IAQM Criteria	Dust Emission Magnitude
Demolition	• Total volume of buildings to be demolished is estimated by the client to be 12,000-75,000 m2 • On-site crushing and screening is predicted to be proposed • Height of demolition activities above ground is estimated to be 6-12 m • Potential dusty demolition materials on-site are anticipated as existing infrastructure is assumed to be demolished • The demolitions works is assumed to take place all year round during wetter and drier seasons	Large
Earthworks	• Total area where earthworks will take place is estimated by the client to be >110,000 m2 • Soil type of the site is assumed to be sand • The number of heavy earthmoving vehicles is estimated to be >10 during peak of earthworks • Height of stockpiled materials is predicted to be >6 m • Total materials moved is estimated to be >100,000 tonnes	Large
Construction	• Total volume of buildings to be built is estimated to be >75,000 m³ • On-site concrete batching is predicted to be proposed • On-site concrete sandblasting is predicted to be present • Potential dusty construction materials on-site	Large
Trackout	• The maximum number of heavy-duty vehicle (HDV) outward a movement in any one day is anticipated to be 20-50 • Surface type of the site is assumed to be dusty surface material (e.g. high clay content) • Extent of unpaved road length within site is estimated to be >100 m	Large

The IAQM construction dust guidance indicates that the 'area sensitivity' can be determined based on the following factors:

- the sensitivity of individual receptors in the area

- the proximity and number of those receptors
- in the case of PM_{10}, the local background concentration
- site specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust

Dust sensitive receptors for demolition/earthworks/construction activities were identified within the boundary of and surrounding the proposed development site following the guidance published by IAQM. It is observed less than 1-10 'high' sensitivity receptors are surrounding site boundary (<20 m). The sensitivity of the area to dust soiling, human health and ecological impacts is summarised in Table 10.4-20.

No designations or protected areas, such as Ramsar sites, National Nature Reserves or Local Nature Reserves are identified within 50m of the site boundary or potential track out routes. Impacts of ecological receptors are therefore not considered applicable and have not been considered further.

As track out dust emission magnitude has been determined as Large, a 250 m trackout route has been considered. Dust sensitive receptors for trackout activities were identified within the boundary of and surrounding each railway station following the guidance published by IAQM. It is observed more than 1 'medium' sensitivity receptors are surrounding the trackout route (<20 m) of each railway station. The sensitivity of the area to dust soiling, human health and ecological impacts is summarised in Table 10.4-20.

Background PM_{10} concentrations for the proposed development site are fairly limited and vary vastly due to different study locations. Therefore, the annual mean PM_{10} concentrations are based on the short-term baseline monitoring programme summarised in Chapter 8. It is assumed that the locations would have the potential to exceed 32 ug/m^3 for a conservative approach on determining the potential construction phase impacts.

Table 10.4-20: Summary of the Sensitivity of the Area to Dust Soiling and Human Health

Potential Impact		Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout Station 1, 2, 3, 4, 5, 6, 7, 8
Dust soiling	Receptor sensitivity	High	High	High	Medium
	Number of receptors	1-10	1-10	1-10	>1
	Distance from the source	<20 m	<20 m	<20 m	<20 m
	Overall Sensitivity of the Area	Medium	Medium	Medium	Medium
Human health	Receptor sensitivity	High	High	High	Medium
	Annual mean PM_{10} concentration	>32 ug/m^3	>32 ug/m^3	>32 ug/m^3	>32 ug/m^3
	Number of receptors	1-10	1-10	1-10	1-10

Potential Impact		Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout Station 1, 2, 3, 4, 5, 6, 7, 8
	Distance from the source	<20 m	<20 m	<20 m	<20 m
	Overall Sensitivity of the Area	High	High	High	Medium

Combining the dust emissions magnitude and the sensitivity of the surroundings, the overall dust risks associated with the construction project were assessed and are summarised in the below Table 10.4-21.

Table 10.4-21: Summary of the Dust Risk from all Construction Activities

Potential Impact	Dust Risk Impact			
	Demolition	Earthworks	Construction	Trackout Station 1, 2, 3, 4, 5, 6, 7, 8
Dust soiling	High Risk	Medium Risk	Medium Risk	Medium Risk
Human health	High Risk	High Risk	High Risk	Medium Risk

The fugitive dust emissions from construction activities could be greatly reduced or eliminated by the implementation of appropriate dust control measures, such as applying water suppression during demolition operations, only removing the cover in small areas during work and not at once, storing sand and other aggregates in bunded areas, and avoiding any dry sweeping of large areas. For the details of mitigation measures, please refer to section below.

In addition, the impact magnitude for construction stage fugitive dust is likely to be localised and within 250 m of the boundary, and short term, limited to the period of construction activities near receptors, and therefore with the implementation of mitigation measures outlined overleaf, it would be reasonable to determine a ‘low’ magnitude, however impacts may be felt by receptors at a local level, though these should be readily controllable by mitigation, therefore a conservative magnitude descriptor of ‘minor’ was assigned.

A good standard of amenity and air quality should be expected at residential properties and this is considered important locally. Recovery would be expected to be relatively swift following completion of construction; therefore a ‘medium’ sensitivity was assigned for all receptors, leading to an impact significance of ‘Minor negative impact’.

Table 10.4-22: Impact significance matrix

Receptor	Distance	Magnitude	Receptor sensitivity	Impact significance
Residential/Commercial/ Industrial/Agricultural parcels	within 250 m of site boundary	Minor	Medium	Minor Negative Impact

In addition to the factors discussed above, when considering unplanned events, the likelihood of an event occurring also requires consideration. Failures in mitigation may occur from time to time leading to brief episodes of uncontrolled fugitive dust, therefore an 'occasional' likelihood was assumed, leading to a 'Minor' impact estimate, as shown in Table 10.4-23, below.

Table 10.4-23: Environmental risk estimation

Receptor	Impact significance	Likelihood	Impact Estimation
Residential/Commercial/ Industrial/Agricultural parcels	Minor	Occasional	Minor

Mitigation measures

Evidence and experience show that fugitive dust emissions from construction activities can be effectively controlled by appropriate dust control measures and any adverse effects can be greatly reduced or eliminated.

The IAQM 2024 guidance divides site-specific mitigation measures are divided into general measures applicable to all sites, and measures specific to demolition, earthworks, construction and trackout. Depending on the level of risk assigned in relation to each type of construction activity, different mitigation is assigned. The method for assigning mitigation measures as detailed in the IAQM guidance has been used. For those 'general' mitigation measures, the greatest risk category assigned to the assessed construction activities should be applied. Therefore, in this case, the 'high risk' 'general' site mitigation measures have been recommended.

Communications

- develop and implement a stakeholder communications plan that includes community engagement before work commences on site
- display the name and contact details of people accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager
- display the head or regional office contact information.

Dust Management

- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly

recommended measures. The desirable measures should be included as appropriate for the site. Visual monitoring is to be carried out and documented, with consideration to be given to quantitative monitoring in particularly sensitive locations only (e.g. high-density residential areas very close to construction sites, hospitals, schools etc.) or where complaints are received.

Luena-Saurimo railway will be 260 km long, so it will clearly not be reasonable or proportionate to carry out continuous PM_{10} monitoring along the entire length for the entire construction corridor. The ESIA Report (Air quality impacts significance) shows that the 'dust impact risk' was assessed as 'Medium' for dust disamenity during earthworks, construction and trackout at stations (no demolition is proposed for the 'construction phase') and 'high' for human health relevant PM_{10} during earthworks and construction, but in reality this is mainly because of the size of the project, rather than suggesting a 'medium' or 'high' impact risk at any one individual receptor.

Therefore, based on our experience of similar linear projects, the C-ESMP or Dust Management Plan should specify, as a minimum, visual monitoring to be carried out and documented, with consideration being given to quantitative monitoring in particularly sensitive locations only.

Site Management

- record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken
- make the complaints log available to the local authority when asked
- record any exceptional incidents that cause dust and/or air emissions, either on- or off-site or the action taken to resolve the situation in the logbook
- where feasible, hold regular liaison meetings with other high risk construction sites within 250 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.

Monitoring

- undertake regular on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available on request. This should include regular dust accumulation checks of surfaces such as street furniture, cars, and windowsills within 100 m of site boundary. If project related dust accumulation is confirmed, appropriate with cleaning to be provided
- carry out regular site inspections to monitor compliance with any dust management plan, record inspection results, and make an inspection log available to the local authority when asked
- increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions
- consider dust deposition, dust flux, or real-time PM_{10} continuous monitoring in particularly sensitive areas, or high 'dust risk' activities.

Preparing and maintaining the site

- plan site layout so that machinery and dust causing activities are located away from receptors as far as possible
- erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
- fully enclose site specific operations where there is a high potential for dust production and the site is active for an extensive period
- avoid site runoff of water or mud
- keep site fencing, barriers and scaffolding clean using wet methods
- remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below
- cover seed or fence stockpiles to prevent wind whipping.

Waste Management

- avoid bonfires or burning of waste materials

Measures Specific to Demolition (other impacts mentioned that no demolition will be undertaken)

- soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust)
- ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground
- avoid explosive blasting, using appropriate manual or mechanical alternatives
- bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Earthworks

- re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable
- use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable
- only remove the cover in small areas during work and not all at once.

Measures Specific to Construction

- avoid scabbling (roughening of concrete surfaces) if possible
- ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place
- ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery

- for smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures Specific to Trackout

- use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use
- avoid any dry sweeping of large areas
- ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport
- inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable
- record all inspections of haul routes and any subsequent action in a site log book
- install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- ensure there is an adequate area of hard surface road between the wheel wash facility and the site exit, wherever site size and layout permits.
- access gates to be located at least 10 m from receptors where possible.

Operation and maintenance phase

During the operational phase, impacts are likely to be exhaust emissions from diesel locomotives proposed for this railway project discussed below

10.4.2.2 Increased exhaust emissions

Preconstruction and construction phase

The number of plant items operating at any one worksite is likely to be small, fewer than 30 in all probability, and their presence temporary, working in phases. Their exhaust emissions are unlikely to result in a significant impact on air quality, therefore dispersion modelling is considered unnecessary and should not be required. The number of project light duty vehicles travelling any one road per day is likely to be assumed <500 and the number of heavy goods vehicles (HGVs) travelling on any one road per day is likely to be <100, therefore exhaust emissions are unlikely to result in a significant impact on air quality during the construction stage.

Operation and maintenance phase

Based on information available, 2 diesel locomotives (model GE C30ACi) are proposed for each train and there is maximum four trips per day between Luena and Saurimo, 2 passenger trains and 2 cargo trains per day. Considering the train schedule and frequency, the exhaust emissions from the moving diesel locomotives is anticipated to be negligible. Therefore, impacts from the moving diesel locomotives are not assessed further. Only the impacts from the stationary locomotives are assessed in this report.

During the operation of the railway project, it is assumed that trains generally run between 6am and 7pm every day and will be regularly stationary at each station for a period of 15

minutes. No night time operations are expected. Two diesel locomotives proposed are expected to be located at the front of the train, with approximate 17 m between each locomotive. Therefore, the stationary diesel locomotives are likely to give rise high short-term NO_2 concentrations near railway stations. A quantitative point source modelling assessment has been carried out.

10.4.2.3 Sources of railway emissions

Railway emissions have been calculated for the proposed diesel locomotives for trains that are expected to be in service in the future. The emissions and gross horsepower of the locomotives have been sourced from GE Transportation locomotive product catalogue. The emissions of the locomotives meet the International Union of Railways (UIC) standards, UIC II. The locomotive emission rates have been calculated and presented in Table 10.4-24.

Table 10.4-24: Locomotive emission rates for NOx, PM and CO

Locomotive Model	Gross Horsepower (HP)	Gross Horsepower (kW)	Pollutant	Exhaust Emission Limit Values from UIC II (g/kWh)	Emission Rate (g/s)
GE C30ACi	3300	2461	NOx*	9.9	6.77
			PM	0.25	0.17
			CO	3	2.05

Note*: A worst case scenario of the revolutions per minute (rpm) (n>1000) is assumed for a conservative approach.

Modelling software

The impact of the exhaust emissions from the stationary diesel locomotives was quantified using the atmospheric dispersion model ADMS 6 (version 6.0.0.1). This model uses detailed information regarding the pollutant releases, local building effects and local meteorological conditions, to predict pollutant concentrations at specific locations selected by the user and is approved by the EA for regulatory applications.

Model Parameters

Based on the information available, a single-track railway is proposed for this project so only 1 train is expected to be moving on the railway track all the time. As there are maximum 4 trains per day, it is assumed that 2 trains are operating in each direction, running from Luena towards Saurimo (Northbound) and running from Saurimo towards Luena (Southbound). The following two scenarios for the emissions from the stationary diesel locomotive have been considered in this assessment:

- trains operating from Luena towards Saurimo (Northbound)
- trains operating from Saurimo towards Luena (Southbound).

For a conservative assessment, the potential long-term air quality impacts from the stationary diesel locomotives are anticipated to be combination of both modelled scenarios, northbound and southbound trains, while the potential short-term air quality impacts are predicted to be the maximum value of both modelled scenarios.

The locations of point sources for the two modelled scenarios are outlined in Table 10.4-25 below. The summary of model inputs is presented in Table 10.4-26.

Table 10.4-25: Locations of Point Sources

Scenario	Source ID	Station	Grid Reference (WGS 84 UTM Zone 34S)	
			X	Y
Northbound Trains	N1-1	1	387135	8701129
	N1-2	1	387121	8701118
	N2-1	2	393917	8722699
	N2-2	2	393905	8722687
	N3-1	3	410607	8736821
	N3-2	3	410610	8736804
	N4-1	4	413188	8778402
	N4-2	4	413190	8778384
	N5-1	5	415931	8811514
	N5-2	5	415938	8811498
	N6-1	6	418352	8868614
	N6-2	6	418349	8868597
	N7-1	7	430062	8902818
	N7-2	7	430059	8902801
	N8-1	8	445799	8929733
	N8-2	8	445792	8929718
Southbound Trains	S1-1	1	386692	8700786
	S1-2	1	386706	8700796
	S2-1	2	393524	8722300
	S2-2	2	393537	8722312
	S3-1	3	410728	8736274
	S3-2	3	410724	8736291
	S4-1	4	413260	8777846
	S4-2	4	413258	8777863
	S5-1	5	416154	8811000
	S5-2	5	416147	8811016
	S6-1	6	418225	8868069
	S6-2	6	418229	8868085
	S7-1	7	429944	8902271
	S7-2	7	429948	8902288
	S8-1	8	445545	8929234

Scenario	Source ID	Station	Grid Reference (WGS 84 UTM Zone 34S)	
			X	Y
	S8-2	8	445552	8929249

Table 10.4-26: Summary of Model Inputs

Parameters	Input into Model
Point Source	Northbound Trains N1-1, N1-2, N2-1, N2-2, N3-1, N3-2, N4-1, N4-2, N5-1, N5-2, N6-1, N6-2, N7-1, N7-2, N8-1, N8-2 Southbound Trains S1-1, S1-2, S2-1, S2-2, S3-1, S3-2, S4-1, S4-2, S5-1, S5-2, S6-1, S6-2, S7-1, S7-2, S8-1, S8-2
Number of Engines in Operation	1
Operation Hours per day	06:00 – 19:00
Height (m)	4
Diameter (m)*	0.5
Velocity (m/s) *	11
Temperature (°C)*	150
NOx Emission Rate (g/s)	6.77
PM_{10} Emission Rate (g/s)#	0.17
CO Emission Rate g/s)	2.05

*The emission characteristics of locomotives were not available. Therefore, the emission velocity was estimated with reference to the similar velocity of high-speed fan. The temperature and diameter were estimated with reference to the similar parameters of diesel generators.
#All the particulate matters released to the ambient air are assumed to be in the form of PM_{10}. The emission rate of PM_{10} is calculated based on the exhaust emission limit value of PM.

Buildings

No buildings were included in the model since the emissions are represented by point sources.

Meteorological Data

2023 hourly sequential meteorological data from the Luena meteorological station was employed in the dispersion model. This meteorological station is considered to be representative of the development site condition. The windrose derived from the 2023 dataset is presented in

Figure 10.4-1. The predominant wind direction was from the southeast.

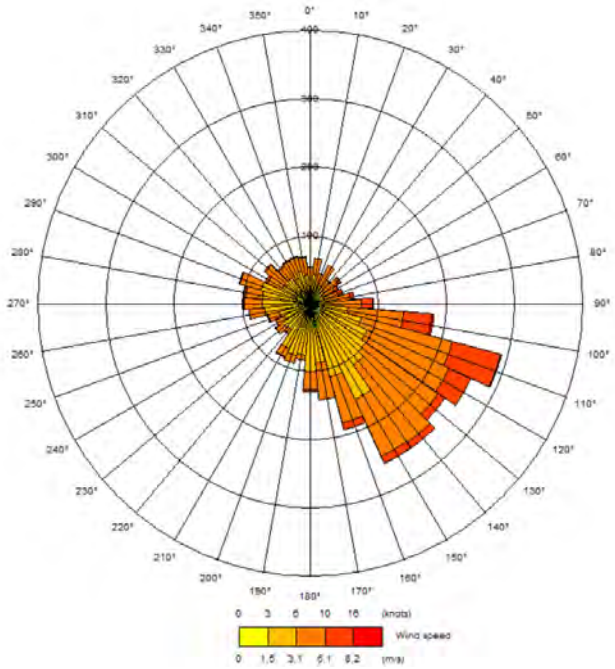


Figure 10.4-1: Windrose from the Luena Meteorological Station in 2023

Surface Roughness Length

A surface roughness length of 0.3 m was used in the dispersion modelling study for the dispersion site and meteorological station. The value is considered appropriate for the morphology of the assessment area and the meteorological station and is suggested within ADMS 6 as being suitable for ‘agricultural areas (max)’.

Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30 m was used in the dispersion modelling for the study area and 10 m was used for the meteorological station.

Sensitive Receptor Locations

The Project AoI during the operation phase is defined as the area with human receptors along the railway included in the study at location where the greatest changes in the railway emissions from the proposed diesel locomotives were predicted due to the operation phase.

Pollutant concentrations were predicted at a number of existing and proposed sensitive receptor locations within its respective AoI. A height of 1.5 m was used for human receptors to present the approximate average breathing height of an adult. Details of all specific receptors included in the modelling study are summarised in Table 10.4-27.

Table 10.4-27: Receptors Included in the Dispersion Modelling Assessment

Receptor ID	Receptor Location	Grid Reference (WGS 84 UTM Zone 34S)		Height (m)
		X	Y	
Existing Sensitive Receptors				
ER1-1*	Existing Receptor, near Station 1	387085	8701026	1.5
ER1-2*	Existing Receptor, near Station 1	386404	8700758	1.5
ER1-3	Existing Residential Receptor, near Station 1	387242	8701140	1.5
ER2-1	Existing Residential Receptor, near Station 2	392823	8722731	1.5
ER2-2	Existing Residential Receptor, near Station 2	393323	8723102	1.5
ER2-3	Existing Residential Receptor, near Station 2	393981	8723605	1.5
ER3-1	Existing Residential Receptor, near Station 3	410495	8736126	1.5
ER3-2	Existing Residential Receptor, near Station 3	410039	8736521	1.5
ER4-1	Existing Residential Receptor, near Station 4	412721	8778389	1.5
ER4-2	Existing Residential Receptor, near Station 4	412790	8778750	1.5
ER5-1	Existing Residential Receptor, near Station 5	416293	8810023	1.5
ER6-1	Existing Residential Receptor, near Station 6	417779	8867448	1.5
ER7-1	Existing Residential Receptor, near Station 7	429794	8902551	1.5
ER7-2	Existing Residential Receptor, near Station 7	429836	8902761	1.5
ER7-3	Existing Residential Receptor, near Station 7	429687	8902380	1.5
ER8-1	Existing Residential Receptor, near Station 8	443512	8930428	1.5
ER8-2	Existing Residential Receptor, near Station 8	445217	8927811	1.5
Proposed Sensitive Receptors				

Receptor ID	Receptor Location	Grid Reference (WGS 84 UTM Zone 34S)		Height (m)
		X	Y	
PR1-1*	Proposed Receptor – Station 1	387372	8700663	1.5
PR2-1*	Proposed Receptor – Station 2	394101	8722156	1.5
PR3-1*	Proposed Receptor – Station 3	411169	8736657	1.5
PR4-1*	Proposed Receptor – Station 4	413714	8778209	1.5
PR5-1*	Proposed Receptor – Station 5	416517	8811453	1.5
PR6-1*	Proposed Receptor – Station 6	418803	8868219	1.5
PR7-1*	Proposed Receptor – Station 7	430500	8902428	1.5
PR8-1*	Proposed Receptor – Station 8	446157	8929260	1.5
*Commercial/industrial receptors where annual mean NO_2 and PM_{10} AAQSs do not apply.				

Uncertainties and assumptions

The following uncertainties and assumptions have been made in the air quality assessment:

- there will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that meteorological conditions measured at the Luena meteorological station in 2023 was representative of the meteorological conditions at the site
- there is an element of uncertainty in all measured and modelled data. All values presented in this report are considered reasonable estimates. Where estimations in emissions are made, these are overestimated and hence the impacts on local air quality reported are considered to be conservative in nature
- where information is not yet known, a conservative approach has been adopted and professional judgement has been used based on the scale of the proposed development and experience of working on similar schemes. Furthermore, conservative rating has been selected
- in the absence of measured long-term NO_2, PM_{10} and CO at the proposed development location, pollutant concentrations of the process contribution were assessed only in the assessment
- a conversion factor of 0.7 has been applied for estimating the concentrations of annual average NO_2 from NO_x, and a conversion factor of 0.35 has been applied for estimating the concentrations of 1-hour average NO_2 from NO_x
- since trains are assumed to be stationary at each station for a period of 15 minutes, instant peak mean NO_2 concentration is considered in the assessment.
- the pollutant concentrations in 24-hour average would be a very conservative approach as it is assumed that the trains would be stationary at each station for a period of 15 minutes. For modelling purposes, when calculating the 24-hour average of the pollutant concentrations, it is assumed that the locomotive is operating continuously between 06:00 and 19:00; and
- when calculating the annual average of the pollutant concentrations for each modelling scenario (northbound trains and southbound trains), a factor of 0.038 has been applied to avoid overestimating the annual average. It is assumed that 2 trains will operate daily between 06:00 and 19:00 in each direction, running from Luena towards Saurimo (Northbound) and running from Saurimo towards Luena (Southbound), with each train stationary at each station for 15 minutes, so

the total daily stationary time at each station for each modelling scenario is 30 minutes. The factor of 0.038 is derived by calculating the percentage of total daily stationary time at each station from the daily operating hours (13 hours).

10.4.2.4 Railway Emission Dispersion Modelling Results

Nitrogen Dioxide (NO_2)

The ambient air quality standards (AAQS) for annual and instant peak (i.e. 15-minute) mean NO_2 concentrations are 10µg/m^3 and 940µg/m^3 respectively. The results of the assessment show that the concentrations of the process contribution are predicted to be below the annual mean and instant peak mean NO_2 objectives at all assessment receptors.

Table 10.4-28 shows the annual mean NO_2 concentrations of both modelling scenarios, Northbound Trains and Southbound Trains, at sensitive receptor locations and the combination of annual mean NO_2 concentrations of both scenarios at sensitive receptor locations. The results as percentages of the AAQS are also presented.

Table 10.4-29 shows the instant peak mean NO_2 concentrations of both modelling scenarios at sensitive receptor locations and the maximum value of the instant peak mean NO_2 concentrations of both modelling scenarios at sensitive receptor locations. The results as percentages of the AAQS are also presented.

The results indicate that no exceedances of the annual and instant peak mean NO_2 concentration AAQS are predicted at any of the assessed or proposed receptors within the development site. The effect of the proposed development on NO_2 concentrations, prior to mitigation, is therefore considered to be not significant.

Table 10.4-28: Predicted Annual Mean NO_2 Concentrations

Receptor ID	Annual Mean NO_2 Concentration (µg/m^3)			NO_2 Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER1-1*	1.86	0.09	1.95	20%
ER1-2*	0.07	0.78	0.85	8%
ER1-3	1.27	0.05	1.32	13%
ER2-1	0.11	0.31	0.42	4%
ER2-2	0.38	0.12	0.50	5%
ER2-3	0.06	0.03	0.09	1%
ER3-1	0.08	0.41	0.49	5%
ER3-2	0.10	0.40	0.50	5%
ER4-1	0.44	0.27	0.72	7%
ER4-2	0.53	0.12	0.65	7%

Receptor ID	Annual Mean NO_2 Concentration (µg/m³)			NO_2 Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER5-1	0.02	0.04	0.06	1%
ER6-1	0.02	0.06	0.08	1%
ER7-1	0.24	0.72	0.95	10%
ER7-2	0.97	0.24	1.20	12%
ER7-3	0.11	2.00	2.11	21%
ER8-1	0.05	0.05	0.10	1%
ER8-2	0.01	0.02	0.03	0%
PR1-1	0.14	0.08	0.22	2%
PR2-1	0.11	0.11	0.22	2%
PR3-1	0.11	0.07	0.18	2%
PR4-1	0.12	0.06	0.19	2%
PR5-1	0.10	0.09	0.19	2%
PR6-1	0.10	0.08	0.18	2%
PR7-1	0.11	0.09	0.19	2%
PR8-1	0.11	0.09	0.20	2%
AAQS		10 µg/m³		

*Commercial/ industry receptors where annual mean NO_2 AAQS does not apply. To adopt a conservative approach, this assessment also includes annual mean results for commercial/ industry receptors
#For a conservative assessment, the annual mean NO_2 concentrations of process contribution are the combination of both modelled scenarios, northbound and southbound trains.

Table 10.4-29: Predicted Instant Peak Mean NO_2 Concentrations

Receptor ID	Instant Peak Mean NO_2 Concentration (µg/m³)			NO_2 Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER1-1	753.79	171.02	753.79	80%
ER1-2	165.43	309.32	309.32	33%
ER1-3	753.35	177.26	753.35	80%
ER2-1	174.83	215.21	215.21	23%
ER2-2	246.40	227.00	246.40	26%

Receptor ID	Instant Peak Mean NO_2 Concentration (µg/m³)			NO_2 Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER2-3	199.21	143.10	199.21	21%
ER3-1	195.51	229.54	229.54	24%
ER3-2	211.45	253.21	253.21	27%
ER4-1	278.15	235.43	278.15	30%
ER4-2	309.34	191.23	309.34	33%
ER5-1	75.38	98.34	98.34	10%
ER6-1	89.57	102.71	102.71	11%
ER7-1	198.06	327.71	327.71	35%
ER7-2	373.63	331.78	373.63	40%
ER7-3	196.09	342.53	342.53	36%
ER8-1	69.32	71.82	71.82	8%
ER8-2	89.29	97.92	97.92	10%
PR1-1	216.79	222.04	222.04	24%
PR2-1	196.75	201.11	201.11	21%
PR3-1	182.69	231.98	231.98	25%
PR4-1	231.07	285.06	285.06	30%
PR5-1	141.24	232.95	232.95	25%
PR6-1	265.58	177.10	265.58	28%
PR7-1	280.90	196.80	280.90	30%
PR8-1	120.34	160.75	160.75	17%
AAQS		940 µg/m³		
#For a conservative assessment, the instant peak mean NO_2 concentrations of process contribution are the maximum value of both modelled scenarios, northbound and southbound trains.				

Particulate Matter (PM)

The AAQS for annual and 24-hour mean PM_{10} concentrations are 20 µg/m³ and 50 µg/m³ respectively. The results of the assessment show that the concentrations of the process contribution are predicted to be well below the annual mean and 24-hour mean PM_{10} objectives at all assessment receptors.

Table 10.4-30 shows the annual mean PM_{10} concentrations of both modelling scenarios, Northbound Trains and Southbound Trains, at sensitive receptor locations and the

maximum value of annual mean PM_{10} concentrations of both scenarios at sensitive receptor locations. The results as percentages of the AAQS are also presented.

Table 10.4-31 shows the 24-hour mean PM_{10} concentrations of both modelling scenarios at sensitive receptor locations and the maximum value of the 24-hour mean PM_{10} concentrations of both modelling scenarios at sensitive receptor locations. The results as percentages of the AAQS are also presented.

The results indicate that no exceedances of the annual and 24-hour mean PM_{10} concentration AAQS are predicted at any of the assessed or proposed receptors within the development site. The effect of the proposed development on PM_{10} concentrations, prior to mitigation, is therefore considered to be not significant.

The AAQS for annual and 24-hour mean $PM_{2.5}$ concentrations are 25 µg/m^3 and 50 µg/m^3 respectively. If all the particulate matters generated from the stationary locomotives are released to the ambient air in the form of $PM_{2.5}$, the results also show that the concentrations of the process contribution are predicted to be well below the annual mean and 24-hour mean $PM_{2.5}$ objectives at all assessment receptors. The effect of the proposed development on $PM_{2.5}$ concentrations, prior to mitigation, is therefore considered to be not significant.

Table 10.4-30: Predicted Annual Mean PM_{10} Concentrations

Receptor ID	Annual Mean PM_{10} Concentration (µg/m^3)			PM_{10} Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER1-1*	0.07	<0.01	0.07	0%
ER1-2*	<0.01	0.03	0.03	0%
ER1-3	0.05	<0.01	0.05	0%
ER2-1	<0.01	0.01	0.02	0%
ER2-2	0.01	<0.01	0.02	0%
ER2-3	<0.01	<0.01	<0.01	0%
ER3-1	<0.01	0.01	0.02	0%
ER3-2	<0.01	0.01	0.02	0%
ER4-1	0.02	0.01	0.03	0%
ER4-2	0.02	<0.01	0.02	0%
ER5-1	<0.01	<0.01	<0.01	0%
ER6-1	<0.01	<0.01	<0.01	0%
ER7-1	0.01	0.03	0.03	0%
ER7-2	0.03	0.01	0.04	0%
ER7-3	<0.01	0.07	0.08	0%

Receptor ID	Annual Mean PM_{10} Concentration (µg/m³)			PM_{10} Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER8-1	<0.01	<0.01	<0.01	0%
ER8-2	<0.01	<0.01	<0.01	0%
PR1-1	<0.01	<0.01	0.01	0%
PR2-1	<0.01	<0.01	0.01	0%
PR3-1	<0.01	<0.01	0.01	0%
PR4-1	<0.01	<0.01	0.01	0%
PR5-1	<0.01	<0.01	0.01	0%
PR6-1	<0.01	<0.01	0.01	0%
PR7-1	<0.01	<0.01	0.01	0%
PR8-1	<0.01	<0.01	0.01	0%
AAQS			20 µg/m³	

*Commercial/ industry receptors where annual mean PM_{10} AAQS does not apply. To adopt a conservative approach, this assessment also includes annual mean results for commercial/ industry receptors
#For a conservative assessment, the annual mean PM_{10} concentrations of process contribution are the combination of both modelled scenarios, northbound and southbound trains.

Table 10.4-31: Predicted 24-hour Mean PM_{10} Concentrations

Receptor ID	24-hour Mean PM_{10} Concentration (µg/m³)			PM_{10} Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER1-1	4.65	0.29	4.65	9%
ER1-2	0.18	2.18	2.18	4%
ER1-3	12.31	0.24	12.31	25%
ER2-1	0.64	0.88	0.88	2%
ER2-2	0.94	0.89	0.94	2%
ER2-3	0.33	0.11	0.33	1%
ER3-1	0.03	1.64	1.64	3%
ER3-2	0.29	1.40	1.40	3%
ER4-1	1.77	0.99	1.77	4%
ER4-2	1.62	0.69	1.62	3%

Receptor ID	24-hour Mean PM_{10} Concentration (µg/m³)			PM_{10} Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER5-1	0.10	0.04	0.10	0%
ER6-1	0.04	0.20	0.20	0%
ER7-1	0.96	2.20	2.20	4%
ER7-2	2.15	1.58	2.15	4%
ER7-3	0.40	4.69	4.69	9%
ER8-1	0.24	0.18	0.24	0%
ER8-2	0.01	0.01	0.01	0%
PR1-1	0.70	0.98	0.98	2%
PR2-1	0.64	1.29	1.29	3%
PR3-1	1.32	0.73	1.32	3%
PR4-1	1.40	0.58	1.40	3%
PR5-1	1.25	1.11	1.25	3%
PR6-1	0.57	0.55	0.57	1%
PR7-1	0.57	0.60	0.60	1%
PR8-1	0.28	0.96	0.96	2%
AAQS		50 µg/m³		
#For a conservative assessment, the 24-hour mean PM_{10} concentrations of process contribution are the maximum value of both modelled scenarios, northbound and southbound trains.				

Carbon Monoxide (CO)

The AAQS for 24-hour mean CO concentrations is 4 mg/m³. The results of the assessment show that the concentrations of the process contribution are predicted to be well below the 24-hour mean CO objective at all assessment receptors.

Table 10.4-32 shows the 24-hour mean CO concentrations of both modelling scenarios at sensitive receptor locations and the maximum value of the 24-hour mean CO concentrations of both modelling scenarios at sensitive receptor locations. The results as percentages of the AAQS are also presented.

The results indicate that no exceedances of the 24-hour mean CO concentration AAQS are predicted at any of the assessed or proposed receptors within the development site. The effect of the proposed development on CO concentrations, prior to mitigation, is therefore considered to be not significant.

Table 10.4-32: Predicted 24-hour Mean CO Concentrations

Receptor ID	24-hour Mean CO Concentration (mg/m^3)			CO Concentration of Process Contribution as % of AAQS
	Northbound Trains Scenario	Southbound Trains Scenario	Process Contribution#	
ER1-1	0.06	<0.01	0.06	1%
ER1-2	<0.01	0.03	0.03	1%
ER1-3	0.15	<0.01	0.15	4%
ER2-1	0.01	0.01	0.01	0%
ER2-2	0.01	0.01	0.01	0%
ER2-3	<0.01	<0.01	<0.01	0%
ER3-1	<0.01	0.02	0.02	0%
ER3-2	<0.01	0.02	0.02	0%
ER4-1	0.02	0.01	0.02	1%
ER4-2	0.02	0.01	0.02	0%
ER5-1	<0.01	<0.01	<0.01	0%
ER6-1	<0.01	<0.01	<0.01	0%
ER7-1	0.01	0.03	0.03	1%
ER7-2	0.03	0.02	0.03	1%
ER7-3	<0.01	0.06	0.06	1%
ER8-1	<0.01	<0.01	<0.01	0%
ER8-2	<0.01	<0.01	<0.01	0%
PR1-1	0.01	0.01	0.01	0%
PR2-1	0.01	0.02	0.02	0%
PR3-1	0.02	0.01	0.02	0%
PR4-1	0.02	0.01	0.02	0%
PR5-1	0.02	0.01	0.02	0%
PR6-1	0.01	0.01	0.01	0%
PR7-1	0.01	0.01	0.01	0%
PR8-1	<0.01	0.01	0.01	0%
AAQS		4 mg/m^3		

#For a conservative assessment, the 24-hour mean CO concentrations of process contribution are the maximum value of both modelled scenarios, northbound and southbound trains.

With reference to the project methodology criteria, the overall magnitude of impact and sensitivity of receptor were used to assess the likely significance of any impacts, as shown in Table 10.4-33.

The impact magnitude for operation phase railway emission is likely to be limited to the period of stationary locomotives at the station. Since no exceedances of NO2, PM10 and CO AAQS are predicted at all assessment receptors, a conservative magnitude descriptor of 'minor' was assigned for short-term impact and a conservative magnitude descriptor of 'Slight' was assigned for long-term impact. A 'medium' sensitivity was assigned for all receptors, leading to an impact significance of 'Minor negative impact'.

Table 10.4-33: Impact significance matrix

Receptor	Impact Duration	Magnitude	Receptor sensitivity	Impact significance
Residential/Commercial/ Industrial	Short-term	Minor	Medium	Minor Negative Impact
Residential/Commercial/ Industrial	Long-term	Slight	Medium	Minor Negative Impact

Considering the proposed train schedule of a maximum of 4 trains per day, an 'unlikely' likelihood was assumed, leading to a 'Minor' impact estimate, as shown in Table 10.4-34, below.

Table 10.4-34: Environmental risk estimation

Receptor	Impact Duration	Impact significance	Likelihood	Impact Estimation
Residential/Commercial/ Industrial	Short-term	Minor	Unlikely	Minor
Residential/Commercial/ Industrial	Long-term	Minor	Unlikely	Minor

Mitigation measures

Based on the assessment results and the impacts are expected to be limited to a very short period (i.e. 15-minute), no significant operational phase impacts on local air quality are anticipated. Ambient air quality is not expected to have significant adverse effects on future site users. Therefore, the impact of the operational phase of the proposed development on local air quality is considered to be negligible and no specific mitigation measures will be required for the operational phase.

10.4.2.5 Assessment of residual impacts

For construction phase, it is assumed that the impact after implement of mitigation measures will be negligible. For operation phase, it is assumed that the impact will be negligible. As a result, there will be no residual impact and the assessment on residual impact is required

10.4.3 Surface water

The rivers form part of the Zambezi Basin in the southern parts of the project area between the towns of Luena and Camanongue and the Congo Basin further north up to the town of Saurimo. The rivers are of high importance to both ecosystems, but also human populations as local communities are highly dependent on these features as a source of water and for agricultural activities. Therefore, the sensitivity of this receptor is considered as medium.

10.4.3.1 Increased sediment load

Preconstruction and construction phase

Site clearance, excavation works, and stockpiling can result in the addition of sediment loads into nearby watercourses, impacting on water quality and potentially causing the erosion of channel banks. This includes sedimentation in watercourses from dewatering and pumping during excavation works. Construction-related sedimentation in watercourses can also cover aquatic vegetation, cause instream habitat deterioration and impact negatively on biodiversity. The magnitude of this impact is considered as medium and the impact is assessed as moderate.

Mitigation measures – Pre-construction and construction phase

- Implement the existing management plans
    - Reference to existing Management Plan(s):
        - PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
        - PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN
- Integrate sediment control measures into final design to minimise sediment load in surface water bodies - (Mitigation measures in the above-mentioned plans will minimise sediment load in surface water bodies).

Further measures will be integrated into the detail designs.

The residual impacts with the implementation of the current mitigation measures are considered to be negligible.

Operation and maintenance phase

Operational activities are not expected to increase sediment loads into watercourses, therefore not assessed for this phase.

10.4.3.2 Reduced water quality

Water quality in watercourses can be affected by the solid and liquid waste generated during construction, along with chemical and fuel leaks from construction vehicles and equipment. This includes localised pollution in surface waters that impact negatively on nearby community drinking, livestock watering, cloth washing, and bathing areas. This is of particular concern due to the reliance of communities on surface water resources, as many of the inspected boreholes were not functional due to a lack of infrastructure maintenance (e.g. broken pumps). The magnitude of this impact is considered as medium and the impact is assessed as moderate.

Pre-construction and construction phase

Potential pollutant sources include fuel storage areas, refuelling areas, stockpile locations, mobile toilets along the construction corridors, and chemical stores. In addition, untreated effluents from camps, concrete batching plants and sleeper production plants can pollute nearby surface water bodies if not contained and transported with surface runoff. This is of particular concern due to the reliance of communities on surface water resources, as many of the inspected boreholes were not functional (e.g. broken pumps). Localised pollution in surface waters that impact negatively on nearby community drinking, livestock watering, cloth washing, and bathing areas.

Mitigation measures – Pre-construction and construction phase

- Limit surface water abstraction within 500 m upstream of a community settlement in order to help prevent the possible deterioration of water quality.
- Implement the established procedures that avoid potential contamination of land and surface water from effluents. The procedure is as follows:
    - Obtain the estimated flow of sewage water, per campsite, from the Water Consumption Study (Approximately 80% of Consumed Water turns into sewage water)
    - Design the Sewage Treatment System, to ensure that the resulting treated water to be discharged will respect the chemical and physical requirements of Angolan Regulations
    - Design the location of the Water Treatment System, at each campsite, ensure that the treated discharge is not near any existing surface or underground water body
    - Prepare a Technical Report on the Water Treatment System, for each campsite. Include this in the General Waste and Wastewater Management Plan
    - Send the General Waste and Wastewater Management Plan to Agência Nacional de Resíduos (ANR), to obtain approval; Pay the required legal fees
    - Send the Technical Report on the Water Treatment System, to the Secretaria do Ambiente do Governo Provincial, to obtain approval; Pay the required legal fees
    - Send the Technical Report on the Water Treatment System, to Instituto Nacional de Recursos Hídricos (INRH), to obtain approval; Pay the required legal fees
    - After obtaining approval, invest in and install the sewage water treatment system, at each location
    - Before operation, perform tests on the treated sewage water to ensure that the treatment system complies with Angolan discharge regulation limits; Collect a sample and send it to a certified Lab. Pay the required legal fees
    - After tests approve and confirm the water treatment system's efficiency, the operation can start.

Reference to existing Management Plan(s):

- PI-MP-007-OECLS Construction Stage - Waste and Hazardous Materials Management Plan
- PI-MP-007-OECLS Construction Stage – Water Management Plan

- PI-MP-010-OECLS Construction Stage – Waste Water and Drainage Management Plan
- 2024-07-28-OECL-OAL-OECLS-DC-086-2024 Descriptive Memory for Discharging Effluents into the Water Environment Temporary Shipyard for Construction Contract
- PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
- PI-PL-060-OECLS_Water Management Plan_EN
- PI-PL-092-OECLS_WASTE WATER MANAGEMENT PLAN_EN
- PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN.

The residual impacts are considered to be negligible with the implementation of the proposed mitigation measures.

Operation and maintenance phase

The regular operation of stations and running of passenger wagons will generate liquid and solid waste. Improperly discarded litter can be transported with runoff into lower-lying watercourses and contaminating watercourses. Liquid waste from cleaning of station floors/platforms and improperly managed sewage at stations can also leak into nearby lower lying watercourses if improperly contained and regularly maintained. This impact is considered minor in magnitude because the design is including septic tanks and onsite solid wate collection at stations. The impact significance is assessed as moderate.

Mitigation measures – operations phase

- The Operator is to ensure that a licensed wastewater collection contractor is used to empty the septic tanks at stations and dispose the waste water at waste water treatment plants authorised by the municipal governments.
- The operator is to ensure that all locomotives have storage bins for solid waste that are emptied in designated waste storage location at the stations.

Mitigation measures in the plan to avoid and minimise impacts on surface water quality are included to:

- provide signage within passenger wagons and at stations that discourages littering while in transit. Signage should be provided in applicable languages and can incorporate fines as a means of deterrence
- ensure that a waste management system is in place and operational at train stations.

The residual impacts are considered to be negligible with the implementation of the proposed mitigation measures.

10.4.3.3 Reduced surface water flows from abstraction

Pre-construction and construction phase

The main project activities that will require water include dust repression, soil compaction, concrete mixing and batching, equipment cooling, masonry works, construction and operation of camps and worker daily needs. The estimated demand (included in Chapter

2 Project Description, section 2.7.1.7) can strain existing surface water sources, As detailed information on the extent of surface water abstraction versus groundwater abstraction could not be provided during the ESIA phase, it is recommended that once these estimated volumes per month from surface water are known that adequate water yield and quality testing be undertaken to further quantify potential impacts.

Therefore, risks discussed in this section are presented at a high level and based on similar project experience. The anticipated magnitude of the impact is considered as medium and the significance of the impact as medium.

Mitigation measures – Pre-construction and construction phase

The IFC Environmental Health and Social Guidelines for Water and Sanitation require development projects to

- Evaluate potential adverse effects of groundwater withdrawal, including modeling of groundwater level changes and resulting impacts to surface water flows, potential land subsidence, contaminant mobilization and saltwater intrusion.
- Modify extraction rates and locations as necessary to prevent unacceptable adverse current and future impacts, considering realistic future increases in demand.

The Project shall conduct a surface water abstraction assessment and update their PI-MP-007-OECLS Construction Stage – Water Management Plan to integrate the results during the pre-construction phase.

The residual impacts are considered to be minor with the implementation of the proposed mitigation measures.

Operation and maintenance phase

During operations, the Project does not anticipate using surface water, as the stations will rely on groundwater sources. Therefore, further impacts as a result of surface water abstraction are not anticipated and not assessed further.

10.4.4 Geohydrology

The project corridor traverses four aquifer types: Quaternary Unconsolidated Aquifers, Sedimentary Aquifers - Intergranular flow, Sedimentary Aquifers - Intergranular and Fracture flow and Basement Aquifers. Local communities are dependent on groundwater as a source of water therefore the impact assessment considers project activities that could negatively influence the ability of local residents to abstract groundwater or negatively impact sensitive ecological receptors. The sensitivity of the receptor is considered as medium.

10.4.4.1 Decreased water table levels from abstraction

Decrease in ground water levels occur due to ongoing abstraction demands. These demands are not only for the project but also relate to the variety of socio-economic features observed and recorded during the surveys described in Chapter 6. These include government and private offices, household consumption, livestock, farming, social services and schools, the current construction of the EN-180 and small-scale industries.

Preconstruction and construction phase

The main project activities that will require water include dust repression, soil compaction, concrete mixing and batching, equipment cooling, masonry works, construction and operation of camps and worker daily needs. . The estimated demand (included in Chapter 2 Project Description, section 2.7.1.7) can strain existing water sources, potentially leading to over abstraction of groundwater from local aquifers that can result in a decreased water table that can impact negatively on local communities reliant on boreholes.

As detailed information on the location and extent of groundwater abstraction could not be provided during the ESIA phase, it is recommended that once these locations are known and installed that adequate water yield and quality testing be undertaken to further quantify potential impacts. Community demand should then in turn be evaluated where groundwater abstraction occurs in close vicinity to the construction camps or railway stations.

Therefore, risks discussed in this section are presented at a high level and based on similar project experience. The Contractor's existing procedures to test and monitor abstraction of water, therefore the anticipated magnitude of the impact is considered as medium and the significance of the impact as medium.

Mitigation measures – Pre-construction and construction phase

The IFC Environmental Health and Social Guidelines for Water and Sanitation require development projects to

- Evaluate potential adverse effects of groundwater withdrawal, including modeling of groundwater level changes and resulting impacts to surface water flows, potential land subsidence, contaminant mobilization and saltwater intrusion.
- Modify extraction rates and locations as necessary to prevent unacceptable adverse current and future impacts, considering realistic future increases in demand.

The Project shall conduct a groundwater abstraction assessment and update their PI-MP-007-OECLS Construction Stage – Water Management Plan to integrate the results during the pre-construction phase.

Reference to existing Procedures in establishing and utilising boreholes in Angola:

The process for obtaining the Permit for water use in Angola requires the contractor to:

- design and calculate the estimated water consumption per temporary campsite (human consumption, works consumption)
- plan the location of each water borehole at each temporary campsite
- hire a local water borehole specialist to execute a pilot borehole at the planned location. Conducting pump tests on all boreholes to be used, in order to determine the yield and aquifer recovery of each, which should relate into management measures that will ensure sustainable abstraction rates. This will help to ensure that rural community members reliant on groundwater resources are not negatively affected and future water demands do not negatively affect sensitive ecosystems.
- obtain data on water parameters at the location (quantity, yield, deepness, capacity, etc.)

- obtain a water sample from the borehole and send it to a Licensed local Laboratory for chemical and physical analyses of the water quality
- after obtaining all borehole data, decide on the requirement for a Water Treatment Plant, as per local regulation. Decide on the number of boreholes to be installed at each location
- design the decisions made and prepare a documental report
- send the documental report to the E&S Consultant to consider in the ESIA Report
- send the ESIA Report to MINAMB, to obtain the Environmental Installation License for the Construction
- send the report for approval and requesting authorization to proceed to the local Secretaria do Ambiente, do Governo Provincial, responsible for the Area; Pay the requested legal fees, for the process
- with the Approval of the above entity, prepare a process and send it to INRH (Instituto Nacional de Recursos Hídricos). Pay the requested legal fees, for the process with the approval of the 3 entities above, proceed with the completion of the pilot borehole, and the remaining infrastructure related to the Water Use Permit. Ensure to consider water meters at each water borehole.

The residual impacts are considered to be minor to negligible with the implementation of the proposed mitigation measures.

Operation and maintenance phase

During operation phase, the project will have boreholes at six of the eight stations. Unregulated abstraction has a potential to decrease water level in ground water resources due to on-going abstraction to meet project demands. The magnitude of the impact during operation phase is minor considering the relatively low passenger capacity of the stations and two passenger trains planned to operate only during the daytime. The significance of the impact is considered minor.

Mitigation measures – operations phase

Mitigation measures in the plan to minimise reduction of water table levels during operations include to:

- follow abstraction volumes as prescribed in authorisation permits and monitor usage
- install water flow meters on all water abstraction points (surface water, wells, and boreholes). Undertake hydraulic pump testing of all boreholes to be used as long-term water supply source to calculate sustainable yields.
- conduct regular inspection and maintenance that implement a leak detection and repair program (including records of past leaks and unaccounted-for water to identify potential problem areas). Consider replacing mains with a history of leaks of with a greater potential for leaks because of their location, pressure stresses, and other risk factors.

The residual impacts are considered to be minor with the implementation of the proposed mitigation measures.

10.4.4.2 Damage to un-identified private wells or boreholes

During the dry and wet season surveys, five boreholes were identified, however not all were fixed with functioning pumps. Social surveys also recorded that communities rely

on groundwater for human consumption that may be accessed from un-marked private boreholes and shallow wells.

Preconstruction and construction phase

Therefore, during preconstruction phase, enabling works such as demining, geotechnical site investigations and vegetation clearance can damage un-identified and un-marked boreholes and shallow wells used by the community. This impact is considered as medium in magnitude and moderate in significance.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-MP-007-OECLS Construction Stage – Water Management Plan
- PI-PL-060-OECLS_Water Management Plan_EN.

The above-mentioned plans include mitigation measures to avoid damage to un-identified and un-marked boreholes and shallow wells. To avoid potential conflicts with communities, it is recommended to repair existing community boreholes that are damaged to enable residents to have access to water sources without competing with water points designated for construction. In addition, the Contractor should repair any damage to private wells and boreholes used by community members if a completed incidence investigation concludes that damage was a direct result of a project construction activity.

The residual impacts are considered to be minor with the implementation of the proposed mitigation measures.

Operation and maintenance phase

During the operational phase, the stations will have their own water sources and the operational activities are not anticipated to pose a risk to directly damage un-identified and un-marked boreholes and shallow wells.

10.4.5 Hydrology

As indicated in the hydrological baseline in Chapter 8, the project corridor traverses two hydrological basins and 11 surface water crossings. The sensitivity of the receptor has been considered as medium due to the number of physical infrastructures that have been incorporated into the design to minimize where the design has planned 11 bridges. In addition, there are 12 planned culverts to allow for cross sectional drainage flows. The preliminary designs have also incorporated trapezoidal earth bench trenches for longitudinal surface drains planned along the railway RoW and along cut and fill sections (Drawing 23DD-LS-2-GE-G00-00-C-51-DE-0003_0).

10.4.5.1 Wetland desiccation

Wetland features along the project corridor will be impacted during the construction phase for the construction of access routes, the railway track and bridges. The baseline describes the interaction between surface runoff and infiltration into groundwater and conceptual illustrations of how railway infrastructure can impact natural flow and infiltration patterns.

Pre-construction and construction phase

During preconstruction phase, the creation of open temporary drains to create drier conditions for construction activities, such as vehicle access and dewater around excavation works will result in wetland habitat desiccation by locally lowering the water table. The detailed designs will determine if construction works requires draining localised watercourse areas where a high water table (e.g. wetlands) is present and require permanent modification of interflow in the soil profile. Longitudinal subsoil drains may also be required in areas with a high water table is present. The creation of subsurface and other drains in watercourses with a high water level (e.g. wetlands) will result in habitat desiccation. Wetlands that contain peat soils are particularly susceptible as drainage can cause peat to dry out and decompose through oxidation and/or burn during fire events. The creation of these drains is not anticipated at each river and culvert location planned along the railway alignment; therefore, the magnitude of the impact is considered as medium and the significance of the impact as moderate.

Mitigation measures – Pre-construction and construction phase

- Where high water tables are found like swampy areas with no natural drainage, preference will be given to solutions with no required maintenance like embankments provided with blankets of granular free draining material or embankments made of rockfill.
- Perforated drainpipes wrapped in geotextile with surrounding gravel as filter material should be avoided because of the difficulties associated with maintenance thereof.
- The detail of the embankment solutions will be provided by the geotechnical design.

The residual impacts are considered to be minor to negligible with the implementation of the proposed mitigation measures.

Operation and maintenance phase

Impacts on wetland desiccation is only anticipated during the construction phase where the deigns and locations of suitable drainage solutions are developed to avoid long term and irreversible desiccation of wetlands throughout the operation of the railway line. Therefore, operational impacts are not assessed. Desiccation as an indirect outcome of changing rainfall patterns is considered as a Climate Change risk, addressed separately.

10.4.5.2 Changes in surface drainage patterns

During the establishment of construction camps, there may be a need to create new temporary channels to divert surface water from the area delineated for camps. In addition of modifications of existing channels to divert surface flow during construction activities. This can be open temporary drains to create drier conditions for construction activities, such as vehicle access roads and to dewater around excavation works.

Pre-construction and construction phase

Open channels can erode and form new channels that become preferential flow paths. Open channels could relate to constructed drainage channels at camps, along the railway

embankment and at stations. The magnitude of this impact is considered medium, sensitivity medium and significance moderate.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-MP-009-OECLS Construction Stage – Water Management Plan
- PI-PL-061 Water Management Plan
- PI-PL-090 Erosion Control Management Plan.

The final project design will integrate mitigation measures to minimise the need of diverting surface water that include:

- avoid the use of diversion channels during construction as much as possible by potentially revising the location of the infrastructure or adjusting alignments
- avoid open drains on steep slopes that cut directly across contour lines for the shortest flow path. Erosion is more likely along these drains. All temporary drains should consider the local topography and be aligned by taking contour lines into consideration to help avoid erosion impacts
- monitor and stabilise erosion features in temporary drains and diversion channels
- close all remaining temporary drains once construction is complete and reinstate the original topography, after reintroducing subsoil and topsoil in the correct sequence.

The residual impacts are considered to be minor with the implementation of the proposed mitigation measures.

Operation and maintenance phase

Impacts on diverging surface water is only anticipated during the construction phase where the locations for permanent infrastructure and alignments are finalised. Further studies to inform the detailed design will incorporate measures to avoid long term and irreversible creation of surface water flow paths throughout the operation of the railway line. Therefore, operational impacts are not assessed.

10.4.5.3 Modification of longitudinal and cross drainage caused by railway infrastructure

In general, any railway crossing infrastructure (functioning as hydrological obstructions in watercourse) can alter or modify the prevailing drainage pattern in a watercourse, both in terms of longitudinal and lateral flow. Careful consideration in the preliminary designs have been made in terms of adjusting the spans and alignment of bridges to limit major modifications to the watercourses traversed by the project.

Pre-construction and construction phase

During the construction of the railway bridges, the supporting pillars can act as hydrological obstructions in watercourses. In addition, the construction of the access roads parallel to the alignment can cause obstruction to surface runoff channels that connects to downstream wetlands and rivers. The magnitude of this impact is high and the significance moderate. Careful design considerations already made and free flow conditions are assumed through bridge structures.

Mitigation measures – Pre-construction and construction phase

The following mitigation measures to minimize impacts on changed longitudinal drainage patterns are to be reviewed and updated into respective management plans indicated in the table below

Table 10.4-35 Measures to minimize impacts from the creation of longitudinal drains

SN	Measures to minimize impacts from the creation of longitudinal drains	Reference to existing Management Plan
1	Construction of drainage elements must be considered during all the construction phases in railways. Initially during the execution of infrastructure elements and then during the execution of the elements of the superstructure. Elements of the drainage system of railways include external drainage (out of the track) and internal drainage.	To be incorporated into the detailed design
2	A standard cross section for longitudinal drainage should be defined for the entire railway alignment.	To be incorporated into the detailed design
3	Existing (pre-construction) drainage patterns and flows should be maintained and where temporarily altered, restored to original conditions as far as is practically possible	To be incorporated into the detailed design
4	Unchannelled watercourse systems should therefore remain unchannelled and new channels and drains should not be created. This includes drains and open channels in seeps adjacent to streams.	To be incorporated into the detailed design
5	The calculation of flood hydrographs should be done and used to implement hydrological works required for longitudinal drainage.	To be incorporated into the detailed design
6	Longitudinal drainage will be required along the length of the railway where slopes have a sufficient steepness. Longitudinal drainage along flatter areas will make use of culverts and pipes.	To be incorporated into the detailed design
7	Trapezoidal side drains are recommended and have been accordingly designed along the of embankments.	(OEC document 23DD-LS-2-GE-G00-00-G-00-RT-0001-0)
8	In cut sections where slopes are steeper unlined side drains can be used where water velocities of 1.5 m/sec or less are expected, while side drain ditches with flow velocities of greater than 1.5 m/sec and less than 3.0 m/sec should be protected with rip rap or concrete. Side drains should be lined with concrete and include a shoulder for flow velocities of greater than 3.0 m/sec up to 4.5 m/sec. Flow velocities can be controlled with check dams, stepped cascades, the spacing of mitre drains, and cross drainage structures to remove water from side drains.	To be incorporated into the detailed design
9	Water that collects inside drains where no watercourse is available for discharge, can be discharged by diverting the drain away from the railway alignment before it has become too long, collected too much water, or contain flow velocities that are too high. This can be done by using check bends inside drains to divert runoff into mitre drains. Where this is not practical due to rising approaches bordering the side	To be incorporated into the detailed design

SN	Measures to minimize impacts from the creation of longitudinal drains	Reference to existing Management Plan
	drain, ancillary cross culvert drainage can be used with an outlet channel to be excavated on the lower side of the railway.	
10	Cut sections may result in natural slopes along the top of the cutting to direct runoff towards the railway corridor. In these cases, a trapezoidal drain can be used along the trackway top of embankments to intercept runoff.	23DD-LS-2-GE-G00-00-G-00-RT-0001-0
11	Trapezoidal drains can also be used along bench terraces where they are required. In these cases, the trapezoidal drain will be connected to a catchwater drain.	To be incorporated into the detailed design
12	Trapezoidal and catchwater drains should be designed with the same type of flow mitigation as recommended for side drains (see above).	To be incorporated into the detailed design
13	The following drain offsets are recommended: A minimum offset of 3 m from the back of the shoulder should be used for catchwater drains along the top of cut sections. A minimum offset of 1 m from the back of the shoulder for side drains along the top and bottom of embankments.	To be incorporated into the detailed design
14	Where the height of the embankment is higher than 8 meters, benches (terraces) shall be provided with ditches to concentrate and convey water safely longitudinally, avoiding erosion of slopes.	To be incorporated into the detailed design
15	Energy dissipating measures should be designed and included to control flow velocities at stormwater discharge points along all drains that release water into a watercourse. Discharge points should be located upslope of watercourses as far as possible. These structures are needed to avoid erosion and sedimentation in watercourses.	23DD-LS-2-GE-G00-00-G-00-RT-0001
16	All minor cross drainage structures shall be provided at inlets and outlets with wingwalls, headwalls, aprons and cut-off walls. Inlet and outlet structures shall be constructed from reinforced concrete in a manner to transition the flows into the culvert and away from the culvert without causing damage to the railway embankment. Scour protection in culverts and pipes are required.	23DD-LS-2-GE-G00-00-G-00-RT-0001
17	Longitudinal subsoil drainage that is required where a high-water table is encountered (expected in most wetland crossings where permanently saturated conditions are common) should make use of interventions that require the least amount of maintenance. Drainpipes that require maintenance should only be considered where no other options are feasible or available. Embankment drainage solutions and other drainage options should be guided by findings from the geotechnical study.	To be incorporated into the detailed design

SN	Measures to minimize impacts from the creation of longitudinal drains	Reference to existing Management Plan
18	Hydroseeding using an appropriate seed mix that has been evaluated by an ecologist with working experience in the area should also be applied to cut surfaces and steep slopes to help avoid erosion and sedimentation impacts. Choice of seeds/plants will prioritise native species to avoid introduction of invasive species.	To be incorporated into the detailed design
19	The hydraulic design process for cross drainage structures, such as culverts and bridges, should receive input from climatic, hydrological and hydraulic studies, which include flood risk assessments.	To be incorporated into the detailed design
20	The selection and size of cross drainage structures, such as bridges and culverts, are dependent on the volume and extent of flow modelled for flood events, as well as flow velocity, geomorphological, geological and geotechnical properties of proposed sites (typically located in watercourses). Hydraulic models are recommended to be used for each identified watercourse crossing.	To be incorporated into the detailed design
21	All proposed cross drainage structures should have adequate dimensions to allow flows comparable to natural high flow conditions, while allowing baseflow at the same time. Cross drainage structures should not cause back flooding (ponding) during normal flows (non-flood events), nor cause erosion in downstream watercourse habitat/ reaches	To be incorporated into the detailed design
22	The type of watercourses and its properties as provided in the scoping report and in the ESIA report should be considered in the design of proposed cross drainage structures. Special attention should be placed on identified low energy watercourses and watercourses with peat soils where flows should be spread out (not canalised) and energy dissipaters at outlets will be essential.	To be incorporated into the detailed design
23	The slope of the culvert should be the same gradient of the existing streambed unless the topography is generally flat. In case of the latter, the culvert should be designed to avoid (or restrict) sedimentation and eventual blockage and can be constructed slightly above the natural ground level (NGL).	To be incorporated into the detailed design
24	Perched pipe outlets and culvert release areas should be avoided. Culvert and pipe outlets should also not be below the natural ground level. The barrel of these cross drainage structure should have a longitudinal fall of at least 1 %.	To be incorporated into the detailed design

The residual impacts are considered to be minor with the implementation of the proposed mitigation measures.

Operation and maintenance phase

Impacts on longitudinal and cross drainage typically arise during the construction phase and are linked to the detailed designs. Further studies to inform the detailed design will incorporate measures to avoid long term and irreversible impacts of drainage flows throughout the operation of the railway line. Therefore, operational impacts are not assessed.

10.4.5.4 Impeded surface water channels and flows

Demobilisation after construction is an important activity in ensuring continual surface drainage patters in water channels. Water channels can be obstructed as a result of improper clearance of remnant materials and leaving stockpiles.

Pre-construction and construction

Remnant rock material, geotextiles used to create the construction access roads and subsoil material (stockpiles) that are not removed from watercourses can result in poor vegetation reestablishment and an uneven topography. The latter can modify surface flows and result in channel creation (in unchanneled watercourses) or the modification of existing channels (by concentrating flows in areas where dispersed flows previously existed). The magnitude of this impact is anticipated to be low due to the rigorous standards that already exist with the contractor. The impact significance is assessed as minor.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

The above-mentioned management plans include processes that ensure

- the removal of all remnant rock material, flume pipes, geotextile material and stockpiles associated with temporary construction roads and other construction activities within watercourses
- the close and stabilisation of drainage trenches and diversion channels that were used during the construction phase.

The residual impacts are considered to be minor with the implementation of the proposed mitigation measures.

Operation and maintenance phase

Impacts on impeded water channels typically arise during the construction phase and are addressed during demobilisation. Potential impediment of water channels throughout the operation of the railway line may arise as a result of improper management of litter or erosion into water channels. These are assessed separately below.

10.4.5.5 *Increased localised surface floods from created dams and unplanned crossing structures*

Besides defined watercourses/channels, general surface runoff from bare land, impervious and compacted surfaces will occur during normal rain events. The runoff patterns (direction and low lying collection trenches) is influenced by the current topography and existing structures prior to the construction of the project. The construction of the project will introduce and structures that will affect these runoff patterns.

Pre-construction and construction phase

Topsoil and subsoil stockpiled material and embankments are features that will be created during the preconstruction and construction phases that create a considerable change to the current topography. These can potentially block surface flows and indirectly cause localised surface floods. The magnitude of the impact is assessed to be medium due to the linear nature of the project that includes an embankment. The significance of the impact is considered as moderate.

Mitigation measures – Pre-construction and construction phase

The detail design will incorporate measures of cross-section drainage placement and sizes. In addition, the PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN will identify potential risks of the locations of stockpiled material and apply the following mitigation measures to reduce the likelihood of obstructed surface runoff:

- excess spoil soil material should not be used to create new dams or crossings structures in watercourses for communities or municipalities
- all solid waste and excess spoil soil material should be discarded in appropriately licensed waste disposal sites
- contractor's community land liaisons officers can be used to communicate the importance of rehabilitating watercourses to avoid direct and indirect impacts outside of the railway corridor footprint.

Residual impacts are considered negligible.

Operation and maintenance phase

The operational activities that may create obstructions to surface runoff are primarily related to the operation of workshops where spare parts broken down locomotives waiting to be repaired and other machinery will be stored. There will also be solid waste generated at stations and on the wagons that if improperly managed can create localised heaps that will function as obstructions to surface runoff at stations or along the RoW (e.g. at culverts). In addition, although not frequently, if dredged material from maintenance dredging at water courses are stockpiled on the banks, these stockpiles will obstruct surface runoff into the water channel.

Mitigation measures – operations phase

- the operator will develop their solid waste management plan for stations that will prohibit waste disposal adjacent to the buildings and include guidance on

authorised municipal waste collection and disposal sites to be used during operation.

Residual impacts are considered negligible.

10.4.6 Soils

10.4.6.1 Erosion

Preconstruction and construction

Drainage trenches along remnant vehicle access tracks remain open resulting in habitat desiccation and potentially the creation of new erosion features during high flow events. In addition, erosion can occur at the banks of rivers where bridges are constructed and during the construction of culverts. This can result in excess sedimentation. Sedimentation in watercourses is more sensitive compared to sedimentation downslope of the embankments. The sensitivity of the receptor is medium and as the current designs have considered tapered/step erosion control measures the magnitude of this impact is considered as moderate and the significance is moderate.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN
- PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN.

The current management plans are to be reviewed and updated to include the following mitigation measures to reduce erosion effects:

- erosion protection measures that can be considered below culvert outlets to prevent scour erosion and new channel formation include the following general guidelines:
  - rip rap apron for maximum flow velocities of up to 4 m/sec (these aprons should not be too short and be designed to spread flow)
  - reno mattresses for flow velocities between 4 m/sec to 6 m/sec (reno mattress toes should be covered with river bed material and the structures should be used with geotextile and engineering input)
  - gabion mattresses for flow velocities between 6 m/sec to 7.5 m/sec (gabions should be used in a designed water retention basin or other suitable structure that requires engineering design input on a site specific basis)
  - higher flow velocities should consider different design options, and/or different section and slope conditions
- unlined channels below culverts erode easily and should only be considered where rock outcrops are present, such as a rocky channel bed. Open channels should not be created in unchanneled valley bottoms wetlands, where flows need to be dispersed over a wide area.

The residual impacts after implementing the mitigation measures is minor.

Operation and maintenance phase

Erosion and sedimentation can occur along railway lines at stormwater discharge points and at watercourse railway crossings resulting in sedimentation in watercourses and a lowering of water quality. Erosion at poorly vegetated embankments and slopes along approaches bordering watercourses will result in excess sedimentation in water courses and downslope on terrestrial vegetation. Erosion was recorded along the recently constructed tar road located to the west of the railway alignment. This receptor is medium in sensitivity therefore the impact is considered as moderate in magnitude and moderate in significance.

Mitigation measures – operations phase

Mitigation measures to reduce erosion effects during operations:

- clear culverts, pipes and stormwater outlets from blockages to prevent erosion. This is especially important during wet seasons
- inspect cut and shaped surface for signs of erosion and sedimentation. Stabilise areas where erosion is observed using vegetation or other means or erosion control.

The residual impacts after implementing the mitigation measures is minor.

10.4.6.2 Deterioration of soil quality/structure

Preconstruction and construction phases

Excavation during vegetation clearing and demining activities can impact soil quality and its structure significantly, reducing its organic matter content, nutrient levels and overall fertility. During excavation, topsoil is removed and/or mixed with subsoil during soil piling and spreading. The removal of topsoil, which is the most fertile soil losses its essential nutrients when disturbed in its natural structural state, causing changes in the soil texture. The sensitivity of the receptor is medium and the impact is considered as moderate in magnitude and moderate in significance.

Reference to existing Management Plan(s):

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN
- PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN.

Mitigation measures – preconstruction and construction phase

- limit the area of excavation at any given time to reduce the extent of soil disturbance. Use precise excavation techniques to minimise unnecessary soil disruption
- implement a phased construction approach to allow for gradual soil disturbance and recovery
- add organic matter, such as compost or manure, to the soil to replenish lost nutrients and improve soil structure.

The residual impacts after implementing the mitigation measures is minor.

Operational and maintenance phases

Continuous clearing of vegetation along the RoW weakens the soil and leaves it exposed. Exposed soil becomes more susceptible to erosion by wind and water, which can further deplete soil nutrients and lead to sedimentation in nearby water bodies, near culverts and bridges. The sensitivity of the receptor is medium and the impact is considered as moderate in magnitude and moderate in significance.

Mitigation measures – operation and maintenance phase

- clear culverts, pipes and stormwater outlets from blockages to prevent erosion. This is especially important during wet seasons
- inspect cut and shaped surface for signs of erosion and sedimentation. Stabilise areas where erosion is observed using vegetation or other means or erosion control
- install silt fences along the RoW to capture sediment and prevent it from reaching nearby water bodies.

The residual impacts after implementing the mitigation measures is minor.

10.4.6.3 Soil contamination

Preconstruction and construction phases

Soil contamination can occur from spills of hazardous substances, improper handling, storage, and disposal of hazardous materials and chemicals. During these phases, the common sources of spills and leaks will be from construction equipment and vehicles which can seep into the soil. In addition, paint works can also introduce contaminants.

Additionally, activities that generate waste materials such as metal scraps, debris, unexploded ordnance, plastics, and treated wood, can degrade and leach harmful substances into the soil.

The sensitivity of the receptor is medium and the impact is considered as moderate in magnitude and moderate in significance.

Reference to existing Management Plan(s):

In addition to the Contractor's procedures on the discharge of effluents presented in section 10.4.3.2 above, there following plans and procedures will be applied:

- PI-MP-010-OECLS Construction Stage - Waste Water and Drainage Management Plan
- 2024-07-28-OECL-OAL-OECLS-DC-086-2024 Descriptive Memory for Discharging Effluents into the Water Environment Temporary Shipyard for Construction Contract
- PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN
- PI-PL-060-OECLS_Water Management Plan_EN
- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN
- PI-PR-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN

- PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN.

Mitigation measures – preconstruction and construction phase

In addition to the above management plans and procedures the Contractor shall

- Prepare readily available spill kits, absorbent materials, and containment booms to quickly address any spills
- store hazardous materials and chemicals in designated, secure areas with secondary containment systems to prevent leaks
- regular maintenance and inspections of construction equipment and vehicles to prevent leaks and spills.

The residual impacts after implementing the mitigation measures is minor.

Operational and maintenance phases

Soil contamination can occur from spills of hazardous substances, improper handling, storage, and disposal of hazardous materials and chemicals. During these phases, the common sources of contamination are from wastewater used for cleaning stations, spills and leaks from equipment used for maintenance which can seep into the soil. During this phase wastewater/effluents from cleaning the station and its infrastructure can leach into the soil. The chemicals contained in wastewater can weaken soil structure, leading to soil becoming susceptible to erosion.

Additionally, activities that generate waste materials such as general domestic waste at from passengers at the stations can degrade and leach harmful substances into the soil.

The sensitivity of the receptor is medium and the impact is considered as moderate in magnitude and moderate in significance.

Mitigation measures – operation and maintenance phase

- regularly monitor soil quality to detect any signs of contamination or erosion
- ensure that wastewater and effluents are properly disposed of in designated areas or facilities designed to handle such waste
- avoid discharging untreated wastewater into the soil or nearby water bodies.
- use environmentally friendly and biodegradable cleaning agents that have minimal impact on soil quality
- readily available spill kits, absorbent materials, and containment booms to quickly address any spills
- store hazardous materials and chemicals in designated, secure areas with secondary containment systems to prevent leaks
- regular maintenance and inspections of construction equipment and vehicles to prevent leaks and spills.

The residual impacts after implementing the mitigation measures is minor.

The review of available literature and existing sediment quality data (ECOS, 2023; Jones et al., 2020) demonstrates that the project area is not affected by regional contamination events like the Catoca spill and that sediment profiles do not show elevated levels of polluting minerals. Therefore, the contamination risk for the project is considered

negligible, and no further specialized contamination assessment is deemed necessary. Standard construction and soil erosion control practices are sufficient to manage the identified environmental risks to minor.

10.4.7 Landscape and Land use

The project will require available land to for the construction of project infrastructure, access roads, storage areas and placement of temporary facilities. The demand of land will lead to significant land changes, affecting the overall landscape and land use and visual character.

10.4.7.1 Increased changes in land use from migration

Preconstruction and construction phases

An influx of labour will necessitate for the development of temporary and permanent accommodation, and other infrastructure such as sanitation and water facilities to support the workforce. The development of the infrastructure can lead to the conversion of agricultural land and natural habitats into urban or semi-urban areas, altering the land use patterns significantly.

Mitigation measures – preconstruction and construction phase

- establish buffer zones around agricultural and natural areas to protect them from development activities
- reforestation and afforestation programs to compensate for any loss of natural habitats
- develop mitigation strategies that protect agricultural land and natural habitats with local farmers
- conduct awareness programs to educate the workforce and local communities about the importance of land conservation.

The residual impacts after the implementation of the mitigation measures are expected to be minor.

Operational and maintenance phases

Not applicable.

10.4.7.2 Alteration of landscape

Preconstruction and construction phases

The construction activities include clearing the project area for demining and other activities. Natural vegetation will be cleared along the RoW to create a suitable foundation for constructing infrastructure and cleared to easily detect UXO remnants. The removal of natural vegetation can alter land surface, reshape the natural terrain of the environment and change drainage patterns. Moreover, land clearing will also require excavation activities, cut and fill, blasting at quarries and stockpiling material, further modifying existing slopes and embankments, disrupting the original scenic and aesthetic value of the area.

Mitigation measures – preconstruction and construction phase

- Only clear vegetation that is absolutely necessary for construction and demining activities
- preserve as much natural vegetation as possible
- replant cleared areas.

The residual impacts after the implementation of the mitigation measures are expected to be minor.

Operational and maintenance phases

Although the landscape and land use would have been altered during the preconstruction and construction phases, the operation and maintenance will have minimum effect to the visual character as vegetation will only be cleared along the railway tracks and culverts. The continuous clearing will however weaken the soil structure and affect the quality of soil.

Mitigation measures – operation and maintenance phase

- prioritize the restoration of cleared areas by replanting
- focus on preserving existing vegetation where possible and only remove vegetation that directly interferes with railway operations or poses safety risks.

The residual impacts after the implementation of the mitigation measures are expected to be negligible.

10.4.7.3 Modification of scenic and aesthetic value

Preconstruction and construction

The development of project infrastructure such as access roads, stations and associated facilities will introduce additional built elements into the landscape; however, these occur within an already evolving infrastructure corridor. In the Luena–Saurimo area, the railway forms part of wider national development and is situated adjacent to existing structures and EN180 bridge crossings. As a result, changes to the visual character are expected to be incremental rather than transformative, with the new elements integrating into a setting that already includes established transport infrastructure. The overall aesthetic value of the landscape is therefore not anticipated to be significantly diminished. Permanent structures to be introduced include:

- 2 worker accommodation that will be built in Camanongue and Caiza construction camps
- 8 train stations along the RoW
- 4 Boreholes
- 11 bridges
- 12 culverts.

The movement of heavy construction vehicles during the construction phases may temporarily influence the sense of place and the way the surrounding area is experienced, including cultural or recreational uses. Occasional vehicle breakdowns may

require short-term emergency repairs or maintenance, which could take place outside designated laydown areas. Such activities may introduce temporary visual changes within the project corridor. Vehicle maintenance can also generate routine waste streams—such as used oils, filters, lubricants, and worn parts—which, when managed according to project environmental procedures, can be handled and disposed of appropriately to avoid contamination or lasting visual effects. Given the temporary nature of these activities and the implementation of established waste-handling and environmental management measures, long-term effects on landscape character are not expected.

Mitigation measures – preconstruction and construction phases

- prioritise the preservation of significant natural features and landscapes within the project area
- identify and protect areas of ecological or scenic value through zoning
- landscaping and vegetation plans that complement the natural surroundings
- engage with local communities to identify cultural significant areas that do not need to be disturbed.

The residual impacts after the implementation of the mitigation measures are expected to be negligible.

Operational and maintenance phases

The movement of the train can bring both positive and negative visual impacts within the project area. The movement of the train through the main town of Luena and along the rural areas, makes the areas feel more industrialised and enhances the aesthetic perspective of people as the area moving towards better development.

However, the daily movement of the train and the presence of tracks, overhead lines and other railway infrastructure can disrupt the visual harmony of the landscape. The sight of the train passing by through areas of natural beauty or historical significance, can be seen as disruption to an otherwise pristine environment.

Mitigation measures – operation and maintenance phase

- engage with local communities, stakeholders, and experts during the planning and design phases to understand concerns and preferences
- consider integrating artistic elements along the railway corridor to enhance visual appeal and cultural significance.

The residual impacts after the implementation of the mitigation measures are expected to be negligible.

10.4.7.4 Impact on visual landscape from generation of waste

Preconstruction and construction phases

The generation of waste from the worker accommodation and construction activities can have a significant visual impact on the landscape. Construction debris, materials, waste storage facilities and domestic waste can create unsightly scenes that detract from the natural environment. Improper waste management practices may result in littering, illegal

dumping, and visual blight, affects the overall appearance and land use suitability of the project area. Moreover, the use of existing waste facilities/dumpsites for construction and domestic waste disposal may exacerbate existing waste management challenges, including limited landfill capacity, inadequate waste segregation, and lack of recycling infrastructure. This will lead to the accumulation of waste, creating a perception of negligence regarding the environments visual character.

Mitigation measures – preconstruction and construction phase

- prioritise reuse and recycling of construction materials and waste wherever possible
- provide signage within camps and at construction zones along the railway RoW. Signage should be provided in applicable languages and can incorporate fines as a means of deterrence.
- Implement the contractor's PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN and the Project's Waste Management Plan prepared with the ESMP.

The residual impacts after the implementation of the mitigation measures are expected to be minor.

Operational and maintenance phases

Waste, especially if not managed properly, particularly at the stations where there is an influx of people, can accumulate in open areas, leading to visual blight. Piles of garbage and litter can mar the natural beauty of landscapes, reducing their aesthetic value. Additionally, littered waste can spread beyond designated areas due to wind or water runoff, further impacting the visual landscape across larger areas.

Mitigation measures – operation and maintenance phase

- designated areas for temporary waste storage that are visually screened and properly managed
- use covered bins or containers to prevent littering and illegal dumping,
- provide signage within passenger wagons and at stations that discourages littering while in transit. Signage should be provided in applicable languages and can incorporate fines as a means of deterrence.
- ensure that a waste management system is in place and operational at train stations.

The residual impacts after the implementation of the mitigation measures are expected to be negligible.

10.4.8 Pollution risks

This section presents a consolidated assessment of the project's potential pollution impacts, drawing the details presented by the specialists as well as the detailed assessment discussed in the above impact assessment sections. The pollution impacts risks associated with the project arise from atmospheric emissions, noise generation, waste generation and wastewater discharge.

The baseline air quality conditions are described in Chapter 8.12, based on the monitoring surveys undertaken in 2024. The results indicated that measured baseline concentrations of CO, SO2 and VOCs were well withing the relevant guideline values across the monitored locations. However, monitoring locations had existing exceedances of PM10 and PM2.5 concentrations as well as NO2 and 03. These results indicate that baseline conditions are already compromised for certain pollutants. As such, there is a heightened sensitivity to additional project related air emissions, particularly during construction phase.

The quantitative noise predictions are presented in Chapter 8.11 and indicate that noise impacts are primarily associated with construction activities and equipment-use during construction activities. During the constructions phase, noise pollution risks arise for earthworks, operation of heavy material and track installations. These activities may result in temporary increases in ambient noise levels and potential exceedances of applicable guideline values, disturbance to communities and fauna. However, these risks are expected to be low and localised in nature and where exceedance is identifies, mitigation measures have been put in place to reduce noise emissions as low as reasonably practicable. As a result, noise pollution risks to sensitive human receptors are assessed to be low. Predicted noise emissions associated with construction and operation of the railway are expected to be localised and short-term in nature during construction, and intermittent during operation. Additionally, at the time of writing no permanent noise-sensitivity receptors were identified, the noise risks remain due to potential presence of transient receptors and future land uses near the alignment.

Estimated waste and wastewater to be generated as a result of the project are provide in Chapter 2.4. These have been estimated using per capita waste/wastewater generation rates derived from reputable international sources consistent with IFC and GIIP. The potential pollution risks include soil and water contamination due to improper waste management.

Mitigation measures to manage pollution risks are described in detail in their relevant subsections above. The mitigation measures have ensured alignment with EHS Guidelines and GIIP, therefore the pollution risks are expected to be manageable and reduced to acceptable levels.

The detailed significance assessment of physical environment impacts presented above is provided separately in Appendix 16.4.

10.5 Biodiversity

10.5.1 Legally Protected Areas and Key Biodiversity Areas for Conservation

Section 9.4 in baseline section has identified Cameia National Park (Parque Nacional da Cameia), which is also recognised as an IBA as the closest protected area to the project. It's location and is outside of the Project's indirect AoI of 20 km. The International Biodiversity Assessment Tool (IBAT) database similarly does not indicate a protected area or an internationally recognised area for Biodiversity Conservation within 50 km from the project. The Project is similarly not expected to contribute to any increased potential for exploitation or illegal logging pressures on protected areas. Furthermore, there are no

documented or observed wildlife migratory routes that traverse the Project's RoW or located within the Project's AoI. As the construction activities are limited to the Project footprint and will occur within demarcated camps, construction zones along the railway RoW, it is not expected that any direct or indirect impacts will occur to the identified protected area. Therefore, potential impacts to Protected Areas, IBAs and Key Biodiversity Areas is scoped out of the impact assessment.

10.5.2 Terrestrial biodiversity impacts

10.5.2.1 Increased habitat fragmentation *& ecological disturbance*

Construction of any man-made infrastructure on green-field sites requires the removal of forest, savanna and grassland habitats and refugia, thus breaking the continuity of habitat available for animals to move through. This process will segment and fragment the continuity of habitat on all sides of the development footprint, resulting in separation of previously homogenous habitat and genetic resources.

10.5.2.2 Pre-construction and construction phase

The process of establishing camp facilities and handover of project corridor (including locations for stations can include physical delineation of the immediate footprint and potentially erecting barriers/fences. This will apply in locations with natural miombo woodland and savanna grasslands long the RoW. The magnitude of this impact is assessed as high, while the habitat receptor sensitivity has also been assessed as medium as the extent of the miombo woodland ecoregion and connectivity of the savanna grasslands is extensive, therefore it will expectedly be possible for any resident fauna to move around and through the area without needing to venture into completely modified habitats. The resulting impact significance is therefore considered to be moderate.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan: PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN

Mitigation measures in the plan to minimize extent of habitat fragmentation are included to:

- minimise clearance of natural vegetation and habitats at the fringe of the sites, to allow for greater connectivity of habitat
- use of native flora of local providence to replant any denuded areas which are not directly beneath the footprint of construction.
-

- Proposed considerations for the final designs include:
  - design of culverts and where necessary species-appropriate guiding fences or other structures to allow for passage of small mammals and reptiles through such culverts rather than across the rail
  - minimal physical alteration of rivers and adjacent floodplains and riparian areas

Despite the implementation of mitigation measures, residual impacts are anticipated with continued habitat fragmentation and ecological disturbance being unavoidable around the RoW. Although the overall connectivity of the wider woodland and savanna system remains largely intact, some areas may stay partially degraded after construction.

Overall, this results in a minor residual impact as the impacts a localised and are reversible for specific locales.

10.5.2.3 Operation and maintenance phase

The Project is not expected to contribute to any increased potential for the exploitation of timber and other forest products, nor increased pressure for additional land for small-holder faming activities. Nonetheless, measures should be put in place to protect the natural habitats and closer encroachment to the protected are from the effects of population influx during operations. Unplanned influx management can indirectly lead to increased habitat fragmentation of the miombo woodlands and grasslands.

Mitigation measures during the operations phase to avoid any inadvertent impacts to these valuable biodiversity receptors include:

- local education programs identifying biodiversity resources that are threatened and/or protected and discuss alternatives, such as conservation forestry.

Despite the implementation of mitigation measures, residual impacts are anticipated with indirect habitat fragmentation and degradation as a result of influx pressures. While the proposed project does not drive timber exploitation/extraction, the overall residual for habitat fragmentation/disturbance is considered minor due to the reversible nature for specific locales.

10.5.2.4 Reduced terrestrial vegetation cover

Clearance of both natural and modified habitats will occur during the pre-construction and construction phases of the project along the RoW and at sites for camps, stations, concrete batching plants and sleeper production sites. These activities will result in the temporary destruction of native vegetation across the site and removal of any secondary vegetation growth within modified habitats. The flora of the Project area is known to be already exploited for firewood and building materials. The grassland and miombo woodland habitats within a 1 km to 5 km area are considered natural but already show varying degrees of degradation as a result of existing agricultural fields, fuel source exploitation and the presence of alien invasive species. The natural habitats are therefore considered to be of low conservation importance and medium in sensitivity. In locations where the project will clear vegetation at existing quarries and for the connection to existing municipal infrastructure/services (water and electrical supply lines), the existing vegetation cover is expected to be modified. The sensitivity in these locations is considered low. The approximate extents of habitats that will be completely modified for the construction is indicated in the table below. Pre-construction landmine clearance will temporarily alter vegetation to facilitate clearance, but vegetation will be able to regrow post mine-clearance, as herbaceous as well as woody components of the indigenous vegetation have a high natural resprouting capability.

Vegetation unit	IFC Habitat	Disturbance level	Habitat condition	Approximate extent in AoI	Approximate extent to be converted
Aquatic areas - including rivers and wetlands	Natural	Low to Very High	Good to poor	± 4471.8 ha (± 8.5%)	Bare land ± 20 ha (± 0.04 % of AoI)

Vegetation unit	IFC Habitat	Disturbance level	Habitat condition	Approximate extent in AoI	Approximate extent to be converted
(Land cover classes water, wetlands and open bare land)					Wetlands ± 18 ha (± 0.03 % of AoI) Water will be avoided
Angolan Miombo Woodlands (Land cover class Forest/Woodland)	Natural	Moderate to High	Slightly degraded to Very poor	Combined: ± 1812.2 ha (± 3.4 %)	Combined: ± 16.3 ha (± 0.03% of AoI)
Forests (Land cover class Forest/Woodland)	Natural	Moderate to High	Slightly degraded to Poor		
Savannas and Grasslands (Land cover class Shrubland and Grasslands/ Herbaceous)	Natural	Moderate to High	Slightly degraded to Very poor	Combined: ± 31486.6 ha (± 59.7%)	Combined: ± 284 ha (± 0.54% of AoI)
Agricultural/ Croplands (Land cover class Croplands)	Modified	N/A	N/A	± 13312.7 ha (± 25.2%)	± 120 ha (± 0.23 % of AoI)
Modified/Degraded Habitats (Land cover class Built-up)	Modified	N/A	N/A	± 1669.8 ha (± 3.2 %)	± 16 ha (± 0.03 % of AoI)

10.5.2.1 Pre-construction and construction phase

The clearance of vegetation is expected to be limited to the footprint of the site and immediate surrounds. The impact magnitude and significance arising from clearance of the site has been assessed as major with respect to works related to along the RoW including cut and fill sections and excavation works and at sites for fixed camp sites, stations, concrete batching plants and sleeper production sites because the impact is inevitable and permanent. The significance of the removal of vegetation in locations where topsoil will be stripped along the RoW, at existing quarries or along excavated trenches to connect to municipality infrastructure/services is considered minor/negligible.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

Mitigation measures to be reviewed and updated in the above management plans during the construction phase to minimize the clearance of vegetation cover include:

- Rivers, riparian areas and their wetland floodplains to be avoided to the extent possible from direct clearance. Where this cannot be avoided to construct bridges and/or culverts, full reinstatement of the river and wetlands will be undertaken as soon as construction is completed
- clearance to be conducted under supervision by a trained and qualified ecologist who can identify instances of breeding birds and enact protective measures to ensure breeding or nesting is not interrupted
- pre-clearance checks for any other non-mobile species to be conducted by a suitably trained ecologist, with capture and relocation of individuals to adjacent suitable habitats where feasible
- sensitive and soft-start approach to vegetation clearance will be employed to enable fauna to disperse into surrounding habitats, starting at one end and working in a single direction
- avoid removal of large sections/patches, where feasible
- avoid removal of and sections/patches which will not be directly replaced by project infrastructure, where feasible
- identify, retain and/or relocate mature specimens of conservation importance
- identify and relocate young specimens of native trees during land clearance
- protected vegetation clearly marked (e.g. using flagging tape) and personnel and contractors must be instructed in the requirement to protect vegetation that has been marked
- avoid the use of herbicides and fire to clear vegetation
- replanting of native flora following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities
- areas to be cleared will be delineated and vegetation removal will be restricted to these designated areas only
- minimise access, disturbance to land and clearing of vegetation to prevent unnecessary ground disturbance
- limit access and disturbance to any additional natural areas outside of demarcated clearance zones.

Despite the implementation of mitigation measures, residual impacts from vegetation clearance are anticipated and are unavoidable. While sections of the RoW will continue to experience reduced vegetation cover compared to the surrounding areas. The residual impact is considered as minor, as the impacts localised and may recover over time, expect minimum direct areas where clearing was permanent.

Operation and maintenance phase

During the operation of the railway, there will be regular maintenance of the embankments and in culverts will include clearance of overgrown vegetation that has a direct effect to the safety of the track and the drainage capacity of the culverts. This is related to the potential impacts of the introduction of invasive species (below) and not appliable to the clearance of vegetations that could have already taken place during the construction phase.

Mitigation measures – operations phase

Mitigation measures during the operations phase to support the regeneration of native vegetation cover and in the long-term natural habitats include:

- avoid the use of herbicide and fire to clear vegetation (unless there is a significant increase in invasive alien vegetation to be kept under control)
- replanting of native flora following construction in cleared areas, which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities.

Despite the implementation of mitigation measures, residual impacts from routine operational vegetation clearance are anticipated and are unavoidable. While the repeated cutting may prevent vegetation from fully reestablishing, the residual impact remains minor as these are localised and short-term.

10.5.2.5 Removal of fertile topsoil to support vegetation recovery

Clearance and earthworks will result in removal of topsoil across the site in preparation for construction of project infrastructure. This process may also have secondary impacts associated with it, including increased potential for erosion and loss of primary and secondary seedbanks. It is expected that the loss of topsoil layers both beneath the construction footprint and adjacent areas will likely occur as direct impact of the construction phase. In addition, erosion created from surface run-off due to increase in impervious and hardened surfaces due to construction will contribute to soil infertility.

Pre-construction and construction phase

Given the temporary nature and highly localised extent of this effect, the magnitude has been assessed as low. The receptor sensitivity has been assessed as medium. The resulting impact significance is therefore considered to be moderate.

Mitigation measures – construction phase

Reference to existing Management Plan(s):

- *PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN.*

Mitigation measures already included in the Soil and Drainage Management Plan during the construction phase to avoid and reduce impact of loss of topsoil fertility, include:

- preservation and translocation of topsoil and seed bank as part of site rehabilitation / revegetation process. To be set aside for rehabilitation during post-construction landscaping
- all scoured topsoil to be stockpiled and maintained for use in re-vegetation of undeveloped areas, fringes, embankments and surrounds.

The residual impacts from topsoil removal are anticipated and are unavoidable, particularly with the reduction of soil quality and seedbank integrity. As the areas are expected to fully recovery, although at a slow rate, the overall residual impact is considered as minor.

Operation and maintenance phase

It is not anticipated to have continued earthworks and topsoil removal during operation phase. Consideration is given to unexpected, uncontrolled discharge of untreated effluents from cleaning of stations and liquid waste from septic tanks at the stations. These effluents will impact the fertility of the topsoil surrounding stations. Given the localised nature of the impact and the medium sensitivity of the receptor during operations, the magnitude is considered as medium and impact is assessed as moderate.

Mitigation measures – operation phase

Mitigation measures during the operational phase to avoid and reduce impact of loss of topsoil fertility

- installation of surface water drains around the hard surfaces at stations to collect and direct effluent to the designated septic tanks
- regular emptying of station septic tanks to the municipal wastewater treatment plants.

An anticipated and unavoidable residual impact is the localised alteration and degradation of the topsoil quality, even with the implementation of mitigation measures, small contamination may persist. However, the residual impact is considered as negligible as it is of a very small scale and can be further minimised through routine monitoring.

10.5.2.6 Introduction of alien invasive species

Pre-construction and construction work involves the mobilisation of workers, mobilisation of machinery and equipment and the collection, transportation, handling, storage and disposal of various types of materials. This movement between towns along the project corridor and where necessary from other cities outside of the project area increases the chances of the introduction of invasive or non-native floral or faunal species, also known as Alien Invasive Species (AIS). Other activities during construction and operation phases that can introduce AIS includes the movement of solid waste from camps to the designated dumpsite(s) and during the restoration of construction sites and the spreading of stockpiled soil. These invaders may out-compete or predate upon the native species, resulting in a shift of ecological landcover in the area. Such an introduction would be considered an unintended impact but may occur as a result of planned activities and have far-reaching consequences if left unmitigated.

As the terrestrial project area is largely within natural habitats and closely surrounded by a similar assemblage of floral species, the areas immediately surrounding the site would be susceptible to significant impact from the introduction of AIS to the area. Introduction of pest species such as rats or feral cats via mobilisation of construction workforce and equipment may also impact native fauna and avifauna populations.

Pre-construction and construction phase

The potential introduction of a floral or fauna AIS would be considered potentially significant, as the spread of any AIS into either wetland, woodland or grassland habitats may result in similarly damaging results. Receptor sensitivity of the landcover within the project AoI has been assigned as high, given that such impacts may cause generational reduction in populations and genetic diversity. The impact magnitude arising from the potential introduction of AIS has been assessed as high during the removal to topsoil, removal of sub-soils, stockpiling and spreading of stripped soils and rehabilitation of land restoration activities during construction demobilisation activities, resulting in a significantly major impact. The magnitude of the impact during other construction activities is considered medium and the significance as moderate.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-PL-057-OECLS_INVASIVE SPECIES MANAGEMENT PLAN_EN
- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

Mitigation measures to be reviewed and updated in the above management plans during the construction phase to avoid and reduce impacts of AIS include:

- implement an eradication programme to remove existing and new introduced and/or invasive species, particularly along roadsides and construction sites within the Project footprint area
- regular inspections within new and existing disturbed areas and newly disturbed areas for seedlings of AIS species
- control measures for weed management will include wash down facilities, controlled access to designated areas, ongoing monitoring and personnel training
- eradication programs will be considered with regards to pest fauna species
- where pest management has been identified as required (e.g. feral cats, rats, etc.), control measures will be considered including trapping, eradication, relocation and baiting. These programs will be supported by relevant training and awareness of employees and contractors
- wastes disposed of in the landfill shall be routinely covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species
- depending on the chosen method of the selected waste site, the waste will be covered/removed regularly to limit the exposure to fauna and potential of diseases being spread
- waste should only be collected in receptacles in designated areas, which will be emptied regularly at the landfill
- continuous awareness raising, training and site inspections regarding introduction and invasion of alien fauna and spread of diseases.

An anticipated and unavoidable residual impact is the localised persistence of more alien invasive species despite the implementation of mitigation measures. As the receptor sensitivity is assessed as high during the construction phase vegetation clearance, the residual impact is considered as minor as the impact is highly localised and invasive species are required to be removed rapidly, reducing their presence and reducing the edge effect.

Operation and maintenance phase

It is expected that during operations, AIS can continue to be introduced in the project area from the continuous movement of the locomotives, the movement of people, goods and equipment. It is therefore assessed that impact magnitude arising from the introduction of AIS into the surrounding environment is medium, given that such impacts may cause generational reduction in populations and genetic diversity. The resulting impact significance is considered to be moderate.

Mitigation measures – operations phase

Mitigation measures during the operation phase to avoid and reduce impacts by AIS include:

- eradication programs will be considered with regards to pest fauna species
- where pest management has been identified as required (e.g., feral cats, rats, etc.), control measures will be considered including trapping, eradication, relocation and baiting. These programs will be supported by relevant training and awareness of PAPs
- wastes disposed of in the landfill shall be routinely covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species
- depending on the chosen approach to waste management, the waste will be covered/removed regularly to limit the exposure to fauna and potential of diseases being spread
- waste should only be collected in receptacles in designated areas, which will be emptied regularly at the landfill.

An anticipated and unavoidable residual impact is the localised persistence of more alien invasive species along the RoW despite the implementation of mitigation measures. The residual impact is however considered as minor as the impact is highly localised, requiring ongoing monitoring and rapid removed measures, reducing their presence and reducing the edge effect.

10.5.2.7 Disturbance and emigration of fauna (and avifauna) species due to habitat degradation

Clearance and modification of both natural and modified habitats (impact of loss of terrestrial vegetation above) are required to make way for construction of the project infrastructure indirectly contribute to the degradation of habitats and subsequent loss or displacement of native fauna, particularly those species not able to move out of the area quickly at the onset of clearance activities. In addition, the loss of these habitats will result in loss of available breeding habitat for both avifauna and various herpetofauna which traverse the project's RoW. This is for concern for Terrestrial and avifauna SCC in the project AOI including: *Aonyx capensis* – Cape Clawless Otter, *Terathopius ecaudatus* – Bateleur and *Falco vespertinus* – Red-footed Falcon. This receptor of terrestrial fauna and avifauna is considered to be of relatively high sensitivity.

Similarly, whilst using the most conservative approach, critical habitat is possible for the Amur Falcon and the Angolan Catfish. Both species have been confirmed in the AoI, which is respectively over 600 km and 100 km away from the known distribution (as assessed by IUCN and others) of these species. This expansion of range of both species highlights the deficiencies in knowledge regarding both species and local biodiversity, but with further monitoring data that can be collected during construction and operation, it is anticipated that it can be scientifically verified that the AoI does not qualify for critical habitat, but does contain priority biodiversity features.

Pre-construction and construction phase

Given the highly localised extent of this effect, the magnitude has been assessed as medium. As the impact is permanent however, the resulting impact significance is therefore considered to be moderate.

Mitigation measures - Pre-construction and construction phase

Reference to existing Management Plan(s):

- *OECLS-AF-PG-GER-002_TRAINING PLAN_EN.*

The above-mentioned training plan to include the following topics during the construction phase to avoid and reduce impacts to fauna on the site include:

- ongoing monitoring during construction and at least the first five years of operation on the seasonal occurrence and abundance of Amur Falcon (and informing if adaptive management will be required), and the Angolan Catfish – latter could be done by collecting eDNA samples during the wet and dry seasons, with emphasis on perennial rivers and wetlands
- induction training to include topic on prohibiting construction site staff and contractors from hunting, buying, or trading of wildlife as well as the collection of aquatic resources, timber and other resources to help conserve existing fauna and forestry resources
- environmental education and awareness programs for all Project staff and contractors (e.g. through staff inductions). This will improve the understanding of the importance of native resources for local communities and ensure that the prohibitions and penalties regarding hunting, wildlife trade and the collection of other forestry resources are widely known.

An anticipated and unavoidable residual impact is the localised reduction of habitat availability for sensitive terrestrial and avifauna species, despite the implementation of mitigation measures. The residual impact is expected to be site-specific, short-medium term and of minor significance, reflecting the alteration of the habitat within the cleared RoW and the ability of species being able to relocate, adapt and thrive within the new environments.

Operation and maintenance phase

The activities related to the clearance of vegetation that support fauna and avifauna will primarily take place during construction phase. The operational activities that may contribute to the disturbance and emigration of fauna are considered as noise and vibration described below.

10.5.2.8 *Impact from light, dust, noise and vibrations on terrestrial fauna* (and avifauna)

Construction activities will result in direct localised impacts from dust lift, noise and vibrations arising from construction vehicle and heavy machinery movements as well as piling and other required construction processes. These emissions may result in avoidance and other behavioural changes by mobile fauna. From the perspective of project fauna receptors, such impact will expectedly be highly localised and transient in keeping with the nature of the corresponding construction activities, and occasional during the operation of the locomotives.

Pre-construction and construction phase

Given the temporary nature and relatively localised extent of this effect, the magnitude has been assessed as medium and the significance as moderate. This is with except for relatively loud activities such as blasting and crushing at quarries where the magnitude is assessed as high and significance as major.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN

- PI-PR-104-OECLS_PROCEDURE FOR CONTROLLING ATMOSPHERIC EMISSIONS, NOISE AND VIBRATION_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

The above existing Management Plans to be reviewed and updates as necessary to include the following mitigation measures during the construction phase to avoid and reduce dust and noise impacts to surrounding fauna:

- avoid works during particularly windy conditions
- confine vehicle movement to designated access routes and roads
- minimise dust and pollution emissions using equipment with industry standard reduction systems and comply with applicable standards, where practicable
- minimise dust through watering roads and cleared areas, especially during the dry season
- use of native flora of local providence to provide a natural dust, light and noise barrier areas which are surrounding the footprint of construction zones like concrete batching plants and sleeper production site.
- maintain all machinery to ensure both air and noise emissions are minimised and below applicable standard levels
- where exceedance of the work site or environmental noise limits occurs, secondary noise barriers such as hoarding should be provided where feasible
- install lights that illuminate towards and within delineated construction zones and avoid illuminating upwards or outwards towards natural vegetation cover.

An anticipated residual impact is the temporary disturbance to mobile species causing minor displacement and behavioural changes from the immediate project footprint. As project noise activities are not intense and transient in nature, the residual impact is considered as minor and largely reversible.

Operation and maintenance phase

Movement of locomotives along RoW and movement of fuel trucks are the primary activities during operational phase that will generate noise and vibrations. The occasional use of the existing quarries for maintenance works along the embankments may raise dust, however this is considered as a negligible. The sensitivity of the receptor is considered high, however because of the relatively few numbers of trains scheduled per day with no night time schedule, the magnitude and significance of the impact is considered moderate.

Mitigation measures – operation and maintenance phase

Mitigation measures during the operation phase to reduce impacts of noise include:

- confine maintenance vehicle movement to designated access routes along the railway RoW
- use of native flora of local providence to provide a natural dust, light and noise barrier areas which are surrounding the footprint of construction zones like concrete batching plants and sleeper production site
- maintain locomotives to ensure both air and noise emissions are minimised and below applicable standard levels

- where exceedance of the work site or environmental noise limits occurs, secondary noise barriers such as hoarding should be provided where feasible
- install lights that illuminate towards and within delineated station boundaries and avoid illuminating upwards or outwards towards natural vegetation cover.

An anticipated residual impact is the localised and intermittent disturbance to mobile species from noise and vibration causing minor behavioural changes from the immediate project footprint. As operation of the railway are not intense, have limited movements, transient in nature and with no nighttime operations, the residual impact is considered as negligible, with minimal long-term effects for the broader species population.

10.5.2.9 *Direct mortality of fauna (and avifauna) from collision*

Preconstruction and construction activities will increase the number of vehicles, heavy vehicles and machinery along the railway RoW and at infrastructure locations. This will increase the risk of road kill. The sensitivity of fauna and avifauna has been considered as negative due to the greenfield nature of the project corridor. Carcass left along the RoW will also attract pests and scavengers and increase bad odours if left un-disposed.

Pre-construction and construction phase

The magnitude of the impact is assessed as medium considering the distance the project corridor is from critical habitats and protected areas, the absence of migratory routes, the absence of IBA or avifauna assemblage hotspots and the relatively low abundance of fauna observed during the surveys. However, as the impact will most likely occur as a result of the increased number of vehicles, the impact is assessed as moderate.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- *OECLS-AF-PG-GER-002_TRAINING PLAN_EN.*

The above-mentioned training plan to include the following topics during the construction phase

- induction topic on road kill and incidence recording and reporting procedure
- environmental education and awareness programs for all Project staff and contractors (e.g. through staff inductions). This will improve their understanding of the importance to avoid direct mortality of any fauna encountered either at the camps or along the construction sites.

In addition to training, the Project shall include the following mitigation measures:

- implement reduced train speeds in sones with potentially more wildlife
- construct trenches along the track that can act as deterrence (steepness), re-direction or to trap wildlife at a distance safe from the railway track

Despite the implementation of mitigation measures, residual impacts are anticipated and unavoidable with ongoing risk of wildlife mortality. Some sensitive small-medium sized terrestrial species the move across the construction areas may continue to be affected. Overall, the residual impact is site specific and largely limited to areas of high traffic concentrations, of which no higher traffic concentration areas are not anticipated, and is therefore considered minor in significance.

Operational phase

During operational phase, the potential incidences of mortality of fauna would relate to collision with either the locomotives or the signs placed along the RoW (the latter mostly related to avifauna). The magnitude of the impact is assessed s medium and the impact significance as moderate.

Mitigation measures –operation phase

- conduct environmental education and awareness programs for all Project staff at stations and operating the locomotives. This will improve their understanding of the importance to avoid direct mortality of any fauna
- regular inspection of the railway alignment to re-locate nests and burrows that fauna are establishing within the immediate 50 m of the track.
- clear vegetation near the tracks to remove attractive sites for foraging or shelter
- maintain monitoring records of wildlife mortality due to collisions along the railway to inform whether there is a need to implement deterrent systems (olfactory repellents or acoustic devices) at locations where there is evidence of higher wildlife crossing and collisions.
-

Despite the implementation of mitigation measures, residual impacts are anticipated and unavoidable with ongoing risk of wildlife mortality. Some sensitive small-medium sized terrestrial species the move across the operational areas may continue to be affected. Overall, the residual impact is site specific and largely limited to areas of high traffic concentrations, of which no higher traffic concentration areas are not anticipated, and is therefore considered minor in significance.

10.5.2.10 Waste and litter accumulation in nearby habitats

Should temporary workforce accommodation or catering services be required at the construction site, generation of litter on site during the construction phase would expectedly be limited to construction wastes and waste streams associated with preparation of food for workers.

Packaging and food waste will typically be generated in a single location at the kitchens or mess facilities. If not properly managed, such wastes will likely enter the environment and surrounding habitats where such accumulation may result in generalised degradation of habitats as well as choking hazards to fauna species mistaking waste as food. This impact is easily prevented and managed through application of simple housekeeping procedures and good waste management processes.

Pre-construction and construction phase

The rate of waste generation is expectedly relatively small for a construction project of this type and the magnitude of this impact is conservatively assessed as low. The receptor sensitivity has been assessed as low, as it is expected that such an impact would be limited to the local area immediately adjacent to the construction site and catering facilities. The resulting impact significance is therefore considered to be low.

Mitigation measures – construction phase

Reference to existing Management Plan(s):

- PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN.

Mitigation measures during the construction phase to avoid and reduce litter impacts to surrounding fauna included in the existing management plan have considered that:

- disposable food and plastic waste should be temporarily stored in labelled, secure bins and skips before being disposed of in the appropriate landfill or recycling facility
- packaging for both food, ingredients and construction materials should be segregated into appropriate bins / skips and disposed of in accordance with the Project waste management plan
- bins and skips shall be covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species.

Despite the implementation of mitigation measures, residual impacts are anticipated and unavoidable with waste that may not be fully contained or removed, potentially attracting pests. However, waste is expected to be quickly managed at site -specific level, and the residual impact is therefore considered negligible-minor with no lasting consequences.

Operation and maintenance phase

Once inhabited, the relocation housing will expectedly operate under municipal or local waste collection systems. It is expected that waste generation will be relatively small for a settlement of this size, with a subsequent impact significance of minor.

Mitigation measures – operations phase

Mitigation measures during the operations phase to avoid and reduce litter impacts to surrounding fauna include:

- disposable food and plastic waste at stations should be temporarily stored in labelled, secure bins and skips before being disposed of in the appropriate landfill or recycling facility
- bins and skips at stations shall be covered to prevent wind-blown litter, odours and to limit access by native fauna and pest species
- waste disposal protocols at stations should be kept in line with the recommendations of the waste management practices.

Despite the implementation of mitigation measures, temporary residual impacts are anticipated and unavoidable with small waste that may not be fully contained or removed, potentially attracting pests. However, waste is expected to be quickly managed at site -specific level, and the residual impact is therefore considered negligible-minor with no lasting consequences.

10.5.3 Aquatic biodiversity impacts

10.5.2.11 Reduced water quality in waterways due to increased siltation

Water quality surveys indicate that the surface watercourses of the Project area are typically unpolluted with the exception of *e. coli* and faecal coliforms. Baseline sediment and siltation levels are therefore considered to be generally within normal parameters. Clearance of surface vegetation increases the likelihood of soil erosion and resultant siltation impacts occurring in local waterways. During periods of heavy rain, there is a potential for sedimentation impacts to arise in areas of ongoing earthworks or cleared of vegetation and not yet replanted.

Pre-construction and construction phase

Runoff water from construction sites may be laden with soil or spoil materials and may obstruct natural drainage systems, watercourses and natural sedimentation regimes. Such changes in hydrology and drainage regimes may result in impacts to downstream aquatic species and habitats, both within the water column and benthos. In addition, the construction of the bridges will disturb the sediment in waterways and increase siltation further downstream.

Receptor sensitivity has been assigned as high, while the impact magnitude arising from the loss of water quality and potential siltation of surface watercourses has been assessed as medium. The resulting impact significance is considered to be moderate.

Mitigation measures – Pre-construction and construction phase

Reference to existing Management Plan(s):

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-090-OECLS_EROSION CONTROL OF THE MANAGEMENT PLAN_EN
- PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN.

The above-mentioned Management Plans have measures to be applied during the construction phase to avoid and reduce impacts to aquatic habitats. The following proposed measures are to be reviewed and adopted based on the results of the site specific Identification of Aspects and Assessment of Environmental Impacts procedure:

- retention of natural sediment traps
- retention of wetlands and existing drainage channels
- stabilise landforms and implement erosion prevention measures during construction
- any enabling / earthworks required in riverbeds will be conducted during the dry season and confined to the smallest area possible
- maintain root systems (wherever practical) to maintain soil stability by cutting vegetation at ground level, thereby minimising soil erosion
- install sediment traps to capture suspended sediments in drainage systems or channels susceptible to erosion
- areas to be cleared will be delineated and vegetation removal will be restricted to these designated areas only.

Despite the implementation of mitigation measures, residual impacts are anticipated and unavoidable with the temporary reduction in water quality and increased siltation, causing short-term aquatic species and habitat disturbance. Overall, the residual impact is site-specific, expected to be largely reversible after the construction phase and natural sedimentation and waterflow restored, therefore the residual impacts are considered as minor.

Operations and maintenance phase

Removal of surface vegetation will expectedly occur across the wider AoI as more people move into the provinces where ethe project is located. Moxico Province has potential to increase its agricultural produce and people the increase utilisation of any available land for farming and grazing practices will increase surface run off and sedimentation in the

rivers. This is an indirect impact of the operation of the railway. The effect of this on water quality in neighbouring surface streams is however not expected to result in significant levels of change.

A more direct impact during operation phase that results in increased siltation is maintenance dragging works at bridge locations. While the receptor sensitivity is still considered high, this impact is conservatively assessed as moderate in magnitude, short in duration, occasional and local in extent. The resulting significance is therefore assessed as moderate.

Mitigation measures – operations phase

Mitigation measures during the operations phase to avoid and reduce impacts to riparian habitats include:

- retention of natural sediment traps
- retention of wetlands and existing drainage channels
- maintain root systems (wherever practical) to maintain soil stability by cutting vegetation at ground level, thereby minimising soil erosion
- install sediment traps to capture suspended sediments in drainage systems or channels susceptible to erosion.

Despite the implementation of mitigation measures, residual impacts are anticipated and unavoidable with the occasional reduction in water quality and increased siltation during maintenance activities. The residual impact is considered minor as the project activities are not expected to cause significant changes, with minimal long-term consequences for the aquatic ecosystem.

10.5.2.12 Reduction in water quality in waterways due to waste and discharges

Water quality surveys indicate that the surface watercourses of the Project area are typically unpolluted with the exception of e. coli and faecal coliforms. Mobilization and construction work involve collection, transportation, handling, storage and disposal of various types of materials, solvents, etc., some of them containing pollutants. Planned or accidental discharges will involve various types and quantities of both hazardous and non-hazardous solid and liquid wastes. Even small quantities if not properly managed may have impacts on the receiving environment and may degrade the habitat in which they accumulate. In particular, pollution entering watercourses and downstream wetland areas is potentially detrimental to the habitat and its ability to support the aquatic fauna and flora that utilise them. The Project is also expected to require usage or storage of large quantities of fuel.

Pre-construction and construction phase

Receptor sensitivity has been assigned as high, while the impact magnitude arising from the potential introduction of waste and pollutant materials to surface watercourses has been assessed as medium, given that such impacts will expectedly occur for a relatively rarely, for a short period and on a local scale. However the project area has numerous watercourses, the resulting impact significance is considered to be moderate.

Mitigation measures – construction phase

Reference to existing Management Plan(s):

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN
- PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN
- PI-PL-101-OECLS_SOIL AND DRANAGE MANAGEMENT PLAN_EN
- PI-PL-060-OECLS_MANAGEMENT OF SOLID WASTE AND HAZARDOUS MATERIALS_EN.

The above-mentioned Management Plans have measures to be applied during the construction phase to avoid and reduce impacts to aquatic habitats that includes:

- waste materials from the construction process to be utilised as fill where feasible, with a zero-dumping policy for catchment areas and waterways
- all liquid pollutants and wastes stored within secondary containment and hard stand flooring, a minimum of 100 m from open water bodies and surface water courses
- all solid and liquid fuel stores placed within secondary containment and hard stand flooring, a minimum of 100 m from open water bodies and surface water courses
- all liquid material and waste storage facilities to be equipped with appropriate spill kits and containment instructions for unplanned spills
- the contractor will develop a fit-for-purpose spill response plan, including training for all on-site personnel, as part of the Project's ESMP
- all solid waste stores to have appropriate covers to prevent wind blown materials entering the environment.

An anticipated residual impact is the localised, short-term risk of water pollution from accidental discharge of hazardous and non-hazardous materials, despite the implementation of mitigation measures. This may lead to temporary reductions in water quality and disturbance of the aquatic ecosystem. The residual impact is site-specific and largely reversible after the construction phase, and therefore it is considered a minor significance.

Operation and maintenance phase

During operations, the use and maintenance of stations will involve collection, transportation, handling, storage and disposal of various types of materials, solvents, etc., some of them containing pollutants. Planned or accidental discharges will involve various types and quantities of both hazardous and non-hazardous solid and liquid wastes. In addition, there will frequent transportation of fuel and considerable fuel storage at designated stations. Receptor sensitivity has been assigned as high, while the impact magnitude arising from the potential introduction of waste and pollutant materials to surface watercourses has been assessed as medium, given that such impacts are not expected to occur on an ongoing basis. The resulting impact significance is considered to be moderate.

Mitigation measures – operations phase

Mitigation measures during the operations phase to avoid and reduce impacts to riparian habitats include:

- all liquid pollutants and wastes stored within secondary containment and hard stand flooring, a minimum of 100 m from open water bodies and surface water courses
- all solid and liquid fuel stores placed within secondary containment and hard stand flooring, a minimum of 100 m from open water bodies and surface water courses
- all liquid material and waste storage facilities to be equipped with appropriate spill kits and containment instructions for unplanned spills.

An anticipated residual impact is the localised, short-term risk of water pollution from accidental discharge of hazardous and non-hazardous materials at the stations, despite the implementation of mitigation measures. This may lead to temporary reductions in water quality and disturbance of the aquatic ecosystem, but the residual impact are expected to be short-term, site-specific, with minimal consequences, and therefore it is considered a minor significance.

10.5.2.13 Disturbance and emigration of aquatic fauna (and avifauna) species due to habitat degradation

Clearance and modification of riparian habitats and instream benthic ecosystems are required to for the construction of the bridge. The Project has 11 planned bridges; therefore, the extent is considered as high. The degradation of these aquatic habitats will result in a temporary decrease loss or displacement of native aquatic fauna and avifauna, disturb breeding sites. This receptor of aquatic fauna and avifauna is considered to be of relatively high sensitivity.

Pre-construction and construction phase

Given the highly localised extent of this effect, the magnitude has been assessed as medium. As the impact is permanent however, the resulting impact significance is therefore considered to be moderate.

Mitigation measures - Pre-construction and construction phase

Reference to existing Management Plan(s):

- *OECLS-AF-PG-GER-002_TRAINING PLAN_EN*
- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

Mitigation measures included in the above-mentioned Management Plans during the construction phase to avoid and reduce impacts to aquatic fauna and avifauna on the site include:

- prohibit construction site staff and contractors from establishing instream aquaculture ponds, large scale fishing, as well as the collection of aquatic resources such as sand mining to help conserve existing habitats and aquatic resources that support aquatic fauna and avifauna
- conduct environmental education and awareness programs for all Project staff and contractors (e.g. through staff inductions). This will improve the understanding of the importance of native resources for local communities and ensure that the prohibitions and penalties regarding hunting, wildlife trade and the collection of other forestry resources are widely known

- replanting of native flora following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities.

Despite the implementation of mitigation measures, residual impacts are anticipated and unavoidable with the alteration of riparian and instream habitats, resulting in displacement of species and loss of habitat. The residual impacts are however considered as minor due to it being confined to the immediate project footprint.

Operation and maintenance phase

The activities related to the clearance of riparian habitats and disturbance of benthic ecosystems that support aquatic fauna and avifauna will primarily take place during construction phase. Therefore, operational impacts are considered negligible. Impacts related to maintenance dredging is covered above with respect to siltation.

Operational activities are not expected to exacerbate the residuals impacts similar to the construction phase, and therefore the residual impacts are considered negligible.

The detailed significance assessment of the biodiversity impacts presented above is provided separately in Appendix 16.5.

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10.6 Ecosystem Services Impact Assessment

The communities within the project area depend on and benefit from the ecosystem services provided by the natural environment, including provisioning services (i.e. food, water, natural raw materials indicated in chapter 6), regulating (i.e. climate, natural processes), cultural (i.e. reactional and spiritual benefits indicated in chapter 7) and supporting services (i.e. nutrient and water cycling indicated in chapter 9). As a result of the project activities, access to ecosystem services can be disrupted/impacted. These impacts associated with the project activities are discussed below.

10.6.1 Destruction of medicinal plants .

There are communities within the project area that rely on native plants for medicinal and wellbeing purposes. Historically, the people of the Tchokwe culture have always resorted to traditional medicine to solve their health-related issues. The baseline conditions indicate that these plants may be impacted during the project activities. However, traditional authorities and community members stated that the clearance of the medicinal plants within the project area will not prevent their continued use for medicinal and wellbeing purposes. In line with IFC Performance Standard 6 (PS6) and Guidance Note 6, medicinal plants used by local communities fall under type I of Priority Ecosystem Services. Specifically, they are considered a provisioning ecosystem service because they provide direct material benefits to people

10.6.1.1 Construction

Construction activities involve land clearing, particularly for the development of access roads, RoW, camps and stations. Land clearing can cause the removal/destruction of medicinal plants such as the Muxihi/Mussivi, Mumanga, Mutxatxa, Muaio, Mucondo, Mussala, and Mutongo, that are more common to certain communities (see Table 10.6-1 below). These communities depend on these plants for health purposes, and the destruction of the plants will reduce access to natural remedies, that residents use for well-being and health.

This impact is considered medium in sensitivity and magnitude because of the common use of medicinal plants in multiple communities along the road, with medium term duration during construction phase where communities will need to identify alternative locations to access the plants used. The impact significance is assessed as moderate.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en
- PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

The above mentioned plans have appropriate measure for the identification of potential impacts on medicinal plants, minimizing the footprint of vegetation clearance avoid removal of large sections/patches, where feasible and restoring construction areas. These will be reviewed and updated to reflect the importance of medicinal plants along the Luena Saurimo Corridor and include the following:

- conduct a comprehensive survey to identify and map areas where important medicinal plants used by the Tchokwe community are located. Engage local traditional healers and community members in the identification process
- clearance to be conducted under supervision by a trained and qualified ecologist who can identify medicinal plants used by the communities
- where possible avoid removing or damaging medicinal plants
- create local nursery sites of native plants towards replenishing lost stock of medicinal plants.

Despite the implementation of mitigation measures, residual impacts are anticipated with the loss of some individual medicinal plants being unavoidable. However, the residual impacts are considered to be minor due to the reversible nature for specific locales and affecting communities directly adjacent to the cleared areas.

10.6.1.2 Operational and maintenance phases

The operational and maintenance phases include regular maintenance of RoW and stations that will require excess growth of natural vegetation along railway embarkments, culvert and bridges to be cleared. This will mean any medicinal plants that have re-grown along these areas will need to be removed. Overall clearing of natural re-grown vegetation will disturb the natural environment and spread invasive species, leading to a

decline/destruction of medicinal plants used by the communities. This can have an indirect effect of eroding the cultural knowledge on the use of native plants for medicinal and wellbeing purposes and increase the dependency on pharmaceutical drugs that are more costly, especially within the rural communities of the project area.

This is a long term impact indirect impact of moderate sensitivity and magnitude. The significance is assessed as moderate.

Mitigation measures – operation phase

The operator will develop and implement a procedure that will include measures to

- maintain the locations where rehabilitation and restoration of degraded areas were initiated during construction
- avoid removing or damaging medicinal plants during maintenance of the project locations
- contribute to tree nurseries established during construction.

Despite the implementation of mitigation measures, residual impacts are anticipated with the loss of some individual medicinal plants being unavoidable. However, the residual impacts are considered to be minor due to the reversible nature for specific locales and affecting communities directly adjacent to the cleared areas.

10.6.2 Reduced access to/availability of forest derived products

The Project activities will require the clearance of vegetation during construction for the development of project infrastructure. This will lead to the disturbance and/or removal of natural habitats and natural vegetation cover. This will impact communities who depend on the forest products used for their daily activities and economic activities. Table 10.6-1 provides a summary of how the communities within the project area benefit from the ecosystem services of natural forest/woodland habitats.

Reduced access to/availability of forest-derived products should is classified as a Type I Priority Ecosystem Service since it reduces the availability of forest products (fuelwood, construction materials, wild foods, medicinal plants) that communities rely on for daily subsistence and economic activities.

Table 10.6-1: Community resources derived from forest ecosystems

Province	Municipality	Communities	Ecosystem services
Lunda Sul	Saurimo	Muieie	Charcoal and firewood[110]
		Luari	Charcoal and firewood
		Nanguanza	Charcoal and firewood
		Muamucalanganza	Firewood and medicinal purposes
		Muanguji	Honey

[110] Firewood (synonym: fuelwood) is defined by the Food and Agriculture Organization of the United Nations (FAO) as “wood in the rough (from trunks and branches of trees) to be used as fuel for purposes such as cooking, heating or power production.

Province	Municipality	Communities	Ecosystem services
		Saquembue	Firewood and medicinal purposes
		Caiaza	Farming, hunting, firewood and charcoal
		Cassamba 1	Charcoal, firewood, timber, beams
	Dala	Sangoma	Firewood and medicinal purposes
		Mombo	Charcoal and wood
		Mucuangaji	Firewood and medicinal purposes
		Satxitende	Farming, hunting, firewood and charcoal
		Nacatoco, Sayassua	Honey
		Luele	Cultivation, firewood and charcoal
		Sassuco, Biula, Sacacuca	Firewood
Moxico	Moxico	Canda I, Canda II, Samauzo	Cultivation and firewood
		Sacapiasso, Migotchi	Firewood and medicinal purposes
	Camanogue	Musseringinge	Firewood and medicinal purposes
		Samucanda, Sacambuji	Firewood and medicinal purposes
		Muapeso	Cultivation and honey
		Mumanga, Caiza, Saissazo	Firewood and medicinal purposes
		Camanongue Municipality, Central neighborhood, Neighborhood 5000, Neighborhood 200 casas, Samalengue	Firewood and medicinal purposes
		Kamaleke	Honey, make beams, boards, and other timber products

10.6.2.1 Construction

During land clearing activities, trees at camp locations, station location, areas along the RoW and proposed access road would need to be cleared/cut down. This will impact communities that depend on the forest products highlighted in Table 10.6-1above. The removal/destruction can lead to reduced availability of raw materials to make firewood,

charcoal and lumber, causing a loss in informal local economies. Moreover, households will have an increased dependency of purchased fossil fuels as a source of energy for cooking purposes. In addition, trees provide essential ecosystem services such as air and water purification, climate regulation, and soil stabilization. Un-controlled deforestation can impair these services, affecting long-term human well-being and environmental health.

This impact is considered medium in sensitivity and magnitude because of the common use of forest products in multiple communities within the project area, with medium term duration during construction phase where communities will need to identify alternative locations to access the forest products needed. The impact significance is assessed as moderate.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

- PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN
- PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en
- PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN
- PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.
- Identify potential impacts on natural habitats and vegetation cover before construction.
- Minimize vegetation clearance footprint, avoiding removal of large sections or patches.
- Restore cleared construction areas by replanting suitable vegetation based on sunlight and rainfall conditions.

The above plans have appropriate measure for the identification of potential impacts on natural habitats and vegetation cover, minimizing the footprint of vegetation clearance, avoiding removal of large sections/patches, where feasible and restoring construction areas by replanting following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities.

Despite the implementation of mitigation measures, residual impacts are anticipated with the localised reduction in the availability of resources, however, as the effects are site-specific and affect communities that previously depended on these resources, the overall residual impact is considered as minor.

10.6.2.2 Operation

During the operational and maintenance phase, the activities undertaken are not anticipated to pose a risk or cause any disturbance to natural forest/woodland habitats and vegetation cover.

10.6.3 Modification of agricultural land

As the agricultural land provides provisioning services (food, income, livelihoods) directly to affected communities. Modifying the agricultural land will most have an adverse impact

on communities, reducing access to land and productivity. This is categorized as Type I priority ecosystem services as per IFC Guidance Note 6.

10.6.3.1 Construction

The construction of the Project infrastructure such as permanent camp facilities, stations and rail infrastructure will require the availability of land. This means that the existing land will require clearing and permanent removal of natural vegetation cover to accommodate the new infrastructure along the RoW. This will lead to permanent change/modification of the natural landscape, potentially affecting or reducing the amount of land available for agriculture purposes. Moreover, the destruction of natural vegetation cover can interfere with natural nutrient cycles, affecting plant growth and reducing the quality of soil.

The sensitivity of the landscape is considered as medium because although the construction is a greenfield project, parts of the right of way are already modified habitats cleared by residents for agriculture (refer to section 9.7 in the biodiversity baseline). The potential effect of decreased crop production will be determined during the preparation of a separate Livelihoods Restoration Plan (LRP). The magnitude is considered moderate due the number of stations, land needed for the camps and length of railway RoW needed. Therefore, the impact significance is assessed as moderate in significance.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN

PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en

PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN

PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

The above management plans include measures that will

- minimise clearance of agricultural land, natural vegetation and habitats at the fringe of the construction sites,
- replant following construction in cleared areas which still exhibit suitable conditions (sunlight, rainfall etc.) to sustain the original vegetative communities.
- avoid removal of large sections/patches, where feasible

An anticipated residual impact expected is the permanent alteration of the land and reduced agricultural land, affecting livelihoods; however the residual impact is considered as minor with the full extent of socioeconomic consequences to be addressed through the LRP.

10.6.3.2 Operations and maintenance

The continuous clearance of natural vegetation near and around bridges, stations, camps and along RoW during operational phase will contribute to the permanent modification of land that would otherwise be used for agriculture interfere with natural nutrient cycles, reduce the quality of soils for plant growth. The sensitivity of the landscape and soils surrounding the project infrastructure is medium, however the magnitude of the potential

impact is low because the receptor would be already modified from the construction phase. Therefore, the significance is assessed as minor. The separate LRP will consider the magnitude and sensitivity of its indirect contribution to an overall decrease in crop production, particularly within communities that depend on farming and cultivating on these lands. The separate LRP to be conducted is to consider this long-term impact and provide appropriate measure for the communities.

Despite the implementation of mitigation measures, residual impacts on the modification of agricultural land are anticipated and unavoidable. Since areas will be modified during the construction phase, the additional operational contributes minimal loss or disruption of soil. Therefore, the residual impacts are considered as minor, with broader socioeconomic consequences to be addressed through the LRP.

10.6.4 Displacement of wild animals and bees

The biodiversity baseline (refer to Chapter 9) indicates that communities within the project area that use on open land/forests for hunting wild animals and beekeeping for producing honey. Although the current baseline information indicates that there is a small dependency on hunting wildlife animal, the construction activities can disrupt the connectivity of natural habitats and disturb wild animals leading to their displacement.

Hunting and beekeeping are provisioning ecosystem services that provide food, income, and cultural value to affected communities. Even though dependency on hunting is relatively small, project activities (vegetation clearance, habitat fragmentation, disturbance of wildlife) can directly reduce availability of these resources. This fits the definition of Type I, as the project's operations are likely to have an impact that results in adverse effects on communities.

10.6.4.1 Construction

During preconstruction and construction activities that include vegetation clearance, earth works and the construction of temporary roads and campsites, there is a potential of animals being displaced, as their natural habitats become destroyed or altered. There will also be the generation of noise from the increase in construction activities and movement of workers and construction vehicles and the use of equipment that will disturb/alarm wild animals that will tend to move away from the vicinity. In some cases, the displaced animals may face increased mortality rates due to the lack of suitable habitats or human-wildlife conflicts. The sensitivity of the receptor is considered medium because although the project corridor features some areas of natural habitats, there are some modified habitats. In addition, the project corridor does not feature any protected areas or habitats of biodiversity significance. The magnitude is considered low because the AOI did not indicate to have any major wildlife corridors and wildlife occurrence within the immediate AOI were relatively low. The extent of construction activities will not irreversibly restrict the ability of bees to colonise a new area for honey production. Therefore, the significance of this impact is assessed as minor.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN

PI-FR-003-PLN-0016-01 - PIAAIA Topographical Survey and Marking en

PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN

PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

In addition to the above plans, the contractor will:

- monitor wildlife populations and, if necessary, relocate them to safer areas before construction begins
- assist residents who have any beehives near delineated construction zones to relocate them to minimize noise disturbances to the bees
- design of any fencing to allow for passage of small mammals and reptiles through the construction sites where possible
- incorporate training on non-lethal ways of removing animals within camps and construction zones
- incorporate training for drivers on avoiding and reporting on roadkill.

The displacement of wildlife and bees is an inevitable consequence of habitat modification. While mitigation measure can reduce the number of animals and displaced, the residual impacts remain. However, the impacts are considered minor, as populations are expected to recolonize areas once distances cease.

10.6.4.2 Operation and maintenance phase

During operation activities, the use of permanent infrastructure built along the RoW including the railway tracks and stations will permanently involve the generation of noise and the movement of locomotives and people throughout the project corridor. This will affect residents who hunt for small mammals and beekeepers.

Mitigation measures – operation phase

- monitor wildlife populations and, if necessary, relocate them to safer areas before operation begins
- incorporate training on non-lethal ways of removing animals within stations and workshop zones
- incorporate training for employees on avoiding and reporting on roadkill.

The residual impacts during the operational phase are considered as minor, as effects on community hunting activities and beekeeping productivity are limited

10.6.5 Disruption in grazing patterns.

Construction and operational activities can potentially affect grazing patterns and grazing land across both sides of the RoW. The baseline conditions indicate that livestock will experience restricted access to certain areas during the project phases, and this will affect access to the grazing land and eventually lead to changes in grazing patterns.

Grazing land provides a provisioning ecosystem service that is essential for community livelihoods, food security, and economic wellbeing. Project activities (construction and operation) will restrict access to grazing areas along the right-of-way (RoW), directly impacting livestock and therefore the communities who depend on them. As per the IFC Guidance Note 6 this is Type I priority ecosystem service.

10.6.5.1 Construction

The construction activities restrict the movement of animals in and around grazing land along and beyond the RoW, making it difficult to find grazing territory and impacting grazing patterns. The baseline has not indicated the presence of large ranches in the project corridor, rather the presence of small holder livestock keepers who traverse across the RoW. Therefore, the magnitude is considered moderate because there may be additional tracks used that were not marked and identified during the ESIA. The sensitivity of fauna (wild foraging animals/livestock) is high because of the potential for collision risks that can injure and potentially kill the animal in addition to some community members that depend on livestock keeping for income generation. Therefore, the significance is assessed as moderate.

Mitigation measures – preconstruction and construction phase

Reference to existing management plans:

PI-PR-003-OECLS_IDENTIFICATION OF ASPECTS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS_EN

PI-PL-062-OECLS_PLANT SUPPRESSION PLAN_EN

PI-PL-063-OECLS_PLAN FOR THE RECOVERY AND RESTORATION OF DEGRADED AREAS_EN.

- Identify risks of restricted access for livestock and ensure alternative access routes.
- Minimize land clearance and disturbance beyond delineated construction areas.
- Rehabilitate grazing areas after construction activities are completed.
- Conduct engagement sessions with communities on safe livestock crossing zones, restricted areas, and the grievance mechanism.

The above management plans have measures that will identify potential risks of additional restricted access for livestock and ensure alternative access routes that livestock can use. It also includes measure to minimize land clearance and disturbance of land beyond delineated construction grounds and rehabilitate grazing areas after construction activities are completed.

The PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN is to be updated to include engagement session with communities on safe crossing zones, restricted construction zones, locations where safe crossings are established and the project's grievance mechanism.

Despite the implementation of mitigation measures, residual impacts on the disturbance of grazing patches and movement restrictions are anticipated and unavoidable. While mitigation measures can facilitate some movement, the residual impacts remain unlikely fully eliminated s grazing areas become smaller, however it presents a minor effect, as animals would still be able to graze in other areas.

10.6.5.2 Operation and maintenance phases

During operation activities, the railway line will create a permanent barrier between communities and the open land/forest, impacting the accessibility to land. This will affect

grazing patterns and movement across the RoW, forcing animals and livestock to graze in one area, which will lead to overgrazing in one area and under grazing in other areas, inducing changes in vegetation composition and landcover.

The preliminary design has already captured main crossings near Dala and Camanongue that were identified during the ESIA and has made provisions for level crossings across the railway tracks to facilitate movement. Additional locations that may be identified during construction phase will be considered for level crossings as a necessary. The magnitude of disturbed grazing patters is considered minor during operations and impact significance as moderate.

The operator is to develop a Stakeholder Engagement Plan and Grievance mechanism that will include engagement sessions with communities on safe and restricted crossing zones and the project's grievance mechanism.

Despite the implementation of mitigation measures, residual alteration on grazing patterns remains, resulting in localised overgrazing and disturbance of vegetation. The impacts are expected to be spatially limited and therefore the residual significance is assessed as minor, provided ongoing maintenance and community engagements with affected communities is maintained.

10.6.6 Depletion of groundwater

The baseline indicates that the local communities depend on groundwater supplied from communal fountains. While other communities experience inadequate water resources as a result of damaged fountains, they rely on water from nearby rivers, streams and unidentified boreholes. The proposed Project can put pressure on water resources, particularly in areas along the RoW where communities already experience water shortages.

As per IFC Performance Standard 6 (PS6) and Guidance Note 6 depletion of ground is type I and II since it will affect the community and the project will depend on the groundwater. Type I, groundwater accessed through communal fountains, rivers, streams, and boreholes is a provisioning ecosystem service essential for community health, wellbeing, and livelihoods. Project activities that will place pressure on groundwater resources will result in adverse impacts to affected communities, particularly in areas already experiencing shortages. Type II, the project itself requires groundwater abstraction for its own operations (e.g., construction water supply, dust suppression, or process water), then groundwater is also a Type II service, because the project is directly dependent on it.

10.6.6.1 Construction

The project will make use of groundwater as a source of water supply for their construction activities and for consumption at the campsites. The Project proposes to make use of existing boreholes and drill more so that there are enough water resources for equipment cooling, dust suppression activities etc (refer to Project Description in Chapter 2).

The over extraction/consumption of groundwater from the boreholes will lead in the reduced available in water supply as the communities also depend on groundwater for their livelihoods. This will affect the access to water as the demand increases, this will lower the water table, lead to loss of water and potentially contaminate nearby shallow boreholes. The magnitude of the impact is considered as moderate due to the reliance of the communities along the RoW to groundwater and sensitivity also as moderate because the baseline indicates extensive aquifers within the project AoI with favourable groundwater recharge conditions of the soils. The significance of the impact is considered as moderate.

Mitigation measures operation phase

Reference to existing management plan(s):

PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN

PI-FR-003-PLN-0016-01 - PIAAIA water management

PI-PL-031-OECLS_RESOURCE EFFICIENCY MANAGEMENT PLA – Cópia

PI-PL-061-OECLS_WATER MANAGEMENT PLAN_EN.

The above plans will be reviewed and updated to include the following measures as applicable for the project corridor:

- follow abstraction volumes as prescribed in authorisation permits and monitor usage
- conducting pump tests on all boreholes to be used, in order to determine the yield and aquifer recovery of each, which should relate into management measures that will ensure sustainable abstraction rates. This will help to ensure that rural community members reliant on groundwater resources are not negatively affected
- limit surface water abstraction within 500 m upstream of a community settlement in order to help prevent the possible deterioration of water quality
- ensure efficient use of water resources
- create awareness on water conservation practices.
- Monitor water usage and ensure compliance with abstraction volumes as per authorization permits.
- Install water flow meters at all water abstraction points (surface water, wells, and boreholes).
- Conduct hydraulic pump testing on all boreholes intended for long-term water supply to calculate sustainable yields.
- Conduct annual training on water conservation practices for personnel at stations and workshops.

Despite the implementation of mitigation measures, residual impacts of lowered water tables are anticipated and unavoidable. While mitigation measures can reduce this impact and the locales indicate extensive aquifers, with strong recharge potential, the residual impacts remain and present a minor effect.

10.6.6.2 Operation and maintenance phases

Continuous and intensive extraction during operation can deplete the groundwater resource, leading to long-term sustainability issues. Water will be used for consumption at the campsites and maintenance purposes such as cleaning activities along the RoW.

Mitigation measures – operation phase

- follow abstraction volumes as prescribed in authorisation permits and monitor usage
- install water flow meters on all water abstraction points (surface water, wells, and boreholes).
- Undertake hydraulic pump testing of all boreholes to be used as long-term water supply source to calculate sustainable yields
- ensure efficient use of water resources.

Despite the implementation of mitigation measures, residual impacts of lowered water tables are anticipated and unavoidable. While mitigation measures can reduce this impact and the locales indicate extensive aquifers, with strong recharge potential, the residual impacts remain and present a minor effect.

The detailed significance assessment of the ecosystem services impacts presented above is provided separately in Appendix 16.6.

10.7 Unplanned events

The project has adopted to follow a safe engineering design that aims to reduce the probability and consequence of unplanned events that could potentially lead to environmental, socio-economic or health and safety impacts. Throughout the project phases, a series of environmental, socio-economic as well as health and safety studies will be carried out to ensure that unplanned events are prepared for accordingly.

10.7.1 Accidental spills, leakages and contamination

Accidental spills, leakages and contamination of the environment as well as groundwater and surface water can occur during the transportation of fuels, chemicals and other liquid cargos. Although, the baseline condition does not indicate that environmental contamination may occur, however there are unanticipated events that need to be prepared/accounted for during the project activities. Accidental spills, leakages and contamination can occur as a result of the following project activities:

- procurement of imported materials and equipment via shipping
- mobilisation of workers, machinery, construction equipment
- transportation of all required materials, equipment, and components to the camps sites
- waste production management and treatment
- operating and maintenance (marshalling yards, workshops, control centre)
- fuel supply, storage and management
- materials management

- operation and maintenance of waste of waste facilities.

10.7.1.1 Preconstruction and construction phases

Activities that involve handling and storage of hydrocarbons or hazardous and dangerous chemicals pose a significant risk of accidental environmental contamination. The proposed project activities include the transportation and handling of chemicals, materials and equipment sorted in containers that may leak or spill due to improper sealing or containers that may rapture or become damaged enroute to the project site. The use of uneven/poorly structured roads along the EN180 can cause instability on moving construction vehicles, leading to accidental spillage. Moreover, increased vehicle movement could increase the risk of vehicle collisions, resulting in accidental spills.

The proposed project includes the development of storage areas/facilities mainly in Dala and at the campsites that will serve as a safe storage unit. Improper storage and sealing can cause liquid chemicals to seep into the ground, leading to contamination of soil and waterbodies, potentially impacting the ecosystem and making groundwater unsafe to consume.

Both these impacts can result in the direct release of hydrocarbons or other hazardous and dangerous chemicals onto the roads, soils and into water bodies. In the event of an accidental leak/spill the fertility of the surrounding soil will decrease and natural/modified habitat and vegetation cover will die off. Depending on the amount and the type of substance that was spilled, it may cause health concerns, particularly on workers at the campsite due to exposure to toxic substances or by contaminating drinking water sources. Moreover, it may lead to long-term environmental degradation, affecting biodiversity and potentially harming local flora and fauna. These receptors are medium in sensitivity. The magnitude of accidental spill is considered as moderate/medium as they are anticipated to be localised. Therefore, the significance of accidental spills and leaks is assessed as moderate.

Mitigation measures – preconstruction and construction phase

Reference to existing Management Plan(s):

- PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN
- PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN
- PI-PR-048-PRELIMINARY RISK ANALYSIS_EN
- PI-PR-040-EQUIPMENT, MACHINES AND TOOLS_EN
- PI-PR-041-CARGO HANDLING_EN
- PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
- PI-PL-105-OECLS_CHEMICALS MANAGENT PLAN_EN
- PI-PR-002-HAZARD IDENTIFICATION AND OSH RISK ASSESSMENT_ENPI-PL-109-OECLS_POLLUTION PREVENTION AND CONTROL_EN
- OECLS-AF-PG-GER-002_TRAINING PLAN_EN.

The above-mentioned management plans include processes to identify potential risks and procedures for managing emergencies. They aim to follow good Industry Practices and Environmental Health and Safety (EHS) standards for the storage, handling and

transportation of dangerous goods in line with international requirements. As reasonably practicable provide relevant training and refresher training to construction personnel.

The residual risk of accidental oil spills and leakage causing contamination remains, as unplanned events are unpredictable. However, the residual impacts are considered to be minor due to the robust mitigation measures in place, preventing significance contamination.

10.7.1.2 Operational and maintenance phases

Cleaning of stations and associated facilities, equipment, project infrastructure, fuel tanks, and the maintenance, servicing and refuelling of vehicles and the trains can inadvertently result in spills that release oils, lubricants, or other chemicals into the environment.

Moreover, contamination may occur along the ROW from the proposed train operations that include the daily transportation of fuels and other liquid cargos. This is the greatest risk to environmental degradation due to their ability to migrate rapidly and impact a larger area. Accidental spills can directly release dangerous chemicals into nearby water bodies and groundwater used for consumption, potentially affecting the health of communities along the ROW.

The sensitivity of water bodies contaminated by spills and leaks from transported fuel and liquid cargo is high because the train traverses numerous waterbodies. Contamination will have immediate long-term negative effect and clean ups and remediation methods will take a long time to reverse the effects. Therefore, the magnitude is considered as high and the significance of the potential impact as major.

Mitigation measures – operation and maintenance phase

- implement IFC Guidelines, namely:
    - implement systems for the proper screening, acceptance and transportation of dangerous goods
    - rail tank cars to meet international standards
    - preparation of spill prevention and control, and emergency preparedness and response plans, based on an analysis of hazards, including the nature, consequence, and probability of accidents. Based on result of the hazard analysis, implementation of prevention and control measures which may include:
    - routing and timing of hazardous materials transport to minimize risk to the community (e.g. restricting transport of hazardous materials on some routes)
    - limiting train speed in developed areas
    - dissemination of emergency preparedness and response information to the potentially affected communities (e.g. emergency notification systems and evacuation procedures)
- develop an emergency response plan to cater for large scale spills or leaks from rail tankers and/or wagons. Identify suitably trained professionals and equipment to limit and rehabilitate spills to minimise impact to the environment. As reasonably practicable conduct regular inspections of wagons/tankers to identify loss of containment scenarios

- ensure that cleaning and contamination equipment to deal with smaller accidental events are located at storage and refuelling sites, and that they are discarded at acceptable waste disposal facilities once used
- keep stocks of materials needed to clean and contain spill events
- provide relevant training to operational personnel.

The residual risk of accidental oil spills and leakage causing contamination remains, as unplanned events are unpredictable. However, the residual impacts are considered to be minor due to the robust mitigation measures in place, preventing significance contamination.

10.7.2 Traffic collisions and accidents

Traffic accidents are likely to occur as a result of construction vehicles entering and exiting the project area, causing a disruption in the normal flow of traffic. The accidents may involve vehicle collisions at intersections, onsite, livestock, animal collision or pedestrian accidents. The accidents may lead to contamination (see explanation under accidental spills), injuries or fatalities.

10.7.2.1 Preconstruction and construction phases

The increase in vehicle traffic as a result of the project transporting materials, equipment and workers could increase the risk of vehicle collision, especially along the EN180 which is also a national road. Private and construction vehicles use the EN180 resulting into the potential increase of accidents with other road users causing injuries or fatalities. Additionally, accidents can occur from speeding, not following road rules and due to poor road conditions.

In addition, the temporary closure of roads and unexpected detours/rerouting which causes confusion between pedestrians and drivers who are not aware of the temporary road changes. The vehicle and pedestrian collisions may occur in cases where the detours are not clearly marked or where pedestrians' pathways have been temporarily changed into access roads.

Moreover, the communities within the project area have livestock roaming around. Accidental collision can occur when animals unexpectedly cross the road during the movement of construction vehicles.

The receptors that could be affected are people and livestock, both with a high sensitivity because accidents/collision can be fatal or leave the person/animal severely injured. However, the project area is not very densely populated and the railway RoW does not traverse through settlements, therefore the magnitude is considered as medium and significance as moderate.

Mitigation measures – preconstruction and construction phase

Reference to existing Management Plan(s):

- PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN
- PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN
- PI-PR-048-PRELIMINARY RISK ANALYSIS_EN
- PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN.

The above-mentioned management plans have included a process to identify traffic accidents, risks, investigation methodologies and procedures for the movement of workers and relevant construction cargo. Further transport/traffic management plans that will be developed as part of the detailed construction schedules should include:

- controls to ensure drivers are trained and have required licences to operate designated vehicle
- identification of dangerous routes and measures to avoid them to reduce the risk of accidents
- schedules that are monitored to control drivers' actions and that indicate vehicle maintenance
- speed and night time travel restrictions on construction vehicles
- an identified fleet monitoring system that will be applied for construction vehicles that includes telemetry to track vehicle locations, fuel usage, emissions and overall vehicle performance metrics.

The residual risk of traffic collisions and accidents remains, as unplanned events are unpredictable as well as factors outside the Projects full control, including roaming animals, general road conditions and road users. However, the residual impacts are considered to be minor due to the robust mitigation measures in place.

10.7.2.2 Operational and maintenance

The railway line does not transect communities or roads and therefore vehicle and train collisions are avoidable. However, derailment and collisions represent a severe unplanned events, with environmental, social and safety impacts. This may result in wildlife, livestock and pedestrian collision that causes injuries, fatalities and profound psychological trauma for victims and witnesses. The following impacts may occur:

- derailment may result in mortality of passengers, train crew and animals of people who are near the railway fencing or corridor
- railway line acts as a barrier for wildlife, causing collisions with larger animals
- pedestrians trespassing on the railway line can cause a risk of fatalities during derailment or general operations
- derailment can also lead to fires or explosions

Mitigation measures – operation and maintenance phase

- provide wildlife safe cross passes which allows animals to cross the railway safely without interacting with trains
- operator should impose lower speed limits in high-risk areas or near the station, as slower train can stop easily and quicker to avoid wildlife, animal and pedestrians
- install fences along railway corridor to prevent trespassing

The residual risk of traffic collisions and accidents remains, as unplanned events are unpredictable as well as factors outside the Projects full control, including roaming animals, general road conditions and road users. However, the residual impacts are considered to be minor due to the robust mitigation measures in place.

10.7.3 Social conflicts/ community unrest

Social unrest includes disturbances that may cause public disorder through organised or unorganised protests, which threaten the continuation of the project activities and the safety of workers and general public. Social unrest may be caused by community members or the workforce from factors that negatively affect them.

10.7.3.1 Preconstruction and construction phases

Community unrest may arise when local communities are negatively impacted by the project, as a result of the following factors:

- accidents that cause fatalities
- when cultural norms and values are overlooked by either the project or migrant workers
- damage to heritage sites
- excluding communities in decision making processes
- unequal benefits from the project.
- unfair recruitment processes and labour conditions
- unsafe conditions around campsites and construction zones.

In addition, workers may also demonstrate protests, as a result of the following:

- poor and unsafe working conditions
- issues with fair wages and working hours
- inadequate worker benefits
- poor leadership.

Both the negative impacts faced by communities and workers can trigger a series of community/worker protests, which may sometimes include violent actions, deliberate intent to cause injury or damage. This will lead to construction delays.

The receptors of the potential impact are labour and communities, both of which are considered as moderate. The magnitude is considered as medium and the impact significance as moderate.

Mitigation measures

Reference to existing Management Plan(s):

- PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
- PI-PL-007-OECLS-STAKEHOLDER ENGAGEMENT PLAN_EN
- PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN
- PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN
- PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.

The above-mentioned management plans have measure that will

- ensure continuous community engagements
- include community leaders in project decision making process
- implement safeguards that address health, security and safety concerns

- implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual
- the Contractor shall adapt and update the Grievance Redress Mechanism incorporated in the Stakeholder Engagement Plan for the ESIA to be used during construction phase. This GRM is to be shared to both residents in the communities and workers of the grievance mechanism process
- OEC's HR Policy and Recruitment Policy ensures adequate working conditions and fair compensation.

The residual risk of social conflicts remains, as unplanned events are unpredictable as well as factors, such as politics, remain outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place and any incident that may arise is expected to be limited in duration and scope.

Operations and maintenance phases

During these phases, social unrest can be caused by external structural changes in society that may impact the project operations as well as project infrastructure. In addition, the following factors may result in conflict/unrest amongst residents:

- frequent accidents that cause fatalities
- rude or bad language used towards passengers and communities
- unsafe conditions at stations and when boarding/offloading locomotives.

In addition, workers may also demonstrate protests, as a result of the following:

- poor and unsafe working conditions
- issues with fair wages and working hours
- inadequate worker benefits
- poor leadership.

Un-resolved conflicts can affect the day-to-day operations of the train movements, also leading to vandalism of infrastructure.

The receptors of the potential impact are labour and communities, both of which are considered as moderate. The magnitude is considered as medium and the impact significance as moderate

Mitigation measures – operation and maintenance phase

The operator is required to:

- develop and implement an operational Stakeholder Engagement Plan to ensure continuous community engagements
- Establish a network of community/stakeholder liaison officers that will actively involve community leaders in project decision making process
- Develop and inform both locals and workers of the grievance mechanism process for operation phase
- ensure adequate working conditions and fair compensation
- develop effective management plans

- implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual.

The residual risk of social conflicts remains, as unplanned events are unpredictable as well as factors, such as politics, remain outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place and any incident that may arise is expected to be limited in duration and scope.

10.7.4 Flooding

The project area has several rivers, due to the location, it is vulnerable to unexpected flooding from heavy rains and inadequate drainage systems. The rivers can overflow their banks, impacting the construction site and local communities. Flooding can occur during all project phases and can cause same impacts such as damages to infrastructure, equipment, causing temporary disruption in project activities, posing health and safety issues for both the project and communities.

10.7.4.1 Preconstruction and construction phases

Unexpected floods from overflowing riverbanks and inadequate drainage systems as a result of heavy and prolonged rainfalls can affect the construction activities along extensive cut and fill sections at construction zones. These can damage equipment and affecting the ability of workers to commute from their campsites and access the project site, therefore causing delays in works. In addition, floods can pose a health and safety risks to workers and communities, such as drowning, exposure to contamination of groundwater used for consumption.

Drilling activities during preconstruction geotechnical investigations may pierce a ground water aquifer causing sudden overflow of groundwater above ground leading to localised flooding.

The receptors affected by flooding are labour and potentially groundwater is considered to be moderate in sensitivity. Flooding is unlikely, short term with minor to moderate magnitude. The significance is considered to be moderate.

Mitigation:

- implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual.

The residual risk of flooding remains, as unplanned flood events are unpredictable as a result of natural factors and remain outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place and any flood-related incident that may arise is expected to be localised and short-term, with no long-term impact on construction progress or impacts on groundwater quality.

10.7.4.2 Operations and maintenance phases

The Project Area does not have any records of frequent flooding events over the past 10 to 20 years, therefore severe flood events that would impede the operations of the

locomotives or damage the constructed bridges is not anticipated. Furthermore, drainage channels along the embankments, at bridges, culverts and at stations are already integrated into the design to minimise localised pools and/or flooding from rainfall events.

The likelihood of any residual flood related impacts to occur during operational phase is considered as negligible.

10.7.5 Fires

The project area is covered by vast amounts of natural vegetation which are highly combustible under certain weather conditions, particularly when dry. During all project phases, fire outbreaks can impact both communities and project.

The negative impacts associated with fires include air pollution leading to respiratory issues, safety risks such as burns or fatalities and damage to infrastructure and project equipment. In addition, an uncontrollable fire can lead to project activities being stopped.

10.7.5.1 Preconstruction and Construction phases

Fires can be caused by electric faults, as a result of machine malfunctions and poor wiring that can overheat, igniting sparks that cause fires during construction activities onsite. In the event of a fire on site or at the campsites, the potential risk of the fire spreading is great because it can encounter highly flammable chemicals and material stored onsite such as paints and fuels. Moreover, fires can be caused by careless human action, such as not properly disposing cigarettes, or disposing cigarettes that are still lit in areas where it can easily start a fire. This could particularly occur at the worker campsites.

The population depend on fossil fuels for cooking purposes, and burning of household waste, of which these activities can easily cause a fire spread. Communities use fossil fuels for domestic purposes, such as cooking and burning waste. These fossil fuels are easily flammable and when left unattended they can rapidly spread.

Fires at disposal sites/dumpsites from flammable waste products, increased methane and heat exposure are not expected. However, in the event fire does erupt at dumpsites when left unattended they can rapidly spread.

The sensitivity of this impact is considered moderate/medium on property and land. The magnitude of the impact related to electric faults and careless disposal of cigarettes is considered minor as it will be focused to camps and storage or equipment workshop locations. The magnitude of potential fires at waste dumpsites is considered medium due to the flammable material available and ability to spread quickly. In both instances, the significance of the impacts are considered moderate

Mitigation measures – preconstruction and construction phase

Reference to existing Management Plan(s):

- PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
- PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN
- PI-PR-044-TRANSPORT OF PEOPLE AND CARGO AND STORAGE OF MATERIALS AND SUPPLIES_EN
- PI-PR-048-PRELIMINARY RISK ANALYSIS_EN

- PI-PR-080-RISK MANAGEMENT ASSOCIATED WITH PROPRETY SECURITY_EN.

Review and update the above management plans to include:

- ensuring that all workers are regularly trained on fire safety practices
- placing signage to keep unauthorized personnel away from areas where open fires are likely to occur
- Measures to prevent fires by eliminating risks, removing ignition sources near combustible materials and limiting fast fires and smoke development
- implement the developed Emergency Response measures from the EPRP and Risk Management Procedure
- the emergency response plan should include evacuation procedures, fire suppression systems, and first-aid provisions can help mitigate the impacts of a fire
- evacuation procedures will take into consideration measures such as clear unimpeded escape routes, accessibility to the impaired or handicapped, marking and signing, and emergency lighting
- ensure workers always wear appropriate PPE
- detection and alarm system is required which includes communication methods
- compartmentation measures to prevent or slow the spread of fire and smoke and include separation firewalls, floors, doors, dampers and smoke control systems
- fire suppression control measures (example automatic sprinkler systems, manual portable extinguishers as well as firehouse reels).

The residual risk of fires related impacts occurring remains, as unplanned events are unpredictable and the outbreaks of fire may be outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place.

10.7.5.2 Operation and maintenance phases

Communities use fossil fuels for domestic purposes, such as cooking and burning waste. These fossil fuels are flammable and when left unattended they can rapidly spread. Potential spreading and affecting the project infrastructure.

Moreover, poor housekeeping at the stations and its surrounding areas can increase the risk of a fire by creating an environment where combustible materials/debris and waste materials accumulate. The accumulation of materials and debris can act as a fuel for fire and obstruct emergency exit ways, making it difficult to evacuate or access fire extinguishers in an emergency. Overall, poor housekeeping not only increases the likelihood of a fire starting but also exacerbates its spread and the potential for severe damage.

Fires caused by slash and burn activities to clear land for farming or from cigarettes thrown out from locomotives can burn along the embankments can potentially damage the rail infrastructure.

Similar to construction phases, fires can also erupt at:

- disposal sites/dumpsites from flammable waste products, increased methane and heat exposure; when left unattended they can rapidly spread

- storage locations and workshop locations for servicing equipment caused by electric faults, as a result of machine malfunctions and poor wiring that can overheat, igniting sparks that cause fires onsite.

The sensitivity of this impact is considered moderate/medium on property and land. The magnitude of the impact related to electric faults and careless disposal of cigarettes is considered minor as it will be focused to storage or equipment workshop locations. The magnitude of potential fires at waste dumpsites, at stations and along the RoW embankments is considered medium due to the flammable material available and ability to spread quickly and the risk to people present at stations. In these instances, the significance of the impacts are considered moderate. The significance of fire outbreaks is considered major in relation to fuel storage and refuelling stations due to the highly flammable and explosive risk at these locations and high sensitivity of injury/death of personnel and damage to infrastructure.

Mitigation:

- develop and implement an operational Emergency Response measure from the EPRP and a Risk Management Procedure And Life and Safety Master Plan for operation phase
- the EPRP should include trainings for workers at stations and communities on how they should respond to a fire outbreak
- ensure that stations and maintenance workshops have fire abatement equipment
- all new buildings or upgrades to train stations accessible to the public will be designed and constructed in full compliance with local building codes and fire regulations. and fire safety standards
- implement mandatory regular maintenance and testing of systems is required to ensure that all mechanical, electrical, and civil structures and systems conform with operational requirements.

The residual risk of fires related impacts occurring remains, as unplanned events are unpredictable and the outbreaks of fire may be outside the control of the Projects full control. However, the residual impacts are considered to be minor due to the robust mitigation measures in place.

10.7.6 Health epidemics

Within the project area, health epidemics may occur as a result of the proposed project, impacting both communities and project workforce. These epidemics can result in all phases of the project and are triggered by influx of people and inadequate sanitation.

Some examples of health epidemics that can occur include:

- cholera caused by contaminated water sources. This usually occurs in areas without adequate sanitation
- respiratory disease such as tuberculosis, COVID-19, etc. These viral infections can easily and quickly spread in highly populated areas (i.e. campsites).

The impact of health epidemics can cause widespread illness among workers, leading to severe labour shortages, reducing productivity and delaying project schedules. It could necessitate temporary closure, particularly if it is an infectious disease like COVID or other contagious illnesses that can infect workers and communities within the project

area. Moreover, it can put a strain on the local healthcare facilities that are barely fully functional, unevenly distributed throughout the project areas and are not well-equipped facilities in certain communities.

10.7.6.1 Preconstruction and Construction phases

In the preconstruction phase, there will be recruitment and migration of labour to the project area. This will require established health facilities to have the capacity to handle the influx, and additional health facilities support at the established campsites. The influx of new residents increases the risk of communicable diseases and health epidemics. The receptors (labour and communities) are highly sensitive because deteriorated health affects individuals and households and if not addressed can lead to fatality. The magnitude is considered as high because of the potential long-term and regional scale of the impact across the two provinces in the project area. Therefore, the significance of the impact is assessed as Major.

Mitigation measures – preconstruction and construction phase

Reference to existing Management Plan(s):

- PI-PR-012_INCIDENT INVESTIGATION METHODOLOGIES_EN
- PI-PL-100 OECLS-EMERGENCY RESPONSE PLAN_EN
- PI-PR-048-PRELIMINARY RISK ANALYSIS_EN
- PI-PL-081-OECLS_COMMUNITY HEALTH AND SAFETY MANAGEMENT PLAN_EN
- PI-PL-082_INFLUX MANAGEMENT PLAN_EN
- OECLS-AF-PG-GER-002_TRAINING PLAN_EN
- PI-PR-006-OECLS-COMPETENCE AND AWARENESS_EN
- PI-PR-020-OECLS_PROG OCCUPATIONAL HEALTH MEDICAL CONTROL_EN
- PI-PR-021-OECLS_HEALTH SERVICES OPERATION ACTIVITIES PROGRAMME_EN
- PI-PR-024-OECLS_INDIVIDUAL AND COLLECTIVE HEALTH PROMOTION PROGRAMME_EN
- PI-PR-052-OECLS_GUIDELINES FOR DRAWING UP THE RESPIRATORY PROTECTION PROGRAMME_EN.

The residual risk related to health epidemics occurring remains, as localised outbreaks are unpredictable and/or may persist, affecting workers and communities both short-term and long-term depending on the severity of the health epidemic. Therefore, the residual impacts are considered to be minor – moderate.

10.7.6.2 Operation and maintenance phases

Train operations will facilitate the continuous movement of people across the Provinces and also attract new residents and entrepreneurs. There will be interaction with personnel manning stations and locomotives increasing the risk of contagious and communicable diseases to spread. Health epidemic as a result of increased prevalence of communicable diseases can occur if there are inadequate health facilities in the Project area. The receptor (labour and communities) are sensitive because deteriorated health affects individuals and households and if not addressed can lead to fatality. The

magnitude of the impact is considered as high because there will be daily train movements, the regional scale and the potential long term effect of the impact. The significance of the impact is considered as major

Mitigation measures – operational and maintenance phase

- awareness campaigns will be implemented on health and communicable diseases
- develop and implement a training program for operational staff on health and hygiene management
- develop and implement a community health and safety plan for operational phase
- develop and implement an emergency response plan for operations.

The residual risk related to health epidemics occurring remains, as localised outbreaks are unpredictable and/or may persist, affecting workers and communities both short-term and long-term depending on the severity of the health epidemic. Therefore, the residual impacts are considered to be minor – moderate.

10.7.7 Unexploded ordnance (UXO)

It is known that the project area has the presence of remnant active landmines and UXO's from past conflicts. The process of clearing landmines and UXO are highly explosive and can be triggered by minor disturbances, however the clearance offers positive impacts of which outweighs the negative impacts. This includes

- potentially saving lives and prevent unplanned human amputation injuries
- land reclamation, as land will be returned to productive use for farming, animal grazing, building new homesteads or facilitating new developments
- safer access to areas where potential natural resources (i.e firewood) can be collected

10.7.7.1 Preconstruction and Construction phase

Demining activities will be undertaken prior to the commencement of the proposed project activities. During demining activities, there is a slight chance that undetected UXO can be accidentally triggered, causing it to detonate. This will cause it to explode, resulting into injuries, fatalities and damage to households. Moreover, one detonated UXO, can trigger a reaching of uncontrolled explosions if there are multiple UXO within the area.

In addition, the movement of heavy vehicles moving over the ground can generate vibrations that disturb UXOs, potentially causing them to detonate.

Demining activities can cause soil erosion, habitat destruction, and soil compaction during clearance.

Mitigations:

- asses potential damage and benefits from recent demining activities during household survey for the development of the RAP to identify impacts prior demining activities and that the LRP measures are accurately captured
- use trained personnel equipped with appropriate protective gear and detection tools to remove UXOs
- use low impact demining techniques to minimise soil destruction or damage
- identified and remove UXOs safely before construction activities commence

- monitor cleared areas for residual risks and ensure the area is safe
- implement the developed Emergency Response measures from the EPRP, a Risk Management Procedure, and an Environmental and Social Management System Manual
- provide ongoing training for communities on response plan on potential undetected UXOs explosion discoveries by communities or workers
- rehabilitate areas disturbed during demining activities
- temporary erect fencing and warning signs around demining perimeter to prevent accidental entry

The residual risk of accidental detonation of UXO occurring remains, particularly in areas with dense concentration of unexploded ordnance. The residual impacts is considered as negligible – minor, as these incidents are expected to be extremely rare

Operation and maintenance phases

During the operational and maintenance phase, the activities undertaken are not anticipated to pose a risk as UXO's would have been identified and removed prior to the project commencement.

The detailed significance assessment of the unplanned impacts presented above is provided separately in Appendix 16.7.

11 CUMULATIVE IMPACTS ASSESSMENT

This chapter assesses cumulative impacts that result from the successive, incremental and/or combined effects of a Project or activity, when added to other past, existing, planned and/or reasonably anticipated future ones (IFC, 2013). As per PS 1, this cumulative impact assessment (CIA) will consider (i) other existing projects or conditions, and (ii) other future developments (including future stages of the project itself) that are realistically defined at the time the ESIA is undertaken and for with the sphere of influence of the various projects or developments may overlap.

Given the site-specific nature of cumulative impacts, a qualitative, case-by-case assessment was adopted. The CIA follows the Rapid Cumulative Impact Assessment (RCIA) framework recommended by the IFC Good Practice Handbook, which is appropriate for emerging markets in circumstances whereby:

- baseline data on other developments are limited
- uncertainties associated with anticipated developments
- integrated planning frameworks are still evolving.

In line with IFC PS 1 guidance notes (GN41) that the assessment should be "commensurate with the incremental contribution, source, extent, and severity of cumulative impacts anticipated", this assessment attempts to focus only on the potentially significant cumulative impacts.

11.1 Approach

The cumulative impacts were identified and assessed in accordance with the 'IFC Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets' (2013). The IFC Good Practice Handbook (GPH) uses a six-step approach to cumulative impact assessment (CIA), as presented in Figure 11-1 This approach is described in more detail in the sections below.

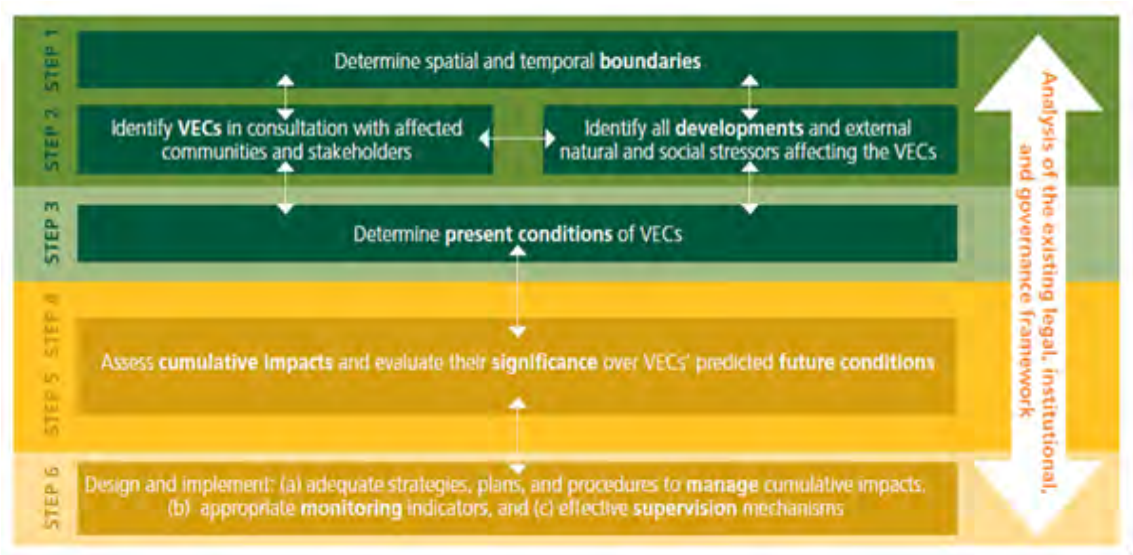

Figure 11-1: IFC cumulative impact assessment process

11.1.1 Defining the area of influence (Step 1)

For the CIA, the same Area of Influence (AoI) defined for the Project Impact assessment, as outlined in Chapter 2, Section 2.8 of the Project Description and in Chapter 10 on Impact Identification and Assessment, is utilised. The direct footprint of the project includes a 100 m buffer (50 m on either side and of the centreline of the railway alignment). This is to accommodate the 17.5 m wide embankment and any additional space required for spoil soil storage piles, temporary lay-down/storage areas along parts of the railway alignment as well as the locations for the campsites and stations. This direct footprint is the direct AoI for acoustics and AQ impacts.

The wider AoI covers an area of 5 km for hydrology and geohydrology aspects and the PACs (settlements, communities, villages and centres/towns with a geographical boundary that overlaps the defined project's land take requirements, construction, and operation activities). The 5 km hydrology AoI was selected based on consistency with similar railway projects and validated through on-site observations, which showed that impacts such as siltation, erosion, and ponding generally did not extend beyond this distance. This buffer is therefore considered both practical and technically defensible for capturing hydrological effects

The project traverses a wider AoI of 20 km for biodiversity aspects and that includes the provincial landscape and locations where all project Aspects (infrastructure and facilities as presented in Section 2, including quarry sites and camp sites). The 20 km indirect AoI was selected as a sufficient and defensible boundary to identify sensitive receptors and potential indirect impacts during the iterative Project design and construction, while ensuring the assessment remains practical and aligned with international best practice for defining spheres of influence. The temporal boundary of the CIA is the lifetime of the Project (described in Chapter 2, Section 2.6) is the duration of potential cumulative impacts on receptors. The preconstruction and construction phases are expected to take 60 months. The design and operational lifespan of the Luena-Saurimo railway is estimated to be 100 years.

In addition, the two provinces and four municipalities (Moxico Province: Municipalities of Moxico and Camanongue) and (Lunda – Sul Province: Municipalities of Saurimo and Dala) have been used to identify third party projects that have the potential to lead to cumulative impacts. The study area, as shown in Figure 11-2, is a radius of approximately 20 km around the Luena-Saurimo project footprint.

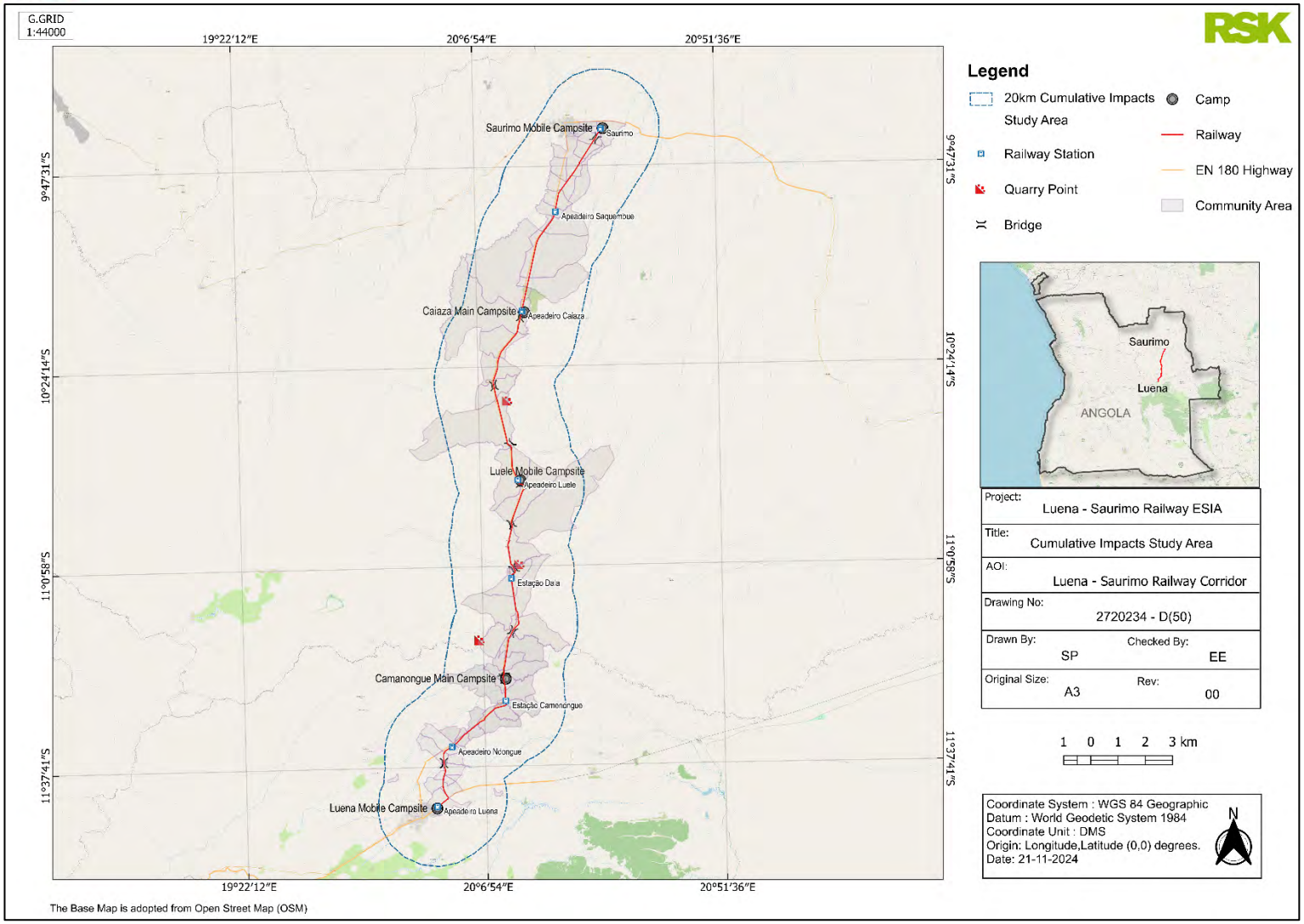

Figure 11-2: Luena-Saurimo 20 km cumulative impact study area

11.1.2 Stakeholder engagement (Step 2)

Stakeholder engagement has been carried out with Provincial governments, municipal administrations, traditional authorities, communities and non-governmental organizations as presented in Chapter 5. The output from this engagement has been used to identify environmental and social concerns and potential sources of cumulative impact in the Project's AoI. Some of the comments/questions raised by stakeholders that are relevant to be considered in the cumulative impacts are summarised in Table 11-1. Some of the stakeholder's concerns noted during the activities includes:

- biodiversity impacts (flora and fauna)
- graves impacts and associated relocation
- community health and safety issues including crossings
- economic displacement and livelihood impact around affected farms and related compensation issues as a result of Project
- access roads/tracks to the rivers/water sources and farms
- dust and noise pollution.

Table 11-1: Summary of stakeholder concerns relative to cumulative impacts

Question/Comments Raised	Consideration for the Cumulative Impact Assessment
Stakeholders commented on the impacts on flora and Flora. Mention was made with respective to the 'Mussivi' plant that is found in Dala that must be preserved.	Construction of other third (3rd) party projects will involve vegetation clearance during site preparation works. Therefore, overlapping AoIs will have a cumulative impact on flora and concern of the medicinal plants like the Mussivi plant.
Stakeholders at provincial and municipal level raised concern that the Project is likely to affect some small holder farms, and access to rivers. It was indicated that people live far from the rivers but travel for fishing and they will be affected if don't have access. Some people have a strong connection with loved ones who live in neighbouring communities/municipalities and may need to cross the Railway track. In addition, community members questioned whether their fields will be affected, or if they would be impacts on any ecosystem services (river, firewood collection, collection of food/medicinal plants). How will the project influence accessibility and mobility of individuals and communities to access the services they need for daily life? Will it enhance opportunities, constrain, or modify them? The community member demonstrated concerns regarding the area where the animals graze, ploughs and medicinal trees are located expressing that they should not be affected.	Implementation of multiple projects that traverse land and routes used by communities may contribute to restricted access to resources, social connectivity and land used by small holder farmers.
The government stakeholder and community members relayed that there are several expectations, including an increase/improved: • movement of between people and goods • commercial exchange/trade • circulation of money • development of partnerships • lives of communities.	Socio-economic growth can be stimulated as a result of multiple developments/projects within the same AoI.
Community participants expressed concern related to pedestrian safety: The community responded that the machines should be far away from the residences at	Multiple construction activities occurring at the same time will increase noise and dust in the air for residents.

Question/Comments Raised	Consideration for the Cumulative Impact Assessment
up to 1 km to avoid excessive noise. In the case of dust, the community states that the increase of dust in the construction phase must be managed.	
The community raised concerns regarding safety in relation to crossing construction areas and also during the operation of the railway. Some asked if there would be a security guard assigned to the project to indicate the crossing areas for children and the elderly, also signs prohibiting access to the construction site.	Multiple construction activities occurring at the same time will increase safety risks for residents.
Provincial government stakeholders and community members raised questions whether any cemeteries will need to be moved. Concern was raised that residents tend not to prefer to move away from their buried relatives and have their own customary process if graves need to be moved	Multiple construction zones near cemeteries to be considered as a potential cumulative impact.
Some of the challenges mentioned with the Benguela railway are: • floods at stations • low frequency of trains in the region • people sleeping in the open areas to catch the train.	Potential effects of flooding as a result of disrupted or blocked drainage patterns caused by multiple developments implemented or planned need to be factored as a potential cumulative impact
Stakeholders from local government, NGOs and community levels commented that with the implementation of the Luena Saurimo project is expected to increase the level of employment of local residents	Direct and indirect employment and other income generation can be stimulated as a result of multiple developments/projects within the same AoI. Employment opportunities and employment grievances are relevant for Luena Saurimo Railway Project as well as other potential 3rd party projects in the same municipality.
Some municipalities commented that some challenges they have include: • the reconstruction of social infrastructures • reliable electricity supply • challenges in accessing potable water supply • the land is arable and there are many rivers.	Other third (3rd) party projects will also require social infrastructure, potable water, power and land. Cumulative impacts need to consider the timeframe and locations in relation to the Luena Saurimo Project.

11.1.3 Valued components (Step 3)

The IFC GPH defines valued components (VCs) as “environmental and social attributes that are considered important in assessing risks”, (IFC, 2013). These attributes may be:

- physical features described in Chapter 8
- biodiversity in Chapter 9
- ecosystem services presented in Chapter 6
- social conditions (e.g., health, economics) in Chapter 6, or
- cultural aspects (e.g., traditional spiritual ceremonies) in Chapter 7.

In accordance with the IFC GPH, the following criteria for the identification of VCs (or receptors) has been defined:

- identified as important and/or sensitive in this ESIA
- identified as important by the national/international scientific community, i.e., meeting the GPH criterion that a VC should be recognised as important on the basis of scientific concern
- identified as important or sensitive by stakeholders, summarised in Table 11-1 above.

- A list of the identified VCs used for the CIA are presented in Table 11-2. The baseline condition of each VC included in the previous Chapters 6, 7, 8 and 9 above.

The thresholds, limits of acceptable change, or preferred condition required by the GPH are defined in Table 11-2 on a case-by-case basis depending on the receptor and the nature of the cumulative impact being assessed. Where objective threshold values are identified by legislation, or by the IFC guidelines, these have been adopted (if relevant to the cumulative impact). For most receptors, however, threshold values are not defined and limits of acceptable change, or preferred condition have been used instead.

Table 11-2: VCs considered in the CIA

VC	Reason for Inclusion/Exclusion	Preferred Condition	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
Physical environment					
Air quality	The health and wellbeing of humans and biodiversity is associated with the ambient air quality in the project area. Concern was raised by stakeholders regarding the amount of dust that will be raised during construction. Potential impact of dust smothering was considered in the biodiversity impacts.	WHO standard for PM_{10} of 0.15 mg/m3 is not exceeded from the combined effects of the project and other developments for a duration of more than 6 months. Dust smothering of flora has not resulted in substantial change to the baseline and long term (>5 years) changes in an ecosystem.	L	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	Contractor
Climate	This VC is the global climate, including greenhouse gas emissions.	Angola's ability to meet its emission reduction target published as part of the UNFCCC's Paris Agreement is not impacted. As part of its National Determined Contribution (NDC) submitted in 2021 Angola has set an unconditional target to achieve 14% GHG emissions reduction by 2025 relative to an emissions baseline of 2015. Emissions from transport are included within the conditional targets category only, with a reduction potential of 6,590 tCO2e in 2025 and 13,180 tCO2e in 2030. Currently, there are no rail specific targets as part of	L	Conduct a GHG inventory for the project and implement an energy efficiency and emissions reduction plan. Use low-carbon technologies where feasible.	Operator

VC	Reason for Inclusion/Exclusion	Preferred Condition	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
		Angola's unconditional and conditional contributions.			
Noise	The health and wellbeing of humans and fauna is associated with the ambient sound level in the project area	No project environmental standard is exceeded from the combined effects of the project and other developments. The noise and vibration significance levels applied as major are: construction & decommissioning phases noise = > 75 dB $L_{Aeq,T}$ construction & decommissioning phases vibration = > 5 mm/s PPV operational noise (fixed plant) = <55 $L_{Aeq,1hr}$, or 10 dB above background ($L_{A90,1hr}$), whichever is the lower.	L	Where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements.	Contractor
Surface water	Surface water bodies are located within the Luena-Saurimo railway AoI. Access to water sources raised as a concern by stakeholders	No impact to pre-construction channel morphology and stability, water quality and drainage patterns.	M	Develop and implement an Erosion and Sediment Control Plan. Establish and maintain buffer zones from watercourses. Prohibit refuelling and equipment. washing near water bodies.	Contractor

VC	Reason for Inclusion/Exclusion	Preferred Condition	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
Groundwater	Water abstraction for multiple development projects can result in a cumulative reduction in water tables and impact the availability of potable water in existing boreholes and shallow wells that the community use.	No substantial change to the baseline and long term (>5 years) changes in an aquifer.	L	Follow abstraction volumes as prescribed in authorisation permits and monitor usage.	Operator
Biodiversity					
Legally protected, internationally or nationally recognised areas	No Critical Habitat Areas were identified by the biodiversity specialists, nor are there any international or nationally recognised or legally protected areas within the project AoI. Therefore, this VC is excluded.	N/A	N/A	N/A	N/A
Habitats, flora and fauna species of conservation importance	Flora and fauna species of conservation importance within the project AoI include species that are of conservation concern under IUCN (or national equivalent).	The preferred condition is that the number of species and individuals remains stable or increases, relative to the background changes in population levels. The limit of acceptable change is a short-term decrease followed by recovery to pre-construction numbers.	L	Minimise clearance of natural vegetation and habitats at the fringe of the sites, to allow for greater connectivity of habitat.	Contractor
Socioeconomic					

VC	Reason for Inclusion/Exclusion	Preferred Condition	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
Governance and economy	Presence of project in the AOI may directly or indirectly impact economic activities and conditions. Stakeholders shared their expectations in terms of improved/increased job creation, imports and exports of project-related goods, increased movement of people and goods. Concerns were also raised in relation to the influx of new populations (e.g., workers from other regions, or foreign workers) and the affordability of goods and transport for local residents with relatively lower income. (see Chapter 5 – Section 5.6).	The preferred condition is for the standards of living of communities in the AoI to be equal to, or better than, before construction.	M	Implement a Local Employment and Procurement Plan (LPP) with transparent targets and reporting. Establish a Grievance Redress Mechanism (GRM).	Operator
Land and livelihoods	Land and livelihoods that may be affected by the project through permanent and temporary acquisition or change in value. This was raised as a concern by stakeholders in Chapter 5, Section 5.6.	The preferred condition for land, property and livelihoods is for the standards of living of the impacted individuals and households of the affected PACs to be equal to, or better than, before construction.	M	Develop and implement a Livelihood Restoration Plan (LRP) and a Resettlement Action Plan (RAP) in line with international standards (e.g., IFC PS5).	Operator
Infrastructure and services	Physical and social infrastructure such as access to utilities, waste services, roads, and education services. Some municipal	The preferred condition is either to return to the original condition of social infrastructure and services before construction or contribute to the	M	Conduct a pre-construction infrastructure survey. Develop	Operator & Municipalities

VC	Reason for Inclusion/Exclusion	Preferred Condition	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
	governments commented that there are current challenges in the provision of public infrastructure and social services, therefore may not be sufficient to meet the increased pressure/demand from multiple projects.	improvement of the social infrastructure and services.		a Collaborative Service Delivery Plan with municipal authorities, which may include co-investment in upgrading key infrastructure.	
Demography and social fabric	Concerns were raised in relation to the influx of new populations (e.g., workers from other regions, or foreign workers) and community welfare, potential social tensions/conflicts and the erosion of customary/traditional mechanisms to make decisions. Welfare includes social cohesion and community stability.	The preferred condition is that changes in social, economic or cultural dynamics do not have a major adverse effect on the population's wellbeing. In addition, no increase in social ills and no change in social cohesion and community wellbeing caused from the combined effects of the project and other developments.	L	Implement zoning regulations and incentives for private developers to construct new housing.	Municipalities
Health, safety and security	This includes the health and safety of the construction and operations personnel, as well as the security of project personnel and property that could be damaged/vandalised/stolen. Multiple stakeholders (chapter 5 section 5.6) raised increased community safety risks from construction traffic and road use and safe crossing sites during construction and operation. The health and security of residents can	The preferred condition is no increase disease, no overburdening of the health care system including the result of traffic accidents.	L	Conduct regular health screenings and provide vaccinations for workers.	Operator

VC	Reason for Inclusion/Exclusion	Preferred Condition	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
	also be affected by presence of migratory workers, new populations, and security arrangements.				
Tangible and intangible cultural heritage	Tangible cultural heritage sites and intangible cultural heritage valued by communities in the AOI including cultures and traditions. Most stakeholders were concerned about the effects of project activities on the cemeteries, sharing their preference to be avoided or compensated through a process that respects their customary practices.	The preferred condition is for TCH to be preserved in situ. The limit of acceptable change in the event that the structure is excavated is for it to be preserved for research purposes. The preferred condition for ICH is that the use and appreciation of the ICH to be maintained. The limit of acceptable change in the event that the ICH is altered, with the agreement of stakeholder an alternative will be developed.	L	If the community's access path to cultural heritage sites is used for the project, provide alternative paths to avoid disruption.	Contractor
Ecosystem services	Ecosystem services will be covered as appropriate in the VCs presented above.	The preferred condition is that key provisioning (e.g., medicinal plants, water), regulating (e.g., air quality, erosion control), and cultural services are maintained or enhanced.	L	Integrate ecosystem services evaluation into the impact assessment for relevant VCs (e.g., Biodiversity, Surface Water, Land). Specific mitigation for medicinal plants could include a transplantation and propagation program.	Operator & Contractor

11.1.4 Defining the sources of cumulative impacts (Step 4)

A source of potential cumulative impact is something that affects the condition of the identified VCs. Cumulative impacts in the Project area, as defined in Section 11.1.1, potentially occur from the combined impacts of project activities with other activities. These include:

- associated facilities
- past and existing third-party projects that continue to affect the current and predicted future of the receptor
- reasonably defined/foreseeable third-party projects
- developments or activities induced by the Project
- other sources of human and natural stressors on the receptors.

The Project Description (Chapter 2) does not identify any Associated Facility (AF), therefore potential cumulative impacts in relation to AF, therefore it is not included in this cumulative assessment. It should be noted that unplanned/accidental events are not considered in this CIA as the likelihood of simultaneous large-scale events is considered too remote.

11.1.4.1 Third party developments

Planned third-party developments have been identified (within the Project AoI defined in Section 11.1.1) based on the IFC definitions that projects are reasonably defined, reasonably predictable or foreseeable.

Table 11-3 and Figure 11-3 presents the projects that have been screened into the CIA (i.e., they are reasonably defined, reasonably predictable or foreseeable) and provides justification for screening out other identified projects. A brief description of the other projects that have been screened in is provided below.

11.1.4.2 Induced development of facilities and services

The CIA considers project-induced development. Induced development are impacts from non-project activities that are encouraged to happen because of the project and that would not occur in the absence of the project, for example new/opportunistic businesses (not directly supported by the project) established to cater for increased number of construction workers in the area.

11.1.4.3 Other sources of human and natural stressors

Receptors are exposed to stresses, threats and pressures that are not directly connected with formal development. Consequently, they have not been considered as a source of cumulative impact and are assumed to be part of trends described in the baseline sections in Chapters 6, 7, 8 and 9.

Table 11-3: Identified third-party projects

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/ Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
	Third party projects – screened into CIA					
	New 220kV Transmission Corridor	Angola's National Energy Network Map in 2025 and Development Corridors.	Between Dala and Camanongue towns	The new 220kV transmission line running north on the eastern Provinces of Angola runs along the EN180 highway in parallel to the Luena-Saurimo Railway corridor.	Angola Energy 2025, Angola Power Sector Long Term Vision	Screened in because the operation of the project will provide power to locations within the Luena-Saurimo AoI during construction and potentially to stations in the respective municipalities.
	Rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena	Inea - Instituto Nacional De Estradas De Angola.	Luena City to Saurimo Town	The road being built and/or upgraded between Saurimo and Luena will provide access to the proposed railway development. Construction materials and goods will be transported along this road. This work consists of the rehabilitation of a 106 km stretch of the road that connects the capital Moxico Province (Luena) to the capital of Lunda-Sul Province (Saurimo).	TPF Angola Consultores, LDA (https://tpfangola.com/sobre.php)	Screened in. Construction activities overlaps in the Luena Saurimo AoI.

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/ Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
				The main works include deforestation, execution of sub-base in laterite, base in gravel and application of bituminous concrete. The contract includes the intervention in 5 bridges' structures: • Lumeje: 40 m • Luachimo: 50 m • Tchihinhi: 15 m • Cassai: 100 m • Chirrumbuei 40 m.		
	Saurimo Ring Road Construction Project	Saurimo Municipality	Saurimo Municipality	Construction Ring Road, with a delivery deadline of August 2025 (ongoing).	Saurimo Municipality	Feb.2024: Screened in because construction of the ring road will be almost finished as the Luena Saurimo Railway construction begins, increasing movement of people, machinery and equipment to the construction zones and campsites. Dec.2025: screened out because ring-road construction has been completed and the road is

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/ Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
						currently operational while railway construction has not begun. No construction temporal overlap with railway.
	Ceramic/clay mine	Sociedade Mineira de Catoca	(Access road near KM234+500)	Existing Ceramic/clay mine.	Interview at municipality/site visit to gate	Feb.2024: Screened in because nature of operations requires water, involves operational traffic and extraction of raw materials that produce dust. Qualitative inclusion of cumulative impacts due to insufficient details on production volumes, type and nature of equipment, volume of water abstraction, employees etc.
	Sonangol Oil and Fuel depot in Luena	Sonangol	+/-3km from Station	Existing diesel and petrol storage depot about 3km from Station 1. Operational since 2012.	Site visit	Fe.2024: Screened in because nature of operations may induce increase of traffic between the depot and the train station on the public road for the transportation of oil and fuel north using the Luena-Saurimo Railway. Qualitative assessment of cumulative impacts

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/ Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
						because details on volume, quantities of vehicles and frequency is not known. Dec:2025: screened out because construction has been completed and the facility is currently operational. No construction temporal overlap with railway
	New University: University Lueji a´Nkonde	University Lueji a´Nkonde	(planned in Saurimo near station 8)	Building of a new university that will be completed end of August 2024.	Site visit	Screened in because operations of the university and the railway will have long term cumulative impacts on the number of people moving between the two cities and increased pressure on social services near station 8. Initial information from the municipality indicates 2,300 students are anticipated to be enrolled. Qualitative assessment of cumulative impacts due to limited information on anticipated number of staff and students expected at the university, power demand,

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/ Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
						water abstraction and waste to be generated.
	Saurimo Industrial Complex	Not confirmed	Saurimo Municipality	Consultation with the Saurimo Municipality indicated initial discussions for the establishment of an industrial complex. Details on location and size not yet known.	Saurimo Municipality, Infrastructure department	Screened in because the completion of the Luena Saurimo Railway will induce more industrial investment in Saurimo and the potentially contribute to the establishment of the industrial complex.
	Water Treatment Plant	Saurimo Municipality	Saurimo Municipality	Water Treatment Plant is under construction to accommodate the planned expansion to the water distribution network in the municipality. The location and timeframe were not confirmed.	Saurimo Municipality, Infrastructure department	Screened in because the construction will most likely overlap the construction phase for the Luena Saurimo Project. The WTP can be a source of water for the Luena Saurimo Project during construction and operation phases.
	Water Treatment Plant	Dala Municipality	Dala Municipality	A Water Treatment Plant and a storage tank are under construction. With a storage capacity de 500 m3. It is currently under construction and expected to finish in 5 years.	Dala Municipality	Screened in because construction of the WTP overlaps in timeframe with the Luena Saurimo Railway. In addition, the operation of the WTP.
	Third party projects – screened out of the CIA					

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/ Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
	Catoca Diamond Mine	Sociedade Mineira de Catoca	Sociedade Mineira de Catoca – 45 km north of saurimo	Existing Diamond Mine – one of the Project's identified quarries.	Interview at Saurimo Municipality	Screened out. The location is beyond the 20km study area for cumulative impacts defined in section 11.1.1 The water source is Chicapa River and Power is sourced from Chicapa Dam. Both are not in the Luena Saurimo AoI.
	Photovoltaic Park	Saurimo Municipality	Saurimo Municipality	Photovoltaic Park in operation since March 2024.	Saurimo Municipality	Screened out.
	Expansion of schools	Saurimo Municipality	Saurimo Municipality	• Secondary school – 14 classrooms concluded April 2024. • Secondary school – 12 classrooms concluded March 2024 - Luari • Secondary school – 4 classrooms concluded February 2024 - Luari • Secondary school – 24 classrooms (in construction to be concluded June 2024)	Saurimo Municipality	Screened out. The expansions are for existing schools and involve the addition of classrooms for students.
	Photovoltaic Park of the City of Luena	Moxico Municipality	Luena City	Photovoltaic Park in operation since May 2024	Moxico Municipality	Screened out. All construction works are completed. Operation

Sn	Project	Proponent	Location (Commune/Settlement/Municipality/Provinces/Ward, District)	Description (Including Timescale)	Source	Screening at the Time of the Luena Saurimo ESIA Study
						works does not interact with the Luena Saurimo Railway.
	Water supply expansion	Moxico Municipality	Municipal headquarters	Water supply boreholes. The year construction is planned to begin is not yet known.	Moxico Municipality	Screened out. Exact locations and volumes of extraction are not yet defined to determine effects on the aquifer.
	Water supply expansion	Camanongue Municipality	Camanongue Municipality	Water supply boreholes to be constructed in 5 years. The year construction is planned to begin is not yet known.	Camanongue Municipality	Screened out. Exact locations and volumes of extraction are not yet defined to determine effects on the aquifer.
	Water supply expansion	Dala Municipality	Dala Municipality	Water supply boreholes to be constructed in 5 years. The year construction is planned to begin is not yet known.	Dala Municipality	Screened out. Exact locations and volumes of extraction are not yet defined to determine effects on the aquifer.
	PLANAGRÃO	Ministry responsible for agriculture	Not yet defined	Promotion of the production of grains at a national level. Timeframe is not yet known.	Moxico Municipality	Screened out. Timeframes and defined interventions are not yet known.
	Expansion of the maternity hospital in Dala Municipality	Dala Municipality	Dala Municipality	Planned expansion of the maternity hospital in Dala	Dala Municipality	Screened out. Timeframes and defined interventions are not yet known.

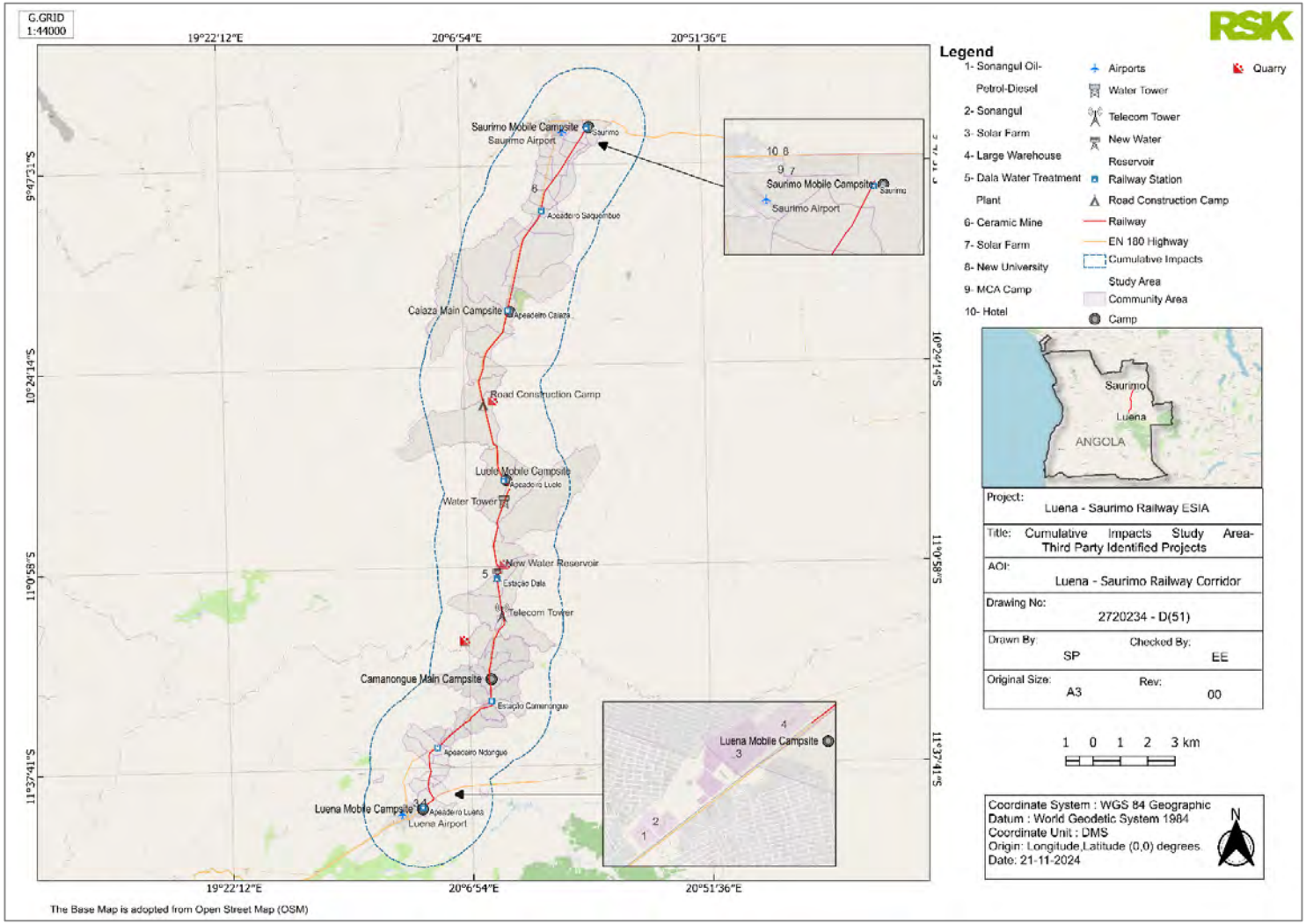

Figure 11-3: Third party projects within the Luena-Saurimo project footprint

11.1.5 Impact assessment (Step 5)

The impacts considered as cumulative impacts (Section 11.2) relate to activities of both the Luena Saurimo Project and other third (3rd) party Projects that occur within the Project AoI and occur at the same timescale.

Where available information on 3rd Party Projects is limited, professional judgement has been used to predict the impacts from these developments.

The significance of cumulative impacts has been determined qualitatively based on a predicted exceedance of VC thresholds, limit of acceptable change or preferred condition as recommended by the GPH.

11.1.6 Management and monitoring (Step 6)

The final step of the IFC GPH CIA process is concerned with designing and implementing the management and monitoring measures required to prevent significant cumulative impacts (i.e., above the threshold, or outside the limits of acceptable change) from occurring. If they are not avoidable, any adverse impact should be reduced as far as reasonably practicable. A distinction has been drawn, as discussed in the GPH, between management of significant cumulative impacts associated with the project (where it can be expected that the railway operator has a high degree of control or influence over mitigation/management) and management of impacts outside of Operator's control (because other third-party projects are the main cause of the cumulative impact). Figure 11-4, taken from the GPH, illustrates this difference and suggests how management/mitigation should proceed ideally, depending on whether the project has control or can exercise leverage, to achieve optimal cumulative impact management.

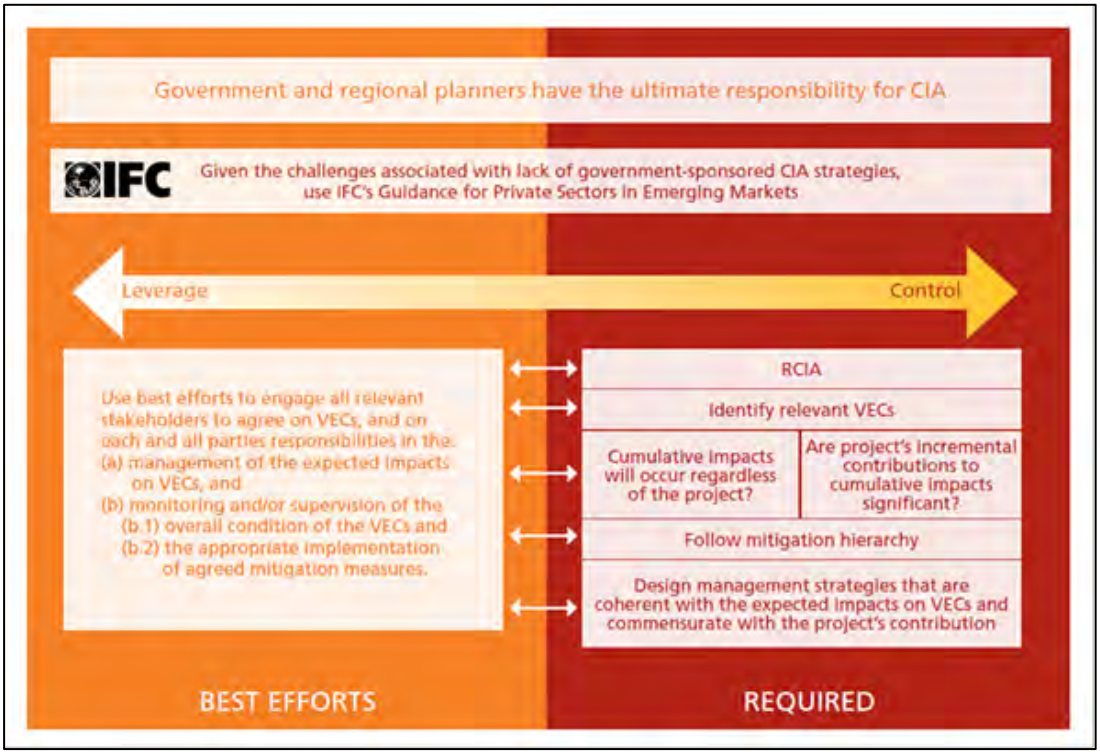

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Figure 11-4: IFC guidance on responsibility for management and mitigation of cumulative impacts (IFC, 2013).

It is acknowledged in the GPH that the total cumulative impacts due to multiple projects typically should be identified in government-sponsored assessments and regional planning efforts. According to IFC PS 1, IFC clients are expected to ensure that their own assessment determines the degree to which each project under review is contributing to the cumulative effects. Figure 11-4 shows the importance of differentiating between those actions over which a private sector sponsor has direct control and those for which it may have leverage to influence others to achieve optimal cumulative impact management as part of a multi-stakeholder effort; an effort that ideally should be led by government agencies, but at a minimum must involve government agencies.

11.1.6.1 Management of impacts where railway operator has control

As outlined in this ESIA, both OEC and the Railway Operator (CFB) are committed to implementing a comprehensive suite of management and monitoring activities. These measures have been carefully designed to effectively address cumulative impacts, aligning with the principles of the mitigation hierarchy:

- avoid at source: remove the source of the impact
- abate at source: reduce the source of the impact
- attenuate: reduce the impact between the source and the receptor
- abate at the receptor: reduce the impact at the receptor
- remedy: repair the damage after it has occurred
- compensate/offset replace in kind or with a different resource of equal value.

Where existing mitigation measures from section 10.2 to section 10.6 that are within Operator's control are sufficient to manage the cumulative impact, no further action is recommended. These are mitigation measures related to the direct operations of the Luena Saurimo Railway listed in Chapter 2, i.e. Railway service operations of locomotives, stations, workshops, maintenance of RoW and stations, use of existing quarries and borrow pits for maintenance, management of waste and wastewater and fuel supply.

11.1.6.2 Management of impacts outside of direct operator control

Where significant potential cumulative impacts are identified but action from other parties is required to manage the cumulative impact, Operator will make best endeavours to engage with the appropriate parties and use the leverage it may have to:

- inform others of the potential cumulative impact
- exchange information to assist in the further definition of the cumulative impact as needed
- agree responsibilities for the management of cumulative impacts
- agree monitoring measures as appropriate.

These parties may include the proponents of other project developers, government agencies and affected communities. The actions taken and the effort expended will be proportionate to the likely scale of the cumulative impacts.

Proposed management and monitoring are presented in Section 11.3

11.1.6.3 Limitations

The CIA involved review of available information, including existing national documents, baseline data, output from stakeholder engagement, and online publicly available information. The assessment considers the typical limitations that a project developer may face in this type of evaluation, including:

- uncertainty regarding the execution of future projects. Examples of these are related to the proposed industrial complex in Saurimo and the PLANAGRÃO project that is being implemented at a national level.
- incomplete information about other projects and activities (for example, if the information is not available in the public domain). Complete information of most of the projects screened in (Table 11.3 above) was not available at the time of writing this ESIA as a result of either not able to secure meeting with representatives, lack of documentation requested that can provide information and some information regarded as confidential.

11.2 Cumulative impact assessment

To determine the cumulative impacts which could occur as a result of the proposed project, it is necessary to identify interactions between project aspects and VCs, see Table 11-2. Once interactions have been identified, literature sources and professional judgement have been used to understand the potential impacts on VCs and how these impacts may change with the inclusion of future projects. The current condition of each VC is considered, as well as any potential natural stresses and events.

Analysis of cumulative impacts on VCs focusses on estimating the future state of the VCs that may result from the impacts they experience from predictable third-party future developments. Past and existing third-party projects that continue to affect the current and predicted future of the receptor are also discussed in certain cases where it is important that trends are considered. The objective is to estimate the state of VCs from the aggregated stresses that affect them.

In CIA, impacts are measured not in terms of the intensity of the stress added by a given development but in terms of the VC's response and ultimately, any significant changes to its condition.

Table 11-4: Cumulative impacts interaction table

VC	Third Party Project Development								
	New 220kV Transmission Corridor	Rehabilitation of a 106 km Extension of the EN180 Road Between Saurimo and Luena	Saurimo Ring Road Construction	Ceramic/clay mine	Sonangol Oil and Fuel Depot in Luena	New University: University Lueji a´Nkonde	Saurimo Industrial Complex	Water Treatment Plant (Saurimo Municipality)	Water Treatment Plant (Dala Municipality)
Air quality		X	X	X			X		
Climate									
Noise		X	X	X	X		X	X	X
Surface water	X	X	X	X	X	X	X	X	X
Groundwater	X	X	X	X	X	X	X	X	X
Legally protected, internationally or nationally recognised areas	X			X	X	X	X	X	X
Habitats, flora and fauna of	X	X	X	X	X	X		X	

VC	Third Party Project Development								
	New 220kV Transmission Corridor	Rehabilitation of a 106 km Extension of the EN180 Road Between Saurimo and Luena	Saurimo Ring Road Construction	Ceramic/clay mine	Sonangol Oil and Fuel Depot in Luena	New University: University Lueji a´Nkonde	Saurimo Industrial Complex	Water Treatment Plant (Saurimo Municipality)	Water Treatment Plant (Dala Municipality)
conservation importance									
Governance and economy	X	X	X	X	X	X	X	X	X
Land and livelihoods	X	X		X		X	X		
Infrastructure and services		X		X	X	X			
Demography and social fabric	X		X	X		X	X	X	X
Health, safety and security	X	X	X	X	X	X	X	X	X
Tangible and intangible cultural heritage	X			X	X	X	X	X	X

VC	Third Party Project Development								
	New 220kV Transmission Corridor	Rehabilitation of a 106 km Extension of the EN180 Road Between Saurimo and Luena	Saurimo Ring Road Construction	Ceramic/clay mine	Sonangol Oil and Fuel Depot in Luena	New University: University Lueji a´Nkonde	Saurimo Industrial Complex	Water Treatment Plant (Saurimo Municipality)	Water Treatment Plant (Dala Municipality)
Ecosystem services	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	X

*Note: X = interaction between Luena Saurimo railway and other project; **X** = significant impact.*

Ecosystem services are covered in each of the subsections below as appropriate.

11.2.1 Physical environment

11.2.1.1 Increased fugitive dust emissions

Air quality declining due to construction-related dust dispersion. Potential cumulative impacts are predicted between the construction and operation of the Luena -Saurimo Railway Line and the following projects:

- upgrade and building of the EN180 road
- Saurimo Ring Road.

The baseline of the air quality in the AoI is provided in Chapter 8.

Construction phase

Exceedances of PM10 and PM2.5 concentrations were recorded in 10 monitoring locations. Within Saurimo, the measured PM10 and PM2.5 concentrations at more than half the monitoring locations would be within the WHO 24-hour guideline and the annual mean Interim Targets, though there are exceedances at 4 monitoring locations. Also, there are PM10 and PM2.5 concentration exceedances at most of the monitoring locations within Dala and Camanongue and the only monitoring location within Luena.

The particulate matter data represent a limited dataset of day-time measurements and are therefore likely overestimates the 24-hour and annual mean. The periods monitored are substantially less than a full year and therefore are not appropriate for formal comparison with the WHO annual mean guideline.

The impacts associated with fugitive dust and exhaust emissions are considered localised and medium term (up to 5 years). The sensitivity of the receptor and magnitude of the impact is considered as moderate; therefore, the significance of the cumulative dust emissions is assessed as moderate.

Mitigation measures

- OEC will follow good industry practices to minimise impacts on air quality and apply the mitigation measures included for air quality as a result of activities directly related to the construction of Luena Saurimo
- as far as possible, the construction phases between should be coordinated with the EN180 road construction and the Ring Road construction to minimise the potential for a cumulative impact
- publish public notices of the location and duration of construction informing the community of periods of increased activity that will generate dust.

Operation phase

The cumulative fugitive dust emissions from the Luena Saurimo Railway, the EN180 and the Saurimo Ring Road are not expected to be significant during the operations phase. Therefore, this is not considered further.

11.2.1.2 Increased exhaust emissions

Regional emissions rising from project-related vehicle and machinery use. Potential cumulative impacts are predicted between the construction and operation of the Luena - Saurimo Railway Line and the following projects

- upgrade and building of the EN180 road

- Saurimo Ring Road.

The baseline of the air quality in the AoI is provided in Chapter 8

Construction phase

Impacts on local air quality as a result of exhaust emissions during the construction phase of the Luena Saurimo Railway have been assessed as not significant (Chapter 10.4). At the time of writing, quantitative information on the traffic volumes on the current EN180 was not available, however and Appendix 15 indicates that the Luena Saurimo project emissions as moderate. The magnitude is considered moderate due to the relatively low population density, few construction vehicles planned and anticipated of the completion of the EN180 road construction before the railway construction. The sensitivity of the receptor is considered as high therefore the significance is considered

Mitigation measures

The GHG assessment report (Appendix 15) has indicated mitigation measures related to emissions as follows:

- implement measures to decrease fuel use by maximising energy efficiencies, e.g. switch off all vehicles when stationary and maintain construction vehicles and conform to current emissions standards
- where possible, a proportion of imported energy to be sourced from renewable energy sources
- suitable training to operators to maximise the efficiency of using the equipment and reduce idling
- make sure that periodic inspections of vehicles are carried out
- make sure that the work planning is done properly. Make sure that no more than one work activity is performed for the same work
- the use of solar light systems to reduce generator fuel consumption
- the use of locally sourced and/or produced materials. Where wood is to be integrated within the design, source from certified managed/sustainable forests. The use of recycled aggregates, where appropriate, for foundations, subbases, hard-standings and pavement materials. Maximise use of recycled steel and alternative cement replacements where feasible
- optimise transport logistics for efficient journeys of materials to site.

As part of its National Determined Contribution (NDC) submitted in 2021 Angola has set an unconditional target to achieve 14% GHG emissions reduction by 2025 relative to an emissions baseline of 2015. It has also stated an additional targeted contribution, based on the provision of international support and funding, of a further 10% reduction by 2025. IFC and EP4 guidelines call for the quantification of these emissions on an annual basis. Therefore, the Contractor is to

- establish a GHG monitoring that will record and maintain quantitative records of emissions during construction phases
- conduct annual GHG assessments
- disclose results of the annual GHG assessment publicly through corporate reports or voluntary disclosure mechanisms. that will be reported to the Angolan Government.

Operation Phase

The operational GHG assessment indicates an overall positive contribution of the Railway project to the national target. Therefore, with the operation of the EN180 road and the Saurimo Railway, the magnitude of the cumulative GHG emissions during operations are considered as minor. The long-term impact of GHG emissions needs to be monitored due to the high sensitivity of the receptor. The cumulative impact of GHG emissions is assessed as moderate.

Mitigation measures

The GHG assessment report (Appendix 15) has indicated mitigation measures related to emissions as follows:

- prioritise the procurement of efficient locomotives
- minimise the idling times of locomotives
- promote fuel efficiency for operation of the locomotives, including efficient driving guidelines
- the use of renewable energy sources (e.g. solar PV units) should be investigated
- LED lighting can be used use at stations to increase energy efficiency
- the use of locally sourced and/or produced materials
- optimise transport logistics to ensure efficient journeys of materials to site.

The Operator (CFB) and MINTRANS are to establish a monitoring system of projects that emit GHGs and offer technical advisory services to the projects occurring along the Luena Saurimo Railway AoI to minimize their GHG emission contributions during operations.

11.2.1.3 Noise

Ambient noise levels increasing near construction and operational zones. Potential cumulative impacts are predicted between the construction and operation of the Luena - Saurimo Railway Line and the following projects (Table 11-4:):

- upgrade and building of the EN180 road
- Saurimo Ring Road
- Sonangol Oil and Fuel depot in Luena
- Saurimo Industrial Complex.

Construction phase

Ambient noise levels are assumed to be typical for rural areas, with the main noise sources expected to be natural (e.g., wind and wildlife); human (e.g., traffic and farming); and traffic from the nearby EN180.

Chapter 10.4 presents the predicted unmitigated construction noise levels during the construction phase of the works.

As a worst-case scenario where noise generating construction activities are conducted concurrently from the upgrade and construction of the EN180, construction of the Saurimo ring road and the Luena-Saurimo railway line there could be accumulative impacts on the communities. The noise associated with the projects is likely to be similar based on assumed construction activities and associated traffic movements on haul and access routes.

The assessment results (Chapter 10.4) indicate that the predicted noise levels indicate that construction works have the potential to exceed the project criteria at up to 75m from

the considered alignment in line with threshold criteria outlined in BS 5228. The duration of activities and the transient nature of the project will mean that these levels will be experienced for very short periods of time. The inherent nature of construction means short term impacts are likely and typically accepted.

The magnitude of the cumulative noise is considered as moderate due to the transient nature of the impact and the sensitivity of the receptor is moderate. Cumulative impacts are expected to be moderate in significance.

Mitigation measures

The Contractor will implement measures already described in Chapter 10.4 and Appendix 17.

Operation Phase

The operation of the Luena station and Saurimo station will have a cumulative impact on noise with the operation of the Sonangol Oil and Fuel depot in Luena and the Saurimo Industrial Complex respectively. This will primarily be as a result of an increase in road traffic to and from the stations for fuel and other cargo goods that will be induced as a result of the railway operations between the two towns of Luena and Saurimo. This magnitude is considered as moderate and the sensitivity of the receptor is moderate, therefore the significance of the cumulative noise impact during operation is assessed as moderate.

Mitigation measures

The CFB and MINSTRANS have no direct control on the increase of noise from traffic. The municipal government needs to:

- consider the location of existing and planned sensitive receptors such as health care facilities, schools and religious buildings along the transport corridor. Attention is to be given to the road transport corridor between the Sonangol Oil and Fuel depot in Luena and Station 1 of the Luena Saurimo Railway, as well as the potential Saurimo Industrial Complex and Station 8 of the Luena Saurimo Railway.
- have regular community engagement activities to sensitize residents and road users on the development projects and the increase in traffic noise.

11.2.1.4 Decreased water levels

Groundwater and surface water availability declining under project pressure. Potential cumulative impacts are predicted between the construction and operation of the Luena - Saurimo Railway Line and the following projects (Table 11-4:):

- upgrade and building of the EN180 road
- Saurimo Ring Road
- Ceramic/clay mine
- Sonangol Oil and Fuel depot in Luena
- New University: University Lueji a´Nkonde
- Saurimo Industrial Complex.
-

Construction phase

The baseline conditions of the water bodies in the AoI are described in Chapter 8. The railway line crosses several perennial rivers, water courses and drainage lines as well as numerous wetlands and floodplains. The construction of the Luena Saurimo Railway has a cumulative impact on the abstraction of water because the other third (3rd) party projects (EN180 road, the Saurimo Rain Road, the university and the potential industrial complex) all require water for camps and construction works. This has the potential to decrease both surface water and groundwater sources over the period of 5 years. The rivers are of high importance to both ecosystems, but also human populations as local communities are highly dependent on these features as a source of water and for agricultural activities. Therefore, the sensitivity of the receptor is considered high, and the magnitude is also high due to the scale of the combined projects. The significance of the potential cumulative impact of decreased water levels is assessed as major.

Mitigation measures

Chapter 10.4 and Appendix 17 has included mitigation measures for the Contractor of the Luena Saurimo Railway.

The respective ministries for Environment and Industries are to establish/update a catchment management plan that will be developed based on scientific hydrological studies to determine the abstraction limits and minimal environmental flows in the rivers that traverse the two provinces (Lunda Sul and Moxico). This will also be the basis for any water use permits that respective proponents will apply for.

Operation phase

The operation of the Luena Saurimo Railway concurrently with the other developments in the AoI will require continuous water supply (surface and groundwater) for drinking, cleaning and support facilities. Therefore, the water abstraction from construction phase applies for operations and can result in a decreased water level in the project AoI. The water demand has not been quantitatively assessed in this ESIA; however, the potential magnitude of the cumulative water demand is considered as high. The sensitivity of the receptor is high and the resulting significance of the cumulative impact is major.

The respective ministries for Environment and Industries are to establish/update a catchment management plan that will be developed based on scientific hydrological studies to determine the abstraction limits and minimal environmental flows in the rivers that traverse the two provinces (Lunda Sul and Moxico). This will also be the basis for any water use permits that respective proponents will apply for.

11.2.1.5 Decreased water quality

Water quality deteriorating due to sedimentation and potential contamination. Potential cumulative impacts are predicted between the construction and operation of the Luena - Saurimo Railway Line and the following projects (Table 11-4:):

- upgrade and building of the EN180 road
- Saurimo Ring Road
- Ceramic/clay mine
- Sonangol Oil and Fuel depot in Luena
- New University: University Lueji a´Nkonde
- Saurimo Industrial Complex.

Construction phase

Assuming that the construction of the other third (3rd) party projects (EN180 road, the Saurimo Rain Road, the university and the potential industrial complex) occurs concurrently with the construction of the Luena Saurimo Railway, there will be similar construction activities along the AoI that has the potential for a short-term increase in sediment concentrations. These activities include soil stripping and stockpiling, excavation works and concrete batching. Concern of increased sediment load in surface water bodies is the long-term decrease in the water quality and potential to change the morphology of channel beds. The sensitivity of the receptor is high. The magnitude of the impact is considered as moderate because majority of the construction works are not anticipated to traverse water bodies except for the bridges. Therefore, the significance of the cumulative impact is considered as moderate.

Mitigation measures

The mitigation measures for the Contractor for the Luena Saurimo Railway are going to integrate sediment control measures in the final design.

Operation phase

The operation of the Luena Saurimo Railway concurrently with the other third (3rd) party projects will involve activities like cleaning permanent buildings, disposal of solid and liquid waste and the use of various oils/lubricants, cleaning agents for maintenance activities. These activities will generate effluents and can involve leaks of these chemical substances that can contaminate surface water bodies if discharge/disposed incorrectly. The long-term impact of the improper collection, treatment and disposal of chemical substances, solid waste and effluents will have a long-term cumulative impact on the water quality of the surface bodies. The sensitivity of the receptor is high, and the magnitude of the potential impact is considered moderate. Therefore, the significance of the cumulative impact is considered as moderate.

Mitigation measures

The mitigation measures for the Contractor for the Luena Saurimo Railway are going to integrate sediment control measures in the final design.

The Departments for Environment/Natural Resources at the municipal offices are to collaborate with the operator of the Luena Saurimo Railway (CFB) as well as other proponents of the third(3rd) party project identified to:

- ensure there are adequate solid waste collection facilities at permanent structures
- regulate the collection and disposal of liquid and solid waste from permanent structures and ensure they are disposed of at the authorised locations
- establish Wastewater Treatment Plants within the municipalities
- establish engineered landfill(s) at an agreed location to be able to absorb the increased solid wate generated
- establish a water quality monitoring system with the universities in the area to detect contamination and institute suitable corrective measures.

11.2.1.6 Increased surface-runoff

Hydrological balance shifting with higher runoff and erosion risks. Potential cumulative impacts are predicted between the construction and operation of the Luena -Saurimo Railway Line and the following projects (Table 11-4:).

- upgrade and building of the EN180 road
- Saurimo Ring Road
- ceramic/clay mine
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex.

Operation phase

Longer term impacts to the morphology of channel beds and riverbanks from erosion resulting from surface runoff into watercourses is anticipated as a result in changes of surface drainage patterns and increased bare/built landcover. Increased surface run off can also increase the frequency of localised surface floods either as a result of high volumes of water after a rain event or blocked surface water drainage as a result of a permanent structures and waste. These outcomes are anticipated during the operation of the Luena Saurimo railway at the same time with the third (3rd) party projects. The magnitude is considered to be minor as the project area has no recorded incidences of server flooding/overflow of the riverbanks after heavy rain events and majority of the structures are not expected to permanently block a surface water channel. The sensitivity of the receptor is still considered high. Therefore, the significance of the impact is assessed as moderate.

Mitigation measures

The respective ministries for Environment and Industries are to establish/update a catchment management plan that will be developed based on scientific hydrological studies to determine the surface drainage patterns in the rivers that traverse the two provinces (Lunda Sul and Moxico) and identify no build zones. This will also be the basis for future monitoring of the water levels and drainage patters in the catchment.

11.2.2 Biological environment

11.2.2.1 Reduced vegetation cover

Natural vegetation declining due to clearance and land conversion. Potential cumulative impacts are predicted between the construction and operation of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- upgrade and building of the EN180 road
- Saurimo Ring Road.

Construction phase

Clearance of both natural and modified habitats will occur during the pre-construction and construction phases of the project along the RoW and at sites for camps, stations, concrete batching plants and sleeper production sites. At the time of the field surveys for this ESIA, the construction of the EN180 highway had begun, however the Saurimo ring

road construction had not yet begun. Therefore, the cumulative impact of vegetation clearance will continue within the next 5 years. The grassland and miombo woodland habitats within a 1km to 5 km area are considered natural but already show varying degrees of degradation as a result of existing agricultural fields, fuel source exploitation and the presence of alien invasive species. Therefore, the sensitivity of the receptor is moderate. The direct footprint of all three linear projects where vegetation will be cleared therefore the magnitude is considered as major and the significance of the cumulative impact is major.

Mitigation measures

- the Contractor for the Luena Saurimo Railway will implement mitigation measures to limit the area of vegetation clearance already included in Chapter 10.5.
- the Municipalities are to conduct regular monitoring visits across all development projects to ensure vegetation clearance does not occur outside of land handed over for each of the respective projects.
- the Contractor shall as much as possible use existing roads and cleared land for spoil soil stockpiles established by the construction of the EN180 and the Saurimo ring road to minimize clearing additional natural vegetation cover.

Operation phase

Based on the installation of the power transmission line the areas under it and in close proximity has already been demined and cleared largely for the installation of the pylons. The areas underneath the power transmission line is usually kept cleared due to the potential dangers of fires can have on the infrastructure. This in turn provide safe passages for people and animals to move. The Luena Saurimo Railway will also maintain the RoW clear of vegetation throughout operations along the embankment, culverts and bridges. The operation of the EN180 and the Luena Saurimo Railway will provide easier accessibility for the transportation of agricultural produce. This can indirectly induce further vegetation clearance during the operation phases for agricultural land. Therefore, the magnitude of this long-term cumulative impact is considered as major, the sensitivity of the receptor is moderate and the significance of the cumulative impact is major.

Mitigation measures.

- The Municipalities are to conduct regular monitoring visits across all development projects to ensure:
    - vegetation clearance does not occur outside of land handed over for each of the respective projects
    - the operators are not using herbicide and fire to clear vegetation
    - construction zones that were rehabilitated after construction are maintained with native flora.

11.2.2.2 Introduction of alien invasive species

Risk of invasive species establishment increasing with disturbed habitats. Potential cumulative impacts are predicted between the construction and operation of the Luena - Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- ceramic/clay mine
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

The movement of people, construction vehicles, machinery and equipment will lead to the spread of alien invasive species through shoes, tires and packaging. Invasive species in this context applies to both floral species as well as faunal species. This movement applies to all third (3rd) party projects (except the existing ceramic/clay mine that is already operational) and the Luena Saurimo Railway Project during the construction of permanent and temporary structures. The magnitude of the impact is considered as major as the movement during construction extends through four municipalities (Luena, Camanongue, Dala and Saurimo). The sensitivity is considered as high because the biodiversity baseline has already indicated that there are areas of modified habitat as a result of clearance for agriculture or forest products. The cumulative significance of the impact is assessed as major.

Mitigation measures

The Contractor for the Luena Saurimo Railway shall implement measures to avoid and minimize the spread of invasive species as indicated in Chapter 10.5.

Operation phase

The operation of the identified third (3rd) party projects, concurrently with the Luena Saurimo Railway will include the movement of people, vehicles, the train locomotives and goods in various packaging. Floral and faunal invasive species can easily move across all four municipalities during operation. The magnitude of the impact is considered as major because of the large geographical extent and long term exposure of the miombo woodlands and savanna grasslands to potential invasive species. The sensitivity is considered as high because if invasives are not controlled the ecological composition and stability will not recover. The significance of the cumulative impact is assessed as major.

Mitigation measures

- the operator for the Luena Saurimo Railway shall implement mitigation measures already indicated in chapter 10.5.
- the municipal departments responsible for agriculture and environment shall develop communication materials for residents in the communities in all four municipalities to inform them on common invasive species (visual appearance,

common methods of spreading and their impacts) and how to remove/manage them.

11.2.2.3 *Increased wildlife mortality*

Wildlife mortality rates rising due to habitat fragmentation and collisions. Potential cumulative impacts are predicted between the construction and operation of the Luena - Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- New University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

Construction activities for the Luena Saurimo Railway and any other third (3rd) party project constructed concurrently will result in an incremental increase in the number of construction vehicles between Luena and Saurimo towns. Although the biodiversity baseline (Chapter 9) did not identify any wildlife corridors, or critical terrestrial habitats for large wildlife species within the 20 km study area, it is common to have smaller reptiles, amphibians and small mammals that may move towards water bodies and feeding grounds. As the wildlife cross construction zones the potential frequency of vehicle collisions will increase and increase wildlife mortality. The increased movement of construction workers will also increase the demand for wild meat that is hunted and sold in the communities. However, the magnitude of the impact is not anticipated to be major or exceed the preferred conditions, therefore considered as moderate. The sensitivity of the receptor is minor as the baseline study did not identify thousands of endangered species or critical habitats with large wildlife. Therefore, the potential cumulative impact is assessed as minor.

Mitigation measures

- the contractor shall coordinate with other third (3rd) party projects to identify common hotspots where wildlife cross or assemble for water/foraging within the respective AoI's through site inspection reports and roadkill incident records.
- the contractor shall coordinate with other third (3rd) party projects as much as possible in the preparation of training materials for construction workers to avoid roadkill and minimize killing wildlife at camps and construction zones.

11.2.3 Socioeconomic environment

11.2.3.1 Employment and economic empowerment

Local employment opportunities increasing, supporting economic empowerment. Potential cumulative impacts are predicted between the construction and operation of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

Construction activities associated with the Luena Saurimo railway line will provide opportunities for employment and some local enterprises to supply goods (e.g. equipment, materials, foods) and services (e.g. transportation, security, cleaning) to the project. Providing goods and services will allow these enterprises to increase their turnover and profit margins during the construction period.

Mitigation measures

The Contractor for the Luena Saurimo Railway will implement mitigation measures already included in Chapter 10.2.

Operational phase

Some of the enterprises used during construction may even continue to prosper during the operational phase of the project. The infrastructure constructed will further have a positive cumulative impact on the livelihoods of people dependant on agriculture for subsistence or commercial enterprises as a result of improved access and increase in people (employees during the operation of the infrastructures and investors).

Mitigation measures

- the provincial governments will regulate the recruitment policies of proponents investing in the project area to ensure that residents from the communities in the project area are promoted and prioritised.
- the provincial governments will regulate the procurement of proponents investing in the project area to ensure that local enterprises are promoted and prioritised.

11.2.3.2 Increase in inflation

Inflationary pressures rising due to project-driven demand and local market shifts. Potential cumulative impacts are predicted between the operation of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex.

Operation phase

The operation of the Oil and Fuel depot, the new university and the potential Saurimo Industrial Complex will have a long term effect on the increase of commodities and services in Luena and Saurimo towns. This can result in a gradual increase in the cost of living and cost of goods. This will have a long term cumulative impact for residents in relation to their purchasing power/affordability. The sensitivity of the receptor is considered as medium and the magnitude is considered as medium. The significance of the cumulative impact is assessed as moderate.

Mitigation measures

The municipal and provincial governments are to regulate overall prices of commodities and services that are essential for social wellbeing (for example public health facilities, water, etc).

11.2.3.3 Increased pressure on public infrastructure and Services

Public services experiencing growing strain from project-related population influx. Potential cumulative impacts are predicted between the construction and operation of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- Rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

Potential cumulative impacts are anticipated where the upgrade and construction of the EN180 and the Saurimo ring road, the new university, water treatment plants and potential Saurimo industrial complex in conjunction with the Luena-Saurimo railway line will result in influx of workers to the area who will need public and social services in the project area. This may lead to a cumulative increased demand and pressure on local health services, water supply, power supply, waste management, legal and government services, food markets and entertainment establishments. The magnitude of the impact is considered large and sensitivity of the receptor as high. The significance of the cumulative increase demand on social services and public infrastructure is considered as major.

Mitigation measures

- the Contractor for the Luena Saurimo Railway will share information on the average number of employees during construction with the municipal governments to inform their development plans.
- the Contractor for the Luena Saurimo Railway has planned to established construction camps that are equipped with social services like medical and sports fields.
- the Contractor for the Luena Saurimo Railway shall coordinate as much as possible with other third (3rd) party project proponents to implement joint CSR initiatives to improve public infrastructure and social services.

Operation Phase

Potential cumulative increased demand on public and social services in the project area are anticipated when the upgrade and construction of the EN180 and the Saurimo ring road, the new university, water treatment plants and potential Saurimo industrial complex will be operational with the Luena-Saurimo railway line. This is a result of the long term in-migration of investors and employees to the AoI. This may lead to a long term cumulative increased demand and pressure on local health services, water supply, power supply, waste management, legal and government services, food markets and entertainment establishments. The magnitude of the impact is considered large and sensitivity of the receptor as high. The significance of the cumulative increase demand on social services and public infrastructure is considered as major.

Mitigation measures

The Municipal offices shall coordinate as much as possible with the operator of the Luena Saurimo Railway and other third (3rd) party project proponents to implement joint CSR initiatives to improve public infrastructure and social services.

11.2.3.4 Increased burden of diseases

Community health burden increasing with exposure to dust, emissions, and stressors. Potential cumulative impacts are predicted between the construction and operation of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

Potential cumulative impacts are anticipated where the upgrade and construction of the EN180 and the Saurimo ring road, the new university, water treatment plants and potential Saurimo industrial complex in conjunction with the Luena-Saurimo railway line will result in influx of workers to the area potentially causing the spread of communicable

diseases. Interaction between workers and the community may exacerbate the spread of communicable diseases (such as STI's). This may lead to a cumulative burden of disease on the local health services. The magnitude of the impact is considered large and sensitivity of the receptor as high. The significance of the cumulative increase of communicable disease is considered as major.

Mitigation measures

- the contractor of the Luena Saurimo Railway shall share information with the municipal offices on the incidences and trends of illnesses and diseases.
- the contractor shall coordinate with the health facilities in Luena and Saurimo in the provision of medical services to prevent outbreaks of diseases
- the contractor shall engage with the residents in the communities through activities outlined in the SEP to sensitize residents on prevention of communicable diseases.

Operation phase

The operation of the third (3rd) party projects and the Luena Saurimo Railway will result in an influx of employees, investors and visitors. The long term increase of people settling in the towns within the 20km study area will increase the risk of communicable diseases. The magnitude of the impact is considered large and sensitivity of the receptor as high. The significance of the cumulative increase of communicable disease is considered as major.

Mitigation measures

- the municipal offices shall share information with the proponents of the development projects in their jurisdiction on the incidences and trends of illnesses and diseases
- the municipal offices shall coordinate with the health facilities in Luena and Saurimo in the provision of medical services to prevent outbreaks of diseases
- the municipal offices shall engage with the residents in the communities to sensitize residents on prevention of communicable diseases.

11.2.3.5 Increased social tension and conflicts

Social cohesion weakening as tensions and conflicts rise over resource use. Potential cumulative impacts are predicted between the construction of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction Phase

The influx of migrant workers and other people seeking economic opportunities associated with the projects may result in unplanned population growth. Cumulatively, the population growth will be higher than other areas. High levels of population growth may change community dynamics leading to an increase in social wellness and a decline in social cohesion. This can include tensions due to different cultural traditions and values between non-local workers and members of the communities in close proximity to the ROW that may even lead to conflict. During the construction, there may be social conflicts between migrant employees and locals. These conflicts may be the cause of differing cultural norms, behaviours and customs that migrant employees may not understand. In addition, cultural misunderstandings may arise due to language differences and the migrant employees not wanting to follow the cultural processes/practices when carrying out certain activities. The magnitude of the impact is considered as minor because the communities have existing traditional/customary leaders who play an integral role in resolving conflicts. In addition, the Luena Saurimo Railway project has a Grievance Redress Mechanism to identify any merging conflicts. The sensitivity of the receptor is moderate and the cumulative impact is assessed as moderate.

Mitigation measures

Future community dynamics is difficult to predict. The contractor for the Luena Saurimo Railway will work closely with the local authorities and traditional/customary leaders to identify and monitor any emerging tensions and conflict related to this impact.

11.2.3.6 Increased road traffic accidents and other incidents

Traffic accident risks increasing with higher vehicle movement. Potential cumulative impacts are predicted between the construction of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

The cumulative impact of the upgrading and building of the EN180, the construction of the Saurimo ring road and the Luena – Saurimo railway line most definitely will introduce more traffic. The construction of the water treatment plants and proposed industrial complex will involve construction vehicles, heavy machinery and the movement of construction workers will also result in the increase of traffic along the main roads. This will increase the risk of more frequent traffic related accidents and incidents. The sensitivity of the receptor is high as it relates to the lives of people. The magnitude of the

impact is considered as moderate and the cumulative impact on road accidents is assessed as moderate.

Mitigation measures

The contractor for the Luena Saurimo Railway shall implement measures to reduce the risk of accidents already indicated in Chapter 10.2.

The Municipal offices, in close collaboration with the relevant project proponents will implement community awareness campaign on road and railway safety.

Operation Phase

The operation of the Luena station and Saurimo station will have a cumulative impact on road traffic accidents with the operation of the Sonangol Oil and Fuel depot in Luena and the use of the EN180 highway. This will primarily be as a result of an increase in road traffic to and from the stations for fuel and other cargo goods that will be induced as a result of the railway operations between the two towns of Luena and Saurimo. In addition, there will be an increase in road traffic with the operation of the new university and the potential industrial complex in Saurimo due to the movement of people and goods to the nearest station in Saurimo. This magnitude is considered as moderate and the sensitivity of the receptor is moderate, therefore the significance of the cumulative noise impact during operation is assessed as moderate.

Mitigation measures

- the operator for the Luena Saurimo Railway shall implement measures to reduce the risk of accidents already indicated in Chapter 10.2.
- the Municipal offices, in close collaboration with the relevant project proponents will implement community awareness campaign on road and railway safety.

11.2.4 Tangible and intangible cultural heritage

11.2.4.1 Access to physical heritage and cemeteries

Community access to heritage sites increasingly constrained by project footprint. Potential cumulative impacts are predicted between the construction of the Luena - Saurimo Railway Line and the following projects (Table 11-4:):

- upgrade and building of the EN180 road
- Saurimo Ring Road

Construction phase

The field surveys identified a number of monuments and cemeteries along the Luena Saurimo Railway RoW (Chapter 7). During Construction of the Luena Saurimo Railway there may be temporary closures of access routes to these cultural sites. Construction of other third (3rd) party projects concurrently will contribute to either the duration of these temporary closures or restricted access to particular areas. This can result in grievances from residents and visitors. The community expressed concerns about access to the cemeteries during stakeholder engagement (referred to in section 11.1 above) therefore the sensitivity of this receptor is considered as high. The magnitude of the potential cumulative impact is considered as minor because the locations of the identified

cemeteries are not located directly in the RoW of the Luena Saurimo Railway. The significance of the cumulative impact is assessed as moderate.

Mitigation measures

- the design of the Luena Saurimo Railway has prioritised the avoidance of all cemeteries along the railway RoW.
- the Contractor for the Luena Saurimo Railway will implement their Cultural Chance Finds Procedure and Stakeholder Engagement Plan that will involve the community leaders to identify any un-marked cultural sites that were not identified during the ESIA field surveys and minimize impacts.

Operation Phase

The operation of the Luena Saurimo Railway in conjunction with the other third (3rd) party Projects are not expected to have negative cumulative impacts on the accessibility to physical heritage sites.

11.2.4.2 Noise interference during cultural and religious services/events

Cultural and religious practices increasingly disrupted by noise intrusion. Potential cumulative impacts are predicted between the construction of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

Construction activities of the Luena-Saurimo Railway and other 3rd Party projects will involve activities that will generate noise and dust. Noise pollution from increased vehicle traffic, machinery and construction activities near the communities that engage in cultural and religious events may experience disturbance. In addition, construction activities of the Luena Saurimo Railway and other 3rd Party projects may disrupt accessibility and scheduling of traditional events. This can result in grievances and community tension with the respective contractors. The sensitivity of the receptor is considered as moderate and magnitude minor and the cumulative impact is assessed as minor.

Mitigation measures

- the Contractor for the Luena Saurimo Railway will implement measures to minimize disruption of community and religious events.

- the Contractor for the Luena Saurimo Railway shall coordinate to the extent possible with other 3rd Party projects to engage communities within their AoI to share information on the locations and timeframes of construction activities.
- the Contractor for the Luena Saurimo Railway shall coordinate to the extent possible with other 3rd Party projects to address grievances raised by communities in relation to the disruption of cultural and religious services/events as a result of the construction activities.

Operation Phase

The operation of the Luena Saurimo Railway in conjunction with the other third (3rd) party Projects are not expected to have a significant negative cumulative impact on cultural and religious services/events.

11.2.4.3 Destruction of native medicinal plants

Traditional medicinal resources declining due to vegetation clearance. Potential cumulative impacts are predicted between the construction of the Luena -Saurimo Railway Line and the following projects (Table 11-4:):

- new 220kV Transmission Corridor
- rehabilitation of a 106 km extension of the EN180 road between Saurimo and Luena
- Saurimo Ring Road Construction Project
- Sonangol Oil and Fuel depot in Luena
- new University: University Lueji a´Nkonde
- Saurimo Industrial Complex
- water Treatment Plant in Dala and Saurimo.

Construction phase

Activities such as vegetation clearance can alter the natural habitats where medicinal plants thrive, leading to the disturbance and decline of the plants. Moreover, this can expose areas of invasive plant species that may displace or replace the medicinal plants. Therefore, interfering with traditional practices that involve these plants. The concurrent construction of third (3rd) party Projects and the Luena-Saurimo Railway will involve vegetation clearance activities. Cleared areas may have plants used for medicinal plants like the Mussivi plant. This is a sensitive receptor as the removal of these medicinal plants has been raised as a concern by multiple stakeholders. The magnitude of the cumulative impact is considered as moderate and the significance of the cumulative impact is assessed as moderate.

Mitigation measures

- The Contractor of the Luena-Saurimo Railway will implement the mitigation measures to minimize the removal of medicinal plants and grievances from communities included in Chapter 10.3.
- The Municipal offices shall develop communication materials in collaboration with traditional/customary leaders that visually identified various plants that are used for medicinal purposes by the communities. These materials shall be distributed

to all development projects during their construction in order to be used to sensitize construction workers during site clearance.

Operation Phase

The operation of the Luena Saurimo Railway in conjunction with the other third (3rd) party Projects are not expected to have negative cumulative impacts on medicinal plants in the project RoW.

11.3 Management of cumulative impacts

The effective management of cumulative impacts requires collaboration of all parties that contribute to these cumulative impacts. Table 11-5 presents a summary of cumulative impacts, proposed measures and shared responsibilities between parties. Ideally, cumulative impact management should be led by government entities that have direct influence on proponents, in order to identify the contributions of each actor and establish the mechanism to handle the cumulative effects. This should be done in collaboration with the Contractor and train operator. International best practice establishes that individual proponents should mitigate the effects generated by their project and, at a minimum, support and influence cumulative effects management strategies (IFC 2013).

OEC will comply with IFC Guidance Note 42, which specifies that commercially reasonable attempts should be made to engage relevant stakeholders (e.g., government authorities, affected communities, other developers) in the assessment, design and implementation of coordinated mitigation measures to manage the potential cumulative impacts resulting from multiple developments in the project's area of influence.

11.3.1 Management of cumulative impacts

The cumulative impacts identified in this assessment are summarised in Appendix 17 which also lists actions for to mitigate cumulative impacts either by management and/or monitoring, and collaborative mitigations in liaison with other proponents (or other authorities) to further understand, assess or manage potential cumulative impacts or improve overall management of cumulative impacts to the general benefit of both or all parties.

In some cases, the proposed measures are beyond OEC's control and should be driven and implemented by the local and district authorities. The potential for this could be explored with the relevant stakeholders as part of ongoing stakeholder engagement.

OEC will engage relevant government authorities, other developers and relevant stakeholders in the implementation of coordinated mitigation measures to manage the potential cumulative impacts. The Project shall host annual stakeholders meetings with existing and new development projects within the municipalities that the Project traverses and representatives of the municipal offices who oversee planning and investment in their jurisdictions. These meetings shall be used to share information on E&S performance, new infrastructural developments, opportunities for collaboration on sustainability/ E&S CSR initiatives. This will be undertaken in accordance with the project Stakeholder Engagement Plan.

It is critical where the combined projects intersect and have cumulative impacts to coordinate their efforts to manage the environmental and social cumulative impacts.

Table 11-5 VCs considered in the CIA

VC	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
Air quality	L	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	Contractor
Climate	L	Conduct a GHG inventory for the project and implement an energy efficiency and emissions reduction plan. Use low-carbon technologies where feasible.	Operator
Noise	L	Where relevant, specific noise and vibration control measures will be incorporated into the contractor's method statements.	Contractor
Surface water	M	Develop and implement an Erosion and Sediment Control Plan. Establish and maintain buffer zones from watercourses. Prohibit refuelling and equipment washing near water bodies.	Contractor
Groundwater	L	Follow abstraction volumes as prescribed in authorisation permits and monitor usage.	Operator
Legally protected, internationally or nationally recognised areas	N/A	N/A	N/A
Habitats, flora and fauna species of conservation importance	L	Minimise clearance of natural vegetation and habitats at the fringe of the sites, to allow for greater connectivity of habitat.	Contractor
Governance and economy	M	Implement a Local Employment and Procurement Plan (LPP) with transparent targets and reporting. Establish a Grievance Redress Mechanism (GRM).	Operator
Land and livelihoods	M	Develop and implement a Livelihood Restoration Plan (LRP) and a Resettlement Action Plan (RAP) in line with international standards (e.g., IFC PS5).	Operator
Infrastructure and services	M	Conduct a pre-construction infrastructure survey. Develop a Collaborative Service Delivery Plan with municipal authorities, which may include co-investment in upgrading key infrastructure.	Operator & Municipalities
Demography and social fabric	L	Implement zoning regulations and incentives for private developers to construct new housing.	Municipalities

VC	Cumulative Impact Level (L/M/H)	Key Mitigation or Coordination Action	Responsibility
Health, safety and security	L	Conduct regular health screenings and provide vaccinations for workers.	Operator
Tangible and intangible cultural heritage	L	If the community's access path to cultural heritage sites is used for the project, provide alternative paths to avoid disruption.	Contractor
Ecosystem services	L	Integrate ecosystem services evaluation into the impact assessment for relevant VCs (e.g., Biodiversity, Surface Water, Land). Specific mitigation for medicinal plants could include a transplantation and propagation program.	Operator & Contractor

12 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

12.1 Key management and implementation aspects

The Environmental and Social Management Plan (ESMP) outline specific strategies for monitoring, mitigating, and managing potential identified environmental and social risks and impacts. It entails the plan for managing impacts during the different phases of the Project and integrates all mitigation measures embedded in the design, existing OEC SOPs and additional mitigations recommended in the ESIA. The mitigation measures were prepared using expert judgement and experience. They aim to minimise potential negative impacts and enhance potential positive environmental and social impacts.

Overall, the Project's impact management strategy has been informed and guided by the IFC's recommended mitigation hierarchy and practices for the implementation in the Project: 'a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimise, and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities and the environment' (IFC Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts, 2012).

For this purpose, the detailed ESMP for the Luena-Saurimo Project has been prepared as a separate stand-alone report that addresses environmental and social impacts and risks. presented outlining specific strategies for managing and monitoring potential impacts (See Appendix 17).

The Project ESMP has been developed in accordance with the following requirements:

- Environmental Impact Assessment Regulations, Law Nº 8/20 of April 16th, 2020
- Environmental Auditing, Decree Nº 1/10 of January 13th, 2010
- IFC Performance Standards.

12.2 Components of the ESMP

The key aspects that the ESMP addresses are outlined below:

- purpose, objectives and legal standing of the ESMP
- summarised project description
- summarised governance framework (regulations, legislation, and LAS)
- description of existing environmental and social policies, plans and OEC's procedures
- roles and responsibilities for implementing the ESMP
- mitigation measures.

Detailed Environmental and Social Management Plan for the Luena-Saurimo railway Project is provided as a stand-alone ESMP Report in Appendix 17.

13 ENVIRONMENTAL AND SOCIAL MONITORING COMMITMENTS

An environmental and social monitoring commitment describes the monitoring activities to ensure that adverse environmental and social impacts are minimized while the positive impacts are enhanced during the Project implementation. The plan describes how, when and where the monitoring activities will be undertaken and who will carry them out. It entails compliance for carrying out the plan, and outlines mechanisms for checking environmental performance during the operation life of the project.

13.1 Purpose of the monitoring

The purpose of environmental and social monitoring is to measure the environmental effects of the project (quantitatively) whenever possible. The environmental and social monitoring program will operate during construction, and operation and maintenance phases. It will consist of a number of activities, each with a specific purpose, key indicators, and significant criteria.

Also, the purpose is to ensure that management measures, identified and described in the environmental and social procedures, are implemented and are effective at achieving an acceptable level of compliance with the Luena- Saurimo railway project ESMP and ESMS. The monitoring program shall include the entities identified as having the primary responsibility for the relevant measures; the timing and frequency that the monitoring measure will need to be undertaken; and the performance indicator(s) (the performance measurement used to measure / bench the level of success for a particular monitoring measure) of that particular monitoring measure.

There are four types of monitoring that are also relevant to this ESIA:

- baseline monitoring: the measurement of environmental parameters during a pre project period and operation period to determine the nature and ranges of natural variations and where possible establish the process of change
- impact/effect monitoring involves the measurement of parameters (performance indicators) during construction and operation Phase in order to detect and quantify environmental and social change, which may have occurred as a result of the project. This monitoring provides experience for future projects and lessons that can be used to improve methods and techniques
- compliance monitoring takes the form of periodic sampling and continuous measurement of levels of compliance with standards and thresholds e.g. for waste discharge, air pollution
- mitigation monitoring aims to determine the suitability and effectiveness of mitigation programs designed to diminish or compensate for adverse effects of the Project.

Appendix 17.5 provides the Monitoring Commitment Register that is to be followed alongside developed Luena-Saurimo railway SOPs. The Register for the Luena-Saurimo railway project detailing parameters to be monitored, frequency, monitoring sites/sampling area, measurement unit/method, target level/standard and responsibility for monitoring.

The following key aspects will be monitored:

- biodiversity
- social aspects
- human rights
- cultural heritage
- surface water quality
- wastewater discharge
- air quality
- CCRA & GHG emissions
- noise and vibrations
- surface water
- groundwater
- solid and liquid wastes.

13.2 Results monitoring

To ensure that the management system remains effective and aligned with environmental and social performance objectives, actions must be taken based on the results obtained during the "Check" phase/monitoring. During the respective phases, responsible parties shall:

- review monitoring results to identify trends, discrepancies, and areas where performance deviates from the set standards
- Conduct a root cause analysis to understand the underlying issues and develop targeted corrective actions i.e. improving training programs, revising policies, or adopting new technologies
- revise and update the E&S management plans to incorporate the proposed corrective and preventive measures
- ensure that sufficient resources (financial, human, and technical) are allocated for the implementation and responsibilities are assigned to specific team members or departments
- ensure that the changes are documented and communicated to all relevant parties including employees, contractors, and stakeholders, about the changes and the reasons behind them. In addition to this a clear communication channels for feedback and reporting should be developed
- establish monitoring mechanisms to ensure that the corrective and preventive actions are effectively implemented.
- evaluate their effectiveness in resolving the issues
- conduct follow-up monitoring to ensure that the actions have led to the desired improvements. This should be accompanied by a continuous improvement by regularly revisiting and refining processes based on the monitoring results.

13.3 Roles and responsibilities

The monitoring responsibilities for the Luena–Saurimo railway project are distributed across several entities to ensure that environmental and social management measures are effectively implemented, supervised, and verified. Contractors are responsible for the

day-to-day implementation of mitigation and monitoring measures, while the Project Owner has overall accountability. Independent consultants and regulatory authorities provide additional layers of verification and oversight. A Community Liaison Officer (CLO) ensures that social aspects and stakeholder engagement are adequately monitored. The following framework summarises the roles and reporting lines.

Table 13-1: Roles and Responsibilities for Environmental and Social Monitoring

Entity/Role	Responsibility in monitoring	Reporting
Contractor (EHS Manager or Project engineer)	Implement all mitigation and monitoring measures defined in the ESMP; conduct daily monitoring; maintain records; prepare site-level reports.	Reports weekly/monthly to the Project Owner's E&S Manager.
Project Owner (E&S Manager / Safeguards Team)	Overall accountability for monitoring; review Contractor reports, carry out spot checks; consolidate results; prepare quarterly reports for Lenders and authorities	Reports to Project Director and to Lenders.
Independent Environmental & Social Consultant (IESC)	Undertake periodic audits; independently verify compliance with the ESMP/ESMS; recommend corrective actions where gaps are identified.	Reports directly to Lenders (and shares reports with Project Owner).
Regulatory Authorities	Provide statutory oversight and inspections; ensure compliance with national environmental, health, labor, and safety requirements.	Receive statutory monitoring reports; enforce compliance.
Community Liaison Officers (CLO)	Monitor community health and safety aspects, grievances, and commitments under the Stakeholder Engagement Plan.	Reports monthly to Project Owner's E&S Manager

The proposed Monitoring Commitment Register for Luena-Saurimo railway Project is presented in Appendix 17.5.

14. IMPACT STATEMENT AND CONCLUSION

The construction of the 260 km Luena – Saurimo railway Project is identified as a medium-term development that will modernise the railway network in Angola, paving the way for future railway developments and economic growth. The implementation of the proposed railway with associated infrastructures represents a significant infrastructure development, linking Luena to Saurimo. The Project is also a foundational element for Angola's transport system transformation, achieving the objectives outlined in their national transport plan.

The Luena – Saurimo railway Project area is characterised by a distinct socio-economic, cultural, and environmental landscape. The railway line traverses one terrestrial bioregion namely the Greater African Subequatorial Savannas & Mixed Woodlands and is fully within the Angolan Wet Miombo Woodlands ecoregion supporting diverse species, including few of conservation concern. . The freshwater ecoregion, known as the Kasai Ecoregion, has sensitive habitats, including wetlands and floodplains, that are integral to both biodiversity and ecosystem services like fishing and agriculture.

Local communities predominantly rely on subsistence farming and informal economies, with significant disparities in education, healthcare and access to services. The local communities primarily source water from rivers, forest products for power and use native plants for medicinal purposes. Traditional leadership, such as Sobas, plays a critical role in land allocation and decision-making. Culturally, the area is rich with traditional practices and historical artifacts.

The physical environment includes distinct wet and dry seasons, varied topography dominated by pedogenesis (soil formation) and hydrological features like wetlands and rivers.

Air quality is impacted by outdoor cooking and waste burning, with some areas exceeding WHO guidelines, however there are no significant large scale industrial operations within the Project's corridor that present significant noise, air and soil contamination risks. Soil types range from well-drained to poorly drained, and apart from eroded soils in limited parts of the Project area, there is no evidence of geological hazards within 50km of the Project corridor.

13.4 Key findings

The key findings highlighted related to the proposed Project potential impacts are outlined below:

- the positive socio-economic impacts include improved mobility, local economic growth through job creation and skills development, and improved access to goods and services between Saurimo and Luena facilitating better transport of cargo to and from the port of Angola. However, Project presents the risk of economic displacement, pressures on local infrastructure and social services, inflation of land and commodities, gender inequalities, occupational and community safety, community health challenges due to worker influx, social tensions over employment and land acquisition, human rights impacts, including risks to livelihoods, community cohesion, public health and displacement

- the proposed Project will have biophysical impacts including habitat fragmentation, reduced vegetation cover, disturbance of and collision mortality of fauna, soil erosion, and the potential introduction of invasive species. Aquatic ecosystems may face reduced water quality from siltation and un-controlled discharges that may affect fish communities. The Project does not traverse any protected areas or critical habitats.
- although noise and vibration will be transient as construction and operational activities advance along the alignment, the impacts are considered minor, only causing disturbance to terrestrial and aquatic fauna and the physical environment.
- Potential surface water and groundwater impacts related to abstraction demands and obstructed surface drainage patterns and flows
- the proposed Project poses risks to both tangible and intangible cultural heritage, including potential disruption to unmarked community grave sites cemeteries, tombs, medicinal plants and traditional practices due to construction activities, dust, noise, and restricted access
- given that the life of the proposed Project is 100 years, the impact of this Project contributes towards climate change mitigation and Angola's NDC commitments and is therefore significantly positive.

13.5 Management measures

The Luena-Saurimo management measures include topic-specific sub-plans that already exist and some that will need to be developed, describing the environmental and social management and mitigation measures to be adopted and implemented to satisfy relevant national and international environmental and social requirements, regulations, guidelines, standards, policies, good international industry practice and LAS detailed in the ESIA

The proposed Project integrates extensive management measures captured in the standalone ESMP. The ESMP provides specific sub-plans and procedures to be updated and/or developed to mitigate all potential identified risks and impacts. The ESMP further emphasises partnerships with local governments, highlighting detailed mitigation measures for the specific environmental and social themes. Some recommendations during construction phase covered in the ESMP are listed below.

- Project detailed design to consider community, livestock and vehicles crossings and access for continued connectivity and livelihoods
- ensuring that construction personnel participate on-the-job training that covers all E&S topics and opportunities for capacity development
- develop and implement labour policies and plans regarding recruitment code of conduct and integrate healthy and fair working conditions. These labour policies and plans are to promote local recruitment of labour, ensure that the rights of workers are upheld, and a fair and transparent workers grievance mechanism is established
- placing CLOs along the Project corridor to maintain frequent information sharing with the local residents and also implement continuous engagement activities

- promote occupational and community health, safety and security through developing and implementing disease prevention initiatives, wellness programmes, awareness campaigns and medical support
- conduct a socio-economic household survey and asset inventory to verify sensitive social receptors. The results are to be used further noise assessments and quantitatively define displacement impacts
- prepare a resettlement action plan and livelihood restoration plan
- develop and implement a cultural heritage management plan and chance finds procedure develop and implement a resettlement action plan and livelihood restoration plan
- minimise pollution by integrating measures to eliminate and minimise potential sources of emissions, contaminants and waste that will impact air, noise, water and land at the design stage and enforcing the respective management procedures during construction works
- conduct additional hydrology and water abstraction assessments that considers flooding risks, climate change scenarios to identify measures to improve the resilience of the Project infrastructure as well as the provisional ecosystem services of the rivers and wetlands traversed by the Project . The results are to be implemented through a robust Water Management Plan
- conduct further biodiversity surveys during the detailed design process to provide updated site specific information in the development and implement a Biodiversity Management Plan to minimize the Project 's ecological disturbance and maintain the ecosystem services used by the communities along the railway RoW
- actively manage alien and invasive species throughout construction
- develop a Construction-ESMP that will update the Contractor's existing Management Plans and Procedures with mitigation measures included in this ESIA and establishes site specific environmental and social monitoring procedures
- adoption of an adaptive management approach to E&S risks and impacts throughout the Project phases.

Through the development of an Environmental and Social Management System (ESMS), the railway operator will integrate the management and mitigation plans/measures into the operational phase of the Project and its management framework. The operator's ESMS will define roles and responsibilities, establish monitoring and reporting systems to ensure long-term compliance and effectiveness and effective implementation and compliance for lasting positive impacts.

The ESIA concludes that the proposed Project preliminary design has already prioritised avoiding and minimising adverse impacts and integrated safety measures into the design plans. The Project will follow strict adherence to construction and operational management plans and mitigation measures to enable the reduction and offsets of the identified potential impacts and will therefore have no anticipated significant residual impacts. The mitigation measures will enable the long-term sustainability of ecological systems and enhance the socio-economic benefits while addressing community vulnerabilities.

In summary, the nature and the physical footprint of the Project , as well as the scale will potentially give rise to negative impacts in both the construction and operational phases. However, through mitigating the majority of impacts can be mitigated to Minor, No effect or Negligible.

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