

Yapi Merkezi Insaat ve Sanayi Anonym Sirketi

Environmental and Social Impact Assessment Report for the SGR Lot 3 (Makutopora-Tabora Line) and Lot 4 (Tabora-Isaka Line)

2040173-01 (03)





RSK GENERAL NOTES

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Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA Report 2040173-01 (03)



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LIST OF ACRONYMS

Definition	Acronym
Annual average daily traffic	AADT
Africa Commission on Human and People's Rights	ACHPR
African Wildlife Foundation	AWF
African-Eurasian migratory waterbird agreement	AEWA
Agricultural marketing co-operative societies	AMCOS
Air quality guidelines	AQG
Alliance for Zero Extinction	AZE
Area of Influence	Aol
Area of occupancy	AOO
As soon as possible	ASAP
Assessment report	AR
Association of the Centre for Social Services	CESOSE
Auto transformer stations	ATS
Bank of Tanzania	ВоТ
Biodiversity Action Plan	BAP
Business-as-usual	BAU
Carbon dioxide	CO ₂
Carbon monoxide	со
CDC Group plc	CDC
Central business district	CBD
Certificates of customary rights of occupancy	CCRO
Construction Environmental and Social Management Plan	CESMP
Critical Habitat Assessment	СНА
Community Health Safety and Security	CHSS
Civil society organisations	CSOs
Climate Change Knowledge Portal	ССКР
Climate change risk assessment	CCRA
Commission for human rights and good governance	CHRGG
Commission for Mediation and Arbitration	СМА
Community based organisations	CBOs
Community health fund	CHF
Community Liaison Officer	CLO
Community Relations Officer	CRO
Compensation and Resettlement Guideline	CRG
construction noise and vibration management plan	CNVMP
Contractors' Registration Board	CRB
Convention in International Trade in Endangered Species	CITES
Cooperative rural development bank	CRDB
coordinated regional Climate downscaling experiment	CORDEX
Council HIV/AIDS Coordinators	СНАС
Coupled model intercomparison projects	СМІР



Definition	Acronym
Critical habitat	СН
Critical habitat	СН
Critically endangered	CR
Cultural heritage impact assessment	CHIA
Cultural heritage monitors	СНМ
Cumulative impact assessment	CIA
Decibels	dB
Democratic Republic of Congo	DRC
Department for environment, food and rural affairs	DEFRA
Department of Culture, Arts and Sports	DCAS
Department of water and sanitation	DWS
Diamond trust bank	DTB
Digital Observatory for Protected Areas	DOPA
Direct influence area	DIA
District Council	DC
Dominant, abundant, frequent, occasional and rare	DAFOR
East African Community	EAC
East African Crude Oil Pipeline	EACOP
European Bank for Reconstruction and Development	EBRD
Ecologically appropriate area of analysis	EAAA
Elephant proof fence	EPF
Emergency response plan	ERP
Employment and Labour Relations Act	ELRA
Endangered	EN
Energy and Water Utilities Regulatory Authority	EWURA
Engineers Registration Board	ERB
Environmental and Social	E&S
Environmental and social impact assessment	ESIA
Environmental and Social Management Plan	ESMP
Environmental and Social Management System	ESMS
environmental impact assessment	EIA
Environmental Management Act	EMA
Environmental management plan	EMP
Environmental, Health, and Safety	EHS
Engineering, procurement, and construction	EPC
Equator Principles	EP
Extent of occurrence	EOO
Faith based organisation	FBO
Flora of Tropical East Africa books	FTEA
Focus group discussions	FGDs
Free prior informed consent	FPIC
Financial service providers	FSPs
Future climate for Africa	FCFA



Definition	Acronym
Game controlled areas	GCA
Gender based violence	GBV
Gender based violence and harassment	GBVH
Global Biodiversity Information Facility	GBIF
Global climate model	GCM
Global facility for disaster reduction and recovery's	GFDRR
Global Positioning System	GPS
Global warming potential	GWP
Good international industry practice	GIIP
Government of Tanzania	GOT
Government of the United Republic of Tanzania	GoT
Greenhouse gas	GHG
Grievance redress mechanism	GRM
Gross domestic product	GDP
Guide to Land Acquisition and Compensation	GLAC
Hydrogen sulfide	H ₂ S
Health of Aids and Family Planning Tabora	HAFATA
Health, safety and security	HSS
Health, safety, and security	HSS
Health, safety, environmental, social and security	HSESS
Heat-related illness	HRI
Heavy duty vehicles	HDV
Heavy goods vehicles	HGV
Hectares	ha
High importance	Н
Health, safety, environment	HSE
Health, safety, environment and security	HSES
Health, safety, security & environment	HSSE
Human development index	HDI
Human rights impact assessment	HRIA
Hydrofluorocarbons	HFCs
Important bird areas	IBA
Indigenous people	IP
Indigenous people plan	IPP
Industrial processes and product use	IPPU
Informed consultation and participation	ICP
Institute of Air Quality Management	IAQM
Institute of Environmental Management and Assessment	IEMA
Intangible cultural heritage	ICH
Integrated biodiversity assessment tool	IBAT
Intergovernmental panel on climate change	IPCC
Internal drainage basin	IDB
International bird areas	IBA



Definition	Acronym
International bulk container	IBC
International Covenant on Civil and Political Rights	ICCPR
International Covenant on Economic, Social & Cultural Rights	ICESCR
International Energy Agency	IEA
International Finance Corporation's	IFC
International Financial Institutions	IFI's
International Labour Organisation	ILO
International Union for Conservation of Nature	IUCN
International Working Group for Indigenous Affairs	IWGIA
invasive alien plant species	IAPS
Julius Nyerere Hydropower Plant	JNHPP
Key Biodiversity Areas	KBAs
Key informant interviews	Klls
Kilograms of carbon dioxide equivalent	kgCO2e
Kilometre points	KPs
Kilometres	km
Kilowatts per hour	kwh
Key performance indicators	KPIs
Land Transport Regulatory Authority	LATRA
Land use, land use change and forestry	LULUCF
Least Concern	LC
Lender appraisal standards	LAS
Livelihoods restoration plans	LRP
Local government authorities	LGAs
Lockout tagout	LOTO
Low importance	LI
Late stone age	LSA
Maximum instantaneous charge	MIC
Medical waste management	MWM
Meter Gauge Railway	MGR
Meters	m
Methane	CH ₄
Microgram	hà
Millenium development goals	MDGs
Ministry of Culture, Arts and Sports	MCAS
Ministry of Finance and Planning, Tanzania	MoFP
Ministry of Natural Resources and Tourism	MNRT
Minutes of Meeting	МоМ
Multi-dimensional poverty index	MPI
Municipal solid waste	MSW
Municipality	MC
National bank of commerce	NBC



Definition	Acronym
National Bureau of Statistics	NBS
National Climate Change Strategy	NCCS
National Communication	NC
National Environment Management Council	NEMC
National Environmental Policy	NEP
National Health Insurance Fund	NHIF
National HIV/AIDS control programme	NACP
National microfinance bank	NMB
National social security fund	NSSF
National Strategy for Growth and Reduction of Poverty	NSGRP
National Transport Policy	NTP
Nationally determined contribution	NDC
Near Threatened	NT
Nitrous oxide	N ₂ O
No net loss	NNL
Non-governmental organisations	NGOs
Non-Timber Forest Products	NFTPs
Organisation for Economic Co-operation and Development	OECD
Overhead line equipment	OLE
Overhead power transmission lines	OHTL
Ozone	O ₃
Participatory assessment	РРА
Particulate matter	РМ
Peak Particle Velocity	PPV
People living with HIV/AIDS TABORA	PLHATA
Perfluorocarbons	PFCs
Performance Standards	PS
Personal protective equipment	PPE
Plan-Do-Check-Act"	PDCA
Polyethylene Terephthalate Recycle Company	PETCO
Polyvinyl chloride	PVC
Poverty reduction strategy	PRS
President's Office Local Government and Regional Administration	PO-RALG
Productive social safety net	PSSN
Productive social safety net	PSSN
Project affected households	РАН
Public address voice alarm	PAVA
Public service sector security fund	PSSSF
Quality assurance and Quality control	QA/QC
Regional medical officer	RMO
Reli Assets Holding Company	RAHCO
Reliability, availability, maintainability, and safety	RAMS



Definition	Acronym
Representative concentration pathways	RCPs
Reproductive, maternal, neonatal, child, and adolescent health	RMNCAH
Request for information	Rfl
Resettlement action plan	RAP
Right of Way	RoW
Royal Institute of Chartered Surveys	RICS
Rural Energy Agency	REA
Rural Water Supply and Sanitation Authority	RUWASA
Safety management system	SMS
Savings and credit co-operative societies	SACCOSs
Scope of Work	SoW
Sexual exploiting and abuse	SEA
Sexual harassment	SH
Sexually transmitted diseases	STD
Sexually transmitted infections	STI
Shared socio-economic pathways	SSP
Shovel test pits	STPs
Site of Special Scientific Interest	SSSI
Small-to-medium scale enterprises	SMEs
Social institutions and gender index	SIGI
Special Area of Conservation	SAC
Special Protection Areas	SPA
Stakeholder Engagement Plan	SEP
Standard Guage Railway	SGR
Sulphur hexafluoride	SF ₆
Sustainable Development Goals	SDGs
Solid Waste Management	SWM
Tabora Carers for People Living with HIV/AIDS	ТАСАРНА
Tabora Development Foundation Trust	TDFT
Tabora Urban Water Supply Authority	TUWASA
Tanzania Bureau of Standards	TBS
Tanzania commission for AIDS	TACAIDS
Tanzania Communications Regulatory Authority	TCRA
Tanzania Electric Supply Company	TANESCO
Tanzania Forest Services	TFS
Tanzania Forestry Service Agency	TFSA
Tanzania Institute of Rail Technology	TIRTEC
Tanzania Meteorological Agency	ТМА
Tanzania National Roads Agency	TANROADS
Tanzania Peoples' Defence Forces	TPDF
Tanzania Ports Authority	ТРА
Tanzania postal bank	ТРВ



Definition	Acronym
Tanzania Railways Corporation	TRC
Tanzania Railways Limited	TRL
Tanzania Rural and Urban Road Agency	TARURA
Tanzania social action fund	TASAF
Tanzania Telecommunication Company Limited	TTCL
Tanzania Wildlife Authority	TAWA
Tanzania Wildlife Research Institute	TAWIRI
Tanzania's Nationally Determined Contribution	NDC
Task Force on Climate-Related Financial Disclosures	TCFD
The National Climate Change Strategy	NCCS
Tonnes of carbon dioxide equivalence	tCO ₂ e
Total vapour phase volatile organic compounds	T-VOC
Traction power stations	TPS
Tuberculosis	ТВ
Tumaini Development Association	TUDEA
Tanzanian Shilling	TZS
UN Framework Convention on Climate Change	UNFCCC
United Nations Educational, Scientific and Cultural Organisation	UNESCO
United Nations	UN
United Nations Declaration on the Rights of Indigenous Peoples	UNDRIP
United Nations Development Programme	UNDP
United Nations Guiding Principles on Business and Human Rights	UNGPs
University of Dar es Salaam	UDSM
Upflow anaerobic sludge blanket	UASB
Vapour phase volatile organic compounds	VOC
Very high importance	VHI
Village community banks	VICOBA
Voluntary counselling and testing	VCT
Vulnerable	VU
Waste management area	WMA
Water supply and sanitation authorities	WSSA
Water supply authorities	WSA
Wildlife Conservation Act	WCA
Wildlife Management Authority	TAWA
Wildlife migratory corridors	WMC
World Database on Protected Areas	WDPA
World Health Organisation	WHO
World Health Organization Global Programme on AIDS	WHO-GPA
Yapi Merkezi	YM



1 INTRODUCTION

The Government of the United Republic of Tanzania (GoT) through the Tanzania Railways Corporation (TRC) is embarking on a major railway revitalisation programme in the country through the rehabilitation and construction of new railway line links. TRC intends to lay an electrified (SGR) from Dar es Salaam to Mwanza via Isaka (1,219 km) as a parallel alignment to the existing meter gauge railway (MGR). This will allow continuation of existing MGR operations during the SGR construction.

The SGR is implemented in phases, which are referred to as "Lots". Lot 1 (Dar es Salaam to Morogoro) and Lot 2 (Morogoro to Makutopora) have a total length of approximately 541 km, for which construction is 98% and 93% complete for Lot 1 and Lot 2, respectively. The current proposed SGR Lot 3 (Makutopora to Tabora, 294 km), and Lot 4 (Tabora to Isaka, 130 km) have a total length of approximately 424 km (construction progress is at 10.92% and 4.10%, respectively). Lastly, Lot 5 (Mwanza to Isaka) covers approximately 237 km mainline and 92 km of the sliding/passing loops and is currently under construction. The GoT through the TRC awarded Yapi Merkezi Insaat ve Sanayi (Yapi Merkezi) the contract to design and offer construction services for the Makutopora to Isaka segment (i.e. SGR Lot 3 and Lot 4) in Singida and Tabora Regions, Tanzania.

Yapi Merkezi's main tasks in the SGR Lot 3 and Lot 4, the project, include mobilisation of the equipment and labour force plus designing and building the required infrastructure. The project will be undertaken as a design and build contract and the reliability, availability, maintainability, and safety (RAMS) is the basic requirement for infrastructure and all systems under the project and shall follow the TRC requirements, technical, environmental and social national regulations, and International Standards.

The aim of the SGR is to promote efficient and sustainable mobility along the central corridor of Tanzania and revitalise the rail sector to contribute to the national economy. Currently, over 95% of the traffic leaving the port of Dar es Salaam is transported by road to the detriment of the road network and resulting in high rates of greenhouse gas (GHG) emissions. It is thus expected that the SGR from Dar es Salaam to Mwanza will increase freight and passenger ability and reduce road transport, thereby releasing pressure on the road network and reducing GHG emissions. The SGR is also expected to reduce the travel times for both goods and passengers.

1.1 Project need and desirability

The aim of the SGR is to promote efficient and sustainable mobility along the central corridor of Tanzania, through the construction of the railway line from Dar es Salaam to Mwanza, and link from Tabora to Kigoma with a link from Uvinza (in Kigoma) to Musongati (in Burundi). The completion of these developments shall unlock the central corridor of the East African Community (EAC), which has potential for agriculture, commodities, industrial, mining and passenger transportation.

These objectives combined contribute towards the United Nations Development Programme (UNDP) sustainable development goals (SDGs). The Project is considered amongst the top priorities to open-up socio-economic opportunities in the hinterland of Tanzania, and between member states of the EAC Region. The SGR will greatly contribute to Tanzania's economy as well as other EAC States. The SGR is viewed as a necessity in relieving the road networks, which are continually being subjected to higher loads than for which they were designed. The SGR will thus reduce maintenance costs to roads and will lower travel and transportation costs of people and goods. In addition, the transfer of current road travel to rail will improve the overall safety of transport. The



transfer of transport to rail will also have a net reduction in GHG emissions and contribute to Tanzania's Nationally Determined Contribution (NDC) commitments (July 2021).

1.2 Project objectives

The SGR aims to promote sustainable mobility along the central corridor of Tanzania, through the construction and upgrades of the railway line from Dar es Salaam to Mwanza. The upgrades and construction shall lead to the unlocking of the central corridor of the EAC, which has potential for agriculture and mining. The SGR will also reduce transport costs, enhance economic development, and people mobility through:

- improving the connection of bordering countries, particularly Uganda, Rwanda, Burundi, and Democratic Republic of Congo (DRC), to the world economy
- providing an SGR line parallel to the existing meter gauge line with improved capacity, reliability, and cost-effective transportation over the central corridor, and specifically for the line from Dar es Salaam to Mwanza.

In an effort to manage projects sustainably, the environmental and social impact assessment (ESIA) seeks to provide an adequate legal and institutional framework under national environmental policy. Section 4(1) of the Environmental Act requires that certain types of development projects be subjected to an ESIA to determine whether a programme, activity, or project will have adverse impacts on the environment.

The regulations provide a framework for the National Environment Management Council (NEMC) to oversee the ESIA process, which culminates with an award of an environmental certificate by the Minister responsible for environment. The types of projects requiring assessment are prescribed in the Environmental Management (Environmental Impact Assessment and Audit) Regulations (2004, amended in 2018) and are split into four categories for proposed projects, namely mandatory projects (A), borderline projects (B1), non-mandatory projects (B2), and projects categorised as special. **The project was classified as Category A by the NEMC.**

TRC commissioned the University of Dar es Salaam (UDSM) to undertake the ESIA in accordance with the Environmental Management Regulations. The Certificate is among other prerequisite approvals required before the Project is implemented. The Final ESIA report was submitted to NEMC on 10 February 2023, and an **Environmental Certificate was obtained on 13 Mach 2023**.

Yapi Merkezi also contracted RSK Environment (East Africa) Limited (RSK) to undertake a "Bankable" ESIA, that builds upon the extensive work already conducted by the UDSM for the NEMC ESIA process, and present alignment of the assessment and project going forward with the lender appraisal standards (LAS).

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 appraisal standards prescribed by the lenders. The following LAS are applicable:

World Bank Group Environmental and Social Framework, 2018, including, inter alia:

- IFC Performance Standards (PS) (1-8), 2012
- General EHS Guidelines
- EHS Industrial Sector Guidelines for Railways
- 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
- o OECD Common Approaches.

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 in promote a sustainable and socially responsible development that is responsive to global, regional, and local pressures.

The ESIA report identifies mitigation measures to avoid or minimise the identified negative impacts, and to optimise the positive effects.



2 PROJECT TEAM

2.1 Project proponent and role players

The role players involved in ESIA process are set out in this section.

2.1.1 Proponent

Table 2-1: Details of the project proponent in Tanzania

Company	Tanzania Railways Corporation
Contact Person	Masanja Kadagosa - Director General
Address	P.O Box 76959, Sokoine Road, Dar Es Salaam
Telephone Number	+255 222 112 695
Email Address	dg@trc.co.tz

2.1.2 Key project role players

Table 2-2: Key delivery parties and third-party advisory

Organisation	Role/Responsibility
Key delivery parties	
Lenders	Credit institutions participating in the debt financing of the project
Ministry of Finance and Planning, Tanzania (MoFP)	The project sponsor
Tanzanian Railway Corporation (TRC)	The SGR will be owned and operated by the TRC
Korail Consortium	Group of 8 companies that together form Korail and act as owner's engineer on behalf of TRC
Yapi Merkezi (YM)	Appointed to design and build the SGR
Third party advisory	
University of Dar es Salaam	Undertook the original ESIA for the project for national approval and is currently undertaking the resettlement action plan (RAP) for Lot 3-4.
RSK	Completed a gap analysis of the UDSM ESIA was commissioned by YM (January 2019) to prepare the Bankable ESIA.
5 Capitals	Completed socio-economic assessment, including land take impact assessment. Completed human rights impact assessment, supply chain screening, community health, safety and security, and biodiversity assessments.



Table 2-3:Key regulating organisations and project partners

Organisation	Role/Responsibility
Regulators	
National Environment Management Council (NEMC)	GoT department responsible for approving local ESIA in accordance with Tanzanian law and issued Environment Certificate for the project.
Land Transport Regulatory Authority (LATRA)	Regulates railway transport, including fares, schedules, and safety and issues operator licenses.
Tanzania Forestry Service Agency (TFSA)	Responsible for forest reserves. Also engaged regarding use of floral species for rehabilitation.
Local and regional government departments specialists	Responsible for approvals such as water abstraction, landfilling, chance finds etc.
Other organisations on whom project construction or operation depends	
Government Chief Valuation Officer	Responsible for valuation and establishing compensation rates set out in the RAP.
TANESCO	Responsible for the construction of the electricity infrastructure to support the SGR.
District and Ward Level Administrations	Key party responsible for supporting TRC in communicating and liaising with project-affected people and communities about the project, and for delivering Government-backed projects and initiatives. This will include responsibilities in delivering stakeholder engagement activities, information disclosure, grievance collection and management, land acquisition and compensation processes and livelihood restoration activities.

2.2 Environmental and social assessment team

The bankable ESIA report was co-ordinated by RSK. The ESIA was developed by a multidisciplinary team comprised of several technical experts with experience of similar studies and/or projects in the region, see Appendix 1.



3 PROJECT OVERVIEW

This section provides a high-level overview of the project, general location, infrastructure and activities, ancillary infrastructure, and associated activities. A detailed project description is included in Section 4.

3.1 **Project location**

The proposed SGR starts at the town of Makutopora in Singida region and routes through the region in a north-westerly direction. The SGR crosses into the Tabora region, near the village of Kazi Kazi, and continues to Tabora town. At Tabora town the SGR turns northwards, routing through the Tabora region until it reaches the northern border of Tabora region 4 km south of the town of at Isaka (which is in the Shinyanga region). The SGR route will run parallel to the existing MGR for most of the SGR route, with significant deviation away from the MGR in only a few places such as the Isaka area, near Tabora and Manyoni town, and other smaller deviations at several other locations.

Lots 3 and 4 therefore passes through two regions namely, Singida and Tabora region. Within these regions it traverses five districts, Manyoni, Uyui, Sikonge, Tabora urban and Nzega district. Detailed information on the districts and villages/communities through which the Lots 3 and 4 passes is presented in Section 11. A map of the route showing the areas traversed and the location of stations and sidings, as well as listing of the kilometre points (KPs) of key infrastructure, is provided in Figure 3-1 and Table 3-1.

3.2 Route description

The aim of the SGR route is to establish it along the MGR way leave. Thus, the proposed SGR line from Makutopora to Isaka runs largely parallel to the existing MGR line. This option minimises potential impacts or risks that are carried by the existing MGR line with its way leave. Exceptions are where the MGR has sharp corners or turns (as the SGR train speed will be significantly higher than the MGR), and where the line interacts with sensitive environmental and social receptors where the corridor has been designed to avoid these to the extent possible.

Lots 3 and 4 are divided into seven sections (five for Lot 3 and two for Lot 4), each with its own camp site, and construction and management teams. Key project aspects (activities and infrastructure) and high-level sensitivities are indicated in Figure 3-3 to Figure 3-9 to contextualise each route within its environmental and social setting. Detailed description of aspects and sensitive receptors are provided in the subsequent sections of this ESIA.


Table 3-1: Key infrastructure along Lot 3 and 4

	Lot 3					Lot 4	
Section name	1. Manyoni	2. Itigi	3. Tura	4.Nyahua	5. Tabora	1. Nzubuka	2. Bukene
Start-end km points	535 - 595	595 - 655	655 - 715	715 - 785	785 - 830	830 - 890	890 - 950
Length (~km)	60	60	60	70	45	60	60
Campsite extent (~ha)	22.37	50.79	26.77	26.37	57.56	22.73	27.48
Passenger stations	Manyoni Agondi	Itigi Kazikazi	Tura	Malongwe Nyahua Goweko	Igalula Tabora	Nzubuka Ipala	Bukene
Freight stations/ sidings	Manyoni	Itigi	None	None	Tabora	None	None
Marshalling yards	None	None	None	None	None	Tabora marshalling yard (18.87 ha)	None
Borrow pits (approved and planned)	8	12	11	12	14	15	11
Rock and sand quarries (km point location)	R-567	R-645	R-681	R-748 R-762	R-809 S-816	R-850	R-891 R-908
Production areas and km point location	None	Itigi production area Sleeper/precast production (619+000)	None	None	Tabora production area Sleeper/precast production 835+605	1	1





Figure 3-1: General key plan (MIT-YMI-AL-GL00X-G-RA-DWG-0001-0) of Lot 3 route showing stations, sidings, and KP tables of key infrastructure





Figure 3-2: General key plan (TAI-YMI-AL-GL00X-G-RA-DWG-0001-0) of Lot 4 route showing stations, sidings, and KP tables of key infrastructure





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Figure 3-3: Map of Lot 3 Manyoni section showing key project infrastructure





Figure 3-4: Map of Lot 3 Itigi section showing key project infrastructure



Lege	nd
۲	KP
	Station
	Camp
	Bridge
•	Rock quarry
	Sand quarry
×	Livestock crossing
	Marshalling yard
	Dumping area
	Itigi Section
	Admin boundaries
	Borrow pit
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Figure 3-5: Map of Lot 3 Tura section showing key project infrastructure



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Figure 3-6: Map of Lot 3 Nyahua section showing key project infrastructure



	KP
	Station
	Camp
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•	Rock quarry
æ	Sand quarry
×	Livestock crossing
•	Marshalling yard
	Dumping area
-	Nyahua Section
	Admin boundaries
	Borrow pit





Figure 3-7: Map of Lot 3 Tabora section showing key project infrastructure

Lege	nd
	KP
	Station
	Camp
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•	Rock quarry
	Sand quarry
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	Marshalling yard
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Figure 3-9: Map of Lot 4 Bukene section showing key project infrastructure



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3.3 Associated activities

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, 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 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'. The relevant associated facility as per the above definition is the 220 kV transmission line, which will be constructed and operated by TANESCO, for the electrification of SGR line (the "TL project").

In such cases where a third party is responsible for an associated facility, IFC PS 1 states that the client should address environmental and social (E&S) risks and impacts in a manner that is commensurate with the client's degree of control and influence over the third party. In the case of the SGR, the GoT-on behalf of TRC (the borrower) shall address environmental and social (E&S) risks and impacts of the 220 kV TL. The TRC must therefore develop and operationalise a controlled Associated Facilities Management Plan, that is demonstrably integrated into the project delivery mechanism, to ensure the transmission lines required to supply the project are constructed in line with the applicable standards. It should also set out the mechanisms for mitigating any cumulative impacts of the transmission line combined with the SGR project impacts. To this end, TRC must ensure that an ESIA, ESMP, SEP, RAP(s) and BAP (latter if relevant) aligned with the Applicable Standards, are prepared for the transmission line.

The above associated facility is further discussed below, including a brief description of known/expected risks/impacts and potential mitigation measures reflecting international practice. The final subsection summarizes further action-commitments to be undertaken by YM and TRC within the constraints of its role in the project organisation.

3.3.1 220 kV transmission line for the electrification of Lot 3 and 4

3.3.1.1 Background and facility description

The SGR is designed to use electricity for powering its trains. Therefore, it is necessary to have reliable power to feed the railway system along its entire length. Thus, to enable proper implementation and smooth operation of the SGR, TRC has submitted a request



to TANESCO concerning the power supply. As requested, TANESCO intends to construct a 220 kV transmission line single circuit alongside the SGR alignment.

The transmission line's power source will be the existing Kinyerezi powerplant and the power will be discharged into substations along the route. These substations were assessed as part of the noise impact assessment, see Section 15. The line will have a total wayleave corridor (right of way) of 35 m, with 17.5 m from each side of the centre line.

A local consultant team contracted by TANESCO is currently completing an ESIA study for the TL project, including a comprehensive consultation campaign along the powerline route as well with key authorities and interested entities and stakeholders.

The key stakeholder concerns will likely relate to compensation for the land take and crop damages, medical education and awareness programs, graves and graveyards compensation costs in case of relocation, employment opportunities, loss of trees and crops, grievance mechanism, accident prevention to workers and villagers, project benefits to the villages. According to the ESIA results, the SGR is highly accepted by the stakeholders if the compensation for the crops and properties will be fair and transparent. The TL project will run in parallel to the project widening the impact footprint but will be linear in nature. TRC and TANESCO should integrate efforts in terms of relocation and livelihoods restoration where the footprints of the two projects overlap or are near each other.

The following are potential impacts typically associated with transmission line projects:

- potential positive impacts:
 - o reliable, cost and time-effective means of power transport
 - increased employment opportunities created by the project and indirect employment opportunities resulting from providing services to the project
 - income generation in form of taxes and service levies to government and district councils
 - o capacity building of local labour engaged in the project activities
 - improvement of the social services in the project area as part of the corporate social responsibility initiatives and from the use of reliable electricity
 - expansion of the business opportunities in the project areas ranging from providing services to supply of materials and equipment.
- potential negative impacts:
 - o loss of farming and grazing
 - o loss of trees and crops
 - o loss of vegetation due to clearance of the wayleave corridor
 - temporary air pollution from fugitive dusts, suspended particles matters and smoke
 - o noise and vibration nuisance
 - o influx population in the project area
 - o loss of biodiversity and natural habitats due to vegetation clearance
 - o interference of wildlife movement corridor
 - risk of soil erosion and land degradation
 - risk of increased crimes due to joblessness and increased income of some individuals in the project area



- increased risks of landlessness and food insecurity to some project affected peoples (PAPs)
- risk to health and safety of the communities around the project area and spread of HIV/AIDS and other communicable diseases
- o occupational, health, and safety of workers
- impairment of water quality and soil due to pollution (liquid and solid waste)
- o project related accidents
- o loss of cultural heritage/properties
- \circ electrocution
- o pollution of water sources.

Relevant mitigation measures to manage the above adverse impacts will need to be assessed in the ESIA being conducted for the TL project.

Assuming that the TL project is performed in accordance with International Standards, it is expected that the implementation of the ESIA obligations and recommendations will be anchored in the loan conditions. The conformance with the implementation commitments would be subject to independent assessment and monitoring so that overall, the project would be in line with the lender requirements of the SGR. Since the TL project is undergoing a separate ESIA process it is not assessed further in this ESIA.

3.4 Area of influence (Aol)

In terms of IFC PS 1 the area of influence must be delimited and should be considered to encompass, as appropriate:

- (i) 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.
- (ii) 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.
- (iii) 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.
- (iv) 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.

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 3-2. 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.



Table 3-2: Project Area of Influence

Aol per	Description of AOI
environmental and social theme/ topic	(note: within each AOI different impact/risks have been identified with differing levels of impact significance, which is described in the RSK ESIA report (2023))
Direct footprint	 SGR ROW of 60 m wide (30 m on either side of the centreline of the railway alignment) SGR ROW exceptions where the ROW widens to around 150 m wide (75 m on either side of the centreline) at approaches either side of stations and marshalling yard, and a few other limited cases where widening is needed footprint of all project Aspects
Thematic Aol's ider	tified, in addition to the direct footprint
Social, Labour, Health, Safety and Security, Human Rights (Appendix 11)	 primary level – project affected communities (PACs) direct project footprint (described above) and area within a 1 km zone around the direct footprint. Includes hamlets, mitaa 1, villages and towns within a geographical boundary defined by project land take requirements, construction, and operation activities. These communities will be directly (e.g., through land acquisition, resettlement 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) – districts and wards 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 – regions traversed by the rail line 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's associated facilities, which include the railway powerline.
Indigenous peoples (IPs)	• AoI includes the IP communities identified in the IP study. The maps generated as part of the IP plan will be used to demonstrate the IP AoI (Appendix 11).
Cultural Heritage	 for tangible cultural heritage, the AoI includes the 100 m zone around the project footprint. for intangible cultural heritage, the AoI is difficult to define at this stage. A sacred site, for example, has no clear boundaries. Spiritual practitioners and worshippers come from various places far from the project footprint. Therefore, the AoI for tangible

1 A Mtaa is the lowest government administrative structure at the urban administrative level.



Aol per	Description of AOI				
environmental and social theme/ topic	(note: within each AOI different impact/risks have been identified with differing levels of impact significance, which is described in the RSK ESIA report (2023))				
	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 are being done as part of the Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) studies.				
	• the AoI for noise during construction was determined to be at a 500 m distance on either side of the project direct footprint (Appendix 11).				
	• the AoI for noise during operation was determined to be at a 200 m distance on either side of the project direct footprint (using IFC criteria) (Appendix 11).				
Noise and Vibration	 The operational vibration Aol has been set to 25 m. This will fall within the RoW of 30 m on either side of the centreline of the alignment from which all PAHs will be relocated. Thus, the Aol for vibration during operation is considered included in the direct project footprint. 				
	• the planned stations, marshalling yard, sidings, and the alignment are permanent and will remain operational over the lifetime of the project, so the temporal AoI's will be approximately 25 years. For the temporary construction access roads, quarries and borrow pits the temporal AoI is for the period of construction.				
Air Quality	 fugitive dust – within 350 m of dust sources (operation and construction) - the IAQM guidance advises that construction impacts are only likely within 350 m of the boundary of the site. Therefore, receptors within 350 m of the construction works boundary may have the potential to be affected by fugitive dust emissions (Appendix 11) 				
	 emissions from marshalling yard diesel locomotives – Aol is within 30 m of the tracks. This will fall within the RoW of 30 m on either side of the centreline of the alignment from which all PAHs will be relocated. Thus, the Aol for air quality is considered included in the direct project footprint 				
Hydrology and Hydrogeology	 the riverine areas 2 to 5 km downstream of watercourses and waterbodies and aquifers directly affected by project footprint due to abstraction or by discharges (planned or accidental) of wastewater or spills. An AoI map has not been produced as this will need to be done by the HSES manager/ chief when setting up a detailed monitoring plan and will require the delineation of the riverine /wetland zone for each water course, after which the AoI can be mapped. This above written description provides sufficient information for the purposes of the ESIA and ESMP 				
Resettlement and displacement	 the AoI for resettlement and displacement is the area within 8 km of the centre line of the Lot 3-4 alignment, within which all project affected households (PAHs) that were identified by the time of writing this ESIA are located (Appendix 11). 				
	 I ne Aoi for severance of access to livelihood assets, commercial centres, social services/ community infrastructure, and 				



Aol per environmental and social theme/ topic	Description of AOI (note: within each AOI different impact/risks have been identified with differing levels of impact significance, which is described in the RSK ESIA report (2023))				
	 ecosystem services includes settlements located within 5 kilometres of the Lot 3-4 alignment2. It should however be noted that the RAP and LRP studies are ongoing and may identify additional PAHs throughout the project lifecycle. This AOI is therefore indicative and shows the magnitude of area affected by the project from a resettlement and/or displacement perspective. The extent of the overall AoI for livelihood impacts associated with land acquisition is subject to review pending the completion of detailed design for the Project's associated facilities, which include the railway powerline. 				
Biodiversity (Appendix 11)	 the Aol for Habitat Loss and Direct Mortality impacts is inclusive of the full project construction and operation footprint, (60 m ROW), and including associated facilities, laydown areas, camps, borrow pits and quarries and any existing or new roads utilized for incoming and outbound traffic the Aol for Habitat Degradation impacts extends beyond the footprint of the project, inclusive of a 500 m buffer, to account for the phenomenon of edge effect the Aol for Habitat Fragmentation and Disturbance impacts extends beyond the footprint of the project inclusive of a 1 km buffer, to account for the phenomenon of barrier effect the Aol for Direct Displacement impacts extends beyond the footprint of the project inclusive of a 5 km buffer, to account for the secondary impacts of displaced wildlife into adjacent areas the Aol for Indirect Displacement or influence upon Wildlife Corridors for the large mammals including elephant, zebra, lesser kudu and lion, leopard, and hyena is necessarily far more extensive due to the size of their foraging/hunting territories and the migration patterns that require them to cross the SGR and therefore this is proposed to be a 20 km buffer. 				

² The 5-km AoI is based on a precautionary analysis drawing on the (i) spatial extent median of villages crossed by the Lot 3 and 4 railway alignment and (ii) high-level accessibility information in the socioeconomic baseline sections of the Lot 3 and Lot 4 RAP reports.



4 DETAILED PROJECT DESCRIPTION

The chapter provides relevant detail on project Aspects as identified in Section 3. It focuses on aspects that have a material or substantive interaction with, and/or potential impact on, the receiving environment. The receiving environment refers to environmental and social receptors, processes, or systems with which the project interacts. Key information relating to size, footprint, capacity, siting, inputs (e.g., resource usage), and outputs (e.g., release of emissions), will be provided where possible in order give context for the identification and assessment of impacts. The information presented is adapted from the UDSM ESIA, 2023, UDSM HRDD, 2023, YM design information and expert inputs.

The project is described in two main phases, construction and operation, and will comprise the key aspects (activities and infrastructure) in each phase as indicated in Section 4.1 and 4.2. Activities such as establishment/mobilisation of workforce, resettlement, demolition, intrusive site investigations (such as test pitting and core drilling), site clearance, and campsite establishment have been combined into the construction phase. Demobilisation activities at the end of construction has also been included in the construction phase. Similarly, while commissioning is sometimes described as a phase on its own, for the purpose of this ESIA it has been included in the operational phase.

Aspect	Sub-aspect				
Construction phase					
Establishment and management of workforce	 recruitment and induction of workforce management of labour and working conditions management of occupational health and safety and community health, safety and security management 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) resettlement of households, temporary/permanent displacement of socio-economic activities and restriction/closure of access to resources/places (natural, social, cultural heritage and religious) demolitions, removal and relocations of pre-existing structures and utilities 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. 				
Cut and fill, quarries and borrow pits, dumpsites, sleeper production and concrete works	 cut and fill, borrow pits and dumpsites blasting and rock breaking excavation / extraction crushing 				

Table 4-1: Key project aspect	s in the co	onstruction and	d operational	phases
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Aspect	Sub-aspect						
	concrete works/batching plants						
	 sleeper production and storage. 						
	construction of access roads						
	construction of campsites						
	erection of ROW fencing						
	 development of drainage/ stormwater management systems and culverts 						
	 construction of embankments and foundations 						
	bridge construction						
	• establishment of underpasses, over passes, level crossings and other specialised crossings for pedestrians, livestock, large mammals, vehicles, railways and services (as applicable)						
Construction (building) activities	 establishment of railway line and laying of rail infrastructure 						
	 construction of stations and marshalling yard (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 						
	 transmission/distribution overhead lines and sub- stations 						
	• laydown/storage of materials, storage of dangerous and hazardous materials.						
	transportation of workers and construction materials						
Movement of vehicles and	abnormal loads						
plant	• temporary obstruction of roads, accesses, livestock routes and footpaths.						
	reduction, recovery and reuse						
Generation and disposal of	 new dumpsites (domestic waste and sewage sludge) 						
waste	use of existing waste facilities						
	liquid wastes/effluents (other than sewage).						
Wastewater management/	wastewater treatment plants						
treatment (sewage and	septic tank systems						
domestic wastewater)	 sludge management/handling. 						
Largescale procurement	goods and services						
\\/	abstraction of water (ground and surface water)						
vvater use	municipal water.						
Demobilisation	 removal of redundant/temporary structures/features, closures, and stockpiles rehabilitation and restoration. 						



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 						
Maintenance of fencing of ROW	maintenance and improvements						
Marshalling yard, workshops	operation and maintenance of fleet/rolling stock						
Quarries and borrow pits	 operation of remaining open/active quarries and 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. 						

4.1 Construction Phase

4.1.1 Workforce

Employment on the site will vary depending on the stage of construction and programme of works scheduled by the contractor(s). The total workforce estimates are not possible to determine at this point as the staff turnover rate of the project is undetermined. A better consideration in terms of potential impacts is to consider the magnitude/size workforce at its maximum. For the project, workforce peaks towards the end of the first year and remains high throughout the second year of construction with a max of ~7,000 people reached for Lot 3, and ~ 4,000 for Lot 4. At some point, however, construction phases, and the maximum that will need to be effectively managed from a workforce, labour and human rights point of view, as well as an OHS point of view, is likely to be closer to ~11,000 people (Section 17).

An analysis of labour and working conditions, recruitment process and procedures for management of the workforce and labour related policies is presented under the labour and working conditions study in Section 17 and OHS impacts are discussed in Section 20.

	Nationality	End yr 1	End yr 2	End yr 3	End yr 4
Lot 3					
Blue collar direct (20% expat – 80% Tanzanian nationals)	Total	2 895	4 025	567	5
	Expat	579	805	113	1
	Local	2 316	3 220	454	4
	Total	1 304	1 418	1 222	343

Table 4-2: Estimated workforce numbers per year for local and expat Blue and White Collar workers for Lot 3 & 4



	Nationality	End yr 1	End yr 2	End yr 3	End yr 4
Blue collar indirect	Expat	261	284	244	69
(20% expat – 80% Tanzanian nationals)	Local	1 043	1 134	978	274
White collar	Total	764	886	769	222
(80% expat – 20%	Expat	611 709		615	178
Tanzanian nationals)	Local	153	177	154	44
	Expat	1 451	1 797	973	247
Total	Local	3 512	4 532	1 585	323
	Grand Total	4 963	6 329	2 558	570
Lot 4					
Blue collar direct	Total	2 100	1 466	46	0
(20% expat – 80%	Expat	420	293	9	0
Tanzanian nationals)	Local	1 680	1 173	37	0
Blue collar indirect	Total	499	784	551	230
(20% expat – 80%	Expat	100	157	110	46
Tanzanian nationals)	Local	399	627	441	184
White collar	Total	292	312	270	99
(80% expat – 20%	Expat	234	250	216	79
Tanzanian nationals)	Local	58	62	54	20
Total	Expat	753	700	335	125

4.1.2 Enabling works

Enabling works in this ESIA include the aspects indicated in Table 4-1. These are further discussed in the sub-sections below.

4.1.2.1 Intrusive site investigations (geotechnical and geophysical)

A lidar survey is undertaken to understand the terrain, after which a topographical survey is done. Since all activities depend on the survey results, the survey is a key project activity. However, this is typically not intrusive and will have little to no impact, wherefore it is not further assessed.

The focus of this section however will be on intrusive works, which has a physical impact. A land survey is followed by geotechnical and geophysical surveys to determine soil profiles, which involves test pit investigations and borehole investigations along the alignment of the proposed SGR corridor, approximately every 200-300 m. Firstly, test pits are excavated and tests are carried out in each test pit. Secondly, borehole investigation is undertaken by means of an auger or core barrel equipment (depending on the type of soil or rock encountered). Soil/rock samples are selected at various depth intervals for laboratory tests for each borehole. Table 4-3 below indicates the number of test pits and



boreholes done per section before preparation of this ESIA. It is likely that further tests may be required as the project progresses, however this will fall within the direct project footprint and the impact is considered as part of the impact of enabling works (clearance, grubbing and stripping).

Section		No. test pits	No. core samples (drilling/auguring)	
	1. Manyoni	238	218	
Lot 3	2. Itigi	355	261	
	3. Tura	361	221	
	4.Nyahua	394	231	
	5. Tabora	317	203	
Let 4	1. Nzubuka	419	207	
LOI 4	2. Bukene	330	166	
Total		2 414	1 507	

Table 4-3: Geotechnical investigations

4.1.2.2 Resettlement of households, temporary/permanent displacement of socio-economic activities, and restriction/closure of access to resources/places (natural, social, cultural heritage, religious)

TRC will acquire the land that is required for the construction of the proposed project. Permanent land acquisition has the potential to result in displacement of households, community assets, infrastructure and economic displacement. Moreover, the construction of the proposed project will require land for camps, laydown areas and other construction related activities that will result in temporary displacement (physical or economic).

The magnitude of the land-take requiring resettlement is estimated and is summarised Table 4-4. The total direct project footprint, and thus the area for land-take will be determined more accurately in the RAP currently being prepared by TRC. The total estimate based on information available for this ESIA is 32,171,414 m². Note, these are estimates based on current information to provide context in terms of the magnitude of land take as well as the sizes of activities to understand the magnitude of potential impact.

More detail on footprint of individual project aspects is provided in Table 4-5. Note that some footprints sizes in Table 4-5 are included in other footprints (e.g. some batching plant footprint is indicated to understand the size of that specific activity, but are included within the their respective campsite footprint) and therefore footprints in Table 4-5 are not additive but included to understand the general magnitude of footprint for the purposes of the ESIA.

Table 4-4: Estimated land required by project aspects

Project facilities	Estimated land size in m ²
Railway right of way (ROW)	25,464,414 m ²
Stations, freight, passing loop and siding	16,594
Marshalling yard	7,820



Project facilities	Estimated land size in m ²
Camp sites	2,282,000
Borrow pits and dumping sites	3,672,000
Rock quarry sites	553,000
Sleeper production and batch plants	200,000
Total land-take	32,171,414

The right of way footprint is estimated at $27,966,462.00 \text{ m}^2$, which will be cleared and maintained as a servitude for the project. A large portion of this is agricultural and natural-degraded land. The biodiversity baseline and impact assessment (Section 1) further investigates landcover and biodiversity as well as impacts of clearance of vegetation for the project ROW.

To facilitate the ROW and the rest of the project area, demolition and removal of existing structures (pre-construction) is required. This includes the closing/covering up of boreholes and structures that are assets and improvements of the community on their land, such as homes, animal sheds, fencing, etc. An estimate of the number of these structures is provided in Table 4-6. Additionally, there are structures or sites of cultural, heritage, archaeological or paleontological importance that will need removal, and in many instances will require permissions/approvals and/or ceremonial or ritual activities before this can be done.



Table 4-5: Direct project footprint - aspects along the project requiring land take

Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)
Station	Malongwe	724+424	560.00	Lot 3	Section 4 Nyahua	small - included in total ROW area
Station	Goweko	769+127	560.00	Lot 3	Section 4 Nyahua	small - included in total ROW area
Station	Igalula	788+519	560.00	Lot 3	Section 5 Tabora	small - included in total ROW area
Station	Nzubuka	857+027	560.00	Lot 4	Section 1 Nzubuka	Small - included in total ROW area
Station	Ipala	889+688	560.00	Lot 4	Section 2 Bukene	Small - Included in Total RoW Area
Station and freight	Manyoni	569+313	2,734.00	Lot 3	Section 1 Manyoni	medium - included in total ROW area
Station and freight	Itigi	611+305	2,734.00	Lot 3	Section 2 Itigi	medium - included in total ROW area
Station and freight	Tabora	827+804	11,067.00	Lot 3	Section 5 Tabora	major - included in total ROW area
Station and freight	Bukene	914+528	1,667.00	Lot 4	Section 2 Bukene	Medium - Included in total RoW Area
Station and quarry siding	Tura	688+756	560.00	Lot 3	Section 3 Tura	small - included in total ROW area
Marshalling yard	Tabora	833+740	9 450.00	Lot 4	Section 1 Nzubuka	included in total RoW Area



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)
Camp site	Manyoni	569+100	223,745.00	Lot 3	Section 1 Manyoni	campsite already established
Camp site	Itigi (Main)	619+000	507,887.00	Lot 3	Section 2 Itigi	campsite already established
Camp site	Tura	681+000	267,660.00	Lot 3	Section 3 Tura	campsite already established
Camp site	Nyahua	750+000	263,659.00	Lot 3	Section 4 Nyahua	campsite already established
Camp site	Tabora (Main)	816+400	575,630.00	Lot 3	Section 5 Tabora	campsite already established
Camp site	Nzubuka	857+000	227,000.00	Lot 4	Section 1 Nzubuka	under construction
Camp site	Bukene	915+500	275,000.00	Lot 4	Section 2 Bukene	under construction
Rock quarry site and batching plant	R-567 Manyoni	567+000	389,291.00	Lot 3	Section 1 Manyoni	ready for use
Rock quarry site and borrow pit	R-645 Itigi	645+000	179,540.90	Lot 3	Section 2 Itigi	ready for use
Rock quarry site	R-682 Tura	681+000	945,421.32	Lot 3	Section 3 Tura	ready for use
Rock quarry site	R-748	748+000	99,088.16	Lot 3	Section 4 Nyahua	land acquisition ongoing
Rock quarry site and borrow pit	R-762 Nyahua	762+000	476,644.71	Lot 3	Section 4 Nyahua	ready for use
Rock quarry site and borrow pit	R-809-1 Tabora	809+500	490,489.00	Lot 3	Section 5 Tabora	ready for use



		Kilometer point plus distance within the km (where the start				Additional notes (where applicable)
Aspect Infrastructure type	Name/ID number	of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	
Rock quarry site and crusher	R-850	850+000	473,000.00	Lot 4	Section 1 Nzubuka	land acquisition ongoing - crusher & batch plant & mix plant and stock area
Rock quarry site	R-891	891+000	275,000.00	Lot 4	Section 2 Bukene	handed over (crusher & batch plant & mix plant & stock area)
Rock quarry site and crusher	R-908	908+000	362,000.00	Lot 4	Section 2 Bukene	handed over (crusher & batch plant & mix plant & stock area)
Sand quarry site	S-816	816+000	59,877.00	Lot 3	Section 5 Tabora	
Sleeper/precast production area	Itigi	619+000	100,000.00	Lot 3	Section 2 Itigi	
Sleeper/precast production area	Tabora	811+000	186,547.00	Lot 3	Section 5 Tabora	
Stock Area	P-645	645+000	100,000	Lot 3	Section 2 Itigi	ready for use
Batching plant (included in campsite footprint)	Itigi	619+000	8,000.00	Lot 3	Section 2 Itigi	
Batching plant (included in campsite footprint)	Tabora	816+4000	8,000.00	Lot 3	Section 5 Tabora	
Batching plant (included in campsite footprint)	Tura camp	681+000	8,000.00	Lot 3	Section 3 Tura	
Batching plant (included in campsite footprint)	Nyahua	750+000	8,000.00	Lot 3	Section 4 Nyahua	ready for use



Aspect Infrastructure	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)
Batching plant (included			, u cu (iii)			
in campsite footprint)	Bukene camp	917+500	8,000.00	Lot 4	Section 2 Bukene	construction complete
Borrow pit	B-554	553+500	154,761.87	Lot 3	Section 1 Manyoni	submitted in September
Borrow pit	B-576	576+000	150,472.37	Lot 3	Section 1 Manyoni	will be submitted in November
Borrow pit	B-581	581+500	100,000.00	Lot 3	Section 1 Manyoni	will be submitted in November
Borrow pit	B-585	584+750	100,000.00	Lot 3	Section 1 Manyoni	will be submitted in November
Borrow pit	B-593	593+600	69,983.32	Lot 3	Section 1 Manyoni	ready for use
Borrow pit	B-595	594+800	79,736.82	Lot 3	Section 1 Manyoni	ready for use
Borrow pit	B-603	603+100	74,826.35	Lot 3	Section 2 Itigi	submitted in September
Borrow pit	B-607 - B-610	607+800 610+000	42,365.40	Lot 3	Section 2 Itigi	checking location
Borrow pit	B-621	621+500	74,734.15	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-621-1	621+500	149,740.00	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-630	630+000	79,717.00	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-634	634+600	49,583.20	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-639	639+000	121,372.88	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-644A	644+000	50,294.05	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-649, D49	649+000	39,881.88	Lot 3	Section 2 Itigi	ready for use



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)
Borrow pit	B-654	653+900	39,915.07	Lot 3	Section 2 Itigi	ready for use
Borrow pit	B-660 - B-661	660+100 661+000	150,116.69	Lot 3	Section 3 Tura	ready for use
Borrow pit	B-666	665+600	49,799.17	Lot 3	Section 3 Tura	submitted in August
Borrow pit	B-670	670+000	59,786.97	Lot 3	Section 3 Tura	submitted in September
Borrow pit	B-675	675+500	49,809.55	Lot 3	Section 3 Tura	submitted in August
Borrow pit	B-681	681+500	49,857.15	Lot 3	Section 3 Tura	submitted in September
Borrow pit	B-686	686+300	39,888.73	Lot 3	Section 3 Tura	submitted in August
Borrow pit	B-691	691+100	99,531.83	Lot 3	Section 3 Tura	submitted in September
Borrow pit	B-691A	690+800	65,000.00	Lot 3	Section 3 Tura	will be submitted in October
Borrow pit	B-696	696+400	39,826.62	Lot 3	Section 3 Tura	submitted in August
Borrow pit	B-703	702+750	70,252.20	Lot 3	Section 3 Tura	submitted in September
Borrow pit	B-707	707+500	120,000.60	Lot 3	Section 3 Tura	submitted in August
Borrow pit	B-717	717+900	39,842.60	Lot 3	Section 4 Nyahua	submitted in July
Borrow pit	B-722	721+500	39,888.21	Lot 3	Section 4 Nyahua	submitted in August
Borrow pit	B-730	730+000	218,956.59	Lot 3	Section 4 Nyahua	submitted in August
Borrow pit	B-747	747+000	125,766.24	Lot 3	Section 4 Nyahua	ready for use
Borrow pit	B-753	753+000	49,801.15	Lot 3	Section 4 Nyahua	ready for use



Aspect Infrastructure	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)		
						will be submitted in		
Borrow pit	B-753-1	753+000	51,390.00	Lot 3	Section 4 Nyahua	October		
Borrow pit	B-758	758+000	99,988.00	Lot 3	Section 4 Nyahua	submitted in August		
Borrow pit	B-766	766+000	100,768.07	Lot 3	Section 4 Nyahua	submitted in August		
Borrow pit	B-772	771+500	59,794.12	Lot 3	Section 4 Nyahua	submitted in September		
Borrow pit	B-778	778+400	49,846.12	Lot 3	Section 4 Nyahua	submitted in September		
Borrow pit	B-783	782+900	49,860.73	Lot 3	Section 4 Nyahua	submitted in September		
Borrow pit	B-789	788+900	49,800.10	Lot 3	Section 5 Tabora	submitted in August		
Borrow pit	B-790	790+600	169,843.00	Lot 3	Section 5 Tabora	will be submitted in October		
Borrow pit	B-794	793+600	91,232.50	Lot 3	Section 5 Tabora	submitted in September		
Borrow pit	B-795	795+000	137,214.58	Lot 3	Section 5 Tabora	will be submitted in October		
Borrow pit	B-800	800+000	69,880.46	Lot 3	Section 5 Tabora	submitted in August		
Borrow pit	B-804	804+000	193,835.00	Lot 3	Section 5 Tabora	ready for use		
Borrow pit	B-816	816+500	60,000.00	Lot 3	Section 5 Tabora	will be submitted in October		
Borrow pit	B819-2	819+000	89,161.00	Lot 3	Section 5 Tabora	submitted in August		
Borrow pit	B-821	821+200	80,647.76	Lot 3	Section 5 Tabora	will be submitted in October		
Borrow pit	B-823	822+500	101,845.00	Lot 3	Section 5 Tabora	submitted in June		



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)	
Borrow pit	B-826	826+900	70,000.00	Lot 3	Section 5 Tabora	will be submitted in October	
Borrow pit	B-830	829+500	89,572.00	Lot 3	Section 5 Tabora	submitted in June	
Borrow pit	B-830A	829+800	132,000.00	Lot 3	Section 5 Tabora	will be submitted in October	
Borrow pit and dump site	B-537, D-537	537+000	150,895.10	Lot 3	Section 1 Manyoni	ready for use, borrow pit will be submitted in October, dumpsite is handed over.	
Borrow pit and dump site	B-58, BP-589	589+500	49,893.34	Lot 3	Section 1 Manyoni	ready for use, borrow pit will be submitted in October, dumpsite is handed over.	
Borrow pit and dump site	B&D-831	830+885	144,375.00	Lot 4	Section 1 Nzubuka	submitted - ongoing	
Borrow pit and dump site	B&D-834	834+558	210,496.00	Lot 4	Section 1 Nzubuka	compensation stage	
Borrow pit and dump site	B&D-839	838+996	275,299.00	Lot 4	Section 1 Nzubuka	compensation stage	
Borrow pit and dump site	B&D-843	843+276	134,585.00	Lot 4	Section 1 Nzubuka	handed over	
Borrow pit and dump site	B&D-848	847+922	192,560.00	Lot 4	Section 1 Nzubuka	submitted - ongoing	
Borrow pit and dump site	B&D-852	852+119	114,033.00	Lot 4	Section 1 Nzubuka	compensation stage	
Borrow pit and dump site	B&D-858	857+662	143,283.00	Lot 4	Section 1 Nzubuka	compensation stage	
Borrow pit and dump site	B&D-861	861+057	159,136.00	Lot 4	Section 1 Nzubuka	handed over - in use	
Borrow pit and dump site	B&D-865	865+180	109,697.00	Lot 4	Section 1 Nzubuka	handed over	



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)	
Borrow pit and dump site	B&D-869	869+000	100,000.00	Lot 4	Section 1 Nzubuka	handed over	
Borrow pit and dump site	B&D-873	873+462	100,000.00	Lot 4	Section 1 Nzubuka	handed over	
Borrow pit and dump site	B&D-876	876+168	120,000.00	Lot 4	Section 1 Nzubuka	handed over	
Borrow pit and dump site	B&D-880	880+146	102,938.00	Lot 4	Section 1 Nzubuka	handed over	
Borrow pit and dump site	B&D-883	883+136	141,924.80	Lot 4	Section 1 Nzubuka	submitted - ongoing	
Borrow pit and dump site	B&D-887	886+989	140,000.00	Lot 4	Section 1 Nzubuka	submitted - ongoing	
Borrow pit and dump site	B&D-891	890+500	294,323.00	Lot 4	Section 2 Bukene	compensation stage	
Borrow pit and dump site	B&D-895	895+184	150,000.00	Lot 4	Section 2 Bukene	will be submitted	
Borrow pit and dump site	B&D-899	898+845	112,503.00	Lot 4	Section 2 Bukene	submitted	
Borrow pit and dump site	B&D-901	901+374	125,811.00	Lot 4	Section 2 Bukene	compensation stage	
Borrow pit and dump site	B&D-905	905+531	143,350.00	Lot 4	Section 2 Bukene	handed over	
Borrow pit and dump site	B&D-910	910+293	124,615.00	Lot 4	Section 2 Bukene	compensation stage	
Borrow pit and dump site	B&D-914	913+936	199,176.03	Lot 4	Section 2 Bukene	submitted - ongoing	
Borrow pit and dump site	B&D-918	918+593	158,700.00	Lot 4	Section 2 Bukene	handed over - in use	
Borrow pit and dump site	B&D-921	921+025	115,763.00	Lot 4	Section 2 Bukene	compensation stage	
Borrow pit and dump site	B&D-924	924+242	153,697.00	Lot 4	Section 2 Bukene	compensation stage	
Borrow pit and dump site	B&D-928	927+928	115,200.00	Lot 4	Section 2 Bukene	compensation stage	
Borrow pit and dump site	B&D-931	930+750	150,000.00	Lot 4	Section 2 Bukene	will be submitted	
Borrow pit and dump site	B&D-937	937+567	158,881.00	Lot 4	Section 2 Bukene	submitted - ongoing	



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)
Borrow pit and dump site	B&D-943	943+398	187,480.00	Lot 4	Section 2 Bukene	compensation stage
Borrow pit and dump site	B&D-948	947+988	200,000.00	Lot 4	Section 2 Bukene	will be submitted
Borrow pit and dumpsites x2	B-616, D615, D616	616+200	215,820.00	Lot 3	Section 2 Itigi	submitted in June
Dump site	D-540	540+000	116,290	Lot 3	Section 1 Manyoni	land acquisition ongoing
Dump site	D-541	541+000	119,801	Lot 3	Section 1 Manyoni	land acquisition ongoing
Dump site	D-544	544+000	40,051	Lot 3	Section 1 Manyoni	land acquisition ongoing
Dump site	D-566, D566-1	566+000	15,097	Lot 3	Section 1 Manyoni	handed over
Dump site	D-567	567+000	11,951	Lot 3	Section 1 Manyoni	handed over
Dump site	D-568	568+000	23,550	Lot 3	Section 1 Manyoni	handed over
Dump site	D-587	587+000	17,354	Lot 3	Section 1 Manyoni	handed over
Dump site	D-590	590+000	8,037	Lot 3	Section 1 Manyoni	ready for use
Dump site	D-592	592+000	14,937	Lot 3	Section 1 Manyoni	ready for use
Dump site	D-594	594+000	12,455	Lot 3	Section 1 Manyoni	handed over
Dump site	D-601	601+000	7,967	Lot 3	Section 2 Itigi	handed over
Dump site	D-606	606+000	11,016	Lot 3	Section 2 Itigi	handed over
Dump site	D-624	624+000	8,958	Lot 3	Section 2 Itigi	ready for use
Dump site	D-629	629+000	9,955	Lot 3	Section 2 Itigi	ready for use
Dump site	D-629-2	629+000	18,593	Lot 3	Section 2 Itigi	ready for use
Dump site	D-633	633+000	51,122	Lot 3	Section 2 Itigi	ready for use



Aspect Infrastructure		Kilometer point plus distance within the km (where the start of Lot 3 is			Additional notes	Additional notes (where applicable)	
type	Name/ID number	000+000)	Area (m²)	Lot	(where applicable)		
Dump site	D-635	635+000	16,681	Lot 3	Section 2 Itigi	ready for use	
Dump site	D-636-R	636+000	19,030	Lot 3	Section 2 Itigi	ready for use	
Dump site	D-641	641+000	33,943	Lot 3	Section 2 Itigi	ready for use	
Dump site	D-642	642+000	20,700	Lot 3	Section 2 Itigi	ready for use	
Dump site	D-645-R	645+000	50,526	Lot 3	Section 2 Itigi	ready for use	
Dump site	D-649	649+000	40,901	Lot 3	Section 2 Itigi	ready for use	
Dump site	D-657	657+000	108,218	Lot 3	Section 3 Tura	ready for use	
Dump site	D-662	662+000	42,129	Lot 3	Section 3 Tura	ready for use	
Dump site	D-667	667+000	41,759	Lot 3	Section 3 Tura	handed over	
Dump site	D-672	672+000	89,551	Lot 3	Section 3 Tura	handed over	
Dump site	D-679	679+000	42,101	Lot 3	Section 3 Tura	handed over	
Dump site	D-681	681+000	10,353	Lot 3	Section 3 Tura	handed over	
Dump site	D-684	684+000	45,585	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-688	688+000	25,858	Lot 3	Section 3 Tura	handed over	
Dump site	D-690	690+000	20,355	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-693	693+000	64,772	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-698	698+000	24,707	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-702	702+000	37,712	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-705	705+000	22,600	Lot 3	Section 3 Tura	land acquisition ongoing	



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)	
Dump site	D-708	708+000	33,431	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-714 Tura	714+000	44,952	Lot 3	Section 3 Tura	land acquisition ongoing	
Dump site	D-716	716+000	17,280	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-722	722+000	22,463	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-724	724+000	42,313	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-728	728+000	23,174	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-731	731+000	28,037	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-735	735+000	47,517	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-739	739+000	46,822	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-742	742+000	52,145	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-750	750+000	22,902	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-758	758+000	20,039	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-762	762+000	19,109	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-766	766+000	29,447	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-772	772+000	31,849	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-776	776+000	21,605	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-780	780+000	24,804	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-782	782+000	21,652	Lot 3	Section 4 Nyahua	handed over	
Dump site	D-800	800+000	40,328	Lot 3	Section 5 Tabora	handed over	



Aspect Infrastructure type	Name/ID number	Kilometer point plus distance within the km (where the start of Lot 3 is 000+000)	Area (m²)	Lot	Additional notes (where applicable)	Additional notes (where applicable)
Dump site	D-805	805+000	50,000	Lot 3	Section 5 Tabora	handed over
Dump site	D-810	810+000	61,859	Lot 3	Section 5 Tabora	handed over
Dump site	D-812	812+000	25,692	Lot 3	Section 5 Tabora	handed over
Dump site	D-812-1	812+000	15,455	Lot 3	Section 5 Tabora	handed over
Dump site	D-819-1	819+000	57,800	Lot 3	Section 5 Tabora	handed over
Dump site	D-821-R	821+000	39,772	Lot 3	Section 5 Tabora	handed over
Dump site	D-826	826+000	79,938	Lot 3	Section 5 Tabora	handed over



Table 4-6: Pre-existing structures and assets of PAPs falling within the ROW and project footprint requiring removal in Lot 3 (TRC RAP, 2023)

Village/Street	Complete residential structures	Incomplete/ under- construction structures	Outside toilets	Outside kitchen	Store building	Animal shades	Boreholes/ covered and uncovered wells	Water reservoirs	Fences	Business structures	Total
Manyoni	98	35	73	13	3	23	20	5	4	0	280
Itigi Town Council	119	70	60	30	5	14	35	16	13		366
Sikonge	0	0	7	0	0	1	0	0	0	2	11
Tabora Municipal Council	22	3	1	0	2	3	4	1	0	0	40
Uyui	58	9	1	5	10	16	3	1	0	16	124
Total	297	117	142	48	20	57	62	23	17	18	821

Table 4-7: Pre-existing structures and assets of PAPs falling within the ROW and project footprint requiring removal (UDSM HRDD, 2023, which cites TRC RAP, 2023 as the source of the data) – Lot 4

Village/Street	Complete residential structures	Incomplete/ under- construction structures	Outside toilets	Outside kitchen	Store building	Animal shades	Boreholes/covered and uncovered wells	Wate reservoirs	Fences	Business structures	Total Structu res
Tabora Municipal	11	0	05	01	0	04	0	0	0	0	21
Uyui	11	0	05	0	03	07	01	0	0	0	17
Nzega	75	0	39	03	04	28	04	02	0	03	158
Total	97	0	49	04	07	39	05	02	0	03	206





A cultural heritage study was undertaken to understand the cultural heritage resources and assets present within the study area. Key cultural heritage resource that will be affected include:

- several archaeological sites with various artefacts, including decorated pieces of ceramics, and glasses, several ritual and intangible heritage sites
- graves (663 in Lot 3) and 342 in Lot 4
- several tangible cultural heritage sites, including ritual sites, sacred trees, etc.

These are estimates and more will potentially be identified as the study goes.

Detailed findings of the cultural heritage study are included in Section 12. Recommendations to mitigate the impacts are included in the standalone Environmental and Social Management Plan (ESMP).

The construction of the project requires installation of new infrastructure, which can result in the disruption of existing infrastructure such as utilities infrastructure and road infrastructure. Excavation work and heavy machinery can damage underground utilities, leading to service disruptions and safety concerns.

An inventory of existing social facilities and utilities in the project area shows that about 41 public buildings/structures such as schools, churches, mosques and communitybased organizations (CBOs), shallow wells, underground water pipes, power distribution lines will be affected by the project. These will be further assessed as part of the RAP process.

It should be noted that data provided in this section are estimates only and based on the most recent information available at the time of preparing the ESIA. The estimates are based on current information to provide context in terms of the magnitude of land take and displacement/relocation or destruction of social and cultural heritage assets and facilitate impact identification and assessment within the ESIA process. Exact numbers and detail will be provided in the RAP currently being prepared by TRC.

4.1.2.3 Vegetation clearance (brush cutting and grubbing), stockpiling and re-use/ disposal

As an early step in enabling works, and to prepare the project footprint for construction of the project, vegetation clearance will be required. This entails cutting and removal of underbrush first, which will be stockpiled on site. After this, larger plants and trees are felled, removed and stockpiled. This is followed by grubbing, which entails removal of stumps, roots and other debris such as rocks. Vegetative grubbed material is sometimes mulched. Depending on the reason for clearing, brush cutting should be used as an alternative to full vegetation clearance where possible.

Due to the substantial footprint of the project, large volumes of vegetation and grubbed materials will be stockpiled. Substantial planning and resources will be required to manage these stockpiles and determine the final destination of the materials.

4.1.2.4 Topsoil removal and stockpiling for reuse, stripping

After vegetation removal and grubbing, topsoil is removed. This entails removing 10-20 cm of the top layer of the soils, which contains high concentrations of organic matter, organisms and seedbank. Topsoil is essential for re-establishment of vegetation after construction and must therefore be stockpiled on site for reuse.

After removal of topsoil, the stripping of the subsoil may also be required depending on the project component to be built. Depending on the nature of the soils, these will be stockpiled for use in construction, or they will be stockpiled and later removed and


dumped at new dumpsites that will be established for the project (see Table 4-5 and Section 4.1.3 for further information on dumpsites).

4.1.3 Cut and fill, quarries and borrow pits, dumpsites, sleeper production, concrete works

The construction of the project will require a significant amount of construction materials such as aggregate stones, murram and sand. Other typical construction materials include steel bars, aggregates (hard stones), cement, water, sand and timber. All apart from steel rail bars and cement premix will be sourced locally. Borrow pits and quarries will be established to provide fill, aggregates, stones and sand (Table 4-5).

4.1.3.1 Cut and fill, quarries and borrow pits and dumpsites

A large portion of the line requires fill or embankments to achieve the required levels and curves to meet the SGR specifications. Table 4-8 provides estimates of the proposed volumes of fill required, estimated volumes that can be fulfilled through re-use of cut material, and the additional volumes of fill needed. As can be seen, only a low proportion of materials excavated along the line can be reused for fill or construction. This creates a large demand for fill materials.

Table 4-8: Cut and fill volumes required for Lots 3 and 4

Description of activity	Volume (m ³)
Estimated earth fill materials quantity required	32,190,797
Estimated materials from cut along the alignment that can be re-used as fill	3,541,524
Estimated remaining material required from extraction (borrow pits)	28,649,274
Estimated materials to dump (unusable)	14,118,066

The project has identified borrow pits with extraction capacity estimated to supply the full fill volumes required (32,190,797mil m³).

Excavated materials unsuitable for reuse in the fill process, will be disposed of at specified dump sites (Table 4-5). The planned volume total requirements for dumpsites is 14,118,066 mil m³.

4.1.3.2 Blasting and rock breaking

Blasting and rock crushing activities are required at the five different quarry sites. Where necessary, blasting might be conducted during the construction of the worker camp sites and the railway alignment. Blasting activities are estimated to include the following.

- a designated blast area of 200 m2 (20 m x 10 m)
- 80 blast holes with a depth of 10 m and 2 m x 2 m per day
- 1,145,505 m3 requires 1146 blasts of surface area 200 m2 and 91,680 drill holes (blast holes).

The importance of the impact of the blasting activities is further assessed in more details within the social section (Section 11), and noise and vibration study section (Section 15).



4.1.3.3 Crushing

Table 4-9 describes the anticipated crushing activities. Crushing will be implemented 24 hours per day.

Section	Area	Description	Volumes (ton) estimated for three years of construction period
Manyoni	R-567	Rock Quarry + Crusher	1.220.000
Itigi	R-645	Rock Quarry + Crusher	1.230.000
Tura	R-681	Rock Quarry + Crusher	1.070.000
Nyahua	R-762	Rock Quarry + Crusher	1.300.000
Tabora	R-809	Rock Quarry + Crusher	950.000

Table 4-9: Proposed crushing activities

4.1.3.4 Cement works/batching plants, sleeper production and storage

The project alignment requires large volumes of cement for the general construction and infrastructure development but also specifically for the production of railway sleepers for the railway line.

Due to the volumes of cement needed it is more cost effective for the project to produce its own cement at batching plants than buying in ready mixed cement. This option is also preferable from an environmental and social perspective as bringing in ready mixed cement would bring increased emissions from cement trucks, increased wear and tear on road systems and have a much higher safety risk for drivers, operators, and other road users.

Batching plants and sleeper precast production sites have been proposed at Itigi ballast and sleeper precast production area and Tabora ballast and sleeper precast production area in Lot 3. Additional smaller batching plants are planned at Tura and Nyahua camps on Lot 3 and Bukene camp on Lot 4.

The quantity of crushed stones and sand materials required is estimated to be 1,500,000 t which will be sourced from graded rock quarry sites. An estimated amount of 307,635 t cement (dry mix) is required which will be sourced from commercial sources for mixing at the batching plants.

4.1.4 General construction activities

4.1.4.1 Construction of service roads

A service road will be constructed along the full length of the SGR Lot 3-4 route. The road will run in parallel to the SGR and will be on the opposite side of the SGR line to the MGR.

The service road will be constructed within the ROW, and within the ROW fence line. The service road will 4 m wide with a 0.6 m shoulder on either side (thus a total of 5.2 m wide



for the road). The road will be a gravel road and will be able to accommodate 10-ton vehicles at 25 km/hr.

During construction the service road will be used to transport labour, plant and materials along the route. During the construction phase, YM will be responsible for the monitoring and maintenance of the road, and for safety measures along the road.

During operation, the road will be used for transporting labour and materials for operational activities such as monitoring and maintenance. TRC will be responsible for the ongoing monitoring and maintenance and safety of the service road during operation.

The culverts to be established for the ROW and railway line will be extended to pass below the service road, and the service road is therefore included in the flood management design.

For cross-drainage purposes, drift crossings will be implemented on service roads across the railway culverts/bridges. A drift crossing consists of a flat slab and two inclined approach ramps over which water and vehicles can pass, thus a drift crossing carries water over the road with an improved running surface constructed from imported materials.

4.1.4.2 Construction of access roads

The project will require access roads to the construction sites for stations (passenger and freight), marshalling yard, sleeper and ballast productions areas, borrow pits, dumpsites and quarries, as well as for use during both the operational phase of the project.

The existing main and feeder roads will be utilized to reach the access road, while the necessary materials from borrow pits, quarry sites, water sources, and dumping sites will be accessed through newly developed access routes located outside the ROW. However, certain facilities such as campsites, marshalling yard and stations will be constructed within or adjacent to the existing MGR line, and these areas can be conveniently accessed by the access road constructed by the contractor.

To minimize the impact of haulage roads on local residents, local businesses, and traffic, the contractor will develop a comprehensive construction traffic management plan. The plan will include measures to mitigate any potential negative effects. All access roads will be constructed to appropriate standards in terms of grades and widths, avoidance of sharp curves, blind corners and hazardous intersections. The contractor will also provide adequate lighting, signs, barricades and distinctive markings to enable the safe movement of both traffic and pedestrians.

Access roads are considered within the resettlement, social and biodiversity Aols.

4.1.4.3 Construction of campsites

The development of Lots 3 and 4 will entail the construction of workers' campsites to facilitate accommodation, office spaces and other associated components including workshops and fuel depots. The workers' camps in Lot 3 consist of a main camp and small camps, covering a total land area of 1,838,581 m² while Lot 4 consists of .a small, mini and main camp, covering a total land area of 520,918 m² (Table 4-10 and Table 4-11). However, not all workers will be accommodated within these camps, and some will need to find accommodation in nearby towns and villages.



Camp name	Description	Size (m²)	No. staff on a typical day	Locations	% complete
Manyoni camp	Small Camp	223,745	400	Kipondoda	85%
Itigi camp	Main Camp	507,887	550	Kitaraka	97%
Tura camp	Small Camp	267,660	400	Tura	47%
Nyahua camp	Small Camp	263,659	400	Nyahua	70%
Tabora camp	Main Camp	575,630	650	Inala	97%
Total land area		1,838,581			

Table 4-10: Names and sizes of workers camps for Lot 3

Table 4-11: Names and sizes of workers camps for Lot 4

Camp name	Description	Size (m²)	No. staff on a typical day	Locations	% complete
Nzubuka	Small Camp	227,255	520	Nzubuka	35%
Bukene	Main Camp	274,881	650	Bukene	55%
Marshalling yard	Mini Camp	18,782	100	Tabora	95%
Total land area		520,918			

The camps situated along the project corridor are positioned near the ROW and in proximity to the MGR to facilitate transportation convenience. However, Manyoni and Itigi workers' camps are situated in areas classified as sensitive habitats, specifically characterized by Itigi thickets. Moreover, these two camps are located within an active wildlife corridor, as confirmed by information from local sources and the presence of elephant signs recorded during the ESIA study. Assessment of potential impacts on habitats, elephants and other wildlife is provided in Section 1.

4.1.4.4 Erection of ROW fencing

The project ROW will be fenced along the entire Lot 3-4 alignment. This fencing will consist of 2.1 m high razor wire fencing. Elephant and wildlife routes cross the existing MRG and the planned Lot 3-4 alignments in Muhalala, Chaya, Malongwe, Nyahua (Lot 3) and Imgombe river forest reserve and Ilomelo hill forest reserve (Lot 4) and elephant proof fencing will be erected to prevent elephants and other large animals crossing the alignment, and elephant crossings will be provided at key routes to enable these animals to continue to transverse the area safely. Elephant crossing will include culverts, underpasses and bridges located at strategic points and will be designed with a minimum height of 3 meters. Section 1 and the BAP provide more information on the location and design of the elephant proof fencing and the elephant crossings.



4.1.4.5 Development of embankments, drainage/stormwater management systems, culverts, bridges

The construction corridor designated for Lot 3-4 intersects areas that are prone to heavy rainfall and contain seasonal wetlands. Additionally, climate projections for the project area indicate an expected rise in temperature, leading to increased evapotranspiration. Consequently, these climatic changes may result in elevated rainfall levels and potential flood risks. Hydrological assessments were conducted for the Lot 3 and Lot 4 (MIT-YMI-AL-GL00X-G-HY-REP-0002-1 and TAI-YMI-AL-GL00X-G-HY-REP-0002-0, respectively), which included analysing meteorological, topographical, and land use data as well as existing culverts, bridges and signs of previous flood damage along the existing MGR route.

Flood design was done using various methods and models (rational, Transport and Road Research Laboratory East African Model and Snyder Unit Hydrograph). Based on the outcomes of the assessment, an infrastructure design that incorporates measures to ensure the safe passage of the SGR through watercourses and drainage areas has been developed. In locations where natural watercourses are encountered or where drainage is required beneath the SGR, culverts will be constructed. Furthermore, for significant river crossings, larger bridges will be constructed to facilitate the passage of the SGR. As part of the ESIA the Hydrology reports were considered, and the project was assessed to determine potential impacts on surface and ground water (Section 18).

For the Makutupora-Tabora Standard Gauge Railway Project, data on hydrology and meteorology were gathered. However, there were no hydrometric records available for streams intersecting the railway in Lot 3 section (Km 535 – 833). Evaluation of catchment flows was conducted considering their individual basin characteristics, utilizing synthetic hydrograph methods and empirical approaches based on physical features such as area, slope, soil type, and land use.

The Rational Method was employed for smaller catchment areas (less than 1 km²), while catchments ranging from 1 to 200 km² were analyzed using the TRRL East Africa Flood Model method. For larger catchments, the Snyder method was utilized. Results from these methods were consolidated in this section. Estimations for 50 and 100 years return periods were derived using the mentioned methodologies. Should any structures be susceptible to flooding, sizing adjustments should be made accordingly. In such instances, further 2D flood modeling would be necessary to finalize the structural layout. Balancing risks and costs can be achieved by selecting an appropriate design return period, drawing from field observations and experience applied to hydrological analyses, as demonstrated in the report MIT-YMI-AL-GL00X-G-HY-REP-0002-0 and MIT-YMI-AL-GL00X-G-HY-REP-0002-1.

The site structure survey identified 22 possible locations for bridges and complex particular cases such as Catchment CU_737-1 hydrological computations produce over 100 m3/s. This culvert is located close to catchment BR14, CU_743-1 and BR15. These areas will all work together when high flow events occur. Also BR16 - BR17 basins and BR18 – CU_768- 2 catchment areas work together during flood events.

The Tabora to Isaka Standard Gauge Railway Project involved a thorough assessment of all the catchments using a rainfall-runoff methodology, which relies on a blend of rainfall data and associated runoff patterns. Given the absence of extensive, recent, and consistent hydrometric data, flow data analysis couldn't be conducted. Consequently, hydrological computations relied solely on the gathered rainfall data. Statistical examination of rainfall records was conducted, with the selection of the most suitable statistical distribution for each meteorological station. The TRRL IDF curves distribution was utilized to determine rainfall intensity for various storm durations and return periods.



Various catchment characteristics such as soil type, land use, and slope were collected and analyzed. Different discretization approaches for rainfall-runoff methods were adopted: the Rational Method for catchment areas below 1 km², the TRRL method for areas between 1 km² and 200 km², and the HEC-HMS software with the SCS unit hydrograph for areas exceeding 200 km².

The discharges computed in these two reports were used as input hydrograms to the flood models to be produced during the following stages of the design based on which the type of structure to be used effectively will be decided.

In response to identified flood concerns, an assessment of the flooding in the area was conducted. This involves analyzing both the existing conditions before the development of the Standard Gauge Railway (SGR) and the anticipated impact of the project. The aim is to minimize adverse effects on existing structures and residential areas and prevent overtopping of existing roadways, MGR, and other infrastructure due to water accumulation on the SGR and resulting backwaters in previously unaffected areas.

Additionally, measures to protect against erosion and ensure the stability of SGR embankments and structures are outlined in each zone flood risk assessment reports (MIT-YMI-AL-GL00X-G-REP-0003-02, MIT-YMI-AL-GL00X-G-REP-0004-01, MIT-YMI-AL-GL00X-G-REP-0005-01, MIT-YMI-AL-GL00X-G-REP-0006-01, MIT-YMI-AL-GL00X-G-REP-0007-01, MIT-YMI-AL-GL00X-G-REP-0008-01, MIT-YMI-AL-GL00X-G-REP-MIT-YMI-AL-GL00X-G-REP-0011-00, 0009-00, MIT-YMI-AL-GL00X-G-REP-0010-0, MIT-YMI-AL-GL00X-G-REP-0012-1, MIT-YMI-AL-GL00X-G-REP-0013-1, MIT-YMI-AL-GL00X-G-REP-0014-00, MIT-YMI-AL-GL00X-G-REP-0015-00, MIT-YMI-AL-GL00X-G-REP-0016-1, MIT-YMI-AL-GL00X-G-REP-0017-1, MIT-YMI-AL-GL00X-G-REP-0018-00, MIT-YMI-AL-GL00X-G-REP-0019-1. MIT-YMI-AL-GL00X-G-REP-0020-1. TAI-YMI-DD-TAI-YMI-DD-GL00X-G-HY-REP-0004-2, GL00X-G-HY-REP-0003-1. TAI-YMI-DD-TAI-YMI-DD-GL00X-G-HY-REP-0006-0, GL00X-G-HY-REP-0005-0, TAI-YMI-DD-GL00X-G-HY-REP-0007-0, TAI-YMI-DD-GL00X-G-HY-REP-0008-0, TAI-YMI-DD-GL00X-G-HY-REP-0009-0, TAI-YMI-DD-GL00X-G-HY-REP-0010-0, and TAI-YMI-DD-GL00X-G-HY-REP-0011-0). These measures are determined based on factors such as flow velocities along the embankments, the extension of flood plains, and the duration of flood exposure.

The design criteria for flood return periods vary depending on the type of structure. For instance, large river bridges undergo a 100-year analysis, while cross drainage structures are assessed over a 50-year period.

The selection of sizes for hydraulic structures is guided by hydrological considerations, including peak discharge at control points for catchments as defined in the Hydrology Report (MIT -YMI-AL-GL00X-G-HY-REP-0002-0 and MIT-YMI-AL-GL00X-G-HY-REP-0002-1) and employer requirements, as outlined in Hydrological and Drainage Design Manual (TAI-YMI-AL-GL00X-G-HY-REP-0001-0).

Below list presents applicable Standards, Codes of Practice and Technical documents used for designing of hydraulic structures, subdivided into primary (Employer Requirements) and ancillary references is presented below.

Primary References:

- Ministry of Works: Standard Specifications for Roadworks, 2000
- American Railway Engineering and Maintenance-of-Way Association (AREMA)
 Manual for Railway Engineering, 2018
- Tanzania Railways Corporation Civil Engineering Manual, 1999
- Ministry of Works: Road Geometric Design Manual, 2011



- Transport Road Research Laboratory East Africa Flood Model (EAFM)
- Ministry of Works, Transport and Communication : Low Volume Roads Manual 2016 (Part two for drainage)

Ancillary References:

- Hydraulic Engineering Circular No. 11 Design of Riprap Revetment, 3rd Edition (HEC-11).
- Hydraulic Engineering Circular No. 14 Energy Dissipator for Culverts and Channels, 3rd Edition (HEC-14)
- Hydraulic Engineering Circular No. 15 Design of Roadside Channels with Flexible Linings, 3rd Edition (HEC-15)
- Hydraulic Engineering Circular No. 18 Evaluating Scour at Bridges, Fifth Edition (HEC-18)
- Hydraulic Engineering Circular No. 20 Stream Stability at Highway Structures, Fourth Edition (HEC-20)
- Hydraulic Engineering Circular No. 23 Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance, 3rd Edition (HEC-23)
- Federal Highway Administration (FHWA) Hydraulic Design of Highway Culverts, Hydraulic Design Series N^o.5 (HDS-5)

Generally, detailed flood study was performed as summarized above and as per the finding prevention measures like provision of Dykes, channelization and river bed protection works using gabion and reno mattress applied. For each hydraulic structure (culvert-bridge etc.), the contractor prepares scour protection report-drawings-details for inlet-outlet parts accordingly. 13% rainfall maximization were considered as climate change factor from the raw data's collected from meteorological services.

Construction of embankment and foundations

The development of the project will entail the construction of permanent components such as embankments and foundations to support the railway, stations, crossings, bridges, and other fixed infrastructure. The construction of embankments and foundations shall consider geotechnical and hydraulic parameters to determine the structure loads and select suitable foundations systems that do not compound negative impacts.

Bridges, culverts

Bridges will be constructed over rivers, and over infrastructure (such as roads and other railways) where required. It is anticipated that there will be 44 bridges for Lot 3 and Lot 4 as seen in Table 4-12 and Table 4-13.

No.	Start (km)	End (km)	Length (m)	Span No	Height	Notes
Br01	537+022	537+055	32.2	1	8	Hydraulic bridge
Br02	546+857	546+923	65.5	2	8	Hydraulic bridge



No.	Start (km)	End (km)	Length (m)	Span No	Height	Notes
Br03	553+800	553+821	20.6	1	8	Hydraulic bridge
Br04	557+940	557+961	20.6	1	8	Hydraulic bridge
Br05	561+894	561+927	32.2	1	8	Hydraulic bridge
Br05A	572+995	573+006	11.0	1	8	Elephant crossing
Br06	596+630	596+650	20.6	1	8	Hydraulic bridge
Br07	597+079	597+099	20.6	1	8	Hydraulic bridge
Br08	641+714	641+756	42.3	2	8	Hydraulic bridge
Br09	644+678	644+710	32.2	1	8	Hydraulic bridge
Br10	674+303	674+335	32.2	1	8	Hydraulic bridge
Br11	678+309	678+341	32.2	1	8	Hydraulic bridge
Br12	687+219	687+251	32.2	1	8	Hydraulic bridge
Br13	713+573	713+677	103.6	3	8	Hydraulic bridge
Br14	730+974	730+994	20.6	1	8	Hydraulic bridge
Br15	733+725	733+745	20.6	1	8	Hydraulic bridge
Br16	751+446	751+478	32.2	1	8	Hydraulic bridge
Br17	756+061	756+093	32.2	1	8	Hydraulic bridge
Br18	759+451	759+471	20.6	1	8	Hydraulic bridge
Br19	763+067	763+099	32.2	1	8	Hydraulic bridge
Br20	767+294	767+326	32.2	1	8	Hydraulic bridge
Br21	772+276	772+308	32.2	1	8	Hydraulic bridge
Br22	775+453	775+486	32.2	1	8	Hydraulic bridge



No.	Start (km)	End (km)	Length (m)	Span No	Height	Notes
Br23	784+809	784+841	32.2	1	8	Hydraulic bridge
Br24	797+712	797+754	42.3	2	8	Hydraulic bridge
Br25	798+445	798+487	42.3	2	8	Hydraulic bridge
Br26	798+873	798+915	42.3	2	8	Hydraulic bridge
Br27	808+069	808+101	32.2	1	8	Hydraulic bridge
Br28	813+390	813+410	20.6	1	8	Hydraulic bridge
Br29	813+675	813+695	20.6	1	8	Hydraulic bridge
Total			1019.30	38.00		Hydraulic bridge

Table 4-13: Bridges location and dimension for SGR line for Lot 4

No.	Start (km)	End (km)	Length (m)	Span No.	Height	Notes
Br01	831+431	831+465	33.8	1	10	Rail over rail
Br02	846+031	846+031	11.0	1	8	Hydraulic bridge
Br03	853+838	853+870	32.2	1	8	Hydraulic bridge
Br04	877+340	877+340	11.0	1	8	Hydraulic bridge
Br05	878+265	878+265	11.0	1	8	Hydraulic bridge
Br06	887+500	887+500	11.0	1	8	Hydraulic bridge
Br07	889+027	889+093	65.5	2	8	Hydraulic bridge
Br08	916+150	916+150	11.0	1	8	Hydraulic bridge
Br09	917+824	917+858	33.8	1	10	Rail over rail
Br10	921+830	921+830	11.0	1	8	Hydraulic bridge
Br11	931+683	931+715	32.2	1	8	Hydraulic bridge



No.	Start (km)	End (km)	Length (m)	Span No.	Height	Notes
Br12	935+713	935+713	11.0	1	8	Hydraulic bridge
Br13	938+930	938+930	11.0	1	8	Hydraulic bridge
Total			285.50	14.00		

Culverts will be provided where natural waterways/channels cross the SGR route, in areas where there is a risk of flooding to minimize impact on the SGR embankments. Detail hydraulic structure list is provided in Appendix 12

4.1.4.6 Establishment of underpasses, over passes and other specialised crossings for pedestrians, livestock, wildlife crossings, vehicles, railways and services (as applicable)

The proposed project will intersect existing roads and areas frequently used as livestock crossings. Due to the ROW fencing that will be erected, establishment of crossings of various kinds will need to be provide. Crossings proposed include a combination of underpasses and overpasses at major road crossings. Furthermore, livestock crossings have been strategically incorporated every approximately 4 km, on average, as per the requirements of the client.

The proposed project is anticipated to have 22 underpasses and 15 overpasses (Table 4-14 and Table 4-15).



No.	Centre point (km)	Length (m)	Depth (m)
Lot 3			
UP01	567+322	100	8.4
UP02	587+720	20	8.4
UP03	615+125	20	8.4
UP04	650+160	20	8.4
UP04A	668+863	20	8.4
UP05	726+720	20	8.4
UP06	808+925	20	8.4
UP07	814+541	20	8.4
UP08	819+030	40	8.4
UP09	821+870	60	8.4
UP10	823+825	50	8.4
Total		390.00	
Lot 4			
UP01	839+541	25	8.4
UP02	842+826	25	8.4
UP03	855+729	25	8.4
UP04	862+827	25	8.4
UP05	875+232	25	8.4
UP06	884+420	25	8.4
UP07	902+353	25	8.4
UP08	905+286	25	8.4
UP09	912+870	25	8.4
UP10	917+422	25	8.4
UP11	923+903	25	8.4
UP12	940+854	25	8.4
Total		300.00	

Table 4-14: Location and dimension of underpasses for Lots 3 and Lot 4



No.	Centre point (km)	Length (m)	Span No.	Width (m)
Lot 3				
OP01	554+355	20	1	9
OP02	572+307	32	1	10
OP03	600+953	65.1	2	9
OP04	609+594	20	1	10
OP05	613+670	41.1	2	8
OP07	687+909	20	1	10
OP08	749+166	65.1	2	8
OP09	765+251	65.1	2	10
OP10	769+672	65.1	2	8
OP11	787+461	65.1	2	8
OP12	825+850	32	1	8
Total		490.60	17.00	
Lot 4				
OP01	830+753	32	1	14.8
OP02	837+235	32	1	14.8
OP03	929+262	32	1	14.8
Total		96.00	3.00	

Table 4-15: Location and dimension of overpasses for Lots 3 and Lot 4

Livestock crossings have also been included in the project design. This is to facilitate herding of live animals across the railway line but also to facilitate the transportation of slaughtered livestock as these routes are also used for the trade of meat between communities on either side of the railway line. Livestock crossing design is based on the estimated number of livestock movement per day (Table 4-16). Seventy-nine livestock crossings have been proposed (Table 4-17). The location of these have been guided by the railway alignment design requirements, as well as various engagements with stakeholders throughout the planning and ESIA phases of the project. Refer to Section 11 and Section 13 for further information. Additionally refer to the TRC RAP that will be completed in the near future.

Table 4-16: Typical ar	nd sizes of livestock	crossings as per	client requirements
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Equivalent livestock movements	Types of livestock	Size width x height (mm)	Type of construction
< 500 per day	Sheep, goats, cattle and donkeys	1,800 x 1,800	Prefabricated or in situ box culvert
		1,730 x 1,980	Prefabricated or in situ box culvert



Equivalent livestock movements	Types of livestock	Size width x height (mm)	Type of construction
	Horses, mules and ostriches	2,400 x 2,400	Prefabricated or in situ box culvert
		1,780 x 2,340	Prefabricated or in situ box culvert
> 500 per day	Sheep, goats, cattle and donkeys	3,700 x 2,000	Cast in situ box culvert
	Horses, mules and ostriches	3,700 x 2,500	Cast in situ box culvert

Table 4-17: Location and dimension of livestock crossings designed for Lots 3 and 4

No.	Centre point (km)	Length (m)	Depth (m)	
Lot 3				
LS01	552+790	20	5.4	
LS02	558+620	20	5.4	
LS03	564+050	20	5.4	
LS04	573+650	20	5.4	
LS05	581+846	20	5.4	
LS06	585+346	20	5.4	
LS07	590+040	20	5.4	
LS08	595+581	20	5.4	
LS09	597+963	20	5.4	
LS10	605+303	20	5.4	
LS11	606+454	20	5.4	
LS12	619+489	20	5.4	
LS13	624+534	20	5.4	
LS14	628+796	20	5.4	
LS15	633+206	20	5.4	
LS16	638+275	20	5.4	
LS17	641+875	20	5.4	
LS18	647+182	20	5.4	
LS19	654+158	20	5.4	
LS20	658+215	20	5.4	
LS21	662+235	20	5.4	



No.	Centre point (km)	Length (m)	Depth (m)	
LS22	666+636	20	5.4	
LS23	672+977	20	5.4	
LS24	676+248	20	5.4	
LS25	680+149	20	4.2	
LS26	683+348	20	5.4	
LS27	691+309	20	5.4	
LS28	696+454	20	5.4	
LS29	701+009	20	5.4	
LS30	705+239	20	5.4	
LS31	708+709	20	5.4	
LS32	717+309	20	5.4	
LS33	721+839	20	5.4	
LS34	731+106	20	5.4	
LS35	733+590	20	5.4	
LS36	737+876	20	5.4	
LS37	743+176	20	5.4	
LS38	747+193	20	5.4	
LS39	751+646	20	5.4	
LS40	755+846	20	5.4	
LS41	759+346	20	5.4	
LS42	772+606	20	5.4	
LS43	775+946	20	5.4	
LS44	780+571	20	5.4	
LS45	784+746	20	5.4	
LS46	791+246	20	5.4	
LS47	795+691	20	5.4	
LS48	799+046	20	5.4	
LS49	805+425	20	5.4	
Total		980.00		
Lot 4				
LS01	832+067	20	5.4	
LS02	838+835	20	5.4	
LS03	845+937	20	5.4	
LS04	850+295	20	5.4	
LS05	853+090	20	5.4	



No.	Centre point (km)	Length (m)	Depth (m)
LS06	859+438	20	5.4
LS07	868+548	20	5.4
LS08	872+551	20	5.4
LS09	878+900	20	5.4
LS10	882+016	20	5.4
LS11	888+750	20	5.4
LS12	890+632	20	5.4
LS13	894+000	20	5.4
LS14	895+422	20	5.4
LS15	896+788	20	5.4
LS16	899+172	20	5.4
LS17	901+673	20	5.4
LS18	904+181	20	5.4
LS19	906+950	20	5.4
LS20	910+497	20	5.4
LS21	918+781	20	5.4
LS22	920+263	20	5.4
LS23	925+179	20	5.4
LS24	927+354	20	5.4
LS25	931+890	20	4.2
LS26	934+640	20	5.4
LS27	939+076	20	5.4
LS28	943+670	20	5.4
LS29	944+545	20	5.4
LS30	946+619	20	5.4
Total		600.00	

4.1.4.7 Establishment of railway line and laying of rail infrastructure

The construction of the railway line requires appropriate sequencing of steps. Following on from enabling works, cut and fill and other earthworks, as described in the preceding sections, the next key steps are as follows:

- construction of culverts/underpasses and overpasses
- track works
- catenary (electrical) works
- signalling & telecommunication works



- building works
- fencing
- electrification
- commissioning.

Catenary works, signalling and telecommunication works, electrification and commissioning entails:

- catenary works following the completion of track works, excavation of catenary
 pole foundations will be undertaken through use of a mobile drill rig. Catenary
 poles will be anchored by concrete being poured into the drilled foundation and
 under the catenary pole base plate. Catenary system takes electricity from the
 TANESCO transmission/distribution system (see electrification below) and
 distributes this along the railway alignment to power the trains, signalling and
 other electrical requirements for the railway system. Catenary works are also
 referred to as overhead traction lines
- signalling & telecommunication works excavation of trenches will be done along the proposed project alignment, following which high-density polyethylene (HDPE) pipes will be installed. Underground signalling and telecommunication cables will be installed within these pipes. Mobile communication towers will also be installed
- electrification TANESCO will be responsible for supplying electricity that will run the trains. Electricity will be provided close to the line from the towers inked to stations where it will then be connected to line towers
- commissioning following the completion of the above-mentioned activities the project will be commissioned.

Train speeds will be 160 km/h for passenger trains and 120 km/hr for freight. The trackform will be ballasted track on foundations/embankments and on bridge underpass and overpasses. There are no tunnels or viaducts proposed.

4.1.4.8 Construction of stations and marshalling yard (including ancillary structures, services and utilities)

The project also requires additional land outside the ROW to accommodate various supporting facilities. These facilities include stations and siding/passing loops and marshalling yard (Table 4-5), each serving different operational purposes and requirements.

Stations vary in size, categorized as major, medium and small stations. Major and medium stations are equipped with essential amenities such as ticket offices, waiting rooms, and parcel and baggage services. From an operational standpoint, the primary distinction between major and medium stations lies in the fact that trains will board and disembark passengers from platforms adjacent to the main track.

Major stations are designed to handle multiple tasks including train shuttling, offloading, loading of high volumes of cargo and servicing workshops. They have separate sections for passengers and freights. Medium stations accommodate mass passenger traffic and medium-sized cargo without freight facilities, featuring multiple tracks and no servicing workshop. Small stations, classified as halts, serve few passengers in small townships with basic amenities, offering train stops with weather protection and vandal-proof seating. They are equipped with water tanks for remote water supply and utilize septic tanks for wastewater discharge.



The construction of stations and a marshalling yard, along with their associated ancillary structures, services and utilities, is a crucial aspect of railway development. These facilities serve as vital hubs for the efficient operation and management of the railway system. Stations provide platforms for passenger boarding and alighting, ticketing services, waiting areas and other amenities. Similarly, the marshalling yard plays a pivotal role in the maintenance and repair of trains, organisation and coordination of train movements, allowing for efficient sorting, assembling and dispatching of freight trains. These facilities are fundamental to the overall functionality, convenience and success of a railway system. The yard will have its own utility supply systems, including water and electricity, as well as designated areas for vehicle parking and storage of small cargo. The marshalling yard will incorporate specific facilities such as a tank washing point, a shed for shunting trains, a wheelset store shed and an air blower studio. Moreover, living quarters, spaces for businesses, washrooms and offices will be provided to cater to the needs of the personnel operating within the yard. The marshalling yard will incorporate specific facilities such as a tank washing point, a shed for shunting trains, a wheelset store shed and an air blower studio. Moreover, living quarters, spaces for businesses, washrooms and offices will be provided to cater to the needs of the personnel operating within the yard.

4.1.4.9 Spill containment and management

Construction sites involve the handling and management of a number of pollutants, namely hazardous materials, including fuel, solid waste, wastewater and concrete. Thus, spill containment and management are critical components in pollution prevention. Procedures for emergency preparedness and spill response are discussed further in the ESMP. The ESIA further assesses potential impacts of slips and pollution, as well as the handling of resultant contaminated materials.

4.1.4.10 Service/maintenance and emergency repairs of heavy equipment/plant and light vehicles, metal works, coating and painting

During project construction, there will be a need for maintenance and emergency repairs of heavy equipment, plant and light vehicles. There will be mechanical workshops at each camp. In Manyoni section there will be an additional workshop at the Manyoni batching plant site.

Metal works, coating, and painting of steel structures will be done to protected against corrosion. The protection coating shall be suitable for a minimum period of 15 years for the exposure conditions on the site.

4.1.4.11 Laydown/storage of materials, storage of dangerous and hazardous materials

All dangerous and hazardous materials will be stored at the designated, secured, impermeable area at camps. Hazardous materials which are used for concrete production will be stored separately in the batch plant area. Materials will be stored in their original bins and labelled with material name and appropriate hazard warnings. Storage areas will be provided with suitable secondary containment to prevent spills. Adequate fire protections and spill kits will be in place. Hazardous material storage areas will be inspected monthly.

4.1.4.12 Movement of vehicles and plant

During project construction, there will be movement of heavy vehicles and plant equipment for excavation, grading and track laying as well as transportation of workers. These activities pose potential environmental and social impacts, such as:



- soil erosion and sedimentation: the movement of heavy vehicles and plant equipment can cause soil erosion, which can lead to sedimentation in nearby water bodies, affecting water quality
- noise pollution: use of heavy equipment, which can generate high levels of noise, causing disturbance to nearby receptors
- air pollution: the movement of vehicles and plant equipment can result in the emission of dust and other pollutants
- traffic congestion: heavy vehicles can cause traffic congestion, as well as put pressure on the existing road infrastructure
- safety of workers and the general public: the movement of vehicles and plant is a risk for collision and accident with public property, wildlife and livestock and people, potentially resulting in costs, injury and death.

Impact associated with movement of vehicles and plant have been further addressed across several environmental and social themes in the baseline and impact assessment chapters.

4.1.5 Generation and disposal of waste and wastewater

Waste types that will be generated by the project during construction will include, *inter alia*, the following key types:

- general / domestic
 - o overburden/ spoil soils and biomass (from vegetation clearance)
 - demolition wastes (demolition of housing and other household/farm structures made of mud, grass and brick)
 - o construction wastes (concrete, damaged materials, packaging)
 - o office/ commercial wastes (paper, packaging)
 - o domestic wastes (including waste food) at campsites
 - o garden/ yard wastes
 - o scrap metal
- hazardous wastes
 - garage and workshop wastes (waste oils, lubricants, grease, soiled rags, containers, filters, waste tyres, batteries)
 - contaminated soils (from sites where oils and chemicals are used and spills could occur)
 - medical wastes (infections wastes, sharp objects, chemicals/ medications)
 - o wastewater sludges (from sanitation facilities)

Wastewater that will be generated by the project will include, *inter alia*, the following key types:

- grey water, runoff water, contaminated storm water
- sewage water

Waste management activities will include, inter alia:

 reuse – overburden will be reused where possible for fill or levelling of disturbed sites



- recycle –demolition wastes are potentially recyclable/reusable by communities or used as cover material at local landfill sites; a high proportion of office and domestic wastes are recyclable (packaging, plastics, paper, glass, tins) and will be collected and separated at dedicated waste areas in camp sites
- solid wastes that cannot be re-used or recycled will be collected on side and removed to local waste facilities run by the local government authorities (LGAs)
- onsite wastewater (campsites and stations stations) will involve the use of septic tanks and soak aways, and once full the sludge from the septic tanks will be emptied and disposed of at local government facilities

It has been identified that the local governments capacity to accept solid waste and sewage sludge is not sufficient to support the project and the project will assist with the establishment of new areas for solid waste disposal and sewage sludge drying. The following is therefore planned:

- overburden, spoil: will be spread at the oil dumpsites discussed in Section 4.1.3
- recyclables and hazardous wastes will be removed by a certified waste management company for management (reuse, recycling or disposal)
- remaining solid waste will be disposed of at municipal dumpsites

The dump sites and capacity referred in Section 4.1.3 purely refer to the spoil materials that cannot be used during cut and fill operations. These are dealt with separately from the normal waste stream.

The ongoing management of waste and wastewater during the operational phase will be an extension of the processes and routines already established during the construction phase. The only exceptions will be where camps and other infrastructure will be removed or demobilised. In this event the result from the waste would be guided by the demobilisation plan.

4.1.6 Abstraction of water

Water abstraction refers to the process of extracting water from natural sources, such as groundwater, rivers and lakes for different uses where water is not adequately available. Water abstraction is achieved through different methods based on the intended purpose of use. This involves constructing water infrastructure to redirect and capture water.

Water will be sourced from ground water sources (wells/ boreholes) along the project ROW, but mainly at the camps. The contractor will acquire the necessary water use permits required for water abstraction before any abstraction. Furthermore, there are no permanent rivers in the project area and the available water sources are used by others including local communities, livestock, wild animals and the environment. Therefore, it is crucial to manage water usage effectively to maintain access to water for everyone while also preserving enough for the environment.

Water will be required for the following activities during construction:

- by earthwork teams required for compaction
- for concrete production
- for dust suppression along service and access roads
- water use in the camp sites.

The boreholes in Lots 3 and 4 that will be or have already applied for water use permits is summarised in Table 4-18. Volumes of abstraction proposed/permitted is also indicated in the tables where flow testing has been completed.



Table 4-18: Lots 3 and 4 water wells location

Water wells location and use					
ID	Use	Chainage	Section/ location	Lot	Flow Rate (L/sec)
EW WW 1	Earthworks	535+000	Section 1	Lot 3	5
EW WW 2	Earthworks	546+000	Section 1	Lot 3	-
EW WW 3	Earthworks	555+000	Section 1	Lot 3	-
MRQ WW1	Manyoni rock quarry	567+000	Section 1	Lot 3	2
MRQ WW2	Manyoni rock quarry	567+000	Section 1	Lot 3	DRY
EW WW 4	Earthworks	567+000	Section 1	Lot 3	DRY
MC WW1	Manyoni camp site	569+000	Section 1	Lot 3	3
MC WW2	Manyoni camp site	569+000	Section 1	Lot 3	1.25
EW WW 6	Earthworks	597+000	Section 2	Lot 3	1.25
EW WW 7	Earthworks	606+000	Section 2	Lot 3	-
EW WW 8	Earthworks	614+000	Section 2	Lot 3	-
IC WW 1	Itigi camp site	618+400	Section 2	Lot 3	2.77
IC WW 2	Yapiray Itigi production area	620+000	Section 2	Lot 3	2.77
EW WW 9	Earthworks	624+610	Section 2	Lot 3	5
EW WW 10	Earthworks	628+080	Section 2	Lot 3	4
EW WW 10A	Earthworks	629+800	Section 2	Lot 3	1.40
EW WW 11	Earthworks	638+000	Section 2	Lot 3	-
EW WW 13	Earthworks	654+000	Section 3	Lot 3	-
EW WW 14	Earthworks	668+000	Section 3	Lot 3	-
EW WW 31	Earthworks	678+000	Section 3	Lot 3	DRY
TUC WW 1	Tura camp site	681+000	Section 3	Lot 3	0.9
TUC WW 2	Earthworks	681+000	Section 3	Lot 3	-
EW WW 16	Earthworks	681+000	Section 3	Lot 3	DRY
TCS WW 1	Tura rock quarry	682+000	Section 3	Lot 3	-
TCS WW 2	Tura rock quarry	682+000	Section 3	Lot 3	-
EW WW 32	Earthworks	690+000	Section 3	Lot 3	-
EW WW 33	Earthworks	701+600	Section 3	Lot 3	-
EW WW 19	Earthworks	714+000	Section 4	Lot 3	-
EW WW 20	Earthworks	724+000	Section 4	Lot 3	-
EW WW 21	Earthworks	734+000	Section 4	Lot 3	-



Water wells location and use					
ID	Use	Chainage	Section/ location	Lot	Flow Rate (L/sec)
EW WW 22	Earthworks	748+000	Section 4	Lot 3	2.25
NC WW 1	Nyahua camp site	750+000	Section 4	Lot 3	DRY
NC WW 2	Nyahua camp site	750+000	Section 4	Lot 3	DRY
EW WW 23	Earthworks	754+000	Section 4	Lot 3	-
NCS WW 2	Nyahua rock quarry	762+000	Section 4	Lot 3	-
EW WW 24	Earthworks	762+000	Section 4	Lot 3	-
EW WW 25	Earthworks	774+000	Section 4	Lot 3	-
EW WW 26	Earthworks	784+000	Section 5	Lot 3	-
EW WW 27	Earthworks	794+000	Section 5	Lot 3	-
EW WW 28	Earthworks	803+500	Section 5	Lot 3	-
809RQ WW2	809 km rock quarry	809+000	Section 5	Lot 3	-
809RQ WW1	809 km rock quarry	810+000	Section 5	Lot 3	DRY
TPRO WW 1	Yapiray Tabora production area	812+000	Section 5	Lot 3	1.60
TPRO WW 2	Yapiray Tabora production area	812+000	Section 5	Lot 3	1.50
TPRO WW 3	Yapiray Tabora production area	812+000	Section 5	Lot 3	1.10
EW WW 29	Earthworks	814+000	Section 5	Lot 3	2
TC WW 1	Tabora camp site	816+000	Section 5	Lot 3	7
TC WW 5	Tabora camp site	816+000	Section 5	Lot 3	2
TC WW 4	Tabora camp site	816+000	Section 5	Lot 3	DRY
TC WW 2	Tabora camp site	816+800	Section 5	Lot 3	DRY
TC WW 3	Tabora camp site	816+900	Section 5	Lot 3	DRY
EW WW 35	Earthworks	821+000	Section 5	Lot 3	-
EW WW 30	Earthworks	824+000	Section 5	Lot 3	-
EW WW 36	Earthworks	828+000	Section 5	Lot 3	-
SAMOTA	Batch plant		Section 5	Lot 3	1
MY WW 1	Marshalling yard	836+000	Section 1	Lot 4	-
MY WW 2	Marshalling yard	836+000	Section 1	Lot 4	-
R850 WW 1	R/850 Rock quarry	850+000	Section 1	Lot 4	-
EW WW 1	Earthworks and Nzubuka station	856+400	Section 1	Lot 4	-



Water wells location and use					
ID	Use	Chainage	Section/ location	Lot	Flow Rate (L/sec)
NZC WW 1	Nzubuka camp	861+000	Section 1	Lot 4	-
NZC WW 2	Nzubuka camp	861+000	Section 1	Lot 4	-
EW WW 2	Earthworks	875+000	Section 1	Lot 4	-
EW WW 3	Earthworks and Ipala station	885+300	Section 1	Lot 4	-
R891 WW 1	R/891 rock quarry	891+000	Section 2	Lot 4	-
EW WW 4	Earthworks	895+000	Section 2	Lot 4	-
R908 WW 1	R/908 rock quarry	908+000	Section 2	Lot 4	-
EW WW 5	Earthworks and Bukene station	914+160	Section 2	Lot 4	-
BUKC WW 1	Bukene camp site	918+000	Section 2	Lot 4	1.1
BUKC WW 2	Bukene camp site	918+000	Section 2	Lot 4	1.1
EW WW 6	Earthworks	928+000	Section 2	Lot 4	-
EW WW 7	Earthworks	940+000	Section 2	Lot 4	-

4.1.7 Demobilisation (removal of redundant/temporary structures/features, closures, stockpiles)

Demobilization of temporary structures will be done for proper restoration of the sites (e.g., removing/spreading topsoil piled along the railway, restoration of borrow pits to the required grades, removing all temporary structures etc.). Depending on the agreement with the client and authorities, camps may be left for the local communities to use. Other activities include:

- demobilization of the workshops and stockpile yards
- demobilization of camps at least to the original site condition
- clearance of waste including used oil, sewage, sewage, solid wastes (plastics, wood, metal, papers, etc.)
- deposition of all waste to the authorized dumpsite
- restoration of water ponds and temporary quarry sites to a natural and useable condition and termination of temporary employment.

4.2 Operational phase

4.2.1 Operational - general

The operational usage of Lots 3 and 4 is expected to commence after the construction works and will be operated by an operator designated by TRC. The design validity period is 60 years, after which re-laying of new rail may be necessary. Operation will involve transportation of goods and passengers, whilst observing all measures that will be



provided in the management plans including safety-related aspects. During the operation time, TRC will undertake routine maintenance.

The railway will be electrified. Locomotives will be powered by 25 kV MV. For this purpose, nine traction power substations (TPS) and 34 auto transformer substations (ATS) will be required (refer to Section 15 for further information on ATS). The necessary 220 kV high voltage transmission line supplying power to these substations will be provided by TANESCO.

A global system for mobile communications will comprise railway (GSM-R) base stations and signalling system with fibre optic cables and shall be installed throughout the SGR line.

Operation of the SGR and the workforce required during the operation phase will belong to TRC.

The SGR is expected to transport containers, bulk and liquid loads carried via freight trains.

Sewage from the trains shall be discharged at the main stations. These stations will be connected to the local sewerage system or dedicated sewage treatment plant or septic tank-soak away systems at the stations.

4.2.2 Railway service operation

It is initially planned that 24 trains (20 freight and 4 passenger trains) will be using the SGR line during normal operations over 300 days in a year. During the remaining 65 days per year, traffic will be reduced slightly to 20 trains (16 freight and 4 passenger) to enable TRC to carry out routine maintenance activities on the line.

The proposed SGR will accommodate the following locomotive movements:

- **passenger train locomotive routing:** Electric Locomotive (3,000 HP) to take on the passenger train locomotive routing between Dar es Salaam and Makutupora.
- <u>freight train locomotive routing:</u> Electric locomotive (6,500 HP) to take on the freight locomotive routing between Dar es Salaam and Makutupora.

Table 4-19: below shows the proposed types of locomotives to be used.

Table 4-19: Rolling stock types and descriptions

Rolling stock	Description/type	Number required
Eroight trains	Electric locomotive 6,500HP	14
	Diesel locomotive 6,500HP	2
Departmental trains	Electric locomotive 6,500HP	3
Departmental trains	Diesel locomotive 6,500HP	2
Electrical multiple units	Capacity1800 passengers	5
Dessenger seeshes	Coaches class 1	15
Passenger coaches	Coaches economy class	45
	Flat wagons	600
Freight wagons	Box wagons	500
	Oil tankers	200



Rolling stock	Description/type	Number required
	Double stack containers	50
	Bulk wagon	50
	Gondola wagon	70
	Ballast hoppers	60

4.2.3 Maintenance of fencing of ROW

Regular inspections of the fencing will be conducted along the railway tracks to identify any damages. Inspections will assess the condition of the fence and determine if any repairs are required or replaced. Vegetation control will be conducted to ensure that overgrown bushes and trees maintained along the fence line of the ROW.

Warning signs and safety information will be placed on the fencing to alert the public about the dangers of trespassing on railway property. The local community will be trained about the potential dangers of trespassing crossing the SGR. Engaging with the community can help raise awareness and reduce the likelihood of unauthorized access.

4.2.4 Marshalling yard, workshops – operation and maintenance

During the operation of marshalling yard and workshops, various activities will take place to enable smooth functioning and adherence to safety measures. These activities encompass train reception and shunting supervision, train sorting, attachment of outgoing engines, railway track maintenance, rolling stock maintenance, provision of accommodations for workers, storage of materials and equipment, as well as waste management (UDSM ESIA, 2022).

Additionally, TRC will carry out routine maintenance tasks during operation hours to ensure the continued reliability and functionality of the marshalling yard and workshops. By effectively managing these operational activities and maintaining a strong emphasis on safety and maintenance, the marshalling yard and workshops will contribute to the overall success and efficiency of the project.

4.2.5 Quarries and borrow pits

The majority of borrow pits and quarries will be closed once the short-term construction concludes. A few might remain open to provide ballast for maintenance. Quarries and borrow pits will need to be rehabilitated and made safe. Open, steep quarries are high risk in terms of injury and drowning should people or animals enter excavations (dry or water-filled) intentionally or accidentally and cannot exit.

4.2.6 Waste and wastewater – operation and maintenance of waste separation/storage facilities, project dumpsites, wastewater treatment plants, septic tanks

Waste types that will be generated by the project during operation will include, *inter alia*, the following key types:

- general / domestic
 - o office/ commercial wastes (paper, packaging)
 - o domestic wastes (including waste food) at campsites
 - o garden/ yard wastes



- o scrap metal
- hazardous wastes
 - garage and workshop wastes (waste oils, lubricants, grease, soiled rags, containers, filters, waste tyres, batteries)
 - contaminated soils (from sites where oils and chemicals are used and spills could occur)
 - medical wastes (infections wastes, sharp objects, chemicals/ medications)
 - wastewater sludges (from sanitation facilities and septic tank system)

The ongoing management of waste and wastewater during the operational phase will be an extension of the processes and routines already established during the construction phase. The only exceptions will be where camps and other infrastructure will be removed or demobilised and stations will start to operate.



5 POTENTIAL ALTERNATIVES (ADAPTED FROM UDSM ESIA, 2023)

5.1 Introduction

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. During the tender process, the YM and TRC design team undertook the preliminary design of the project. The SGR alignment is designed to pass on/close to the RoW of the existing MGR, to limit resettlement and other impacts. Thus, to a large extent, the alignment of the proposed SGR from Makutopora to Isaka will run parallel to the RoW of the MGR. Some deviations were unavoidable, such as deviation from the MGR line to bypass Tabora and Manyoni towns. There are several other divergences from the MGR RoW along the route to reduce curvature.

The project is implemented under a design and build approach in which the contractor is limited to design and to construct the project according to the employer's requirement, which limits many possibilities of flexibility in some key project elements, such as routing.

However, subsequent to the tendering process, rapid E&S assessments was conducted. As a result, during the later stage of the design, which is the detailed design stage, the design team made efforts to consider the E&S aspects, as long as it was technically feasible.

Consequently, what is presented below, are general high-level alternatives that were already been considered and which may contribute to minimize the impact of the project on the environment and social receptors without having to conduct preliminary environmental and social assessment for each of the alternatives discussed.

Alternatives considered in the proposed construction of SGR from Makutopora to Isaka include the following:

- no project alternative
- improving the existing MGR railway line
- upgrading the existing Dodoma-Mwanza road to a highway
- alternative alignment
- alternative construction schedule
- alternative locations or design of key project aspects.

5.2 No project alternative

The "no project alternative" entails not undertaking the proposed project or part of its activities. It provides the baseline condition against which the impact of other alternatives can be 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. Adopting this option would have meant to retain the MGR on the portion between Makutopora and Isaka, whilst other portions from Dar es Salaam to Makutopora and from Isaka to Mwanza have been developed to the SGR level, which would be inappropriate.



The construction of the proposed SGR from Makutopora to Isaka will connect the SGR railway from Dar es Salaam to Mwanza and assist in unlocking north-western Tanzania and support the land locked countries of Rwanda, Burundi, Uganda, and South Sudan to have access to the port of Dar es Salaam. Connecting this portion with the SGR will also increase the capacity of the Tanzania railways and improve train speed, reduce travel time for passengers and goods, increase transport safety, and protect the environment. The "no project alternative" will result in Tanzania and the SGR missing out on these opportunities.

5.3 Improving the existing MGR railway line between Makutopora and Isaka

The alternative of improving the existing MGR between Makutopora and Isaka instead of constructing the SGR was considered. This alternative would have meant to accelerate and extend the on-going intermodal and rail development project, which focuses on the rehabilitation of the MGR track and bridges between Dar es Salaam and Tabora and extends to the portion between Tabora and Isaka. The planned rehabilitation is also intended to improve terminals in Isaka and Dar es Salaam port.

However, even with such benefits, the improvement of the MGR will not be comparable with the advantages the SGR will offer in terms of services and economic opportunities. The SGR will have a 35-t axle load, a design speed of 160 km/h for passenger trains and 120 km/h for freight trains, and a rail width of 1,435 mm (4 ft 812 in). The rail will be 60 UIC, with a maximum train length of 2000 m and a passenger capacity of 1,100,000/year. It is these advantages that have influenced the choice of the SGR vs. the MGR, which has a maximum speed of 80 km/hr and less capacity to carry heavy cargo. In addition, there is ongoing construction of the SGR from Dar es Salaam to Makutopora and between Isaka and Mwanza, thus necessitating the presence of SGR also for Lots 3 and 4, to fully realise the benefits of the SGR.

5.4 Upgrading the existing Dodoma-Mwanza Road to a highway

This option was considered during scoping as part of a wide range of alternatives the project could consider. This alternative is about improving the T3 (Dodoma – Singida) and T8 (Mwanza – Tabora) trunk roads to be able to carry more cargo and with greater weight. The current maximum allowable axle load limit on Tanzania roads is 56,000 kgs for a truck and drawbar trailer with 7 axles. The lowest allowable axle load is 18,000 kgs for a truck with 2 axles. Currently, the road is being used by many transport trucks carrying heavy cargo and the cost of maintaining the road is very high. In addition, the road is heavily used by transport trucks and other light vehicles. Therefore, it is expected that road accidents leading to loss of human life, livestock, and wildlife may increase as a result. This option cannot compete with the efficiency and capacity of the SGR both interms of carrying cargo, passengers, and the operational costs. Moreover, the completion of the proposed railway has the potential to reduce congestion of the highway, GHG emissions and reduce the relative number of accidents. This option was dropped and instead, the choice to develop the SGR was taken.

5.5 Alternative alignment

The proposed SGR line will traverse through different land uses. As such, it is important to consider the corridor with best viable options and with minimum impact but high benefit to both communities and the nation.



Alternative alignment for SGR Makutopora – Isaka was considered in areas where following along the MGR alignment could result in significant impacts such as physical displacement. In such areas, the SGR alignment has been moved. However, people living in such overlapping areas will be confined between the two lines making it challenging for them to pursue their livelihoods with ease and safety. It is therefore important to consider the alternative of relocating such people away from the overlapping areas.

5.6 Alternative construction schedule

Construction work for the portion from Makutopora to Tabora indicates that works will commence mid to late 2023 and continue to late 2026. Construction will include early works (geotechnical and mobilization works); earth and drainage work; structural works; track works; catenary works; substation works; signalling and telecommunication works; passenger station; and freight facilities. It is likely that multiple sections of the Lots 3 and 4 route will run simultaneously.

The timing of construction activities might impact existing socioeconomic and agricultural activities, especially seasonal activities. Pausing the construction process, to accommodate these activities, may be difficult and more costly than compensation for the temporary disruption. This will however need to be determined by the household surveys, assets valuation and livelihoods surveys currently being conducted by the TRC, which will be considered and incorporated into the resettlement action plan (RAP) and livelihoods restoration plans (LRP) that will be prepared and implemented by TRC before the start of construction.

5.7 Alternative locations of key project aspects

Prior of the initiation of the RSK ESIA (current report), preliminary considerations for location of some project aspects took into account the rapid E&S study conducted for the project and the USDM ESIA, 2023. Based on this, changes to project design as indicate in Table 5-1 were made to reduce potential impacts associated with these aspects. These alternatives were taken forward for assessment in the RSK ESIA. Additional information on design changes implemented to account for biodiversity aspects is included in 1.



Table 5-1: Design changes already made that took into consideration the rapid E&S assessment and USDM ESIA (2023)

Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change		
Lot 3	Lot 3						
Dumping Area	D-751	751+000	Area was cancelled	-There is a seasonal stream in the proximity of 30m distance. -The area surrounded by a water source that is used by villagers	Biodiversity Social		
Dumping Area	D-747	746+800	Area was cancelled	Distance of the settlements was close to the area Dump site was a wetland area	Biodiversity Social		
Borrow Pit	B-608	608+000	608+000 (same KM but vertical distance from the houses were increased)	Close distance of the houses	Social		
Borrow Pit	B-746-1	746+000	Area was cancelled	The area belongs to Tanzania Forest Service (TFS) and it is Nyahua Forest Reserve Area which has some special trees that is used for the medical treatment by the communities. The area was cancelled after the consultation was undertaken with TFS.	Biodiversity		
Borrow Pit	B-766	766+000	766+200	Close distance of the houses	Social		
Borrow Pit	B-691	691+000	691+400	Seasonal stream was within the borrow area	Biodiversity		
Borrow Pit	B-703	703+700	702+700	Close distance of the houses	Social		
Borrow Pit	B-603	603+200	603+000	Close distance of the houses	Social		



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
Borrow Pit	B-795	795+000	795+000 (same KM, vertical distance from the houses were increased.)	Close distance of the houses	Social
Borrow Pit	B-821	821+200	821+200 (same KM,vertical distance from the houses were increased.)	Close distance of the houses	Social
Camp	Nyahua Camp	748+000	750+000	The preliminary area belongs to TFS which has special medical trees. Additionally, the size of the camp has been decreased from 300,000 m2 to 263,659 m2 to reduce the E&S footprint of the project.	Biodiversity (Forest reserve area)
Camp	Manyoni Camp	569+000	-	The size of the camp has been decreased from 300,000 m2 to 223,745 m2 to reduce the E&S footprint of the project.	E&S
Camp	Tura Camp	681+000	-	The size of the camp has been decreased from 300,000 m2 to 267,660 m2 to reduce the E&S footprint of the project.	E&S



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
Station	Tabora station	(812+400- 830+000)	(812+400- 830+000)	Based on the findings of the E&S rapid assessment report, the location of Tabora station has been moved towards the northeastern outskirts of the town and alignment direction has been vertically changed after 812+400 to minimize the need for demolishing and resettling houses, services, and graves which may also be preferable in terms of connection with future SGR lines in Tabora.	Cultural heritage (chief graves), Social
Station	Itigi Station	611+620- 612+020	611+056.976- 611+456.976	Based on the findings of the E&S rapid assessment report, the location of Itigi station has been moved towards the eastern to get away from the flooding area and also to get closer to the town for the ease of access of the communities to the station during the operation phase.	Social
Station	Manyoni Station	568+400- 573+600	568+400- 573+600	Based on the findings of the E&S rapid assessment report, the location of Manyoni station has been moved towards the southern outskirts of the town to minimize the need for demolishing and resettling houses, services, and graves. Due to this change, alignment has been vertically changed between 568+400 and 573+600.	Social
Station	Malongwe Station	723+000	711+500	The location of Malongwe station has been moved to descending chainage to get closer to the town for the easy access of the communities to the station during the operation phase.	Social
Station	Tura	688+500	688+734	The location of Tura station has been shifted approx. 250m to get away from the flooding area	Social



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
Station	Goweko	768+600	768+869	The location of Goweko station has been shifted approx. 250m to get away from the flooding area	Social
Overpass	OP_01A	-	549+200.000	During the detailed design, an overpass has been provided for road crossing as per request of the engineer since there was no crossing structure at this section at the preliminary design.	Social
Overpass	OP_04	610+359.460	610+959.460	Overpass has been shifted to nearby Itigi Station for road crossing as per the request of Employer and Engineer for the ease of access of the communities to the station.	Social
Overpass	OP_05	687+700.000	688+300.000	Overpass has been shifted to nearby Tura Station for road crossing for the ease of access of the communities to the station.	Social
Overpass	OP_05A	-	710+914.000	During the detailed design, an overpass has been provided to provide access to Malongwe Station for the communities.	Social
Underpass	UP_01	567+333.114	567+333.114	As per the request of authorities, provisional road cell has been provided for future road expansion plans of the national authority. It is only structural change and there is no location change for the underpass.	Social
Underpass	UP_03A	-	624+630.020	As per the request by Employer, an underpass has been provided for the existing MGR level crossing which was not planned during the preliminary design.	Social
Underpass	UP_3B	-	628+704.172	An underpass has been provided to enable the connection to the existing MGR level crossing.	Social



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
Underpass	UP_04	650+018.000	648+268.000	Underpass has been shifted to more utilized road (which is closer to the village) through descending chainage as per engineer's request.	Social
Underpass	UP-05	668+450.000	668+855.000	Underpass has been shifted to nearby School area.	Social
Underpass	UP_06	-	802+635.000	At the intersection of SGR and MGR, an underpass has been provided to ensure the continuity of service road and cattle/pedestrian crossing.	Biodiversity Social
Underpass	UP-07A	-	813+700.000	An underpass has been provided for the future ring road planned by TANROADS.	Social
Underpass	UP_09	818+701.479	818+701.479	As per the request of authorities, provisional road cell has been provided for future road expansion plans of the national authority. It is only structural change and there is no location change for the underpass.	Social
Underpass	UP-11	823+489.263	823+489.263	As per the request of authorities, provisional road cell has been provided for future road expansion plans of the national authority. It is only structural change and there is no location change for the underpass.	Social
Bridge	BR_07	-	572+958.539	A bridge has been provided for both drainage purposes and wildlife crossing according to the UDSM ESIA report.	Biodiversity
Bridge	BR_08	-	585+328.584	During the preliminary design there was a livestock crossing (LS06) at this chainage. However, during the detailed design process, it has been observed that there is a need to construct a bridge at the same chainage. Therefore, LS06 has been reutilized for another location.	Biodiversity Social



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
				This bridge which was planned during detailed design process will allow the wildlife and livestock to cross the alignment and minimize the fragmentation impacts of the project.	
Bridge	BR_18	770+109.000	767+802.18	Bridge has been shifted to watercourse after the flood modelling study is completed which will decrease the flooding impact of the project on the communities.	Biodiversity
Bridge	BR_21A	-	800+867.4	A bridge has been provided to this location according to the findings of the flood modelling study which will decrease the flooding impact of the project on the communities.	Biodiversity
Dumping Area	D-581	581+500	581+500 (same KM but does not intersect with the village path due to the vertical change of the location of the area)	During the detailed design, it has been observed that the dumping area intersects with the village path. Therefore, the area has been shifted.	Social
Dumping Area	D-584	584+000	584+000 (same KM but does not intersect with the village path due to the vertical change	During the detailed design, it has been observed that the dumping area intersects with the village path. Therefore, the area has been shifted.	Social



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
			of the location of the area)		
Livestock Crossing	LS_01A	-	543+500.000	A livestock crossing is provided for pedestrian/livestock crossing as per request of engineer.	Biodiversity
Livestock Crossing	LS_03A	-	569+973.000	A livestock crossing is provided nearby Manyoni Station for pedestrian crossing as per request of Engineer.	Social
Livestock Crossing	LS_31A	-	712+493.000	A livestock crossing has been provided across the existing major MGR path as per engineer request.	Biodiversity Social
Livestock Crossing	LS_33A	-	726+426.920	A livestock crossing has been designed to provide access to forest areas for the communities as per engineer request.	Biodiversity Social
Livestock Crossing	LS_38	746+892.000	747+692.000	Livestock crossing has been shifted to nearby village	Social
Livestock Crossing	LS_46A	-	793+869.100	A livestock crossing has been provided for School access as per engineer request	Social
Livestock Crossing	LS_49	803+132.520	805+132.520	At the intersection point of SGR and MGR, Livestock crossing has been provided to ensure cattle/pedestrian crossing.	Biodiversity Social
Livestock Crossing	LS_50	-	809+144.000	A livestock crossing has been provided for the Tabora Region by the request of employer and engineer	Biodiversity Social
Livestock Crossing	LS_53	-	823+392.000	A livestock crossing has been provided for the Tabora Region by the request of employer and engineer	Biodiversity Social



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
Culvert	CU_581-1	-	581+846.68	During the preliminary design there was a livestock crossing (LS05) at this chainage. However, during the detailed design process, it has been observed that there is a need to construct a culvert at the same chainage. Therefore, LS05 has been reutilized for another location. This culvert which was planned during detailed design process are designed to minimize the flooding impacts of the project on the communities.	Biodiversity Social
Lot 4					
Dumping Area	D-751	751+000	Area was cancelled	-There is a seasonal stream in the proximity of 30m distance. -The area surrounded by a water source that is used by villagers	Biodiversity Social
Dumping Area	D-747	746+800	Area was cancelled	Distance of the settlements was close to the area Dump site was a wetland area	Biodiversity Social
Borrow Pit	B-608	608+000	608+000 (same KM but vertical distance from the houses were increased)	Close distance of the houses	Social
Borrow Pit	B-746-1	746+000	Area was cancelled	The area belongs to Tanzania Forest Service (TFS) and it is Nyahua Forest Reserve Area which has some special trees that is used for the medical treatment by	Biodiversity


Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
				the communities. The area was cancelled after the consultation was undertaken with TFS.	
Borrow Pit	B-766	766+000	766+200	Close distance of the houses	Social
Borrow Pit	Borrow Pit 891	891	Cancelled	Since there is a forest area at this chainage, the borrow pit is cancelled.	Biodiversity
Station	Ipala Station	886+318	882+396.462	The location of the station is shifted because the preliminary location was inside the Igombe forest area.	Biodiversity
Overpass	OP1-A	-	833+107	An overpass is designed for the communities by the request of the local authority.	Social
Underpass	UP06 (Ipala)	884+420	884+156	The location of the underpass has been changed to get closer to the village as per the request of local authorities during the stakeholder consultations.	Social
Underpass	Mwakashanhala- UP04-UP05	-	UP_04 KM:862+827 UP_05 KM:875+232	Livestock crossings are designed at these locations due to the request of community after the stakeholder consultations conducted and also as per the request of the Engineer.	Social
Livestock Crossing	Mwakashanhala- LS09	-	878+900	-	-
Livestock Crossing	Bukene and Mogwa-LS20	-	910+497	-	-
Livestock Crossing	Bukene-LS 20-A	-	915+072	-	Social
Culvert	Ipala CU-885-1	-	885+110	The requirement given below from ESIA has been taken into account and culverts are designed between km 885-888 to decrease the impacts of flooding on the	Social



Project Area/Structure	Name or Area of the Location	Preliminary Design (Km or Chainage)	Latest Design (Km or Chainage)	Explanation for the Change	Reason of the Change
				communities. UDSM ESIA Report - Flooding and soil erosion "Another area which is experiencing flood in the project area is in Ipala ward between chainage 885 and 888 km."	
Culvert	Ipala CU-887-1	-	887+329	-	Social
Culvert	Ipala CU-887-2	-	887+585	-	Social
Culvert	Ipala CU-887-3	-	887+697	-	Social
Culvert	Ipala CU-887-4	-	887+870	-	Social
Culvert	Ipala CU-887-5	-	887+929	-	Social



6 ESIA METHODOLOGY

The ESIA included the following steps:

- determine the spatial scope (area of influence, Aol). Defining the Aol will help further refine the scope of investigation planned. The Aol will be prepared for each environmental and social topic and will include the OECD Common Approaches definition of Aol. The Aol will use GIS as a tool to consider different environmental and social themes/topics in relation to proposed project activities and infrastructure.
- baseline studies (desk-based analysis and field surveys) to obtain enough information to characterise the environmental and social conditions. The ESIA upgrade study will use information in the existing ESIA process that has already been undertaken by the TRC's ESIA consultant, desk-top and third-party information, as well as primary data that will be collected in the field by various subject-matter experts.
- identification of project impacts and development of mitigation measures iteratively with the project planning and design (the process will continue through the construction phase). Project-only and potential cumulative impacts with other projects have been considered.
- collation of the mitigation and management measures into an environmental and social management plan (ESMP).

Stakeholder engagement has been undertaken throughout the ESIA process and results have been used to inform the ESIA.

The ESIA upgrade will be conducted in-terms of the LAS and will take the Tanzanian regulatory requirements into consideration. Note: an ESIA process and approval in terms of Tanzanian environmental legislation has already been undertaken by the TRC's ESIA consultant and will not need to be done as part of the upgrade. NEMC approval for the ESIA was obtained on 13 Mar 2023.

The ESIA process will include the following key activities, which are described in further detail in the following sub-sections:

- detailed project description
- description of the project Aol
- governance: assessment of regulatory and lender requirements
- specialist environmental and social baseline and impact assessments
- description/appraisal of stakeholder engagement activities and analysis of comments/issues raised
- integrated impact assessment and impact statement
- management and monitoring requirements.

6.1 **Project description**

A comprehensive but concise description of all the project components planned and the task/activities associated with the implementation of each component was developed (Section 4). Project components to be described include, *inter alia*, infrastructure, processes, spatial settings, resource requirements (including human) and emissions. The



project description will be supported with figures, maps, and concept diagrams that present locations, layouts, and process flows as applicable. Alternatives to project design, activities, and processes will be described.

The project description will be ordered in a sequential manner into sub-sections for each project phase, e.g., planning, pre-construction, construction, commissioning, operation, and handover/decommissioning (as applicable).

6.2 Project Aol

The first step of filling the gaps in the ESIA and describing the existing environmental and social conditions of the project will be to define the AoI, distinguishing between direct and indirect, which is described in IFC PS 1 as:

The area likely to be affected by:

- the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project
- (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location or
- (iii) indirect project impacts on biodiversity or on ecosystem services upon which affected communities' livelihoods are dependent.

Associated facilities, which are facilities that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

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.

Defining the Aol will help further refine the scope of investigation planned. The Aol will be prepared for each environmental and social topic and will include the OECD Common Approaches definition of Aol. The Aol will use GIS as a tool to consider different environmental and social themes/topics in relation to proposed project activities and infrastructure.

6.3 Governance requirements

Governance requirements refers to regulatory, Lender and cooperate governance requirements, and will include review and advisory on the following:

- Tanzanian regulatory requirements the ESIA process in terms of the Environmental Management Act (EMA) No. 20 of 2004, EIA and Audit Regulations, 2005, and its 2018 amendment has been undertaken. The project received an environmental certificate on 13 March 2023
- LAS this will include assessment of requirements in terms of World Bank Group Environmental and Social Framework, 2018, including IFC Performance Standards (1-8), 2012, General EHS Guidelines, EHS Industrial Sector Guidelines for Railways and any other applicable, Equator Principles IV (EP4, 2020) and OECD Common Approaches
- corporate governance identification of the project partners/key role players, and review of any available, applicable policies and plans related to the project.



6.4 ESIA and ESMP package

An ESIA report package will be prepared that will document the findings of the activities described above and will include an ESMP. The ESIA report will include topics such as:

- nature of undertaking process flows, materials, list of chemicals (source, types, and quantities), storage facilities, wastes/by-products (solid, liquid, and gaseous)
- project footprint and key design/technology information relating to size, volume, capacity, inputs/outputs, design parameters/specifications of proposed infrastructure and activities, size of labour force, equipment, and machinery
- infrastructure, activities, and ancillary infrastructure for all phases of the project (pre-construction, construction, commissioning, operations, demobilization/handover, decommissioning)
- utilities water (source, quantity) power (type, source & quantity), transport routes and site access, other major utilities (e.g., sewerage, gas, etc.)
- summary of the regulatory and lender framework and applicable permits, licences, authorisations, notifications and consents
- delineation of the AoI, which is the likely footprint (including activities and processes) to be affected by the Project (as described in IFC PS 1)
- mapping and satellite imagery, including land zoning, adjacent land-uses and proximity to nearest residential and/or other facilities, land ownership, environmental and social receptors/sensitivities
- baseline information gathered through specialist/expert desktop and field studies (see Section 7)
- identification of the type and nature of potential impacts, as well as the environmental and social receptors that may be affected, for further consideration in the ESIA process
- an evaluation of project alternatives, including a zero or no-project alternative in terms of project location, project design or technologies to be used, and a justification for selecting the chosen option (taking into consideration the access to social services, grazing land, water holes and markets).

The ESMP will be prepared outlining potential mitigation measures for each environmental and social impact evaluated and for possible alternatives. ESMP will be based on the legislative requirements and lender requirements. The ESMP will include (where possible) indicators/parameters, sampling locations, measurements, frequency, indicative costs (e.g., minor, significant, or major), and implementation responsibilities related to the monitoring of impacts in all phases of the project.

The ESMP will indicate what sub-plans will be required to be developed in subsequent phases of the project. Determination of costs of mitigation will need to be estimated. For the preparation of the ESIA and ESMP, the existing work of the ESIA consultant will be incorporated into the upgraded ESIA.



7 SPECIALIST/ EXPERT ASSESSMENT METHODOLOGY

The following section describes the methodologies for expert/specialist investigations undertaken as part of the ESIA upgrade.

7.1 Social

The supplemental assessment of the project's potential socioeconomic impacts was based on the processes described in the following sub-sections.

7.1.1 Review of relevant legislation, regulations, binding international conventions, and social performance standards

A review of the national legal and policy framework was carried out, with particular attention to socioeconomic aspects including (but not limited to) ESIA-stage stakeholder engagement, land tenure and acquisition, public health, safety, and security (HSS), worker influx, local economic development, and gender mainstreaming. The legislative review also identified the gaps between lender-prescribed social performance standards and relevant national laws and regulations about the ESIA process, related mitigation planning, monitoring arrangements, and permitting.

The list of reviewed policies, laws and regulations includes (but is not limited to):

- Community Development policy (1997)
- The Land Act No. 4 of 1999
- Village Land Act No. 5 of (1999)
- The Land Acquisition Act 1967
- National Health Policy (2007)
- National HIV and AIDS Policy (2001)
- National Women and Gender Development Policy (2000)
- The HIV and AIDS (Prevention and Control Act (2008)
- Public Health Act (2009).

International E&S Performance Standards factored into the review include the IFC Performance Standards 1,4,5,6,7 and 8. Other benchmarks include IFC, EBRD and CDC group guidance on gender-based violence and harassment (GBVH), World Bank Good Practice Note on addressing sexual exploiting and abuse and sexual harassment (SEA/SH) in investment project financing involving major civil work.

7.1.2 Stakeholder mapping

A stakeholder matrix was developed to demonstrate that all project stakeholders were mapped out for meaningful and continual engagement. This review drew on publicly available literature and mapping of the proposed project facilities relative to multi-level administrative divisions. In the context of impact assessment, stakeholder mapping aided the (i) collection of baseline information, (ii) identification of receptors, (iii) socioeconomic impacts analysis (considering expert and/or local knowledge), and (iv) consultative mitigation planning.



7.1.3 Consolidation and review of primary and secondary baseline information

Primary baseline information presented in Section 11 of this Report was garnered through ESIA-stage and RAP-stage socio-economic surveys, which entailed consultations with project-affected communities (at village/mtaa level) and entities subject to physical and/or economic displacement.

The ESIA-stage socioeconomic baseline study was undertaken within the project's primary 3 km influence area, between July and September 2022. The study involved a household survey, with a sample size of 271 households. The sampling strategy was set to survey no less than 40 households within each of the six project-affected districts. The sizes of the district sub-samples were subsequently adjusted such that they were proportionate to the districts' affected land areas. District-level purposive sampling was performed to demonstrate that the survey covered different settlement densities, agro-ecological zones and household sizes. The household survey was aimed at defining the baseline socioeconomic conditions within the project-affected communities, including existing socioeconomic vulnerabilities. Socioeconomically vulnerable households were identified based on the following criteria:

- households in which multiple members or the household are disabled
- households in which multiple members or the household are chronically sick
- households living in extreme poverty (i.e., under the national basic poverty line of TZS 49,320 per adult equivalent per month)
- female-headed households
- child-headed households
- households with an elderly household head (over 64 years).

The household survey was complemented with focus group discussions (FGDs) and key informant interviews (KIIs) to garner more elaborate information from local government authorities (LGAs) and key resource persons. Data gathered through the baseline study was collated and analysed, with reference to the following sources of supplementary information:

- field data from prior (ESIA-phase) socioeconomic survey
- field data from ongoing (RAP-phase) socioeconomic survey
- minutes of meeting from ESIA-phase stakeholder engagements including focus group discussions (FGDs) and key informant interviews (KIIs)
- original ESIA process report (2022)
- Resettlement Policy Framework (2022)
- indigenous people assessment report (2022)
- published literature and governmental reports (e.g. population and household census, agricultural census, epidemiological surveys, NGO reports etc.)
- list of planned construction and operational activities.

The scope of the baseline information analysis covered (amongst other aspects) local administration, demography, ethnic make-up and cultural context, economy, public infrastructure, access to social services, morbidity, socioeconomically vulnerable groupings, and social security (welfare) facilities.

Baseline information pertaining to community health, safety and security was also examined, in relation to the following:

• list of planned construction and operational activities



- environmental and social management plans and procedures from precedent SGR projects (SGR Lot 1 and Lot 2)
- lessons learned from HSSE risk management on precent projects within the transportation sector.

The RAP-stage socioeconomic survey was undertaken between October 2022 to July 2023, with total coverage of all Project-Affected Persons (PAPs) at the household/ institutional level. While certain advanced feasibility studies and enabling works had commenced in June 2022, the RAP surveys were completed prior to the start of full-on construction.

7.1.4 Identification of socio-economic components/receptors within the project's Aol

Baseline information and stakeholder inputs were analysed at the national, district and community levels to enable the identification and characterization of social receptors subject to the project's socioeconomic impacts. Potentially impacted social receptor groupings based within the project's Aol were identified, in relation to the inventory of planned activities and contingencies within the project's mobilization, construction and operational phases.

7.1.5 Characterization and assessment of potential impacts

The delineation of the project's impacts on various social receptors took stock of baseline socioeconomic information, stakeholder inputs and the regulatory context. A dedicated set of impact evaluation criteria was employed in the detailed assessment of impacts associated with project activities, for each phase of the project. The development of commensurate management measures to address these impacts sought to prioritize preventive measures for adverse social impacts and risks, over abatement means to mitigate any such impacts. Enhancement measures were also framed, with a view to augmenting the project's anticipated benefits.

With regards to potential impacts associated with land acquisition, the impacts analysis involved composite mapping whereby the footprint of planned project facilities (main and ancillary) was overlaid on (i) village boundaries, and (ii) prominent land-use clusters identified with reference to official GIS databases and ongoing resettlement surveys. The analysis served to yield the following information:

- sizes of land tracts to be acquired for the establishment of temporary and permanent project facilities (and relevant siting alternatives)
- number of affected villages and districts
- economic and residential utility of affected landholdings (including affected livelihoods, public land assets, and communal infrastructure)
- provisional counts and categories of potentially affected landowners and landusers (land rights holders)
- high-level description of existing land tenure (including formal and informal land ownership) within the project's footprint.

The assessment of potential physical and economic displacement further included a preliminary identification of disproportionally impacted (vulnerable) PAPs and their distribution along the project corridor. The significance of anticipated resettlement impacts was evaluated for different PAP categories and appropriate management measures were formulated accordingly. The impact analysis was purposive, and the scope of related supplementary information was contingent on the progression of



associated resettlement surveys and plans (i.e., resettlement action plan and severance management plan). In addition, the assessment covered potential livelihood impacts triggered by the incidental encroachment of non-project land and associated property damage.

7.1.6 Scope of the human rights impact assessment (HRIA)

The scope of the HRIA entailed a desk-based review and compilation of readily available information to:

- identify the actual and/or potential adverse human rights risks and impacts from the project. These includes the rights of:
 - formal, informal land users/settlers, and tenants (includes all those who will be economically and physically displaced)
 - o indigenous people
 - other vulnerable groups including female headed households, the elderly, project workers etc.
- understand additional studies including management measures and safeguards that will be required to mitigate potential risks and impacts concurrent to the ESIA and related documents.
- recommend enhancement measures on human rights opportunities during the project's life cycle.

7.1.7 Approach to the HRIA

The following approach was adopted:

- **review of local context:** This included the review of publicly available information to establish an understanding of the local and regional human rights that is pertinent with infrastructure development. This was supplemented through the data available.
- human rights due diligence: Prepared by UONGOZI Institute for and on behalf of the University of Dar es Salaam, for SGR Construction Project: Lots 3 and 4 (October 2022).
- internal engagement with Yapi Merkezi and TRC: On matters relating to human resources, security, livelihood restoration, and resettlement timelines vs construction schedule, grievance mechanism, and other related policies & procedures. This data was requested through the submission of a request for information (RfI) and meetings.
- **compilation of the human rights baseline:** This will be undertaken based on the review of the information and data available to 5 capitals. In addition, baseline information was also obtained from.
 - environmental and social impact assessment (ESIA, December 2022) (UDSM)
 - $\circ~$ draft resettlement policy framework (November 2022) (UDSM and TRC)
 - assessment of indigenous people potentially affected by the proposed SGR Project Lots 3 and 4 (December 2022) (UDSM)
 - $\circ\,$ outcomes and concerns raised during the past stakeholder consultations.
 - o indigenous peoples framework.



- identification of salient human rights impacts: This will be undertaken through the completion of an initial screening for human rights impacts. The topic areas included in the screening will be taken from the International Covenant on Economic, Social & Cultural Rights (ICESCR) and International Covenant on Civil and Political Rights (ICCPR).
- **qualitative risk assessment:** A qualitative assessment of rights at risk, the associated social and environmental impact, description of the rights holders as well as risks, and opportunities to the project will be developed. This will form the crux of the HRIA and the basis to identify embedded controls, and additional mitigation strategies that will demonstrate the project's commitment to respect human rights and to provide access to remedies for rights holders.

7.1.8 Standards, guidelines & approach to the HRIA

The following relevant regulations will be included in the HRIA:

- The Constitution
- Employment and Labour Relations Act, 2004
- Environmental Management Act No. 20 of 2004
- National Act of Eliminating Child Labour (2009)
- Law of the Child Act of 2009 revised in 2019
- Land Act No. 4, 1999
- Village Act No. 5, 1999
- Land Acquisition Act 1967
- Sexual Offences (Special Provisions) Act of 1998
- National Women and Gender Development Policy, 2000
- National Occupational Health and Safety Act, 2003
- Water Resources Management Act, 2009
- Public Health Act, 2009.

This will also include the core international human rights treaties ratified by Tanzania including the core fundamental conventions under the International Labour Organisation.

The following Lender's requirements will also be included in the HRIA:

- Equator Principles 4 (2020)
- IFC Performance Standards on E&S Sustainability (2012)
- ILO Fundamental Conventions including core conventions on labour
- United Nations Guiding Principles on Business and Human Rights (UNGPs).

7.1.9 Constraints

Foreseen limitations of this report are stated below and should be considered when reading the findings herein:

- time limitation is a major constraint as the HRIA must be prepared within less than two months and therefore the report has relied on outcome of consultations undertaken as part of the ESIA process
- as such this is not a detailed human rights impact assessment and does not include all the phases of a HRIA such as those from Danish Institute for Human Rights



7.2 Biodiversity

The biodiversity assessment was conducted by combining desktop studies and fieldwork for ground truthing and collection of data and information. The study draws upon the information with respect to the following:

- international, national, and regionally protected areas
- Aol and key biodiversity areas
- wildlife corridor assessment
- combining wet and dry season survey data
- ecosystem services consultations with local communities
- review of critical habitat screening (ref. draft habitat mapping and critical screening for Lots 3 and 4; RSK, December 2022).

7.2.1 Desktop studies

A review of publicly available studies and data regarding the ecological characteristics of the project sites was undertaken with the aim of gathering information on terrestrial and aquatic habitats, species abundance, richness, and ecological communities along Lots 3 and 4, to initially identify priority species and biodiversity hotspots within the AoI. Key literature sources and tools included:

- Tanzania fauna and flora legislation and policies and local development plans
- National Red List for Tanzania for the following taxa: mammals, birds, reptiles, amphibians, insects, and vascular plants
- flora of Tropical East Africa catalogue
- previous flora and fauna studies conducted in the project areas and regions by universities, research centres, NGOs and international organisations
- relevant international and national guidelines and performance standards, including the IFC Performance Standards and Equator Principles.

The integrated biodiversity assessment tool (IBAT) (www.ibatforbusiness.org) was used by UDSM in the identification of Protected Areas, and to build data and information on Key Biodiversity Areas (KBAs) (KBA status is triggered by the presence of key biodiversity criteria, informed by the IUCN Red List of Threatened Species. The KBAs are informed by several initiatives including Bird Life International's Important Bird Areas), Plant life International's Important Plant Areas and sites identified by the Alliance for Zero Extinction; Broad-scale conservation priorities, including Biodiversity Hotspots, Endemic Bird Areas and High Biodiversity Wilderness Areas.

IBAT was also used by RSK to undertake CHA Screening of the AoI using buffers of 1 km, 10 km and 50 km to provide a wider AoI and enable nearby and fringe sensitivities to be included in the assessment of impacts.

Complimentary existing databases and literature satellite imagery enabled mapping and categorisation of habitats and land use. Satellite imagery from ESRI 2020 zone 36 UTM LULC data (www.arcgis.com/home/item) as overlaid with point data of Lots 3 and 4. The points were input to handheld GPS (WGS 84 – UTM 36S), and mapping was done using GIS software (Arc Gis10.7.1 and QGIS 3.22.11).

The biodiversity assessment has been broadly based on natural and modified habitats (IFC 2012) but has subsequently been updated during critical habitat screening to include



critical habitat as per IFC PS6 updated guidance (2019) to determine the potential for criticality being triggered for habitats or species.

7.2.2 Field surveys

Biodiversity data and information was collected and verified over two seasons. The dry season fieldwork was undertaken between June and August 2022 (UDSM for TRC), with intermediate season habitat mapping November 2022 (RSK for Yapi Merkezi). Wet season sampling was undertaken in February 2023 (EcoTek for Yapi Merkezi). The dry season sampling was comprehensive and included establishing plots for data collection, whilst the wet season sampling was qualitative confirmation of temporal species occurrence determined by the increased availability of temporal wetlands and pools. Seventeen selected sample sites were identified for the wet season survey to include temporal wetland sites. Sites were purposively selected based on a wetland or riverine character (seasonal or permanent) b) purported wildlife crossing, and c) Itigi woodland. Selection points were established from mapping information (see Figure 7-1 below).



Figure 7-1: Wet season survey locations Lots 3 and 4

In the field, data and information were collected and reported using local knowledge surveys, questionnaires, walking transects and camera trapping. The detail of these for fauna and flora together with their findings is presented in the following subsections.

7.2.2.1 Local knowledge surveys

A local knowledge survey was undertaken along Lots 3 and 4 during the dry season surveys to assess and confirm the potential for the areas to support species of high conservation value and determine the length of the existing wildlife crossings and dispersal areas within the areas. Some 50 purposely selected households within the closest vicinity of the alignment were asked about the presence of wildlife in their areas



that included the large to small mammals in their respective areas to ascertain the potential inheritance of fauna within the ROW and surrounds. Of special interest, were identification of elephant crossings and dispersal areas that had been reported during scoping exercises. Apart from the local community consultations, the zonal offices for Tanzania Wildlife Authority and TFSA were consulted for confirmation and verification of information that was generated from local level and from site sampling. The data from community and zonal office levels was collected through a questionnaire.

During the wet season, further consultations were undertaken with local communities from 38 villages using questionnaires to collect the information (see Appendix 4, Biodiversity Annexes). The ecosystem survey questionnaire form is provided in Appendix 4.

7.2.2.2 Fauna

Large mammals

Large mammal sampling during the dry season employed various methods to collect the information, including walking transects, camera traps, and local knowledge surveys. These methods highlight wildlife species composition, abundance, and habitat utilisation in the project area (see Figure 7-2: and Figure 7-3:).

Local knowledge surveys confirm the potential of an area to support species of high conservation value and determine the extent of wildlife crossings and dispersal areas. A questionnaire was administered to 50 purposefully selected households within the vicinity of the alignment were queried about the presence of wildlife in their area. The questions included large and small mammals to ascertain the potential inheritance of Fauna within the alignment of ROW and its surroundings. Particular attention was given to identifying elephant crossings and dispersal areas to confirm the information gathered during scoping. In addition to local knowledge surveys, the zonal offices of the Tanzania Wildlife Authority and TFSA were consulted to validate the information from the field.

The supplementary wet season survey also consulted with the communities living close to the surveyed locations to obtain feedback on elephant crossings, other large wildlife and ecosystem services.

Walking transects

During the dry season, transects were set, according to Margoluis et al. (2009) into two sections separating the proposed SGR line (project impact zone) and control zones (minimal project influence). Two control zones were placed 100 m away from the project impact zone on the left and right of the proposed SGR line. A walking transect of 1 km was established in both control zones (T2 and T3) and the project impact zone (T1). After setting the transects, the team walked along the transects observing direct and indirect signs of animal presence in all directions. Observation included live animals, faeces, footprints, and fur. A total of 45 walking transects were conducted along Lots 3 and 4. Furthermore, opportunistic transects were conducted when interesting observations were encountered outside the designated transects but within the project area. The same approach was used for project-associated facilities such as the borrow pits, quarry sites and stations. During the wet season, large mammal surveys were limited to consultation with stakeholders (local communities) and the authorities to confirm priority wildlife corridors and habitats to be avoided to limit fragmentation. Specific questions were used to determine the frequency and timing of African Elephant movement across the project corridor, including seasons, the number of crossings, the size of herds, and movement during the day/night.





Figure 7-2: Large mammals sampling points for both opportunistic and systematic Makutopora – Tabora

Courtesy: UDSM ESIA (2023)

Camera trapping

Camera trapping involves the opportunistic deployment of cameras in areas with the potential presence of wildlife collected information on the possible presence of rare and/or cryptic species that are difficult to determine during daytime. Cameras were placed strategically along areas suggestive of animal trails. Others were set close to water springs to capture animals coming to water. Bushnell (browning trail cameras BTC-SHDP strike force HD Pro) cameras were used, which have an interval between photos allowing the minimum (rapid fire with no delay) photo bursts. All cameras were deployed for 20 trap nights. Camera trapping only established presence, and thus extended trap nights were not considered necessary. Photo analysis enabled species identification. Six cameras were deployed in Lot 3 and none in Lot 4, due to a high level of local interference from livestock grazing.





Figure 7-3: Large mammals opportunistic and systematic sampling points Tabora – Isaka

Courtesy: UDSM ESIA (2023)

Small mammals and herpetofauna

During the dry season, traps for small mammals and herpetofauna (amphibians and reptiles) were trapped using Sherman, Tomahawk and pitfall traps. A total of 50 Sherman and Tomahawk traps were placed 20 m apart in each sample site. Furthermore, bucket and cup pitfall traps were established 5 m apart, 11 buckets and 11 litre cups per habitat, trapping captured small mammals, amphibians, reptiles, and insects that are largely known to be nocturnal or crepuscular. The traps were set late afternoon and checked every morning and evening over 5 days at each site. Frequent checks avoided unnecessary killing of trapped animals common to those with a high metabolic rate that



needed to be released early enough (Resenberg and Anthony, 1993). Sample sites were selected based on features that would be attractive to the fauna such as rock kopjes, wetlands and miombo woodland and thickets. Two sites were in, or very close to, protected areas, one in Singida (Manyoni, Itigi, and Aghondi beekeeping reserve) and the second in Tabora (Tabora camp, Itulu quarry site, JWTZ forest and Igombe River/llomelo forest reserve).

During the wet season, amphibians were observed through scan searching by walking around or through quadrats systematically searching for the creatures. The searches were undertaken late in the evening (dusk) when the animals were more active.

All observed and captured species were identified in the field, and data was entered onto forms. The information recorded in the field includes point location (GPS), habitat type, and species identity (name - local & scientific). In addition, unidentified species from the field were preserved in 70% ethanol and further identified at the Zoology and Wildlife Department at the University of Dar es Salaam.

Birds

Bird surveys used both fixed-width point counts and opportunistic observations (Bibby et al. 2000; Bennun, and Howell, 2002 and Voríšěk et al. 2008). Point counts were placed along the proposed SGR line (within a 50 m radius during the dry season and 100 m during the wet season) and perpendicular (parallel) to the SGR alignment. Points were established at least 200 m from each other to avoid double counts. An estimated 30 minutes were spent counting birds at each sampling point. Sampling, at a selected point/count station, only started after allowing the birds to settle down. Species were identified by direct observations and signs of presence such as vocalisation, nests and feathers that indicated presence. The team was equipped with high-powered binoculars and avian field guidebooks to aid identification. The conservation status of each species was assessed using the IUCN Red List of Threatened Species (IUCN, 2022) and the National Red List for Tanzania (WCS 2019). The Tanzania Bird Atlas (TBA) (http://tanzaniabirdatlas.net/TZmap%20squarelists.html) and Reynolds, 1967 also provided further guidance.



Figure 7-4: Bird sampling points Makutopora – Tabora Section Courtesy: UDSM ESIA (2023)





Figure 7-5: Bird sampling points Tabora – Isaka Section Courtesy: UDSM ESIA (2023)



Aquatic fauna

Macro-invertebrates, fish and insects were sampled mainly during the wet season. The surveys were conducted within a 100 m radius of the SGR alignment in the 17 selected sample sites that were relevant to the faunal group.

Macro-invertebrates

Macro-invertebrates were collected using a modified d-net with 0.3 m deep and 500 µm mesh sizes attached to a metal frame with an area of 0.65 m and a handle of 1.5 m long. The team randomly selected three sub-sampling locations at each sampling site with each aquatic habitat type present. The riverbed was kicked upstream of the sampling net to collect dislodged macroinvertebrates from mud, stones, vegetation and other objects in water and those swimming in water columns. Material netted was emptied onto a white tray with little water, sorted and identified referencing general invertebrate textbooks and manuals of Gerber and Gabriel (2002) and Day et al. (2003). Unidentified samples were preserved and identified at the department of Zoology and Wildlife Conservation at the University of Dar es Salaam.

Fish

Fish sampling used seine nets for the surveys, and this was limited to riverbanks and shallow water. Fish caught were sorted and identified in the field according to the lowest taxonomic level based on the available field guides by Bernasek (1980), Eccles (1992) and Skelton (1993). Specimens were identified quickly and returned to their natural environment immediately if still alive. Those that died whilst trapping was preserved in 70% alcohol solution and taken as voucher specimens for the university laboratory. The geographic positions of fish sampling sites were recorded. Species identified were checked for listing under IUCN and CITES categories.

Insects

Insects were recorded by direct search and count in the sampling point and observation of suitable habitats or micro-habitats, especially for crawling and ground-dwelling species. The team used locally made sweep nets for flight interception at dusk to catch and identify flying insects.

7.2.2.3 Flora

Characterisation of vegetation types along the corridor and associated facilities for Lots 3 and 4 was done using Google satellite imagery, topographic maps and ground truthing. Ground truthing adopted the railway line chainage linked to geographic location to ascertain cover habitat. At each chainage, major vegetation types were identified using key species composition. Additional surveys were conducted at significant vegetation assemblages within the corridor, material sources (quarry sites, and borrow pits), dumping sites, proposed workers' camps, stations, and marshalling yards. Photographs were also taken during the wet season.

Plant species composition

Species composition in the baseline assessment (dry season sampling) considered an AoI up to 500 m on either side of the proposed SGR centreline. A total of 156 sampling points were established during the dry season following a Transect-Plot sampling technique. Points were established on encountering a change in vegetation within and between habitats. Plots were placed along transects of varying lengths at an interval of



100 m from the edge of each plot. Transect routes and sample area were identified based on desktop map analysis and a review of available data.

In miombo woodland, square plots measuring 20 x 20 m were used to inventory trees, while a nested plot of 5 x 5 m was used to sample saplings, poles, and mature woody species. Herbaceous plants, grasses and seedlings were recorded within 1 x 1 m plots nested in the 5 x 5 m plot. In wetlands, plots of 1 x 1 m were used to assess non-woody species (sedges, grasses, and herbs). Additionally, records were taken of notable plant species or communities encountered between the sampling points.

Photographs, field notes and GPS coordinates were taken at each site. The number of sample points along each transect route was dependent on the presence and size of highly sensitive habitats. The presence of plant species and their abundance was estimated using the dominant, abundant, frequent, occasional and rare (DAFOR) scale.

The vegetation at each site was described referencing the floristic and landscape features observed in the habitat types, the variation in the habitat structure, and species composition. Unidentified species observed during the fieldwork were collected, pressed, and allocated unique numbers for reference; and taken to the Herbarium in the department of Botany at the University of Dar es Salaam for taxonomical identification and confirmation of taxa using the Flora of Tropical East Africa books (FTEA). The conservation status of species was assessed in accordance with the IUCN Red List of Threatened Species (IUCN, 2018).





Figure 7-6: Flora sampling points along the SGR footprint Courtesy: UDSM ESIA (2023)

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Invasive species

Alien invasive species, defined as any introduced plant species (exotic) not indigenous to the survey area, were included in the compilation of all species. During the dry season the cover of the alien invasive species was estimated from the plots depending on the type. Their richness was estimated as the number of species encountered, and their percentage cover will determine relative abundance. GPS locations were recorded for all locations of alien invasive species. A qualitative survey of invasive species was undertaken during the wet season with site photographs.

Ecosystems services

Ecosystem services was assessed under IFC PS6 and its associated guidance note (2019) was used to design a questionnaire that was used for consultation purposes during the biodiversity surveys. The questions aimed to establish the level of importance of specified ecosystem services within the local communities. Two sets of questionnaires were developed and administered one for the dry season and another for the wet season.

Determination of ecosystem services provided by the habitat types present within Lots 3 and 4 was established by two methods, i) through consultative sessions using a checklist of issues upon which the communities were encouraged to give feedback regarding the project area versus the value that was placed on the area, and ii) through direct observation of activities, and nature of disturbance taking place within surveyed areas along Lots 3 and 4 and in the various proposed structures and facilities.

Critical habitat screening

Data collected from the dry and wet season biodiversity surveys were used in the review of potential critical habitat. The screening of critical habitat aligned with the triggers in IFC PS6 and was additionally informed by publicly available data and literature to establish a list of potential critical habitat trigger species. This was discussed with the local expert team and specialists from EcoTek and UDSM to demonstrate that any recommendations that potentially trigger criticality are justifiable and/or confirm if they require further surveys and assessment.

7.3 Indigenous peoples

IFC performance standard (PS) 7 on Indigenous People is triggered if a project area of influence (AOI) includes indigenous peoples, which is the case for the SGR Lot 3-4. In compliance with IFC PS 7, a project requires a specific plan to ensure that indigenous peoples are not negatively impacted by a project, and where there are impacts that these are appropriately mitigated. This is particularly important in terms of potential impacts on land, natural resource use and cultural heritage.

PS 7 also emphasises the need for indigenous peoples to obtain benefits from a project, where possible. In addition, PS 7 requires the development of ongoing communications between a project and the indigenous peoples, based on Free Prior and Informed Consent (FPIC).

The Plan, that has been developed:

- presents international and national standards and regulations for engagement with indigenous peoples in ESIAs
- describes the context of the indigenous peoples in the Project Aol
- identifies the Project impacts on indigenous peoples and proposed mitigations



- provides guidance for engagement with indigenous peoples in the Aol
- indicates the human resources and responsibilities for the execution of the Plan
- provides guidance for monitoring and evaluation of the activities outlined in the Plan.

The methods used for the compilation of this IPP are set out below. To compile the socioeconomic baseline and impact assessment for the indigenous communities, as well as to agree on the ICP and FPIC strategy in the AoI, both primary and secondary sources of information were used.

The results of the IP study and Plan are presented in Section 13.

7.3.1 Identification of the area of influence (AOI)

All villages (including their village lands and sub-villages) that included indigenous peoples3 and that were crossed by the proposed SGR line were identified for the AOI and therefore included in the study.

7.3.2 Secondary Sources

The socio-economic baseline, impact assessment and stakeholder engagement for the indigenous communities in the AOI is informed by:

- a review of the Environmental and Social Impact Statement for the proposed Makutupora to Isaka Standard Gauge Railway - 533 km (SGR Lot 3 & 4) in Singida and Tabora Regions, Tanzania compiled by the University of Dar es Salaam in February 2023
- a review of the Assessment of Indigenous People Potentially Affected by the proposed SGR Project in Lot 3 & 4 compiled by Valentin Ngorisa in December 2022. This report was based on:
 - consultation with diverse indigenous peoples' groups in the AOI of the Project, including village leaders, traditional leaders, traditional religious leaders, youth, women, and the elderly
 - Focus Group Discussions (FGDs) with community groups to gather information about the indigenous communities' perspectives and narratives on the Project in relation to their livelihoods
 - separate discussions with women to ensure that women Projectrelated concerns were included
 - Key Informant Interviews (KIIs) with Community Based Organisations (CBOs), representative of traditional leaders, representative of the Association of Livestock Keepers, and local government officials (Ward Executive Officers, Ward Councillors, Village Leaders).

In addition, information was gleaned from:

• the cultural heritage fieldwork undertaken in February 2023

³ Based on the review of the Assessment of Indigenous People Potentially Affected by the proposed SGR Project in Lot 3 & 4 compiled by Valentin Ngorisa in December 2022 and discussion with Yapi Merkezi community liaison officers (CLOs)



- minutes of meetings with indigenous peoples' representatives to discuss the acceptability of the Project proposed crossings
- exchanges with the contractor YM and other consultants working on the Project.

Data were obtained with regards to governance and decisions making structures, land, livelihood strategies, culture, spiritual and sacred sites, health, education, and security.

7.3.3 Primary Sources

A site visit was conducted during the period 26-31 May 2023 by RSK consultants accompanied by the YM community liaison officers.

The aims of the site visit were to:

- verify the presence of the indigenous peoples in the villages already identified as having indigenous people present, as well as assessing the potential presence of indigenous peoples in other villages in the Project AOI. This included assessing the level of integration of the indigenous peoples with other local residents in the villages and how and when the indigenous communities arrived in the area
- address the social baseline data gaps (e.g., demographics, land use, livelihood strategies, health, education, and security) identified in the draft IPP and obtain the necessary information to conduct a comprehensive assessment of socioeconomic impacts
- verify the existing cultural heritage sites and any potential additional sites
- discuss the potential impacts of the Project on the indigenous communities with the communities (community specific impacts for each community)
- jointly develop a process and mechanism for ongoing stakeholder engagement (in terms of the RAP and other mitigation measures) and to discuss the appropriateness of the grievance mechanism which has been developed for the Project
- obtain FPIC with regards to impacts on land, natural resources, and cultural heritage and the proposed mitigation measures.

To achieve this, the following tasks were undertaken:

- Preparation of field work including development of:
 - stakeholder engagement materials (see posters prepared in Kiswahili in Appendix 10.1) to provide information on the proposed railway crossings for livestock and people in easily accessible visual presentations
 - field guides and mobile applications to record GPS coordinates and photographic evidence.
- The communities (see Appendix 10.2 for the full list) were informed through the YM community liaison officers of a proposed meeting date and time and venue, and agreement was sought. The aim and agenda of the site visit were clearly explained. Care was taken not to propose meetings early or late in the day as this is not in line with cultural practice. Local government courtesy meetings were conducted by the Community Liaison Officers (CLOs) as required.
- A working day session was held on the 25th of May with the CLOs at Itigi camp to plan the field work and for the CLOs to share data and information where possible based on their knowledge of the communities and the Project.



The following activities were conducted in each of the Indigenous communities⁴ (see full list of communities in Appendix 10):

- General meetings where the Project, potential impacts, mitigation measures, proposed crossing points, and grievance management procedure were discussed. In particular the railway crossings and impacts on land and natural resources were discussed in detail. Participants were also asked about their experience with regards to the land acquisition and ESIA process, their preferred ways to raise a grievance, as well as their perceptions and expectations of the Project.
- FGDs with women and men, whereby participants were asked focused questions on their community, particularly around the topics of livelihoods, governance structure, health, education, customs and traditions, in order to create community profiles for each indigenous community.

In total the field work involved 86 participants (66 male participants and 20 female participants). Table 7-1 summarises the number of male and female participants broken down by project Affected Community (PAC) and indigenous groups.

Note that this site visit formed part of an overall ongoing stakeholder engagement process, where communities are kept abreast of Project progress and where their inputs are sought on a number of topics (See Appendix 10).

⁴ The Indigenous communities potentially impacted by the Project were first identified by Valentin Ngorisa as part of his impact assessment research conducted in 2022. These data were triangulated with other secondary data and confirmed during the May 2023 site visit



DAC	Taturu		Sandawe		Barabaig		Maasai		Total	
FAG	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Saranda	5		1				1		7	0
Makutupora	9	3		1			45		13	4
Mdunundu			2	2	6				8	2
Aghondi	6	2							6	2
Kitopeni	3	2							3	2
Itigi town	9								9	0
Kitaraka	2			1				1	2	2
Kazikazi	1		1						2	0
Karangasi	3	1	1	1					4	2
Tura	3	3	1						4	3
Malongwe			8	3					8	3
Total	41	11	14	8	6	06	5	1	66	20

Table 7-1: Number of participants broken down by PAC and indigenous groups.

5 The 4 male Maasai who attended this meeting live in Dabia which is a sub-village of Makutupora. Dabia is located 3km away from Makutopora. They come to Makutupora to see relatives, buy goods, sell animals, and farm products. They also rent vehicles to transport their animals to nearby markets and go to the dispensary.

6 On the day of the meeting, RSK was informed by the male attendees that women could not attend the meeting because they had some chores to do including cooking, fetching water, and going to the market.

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7.3.4 Recording and Feedback

The meetings and FGDs were recorded to ensure evidence of good faith engagement (minutes of meetings including attendance lists are provided in Appendix 10).

Figure 7-7, Figure 7-8, Figure 7-9 and Figure 7-10 below show examples of meetings conducted with IPs in May 2023.

During the meetings, notes about the areas used by the different indigenous groups for farming, livestock rearing and collection of natural resources such as honey and firewood were taken. These locations combined with the location of social infrastructure were compiled to produce PAC profiles for each community (see Appendix 10). These consisted of:

- an overview map showing the community area and its surrounding land
- a detailed map focusing on the centre of the PAC and the social facilities
- A total of 22 maps were produced (2 maps for each PAC), which show:
- the existing MGR train stations and crossings
- the existing MGR line and proposed SGR line
- the proposed SGR crossings (livestock crossings, underpasses, overpasses, bridges and culverts):
 - The livestock crossings, underpasses, overpasses, and bridges are labelled using the crossing ID used by YM. For example, LS_44 for livestock crossing, OP_01 for overpass, UP_04 for underpass, and BR01StartEnd for bridge).
 - The culverts are labelled based on their number and size. The first number corresponds to the number of culverts while the numbers in brackets correspond the size in meters of the culverts. For example, a culvert labelled "2 x (1.5x1.5)" means there are 2 culverts, each with a dimension of 1.5 meters.
- social facilities recorded during the site visit such as health facilities, schools, and religious buildings. Other social features such as water spring, watercourses are also shown.





Figure 7-7: General meeting with the Maasai, Sandawe and Taturu communities of Makutupora, 26th May 2023



Figure 7-8: General meeting with the Taturu community of Aghondi, 28th May 2023





Figure 7-9: FGD with Maasai and Sandawe women of Kitaraka, 29th May 2023



Figure 7-10: FGD with Sandawe men of Malongwe, 31st May 2023



7.4 Labour and working conditions

There are various regulations, standards and guidance that may be applicable for the client's environmental and social management performance derived from in-country laws and regulations and from international financial institutions (IFI's), principally the IFC Performance Standards, and specifically IFC PS 2 (labour and working conditions). In relation to the review of the client's existing labour related plans, together with the understanding of what mitigations the client has in place within its existing policies and plans and the potential impacts/ risks of the project, the most pertinent project requirements and guidelines being considered in our review are outlined in Section 17 as well as the documents listed below (Yapi Merkezi and TRC documentation).

- human resource policy
- disciplinary rules
- grievance registry mechanism training
- recruitment policy and technical assessment and training centre principles
- code of conduct procedure
- HIV/AIDS policy
- influx management strategy
- subcontractor and supplier management procedure
- subcontractor and supplier related forms
- health, safety, environmental, social and security (HSESS) requirements for subcontractors and suppliers
- subcontractor's workers' accommodation check list
- subcontractor audit check list (camp and trade areas)
- subcontractor evaluation form
- supplier evaluation form
- legitimacy of subcontractor and supplier firms (on labour law compliance)
- employment standards subcontractor and supplier labour laws compliance.

In addition to that TRC E&S Policy, version 02 and policy for prevention and response to gender based violence (GBV) that complement the above.

The above were reviewed against the backdrop of related requirements as stated above and within the context of the reviewer's extensive knowledge of and experience in the implementation of fit for purpose systems, policies, and procedures, as well as our knowledge of labour challenges specifically relevant to Tanzania.

The following additional key risks were also be reviewed, and Impacts associated with these will be identified and the client's policies and procedures examined to determine if they mitigate against these impacts, namely:

- expatriates
- accommodation and camps
- monitoring and reporting
- demobilization
- labour related grievance procedures in terms of international requirements, as well as the Tanzanian Employment and Labour Relations Regulations (2017).



7.5 Cultural heritage

The ESIA upgrade studies for cultural heritage were implemented through three strategies, namely desk-based review of literature, site field visits, and post-field follow-up for data analysis. The desk-based studies included reviewing the following documents:

- the Government of Tanzania's legal and policy issues about archaeology and cultural heritage, including living heritage
- previous ESIA studies prepared by UDSM (UDSM 2022 and USDM 2023)
- project information supplied by the client
- published and grey literature about the archaeology and cultural heritage of regions and districts that inform about the culture of the people, colonial history, chiefdom, developmental projects, and other related matters of the area where the railway will cross.

The field survey involved two strategies, namely meeting and talking with relevant stakeholders and conducting site surveys of sampled localities. The stakeholders the field team met, and held discussions with, included local government leaders, traditional healers, cultural officers in the districts, and key or respected elders in some of the nearby villages where Lots 3 and 4 cross. These stakeholders helped identify areas with potential cultural heritage sites, especially ritual sites, locations of graves and ancient settlements. They were also instrumental in providing narratives, histories, myths, and practices, which, in one way or another, helped to connect them with localities where cultural heritage sites would be located.

Site visits/surveys were mainly through ground walkovers at sample locations to understand the type of archaeological materials exposed during the site cleaning. Due to accessibility problems and the time frame, walking along the line was not practicable. The vehicle-aided survey involved stopping at spots along the alignment every 20 and 30 km and walking 6 to 8 km from each spot.

Table 7-2: Provides a summary of the accomplished tasks and implementation strategies.

Phase	Tasks for gap-filling and methodology
Desktop study	• reviewing the published and unpublished references on the cultural heritage of the project area archives, libraries, internet and reports of previous assessments shall be used to accomplish this purpose
	 virtual and physical consultations with the ministry, region, district, and local authorities regarding state of the art on cultural heritage in the project area
	 use Google Earth and available maps to identify potential cultural heritage sites within the project Aol
	 identification of legal and policy documents guiding cultural heritage management in Tanzania
Field visits for ground truthing and locating new sites – both	 field visits are made to conduct surveys along Lots 3 and 4 and identify localities with signatures of cultural heritage GPS points for each identified heritage site are recorded

Table 7-2: Summarized	cultural heritage	methodology	(tasks and	implementatio	n
strategies)	-		-	-	



Phase	Tasks for gap-filling and methodology
tangible and intangible	 certain artefacts located at various sites are examined to understand their types based on what is already established by previous studies
Examination identified sites and artefacts	 the nature, extent, distribution, and chronology of artefacts are examined
	locations or site coordinates are recorded to produce maps
	 images or drawings of the artefacts are produced

7.6 Waste and wastewater

To align with the requirements of IFC PS 1 and PS 3 which govern the risks/impacts of waste and their corresponding best management practices the information included in this document was collected from secondary sources mainly via: client that has previous experience from construction of SGR Lots 1 and 2, consultation with client personnel and persons who visited the project site to conduct baseline studies including the ESIA undertaken by UDSM, applicable local legislation, guidelines and standards governing waste/wastewater and international guidance.

Activities that have a potential to generate waste including their categories were identified based on the IFC General EHS Guidelines and those specific for railways published in 2007, client information as they have experience from construction of SGR Lots 1 and 2; and past environmental studies experience of similar projects.

Estimation of waste quantities was based on generation rates prescribed in: Ministry of Water Design Manual Volume II for Sanitation Projects of 2020 and Investment Guide on Waste Management in Tanzania 2020, and National Solid Waste Management Strategy 2018; the client's experience in similar projects in Tanzania (SGR Lots 1 and 2) and local knowledge.

Mitigation and management measures outlined are based on local requirements specifically Environment (Solid Waste Management) Regulations 2009 as amended in 2016 and Environment Management (Hazardous Waste Control and Management) Regulations of 2021 and National Solid Waste Management Strategy 2018, IFC PS 3 guidance, client Waste management procedure, and local best practices that minimize impacts that are fit for the local context.

In summary, the following activities were conducted:

- identification of the waste streams at each key project component and phase and calculation of their quantities and description and justification of the adopted waste management system/procedures, including sludge and non-biodegradable wastes
- inclusion of a summary of the waste legislation and its relevance to the project waste impacts and respective management
- inclusion of the baseline waste generation, storage, collection, treatment and disposal systems/facilities available in the project area for both solid, liquid and hazardous wastes
- assessment of the impact of waste soil on topography and drainage including the justification for use of dumpsites by assessing cost effective alternatives and residual impact assessment



- assessment of waste generation and management of the impact and cumulative impacts in particularly for utilizing community dumpsites
- inclusion of waste management and monitoring in ESMP.

7.7 Hydrology and geohydrology

In accordance with IFC (2012) PS 1, the desk-based methodology to assess impacts upon groundwater and surface water is presented below.

7.7.1 Groundwater

7.7.1.1 Desk-based baseline study

Data will be collected from a range of secondary sources including geology and water departments at the University of Dar es Salaam and readily available data from the water resource department national database and Ministry of Water and Irrigation and other recognised and accredited sources. This information will be used to characterise the groundwater system within the AoI including depth to the water table, aquifer systems, aquifer vulnerability, sensitivity, groundwater-surface water interaction, groundwater quality, demand on groundwater, a list of all wells, groundwater abstractions, coordinates, name of owner, and any data on depth to groundwater.

The section in the baseline chapter of the ESIA will be prepared comprising descriptions of:

- a list of all secondary sources contacted, published reports, and data
- the aquifers within the AoI with names, formation names and ages, and characteristics and sensitivity as a receptor
- the water quality in the groundwater within the AoI and a summary of any recent data obtained from the relevant authority.

The data from the existing ESIA (2022) will be used as a basis for compiling the sections in the revised ESIA for the second and third bullet points above. Any gaps will be filled by this desk study.

A map will be prepared showing the abstraction points (based on above report) and the aquifer names and approximate boundaries.

7.7.1.2 Impact assessment:

The impact assessment will include potential impacts on groundwater from:

- groundwater abstraction for the project
- impacts to local water abstraction points within the AoI due to the construction activities.

7.7.2 Surface water

7.7.2.1 Desk-based baseline study

A list of streams, rivers, and other surface water bodies will be compiled. This will include the name of the river basin and department office and a map of each body or feature within the AoI and any stream and river crossings. The baseline will also include the characteristics of each surface water body, e.g., seasonal/perennial, summary of water



quality, name of organisation that monitors flow and quality, data on flow rates and flooding, abstractions. Where possible, data for both dry and wet seasons will be used from the existing ESIA (2022).

The baseline will also include the collection of the following desk-based surface water baseline data, depending on the sensitivity of the surface water bodies:

- any current hydrological studies undertaken by the design contractor for the project
- data, including literature at the Ministry of Water and Irrigation on the following:
 - o flow regime in watercourses
 - o community water use
 - flood magnitude and frequency at river crossings
 - o river channel morphology at river crossings
 - o river and floodplain hydraulics under flood conditions at river crossings
 - o river channel instability at crossings
 - o sensitivity of watercourses to potential contamination.

A section in the baseline chapter will be prepared comprising descriptions of:

- a list of all secondary sources contacted and published reports and data
- all surface water bodies and their characteristics together with a table summarizing their sensitivity to the project impacts
- any abstractions in the rivers and streams (details of permits, use and location and owner)
- the water quality in the surface water bodies with recent data from any authorities.

The data from the existing ESIA (2022) will be used as a basis for compiling the sections in the revised ESIA for the second, third and fourth bullet points above.

A map will be prepared based on the above data on the rivers and streams within the Aol and the basin names and boundaries.

7.8 Noise and vibration

The objectives of the noise and vibration impact assessment presented in the report are to:

- identify noise sensitive receptors in the Aol
- define suitable acoustic criteria for the project based on international and national standards and guidance
- determine prominent noise and vibration sources that will be introduced by the project during construction and operational phases
- preparation of a noise prediction model to calculate noise levels that may be experienced by sensitive receptors during construction and operation of the project
- assessment of predicted noise and vibration levels against the acoustic criteria
- consideration of acoustic mitigation measures to offset or reduce the potential for noise and vibration impacts
- assessment of residual noise levels following the introduction of acoustic mitigation measures.



At the time of assessment, there were several assumptions around alignment, plant and station layouts, finished landform and train movements. Therefore, it is not possible to provide a quantitative assessment for all aspects of the project. Using our experience of similar projects, the areas anticipated to have the greatest potential for impact have been considered and topics excluded. The following points document where topics areas have been excluded, along with justification.

- passenger road traffic Passenger train movements are limited to 4 per day across Lots 3 and 4. This limits the number of passengers accessing stations. Most passengers will access stations via foot, with a smaller number using public transport (including taxis, *bodaboda*, and *bajajis*). With the limited number of passengers, and various stations along the route, additional vehicle numbers around stations will be limited. Therefore, the potential for additional noise impacts associated with road traffic around stations will be negligible and has therefore been scoped out of the assessment
- sidings The specific details around siding layout, use and location are limited. In addition, the usage of sidings, due to the small number of daily train movements, will be low. Electric trains, even when idling generate far less noise than traditional diesel trains. Therefore, given the above factors, noise from sidings has not been quantified as part of this study, however simple best practice noise control has been considered for sidings
- marshalling yards The specific details around marshalling yard layout, use and location are limited. In addition, the usage of marshalling yard due to the relatively small number of daily train movements, will be low. Electric trains, even when idling generate far less noise than traditional diesel trains. Noise within the marshalling yard is likely to be limited to manual movement or mechanical movement activities, such as low-level maintenance and loading/unloading of wagons. Therefore, given the above factors, noise from the marshalling yard has not been quantified as part of this study, however simple best practice noise control has been considered
- borrow sites The location of borrow sites may change before construction begins and therefore a quantification of noise from each at a specific location has not been assessed. However, a generic assessment of all borrow sites has been undertaken to look at potential impacts, and possible required noise control measures.
- detailed barrier design Through the operation of SGR (rail movements) the noise levels have been quantified across various separation distances based on assumed calculation parameters. The number of dwellings impacted have bene counted. Noise control measures for operational rail movements are typically limited to Locomotive type, train movements, line speed, the use of acoustic screening (barriers, cuttings and tunnels), and receptor noise insulation. The only variable in each of these is the screening or insulation as locomotive type, speed and number are fixed. For the purpose of this assessment the specific location of barriers has not been identified due to limited information around the rail corridor (i.e. 3D rail corridor data). However, the number of dwellings requiring acoustic screening has been identified providing an indication of pre mitigation impacts and residual impacts. This also includes a methodology for barrier optimisations versus control of noise at receptor through the installation of noise insulation
- overhead line equipment (OLE) The layout and scheme of OLE has yet to be finalised therefore a generic installation method through construction has been assumed. Noise from electrical equipment can sometime generate noise through 'corona discharge', especially in humid conditions however this is limited where



voltage is low. Noise from corona discharge along OLE is typically very low and localised (<5 m) or not present at all. Therefore, the operational noise from OLE has been scoped out of this assessment

- cumulative impacts The SGR alignment route is proposed parallel to that of the existing MGR route. The MGR and SGR will not operate at the same time and therefore cumulative rail noise impacts will not be relevant
- maximum noise levels Noise exposure can be in the form of 'average levels' (energetic average) and/or instantaneous levels (maximum events). Maximum noise events are typically used to assess sleep disturbance where there are regular events. Given the proposed low number of train movement over a nighttime period (<8 at any receptor), the potential for maximum noise level sleep disturbance is negligible (see Section 15). Therefore, the focus of the assessment is on the 'average' noise levels at receptors for operational train movements
- public address voice alarm (PAVA) systems The noise associated with the operation of PAVA systems is beyond the scope of this study and will be looked at during detailed design. PAVA system design will be bespoke to each and every station and will be subject to meeting relevant safety guidelines for audibility and speech intelligibility. Intelligent design and orientation of speakers, and speaker choice will assist in reducing noise impact beyond station boundaries
- audible track warning alarms The noise associated with the operation of track warning systems (crossing alarms such as Yodalarms) is beyond the scope of this study and will be looked at during detailed design. Audible warning system design will be bespoke to each location and will be subject to meeting relevant safety guidelines for audibility. Intelligent design and orientation of alarm (Yodalarms), and speaker choice will assist in reducing noise impact beyond the rail corridor
- operational vibration During the movement of trains there is a potential for local vibration to be generated. The magnitude of vibration is dependent on several 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, the risk of high levels of vibration is limited. Vibration form train movements will be negligible due to the >30 m separation distance between the track and receptors. Therefore, for the purpose of the assessment operational vibration has been scoped out of the assessment.

The proposed alignment will include provision for the following elements, which will be connected along the route via an integrated system:

- main line between Makutopora and Tabora
- siding passing loops
- freight loading/ offloading facilities
- passenger stations
- marshalling yards
- borrow pits
- dumping sites
- ancillary infrastructure i.e. substations etc.

The SGR will operate 24 hours a day, 365 days a year with planned maintenance (for 5 hours per day).


7.8.1 Train movements and types

The train operations long the alignment include the provision for 4 passenger train movements and 20 freight train movements per day (total). In any worst-case hour, the total train movements would be 1 passenger train and 2 freight movements past any given point. The maximum passenger train line speed is 160 km/h and freight train line speed is 120 km/h. The speed limit when approaching stations is 80 km/h. The train model, type and speed are presented in Table 7-3.

Table 7-3: Train types

Train model	Train type	Speed kph
Mainline		
Main Stock: Hyundai Rotem RS Locomotives Alternative: HXD1C Locomotives	Freight	120
Main Stock: 8-car Hyundai Rotem MEU Alternative: SS9 Locomotives + 10 passenger coaches + 1 dining car	Passenger	160
Station Approach		
Main Stock: Hyundai Rotem RS Locomotives Alternative: HXD1C Locomotives	Freight	80
Main Stock: 8-car Hyundai Rotem MEU Alternative: SS9 Locomotives + 10 passenger coaches + 1 dining car	Passenger	50

7.8.2 Stations

The proposed stations for Lot 3 and Lot 4 are presented below.

- Lot 3:
 - o Makutopora (freight)
 - o Makutopora (passenger)
 - o Manyoni
 - o Itigi
 - o **Tura**
 - o Malongwe
 - o Goweko
 - o **Igalula**
 - o **Tabora**
- Lot 4:
 - o Nzunuka Station
 - o Ipala Station
 - o Bukene Station.

Further stations to be used as freight train loading/unloading facilities and passing loops along the route are as follows:

Agondi sidings



- Kazi Kazi sidings
- Tura Quarry sidings
- Nyahua sidings.

7.8.3 Marshalling yards

The marshalling yard in Lot 3 can be found west of Uyui. There is no marshalling yard located within Lot 4.

7.8.4 Infrastructure

In support of the SGR operations a number of ancillary components will be installed along the route. This includes the provision of 9 substations to be installed across Lots 3 and 4.

The specific installation details and layout of the overhead line for power of the locomotives has yet to be finalised. However, the installation of such has been included within the main construction works. This would require further refinement at detailed design.

Several accommodation camps will be created along the route to house the non-local workers required for the construction of the alignment. The camps are considered at the following locations along the route:

- Lot 3:
 - o Manyoni
 - o Itigi (main campsite)
 - o **Tura**
 - o Nyahua
 - o **Tabora**
- Lot 4:
 - o Nzubuka
 - o Bukene.

Access to the site will be through local existing roads and via the access road that will run in parallel to the alignment. It is anticipated that vehicular movements along the access road will be limited to maintenance requirements along the route.

7.8.5 Acoustic criteria

The acoustic criteria relevant to the assessment are set out in the sub-sections below. These have been derived from relevant national and international standards. Where not stated, it has been assumed that the criteria should apply externally. Tanzanian standards take precedent but where these are not available, relevant international standards have been applied.

Unless otherwise stated, daytime refers to the hours between 06:00 and 22:00, with night-time between 22:00 and 06:00.



7.8.5.1 Tanzanian standards

TZS 932: 2017

Tanzania Standard TZS 932: 2017 'Acoustic - general tolerance limits for environmental and occupational noise' specifies limits for environmental noise. The criteria relevant to the assessment are replicated in Table 7-4 and Table 7-5.

Table 7-4: Maximum permissible levels for general environment (TZS 932: 2017)

Essility	Noise limits (dB L _{Aeq,T})		
Facility	Day	Night	
Any building used as a hospital, convalescence home, home for the aged, sanatorium, learning institutions, offices. Conference rooms, public library, and environmental and recreational site	52	42	
Residential building	55	45	
Mixed (with some commercial, residential entertainment and places of worship)	55	45	
Residential and industry/small scale production and commerce	60	50	
Industrial area	70	60	

Table 7-5: Maximum permissible noise levels for mines, quarries, and surrounding areas (TZS 932: 2017)

Facility	Limit value (L _{max}) in dBC
For any building used as hospital, school, convalescent home, old age home / residential building	109
For any building in an area used for residential and one/more of the following purposes: Commerce, small- scale production, entertainment, or any residential apartment in an area that is used for purpose of industry, commerce or small-scale production	114

TZS 1471: 2018

Tanzania Standard TZS 1471: 2018 'Tolerance limits for environmental and occupational vibration specifies limits for general environmental vibration including air overpressure with a view to protect people against risk to their health and safety, and to minimize annoyance to people in residential premises and other sensitive sites exposed to vibration. Criteria relevant to the assessment are replicated in Table 7-6: Tolerance limit for ground vibration at sensitive sites (TZS 1471: 2018) and Table 7-7: Tolerance limit for subsonic vibration / air overpressure (TZS 1471: 2018).



Table 7-6: Tolerance limit for ground vibration at sensitive sites (TZS 1471: 2018)

Туре	Limit
Transient vibration	5 mm/s PPV at all times
Continuous vibration	0.63 m/s ² weighted RMS acceleration

Table 7-7: Tolerance limit for subsonic vibration / air overpressure (TZS 1471: 2018)

Facility	Limit
Sensitive sites	120 dB(Z) at all times

World Health Organisation (WHO) Guidelines

The national standards are derived from the World Health Organisation (WHO) Guidelines on Community Noise which in summary stipulate the following:

- maximum (LAmax) of 45 dB (internal) for no more than 10-15 single instantaneous events during a night-time period to avoid sleep disturbance
- internal noise level of no more than 30 dB(A) Leq, night within a bedroom.

The WHO guidelines stress the importance of events as much as the 'steady' noise environment when determining impacts of noise on sleep disturbance. This is the reason for the maximum noise criterion. In addition to the national standards Section 1.7 of the IFC Environmental, Health, and Safety (EHS) Guidelines 'General EHS Guidelines: Environmental' on noise management sets out criteria for assessing noise (operational noise only). In simple terms there are two sets of criteria which should be met:

- noise impacts should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site or
- exceed an upper limit shown above.

In terms of the maximum noise events (L_{Amax}) this has been excluded from the operational phase assessment) due to the limited number of night-time train movements (<8 at receptors), making the importance of this assessment criteria low. The averaging period of the L_{Max} metric is 1 minute and given the speed of proposed train movements, all trains will be past a receptor within 10-25 seconds. Therefore, only generating a single L_{max} per movement7.

IFC Environmental Noise Guidelines

The World Bank Group Environmental, Health and Safety Guidelines are technical reference documents with general and industry-specific examples of good international

⁷ Many studies have been undertaken around the world on sleep disturbance. The British Document ProPG: Planning and Noise – Professional Practice guidance on Planning and Noise (May 2017) provides a summary of general noise impacts through planning, albeit form a UK perspective but reference international studies including the WHO guidelines. Appendix A of the document provides a literature review on 'Noise Events'. The main conclusion from this is that the fewer the number of noise events, the lesser the chance of sleep disturbance. However the document does provide additional detail around rail generated events, advising that levels of up to 85 dB L_{Amax,F} for <20 events would not equate to significant effects on sleep disturbance. Therefore the scoping out of maximum noise events is considered to be valid. Actual levels in individual situations such as crossings, points should be considered at detailed design.



industry practice and are referred to in the World Bank's Environmental and Social Framework and in IFC's Performance Standards.

Section 1.7 of the document provides noise level guidelines to address impacts of noise beyond the property boundary of the facilities. Table 7-8: Noise level guidelines (IFC) replicates the limits provided in IFC Table 1.7.1.

Table 7-8: Noise level guidelines (IFC)

	One hour L _{Aeq} (dB) ^[1]		
Receptor	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			
¹ For acceptable indoor noise levels for residential, institutional and educational			

^[2] For acceptable indoor noise levels for residential, institutional and educational settings, refer to Guidelines for Community Noise, World Health Organisation (WHO), 1999.

7.8.5.2 Construction noise

The Tanzanian and IFC standards do not differentiate between limits for noise during operation of a development and the construction phase. Construction is temporary in nature, and therefore a higher threshold is commonly adopted for the assessment of impacts. This was reflected in the Environmental Management (Standards for the Control of Noise and Vibrations Pollution) 2015, which permitted up to 60 dB $L_{Aeq,T}$ during the day and 50 dB $L_{Aeq,T}$ at night for the most sensitive receptors. Notwithstanding this, the limits as proscribed within the current Tanzanian and IFC standards should be adopted as lower bound threshold for the onset of adverse impacts, to be achieved where practicable.

7.8.5.3 Adopted significance criteria

The sensitivity of receptors is presented in Table 7-9. It should be noted that the sensitivity of a receptor 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.

Source	Period
High	Residential properties, educational establishments, hospitals, places of worship, hotels, children's nurseries, nursing homes
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

Table 7-9: Receptor sensitivity: noise



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 Table 7-10 have been adopted for the assessment of magnitude of impact.

Based on the national and 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.

Source	Poriod	Significance			
Source	Fenou	Negligible	Minor	Moderate	Major
Construction poico	Day	< 55 dB L _{Aeq,T}	55 – 60 dB L _{Aeq,T}	60 – 65 dB L _{Aeq,T}	> 65 dB L _{Aeq,T}
Construction hoise	Night	< 45 dB L _{Aeq,T}	45 – 50 dB L _{Aeq,T}	50 – 55 dB L _{Aeq,T}	> 55 dB L _{Aeq,T}
Operational paise [12]	Day	< 50 dB L _{Aeq,T}	50 – 55 dB L _{Aeq,T}	55 – 60 dB L _{Aeq,T}	> 60 dB L _{Aeq,T}
Operational noise [1,2]	Night	< 40 dB L _{Aeq,T}	40 – 45 dB L _{Aeq,T}	45 — 50 dB L _{Aeq,T}	> 50 dB L _{Aeq,T}
Blasting ^[3]	All	< 1 mm/s PPV	1-5 mm/s PPV	5-10 mm/s PPV	> 10 mm/s PPV
Vibration	All	< 1 mm/s PPV	1-5 mm/s PPV	5-10 mm/s PPV	> 10 mm/s PPV
[1]	Operational noise criteria should be reduced by 3 dB for any building used as a hospital, convalescence home, home for the aged, sanatorium, learning institutions, offices, conference rooms, public library, and environmental and recreational site.				
:	a noise sensitive location, this is considered to be an indication of a significant adverse impact.				
[3]	Where air overpressure exceeds 120 dB(Z) at any time during blasting activities, this is considered to be an indication of a significant adverse impact.				

Table 7-10: Adopted significance criteria



The overall significance of an effect is determined by combining the sensitivity of the receptor and magnitude as presented in Table 7-11. 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.

Magpituda	Sensitivity of receptor / receiving environment to change			
Magnitude	High	Medium	Low	Negligible
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 7-11: Determining significance of effects

7.8.6 Baseline environment

7.8.6.1 Aol and receptor identification

Aol boundary

Aols apply to existing, planned new and upgraded construction access roads, sidings, marshalling yards, quarries, borrow pits, stations, substations, and the alignment.

The AoI for construction noise has been set at a 500 m radius and the operational phase has been set at a 200 m radius, based on review of engineering information and satellite images taking into consideration likely noise emission levels and to identify the location of potential receptors. The operational vibration AoI has been set to 25 m.

The planned stations, marshalling yards, sidings, substations, and the alignment are permanent and will remain operational over the lifetime of the project, so the temporal AoIs will be approximately 25 years. For the temporary construction access roads, quarries and borrow pits the temporal AoI is for the period of construction.

Study area boundary

The study area boundary is the same as the AoI boundary.

7.8.6.2 Sensitive receptors

The project size and quantity of receptors makes it impractical to predict noise levels at all potentially sensitive receptors closest to the alignment. At this stage individual receptor predictions is not warranted and will not add any more detail to the conclusions of this document. Therefore, using desk-based assessment methods and the results of the noise modelling and vibration calculations, the number of terrestrial sensitive receptors have been identified (both as a baseline and where there are impacts).



Terrestrial receptors (i.e. habitable, religious, educational and health care structures) have been from provided vector mapping data. There will be occasions where a structure may be identified incorrectly. However, where uncertain, the assessment assumes the structure is a sensitive receptor. These will be confirmed following a detailed social study.

The areas surrounding the alignment and ancillary infrastructure are a mixture of rural isolated dwellings, agricultural land, villages, and towns.

Additional noise and vibration sensitive receptors will be introduced temporarily during the construction phase of the development. This includes camps which contain areas for sleeping and rest for non-local workforce and are located east and west of the SGR running in parallel to the route.

While these have been used to identify assessment points, the location identified may represent multiple buildings in the area.

7.8.6.3 Baseline noise environment

A baseline noise survey has been undertaken at the closest sensitive receptors along the alignment. The survey included daytime and night-time noise monitoring at 29 locations representative of the closest sensitive receptors to the route and associated infrastructure. Attended noise monitoring was undertaken for 3 hours (daytime), where the field consultants noted down the noise sources contributing to the noise environment. Further unattended noise monitoring was undertaken for one night with the provision of a guard.

Although the environment changes through the proposed route, the noise sources are similar outside of villages and towns. The main sources of noise were noted to be:

- insects
- birdsong
- windblown foliage
- human interactions
- farming (livestock movements)
- noise associated with the existing MGR operations
- noise sources noted in more densely populated locations i.e. towns and villages were noted to include the following:
 - o human interactions
 - o vehicular movements
 - recreational activities
 - o birdsong
 - o farming (livestock movements)
 - o commercial activities in towns and villages
 - o noise associated with the existing MGR operations.

A technical baseline report will be issued following the findings within this technical document and will summarise noise levels from the monitoring period.

Through initial analysis of data, baseline noise levels across the study area are shown in general to be below project criteria. Therefore, the existing noise environment is unlikely influence the magnitude criteria, but it can often be used to provide context for the impact.



7.8.6.4 Baseline vibration environment

The existing vibration environment has not been quantified and no discernible sources of vibration were observed during the field survey. Receptors at risk of being exposed to vibration generated by the MGR will not be the same as those for the SGR, therefore no potential for cumulative vibration impacts.

In addition, vibration assessments are typically conducted against absolute criteria, rather than comparison to background. Therefore, baseline vibration measurements are not considered necessary.

7.8.7 Noise assessment input

7.8.7.1 Construction

The construction works will 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 from construction will be transient and any impacts short in duration before the works themselves move to the next section.

The exact working methodology and plant to be employed during the construction phase and worker's camp has not been established at this stage in the design. However, an initial estimate of the expected 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).

All construction activities are likely to be undertaken during daytime periods, however, this will need to be confirmed once the methodologies have been further defined during the detailed design phase.

For predicting the likely noise impacts associated with the construction activities, Table 7-12 presents the phases of the works considered.

Construction Activity ¹	Construction Hours ²	Activities	Method of Calculation ³	Temporal Use⁵
Early works	Standard	Site clearance and grubbing Site and camp establishment Access route construction	Generic	<2 years
Earthworks and civils	Standard	Earthworks and civils	Generic	<2 years
Signalling and telecommunications works	Standard	Signalling and telecommunications works	Generic	1-5 Years

Table 7-12: Construction activities



Construction Activity ¹	Construction Hours ²	Activities	Method of Calculation ³	Temporal Use⁵
Track works	Standard	Ballast and track laying Ballast distribution Ballast tamping Rock breaking	Generic	<2 years
Centenary works	Standard	OLE installation / catenary works	Generic	<2 years
Structure works	Standard	Foundations (piling) Foundations (concreting) Steel framework Culvert and bridge works	Generic	1-5 Years
Passenger station and freight facilities (building + signalling + telecom. + IT)	Standard	Mechanical and electrical installations	Generic	1-5 Years

NOTES:

¹ Construction of rather than operation, other than specified

² The National Environment (Noise Standards and Control) Regulations 2003 do not specify daytime or night-time hours for construction although throughout daytime is referred to as 06:00-22:00, with night-time classed as 22:00-06:00. However under other international guidelines specific to Construction noise such as British Standard BS 5228 -1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites', standard construction hours are taken as Monday – Friday 08:00-18:00, and Saturday 09:00-13:00. Therefore, for clarity standard hours will be in line with BS 5228. Extended hours for the purpose of this document mean 24 hours a day potentially 7 days a week.

³Generic means the same noise emissions are expected across duplicate sites and the impacts can be assessed on a wider scale. Site specific means sites modelled and assessed on a site-by-site basis.

7.8.7.2 Commissioning

The noise from the commissioning phase will be equivalent or lower than the noise from the operational phase. Therefore, reference should be made to the operational assessment.

7.8.7.3 Operation

Table 7-13 below provides a summary of the primary noise sources associated with the operational phase of the project that have been considered as part of the assessment.



Table 7-13: Operational phase sources

Source	Noise level and description
Passenger and freight train operational assumptions	Train movements considered as mainline and station approach scenarios. Mainline Worst-case hour Day: 86.9 dB(A) at 0.5 m Night: 86.9 dB(A) at 0.5 m Average day Day: 83.0 dB(A) at 0.5 m Night: 82.3 dB(A) at 0.5 m Station approach Worst-case hour Day: 83.8 dB(A) at 0.5 m Night: 83.8 dB(A) at 0.5 m Average day Day: 80.0 dB(A) at 0.5 m Night: 79.3 dB(A) at 0.5 m
Passenger and freight train model and line speed	Freight Main Stock: Hyundai Rotem RS Locomotives Alternative: HXD1C Locomotives Passenger Main Stock: 8-car Hyundai Rotem MEU Alternative: SS9 Locomotives + 10 passenger coaches + 1 dining car
Line speed	Mainline Freight – 120 kph Passenger – 160 kph Station approach Freight – 80 kph Passenger – 50 kph
Substations	Each traction power station TPS substation is to be designed to achieve a sound pressure level of 75 dB(A) at 1 m. This considers the substation when on load. This also considers the substation working at 100% on-time.
Station fixed plant	Discussed in Section 7.8.7.3 In the absence of substation specification, the assessment approach to substations is to set design limits which will be below the significance thresholds. Therefore, it is assumed mitigation will be embedded into the design (through noise control or plant choice-low noise emitting), or through sympathetic siting/layout).
Operational traffic (maintenance only)	Assumes approximately 50 trucks per day. No more than 2 trucks along a road segment in a single hour.



7.8.7.4 Decommissioning

The decommissioning and construction processes will be similar, but in simple terms 'reversed'. The decommissioning processes will include the following tasks:

- campsite demolition
- quarry and borrow pits backfill.

Therefore, the noise levels associated with the decommissioning phase should be read as similar to the construction phase.

7.8.7.5 Traffic

Traffic movements associated with the operational phase will be associated with the maintenance of the alignment/infrastructure and passenger travel to and from stations.

In terms of operation vehicle movements associated with passengers, these are considered to be limited given the small number of passenger trains occurring on a daily basis. In addition, it is assumed that the majority of passenger will access stations via existing pedestrian routes, and a smaller number through other forms of public transport or taxi / boda-boda / bajaji. Therefore, noise associated with station related traffic movements is considered to be limited and has been scoped out of the assessment.

The service road runs parallel to the track, and within the rail corridor. Vehicle movements along this road will be limited to maintenance and service requirements. Due to the nature of the maintenance requirements i.e. ad-hoc and sporadic in nature, the operational phase traffic has been scoped out of the assessment.

Potential project traffic noise sources include the construction traffic (moving plant and materials). These will use existing, and new permanent roads. This section considers traffic noise associated with construction of Lots 3 and 4, rather than noise from the construction or upgrade of roads.

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 new haul roads (construction).

Traffic data are not available for most roads through Tanzania and therefore it is not possible to undertake a 'typical' quantitative noise assessment of existing roads. It is also difficult to assess the current conditions owing to the general surface, variance in gradients of roads used, high percentage of motorbikes, low flows⁸ and variance in vehicle usage. In a similar way, the possible traffic use on new permanent roads is difficult to estimate accurately for assessment purposes. Therefore, a qualitative assessment has been undertaken to identify possible impacts.

The assessment of existing and new roads is based on the following theoretical principles (generic noise levels presented in Table 7-14. A large number of variables can affect traffic noise (as mentioned above), so these principles provide an indication of noise change rather than report absolute noise levels. The principles are:

⁸ According to the Calculation of Road Traffic Noise, low flows typically ranked as fewer than 200 vehicles in a single hour or fewer than 4000 per day.



- a 25% traffic increase is estimated to result in a 1 dB increase over existing traffic noise, with a 3 dB increase requiring a 100% increase in traffic flows
- an increase from 10% to 50% heavy goods vehicles (HGV), rather than light vehicles, in the traffic composition will increase noise by around 4 dB9
- an increase from 25% to 50% HGVs will result in a noise increase of approximately 2 dB.

Table 7-14: Construction activities: noise

Number of truck movements per hour	Distance between road and receptor							
	5 m	10 m	25 m	50 m	100 m			
	Corresponding L _{eq,T} , dB(A)							
5	62	59	55	52	49			
10	65	62	58	55	52			
25	69	66	62	59	56			

Notes:

 $\bigoplus L_{he_{0}, t} \bigoplus = L_{w_{0}} - 33 + 10 \log_{10}Q - 10 \log_{10}V - 10 \log_{10}d$ (F.6)

where:

L_{wa} is the sound power level of the plant, in decibels (dB);

Q is the number of vehicles per hour;

V is the average vehicle speed, in kilometres per hour (km/h);

d is the distance of receiving position from the centre of haul

road, in metres (m).

Truck sound power $(L_w) = 110 \text{ dB}(A)$

Vehicle speed average = 30 km/h

Angle of view = 180 degrees

The qualitative assessment for traffic noise includes the following assumptions:

- traffic on existing roads will not increase by more than 25%, but the composition of heavy vehicles will increase by up to 25% and therefore the increase in traffic noise is likely to be less than 3 dB based on theoretical principles above
- where a new permanent road is constructed within 100 m of high sensitivity receptors, the impacts will be ranked as significant

⁹ Based on BS 5228:2009-1 Haul Road Calculation method.



- where a new temporary road is constructed within 50 m of high sensitivity receptors, the impacts will be ranked as significant
- 90% of the project traffic will be in the daytime (06:00–22:00 as defined in national standards).

As a general assumption for assessment purposes, the construction traffic flows with regards to material deliveries assume approximately 225 trucks per day with an assumption of a maximum of 5 truck movements in any single hour across a road segment during the daytime period. It is assumed that no HGV movements will occur during the night-time period.

The qualitative assessment for construction traffic is presented in Section 7.8.7.5.

7.8.7.6 General Assumptions and Exclusions – Noise Modelling

Vector layer exclusions

From the information provided, the following information has been excluded from the noise model:

- the following vector drawing layers have been excluded from assessment on the basis they are unlikely to be noise sensitive: Bld_Barn, Bld_Building_Terrace, Bld_electric_santral, Bld_Fuel_Station, Bld_Greenhouse, Bld_Workshop
- all existing buildings within 30 m either side of proposed rail centreline assumed to be removed / resettled as part of works.

Noise model exclusions

The noise sources with the potential to generate noise at a magnitude likely to be discernible above the existing environment beyond the site boundary are considered. Operational project components and equipment not considered in the noise model, but are assessed elsewhere include:

- substations
- fixed plant associated with the stations
- any maintenance operations associated with the marshalling yard.

Idling noise considerations - stations

Based on the time trains will be idle at the stations i.e. no more than 3 minutes at each station, it is unlikely that the noise from the idling trains will be a significant contributor in comparison to the rolling noise from a train. It should be noted that trains would need to idle more than 30 minutes in order to have a significant contribution to the operational noise.

Transportation for workers

Worker transportation has not been considered as impacts deemed to be negligible.

Occupational health

This report does not consider occupational health impacts associated with noise or vibration. All criteria, noise predictions and mitigation recommendations are specific to environmental and social impacts, including community impacts. It is acknowledged that some mitigation measures will also assist with protecting project workers although this is not the primary intent.



The occupants of workers camps have not been assessed quantitatively as these are specifically related to the project, however the mitigation measures do account for the occupants of these camps when layout is considered.

7.8.8 Vibration source considerations

7.8.8.1 Construction

Vibration can be generated through different construction activities. The higher emissions generally occur through high-impact compaction activities, rock breaking and piling, with the level of vibration dependent on the construction method, plant and energy component of the vibration source. However, in most cases, vibration generation is largely imperceptible.

The construction tasks identified above, except for 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 7-15 are considered. Specific rock breaking locations will not be known until refinement of the construction methodology, following detailed surveys of the rail corridor.

Table 7-15: Construction activities: vibration

Construction phase	Activities
Earth works	Rock breaking and rock ripping
Rock breaking	Rock breaking and rock ripping

In a similar way to the prediction and assessment of noise, the vibration levels from each of the above activities will be predicted using empirical formulae and the distances to which magnitude bands are exceeded presented. A buffer distance for significant impact will be identified.

7.8.8.2 Blasting

There are two common environmental effects of blasting: ground vibration and airblast (air overpressure). This can cause human discomfort where audible or result in damage to structures, architectural elements and services if not adequately controlled. Due to the potential for audible impacts and the distances between mining sites and receptors, air overpressure is generally the cause of more complaints than ground vibration.

In addition to blast-induced vibration and overpressure, flyrock is always a risk with blasting; however, a higher risk is usually associated with high charge blasting around mineral extraction sites rather than small scale blasting, as proposed for this project. Although impacts associated with flyrock are not considered true acoustic issues, the damage to property can be similar to the cosmetic damage associated with blast induced vibration. In addition, flyrock can be a risk to people (workers and community) and fauna in the area surrounding the site. Flyrock is not predictable and therefore has not been quantified as part of this study; however, it is assumed that flyrock impacts and control would be covered in a blast management plan.

Accurate estimation of ground vibration and air overpressure is a complex task. The process is highly non-linear and subject to a number of factors including the variability of rock types, ground conditions and meteorological factors.



Typically, the assessment would be undertaken using site-specific measurement data, measured reference data for similar mining activities within the region, and blast contractor parameters. This can be assessed using a probability distribution to properly define the range of possible air overpressure and ground vibration levels. As this information is not available at this stage of the project, estimations have been undertaken using charge weight scaling formulas provided in Australian Standard AS 2187.2-2006 Explosives—Storage and use Part 2: Use of explosives10, based on a range of charge masses.

The predictions should be supplemented by a monitoring campaign of trial blasting to refine the predictions, with the aim of maximising the usable charge mass while reducing impacts on surrounding receptors.

Air overpressure is the pressure caused by a (blast-induced) shock wave above normal atmospheric pressure. The pressure waves contain energy over a wide frequency range. Energy above 20 Hz is perceptible to the human ear as sound, while that below 20 Hz is inaudible, but can be sensed in the form of concussion. Sound and concussion together is known as air overpressure which is measured in decibels (dB).

Since both high and low frequencies are of importance, no frequency weighting network is applied. All frequency components, both audible and inaudible, can cause a structure to vibrate in a way which can be confused with the effects of ground vibrations. The lower, inaudible, frequencies are much less attenuated by distance, buildings and natural barriers. Consequently, air-overpressure effects at these frequencies can be significant over greater distances, and more readily excite a response within structures.

The air overpressure resulting from blasting has been predicted in accordance with the empirical formulae from AS 2187.2 Appendix 5:

$$P = K_a \left(\frac{R}{Q^{1/3}}\right)^a$$

where:

P = pressure, in kilopascals

Q = explosives charge mass, in kilograms

R = distance from charge, in metres

 K_a = site constant

a = site constant

For confined blasthole charges, when using a site exponent of -1.45, the site constant K_a is commonly in the range of 10 to 100. This considers situations that are not affected by meteorological conditions. A site constant of 100 is adopted for purpose of this assessment.

¹⁰ AS 2187.2-2006 The objective of this Standard is to provide requirements, information, and guidance for the use of explosives, the management of a site where explosives are used and the destruction of excess or deteriorated explosives, which ensure risks are acceptable minimized. This Standard is for reference by manufacturers, suppliers, and users of explosives.



7.8.8.3 Ground vibration

As many site-specific factors will affect the transmission of vibration through the ground, prediction is most accurately undertaken based on measurements taken at the site. In absence of this information, the following equation has been adopted to provide initial estimations of ground vibration:

$$V = K_g \left(\frac{R}{Q^{1/2}}\right)^{-B}$$

where:

- V = pressure, in kilopascals
- R = explosives charge mass, in kilograms
- Q = distance from charge, in metres
- $K_g = site constant$

B = site constant

AS 2187.2 gives a site constant for a free face in average field conditions of $K_g = 1140$ and B = 1.6. This value can vary from 1/5 times to four times depending on geological conditions and other factors. Predictions have therefore been undertaken using both average and worst-case ground condition values.

7.8.8.4 Commissioning

The noise from the commissioning phase will be equivalent or lower than the noise from the operational phase. Therefore, reference should be made to the operational assessment.

7.8.8.5 Operation

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, the risk of high levels of vibration is limited.

Through monitoring of vibration by RSK of various trainlines, levels at approximately 6 to10 m away from a trainline (similar running speeds to SGR) as a PPV (peak Particle Velocity) were below 1 mms⁻¹. Levels of this magnitude are below levels of perception. Given that the closest receptors to the running line will be >30 m, vibration from train movements will be negligible. Therefore, operational vibration has been scoped out of the assessment.

7.8.8.6 Decommissioning

The noise from the decommissioning phase will be equivalent or lower than the noise from the construction phase. Therefore, reference should be made to the construction assessment.

7.8.8.7 Traffic

It is likely that the majority of roads used or the project during construction and the service road will be unsealed roads. This therefore increases the potential for vibration induced damage to structures along these roads.



Unsealed roads are more susceptible to damage and deterioration (the creation of ruts, corrugations and potholes) compared with sealed roads. The movement of trucks and buses along the unsealed roads accelerates their deterioration and increases the potential for higher magnitude vibration events from uneven and abnormal load and axle movement.

Quantification of the vibration associated with such movements is dependent on many variables and is therefore not easily quantified. These variables include the:

- road condition
- road foundations
- geology between the road foundations and receptor
- distance between the receptor and road
- vehicle speed
- vehicle weight
- load (the weight distribution across the vehicle, and whether the load is loose or fixed)
- tyre condition
- receptor structure condition
- number of vehicles.

Therefore, a qualitative assessment has been undertaken (see Section 15.2.1.7) considering the mitigation measures to be embedded in the construction management plans. These measures will include speed restrictions, sympathetic routing, regular road maintenance, load management and vehicle maintenance.

The above impacts could be noticed during the operation of the alignment, but the risk is significantly reduced owing to the exceptionally low and intermittent nature of expected vehicle movements during the operational phase compared with the construction phase. Smaller vehicles are also likely to be used. Vibration from operational vehicle movements has therefore been discounted from the assessment.

7.8.8.8 Source data – construction vibration

The vibration emission levels generated through the construction phase have largely been calculated using empirical formulae, based on plant data provided by project engineers. Where data are unavailable, file data from RSK measurements of similar activities have been used to provide an indication of the impacts. However, these data should be reviewed and refined once specific methods are identified.

The source input for the noise modelling/calculation exercise is summarised in Table 7-16.



Construction phase	Activity	Input data: PPV vibration level (mm/s) at distance (m) from activity	5 m	10 m	20 m	30 m	40 m	50 m	Assumptio ns	Source of data
Rock breaking - 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	YM assumption
Earth works - alignment	Rock breaking and rock ripping	Medium rock hammer (0.6 t)	0.2	0.06	0.02	0.01	-	-	Excavator rock breaker or ripper	YM assumption

Table 7-16: Vibration Source Data (Construction Only)

7.8.9 Noise model parameters

Noise modelling has been undertaken using the proprietary noise modelling software Sound PLAN v.8.2. The model has been prepared based on parameters presented in Table 7-17.

Table 7-17: Modelling parameters

Element	Setting
Algorithm	International Standard: ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'.
Met conditions	78% humidity. 28 degrees Celsius. Wind from source to receiver.
	Acoustically hard surfaces typically have a coefficient up to 1 i.e. roads, hard standing areas etc.
Ground absorption	Acoustically soft surfaces typically have a coefficient of down to 0 i.e. grass or vegetated areas.
	The ground absorption in the noise model has been assumed at 0.5 coefficient.
	Receptors identified using Lots 3 and 4 provided vector mapping. This may not include all buildings within the affected area therefore noise sensitive premises should be identified through survey.
Receptor selection	Not all receptors identified may be noise sensitive - applicability for mitigation to be determined at detailed design.
	Receptors within 200 m either side of the alignment have been considered for assessment. These will show the greatest impact and therefore any mitigation included for will benefit receptors further away.



Element	Setting				
Receptor height	The onsite and offsite receptors have been modelled as single storey buildings with a receiver height of 1.5 m above external ground level.				
	For the purpose of this assessment, it is assumed that the site has potential to operate 24 hours a day.				
Operating hours	Stations Marshalling yards Sidings				
Site layout	As per Appendix 5				
	Simplified model only – no consideration for terrain. Based only on distance and ground attenuation. The following elements are not considered at this stage within the model:				
	Cuttings				
Terrain	Tunnels				
	Embankments				
	Bridges				
	Over/ under passes.				
Traffic	Not assessed quantitatively				
Train parameters	Track corrections: Sleepers: Mono-block sleeper on medium stiffness rail pad Railhead roughness: Average network (normally maintained smooth) Train Setup – Freight: Vehicle transfer: Wheel with diameter 920 mm Contact filter: Axle load 25 kN Traction noise: Electric locomotive Wheel roughness: Composite brake Axles: 4 Train Setup – Wagon: Vehicle transfer: Wheel with diameter 920 mm Contact filter: Axle load 100 kN Traction noise: Empty traction Wheel roughness: Composite brake Axle: 6 Train Setup – Passenger: Vehicle transfer: Wheel with diameter 920 mm Contact filter: Axle load 100 kN				



Element	Setting						
	Wheel roughness: Axle: 6	Composite brake					
Speed profiles	Speed profiles - At this stage mainline speeds (F=120 kph/P=160 kph) in all areas apart from 2.5 km either side of each station, where F=80 kph/P=50 kph is assumed. Refinement required - Would be possible to determine from similar graph to fig. 3.5 in TAI0YMI-AL- GL00X-O-OT-REP-0001-0 but this looks to be for only freight in areas of 16% gradient						
Curvature	Assumed radius is always >500 m therefore no curvature correction required. To be confirmed for Lot 3 (no such graph shown)						
Switches/ crossings	Switches/crossings may result in increase in noise/vibration levels however are not considered as part of this appraisal as the final location of such have not been confirmed. Although these may increase noise and vibration levels locally, there are unlikely to impact on the conclusions of the operational study. No allowance for any crossing or construction worker warning alarms has been made.						
Exclusions from the model	Receptors in Kahama / border of Kahama/Nzega will be impacted more significantly by Lot 5 and therefore are omitted from this study.						
	Movements per hour / day based on Lot 4 timetable as Lot 3 report shown in draft - assumed consistent. Considered scenarios have been presented below: Situation 1: Mainline scenario						
	Train	Train type	Number of carriages	Speed (kph)			
	Worst case hour						
Situation	Freight	Locomotive + wagons	2 freight movements: • 3 locomotives 72 wagons	120			
settings	Passenger	EMU	1 passenger movements: • 16 (400 m total length)	160			
	Average day						
	Freight	Locomotive + wagons	14 freight movements:3 locomotives72 wagons	120			



Element	Setting							
	Passenger	EMU	3 passenger movements: • 16 (400 m total length)	160				
	Situation 2: Station Approach Scenario							
	Train Train Type Number of Carriages			Speed kph				
	Worst-Case Hour							
			2 freight movements:					
	Freight	Locomotive + wagons	 3 locomotives 72 wagons 	80				
	Passenger	EMU	1 passenger movements: • 16 (400 m total length)	50				
	Average Day							
	Freight	Locomotive + wagons	14 freight movements: • 3 locomotives • 72 wagons	80				
	Passenger	EMU	3 passenger movements: • 16 (400 m total length)	50				

A model has been prepared to account for average day operations and worst-case hour operations. This enables assessment of the potential worst-case pass by at any given point along Lots 3 and 4.

The purpose of the survey is to characterise existing background noise levels, at locations representative of receptors closest to the planned activities of the SGR project. A desktop study has been undertaken to determine the closest receptors to the project. Indicative noise monitoring locations are presented in a map in Appendix 5. Micro-siting of each measurement location will be undertaken in the field.

The noise surveys comprise a mixture of both attended and unattended monitoring. Attended noise monitoring was undertaken over a period of up to 3 hours during the daytime period (06:00 - 22:00), with the noise meter left in-situ for a further 16 to 20 hours



of unattended noise monitoring covering both day and night-time periods. Noise monitoring locations should be representative of the closest considered noise sensitive receptors (all locations marked 'MP' on the monitoring location plans presented in Section 15) to the proposed SGR. Alternative monitoring locations are chosen where receptor locations have changed or where access is not possible.

Measurements are undertaken in accordance with British Standard BS 7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures', with instrumentation meeting the standards set out in BS EN 61672-1: 2013 'Electroacoustics. Sound level meters – Specifications'.

The meters have a calibration certificate from a traceable laboratory within two years of the date of calibration. The meter is also field calibrated before and after measurements to check the meter is within acceptable measurable limits.

During the installation procedure, the field team monitor and document information related to the dominant noise sources in the vicinity and weather conditions.

The noise equipment list is as follows:

- 2 x Svantek 307A sound level meter
- 2 x Svantek 971 sound level meter
- 2 x NC-74 Rion calibrator
- 1 x SV 33 Svantek calibrator.

The meters are setup to allow the data collected to match the intended use of the data and to log 15-minute periods.

The meter is setup up generally in accordance with the following:

- a-weighting
- fast time response
- range –checked to capture the lowest or highest levels in the environment. In low noise environments a lower range (typically down to 20 dB(A)) are chosen, whereas in high noise environments a higher range is chosen (typically up to 110 dB(A)).

After identification of the general location, the micro-siting of the meter is considered. The specific geographical co-ordinates of the position are noted along with the spatial system used. In general, the meter should be:

- setup on a tripod between 1.2m and 1.5m above the ground
- positioned a minimum of 3.5 m (free field) from any vertical reflective surfaces (i.e. buildings, fences, and walls etc.) and where the meter cannot be set up 3.5 m away from vertical surfaces, the meter should be position at 1 m (façade) from the vertical surface in question, and details of the positioning noted
- located away from localised, dominant noise sources such as commercial or residential generators, pumps, air conditioning units
- setup away from any ad-hoc community events such as festivals, fairs, and markets and away from any noise sources associated with construction activities
- established away from dominant natural noise sources such as rivers and streams



- setup away from field consultants or operators to avoid contamination of measurements through speech
- positioned away from dense vegetation and outside of wooded or forested areas to reduce the potential noise associated with wind through the leaves of trees and plants.

Weather conditions during monitoring are critical to the suitable collection of data, in particular:

- measure when wind speeds are less than 5 m-1
- collect data in dry weather (no rain during the monitoring period, or where roads are saturated with previous rainfall)
- do not measure where snow is on the ground.

Weather information (rain fall, wind, wind direction and temperature) is collected during the monitoring period using local weather stations, project specific weather station or weather observations during monitoring (using anemometer and thermometer).

The following observations are made and noted during the monitoring period:

- co-ordinates of monitoring positions
- photos of the meter in-situ in each direction
- start time and finish of the measurement
- the observed noise contributions (what source can the consultant hear) at the location
- estimate of the contribution dominance
- weather conditions (see above)
- any unusual or ad-hoc noise events
- if near a road, an estimate of the traffic flow (numbers, vehicle composition i.e. cars vs trucks), road surface, and the estimated traffic speed
- If near a train line estimation of number of train movements
- If near an airport/flight path estimation of number of train movements
- the meter field calibration
- the general measurements (broadband summary) at the end of the period.

Noise monitoring locations are selected based on proximity between the proposed project and the closest receptors. The number of monitoring locations are chosen based on the number of settlements surrounding each site location. The number and positions of monitoring locations are selected based on the noise sensitive receptors areas as agreed with the client.

7.9 Air quality

The overall assessment approach includes:

- baseline air quality monitoring
- assessment of construction phase air quality impacts
- assessment of operational phase impacts
- identification of mitigation measures
- high level recommendation of mitigation measures and residual impacts.



7.9.1 Identification of potential impacts

Construction activities can be a significant source of particulate matter (PM) into the atmosphere, and they can have a significant temporary influence on air quality. Land clearance, ground excavation, cut and fill activities, and the construction of a specific facility may all be associated with PM emissions during the construction.

The principal air quality impacts during both the operational and construction phase are likely to be:

- fugitive emissions of dust and particulate matter from construction activities
- exhaust emissions of combustion gases from plant and vehicles on site and on the local road network
- the railway will be electrified and the principal impacts during the operational phase are likely to be:
 - o exhaust emissions from increased road traffic associated with stations
 - o exhaust emissions from diesel locomotives in marshalling yards
 - o fugitive emissions from loading of quarried materials at quarries.

7.9.2 Construction phase impacts assessment

Fugitive dust emissions may be caused during the construction phase by earthworks and preparation of the ground, excavation of materials from quarries and borrow-pits, movement of materials placement of ballast 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 together with information available from the project team on the construction phase of the proposed development.

The IAQM guidance advises that construction impacts are only likely within 350 m of the boundary of the site. Therefore, receptors within 350 m of the construction works boundary may have the potential to be affected by fugitive dust emissions.

Receptors close to roads used by construction traffic may have the potential to be affected by increased road traffic exhaust emissions.

7.9.3 Construction dust assessment methodology

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:

- demolition
- earthworks
- construction
- trackout.

For each activity, the risk of site-derived dust and emissions affecting local sensitive receptors 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 soiling



- the risk of health effects due to an increase in exposure to PM10
- harm to ecological receptors.

The assessment is used to define the appropriate level of mitigation required. The following sub-sections describe the construction dust assessment methodology in further detail.

7.9.3.1 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:

- 350 m of the boundary of the site, or
- 50 m of the route used by construction vehicles onto the public highway, up to 500 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 500 m from the site entrance(s).

7.9.3.2 Step 2: Determine potential dust emission magnitudes

Demolition

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 >50,000 m3, potentially dusty construction material, on-site crushing and screening, demolition activities >20 m above ground level
- **medium:** Total building volume 20,000 50,000 m3, potentially dusty construction material, demolition activities 10 20 m above ground level
- **small:** Total building volume <20,000 m3, construction material with low potential for dust release, demolition activities <10 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 >10,000 m2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes
- medium: Total site area 2,500 10,000 m2, moderately dusty soil type (e.g. silt), 5 10 heavy earth moving vehicles active at any one time, formation of bunds 4 8 m in height, total material moved 20,000 100,000 tonnes
- small: Total site area < 2,500 m2, soil type with large grain size (e.g. sand),
 <5 heavy earth moving vehicles active at any one time, formation of bunds



<4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.

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 >100,000 m3, on site concrete batching
- **medium:** Total building volume 25,000 100,000 m3, potentially dusty construction material (e.g. concrete), on site concrete batching
- **small:** Total building volume <25,000 m3, construction material with low potential for dust release (e.g. metal cladding or timber).

Track out

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 (>3.5 onnes) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
- **medium:** 10 50 HDV (>3.5 tonnes) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 100 m
- **small:** <10 HDV (>3.5 tonnes) trips in any one day, surface material with low potential for dust release, unpaved road length <50 m.

7.9.3.3 Step 2B: Defining the sensitivity of the surrounding environment

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 PM10, 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 7-18 was used to define the sensitivity of different types of receptors to dust soiling, health effects and ecological effects.



Table 7-18: Sensitivity of Individual receptors in the project area

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, medium and long-term car parks and car showrooms.	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. Examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.



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 would not reasonably be expected to be present 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 the Occupational Health and Safety Act.	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.
	The enjoyment of amenity would not reasonably be expected.	Locations where human exposure is transient.	Locations with a local designation where the features may be affected by dust
	Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling.	Indicative examples include public footpaths, playing fields, parks and shopping streets.	deposition. Example is a local nature reserve with dust sensitive features.
Low	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, short term car parks and roads.		



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 7-19, Table 7-20 and

Table 7-21, indicate the method used to determine the sensitivity of the area for dust soiling, human health and ecological impacts, respectively.

Receptor sensitivity	Number of	Distances from the source (m)					
	receptors	<20	<50	<100	<350		
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		

Table 7-19: Sensitivity of the area to dust soiling effects on people and property.

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 7-20: Sensitivity of	of the area to	human health	impacts ((IAQM c	onstruction	dust
guidance)						

Receptor Annual		Number	Distances from the source (m)					
sensitivity	conc.	or receptors	<20	<50	<100	<200	<350	
		>100	High	High	High	Medium	Low	
	>32 µg/m³	10-100	High	High	Medium	Low	Low	
		1-10	High	Medium	Low	Low	Low	
		>100	High	High	Medium	Low	Low	
High	28-32 µg/m³	10-100	High	Medium	Low	Low	Low	
		1-10	High	Medium	Low	Low	Low	
	<24 µg/m³	>100	Medium	Low	Low	Low	Low	
		10-100	Low	Low	Low	Low	Low	
		1-10	Low	Low	Low	Low	Low	
	>32 µg/m³	>10	High	Medium	Low	Low	Low	
		1-10	Medium	Low	Low	Low	Low	
	20 22 ug/m ³	>10	Medium	Low	Low	Low	Low	
Medium	20-32 µg/m°	1-10	Low	Low	Low	Low	Low	
	24.29 µg/m ³	>10	Low	Low	Low	Low	Low	
	24-20 µy/11°	1-10	Low	Low	Low	Low	Low	
	<24 µg/m ³	>10	Low	Low	Low	Low	Low	



Receptor sensitivity	Annual mean PM ₁₀ conc.	Number of receptors	Distances from the source (m)				
			<20	<50	<100	<200	<350
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table 7-21: Sensitivity of the area to ecological impacts

Persenter consitivity	Distances from the source (m)			
Receptor sensitivity	<20	<50		
High	High	Medium		
Medium	Medium	Low		
Low	Low	Low		

7.9.3.1 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 7-22 to Table 7-24 present the matrices used to assign the level of risk for each construction activity.

Table 7-22: Risk of dust impacts from demolition

	Dust emission magnitude				
Sensitivity of area	Large	Medium	Small		
High	High risk	Medium risk	Medium risk		
Medium	High risk	Medium risk	Low risk		
Low	Medium risk	Low risk	Negligible		

Table 7-23: Risk of dust impacts from earthworks/construction

Separativity of erec	Dust emission magnitude				
Sensitivity of area	Large	Medium	Small		
High	High risk	Medium risk	Low risk		
Medium	Medium risk	Medium risk	Low risk		
Low	Low risk	Low risk	Negligible		

Table 7-24: 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	Low risk	Negligible		



Sonoitivity of oron	Dust emission magnitude				
Sensitivity of area	Large	Medium	Small		
Low	Low risk	Low risk	Negligible		

7.9.4 Construction phase: Impact of exhaust emissions from construction plant and vehicle

The operation of vehicles, plant and equipment powered by internal combustion engines results in the emission of exhaust gases containing pollutants including NOx, PM_{10} , $PM_{2.5}$, volatile organic compounds and carbon monoxide. The quantities emitted depend on factors such as engine type, service history, pattern of usage and fuel composition.

Construction traffic will comprise haulage vehicles and vehicles used for workers' trips to and from the project. The greatest impact on air quality due to emissions from construction phase vehicles will be in areas adjacent to the construction site access and nearby road network.

The EPUK-IAQM 2017 guidance provides indicative criteria to determine when air quality impacts may be significant. For HGVs, an increase of 100 trips per day as an annual average daily traffic rate AADT on any one road is the indicative criterion.

7.9.5 Construction phase dust impact assessment

With reference to the IAQM criteria outlined in Appendix 8, the potential dust emission magnitudes for earthworks, construction and track out activities are summarised in Table 7-25, based on information provided by the client.

Activity	IAQM criteria	Dust emission magnitude
Earthworks	 Total area where earthworks will take place is estimated by the client to be >10,000 m² The number of heavy earthmoving vehicles is estimated to be >10 during peak of earthworks Height of stockpiled materials is predicted to be >8 m 	Large
Construction	 >100,000 m³ All retaining structures shall be made up of reinforced concrete Potential dusty construction materials on-site 	Large
Track out	 The maximum number of heavy-duty vehicle (HDV) outward a movement in any one day is anticipated to be >50 Extent of unpaved road length within site is estimated to be >100 m 	Large

Table 7-25: Summary of dust emission magnitudes (without mitigation)

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 PM10, 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 were identified in the vicinity of the proposed development site following the guidance published by IAQM. More than 100 'high' sensitivity receptors are within 20 m of the construction activity boundary. The sensitivity of the area to dust soiling, human health and ecological impacts is summarised in Table 7-26.

European Commission, Digital Observatory for Protected Areas (DOPA) explorer indicates that there are no SSSI, SAC, Special Protection Areas (SPA), Ramsar sites, National Nature Reserves or Local Nature Reserves within 50 m 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 500 m track out route has been considered.

Potontial		Sensitivity of the surrounding area					
Impact		Demolition	Earthworks	Construction	Track out		
	Receptor sensitivity	N/A	High	High	High		
	Number of receptors	N/A	>100	>100	>100		
Dust soiling	Distance from the source	N/A	<20 m	<20 m	<20 m		
	Overall sensitivity of the area	N/A	High	High	High		
	Receptor sensitivity	N/A	High	High	High		
	Annual mean PM ₁₀ concentration	N/A	<24 mg/m ³	<24 mg/m ³	<24 mg/m ³		
Human health	Number of receptors	N/A	>100 >100		>100		
	Distance from the source	N/A	<20 m <20 m		<20 m		
	Overall sensitivity of the area	N/A	Medium	Medium	Medium		

Table 7-26: Summary of the sensitivity of the area to dust soiling and human health

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 7-27.



	2					
Potential	Dust Risk Impact					
impact	Demolition	Earthworks	Construction	Track out		
Dust soiling	N/A	High risk	High risk	High risk		
Human health	N/A	Medium risk	Medium risk	Medium risk		

Table 7-27: Summary of the dust risk from all construction activities

7.9.6 Overall Impact assessment associated with the project methodology

With reference to the project methodology criteria outlined in Section 7 the overall magnitude of impact and sensitivity of receptor were used to assess the likely significance of any impacts, as shown in Table 7-28.

The impact magnitude for construction stage fugitive dust is likely to be localised and within 500 m of the boundary, and short term, limited to the period of construction activities near receptors, and therefore could be assigned a 'low' magnitde, however impacts may be felt by receptors at a local, though these should be readily contollable by mitigation (see Section 16.6 and Appendix 7), therefore a conservative magnitude descriptor of 'minor' was assigned.

A good standard of ameniy 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 adverse'.

Receptor	Distance from project activities	Magnitude	Receptor sensitivity	Impact significance
Residential building (100+)	350 m	Minor	Medium	Minor
Itulu primary School	224 m	Minor	Medium	Minor
Kimungi Primary school	68 m	Minor	Medium	Minor
Nyahua station primary school	350 m	Minor	Medium	Minor
Goweko medical centre	220 m	Minor	Medium	Minor
Nkongwa primary school	165 m	Minor	Medium	Minor
Kazi-Kazi primary school	212 m	Minor	Medium	Minor
Kitaraka primary school	350 m	Minor	Medium	Minor
ltigi hospital	350 m	Minor	Medium	Minor
Isanjandugu primary school	86 m	Minor	Medium	Minor
Kitopeni primary School	125 m	Minor	Medium	Minor
Mabondeni primary school	207 m	Minor	Medium	Minor
Aghondi primary school	230 m	Minor	Medium	Minor

Table 7-28: Impact significance matrix



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 7-29, below.

Receptor	Impact significance	Likelihood	Impact estimation
Residential building 100+	Minor	Occasional	Minor
Itulu primary school	Minor	Occasional	Minor
Kimungi primary school	Minor	Occasional	Minor
Nyahua station primary school	Minor	Occasional	Minor
Goweko medical centre	Minor	Occasional	Minor
Nkongwa primary school	Minor	Occasional	Minor
Kazi-Kazi primary school	Minor	Occasional	Minor
Kitaraka primary school	Minor	Occasional	Minor
Itigi hospital	Minor	Occasional	Minor
Isanjandugu primary school	Minor	Occasional	Minor
Kitopeni primary school	Minor	Occasional	Minor
Mabondeni primary school	Minor	Occasional	Minor
Aghondi primary school	Minor	Occasional	Minor

Table 7-29: Environmental risk estimation

7.9.7 Construction phase plant & vehicles exhaust emissions assessment

The number of plant items operating at any one worksite is likely to be small, fewer than 10 in all probability, and their presence temporary, and their exhaust emissions are unlikely to result in a significant impact on air quality. 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 <500 and the number of 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.

7.9.7.1 Operation Phase Impacts Assessment

The railway line will be electrified; therefore the operation of locomotives will not result in direct emissions to air, however principal impacts during the operational phase are likely to be:

- exhaust emissions from increased road traffic associated with stations
- exhaust emissions from diesel locomotives in marshalling yards
- fugitive emissions from loading of quarried materials at quarries.



7.9.8 Operation phase road traffic exhaust emissions impact assessment

A qualitative assessment of operational phase impacts was based on a review of the proposed activities and environs in accordance with the principals of the IAQM's best practice Land-Use Planning & Development Control: Planning for Air Quality. The guidance suggests indicative screening criteria of 500 AADT for light duty vehicles and 100 AADT for Heavy duty vehicle (HDV) on local roads for indicating when further assessment is likely to be required.

The guidance notes that 'The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them based on professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality'.

No quantitative predictions of increased road traffic due to passengers and freight travel to stations ae available. However it is envisioned that most passengers would be likely to walk to stations, and in view of the small number of trains planned per day, it is considered unlikely that the screening criteria would be exceeded on any one road.

7.9.9 Operation phase marshalling yard locomotive exhaust emissions impact

The operation of diesel locomotives at the marshalling yards may have the potential to result in increased concentrations of locomotive exhaust emissions, which may have the potential to affect air quality at existing sensitive receptors close to the marshalling yards.

The potential impacts of emissions from these diesel locomotives at marshalling yards were assessed in the first instance qualitatively by reference to guidance on the assessment of impacts of railway infrastructure on air quality and the number and proximity of receptors, with further, quantitative assessment using dispersion modelling, where indicated.

The operation of diesel locomotives at the marshalling yards may have the potential to result in increased concentrations of locomotive exhaust emissions, which may have the potential to affect air quality at existing sensitive receptors close to the marshalling yards.

The potential impacts of emissions from these diesel locomotives at marshalling yards were assessed in the first instance qualitatively by reference to guidance on the assessment of impacts of railway infrastructure on air quality and the number and proximity of receptors, with further, quantitative assessment using dispersion modelling, where indicated.
		apilaly 👲
		A
		Key 20m
0 250 50	20	350m Receptors

Figure 7-11: Marshalling yard with receptors & buffer distances

A number of receptors are present between 100 m and 350 m from the boundary, but none is closer than 100 m.

UK DEFRA guidance on the assessment of local air quality suggests screening criteria for detailed assessment of the impact of stationary diesel or steam locomotives on air quality. The relevant criteria read as follows for stationary diesel or steam locomotives:

- identify locations where diesel or steam locomotives are regularly (at least three times a day) stationary for periods of 15-minutes or more
- determine relevant exposure within 15 m of the locomotives
- moving diesel locomotives
- determine relevant exposure within 30 m of the relevant railway tracks.

No steam locomotives are proposed. No information is currently available on where in the marshalling yard diesel locomotives may be regularly stationary. However, given no receptors are present within 15 m or 30 m of the track, a significant impact is unlikely and further assessment should not be required.

7.9.10 Operation phase fugitive emissions of loading of quarried materials

Operational phase fugitive dust impacts due to the loading of freight wagons with potentially dusty materials from quarries were assessed based on a qualitative risk assessment approach.

Most of the fugitive dust from construction and minerals extraction processes is in the coarse fraction and is unlikely to remain in suspension for extended periods of time. Therefore, it is likely to be deposited relatively close to source and consequently it was assumed that impacts were limited to receptors within 350 m of loading operations.



Quarry sites, numbers of receptors and assessed magnitude of fugitive emissions, receiving environment overall sensitivity and impact significance are presented in the table below.

Quarry site	Receptors	Magnitude	Receptor sensitivity	Impact significance
Lot 3: R/567	0	Minor	Medium	Minor
Lot 3: R/645	1 to 10	Minor	Medium	Minor
Lot 3: R/681	0	Minor	Medium	Minor
Lot 3: R/762	10-100	Minor	Medium	Minor
Lot 3: R/809	1 to 10	Minor	Medium	Minor
Lot 4: 850	10-100	Minor	Medium	Minor
Lot 4: 891	10-100	Minor	Medium	Minor
Lot 4: 908 or 915	10-100	Minor	Medium	Minor

Table 7-30: Quarry sites, receptors, magnitude of fugitive emissions, sensitivity and impact significance

7.10 Greenhouse gas emissions and climate change

7.10.1 Greenhouse gas emissions

The assessment of the GHG emissions arising from the proposed development will be 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)
- PAS 2080:2016 Carbon Management in Infrastructure, Royal Institute of Chartered Surveys (RICS) Whole life carbon assessment for the built environment (2017).

The assessment will establish present and future baseline GHG emissions. It will quantify 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 six Kyoto Protocol gas groups are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and perfluorocarbons (PFCs). The global warming potential (GWP) of each is presented in Table 7-31.



Greenhouse gas/group	Chemical formula	GWP (CO ₂ e)
Carbon dioxide	CO ₂	1
Methane	CH ₄	25
Nitrous oxide	N ₂ O	298
Hydrofluorocarbons	HFCs	Depends on specific gas
Sulphur hexafluoride	SF ₆	22,800
Perfluorocarbons	PFCs	Depends on specific gas

Table 7-31: Kyoto Protocol GHGs and their global warming potential (GWP)

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. Emissions have then been quantified by applying the most relevant and up-to date emission factors.

An emission factor is a representative value that relates the quantity of a pollutant released into the atmosphere with an activity associated with the release of that pollutant. Emission factors are typically available from government publications, independent agencies, and scientific research journals; however, the quality and accuracy of such factors can vary significantly. Factors 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.

RSK's approach to the measurement of GHG emissions is to follow the GHG Protocol's core principles where possible:

- **relevance:** selecting an appropriate inventory boundary that reflects the GHG activities and serves the decision-making needs of users
- **completeness:** accounting for all emission sources within the chosen inventory boundary, with any specific exclusions disclosed and justified
- **consistency:** aiming to collect meaningful and consistent data over time whilst transparently documenting any significant changes to data quality and/or format
- transparency: addressing all relevant issues in a coherent and clear manner
- **accuracy:** minimising uncertainty and avoiding systematic over- or underquantification of emissions, and utilising precautionary estimates or assumptions, where required, which are guided by industry standards.

7.10.1.1 Scope

The concept of emission 'scopes' is defined by the GHG Protocol Corporate Standard (2004). Scope 1 emissions are those that occur directly from sources owned or controlled by a defined entity and may include corporate car fleets, on-site power generation, fuel combustion for heating and power, and any process emissions such as refrigerant gas losses. Scope 2 emissions are those that occur due to the import of energy (electricity or heat) to that entity. These emissions occur where that energy is generated, e.g. a power station, and are therefore termed indirect emissions.

Scope 3 includes all other indirect emissions sources not accounted for within scope 1 and 2. The precise sources applicable will depend on a reporting entity's activities. These can occur upstream of an activity, e.g. in the production and supply of materials to that activity, or downstream, e.g. in the use of the product of an activity. Many scope 3



emissions occur in nations other than where the activity or entity whose emissions are under consideration is located. However, depending on the nature and remit of a project, scope 3 activities can contribute a significant proportion of overall emissions.

IFC PS 3 requires projects to reduce project related GHG emissions. It requires projects that are expected to produce more than 25,000 tCO₂e annually to quantify scope 1 and 2 emissions annually, aligned with internationally recognised methodologies and good practise.

Alongside IFC requirements, the fourth iteration of the Equator Principles (EP4) requires quantification of projected scope 1, 2 and, as appropriate, 3 GHG emissions aligned with the methodologies of the Greenhouse Gas Protocol to determine whether a transition climate change risk assessment is required. If scope 1 and 2 emissions are greater than 100,000 tCO₂e annually then a transition climate change risk assessment should be undertaken.

As such, this GHG assessment focuses on scope 1 and 2 emissions from the project, with reference to embodied GHG emissions from construction materials (scope 3), as a material and relevant source of emissions.

7.10.1.2 Significance

Using the reporting thresholds from several organisations, such as the EP4, and IFC Performance Standards, an assessment of emissions magnitude can be made as illustrated in Table 7-32. These are also shown as a percentage of the projected annual emissions Tanzania must be limited to by 2030 in order to ensure a 30% reduction of emissions compared to a 2030 business-as-usual (BAU) scenario (see section 19.1.1.2).

Magnitude level	Annual project GHG emissions (tCO₂e)	% of projected annual emissions needed by 2030 (30% reduction scenario)
Very large	> 1,000,000	> 0.7%
Large	100,000 - 1,000,000	0.1 – 0.7%
Moderate	25,000 - 100,000	0.02 – 0.1%
Small	5,000 - 25,000	0.003 - 0.02%
Negligible	< 5,000	< 0.003%

Table 7-32: Magnitude level for project GHG emissions

Impact assessments normally assess to what degree the proposed development will affect the baseline environment of the study area. In the case of GHG emissions, any emissions will have a long-term, irreversible negative effect on the global climate, which is considered to be highly receptive to any emissions of GHGs. A specific source of GHG emissions cannot be linked to impacts at a specific location but will have impacts globally.

This GHG assessment will therefore evaluate the significance of emissions from the project with relation to Tanzania's national carbon budget. This is aligned with the methodology from IEMA's Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022), which provides a framework of determining significance against the goals of the Paris Agreement (i.e. a science-based 1.5°C trajectory).



Table 7-33: IEMA's guidance to assessing GHG significance (2022) framework for assessment of significant effects

Significance	Level	Criteria	Emissions magnitude
Significant	Major adverse	Project adopts a business-as-usual approach, not compatible with the national Net Zero trajectory, or aligned with the goals of the Paris Agreement (i.e. a science-based 1.5°C trajectory). GHG impacts are not mitigated or reduced in line with local or national policy for projects of this type.	Very large/Large
	Moderate adverse	Project's GHG impacts are partially mitigated, and may partially meet up-to-date policy; however, emissions are still not compatible with the national Net Zero trajectory or aligned with the goals of the Paris Agreement.	Moderate
Not significant	Minor adverse	Project may have residual emissions, but the project is compatible with the goals of the Paris Agreement, complying with up-to-date policy and good practice.	Small
	Negligible	Project has minimal residual emissions and goes substantially beyond the goals of the Paris Agreement, complying with up-to-date policy and best practice.	Negligible
Significant	Beneficial	Project causes GHG emissions to be avoided or removed from the atmosphere, substantially exceeding the goals of the Paris Agreement with a positive climate impact.	N/A

Given the international urgency of climate change, the sensitivity of the receptor (i.e. global climate) to fluctuations in GHG emissions is considered 'Very High'. Thus, the level of the significance of effects is determined by the magnitude, and timing, of GHG emissions and the likelihood of avoiding severe climate change.

7.10.1.3 Mitigation

IFC PS 3 requires developers to "...consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project". This GHG assessment will determine appropriate mitigation and monitoring measures in accordance with the hierarchy for managing project related emissions (avoid, reduce, substitute, and compensate).

7.10.1.4 Assumptions and limitations

The accuracy of a GHG assessment is directly related to the quality of the activity data provided. Data provided by the client represents a forecast of activities and design, which may be subject to change upon future implementation. Estimates, extrapolations and industry averages have been applied according to best practice, but assessments based largely on secondary data should only be viewed as an estimate of GHG emissions impact; actual emissions may vary significantly.

7.10.2 Climate change risk assessment (CCRA)

According to Principle 1 of the fourth iteration of EP4, a CCRA is required:



- for all Category A and, as appropriate, Category B Projects, and will include consideration of relevant physical risks as defined by the Task Force on Climate-Related Financial Disclosures (TCFD)
- for all projects, in all locations, when combined Scope 1 and Scope 2 emissions are expected to be more than 100,000 tCO2e annually. Consideration must be given to relevant climate transition risks (as defined by the TCFD) and an alternatives analysis completed which evaluates lower GHG intensive alternatives.

RSK therefore initially conducts a physical risk assessment and, if the GHG emissions show the project is expected to emit more than 100,000 tCO₂e, a year a transitional risk assessment is carried out under a separate work scope.

The methodology presented here is based on the latest recommendations and guidance from the Equator Principles Guidance Note on Climate Change Risk Assessment (October 2021). RSK undertook a desk-based review of information provided by the project, as well as information found in the public domain. The CCRA is typically split into three parts which are presented in the following subsections:

- physical risk assessment
- transition risk assessment (where required)
- CCRA synthesis report.

7.10.3 Physical risk assessment

The TCFD recommendations state that 'physical risks resulting from climate change can be event driven (acute) or longer-term shifts (chronic) in climate patterns'. Both acute hazards (such as heavy precipitation events) and chronic hazards (such as sustained temperature increase) have the potential to impact on operations and should be identified and disclosed. In line with this, RSK will take a four-step approach in identifying and assessing potential risks including hazard screening, risk to project infrastructure and supply chain, risk to local communities and adaptive measures.

7.10.3.1 Hazard screening

Using published scientific data (historic and current, as well as simulated future projections), a list of potential climate related hazards specific to the project operations is created. RSK uses regional data from the Climate Change Knowledge Portal (CCKP), Tanzania's National Communication to the UNFCCC, and the latest AR6 report from the IPCC. Impacts to be considered in the hazard screening may include increased temperature (including extremes), changes to precipitation (including extremes), droughts/ reduction in water availability and increased flooding.

7.10.3.2 Risk to project infrastructure and supply chain

Based on the findings of the hazard screening, a risk assessment is carried out. Both direct and indirect risks are included. Direct risks include, e.g. the impact of 'hot days' on the efficiency of overhead lines. In addition to the direct physical risks to the infrastructure, climate change impact on supply chains and logistics is covered.

7.10.3.3 Risk to local communities

Data on vulnerability to climate change will be collected from communities in the project area in parallel with the biodiversity, resettlement, and stakeholder consultation field surveys. This data will be analysed alongside data from the hazard screening to understand if, and how the project could potentially exacerbate impacts of climate change on the local community.



7.10.3.4 Adaptive measures

Project documents will be reviewed to identify current strategies to mitigate physical climate risk. In addition, further high-level adaptation strategies will be identified and recommended where appropriate.

7.11 Approach to stakeholder engagement

A Stakeholder Engagement Plan (SEP) was prepared for the project by TRC and YM in February 2022 in accordance with the Tanzanian environmental legislation and submitted to the National Environmental Management Council (NEMC). This SEP was aimed to identify stakeholders for the ESIA and the preparation of the RAP, outline the GRM and the mechanism for ongoing consultations and dissemination of information to the stakeholders.

A gap analysis was undertaken in December 2022 which identified gaps between the existing SEP and the lenders requirements. As such, the SEP is currently being updated in order to align with the lenders' requirements.

7.11.1 Objectives of the SEP

The objectives of the updated SEP include to:

- outline the key stakeholders that have been consulted during the scoping, ESIA and post ESIA/pre-construction stage and identify any additional stakeholders that may be affected by, or may influence the outcome of, the project
- review existing stakeholder engagement documents, identify gaps in relation to lenders requirements and propose corrective actions to address such gaps
- outline consultation methods and the process of informing stakeholders about the project
- outline current and potential emerging issues and to present views and concerns of the relevant stakeholders about the project
- provide a basis for stakeholder participation in environmental and social impact identification, prevention and mitigation including impacts and risks relating to gender-based violence & harassment (GBVH) including sexual exploitation and abuse (SEA)
- present the project specific grievance redress mechanism (GRM) currently being implemented and upgrade this mechanism to align with lenders requirements
- define the roles and responsibilities of the implementation team that will enable effectiveness of the SEP
- outline the ESIA disclosure process in order to address concerns raised by different stakeholders during the Scoping, ESIA and pre-construction phases in line with the lenders ESIA.

7.11.2 Scope of the SEP

The scope of the SEP is to detail the engagement activities and disclosure of E&S documents undertaken during the project pre-construction phase and the methods to efficiently manage and facilitate future engagement with stakeholders during the ESIA disclosure period and construction phases of the project.

The SEP will be prepared to align with applicable IFC PS and the EP4 requirements, specifically EP5 and EP6 that establish requirements for stakeholders engagement and grievance mechanism respectively.



7.11.3 Regulatory requirements

7.11.3.1 National requirements

According to the Tanzanian Environmental Management Act (EMA, No. 20 of 2004) and the environmental impact assessment (EIA) and Audit Regulations (No. 349 of 2005) and the EIA and Audit (Amendment) Regulations (No. 474 of 2018), the project falls under type "A" requiring a full EIA. The First Schedule of the EMA states that transport and infrastructure projects (9. Transport and Infrastructure, (iii) Construction of new, or expansion to existing railway lines) require a mandatory EIA.

The EIA and Audit Regulations (2005) and the EIA and Audit (Amendment) Regulations, 2018 are the major legislation in Tanzania that defines the process of stakeholder engagement when undertaking a project. Part 1 of the Regulation, Article 17 (Public Participation) requires the developer to seek views of any person who is or is likely to be affected by the Project.

In addition, the Environmental Management Act requires that the review of the Environmental Impact Statement is undertaken through public hearings.

7.11.3.2 Lenders requirements

The key lenders requirements pertaining to appropriate stakeholder engagement are:

- EP4 (specifically EP5 and 6)
- Equator Principles Guidance on Implementation of the Equator Principles during the Covid-19 pandemic
- IFC PS (especially PS 1).

All IFC PS include requirements for an amount of stakeholder consultation/engagement (either as part of the ESIA or as part of the future ESMS).

7.11.4 Previous stakeholder engagement

Five Capitals was provided with stakeholder consultations records showing the efforts undertaken by TRC and YM to date. Records provided to 5 Capitals include:

- rapid ESIA stage undertaken between 05 to 12 November 2021
 mostly targeted district and regional governments
- stakeholder consultations during the scoping phase from 27 May to 20 July 2022
 - o undertaken along Lot 3 from Makutopora to Tabora
 - o undertaken along Lot 4 from Tabora to Isaka
- ESIA phase stakeholder consultations undertaken from 09 August to 15 September 2022 which included consultations with government ministries, agencies, regional and district authorities, CSOs, and villages along the SGR from Makutopora to Isaka.

Outcome of indigenous peoples consultations as documented in the Indigenous Peoples Assessment Report (December 2022)

Outcome of other stakeholder engagement activities including:

- community project awareness training
- door to door awareness campaigns
- school trainings
- crossings consultations



• cultural heritage consultations (targeting specific IPs).

The SEP includes key summaries of concerns raised by the different stakeholders including how they were addressed and those that remain open.

Note: In some cases, 5 Capitals have had to rely on reviewing the summary of stakeholder consultations that have been undertaken and summarised within the ESIA report (December 2022) and the Assessment of Indigenous People's Report (December 2022) because Minutes of Meetings or notes of meetings were not available.

7.11.5 On-going stakeholder consultations

The SEP will include a summary of on-going stakeholder consultations currently being undertaken by TRC and YM.

7.11.6 Future stakeholder engagement programme

This will include details of the following:

- engagement methods which will be used to inform stakeholders about the stakeholder engagement process during construction phase of the project
- disclosure requirements of the E&S documents
- stakeholder engagement timetable for the construction phase
- project requirements to avoid reprisal on stakeholders who provide their feedback, opinions and/or raise concerns
- ESIA disclosure requirements and closing out stakeholder consultation gaps.

To prevent stakeholder fatigue and enable sufficient information is available to the stakeholders concurrent with addressing the concerns raised during the past stakeholder engagement process, further stakeholder engagement for the ESIA must be undertaken once the lenders ESIA is completed (during the ESIA disclosure period). This will provide the stakeholders with sufficient information and demonstrate the concerns they raised i.e. on water, land impacts etc can be addressed in line with the updated mitigation measures in the ESIA, RAP, IPP etc.

The ESIA disclosure meetings will include:

- preparation of a stakeholder engagement and notification schedule
- preparation of project materials to be used during the consultations i.e. power points, kmz files, project summary brochures etc.
- training of the TRC and YM CLOs by an international E&S Consultant before the meetings are held with different stakeholders
- recording of outcome of meetings (i.e. MoM, photos etc.)
- TRC and YM will utilise the local government and community offices as Project Information Centres to disclose printed copies of the ESIA Non-Technical Summary, SEP and RAP
- relevant government agencies and CSOs will be provided with links to the reports disclosed online.

At the end of the ESIA disclosure period, a public consultation and disclosure report will be developed explaining the disclosure activities that have been undertaken, how stakeholder concerns (past and current) were addressed and whether any material updates require to be undertaken in the ESIA.



7.11.7 Grievance mechanism

The existing GRM mechanism will be updated in order to demonstrate alignment with the lenders' requirements. It will also include key principles that the project must comply with, the scope, how to publicise it, steps in managing the GRM, GRM procedure for vulnerable groups, how to access it, etc.

7.11.8 Implementation plan

This section will include details on resources available for stakeholder engagement and roles and responsibilities.



8 STAKEHOLDER ENGAGEMENT TO DATE

8.1 Background

An SEP was prepared for the project by YM in February 2022 in accordance with Tanzanian environmental legislation and this SEP was submitted to NEMC. The SEP aimed to identify stakeholders for the ESIA and the preparation of the RAP. It also outlined a mechanism for grievances procedures, a mechanism for on-going disclosure and dissemination of information, consultation, and participation of all stakeholders throughout the lifecycle of the project.

A review and gap analysis on the ESIA was undertaken by RSK on behalf of YM in December 2022. This identified gaps in the ESIA that needed to be addressed in order to meet lenders requirements for approval of project finance.

YM engaged 5 capitals to update the SEP in order close the gaps identified in the ESIA to meet international lenders requirements. The updated SEP is provided in Appendix 3.

8.2 Approach to the SEP

The SEP was prepared based on the review of the (i) UDSM ESIA, (ii) National SEP for Lot 3 - 4, (iii) YM stakeholder engagement and grievance procedures for Lot 3 - 4, (iv) Minutes of meetings and attendance sheets from various Community Engagement Campaigns (such as school trainings, door-to-door awareness, crossing consultations, etc.), and (vi) Information related to the different stakeholder consultations that have been undertaken to date along the SGR Lot 3 & Lot 4 alignment.

8.3 Local context

The regions, districts and wards through which the SGR Lot 3 & 4 Makutopora to Isaka line runs are presented in the SEP. There are 67 villages along the project alignment. Forty-eight of the villages will be directly impacted by the project as they have been identified to be within the project's 1 km AoI, while others will be indirectly impacted by the project. Twelve (12) villages out of 67 villages and two additional villages included in archaeology and indigenous people consultations have indigenous people.

8.4 Approach to the stakeholder identification

According to the existing YM stakeholder engagement and grievance procedure, the stakeholder identification process grouped stakeholders into two (2) main categories – primary stakeholder and secondary stakeholders. Primary stakeholders consist of those who may be directly and in-directly affected by the project. Secondary stakeholders include (i) national regulatory & implementing bodies, (ii) ministries, (iii) government agencies, (iv) regional and local government authorities, (v) civil society organizations, (vi) workers and workers unions, (vii) project lenders and (viii) media.

A stakeholder engagement matrix was prepared based on these categories, which also include vulnerable groups



Stakeholder group	Stakeholder bodies	Relevance to project/nature of interest, level of influence/control	
Primary stakeholders – directly affected stakeholders	Residents of all villages, wards and mtaa where the railway line, project facilities and associated infrastructure will be constructed and within 1 km of the project footprint	Located within 1 km from the railway alignment and may potentially be directly impacted by construction activities (noise, dust, emissions, vibrations, concerns about community health and safety, traffic impacts, livelihood, etc.)	
	Indigenous people within the Aol and those whose resources are affected by the project even if they are outside the Aol.	Indigenous people and vulnerable groups within Aol will	
	Vulnerable groups (including single headed households, women, women headed households, children, elderly, orphan/child headed households, people with disabilities or chronic illnesses, etc.)	be directly affected by the project by virtue of their physical disability, social or economic standing, limited education, lack of employment or access to land	
	Landowners/ land rights holders and users along the alignment (including informal and seasonal land users)	Interest in land acquisition for project use, land use restrictions, resettlement, compensation procedure and additional support as applicable	
	Schools along the railway alignment (Teachers and students)	Located within 1 km from railway alignment with potential risks associated with movement of vehicles and machinery	
	Local businesses	Interest in project impact on their livelihoods, compensation procedure and additional support and assistance in restoration of living standards	
Primary stakeholders – indirectly affected	Residents of villages and communities outside the Aol	May indirectly be impacted from the construction activities.	
	Ward and Village Executive Officers, Village Chairpersons, Village Council Members	Interest in the project beneficial and adverse impact to respective villages	
	District administrators such as District Medical Officers, Officer Commanding District, Council HIV/AIDS Coordinators (CHAC)	Interest in the project beneficial and adverse E&S impact to respective districts	
	District Executive Directors	Effective implementation of	
	District Commissioner	and standards related to	
	District level experts on land, natural resources, environmental management, community	environmental health, sanitation, traffic management, and traffic awareness at the district level	

Table 8-1: Stakeholder engagement matrix for Lot 3 & 4	Table 8-1	1: Stakeholder	engagement	matrix for	Lot 3 &	. 4
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Stakeholder group	Stakeholder bodies	Relevance to project/nature of interest, level of influence/control	
	development, agriculture, town planning, cultural affairs, etc.		
Secondary stakeholders	NEMC	Responsible for approval national EIA.	
 National Regulatory & implementing bodies 	TRC	Responsible for routine maintenance of the project during operation	
	Ministry of Works and Transport		
	Ministry of Finance and Planning		
	Ministry of Livestock and Fisheries		
	Ministry of Agriculture		
	Ministry of Water		
	President's Office Regional Administration and Local Government		
	Vice Presidents Office Union and Environment	Ministries are responsible for establishing policy, granting permits or other approvals for the	
Secondary	Ministry of Minerals		
stakeholders – ministries	Ministry of Energy	Project, monitoring and enforcing	
	Ministry of Natural Resources and Tourism	compliance with Tanzanian Law throughout the lifetime of the project.	
	Ministry of Health		
	Ministry of Industries Trade and Investments	-	
	Ministry of Labour, Youth, Employment and Persons with Disability		
	Ministry of Information, Culture, Arts and Sports	-	
	Tanzania National Roads Agency (TANROADS)		
	Engineers Registration Board (ERB)	Interest in the project's impacts to land and other assets owned	
	Contractors' Registration Board (CRB)	by the agencies (e.g. TANESCO is the owner of the transmission line and electricity petwork that	
Secondary	Tanzania Ports Authority (TPA)	the Project will connect to).	
stakeholders – government agencies	Tanzania Bureau of Standards (TBS)	Responsible for the implementation of legislation, and	
	Tanzania Electric Supply Company (TANESCO)	at the regional level. This includes issuing authorization for	
	Tanzania Rural and Urban Road Agency (TARURA)	land concession and physical resettlement.	



Stakeholder group	Stakeholder bodies	Relevance to project/nature of interest, level of influence/control	
	Rural Water Supply and Sanitation Authority (RUWASA)	Interested in project involuntary displacement impact and keepin up to date with project activities and progress in policymaking,	
	Rural Energy Agency (REA)		
	Energy and Water Utilities Regulatory Authority (EWURA)	regulatory and other activities.	
	Land Transport Regulatory Authority (LATRA)		
	Tanzania Mining Commission		
	Tanzania Meteorological Agency (TMA)		
	Tanzania Communications Regulatory Authority (TCRA)		
	Tanzania Forest Services (TFS)		
	Tanzania Wildlife Research Institute (TAWIRI)		
	Tanzania Wildlife Authority (TAWA)		
	Tanzania Peoples' Defence Forces (TPDF)		
	National Irrigation Commission		
	National Irrigation Zone		
	Singida Region Commissioner / Regional administrative secretary		
	Tabora Region Commissioner / Regional administrative secretary	Responsible for the implementation of legislation, and	
	Shinyanga Region Commissioner / Regional administrative secretary	development plans and policies at the regional level. This	
	Local Government Authority (LGA) - Manyoni District	Includes issuing authorization for land concession and physical resettlement.	
	LGA - Itigi Council	Interested in project involuntary	
Secondary	LGA - Tabora Municipal Council	displacement impact and keeping up to date with project activities	
stakeholders	LGA - Uyui District Council (DC)	and progress in policymaking,	
local	LGA - Sikonge DC	regulatory and other activities.	
government authorities	LGA - Nzega DC	adverse and beneficial impacts	
	Tanzania Police Force at the district level	such as (community health and safety, procurement and supply chain, etc.)	
	Uyui, Sikonge, Nzega)	May be able to influence the	
	High court of Tanzania - Singida, Tabora and Shinyanga	opinion. CSOs may also have useful data or insights into the	
	Commission for Mediation and Arbitration (CMA)	local and national issues raised by the project.	



Stakeholder group	Stakeholder bodies	Relevance to project/nature of interest, level of influence/control	
	Jamil Salama Development Volunteers		
	Tabora Paralegal Centre		
	Link Against Poverty		
	Mamas Development Foundation	Interested in project potential	
	Trade Union' Congress of Tanzania	adverse and beneficial impacts	
Secondary	Association of People living with HIV/AIDS	safety, procurement and supply chain, etc.)	
	Tanzania Institute of Rail Technology (TIRTEC)	May be able to influence the project directly or through public	
– civil society/	Aga Khan Foundation (Tanzania)	useful data or insights into the	
non-	IUCN	local and national issues raised	
organization	CARE	Interested in the project and	
(CSOs/NGOs)	Tanzania Forest Conservation Group	need to be aware of the ability to negotiate for more favourable working conditions and other benefits through collective bargaining.	
	WWF (Regional Office for Africa / WWF Tanzania)		
	Birdlife International (Tanzania)	Grievances from construction	
	African Wildlife Foundation (AWF)	personnei.	
	Project and suppliers' workers and employees		
Project workers including supply chain workers and workers union	Suppliers & their sub-contractors	Key stakeholders in demonstrating that the rights of the supply chain workers are respected and enforced including ensuring that they have access to the grievance mechanism.	
Suppliers	Regional and local mass media (local Radio, TV and blogs)	Media coverage of planned Project enabling wide and regular dissemination of project information and facilitating stakeholder engagement	
Project lenders	Standard Chartered, KfW-DEG, etc.	Decision making stakeholders that will be providing finance for the Project.	

The matrix lists the identified stakeholders and their relevance to the project/nature of interest in the project. The matrix also enables the identification and characterization of vulnerable groups. The following groups are considered vulnerable in the context of the project:

• indigenous peoples of Maasai, Barbaig, Taturu, Tindiga and Sandawe present in Manyoni, Itigi and Uyui district (indigenous people are only found along Lot 3 and none have been identified along Lot 4)



- pastoralist indigenous people and non-indigenous people livestock keeper present in some wards
- elderly people, women, single headed households, orphans/orphan headed households, children, people living with disabilities and chronic illnesses
- people who rely on natural resources such as forests and woodland for their livelihoods
- poor households and those that receive social support or any kind of assistance from the government.

8.5 Stakeholder engagement method

Multiple mechanisms have been used for the stakeholder engagement and project information dissemination, such as (i) informal face-to-face meeting, (ii) formal face-to-face meetings, (iii) correspondences (phone calls & letters), (iv) public meetings, (v) focus group discussions, (vi) key informant interviews, (vii) distribution of visual aids, and (viii) storytelling. Stakeholder communication method for Lots 3 and 4 is provided in more detail in the SEP.

8.6 Summary of previous stakeholder engagement

8.6.1 Rapid ESIA stage

Consultation during the RAPID ESIA was undertaken (05 to 12 November 2021) with selected stakeholders to inform them about the project (specifically the Lot 3 line) and obtain concerns, suggestions and address any environmental and social questions in relation to the project. The consultation was also aimed at gathering information to understand potential landuses along the alignment and obtain clarity of the complexity of the project, so as to prepare the project's environmental and social Scope of Work (SoW) to guide the assessments and studies needed, and to provide recommendations that embrace rational use of resources in the planning process.

The consultation was undertaken at Ihumwa, and the methods used for the stakeholder engagement at this stage included letters and telephone calls and face-to-face meetings. The stakeholders consulted at this stage were from Singida regional office, Itigi DC, Manyoni DC, Tabora Regional Office, Tabora Municipal Council and Uyui District. Participants indicated that there are wildlife corridors, forest reserves, historical sites and items of cultural importance along the alignment. Early adjustments in routing were done where possible to avoid or minimise impact on natural resources.

8.6.2 Scoping phase

Consultation during the scoping phase was undertaken along Lot 3 from Makutopora to Tabora and Lot 4 from Tabora to Isaka alignment from 27 May to 20 July 2022. Consultation at this stage involved both directly and indirect primary stakeholders and the stakeholder bodies consulted are Manyoni, Itigi, Uyui, Sikonge Districts and Tabora Municipality for Lot 3, and Nzega District, Uyui District Wards, Tabora Municipality, and The District Executive Director and heads of department (of Manyoni DC, Uyui DC, Itigi DC, Tabora Municipal Council, Nzega DC, Sikonge DC) for Lot 4.

8.6.3 National ESIA phase

Stakeholder consultation during the ESIA phase was undertaken from 09 August to 15 September 2022. The ESIA Ppase consultation focused on identifying and consulting with vulnerable stakeholders, discussing issues relating to compensation, land valuation



procedure, assistance to affected communities, right of way (RoW), health and safety, project activities, employment opportunities, GRM procedure, etc.

Consultation at this stage mostly involved secondary stakeholders (ministries, government agencies, local government authorities, and CSOs). The full stakeholder bodies consulted are outlined in the SEP. A summary of the outcome of the consultation conducted during the scoping and ESIA is provided in SEP.

IPs of Maasai, Barbaig and Taturu pastoralists are present in the Manyoni and Itigi Districts along Lot 3 alignment. No IP were identified along Lot 4 alignment. The IPs reside mainly Makutopora, Mdunundu, Aghondi, Mabondeni, Kitopeni, Itigi Mjini, and Malongwe villages and they were consulted between 09 August and 20 August 2022 as with other community members of these villages. The consultation involved diverse IP groups including village leader, traditional leaders, traditional religious leaders, youth, women and the elderly.

The national ESIA consultations with IP did not obtain the Free Prior Informed Consent (FPIC) from the IPs. However, it is understood that this will be secured and detailed in the indigenous people plan (IPP).

8.6.4 Stakeholder consultations as part of lenders ESIA

Crossing consultations was held between December 2022 and January 2023 to determine the number of people, wildlife and livestock crossings required by communities and identify suitable locations where the project can establish the crossings within the villages. This consultation involved a total of 671 community members (both male & female) from 24 villages along Lot 3 alignment and included local government officials, influential elders, youth, elderly and women.

8.6.5 Other stakeholder engagements undertaken for the project

In addition to the scoping and ESIA stage stakeholder consultation, other stakeholder engagement activities were conducted to inform communities about the Project particularly those that could not attend public meetings. A summary of community project awareness trainings, door-to-door awareness and school trainings is provided in SEP.

8.6.5.1 Community Project Awareness Training

Project awareness campaigns were undertaken by TRC from 10 April to 13 May 2022. In addition to this, YM conducted community awareness training between 08 July 2022 and 10 August 2022 to inform community members along Lot 3 route of the project activities and potential impacts/risks that may arise, ongoing activities and the health & safety risks associated with access to active construction areas. The meeting also included raising the participants awareness on HIV/AIDS and the project's grievance mechanism. A total of 3,160 people benefitted from the training in 27 villages. Key concerns and requests raised include:

- procedure for the relocating the graves and graveyards within RoW
- provision of crossings for people at specific areas in respective villages
- delay in land compensation procedure
- provision of wildlife and livestock crossing
- prioritizing local workforce and community for project employment opportunities
- employment opportunities from the project
- blockage of water drainage system due to project activities
- influx of people into community because of project's development



• request for compensation and valuation procedure.

8.6.5.2 Door-to-door awareness

Door-to-door awareness was undertaken with community members along Lot 3 alignment and residing in proximity to project facilities which included the crusher, production and quarry area, dumpsites and borrow pits. The awareness was undertaken to provide local community members with knowledge on excavation, blasting, safety, crossing and project GRM. The door-to-door awareness was held between 18 August 24 November 2022 and involved a total of 468 community members from 17 villages. During the door-to-door awareness, majority of the participants had no questions and/or concerns regarding the project activities. Only community members from Itulu village raised concern on the proximity of the quarry and project access road to residences, dust emission from blasting activities and vehicle movement and project undertaking road clearance prior to valuation process.

8.6.5.3 School training

School training was undertaken at a total of 39 primary and secondary schools along Lot 3 alignment from 12 September to 14 November 2022. Students were provided with general information on the project, safety measures in active construction areas, crossing awareness, basic knowledge in excavation and risk associated with excavated areas and the importance of biodiversity conservation and environmental preservation. Students were also informed about the project's grievance mechanism and were informed to submit grievances to their teachers who will submit on their behalf to the project's CLO. During the training, no questions or concerns were raised in the majority of schools. The only concern was regarding speeding of trucks.

8.6.5.4 Human rights consultations

Human rights consultations were undertaken by the project between 24 and 26 August 2022. These consultations were undertaken with the NGOs and groups. The main topics of discussion included the right of communities to adequate standard of living, women's rights (including vulnerability of women in the compensation process), gender-based violence and harassment, children rights (relating to child labour, sexual exploitation of children, child trafficking etc.).

8.7 On-going stakeholder engagement programme

8.7.1 Indigenous people consultations

The schedule and timeline for the additional indigenous people's consultation is currently being finalised by the IP experts. The outcome of the consultation in relation to views, concerns of the IP and their expectations of the project will be detailed in the IPP which will be prepared post-ESIA. (Note that for the purposes of the ESIA, an IP Framework was prepared to guide the scope and activities of the preparation of the IPP, but also to enable, through this ESIA and the ESMP, the Proponent and Contractors commitment to proper procedure for development of an IPP, see Section 13.)

8.7.2 Resettlement action plan

The specific resettlement and livelihood restoration activities for Lots 3 and 4 are currently on-going and being undertaken by the TRC, separately from the Bankable ESIA process. These include the announcement of cut-off dates, socio-economic household surveys, asset inventory and valuation etc. In addition, a guide to land acquisition and compensation (GLAC) will be developed and disclosed in English and Swahili to serve



as a summarizing document of the RAP and present the compensation process in a non-technical manner.

TRC will be responsible for undertaking RAP stakeholder engagement and consultation activities but coordination with YM will be required to address any unanticipated impacts (such as damage to crops, assets) in line with the principles and methodologies established in the RAP.

8.7.3 EPC contractor community awareness consultations

The EPC contractor, YM, is currently undertaking engagement activities with the local community members to inform stakeholders of activities that have commenced along the Lot 3 alignment, as clearance works, geotechnical surveys, establishment of quarries, borrow pits, dump sites, construction amps, etc. These stakeholder engagements are phased based on the construction schedule of the alignment. These consultation meetings include (i) community awareness, (ii) blasting awareness, (iii) grievance mechanism awareness, and (iv) cultural heritage meetings.

8.8 Grievance mechanism

The scope of the grievance mechanism is to evaluate and address stakeholders' problems and concern regarding project activities, the implementation of mitigation and compensation measures as per the ESIA, IPP, RAP and environmental and social performance of the project.

All relevant claims from affected stakeholders will be accepted and no judgment made before investigation, even if complaints are minor. This includes complaints in relation to gender-based violence, sexual exploitation and abuse, sexual harassment, compensation due to involuntary resettlement, impact on sacred sites, impacts on items of cultural importance and conflict between project employees, security guards and community members etc.

8.8.1 Grievance mechanism in construction phase

The construction phase will require two separate grievance mechanisms to be implemented for the following parties:

- internal parties: construction personnel, workers, project staff, (including subcontractors' staff and visitors), supply chain workers
- external parties.

Although TRC will remain responsible and accountable, the EPC contractor, YM, will manage internal and external grievance mechanisms that relates to the construction of the project. It is understood that YM has engaged 4 CLOs to receive and resolve grievances received along the Lot 3 alignment and 1 CLO to receive and resolve grievances along the Lot 4 alignment. YM will also be required to train related staff such as YM security personnel, YM human resources personnel, CLOs etc that will be involved in receiving and/or resolving grievances. Grievances will be investigated by the EPC contractor and may require co-ordination with TRC and other sub-contractors. All received grievances will be acknowledged within 5 working days of receipt, or quicker depending on the urgency of the grievance for the process flow and timeline.

Adequate resources will be allocated to the CLOs and related staff members responsible for receiving, resolving, and managing grievances. The CLOs and related staff members will be experienced in engagement processes and will be familiar with the lender requirement for stakeholder engagement. Where these staff members are not experienced, they will be provided training on lenders requirement on stakeholder engagement and grievance mechanism and the contents of this SEP.



8.8.2 Grievance procedures for women, vulnerable and disadvantages groups

TRC has developed a gender based violence (GBV) policy which aims to effectively eliminate all forms of GBV and SEA and to respond and support victims and survivors, their families and the communities at large during construction of TRC facilities/projects.

According to the GBV policy, TRC will engage leaders from the local government areas and villages along the railway alignment to form the community/ward GBV & SEA committee. This committee will serve as community representatives who can create awareness on GBV& SEA and receive related grievances from the community members immediately and report to social welfare officers/experts assigned by TRC to handle all GBV and SEA cases. The social welfare/experts will inform the GBV and SEA Steering committee on the status of the GBV & SEA related grievance.

The GBV policy requires the process of investigating and addressing GBV and SEA cases to be survivor centred and to protect the rights of the victim, their dignity, safety and other needs. TRC and YM will develop channels and tools for anonymous reporting of GBV cases. The reporting channels will maintain safety and confidentiality to encourage reporting of such incidents. The reporting channels will include any of the following:

- **community members:** Channels may include complaint/feedback boxes, a toll -free telephone number, a designated community organisation (e.g. community/ward GBV & SEA Committee, CSOs/NGOs, etc.), service-user group or local women's organisation. Reporting channels shall include anonymous and child friendly options to encourage children and young people to come forward.
- **workers:** Channels may include complaint/feedback boxes at site/office, online reporting on company website or email or designated staff member who will be trained on how to handle GBV cases.

At the time of writing the SEP, a total of 13 grievances have been received from community members along the SGR Lot 3 alignment. The grievances received were in relation to land encroachment, crossing issues, and property damage and all of these grievances have been resolved accordingly and responses conveyed to complainants/grievant. All grievants expressed satisfaction with the resolution conveyed based on the records provided to 5 Capitals. However, there is a need to align all responses with the lenders requirements to provide stakeholders with sufficient information.

It should be noted that at the time of writing, 5 capitals was advised that no grievances have been received in regard to Lot 4. However, during cultural heritage consultations undertaken by RSK in February 2023, some communities expressed concerns about ongoing activities. The summary of concerns raised is provided in the SEP.

8.9 Implementation plan

The overall responsibility and accountability for the stakeholder engagement and management of the grievance mechanism will be held by TRC – the Project Owner throughout the lifetime of the project. In order for the SEP to function effectively, it is important to determine a management structure and assign suitable personnel(s) to implement and manage SEP.

It is noted that TRC and YM will each be responsible for their own stakeholder engagement and consultation processes and grievance mechanism. However, both TRC and YM will be required to coordinate their implementation of the SEP to avoid confusion or contradictions in how stakeholders are engaged with and/or grievances are addressed.



9 GOVERNANCE REQUIREMENTS

The Lots 3 and 4 SGR project was classified as category A by the NEMC, requiring a full ESIA. Numerous additional Tanzania laws, regulations and standards apply. This section provides identification and review of the key legislation applicable to the project (extracted and adapted from ERM, 2019). Additionally, key applicable LAS, international protocols and corporate governance plans/procedures are reviewed. Additional applicable governance documentation identified is included in Appendix 2.

9.1 The Constitution of the United Republic of Tanzania

The Constitution of the United Republic of Tanzania came into operation on 26 April 1977. It is a fundamental law and considered the foundation of all other legislation enacted in the United Republic of Tanzania. The right to give and receive information is enshrined in the Constitution, which includes the giving and receiving of information on environment and natural resource management. Moreover, the Constitution provides for the protection of citizens to live in a clean and healthy environment.

9.2 Policy and strategic plans

9.2.1 National Transport Policy (NTP, 2003)

The vision of this policy is "to have an efficient and cost-effective domestic and international transport service to all segments of the population and sectors of the national economy with maximum safety and minimum environmental degradation".

The mission of this policy is to "develop safe, reliable, effective, efficient and fully integrated transport infrastructure and operations which will best meet the needs of travel and transport at improving levels of service at lower costs in a manner which supports government strategies for socio-economic development whilst being economically and environmentally sustainable".

This policy acknowledges that in the rural areas of Tanzania the transport situation is highly affected by poor infrastructure. Hence, the key objectives of the transport policy directly applicable to the project are to:

- improve the transport infrastructure to enable easier movement of agricultural and livestock inputs and outputs to and from rural and urban areas. Agricultural and livestock inputs need to be transported into villages and surplus outputs need to be transported to markets, which are normally located in urban areas
- improve infrastructure whilst minimizing wasteful exploitation of natural resources and enhancing environmental protection. Improving infrastructure assists in poverty reduction and eradication, which is a major goal in Tanzania

The project will, in the success scenario, contribute towards delivering efficient and costeffective domestic transport service to all segments of the population along the alignment and sectors of the national economy with maximum safety and minimum environmental degradation.

9.2.2 National Environmental Policy (NEP, 2021)

The policy aims to strengthen the coordination of environmental management in all socioeconomic sectors at all levels. It enhances environmentally sound management of land resources for socio-economic development. It promotes gender and marginal interest



groups in environmental management. It promotes predictable, accessible, adequate and sustainable financial resources for environmental management.

The provisions regarding environmental protection and management of the negative impact associated with the development of the project are to be addressed through the relevant legislation and regulations provided for in the NEP.

9.2.3 The National Climate Change Strategy (NCCS, 2012)

The policy seeks to assist in the efforts to promote the economy and livelihood of the people. The policy insists that environmental management and the development of sustainable tourism is intertwined and not isolated from each other.

As a result, the policy requires that the development of tourism in any area must be based on a careful assessment and improvement of special environmental features in order that tourism development does not conflict with indigenous forests, beaches, mountains and other important vegetation. Section 5.6 the policy states that, "...all proposed land allocations for tourism investment are approved after environmental impact assessment (EIA) studies have been carried out, approved and appropriate license issued as a measure to ensure sound environmental protection".

The Aghondi beekeeping reserve is of relevance under the policy.

9.2.4 The Tanzania 2025 Development Vision

The Tanzania Vision 2025 aims at achieving a high-quality livelihood for its people, attain good governance through the rule of law and develop a strong and competitive economy. Safe, reliable and cost-effective railway transport is considered one of the most important agents to enable Tanzania to achieve its development vision objectives (both social and economic), such as eradicating poverty, attaining food security, sustaining biodiversity and sensitive ecosystems. The implementation of the project contributes to the attainment of the 2025 vision, which has the following specific targets:

- a high-quality livelihood characterized by sustainable and shared growth (equity), and freedom from abject poverty in a democratic environment. Specifically, the vision aims at: food self-sufficiency and security, universal primary education and extension of tertiary education, gender equality, universal access to primary health care, 75% reduction in infant and maternal mortality rates, universal access to safe water, increased life expectancy, absence of abject poverty, a well-educated and learning society
- good governance and the rule of law moral and cultural uprightness, adherence to the rule of law, elimination of corruption
- a strong and competitive economy capable of producing sustainable growth and shared benefits a diversified and semi-industrialized economy, macroeconomic stability, a growth rate of 8% per annum, adequate level of physical infrastructure, an active and competitive player in regional and global markets.

9.3 Legal framework

The following section includes the governance framework presented for TRC in the Lots 1 and 2 ESIA (ERM, 2019) report and adapted with the assessment of the Lots 3 and 4 ESIA team. Other applicable legislation is included in Appendix 2.

9.3.1 Environmental Management Act No. 20 of (2004), Cap 191

The Environmental Management Act (EMA) Act of 2004, Cap 191, is an umbrella law on environmental management in Tanzania. The legislation establishes principles and



provides regulatory framework for decision-making on matters affecting the environment, such as sustainable management of the environment, prevention and control of pollution, waste management, regulation, and compliance. Section 4(1) of the act requires that certain types of development projects be subjected to an environmental and social impact assessment (ESIA) in accordance with the regulations under the act, to determine whether a programme, activity, or project will have any adverse impacts on the environment.

The UDSM, on behalf of TRC, completed the ESIA in compliance with the Environmental Management Act, which was subsequently approved by NEMC. In accordance with the national regulations, the project will be required to commit to implementing the ESMP laid out in the UDSM ESIA.

Integration between the UDSM ESMP and the bankable ESMP (presented with this ESIA) will be required and any material/substantive changes between the two may need to be presented to the NEMC for approval of an updated, integrated ESMP.

9.3.2 The Environmental Management (Impact Assessment and Auditing) Regulations (2005)

These regulations set procedures for conducting EIA and environmental audit in the country. The regulations also require EIA and environmental audits to be undertaken by registered EIA and audit experts respectively. Environmental Licence for the project has already been obtained through the ESIA process conducted by the UDSM.

9.3.3 The Environmental Management (Air Quality Standards) Regulations, 2007

The objectives of these regulations are to set baseline parameters on air quality and emissions and enforce minimum air quality standards. They are also meant to protect public health as well as the environment from various air pollution emissions sources. These Regulations stipulate the role and powers of the National Environmental Standards Committee. Section8 (1) of the regulations prohibit emissions and releases of hazardous substances into the environment and prescribe permissible emission limits and quantities of emissions of sulphur oxide, carbon monoxide, black smoke and suspended particulate matters, nitrogen oxide, ozone, hydrocarbons, dust and lead. Test methods for these are also specified.

According to the regulations, the approval of a permit for emission of air pollutants shall be guided by ambient, receptor, emission and specification standards approved by the Minister. Offences and penalties for contraveners are also provided for in the regulations.

A comparison of Tanzanian, East African and WHO air quality standards/guidelines was conducted. The lowest of the criteria (most stringent) over an appropriate averaging period is typically be selected as the project standard. The project standards select are a combination of the above-mentioned standards and are presented in Table 16-3 of Section 16.

9.3.4 The Environmental Management (Soil quality standards) Regulations, 2007

These Regulations require the project proponent to:

- comply with soil quality standards that may be prescribed by the National Environmental Standards Committee (Part II, Section 5)
- abstain from polluting soils (Part III, Section 15)
- abstain from discharging hazardous, waste, materials and chemicals on soils (Part III, Section 16).



9.3.5 The Environmental Management (Water Quality Standards) Regulations, 2007

The regulations enforce minimum water quality standards prescribed by the National Environmental Standards Committee, enable the National Environmental Standards Committee to determine water usage for purposes of establishing environmental quality standards and values for each use and ensure all discharges of pollutants take into consideration the ability of the receiving water to accommodate contaminants for protection of human health and conservation of marine and aquatic environments.

The Regulations elucidate the role of the National Environmental Standards Committee of Tanzania Bureau of Standards in setting minimum quality standards for water, sewerage, etc. They also give prohibitions and prescribe minimum water quality standards. The applicant of the water right is obliged to indicate the likely impact on the environment and comply with prescribed effluent or receiving water standards, which are not below the standards specified in these regulations if the water right or permit is granted.

The regulations give NEMC the power to designate main water polluting activities for which a prior grant of a permit must be obtained from the Council. It can be observed from the regulations that the NEMC plays a crucial role in water quality compliance and enforcement. Recording and reporting requirements, offences and penalties for noncompliance as well as how appeals against aggrieved decisions should be handled, are stipulated.

The project will discharge pollutants and therefore the project will need to comply with the water quality standards and obtain necessary licences and authorisations and comply with conditions thereof.

9.3.6 The Environmental Management (Solid Waste Management) Regulations, 2009 as amended in 2016

The regulation has been made under section 114, 115, 116, 117, 118, 119, 120, 121, 122 and 230 of Environmental Management Act, 2004. These regulations apply to all matters pertaining to solid waste management. They aimed at setting standards for permits to dispose solid waste and for licenses to own or operate solid waste disposal site.

The SGR Lots 3 and 4 project will be handling solid waste and thus requires the appointment of a waste management contractor. The project comply with the solid waste regulations and obtain necessary permits, licences and authorisations and comply with the conditions thereof.

9.3.7 The Environmental Management (Hazardous Waste Control and Management) Regulations, 2021

These regulations have been made under section 133(4) and (5), 135 (1) and 230(2) (f) of the Environmental Management Act, 2004. These regulations apply to all categories of hazardous waste from generation, collection, storage, transportation, treatment, recycling, reuse, recovery and disposal of hazardous waste and their movement in, into and out of mainland Tanzania. These regulations require that any person dealing with hazardous waste in Tanzania be guided by following principles of environment and sustainable development:

- the precautionary principle
- polluter pays principle
- the producer extended responsibility.

The SGR Lots 3 and 4 project will be handling hazardous waste and thus requires the appointment of a waste management contractor to collect scrap, metals, waste oil, tyres and used batteries. The project must comply with the hazardous waste control regulations



and obtain necessary permits, licences and authorisations and comply with the conditions thereof.

9.3.8 The Environment Managemental (Control and Management of Electrical and Electronic Waste) Regulations, 2021

This applies to all categories of electrical and electronic equipment wastes with respect to generation, collection, storage, transportation, importation, exportation, distribution, selling, purchasing, recycling, refurbishing, assembling, dismantling and disposal of electrical and electronic equipment waste or components, and their movement into or outside mainland Tanzania.

A number of activities in the project have the potential to generate electrical and electronic equipment wastes. YM and TRC will be obliged to adhere to the requirements of the regulation in their management of these wastes.

9.3.9 The Environmental Management (Quality Standards for Control of Noise and Vibration Pollution) Regulations (2011)

These regulations require the project proponent to:

- acquire permission (permits) for activities that make or cause to be made any loud, unreasonable, unnecessary, or unusual noise that annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and that of the environment (Part III, Section 6)
- use the best practicable means to negate the emission of noise from that machinery, facility or premises above the permissible noise levels as specified in Schedule 1 (Part V, Section 8)

9.3.10 Land Act No. 4 of 99 and Village Land Act No. 5 of (1999)

9.3.10.1 Land tenure system

The existing land ownership system has a history of more than forty years. At present the Land Act (1999) and the Village Land Act (1999) provide guidance to land ownership in Tanzania. The laws vest all land in the President and grant occupancy rights to individuals, legal persons and territorial communities. The President holds land in trust for all citizens and can acquire land for public use and benefit, for instance, to resettle people from densely populated areas to sparsely populated areas, settle refugees and so forth. The President can also acquire land for other national projects, like road construction.

9.3.10.2 Compensation rules

Under the government standing order on expropriation for public utility, the holder of a right of occupancy is guaranteed a free enjoyment of the land and is entitled to compensation if dispossessed by the Government for public use. In many cases whilst the holders agree to leave their land, they are not happy with the amount and/or delay in getting compensation e.g. improvements that they have made to the land are omitted or underrated. The expropriation should match the price that improvements can fetch if sold in the open market. Replacement value (defined as the cost of putting up a structure equivalent to the evaluated one) makes allowance for age, state of repair and economic obsolescence. The compensation must therefore include:

- the replacement value of the un-exhausted improvements
- disturbance and transport allowance
- loss of income



- · cost of acquiring or getting an equivalent land
- actual value of the present property/utility available in the land and
- any other immediate costs or capital expenditure incurred in the development of the land.

The project involves resettlement of people and their properties. As part of the bankable ESIA, an assessment of the potential impacts related to involuntary resettlement and physical and/or economic displacement and the extent of land-take has been conducted (Section 11).

The socioeconomic census and survey for the project is being conducted by TRC and was ongoing at the time of this assessment. A RAP and LRP were also being prepared by TRC and should be completed in 2023.

9.3.11 Land (Compensation Claims) Regulations, 2001

The Land Regulations, 2001, were promulgated in terms of the Land Act, Act No. 4 of 1999 sections 12 & 179. The form of compensation is stipulated in Section 10(1) of the Land Regulations, 2001. Furthermore, the Regulations list the entities that are eligible for compensation and/or resettlement. If the person does not agree with the amount or method of payment or is dissatisfied with the time taken to pay compensation, he /she may apply to the high court. The high court shall determine the amount and method of payment and determine any additional costs for inconveniences incurred. The proponent will comply with this Act throughout the project lifetime.

9.3.12 Land Acquisition Act, 1967

Under the Land Acquisition Act, 1967, the President may, subject to the provisions of this Act, acquire any land for any estate or term where such land is required for any public purpose.

Land shall be deemed to be acquired for a public purpose where it is required, e.g. for exclusive government use, for general public use, for any government scheme, for the development of agricultural land or for the provision of sites for industrial, agricultural or commercial development, social services, or housing or; where the President is satisfied that a corporation requires any land for the purposes of construction of any work which in his opinion would be of public utility or in the public interest or in the interest of the national economy, he may, with the approval, to be signified by resolution of the National Assembly and by order published in the gazette, declare the purpose for which such land is required to be a public purpose and upon such order being made such purpose shall be deemed to be a public purpose; or in connection with the laying out of any new city, municipality, township or minor settlement or the extension or improvement of any existing city, municipality, township or minor settlement; etc.

Upon such acquisition of any land, the President is compelled on behalf of the government to pay in respect thereof, out of moneys provided for the purpose by parliament, such compensation, as may be agreed upon or determined in accordance with the provisions of the Land Acquisition Act, 1967.

The President may also revoke a right of occupancy if in his opinion it is in public interest to do so. Accordingly, the land for which a right of occupancy has been revoked reverts back to the Government for re-allocation pursuant to the existing need(s). It should also be noted here that, though the land belongs to the government some changes on the land act has taken place. Land has value to the owner; therefore, any land taken from the user has to be compensated. Based on this act the villagers affected by the project are claiming that they should be compensated for the lost farms and land used for residential purposes.



TRC shall comply with the requirements of this Act during the whole resettlement and compensation process. However, the Act has no provisions requiring disclosure of RAPs or LRPs, even if a project interferes with people's livelihoods. IFC requirements for disclosure will need to be followed and full disclosure of the RAP should be conducted once ready. The Act does however require the Act requires the issuance of prior notices for land acquisition for public development.

9.3.13 Village Land Act, 1999

The Act was enacted specifically for the administration and management of land in villages. The Act gives power to village councils for the management of village land in accordance with the principles of a trustee managing property on behalf of a beneficiary. The Act requires that land be managed with respect to sustainable development, the relationship between land uses, other natural resources and the environment. In relation to the project, the Act mandates the recognition of formal proprietary rights to land within rural areas (village), including deemed customary rights of occupancy.

9.3.14 Land Use Planning Act, 2007

The Act provides for the procedures for the preparation, administration and enforcement of land use plans; to repeal the National Land Use Planning Commissioning Act and to provide for related matters. Among the objectives of the Act as given in Section 4 are to facilitate the orderly management of land use and to promote sustainable land use practices.

The project entails defining a 60 m ROW (i.e. 30 m on either side of the centreline) resulting in the need for acquisition of this land for the ROW as well as for ancillary and associated activities. The Act regulates all issues of land acquisition.

9.3.15 Land (Assessment of the Value of Land for Compensation) Regulations, 2001

The regulations prescribe the principles and methods for the valuation of property within areas designated for expropriation and public development. In addition, the Regulation specify criteria for the assessment of land compensation and set out valuation principles for the provision of disturbance, transportation and living allowances.

In relation to the project, the Act mandates the use of a qualified and licensed valuator to undertake the valuation of property on land subject to expropriation in line with the aforementioned provisions.

9.3.16 Water Resources Management Act No. 11, 2009

This Act regulates the extraction and utilization of water from water sources. It provides guidance for management of surface and underground water resources and stipulates that a permit is required for water disturbance or diversion, dams, storage, abstraction, use and discharges. The abstraction of water and discharge permits must be obtained from the Basin Water Board (Water officer) at the relevant Basin Water Board Offices. The water basin authorities are part of the Ministry of Water and Irrigation. The project will need to obtain necessary approvals/permits and will comply with the provision of this Act.

Other licences under the Act that are pertinent to the project are the **groundwater drilling permit** and **water use permit**

9.3.17 Water Resources Management (Water Abstraction, Use, and Discharge) Regulation, 2010

The Regulations regulate surface water and groundwater use and discharge permitting under the provisions of the Water Resources Management Act, No.11, 2009.



The project will need to abstract water from underground water sources, discharge and manage effluent. The project will obtain necessary licences and authorisations for discharge and comply with conditions thereof.

9.3.18 National Forest Act, 2002

This Act deals with the protection of forests and forest products in forest reserves, the restrictions, and prohibitions in forest reserves. Forest management plans are administered under the Forest Ordinance, 1957. The Act requires licenses or permits for certain activities undertaken within the national or local forest reserves, such as, among others, felling or removal of trees, harvesting forest produce, entering a forest reserve for the purpose of tourism or camping, mining activities, occupation or residence within the reserve, cultivation, erecting any structures.

Section 18 of the Act requires project proponents to prepare an EIA for any development within a forest reserve, private forest or sensitive forest area, including commercial logging, mining development, road construction and laying of pipes. The inclusion of forest descriptions impacts and mitigation measures in this ESIA is in accordance with the Act. For works done in the forests, **a permit** is to be sought from the authority.

The SGR Lots 3 and 4 route traverses Nyahua Forest Reserve in Sikonge District and Aghondi forest as part of National Beekeeping Reserve that is nationally protected. The project will need to engage with the forestry stakeholders and acquire all the necessary permits to ensure that provisions of this Act are adhered to throughout project implementation.

9.3.19 The Wildlife Conservation Act No 5/09, 2009

This Act establishes wildlife protected areas, wildlife management areas and species management areas. It also makes a declaration of protected species and Tanzania's duty to abide by international obligations regarding species afforded protection through international laws and treaties.

The prime purpose of this Act are to:

- make better provisions for the conservation, management, protection and sustainable utilization of wildlife and wildlife products
- repeal the Wildlife Conservation Act Cap. 283
- provide for other related matters.

Section 74 of the Act states that "A human activity, settlement or any other development that will adversely affect wildlife shall not be permitted within five hundred meters from the wildlife protected area borderline without the permission of the Director."

The EIA will consider the extent to which the project will interact with species that are afforded protection through international laws and treaties. TRC and its contractors will comply with the requirements of this Act where applicable.

Under the Act, a permit is required for hunting, capturing, killing, wounding, or molesting any animal, including fish, in any game park or game-controlled area.

There are no designated protected areas within the project, but the wildlife corridors found within the AoI trigger compliance with the Act.

9.3.20 Explosives Act. 56/63

This Act gives the Commissioner for Mines responsibility for regulating explosives. First, section 3 stipulates that no import, manufacture, possession, acquisition, or disposition of explosives shall be allowed without approval from the Commissioner. Sections 7-9 stipulate that a person must have a license from the Commissioner for Mines to legally



manufacture explosives. Part V of the Act further requires a permit for transport of explosives. Part VI requires a permit for acquisition, possession, and disposal of explosives. Part VII requires a permit for storage of explosives. Part VIII requires a permit for use of explosives. An explosives permit can give conditions. The project will need to engage with the relevant stakeholders and acquire all the necessary permits to adhere to provisions of this Act throughout project implementation.

9.3.21 Explosives Regulations of 1964, GN 56/64

The Explosives Regulations of 1964, GN 56/64, establish conditions for licensing stores, magazines and general precautions for explosives. They also stipulate the nature of work that is permissible when blasting, and the requirement that storage places for explosives be at a certain distance from other buildings. A condition on all of the licenses is that the explosives must be stored in a licensed magazine or store or approved storage boxes.

9.3.22 Mining Act No. 4, 2010

This Act states that "building material" includes all forms of rock, stones, gravel, sand, clay, volcanic ash or cinder, or other minerals being used for the construction of buildings, roads, dams, aerodromes, or similar works but does not include gypsum, limestone being burned for the production of lime, or material used for the manufacture of cement.

This Act makes sure minerals are well controlled and Section 6(1) states that "no person shall, on or in any land to which this act refers, prospect for minerals or carry on mining operations except under the authority of Mineral Right granted or deemed to have been granted under this Act." In additional section 50.-(1) (v) of the act states that "The Minister shall grant an application for a mining licence for minerals which has been properly made under section 49 and a successful application for a mining licence made under section 71 unless the applicant has not included the relevant environmental certificate issued under the Environment Management Act".

The project shall apply for relevant mining permits before starting sand, gravel, rock and/or other mining activities. Where these materials are sourced from suppliers, the project must check that they are licensed and compliant prior to using their services.

9.3.23 Mining (Environmental management and Protection) Regulations, 1999

These regulations apart from other things give the Minister responsible for mining the mandate to exempt or ask for environmental information during application for mining licence. Section (4) of this regulations states that "Except in cases where an exemption has been to require EIA granted under section 64 (2) of the Act, an environmental impact statement and environmental management plan must accompany applications for Mineral Rights in all special mining license applications". These regulations require the contractor to apply for mining license for new borrow pits/quarry sites.

The project will apply for mining licenses for new quarry/borrow pits and will use licensed suppliers or operators when using existing suppliers.

9.3.24 Graves (Removal) Act No. 9, 1969

The Act provides for the translocation of graves from land acquired for public purposes. The Act mandates compensation for expenses incurred in the removal, transportation, reinstatement and re-internment of the grave and its contents, and any placatory or expiatory rites or other ceremony accompanying such removal and reinternment.

In relation to the project, the Act mandates compensation and assistance for the reestablishment of graves on replacement sites.



9.3.25 Antiquities Act (Act No. 10 of 1964) as amended (Act No. 22 of 1979)

The Antiquities Act is the principal cultural heritage legislation in Tanzania. The purpose of the act is to provide legal statutes for the preservation and protection of sites and articles of palaeontological, archaeological, historical, or natural interest. The act provides legal protection for relics, monuments, and protected objects.

Relic: any movable object made, shaped, painted, carved, sculptured, inscribed or otherwise produced or modified by human agency before the year 1863, whether or not it shall have been modified, added to, or restored at a later date, and any human or other vertebrate faunal or botanical fossil remains or impressions found in Tanganyika.

Monument: (i) any building, fortification, internment, midden, dam or structure erected, built, or formed by human agency in Tanganyika before the year 1863; (ii) any rock painting or any immovable object painted, sculptured, carved, incised, or modified by human agency in Tanganyika before the year 1863; and (iii) any earthwork, trench, edit, well, cave, tunnel, or other modification of the soil or rock, dug, excavated, or otherwise engineered by human agency before the year 1863.

Protected object: an ethnographic object11 or any wooden door or door frame carved in Tanganyika in any African oriental style, before the year 1940, and includes any object declared to be a protected object.

The Act and its subsequent amendments and implementing rules and regulations establishes the Antiquities Division within the Ministry of Natural Resources and Tourism as the cultural heritage regulator within Tanzania. The Act empowers the Director of the Antiquities Division (the Director) to declare any place or structure of historical interest as a monument and acquire monuments and relics in accordance with other applicable legislation such as the Land Acquisition Act. The Director is responsible for listing protected monuments, relics, and objects in the national Gazette.

The Act includes penalties for destroying or damaging protected monuments, relics, and objects listed in the national Gazette or any resource that could reasonably be assumed eligible for protection as a monument, relic, or protected object. The Act also requires any individual or organization that discovers a monument, relic, or protected object to report the discovery to an administrative officer, the Antiquities Division, and the Conservator or the Curator of the National Museum of Tanganyika.

A number of cultural heritage resources are affected by the Lots 3 and 4 project. The project will need to engage with the Antiquities Division to acquire the necessary permission to remove, relocate or protect affected cultural heritage.

9.4 Lender appraisal standards

9.4.1 IFC sustainability framework

The IFC's sustainability framework articulates the IFC's strategic commitment to sustainable development and is an integral part of risk management. The sustainability framework comprises IFC's policy and PS on environmental and social sustainability. The

¹¹ The 1979 amendment to the National Antiquities Act defines an ethnographic object as any movable object made, shaped, painted, carved, inscribed or otherwise produced or modified by human agency in Tanganyika after the year 1863 for use in any social or cultural activity whether or not it is still being used by any community in Tanganyika, but does not include any object made, shaped, painted, carved, inscribed or otherwise produced or modified by human agency in Tanganyika for sale as a curio.



policy on environmental and social sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. The PS are directed towards clients, providing guidance on how to identify 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 PS 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 IFC to achieve its overall development objectives. Together, there are eight established PS that the client is to meet throughout the life of an investment by IFC.

9.4.1.1 PS 1:Assessment and management of environmental and social risks and impacts

PS 1 requires a thorough environmental and social assessment, as well as adequate stakeholder engagement and disclosure of project information. Critically, the project must maintain a grievance mechanism and be responsive to grievances received through the full life of the project. The fundamental requirements of IFC align well with those of the national legislative requirements for ESIA. PS 1 requires the establishment and maintenance of an Environmental and Social Management System (ESMS), inclusive of an emergency preparedness and response system and plan. PS 1 requires a policy commitment from the Proponent, and sufficient organisational capacity to implement its ESMS efficiently. Both YM and TRC have environmental and social policy signed at CEO and Director General level respectively, thereby demonstrating policy commitment. YM has various environmental and social plans and procedures, including serval related to incidents and emergencies. It was not part of the scope of the Bankable ESIA to review the full ESMS of either TRC or YM in terms of IFC requirements. Rather, policies and plans were referred to as required to determine existing mechanisms in place that cover mitigation measures proposed. The review was only at a very high level. It is recommended that the TRCs ESMS is reviewed to demonstrate it is fit for purpose, or that a project specific ESMS is developed. YM would need to review its ESMS to demonstrate that it aligns with TRCs ESMS and IFC requirements.

9.4.1.2 PS 2: Labour and working conditions

The PS 2 recognizes 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, PS 2 requires the client to provide a safe and healthy work environment, taking into account inherent risks in its particular 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 PS 2 is managed through the client's ESMS. Policy commitment and a system for activate 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 Tanzania, there are five principal legislations that address the issues of labour and work conditions, these are:

- Occupation Safety and Health Act, 2003
- Employment and Labour Relations Act No. 6, 2004
- Workers Compensation Scheme Act No. 20, 2008
- The Railways (Safety Management) Regulation, 2018



• The Railways (Training, Competence and Medical Fitness of Safety Critical Workers) Regulations, 2018.

The legislation enables the workers are treated well and that their rights are protected including the right to work in a healthy environment.

9.4.1.3 PS 3: Resource efficiency and pollution prevention:

IFC recognizes 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 GHG threatens the public health and welfare of current and future generations. Concurrently, more efficient and effective resource use, 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 similar to those used to enhance quality or productivity, which are generally well known to most industrial, agricultural, and service sector companies. The applicability of PS 3 is established during the environmental and social risks and impacts identification process in PS 1. According to IFC, the implementation of the actions necessary to meet the requirements of PS 3 is managed through the client's ESMS.

In Tanzania, there are several legislations, which address the issues of resources use efficiency and pollution prevention. These include:

- The Environmental Management Act,f 2004, as amended: carrying out ESIA, dealing with pollution issues, waste management, environmental standards, etc.
- The Water Resources Management Act No. 11 of 2009 issues water quality and sanitation
- Public Health Act, 2009: issues of control of communicable diseases and hygienic handling of food in marketplaces
- The Environmental Management (Air Quality Standards) Regulations, 2007
- The Environmental Management (Water Quality Standards) Regulations, 2007Solid Waste Management Regulation, 2009 GN. NO. 263
- The Environmental Management Act (Hazardous Waste Control), 2009.

The ESIA for the project shall respond to the requirements of these legislations. In addition, Tanzania is a signatory to several international treaties and conventions including climate change. The ESIA shall also respond to relevant international aspects of the project in respect to environmental and social sustainability.

9.4.1.4 PS 4: Community health, safety and security

The PS 4 recognizes 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, PS 4 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 PS 4 is managed through the client's ESMS.

In Tanzania, the EIA and Audit Regulations, 2005, require project development to take appropriate actions and mitigation measures regarding safety of the workers and the



surrounding communities during the mobilization, construction and operation phases of the project. In addition, PS 4 will be complied to through adhering to the requirements of other relevant legislation such as:

- The HIV and AIDS (Prevention and Control) Act, 2008: control of HIV/AIDS spread in Tanzania
- Public Health Act, 2009: issues of control of communicable diseases and hygienic handling of food in marketplaces
- Occupation Safety and Health Act, 2003: health and safety during construction and operation phases
- The Railways (Safety Management) Regulations, 2018
- The Railways (Safety Assessors and Auditors) Regulations, 2018
- The Railways (Handling and Transportation of Dangerous Goods and Substances) Regulations, 2018
- The Railways (Level Crossing) Regulations, 2018
- The Railways (Accident and Incident Reporting and Investigation) Regulations, 2018
- The Railways (Training, Competence and Medical Fitness of Safety Critical Workers) Regulations, 2018
- The Railways (Safety Standards of Infrastructure and Rolling Stock) Regulations, 2018
- National Gender Policy, 2002.

9.4.1.5 PS 5: Land acquisition and involuntary resettlement

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.

According to IFC, the PS 5 applies to physical and/or economic displacement resulting from the following types of land related transactions:

- land rights or land use rights acquired through expropriation or other compulsory procedures in accordance with the legal system of the host country in question
- land rights or land use rights acquired through negotiated settlements with property owners or those with legal rights to the land if failure to reach settlement would have resulted in expropriation or other compulsory procedures
- project situations where involuntary restrictions on land use and access to natural resources cause a community or groups within a community to lose access to resource usage where they have traditional or recognizable usage rights Certain project situations requiring evictions of people occupying land without formal, traditional, or recognizable usage rights; or Restriction on



access to land or use of other resources including communal property and natural resources such as marine and aquatic resources, timber and nontimber forest products, freshwater, medicinal plants, hunting and gathering grounds and grazing and cropping areas.

In Tanzania, the EMA, 2004, and EIA and Audit Regulations, 2005, require project development to take appropriate actions and mitigation measures to avoid or minimize resettlement. Where resettlement is necessary, authorized valuation and proper compensation procedures must be executed in accordance with the law. Among the applicable legislation include:

- Land (Assessment of the Value of Land for Compensation) Regulations, 2001
- The Land Acquisition Act, 1967
- Local Government Laws (Miscellaneous Amendment) Act, 2006
- Land Use Planning Act, 2007
- The Land Act No. 4, 1999, and the Village Land Act No. 5, 1999
- National Human Settlements Development Policy, 2000
- National Land Policy, 1995.

9.4.1.6 PS 6: Biodiversity conservation and sustainable management of living natural resources

The PS 6 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 PS 6 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, which are the products people obtain from ecosystems
- regulating services, which are the benefits people obtain from the regulation of ecosystem processes
- cultural services, which are the nonmaterial benefits people obtain from ecosystems
- supporting services, which are the natural processes that maintain the other services. Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services.

The PS 6 categorizes environment into three habitats which are:

- modified habitat
- natural habitat
- critical habitats.

Modified habitats are areas that may contain a large proportion of plant and/ or animal species of non-native origin, and/ or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands. PS 6 applies to those areas of modified habitat that include significant biodiversity value, as determined by the risks and impacts identification process required in PS 1.



Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

Critical habitats are areas with high biodiversity value, including:

- habitat of significant importance to critically endangered and/or endangered species
- habitat of significant importance to endemic and/or restricted range species
- habitat supporting globally significant concentrations of migratory species and/or congregator species
- highly threatened and/or unique ecosystems
- areas associated with key evolutionary processes.

PS 6 recognises critical habitats based on certain types of protected areas. Gazetted protected areas that are classified by the IUCN as Management Category I and II, and internationally recognised areas that are recognised by the IUCN as key biodiversity areas (KBA) qualify as critical habitat. Various protected areas and KBA are also described. Based on the above criteria, the following gazetted protected areas and KBA that are potentially impacted by the project and qualify as critical habitat features. These include Pugu Hills Forest Reserve and Ruvu South Forest Reserve (which together form the Kisarawe District Coastal Forest IBA), Uluguru Nature Reserve, AZE site and IBA Mikumi National Park. PS 6 is therefore triggered by the project.

In Tanzania, there are several applicable legislations to protect biodiversity apart from Tanzania being a signatory to the 1992 Rio Convention on Biodiversity Diversity. Among the applicable legislation includes:

- National Land Policy, 1995
- The Wildlife Policy of Tanzania, 2007
- National Agricultural Policy, 2013
- National Forestry Policy, 1998
- The National Water Policy, 2002
- National Human Settlements Development Policy, 2000
- Environmental Management Act No. 20, 2004, Cap. 191
- The Wildlife Conservation Act No 5/09, 2009
- National Forest Act, 2002
- The Environmental Management (Water Quality Standards) Regulations, 2007
- Environmental Impact Assessment and Auditing Regulations, 2005
- The Water Resources Management Act No. 11, 2009
- National Environmental Policy, 1997.

9.4.1.7 PS 7 Indigenous Peoples

IFC PS 7 states that indigenous peoples may be referred to in different countries by such terms as "indigenous ethnic minorities," "aboriginals," "hill tribes," "minority nationalities," "scheduled tribes," "first nations," or "tribal groups". PS 7 requirements for Indigenous peoples with regards to the ESIA process include the following:

Avoidance of negative impacts

An ESIA should identify all indigenous peoples in a project's AOI, assess all potential negative and positive project impacts on the indigenous peoples, and develop strategies



to try to avoid, remedy or compensate for these impacts. The impact assessment process should ensure respect for the Indigenous peoples and preserve the culture, knowledge, and practices of the indigenous peoples.

The affected indigenous peoples should be involved in the development of measures to avoid, mitigate, reduce or remedy adverse impacts. Traditional or local knowledge can help identify solutions or alternatives that the project proponent may not be aware of.

Consultation and participation

During the ESIA, an ongoing relationship should be developed with the indigenous peoples affected by the project and maintained throughout the project's lifecycle, based on Informed Consultation and Participation (ICP). The engagement process should include stakeholder analysis and engagement planning, disclosure of information, consultation, and participation. Engagement should occur freely and voluntarily, without external manipulation, interference, coercion, or intimidation. Sufficient time for decision-making processes should be allowed.

Indigenous peoples' representative bodies and organisations (e.g. councils of elders or village councils), as well as members of the affected indigenous peoples' communities should be included in the engagement process.

A grievance mechanism should be implemented in a culturally appropriate manner and in consultation with the affected indigenous peoples' communities.

Free prior and informed consent

Indigenous communities may be particularly vulnerable to the loss of, alienation from or exploitation of their land and access to natural and cultural resources. In recognition of this vulnerability, the project proponent should obtain the Free Prior and Informed Consent (FPIC) of the affected indigenous people's communities when these assets may be impacted by a project.

The concept of FPIC is derived from the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which is an international instrument with broad support that embodies a convergence of common understanding about the rights of Indigenous peoples. As defined in Equator Principle 4, FPIC builds on and expands the process of ICP, ensures the meaningful participation of indigenous peoples in decision-making, and focuses on achieving agreement. It does not confer veto rights on individuals or sub-groups.

FPIC is understood as:

- **Free**: any consultation with indigenous people along the SGR line (Lot 3 & 4) will be done without any form of intimidation, manipulation, coercion and in other ways that may influence or make indigenous people feel insecure when sharing their views.
- **Prior:** all information provision, discussions and consent will take place before commencement of Project activities.
- **Informed:** TRC and its contractors will ensure that Project information is accessible, clear, consistent, and delivered in culturally appropriate language and format.
- **Consent:** TRC and indigenous communities impacted by the Project will establish a dialogue to address or seek solutions in a mutual respectful manner and in good faith in terms of all the aspects of the Project. This means that indigenous people will freely decide their mode of participation including their own


traditional representative or other customary institutions. Consent is a collective decision given according to their customs and traditions.

FPIC is a process that should be established through good faith negotiation between a project proponent the affected indigenous peoples' communities.

FPIC is required in the following special circumstances:

- Impacts on land and resources subject to traditional ownership or under the customary use of Indigenous peoples. Frequently, lands used by indigenous people are traditionally owned or under customary use. While Indigenous peoples may not possess legal title to these lands as defined by national law, their use of these lands, including seasonal or cyclical use, for their livelihoods, or cultural, ceremonial, and spiritual purposes that define their identity and community, can often be substantiated and documented.
- Relocation of indigenous peoples from lands and natural resources subject to traditional ownership or under customary use. If such relocation is unavoidable the project proponent should not proceed with the project unless FPIC has been obtained.
- Significant impacts on critical cultural heritage. Significance of cultural heritage should be assessed in cooperation with the affected indigenous communities. It may include traditional knowledge which is intangible and includes knowledge, innovations and practices including folklore or traditional cultural expressions that have remained in use for sacred or ritual purposes (sacred groves, sacred bodies of water or waterways, trees or rocks). This potentially includes priority ecosystem cultural services.

For impacts arising from the above special circumstances, IFC PS7 puts forth a process aimed at reaching an agreement with the indigenous peoples' communities impacted by the project, which involves:

- documenting the negotiation process that was mutually agreed to by the project proponent and the affected indigenous communities
- documenting the outcome of the negotiation process, evidencing agreement between the project proponent and the affected indigenous communities.

Project benefits

Where possible the project proponent should promote sustainable development benefits and opportunities for indigenous peoples in a culturally appropriate manner.

Various factors including, but not limited to, the nature of the project, the project context and the vulnerability of the indigenous peoples will determine how these communities should benefit from a project. Identified opportunities should aim to address the goals and preferences of the indigenous peoples including improving their standard of living and livelihoods in a culturally appropriate manner, and to foster the long-term sustainability of the natural resources on which they depend.

It is important to make a distinction between the benefits linked to the mitigation of negative impacts of the project and the broader opportunities, such as employment and economic opportunities the project may provide. Where these broader opportunities exist, it is good practice to assist the indigenous communities to realise such opportunities.



9.4.1.8 PS 8: Cultural heritage

PS 8 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, PS 8 aims to protect cultural heritage in the course of project activities. In addition, the requirements of this PS 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 PS, 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 PS 8.

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.

In Tanzania, the EMA, 2004, and EIA and Audit Regulations, 2005, require project development to take appropriate actions and mitigation measures to avoid or minimize impacts to cultural resources. Among the applicable legislation, having bearing on cultural resources includes:

- The Antiquities Act Cap 333 of 2002 and the Antiquities Rules, 1990
- The Grave (Removal Act), 1968
- The Land (Assessment of the Value of Land for Compensation) Regulations, 2000
- The Compensation and Resettlement Guideline (CRG), February 2008
- The Land Act No. 4, 1999, and the Village Land Act No. 5, 1999.

9.4.2 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 are 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.



9.4.3 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 of locomotives and railcars.

The guideline provides additional health and safety issues specific to railway operations (not addressed in general EHS guideline) include the following rail operational safety, transport of dangerous goods, level crossing safety and pedestrian safety, train/worker accidents, noise and vibration, diesel exhaust, fatigue, electrical hazards, electric and magnetic fields.

It 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.

The guideline also provides performance indicators and monitoring guideline for both environment and occupational health and safety.

This guidance provides recommended measures to prevent and control impacts to wildlife habitats during construction of rights-of-way:

- avoid fragmentation or destruction of critical terrestrial and aquatic habitats by siting railways, rail yards, support facilities, and maintenance roads to avoid such locations or by utilizing existing transport corridors whenever possible. Where fragmentation of critical habitats cannot be avoided, maximize the availability of animal crossings (e.g. bridges, culverts, and over-crossings) and provide jointing chambers to allow small animals a means of escape from the railway
- when rail crossings of watercourses are unavoidable, maintain water flow and fish access by utilizing clear-span bridges, open-bottom culverts, or other appropriate methods. Where sensitive habitats cannot be avoided by rail alignment, construction of bridges should be considered to span at-risk areas (e.g. wetlands)
- minimize the clearing of riparian vegetation during construction
- avoid construction activities during the breeding season and other sensitive seasons or times of day, especially where critically endangered or endangered species are concerned
- avoid the introduction of invasive species during reinstatement activities, preferably using native plant species and, when feasible, clear invasive species during routine vegetation maintenance (see 'right- of-way maintenance' section below)
- when procuring crossties for rail line construction, consider their source to avoid unsustainable harvesting of forest products in a critical habitat.

9.4.4 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.

It also provides community health and safety issues specific to construction materials extraction projects primarily including land instability, water, explosives safety and decommissioning. 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 guideline for both environment and occupational health and safety.

9.4.5 IFC and EBRD worker accommodation: Process and standard

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.

Generally, workers are housed by their employers in cases where, either the number or the type of workers required cannot be sourced from or accommodated within local communities. Thus, provision of workers' accommodation is often associated with the importation of an external workforce into an area. This can occur because the local labour supply or skills base is inadequate, because the workers are simply not available due to the remote location of the worksite, or the particular skills required or because migrant workers due to the nature of the work or the working conditions can only satisfy labour requirements.

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). Depending 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 (PR 2) 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."

PS 2 aims to promote "safe and healthy working conditions, and to protect and promote the health of workers". This covers living conditions as well when these are the responsibility of employers. IFC Guidance Note 2 on labour and working conditions specifically mentions the potential danger of forced labour when housing is provided to workers in lieu of payment or where inappropriate charges for housing are levied.



9.4.6 WHO ambient air standards

9.4.6.1 WHO Air Quality Guidelines, 2000 & 2005

The WHO air quality guidelines (AQG) have been widely used as a reference tool to assist decisionmakers around the world in setting air quality standards and goals. The AQG 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 EHS guidelines reproduce the 2005 WHO guidelines as recommended criteria for air quality, in the absence of national standards.

9.4.6.2 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 (NO₂) are substantially lower than the 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.

9.4.7 Additional applicable World Bank guidelines and standards

Other IFC guidelines and handbooks that should be considered are below. This project team will continuously assess whether any additional guidelines are applicable, as the project develops over the ESIA process:

- IFC General EHS Guidelines, 2007
- IFC's Good Practice Note on Addressing Grievances from Project-Affected Communities, 2009
- IFC's Handbook for Addressing Project-Induced In-Migration, 2009
- IFC and EBRD's Guidance Note on Workers' Accommodation: Processes and Standards, 2009
- IFC's Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, 2013
- IFC's Environmental and Social Management System Implementation Handbook: Construction, 2014
- IFC's Environmental and Social Management System Implementation Handbook: General, 2015
- IFC's Good Practice Note on Managing Contractors' Environmental and Social Performance, 2017
- IFC EHS Guidelines: Waste Management Facilities, 2007.

9.5 International conventions, standards and guidelines

United Nations Framework Convention on Climate Change, 1992. The objective of UNFCCC is to stabilize the concentration of GHG in the atmosphere, at a level that allows ecosystems to adapt naturally and protects food production and economic development. The project shall use fossil fuels during construction. Since Tanzania is a Party to the UNFCCC the Project Proponent shall endeavour to minimise the generation of GHG.



ILO Convention: C138 Minimum Age Convention, 1973 The United Republic of Tanzania ratified the Convention on 16:12:1998. The convention prohibits child labour. The project proponent shall demonstrate no child is employed in the project activities.

ILO Convention: C182 Worst Forms of Child Labour Convention, 1999. Ratified by United Republic of Tanzania on 12:09:2001. The project proponent shall demonstrate no child is employed in the project activities.

ILO Convention: Forced Labour Convention (C029), 1930. The United Republic of Tanzania ratified the Convention on 30.01.1962. The Convention addresses the issue of forced labour and to provide a framework for member states to eliminate this practice. The project proponent shall ensure that no forced labour practices in the project activities.

ILO Convention: Freedom of Association and Protection of the Right to Organise (C087), 1948, which was ratified on 18.04.2000 by The United Republic of Tanzania. This Convention aimed at safeguarding the rights of workers and employers to form and join organizations of their own interest without getting resistance or interference from the state or employers. The project proponent shall demonstrate that no interference to the workers or employers from joining or forming organizations.

ILO Convention: Right to Organize and Collective Bargaining (C098), 1948. This Convention which aim at protecting the rights of workers and employers to engage in collective bargaining and to form and join trade unions freely, was ratified by The United Republic of Tanzania was done on 30.01.1962. the project proponent shall demonstrate no interference to workers or employers to form and join unions.

ILO Convention: Equal Remuneration (C100), 1951. This Convention was ratified The United Republic of Tanzania on 26.02.2002. The Convention aims at equal remuneration for work of equal value for men and women. The project proponent shall demonstrate equal value for men and women.

ILO Convention: Abolition of Forced Labour (C105), 1957. This Convention aims to eliminate all forms of forced or compulsory labour and it was ratified by URT on 30.01.1962. The project proponent will demonstrate no forms of forced or compulsory labour during project implementation.

ILO Convention: Discrimination (Employment and Occupation) (C111), 1958. The United Republic of Tanzania ratified the Convention on 26 Feb 2002. This Convention addresses discrimination in the workplace and aims to promote equality of opportunity and treatment in employment and occupation. The project proponent shall demonstrate no form of discrimination in the workplace.

Convention on Biological Diversity (Rio de Janeiro 1992). This Convention, which calls for the sustainable use biological diversity, was ratified by Tanzania in 1996. Tanzania is a country with rich biodiversity. The project proponent shall demonstrate that no endemic or threatened species in the project corridor that will be adversely impacted. Furthermore, best practices of flora and fauna protection will be observed by contactors.

Convention in International Trade in Endangered Species (CITES), 1973. The CITES of Wild Fauna and Flora, also known as the Washington Convention) is a multilateral treaty to protect endangered plants and animals. It was drafted as a result of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Tanzania ratified it in 09/12/2004. The project proponent will cooperate with designated authority to make sure that no trading in endangered species throughout the project.

Montreal Protocol on the Substances Depleting Ozone Layer, 1987. This is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. Tanzania accessed this protocol on 07.04.1993 and has ratified several of its amendments. While TRC will ensure



no ODS are used in its activities e.g. in refrigerators, Air Conditioners etc., it will cooperate with designated authority to make sure that ODS are not imported in the country illegally.

ILO C148, Working Environment (Air Pollution, Noise and Vibrations) Convention, 1977. The convention was ratified by Tanzania in 1984. It aims at demonstrating safe working environment for workers. The implementation of project must prevent the exposure of its workers and the public from any occupational hazards by providing appropriate security and safety equipment.

IAQM guidance on the assessment of dust from demolition and construction emphasises methodology on dust risk assessment (in terms of disamenity, PM_{10} concentration and the potential for adverse impacts on human health and impacts on sensitive ecological receptors and specification of mitigation measures appropriate to the level of risk identified.

IAQM Guidance of Air Quality Monitoring in the Vicinity of Demolition and Construction Sites (the IAQM 2018 guidance) provides guidance on air quality monitoring in the vicinity of demolition and construction sites which provides high level advice on monitoring but is not designed to be prescriptive with regards the various monitoring techniques that can be used.

9.6 Institutional framework

The institutional arrangement for environmental management in Tanzania is well spelt out in the EMA (2004). There are seven institutions mentioned by the act, of which the Minister Responsible for the Environment is the overall in-charge for administration of all matters relating to the environment.

Part III, Section 13(1) of EMA (2004) states that the Minister responsible for environment shall be the overall in charge of all matters relating to the environment and shall in that respect be responsible for articulation of policy guidelines necessary for the promotion, protection and sustainable management of environment in Tanzania.

The legal institutions for environmental management in Tanzania include:

- National Environmental Advisory Committee
- Minister responsible for Environment; Director of Environment; National Environment Management Council (NEMC); National Environmental Advisory Committee
- The National Advisory Environmental Committee is comprised of members with experience in various fields of environmental management in the public and private sector and in civil society. The committee advises the Minister on any matter related to environmental management
- Minister Responsible for Environment. The Minister is responsible for matters relating to environment, including giving policy guidelines necessary for the promotion, protection, and sustainable management of the environment in Tanzania. The Minister approves an EIA and may delegate the power of approval for an EIA to the DoE, Local Government Authorities or Sector Ministries
- Director of Environment. The Director of Environment heads the Office of the Director of Environment and is appointed by the President of the United Republic of Tanzania
- NEMC. The NEMC's purpose and objective is to undertake enforcement, compliance, review and monitoring of EIA's and to facilitate public participation in



environmental decision-making. Relevance: register and oversee the whole EIA process; controls the implementation of the environmental management plan (EMP) during and after construction of the project; monitors the effects of activities on the environment during & after construction and during operation.

9.7 Corporate and institutional governance

9.7.1 The overall management of the project

From an institutional point of view, TRC is responsible for the overall 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.

Table 9-2 represent list of TRC existing plans, procedures and policies including E&S policy which forms a foundation for YM procedures, plans and policies developed for SGR Lot 3&4 project.

The TRC implementation organisation for the design and build of the project (YM), and any third-party contractors will be contractually bound to the TRC's ESMS and ESMP. YM already has the following systems, plans and procedures in place (Table 9-1), which have been reviewed as part of the ESIA, where relevant.

No	Document Name	Document Type
1	ESMP	Plan
2	Soil management plan	Plan
3	Spill prevention and emergency response plan	Plan
4	Water management plan	Plan
5	Biodiversity management plan	Plan
6	Cultural heritage and chance finds management plan	Plan
7	Integrated pest management procedure	Procedure
8	Off-site working procedure	Procedure
9	Hazardous material management procedure	Procedure

Table 9-1: YM existing plans and procedures



No	Document Name	Document Type
10	Waste management procedure	Procedure
11	Environmental incident response procedure	Procedure
12	Contaminated land management procedure	Procedure
13	Environmental and social training procedure	Procedure
14	Environmental emergency procedure	Procedure
15	Noise and nuisance reduction procedure	Procedure
16	Pollution prevention procedure	Procedure
17	Code of conduct procedure	Procedure
18	Stakeholder engagement and grievance procedure	Procedure
19	Subcontractor and supplier management procedure	Procedure
20	Influx management strategy	Strategy
21	Occupational health and safety management plan	Plan
22	Traffic management plan	Plan
23	Communicable diseases management plan	Plan
24	Blasting and explosive procedure	Procedure
25	Work at height procedure	Procedure
26	Scaffolding procedure	Procedure
27	Safe lifting and rigging operations procedure	Procedure
28	Risk management procedure	Procedure
29	Permit to work procedure	Procedure
30	Incident investigation and notification procedure	Procedure
31	HSES training procedure	Procedure
32	Fire prevention and protection procedure	Procedure
33	Excavation safety procedure	Procedure
34	Emergency response procedure	Procedure



No	Document Name	Document Type
35	Disciplinary action procedure	Procedure
36	Community health, safety and security management procedure	Procedure
37	Personal protective equipment (PPE) procedure	Procedure
38	Start card procedure	Procedure
39	HSE inspection procedure	Procedure
40	Hot works procedure	Procedure
41	Lockout tagout (LOTO) procedure	Procedure
42	Confined space procedure	Procedure



Table 9-2: List of Project-specific policies, plans and procedures developed and adopted for SGR Project (TRC)

Plans and Procedures	Description	Document reference number/ date	Status
Environmental Management System (EMS) Manual	TRC is committed to implementing high standards of environmental performance across all its operations and ensure Environmental Management System (EMS) is integrated within our processes. We believe that focus on environmental management is an integral part of our commitment to sustainable social and economic development.	EMS-01 version 00 20/04/2020	Existing
	The intended outcomes of our EMS are: - Fulfilling all environmental laws, regulations and standards		
	Protecting the environment by applying best management practices to prevent pollution.		
	Adapting best practices as part of continual improvement of our environmental performance.		
	This EMS manual has been developed to help anyone navigate their way through the TRC's Environmental Management System. It also acts as a signposting document to indicate how each of the clauses in ISO14001:2015 standard have been addressed.		
Environmental & Social Policy	The purpose of this policy is to promote sustainability, responsibility, and ethical practices throughout the project lifecycle. Primarily, it serves to ensure that environmental and social considerations are integrated into project planning, implementation, and decision-making processes.	TRC E&S Policy, version 02 22/02/2024	Updated
Environmental Policy	This policy outlines the project's commitment to minimizing negative environmental impacts, preserving natural resources, and safeguarding the well-being of communities and stakeholders affected by the project.	GSD-03 20/04/2020	Existing



Plans and Procedures	Description	Document reference number/ date	Status
Policy for prevention and response to gender based violence (GBV)	The overall objective of this GBV and SEA Policy is to accelerate efforts towards the prevention, response and elimination of GBV and SEA in TRC undertakings	22/02/2024	New
GSP-01: Environmental Risks, Opportunities & Aspects Procedure	The purpose of this procedure is to establish an integrated approach of determining environmental risks, opportunities and aspects within TRC processes including the establishment of actions to manage them. Basically, this procedure aims to address clause 4.1, 4.2, 4.3 and 6.1 of ISO 14001 international standard.	GSP-01 version 00 20/04/2020	Existing
GSP-02: Documented Information Control Procedure	 This procedure defines the requirements for the creation, review, approval, distribution, use and revision of TRC Environmental Management System (EMS) documented information. This procedure applies to: - documented information required by ISO 14001:2015 international standard documented information created by TRC as being necessary for the effectiveness of the environmental management system 	GSP-02 version 00 20/04/2020	Existing
GSP-03: Internal EMS Audit Procedure	 The internal audit has long been recognized as an integral component of effective system management. The purpose of internal EMS audit is to: - determine whether EMS conforms to the requirements of ISO 14001:2015; check whether EMS has been properly implemented and maintained; provide information on the results of the audits to senior management; This procedure defines the process and methods for conducting internal Environmental Management System (EMS) audits within TRC processes 	GSP-03 version 00 20/04/2020	Existing



Plans and Procedures	Description	Document reference number/ date	Status
GSP-04: Management Review Procedure	Management review is the high-level review of the environmental management system aimed at checking the adequacy and effectiveness of the system to enhance the environmental performance.	GSP-04 version 00 20/04/2020	Existing
	This procedure defines the process and methods for conducting management reviews of the environmental management system at TRC.		
GSP-05: Continual Improvement Procedure	The purpose of this procedure is to have a standard approach of identifying opportunities for improvement, dealing with percentification and corrective actions to	GSP-05 version 00	Existing
	enhance environmental management system performance.	20/04/2020	
GSP-06: Environmental Emergency Preparedness & Response Procedure	This procedure outlines the process needed to prepare for and respond to potential emergency situations a view of	GSP-06 version 00	Existing
	and thereby reducing impact on the environment	20/04/2020	
GSP-07: Hazardous Chemical Management Procedure	The purpose of this procedure is to provide steps needed to manage and control oil and other chemicals during storage,	GSP-07 version 00	Existing
	handling and disposal	20/04/2020	
GSP-08: Dangerous Goods Transportation Procedure	The purpose of this procedure is to provide steps needed to manage and control dangerous goods during rail or road	GSP-08 version 00	Existing
	transportation and storage.	20/04/2020	
GSP-09: Engines Emission Management Procedure	The purpose of this procedure is to provide series of actions needed to manage and control emissions resulting from	GSP-09 version 00	Existing
	combustion of diesel / petrol engines. Such engines include locomotive engines, vehicle engines, power generator engines, drilling machines and compressors.	20/04/2020	
GSP-10: Fugitive Dust Management Procedure	The purpose of this procedure is to provide steps needed to manage and control fugitive dusts resulting from construction	GSP-10 version 00	Existing
	works and drilling and blasting activities of TRC including contractors	20/04/2020	



Plans and Procedures	Description	Document reference number/ date	Status
GSP-11: Explosives Management Procedure	The purpose of this procedure is to provide series of actions needed to manage and control explosives used in civil works especially works associated with drilling and blasting	GSP-11 version 00	Existing
	activities.	20/04/2020	
GSP-12: Non-Hazardous Waste Management Procedure	The purpose of this procedure is to provide actions needed to manage and control non-hazardous wastes in all TRC	GSP-12 version 00	Existing
	processes and activities.	20/04/2020	
GSP-13: Trains Toilet Wastes Management Procedure	The purpose of this procedure is to provide actions required to manage and control toilet wastes generated from passengers and block trains. The procedure will support TRC	GSP-13 version 00	Existing
	to gradually adapting advanced technologies in managing and controlling the toilet waste	20/04/2020	
GSP-14: Procurement Management Procedure	The purpose of this procedure is to provide actions required to manage and control the procurement of goods and	GSP-14 version 00	Existing
	services that shall address environmental requirements before purchasing and their use in our TRC processes and service delivery.	20/04/2020	
	This procedure is a supplement document to the Public Procurement Regulations (2013) aims to interpret the regulation for ease implementation. It does not intend to supersede any requirements stipulated in that regulation.		



10 BIODIVERSITY BASELINE AND IMPACT ASSESSMENT

A biodiversity impact assessment was conducted by 5 Capitals and EcoTek, and is copied into this section below, with appendices included at the end of the ESIA report (Appendix 4). Impact assessment and mitigations identified are also included in the Aspects and Impacts Matrix in Appendix 7.

10.1 Protected areas

Tanzania has more than 800 protected areas comprising about 43.7% of the total land area of the country including game-controlled areas covering at least 28% of mainland Tanzania and forest reserves around 15.7% (CBD, 1992). The proximity to the alignment of the SGR Lots 3 and 4 is shown in Figure 10-1, which highlights the multiple forest reserves located within a 50 km buffer from the ROW, and the close proximity (1 km) of Nyahua Mbuga Forest Reserve south of Lot 3 and the llomero Hill and Igombo River Reserves along and adjacent to Lot 4. It also passes through Wembere GCA and Msulguda and Chaya Open Areas.

The overall range of protected areas in the vicinity of, or traversed by, the Lots 3 and 4 include national protected areas, game reserves, game-controlled areas, open areas, forest reserves and a beekeeping reserve. These protected areas are recognized both at national and international levels (under IFC standards and Equator Principles).

PS 6 requires consideration of internationally recognized protected areas in addition to national gazetted protected areas. Among important internationally recognized protected areas are the wildlife migratory corridors (WMC), important bird areas (IBAs) and Ramsar sites which are components for key biodiversity areas.

10.2 Important bird areas (IBA)

There are three IBA and KBA extending from approximately 50 km to 250 km from the project alignment including the first Ramsar site to be designated in Tanzania comprising part of the Moyowosi complex (Figure 10-2). The three IBA are briefly summarised in the sub-sections below.

10.2.1 Wembere Steppe IBA

A review of the IBA has identified that the nearest IBA to the project is Wembere steppe which is less than 50 km north of Lot 3. The Wembere river rises in hilly country southeast of Tabora and south-west of Singida and forms the major river of the Eyasi internal drainage basin flowing north through the Wembere flood-plain before turning north-east at Lake Kitangire and then into Lake Eyasi. Over the last 35 years there has been extensive habitat destruction and alteration such that there are now far fewer trees and increased erosion. However, during periods of heavy rain the area becomes impassable and unsuitable for livestock grazing and this is when waterbirds breed. The populations of IBA trigger species are all IUCN LC with the exception of Fischer's lovebird (NT) and *Karamoja apalis* (VU).

10.2.2 Ugalla River Game Reserve IBA

Ugalla River Game Reserve IBA is located 100 km southwest of Lot 3 alignment. The area is mainly miombo woodland with *Brachystegia spiciformis*, B. longifolia and *B*.



wangermeeana predominating. *Julbernardia globiflora* is also common, as are the commercially important *Pterocarpus angolensis* and *Afzelia quanzensis*.

It was first designated in 1954 as a dry season reserve for concentrations of Hippotragus niger (Sable Antelope) and other large ungulates. With the game-controlled areas (GCA) immediately to the north-west, it is included as part of the Moyowosi complex as the first Ramsar Site in Tanzania.

The IBA trigger species are waders including Wattled Crane, which is IUCN VU and several others that are least concern.

10.2.3 Moyowosi - Kigosi Game Reserves IBA

This site is a vast wetland system of limited access, even in the dry season. During times of peak flood, the floodplains of the Malagarasi, Moyowosi, Nikonga, Kigosi and Gombe rivers cover nearly 1,000,000 ha and the permanent swamps along the margins of the rivers and lakes extend over 350,000 ha. The riverine vegetation is dominated by Borassus and Phoenix palms with stands of Acacia woodland along the margins of the floodplain.

The IBA trigger species are waders including Wattled Crane, Shoebill (VU) and Great Snipe (NT). (Ref: BirdLife International (2023) Important Bird Areas factsheets).





Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA report 2040173-01 (03)





Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA report 2040173-01 (03)



10.2.4 National protected areas

10.2.4.1 National Nature Forest Reserves

Since 2002, the government has been working to identify and upgrade the status of a network of key sites for conservation that were already under the management of the Tanzania Forest Services (TFS) Agency. There are two portfolios of Nature Forest Reserve – firstly within the Eastern Arc Mountains, whilst the other includes the best national examples of other forests.

This process had resulted in the declaration and gazettement of 12 Nature Forest Reserves by early 2017. Of these, eight are found in the Eastern Arc Mountains (from north to south: Chome, Magamba, Nilo, Amani, Mkingu, Uluguru, Kilombero and Uzungwa Scarp), one is located in the Southern Highlands (Mount Rungwe), one is found in the coastal forests in southern Tanzania (Rondo) and one encompasses the forests of a recently dormant volcano (Mount Hanang). The last one (Minziro) includes areas of lowland swamp forest close to the Uganda border that is of similar composition to the forests of the Congo Basin (ref: The Arc Journal, Tanzania Forest Conservation Group, May 2017).

The project traverses several protected areas that include game reserves, GCAs, forest reserves and open areas. In addition, the project traverses in the proximity to Kisigo Game Reserve and Muhesi Game Reserve to south which are part of Ruaha – Rungwa - Ugala River ecosystem and Swaga Swaga Game Reserve to the north. The national ownership of the mentioned protected area categories is described in the following subsections.

10.2.4.2 Game reserves

In Tanzania, game reserves are under the jurisdiction of the Ministry of Natural Resources and Tourism (MNRT) and directly under the management of the Tanzania Wildlife Management Authority (TAWA), which is a parastatal organization under the MNRT.

Muhesi Game Reserve is located south of MGR and the proposed Lot 3 alignment at about 19.5 km from and extending southwards to join Kizigo Game Reserve. Both Kizigo and Muhesi Game Reserves form an extended wildlife area that connects with Swaga Swaga Game Reserve, which is located north of the MGR and the proposed Lot 3 alignment at about 93 kms.

10.2.4.3 Game controlled areas (GCA)

The GCA are another type of protected area provided for under the Wildlife Conservation Act (WCA). The GCA's are declared for conservation of wildlife outside village land where activities detrimental to wildlife are prohibited. Therefore, in the GCA residence, cultivation, and livestock keeping are allowed to take place in the areas. Since GCA allow residence and human activity and were created on areas of traditional use and settlement, many GCA entirely overlap with customarily managed village lands. Lot 3 crosses the Wambere and Chaya GCA, which are also potential elephant dispersal areas (**Error! Reference source not found.**).

10.2.4.4 Forest reserves

Forest reserves are under the MNRT and directly under the management of the forestry and beekeeping department. The department is responsible for issuing policies on the management of forest resources in the country, however, the management of the forest reserves is under the Tanzania Forest Services (TFS) a parastatal organization of the MNRT. TFS is responsible for management of national gazetted forest as well as forests



in open areas. Local government authorities are also responsible for managing village land forest reserves situated on village lands.

The project alignment traverses Nyahua forest reserve in Sikonge district and Aghondi forest as part of National beekeeping reserve that is nationally protected. Furthermore, the Lot 3 alignment also passes through ungazetted forest reserves that are protected by villages by-laws. These include Tura, Malongwe Karagasi and Goweko village forest reserves. The Lot 4 alignment traverses at the centre of Ilomero Hill forest reserve, Igombe FR in Tabora and just closer to Makere forest reserve before making it to Isaka in Shinyanga all of which have the potential to host important fauna species given the fact that they are in the proximity of some GCA and/or open areas (**Error! Reference source not found.**).

Surveys and observations indicate that the forests along the project alignment are rich in terms of natural habitats including thicket forests (largely in Manyoni and Itigi) and miombo forests (covering the largest part of Tabora districts) therefore hosting significant number of wildlife also witnessed through the studies.



Figure 10-3: Lot 3 at proximity and/or traversing some wildlife and forest including the GCA PAs along its ROW Courtesy: UDSM ESIA (2023)

10.2.4.5 Other forests (under forest reserves and village and district lands)

There are several forests under district and village council providing connectivity between nationally protected forests. The majority of these forest stands are highly fragmented, following human encroachment although seemingly they still support a high diversity and abundance of fauna (i.e. mammals and birds). The existing connectivity of forests



between forest reserves and district/village owned forests provide important movement corridors across the project alignment and beyond. Examples of such important connections include the Nyahua Forest reserve through Goweko Forest, Kigwa Rubuga to Igombe and Ilomelo FR and beyond these areas. Beyond national protected forests and areas that provide connectivity, there exist patches of forests are surrounded by agricultural landscapes and human settlement areas which are likely to limit the movement of some medium to large sized mammals between forested areas through to their traditional movement corridors.

In comparative terms, the Nyahua forest reserve (that is crossed by the project alignment) has a high abundance for fauna especially the elephants and medium sized mammals such as antelopes and birds. Other woodlands within the alignment also support some fauna. The Miombo woodland forests and Itigi thickets among the habitats in Lots 3 and 4 do support several species of birds, which are not necessarily forest specialists.



Figure 10-4: Lot 4 alignment crossing through llomelo Hills and Igombe River FRs and at proximity to Makere Game Reserve Courtesy: UDSM ESIA (2023)

10.3 Other Sensitive Areas of High Conservation Value

10.3.1 Itigi Thicket and Miombo Woodland

10.3.1.1 Itigi thickets

Itigi thickets that are highly specialized type of habitats harbouring nearly 100 plant species and are very important habitats for fauna species. The project alignment crosses these important habitats from Makutopora station through to Chaya village in Itigi District. The analysis of large mammals to insect populations has indicated that, the habitat harbours larger numbers of fauna as compared to others e.g. analysis of species richness by habitats along the project had indicated a higher number of large to medium mammal activities were found in the Itigi thickets followed by Miombo woodlands, than in other habitats studied. Elephant and hartebeest are among the large mammals utilizing the Itigi thickets.



10.3.2 Wildlife corridors and dispersal areas

Wildlife migratory corridors are essential links between different animal populations to ensure genetic viability and habitats through migration routes. Access to alternative feeding grounds can be a lifeline during altered weather conditions which may be exacerbated by climate change and/or variation that may in turn help mitigate human wildlife conflict such as crop raiding. Therefore, according to the IFC PS, equator principles and other national and international environmental safeguard standards, wildlife corridors should be protected.

Both Lots 3 and 4 alignments have existing wildlife crossings that are linked to feeding grounds and/or to existing wildlife corridors (**Error! Reference source not found.**). A key wildlife corridor is the Swagaswaga-Muhesi/Kigosi corridor which also contributes to multiple crossing points around Manyoni and Itigi districts. In addition, other sites that have a high number of wildlife crossings are around the proposed Manyoni campsite where numerous signs of elephant presence were recorded during the dry season. The principal elephant crossing points were confirmed during the wet season with two additional locations east of Chaya.



Figure 10-5: Recorded wildlife crossings and the Swaga Swaga-Muhesi/Kigosi corridor along the Lot 3 project area courtesy: UDSM ESIA (2023)

It is noteworthy that, the existence of, Muhesi game reserve which is located south of MGR and the Lot 3 alignment at about 19.5 km from and extending southwards to join Kizigo game reserve, provides evidence that the Swagaswaga-Muhesi/Kigosi corridor is active. Both Kizigo and Muhesi game reserves form an extended wildlife area that connects with Swagaswaga game reserve, which is located north of the MGR and the proposed Lot 3 alignment at about 93 km. A more recent study has indicated that, Rungwa, Kizigo, and Muhesi game reserves have the largest elephant population in Tanzania, with an estimation of 15,836 African elephant (Chase et al. 2016). The ESIA



surveys between June and August 2022 have provided evidence of existence of wildlife movements and crossings both in Lots 3 and 4 project alignment through the Swagaswaga-Muhesi/Kigosi corridor and nearby areas. Although importantly, there were more elephant signs that were recorded in these areas.

The 2010-15 National Elephant Management Plan of Tanzania names Elephant Corridors as its second Strategic Objective, providing a positive conservation agenda for other large mammal species (Ref: Jones, T., Bamford, A. J., Ferrol-Schulte, D., Hieronimo, P., McWilliam, N., and Rovero, F. 2012. Vanishing wildlife corridors and options for restoration: a case study from Tanzania. Tropical Conservation Science Vol. 5(4):463-474. Available online: www.tropicalconservationscience.org).

Although studies by TAWIRI, 2010 recognize only Swagaswaga-Muhesi/Kigosi wildlife corridor, the consultations through TAWA and local community in Lots 3 and 4 have indicated more corridors including those crossing from Nyahua Forest reserve through Goweko-Kigwa/Rubuga_to Puge South to Ilomelo-Igombe to North Makere Reserves. The movement, according to the discussions with TAWA and confirmed through community consultations goes all the way to Muyovosi/Malagarasi game reserves and back. The timings of the movements have been reported to be rainy season (largely March/April) and partly in earliest days of dry season in Lot 4 and all times in Lot 3. The elephant and other wildlife crossings on the project have been confirmed both in Lots 3 and 4 (**Error! Reference source not found.** and Figure 10-6). Noteworthy, the wildlife signs across Lot 4 were less than those identified in Lot 3. This could be because the study was conducted in the dry season. Despite this drawback, the discussions with TAWA, village authorities and some communities provided reliable information on the wildlife movements and seasonality in both Lots 3 and 4.

The Tanzania Wildlife Corridors Assessment, Prioritization and Action Plan (2022 -2026) prepared by TAWIRI on behalf of the Ministry of Natural Resources and Tourism (MNRT) Wildlife Division, with support from Tanzania National Parks (TANAPA) and Tanzania Wildlife Authority (TAWA) provides the latest information on the delineating and prioritization of wildlife corridors, the feasibility for conservation and a Priority Action Plan.

The recent passage of Tanzania's Wildlife Conservation (Wildlife Corridors, Dispersal Areas, Buffer Zones, and Migratory Routes) Regulations (2018), the "Corridor Regulations," exemplifies the commitment of the Tanzanian government to maintain and restore critical wildlife corridors to sustain the incredible biodiversity for which Tanzania is world-renowned. The purpose of the new report was to delineate, assess, and prioritize wildlife corridors across Tanzania, including critical transboundary corridors to protected areas in neighbouring countries, and to develop a "priority action plan," as called for in Tanzania's Corridor Regulations.

The wildlife corridors network identified 61 corridors including eight transboundary corridors that are likely important for wildlife movement between targeted protected areas at the countrywide scale based on natural land cover and various human influences on the landscape. The wildlife corridor network was developed to support a systematic assessment and prioritization of wildlife corridors important to maintaining and restoring Tanzania's rich natural heritage. Detailed assessments and ground truthing of the on-the-ground situation in each corridor will be needed in order to prepare robust plans of action to secure these corridors. (Ref: TAWIRI, 2023)

It is noted in this latest report that the Ruaha Rungwa - Swaga Swaga corridor is one of five corridors of vital importance linking northern and southern Tanzania which require habitat restoration to restore connectivity between wildlife populations.



Figure 10-6: Recorded wildlife crossings and potential corridors in Lot 4 courtesy: UDSM ESIA (2023)

10.3.2.1 Wildlife corridors crossing width

Given the importance to understand specific wildlife crossings in the project to provide suitable mitigation controls and management measures in compliance to national and international standards, calculations of crossing widths in the project were estimated as indicated on **Error! Reference source not found.** and Figure 10-6 and Table 10-1.

It is important to note is that there are more elephant and elephant crossing points in Lot 3 compared to Lot 4. Noteworthy, is that the wildlife corridors and surrounding dispersal areas are not only utilized by elephants but also other species of mammals, birds, herpetofauna and insects. Among these animals, some have been identified greater than IUCN least concern. We therefore use elephants (being an umbrella species) as reference animals to calculate the total widths of the wildlife crossings both in Lots 3 and



4. The total crossing width in Lot 3 is approximated to be 68.43 km while that in Lot 4 is approximately 24.6 km. Although the elephant and wildlife crossings points were identified through systematic sampling of the areas, the same was also confirmed through consultations with TFS, TAWA, TAWARI and local level authorities. Further monitoring of the crossing sites will add precision to the current width/length estimates in the future.

Crossing	Start	End	Width/	Start Coordinates		End Coordinates	
Corridors			Length (km)	Easting	Northing	Easting	Northing
SGR Lot 3							
Muhalala- Aghondi	Muhalala (Manyoni)	Aghondi (Itigi)	40	707562	9361865	671253	9368297
Chaya	Chaya	Chaya	7	619509	9383852	611702	9384740
Malongwe	Malongwe village	Shona river	14.43	582722	9395368	570746	9398997
Nyahua	Nyahua FR	Nyahua station	7	542185	535273	9404093	9405999
SGR Lot 4							
Igombe river forest reserve	Nzubuka village	Nzubuka	10	481681	9473228	485046	9481495
llomelo hill forest reserve	Ipala	Ipala	14.6	486084	9493868	487403	9507133

Table 10-1: Elephant and wildlife crossing corridors with/length estimations

The elephant crossing corridors are shown in Figure 10-7 based on the information in Table 10-1. In addition, the information collected during the wet season survey (February 2023) identified two additional elephant crossing points during the wet season east of Chaya at Site 4 "farmland with potential seasonal riverbed" and Site 5 "Itigi thicket and pond – potential wildlife corridor ". Other crossing points during the wet season are shown for leopard, lion, kudu and hippopotamus in Figure 10-8.





Figure 10-7: Elephant Observations: August 2022, November 2022, February 2023



Figure 10-8: Wildlife crossing points based on community feedback (2023)



10.4 Habitats and flora

Tanzania nationally has recorded more than 10,000 species of vascular plants based on information gathered between 2017 and 2020 from various scientific authors and ranks twenty third in the world in terms of number of plant species, as well as a high degree of range restricted species ("endemic"). The most recent IUCN Red List of Plant Species for Tanzania (2022) lists 373 vulnerable, endangered and critically endangered species (Appendix 4).

The vegetation of the project area falls under Zambezian regional centre of endemism which is part of the greater African subequatorial Savannas & mixed woodlands covering the entire width of the continent from the drylands and grasslands of southern Africa north to the beginning of the Equatorial Forest zone, extending to the southern shore of Lake Victoria. The project area is characterized by vegetation community ranging from natural vegetation forming natural habitat and modified type because of ongoing human activities. The identified flora communities within the project area are Itigi thickets, miombo woodland, forest reserves, shrubs of regenerating miombo woodland and fallow farms and actively cultivated farms forming characteristic modified vegetation.

Of the identified vegetation types, the Itigi thickets and miombo woodland are natural vegetations. In the project area this vegetation exists in both non protected (village land) and protected areas such a forest reserves, beekeeping national reserve and local community reserves.

10.4.1 Itigi thicket

Itigi thicket also known as Itigi-Nsumbu thickets is a dry, primarily deciduous, impenetrable vegetation between 3 and 7 m in height. It grows on unique, highly specialized, and sensitive soils that once disturbed, by farming e.g. suffer irreversible damage which prevents thicket regeneration (Baena *et al*, 2016). It is largely composed of deciduous shrubs such as Baphia burttii, *Baphia massaiensis*, *Burttia prunoides*, *Combretum celastroides*, *Grewia burttii*, *Pseudoprosopis fischeri*, *Tapiphyllum floridundum*, together with scattered emergent such as *Albizia petersiana* and the semi-evergreen *Craibia brevicaudata*. Nearly 100 woody plant species are found, some of which are endemic (Ibid). Stands of thicket occur in Tanzania close to its namesake town of Itigi near Manyoni, and also in Zambia between Lakes Mweru Wantipa and Tanganyika. In all cases these thicket units are discrete and clearly demarcated from the surrounding mopane, miombo, or Acacia woodlands (Ibid).

The largest blocks of intact itigi thickets are found in Zambia on the northern shores of Lake Mweru Wantipa in Mweru Wantipa National Park (Baena et al, 2016). Other portions fall within Nsumbu National Park and Kaputa and Tondwa Game management areas (Ibid.). The part of the ecoregion occurring in Tanzania is largely unprotected and believed to be heavily degraded. During the dry season study, significant portion of the ecoregion was found to be cleared for establishment of cashew nut farms, settlement, and other development activities. However, small areas fall within the Muhesi Game Reserve, Wembere GCA, and Chaya open area.

Few plants are endemic to Itigi thickets, vegetation baseline survey conducted during both scoping and full dry season survey recorded several endemic plants including the climber *Combretum aureonitens* (Combretaceae) and *Vepris allenii* (Rutaceae) and others as listed in table. It is noteworthy *that Vepris allenii* is listed under IUCN as EN, being highly range restricted, while in flora of Mozambique it is cited as possibly being found in Tanzania. *Craibia brevicaudata* subsp. *Burttii* is also listed under IUCN as EN (last updated 1998) and was found in the Kaskazi-Itigi.

The vegetation community is an important refuge for elephants during the dry season, where they feed on the seeds of *Grewia burttii* and *Grewia platyclade* during the day as witnessed by significant number of old and new droppings during study.



Figure 10-9: Itigi thicket site 2, February 2023 (Baphia-Bussea-Dicrostachys-Combretum)

Figure 10-10: and Figure 10-11 below show the land use/habitat along the Lots 3 and 4 alignment within a 10 km wide corridor and highlights the extent of natural Itigi thicket within Lot 3 and the importance of Miombo woodlands in both Lots 3 and 4. The map includes a table showing the percentage of each habitat impacted by the 60 m ROW, including stations, borrow pits, dumping areas, quarries, camps and laydown areas, and highlights whether habitat impacted is "Modified" or "Natural". Ground clearance and construction works for the project will impact an estimated 4400ha of which around 30% is considered "Natural" habitat, comprised of mostly Miombo woodland (21%) and Itigi Thicket (8%). A little more than 40% of the area expected to be impacted is comprised of farmland.

Whilst Itigi thicket to be cleared from the overall ROW for Lots 3 and 4 is 8%, the length of railway from chainage 530 to 670 near Chaya village, which is approximately 130 km, has a much greater percentage of this habitat type comprising 30.6% of Itigi thicket.

In addition to the project ROW corridor, Figure 10-12 show other infrastructure like Manyoni camp, Itigi camp, sleeper production site and borrow pit/dump sites within the Itigi Thicket habitat. Further review of the project infrastructure overlapping with Itigi thicket showed that 14 of these locations can potentially avoid this important habitat by slight adjustments as areas of thicket nearby have previously been cleared for farming.





32,700°E 32,850°E 33,000°E 33,150°E 33,350°E 33,450°E 33,560°E 33,550°E 33,550°E 34,050°E 34,550°E 34,550°E 34,550°E 34,650°E 34,650°E 34,650°E 34,650°E 34,650°E 34,550°E 34,

Figure 10-10: Land use/habitat map for Lots 3 showing areas directly impacted



Figure 10-11: Land use/habitat map for Lots 4 showing areas directly impacted





Figure 10-12: Borrow pits and construction facilities overlapping Itigi thicket Lot 3



10.4.1.1 Design changes considered to avoid Itigi Thicket

It is apparent that the entire ecoregion is potentially threatened by human encroachment and conversion to slash and burn agriculture. Currently the ecoregion is placed at protection level 10 and is argued that in the next 50 years this specialized habitat will be lost completely (Baena et al, 2016).



Figure 10-13: Itigi thicket, site 8 (February 2023) illustrating relatively pristine remnant of the dense Baphia-Lannea-Bussea-Grewia

Yapi Merkezi, to avoid accelerating the loss of the critical Itigi Thicket habitat have considered several design changes to avoid ground clearance and construction within areas containing Itigi Thicket. At the Manyoni Camp it was decided to reduce the camp size by 25%, from 300,000m² to 223,745m² to avoid the loss of Itigi Thicket. See Figure 10-14: below for a visual representation of the decrease in size.



Figure 10-14: Manyoni Camp reduced in size by 25% to avoid Itigi Thicket



10.4.2 Miombo woodland

Miombo woodland is deciduous or semi-deciduous savanna woodland growing in well drained fertile soil. In other literature, it is just referred to as Savanna. It covers extensive area of the savanna from north to south and is usually dominated by 19 defining species. Miombo woodland is defined by species such as Brachystegia speciformis, Brachystegia boehmii Brachystegia longiforlia, Julbernardia globiflora, Julbernadia paniculata and Isoberlinia angolensis, while other principal canopy species are Afzelia quanzensis, Anisophyllea pomifera, Pterocarpus angolensis, Pterocarpus tinctorius, Ervthrophleum africanum. Faurea saligna, Marquesia curatellifolia and *Pericopsis angolensis*. The distribution of miombo vegetation type is presented in Figure 10-15 and Figure 10-16 below. In Tanzania, miombo type of vegetation community occurs in both unprotected land and recognized protected areas such as forest reserves and game reserves.

The baseline survey on flora during the dry season characterized the stretch of the railway corridor from west of Chaya, Tura chainage 677 +000 all the way to Tabora camp chainage 825 +300 being characterized by miombo woodland varying in characteristic species, tree density, understory characteristics and level of degradation. The section covered by miombo type of vegetation constitute about 52% of the entire project length from Makutopora to Isaka. Miombo flora community are known to harbour valuable timber species as such are highly targeted for harvesting. Field survey identified valuable timber species like *Pterocarpus angolensis, Pterocarpus tinctorius* (CITES Appendix iii) *Afzelia quanzensis, Dalbergia melanoxylon* (CITES appendix ii), *Albizia versicolor* and *Albizia harveyi*, on railway corridor, source of materials, workers camps, stations, and marshalling yard. Miombo woodland flora community within the ROW are common especially on central to western Tanzania and are unlikely to qualify as 'highly threatened and/or unique ecosystems' or 'areas associated with key evolutionary processes' in accordance with IFC criteria for critical habitat (IFC, 2012 and GN6, 2019).



Figure 10-15: Extensive Brachystegia-Terminalia-Combretum miombo woodland (site 10)



Figure 10-16: Distribution and classification of miombo woodlands in Tanzania based on White's vegetation map of Africa 74 Courtesy: UDSM ESIA (2023)





Figure 10-17: Miombo woodland Lots 3 and 4 (comprising 21.43% of land cover within the ROW)


10.4.2.1 Design changes considered to avoid Miombo Woodland

As with the Itigi thicket, YM also took some design considerations to avoid loss of the Miombo woodland habitat. It was decided to reduce the size of a further two construction camps, the Nyahua Camp by 12% from 300,000m² to 263,659m² and the Tura Camp by 10% from 300,000m² to 267,660m². See Figure 10-18: and Figure 10-19: below for a visual representation of the decrease in size.

In addition to the reduction of construction camp sizes, two dumping areas, D-751 and D-747 were initially planned to be located within Miombo Woodland habitat but has since been removed from the design. See Figure 10-20: below.



Figure 10-18: Tura Camp reduced in size by 10% to avoid Miombo Woodland



Figure 10-19: Nyahua Camp reduced in size by 12% to avoid Miombo Woodland



Figure 10-20: Dumping Areas cancelled to prevent loss of Miombo Woodland



10.4.3 Cyperus-papyrus dominated wetland community

This flora community characterizes permanent wetland on flood plains with seasonal to permanent rivers and streams. The flora community is more common at Chaya Lake, Tura dam and several other high-water table area and rivers. These sites are nutrient rich area attracting rapid growth of *Papyrus* sp and Reed species with significant population of invertebrates providing suitable feeding grounds for aquatic birds. Species characterizing the areas are *Cyperus exaltatus, Phragmites mauritianus, Pennisetum purpureum, Cynodon dactylon, Polygonum senegalense, Hydrocotyle sibthorpioides, Chenopodium album, Citrullus lanatus, Ipomoe aquatica, Ipomoea cairica, Lemna minor and Nicandra physalodes.*

10.4.4 Shrubland characterized by regenerating woodland

This type of community occurs in previously disturbed areas where the condition has allowed the vegetation to regenerate. The project alignment and associated components touch this type of vegetation at Manyoni camp, cleared MGR corridor, Tabora camp, part of the marshalling yard, Kakola station site, Nzubuka section and area proposed for quarry site near Sojo village. The size of regenerating patches and the age of the tree plants within the woodland varies significantly depending on the nature of disturbance experienced. Areas impacted by charcoal burning appeared to be highly affected compared to similar areas impacted by tree cutting. The characteristics species on this regenerating woodland are *Combretum collinum, Combretum mole, Combretum zeyheri, Markhamia obtusifolia, Combretum celastroides, Dichrostachys cinerea.Julbernadia globiflora, Bussea massaiensis, Brachystegia spiciformis, Albizia harveyi, Excoecaria bussei, Senna singueana.*

10.4.5 Agro-pastoral vegetation

Modified vegetation in the form of agricultural crops produced along the project constitutes a variety of food and cash crops grown by local communities living around the project area. The intensity of farming varies with ethnic group. From Makutopora, Manyoni to Itigi farming is relatively less intense as large part is dominated by pastoralists. In these areas cultivation is restricted to wetland areas where paddy is produced. In recent years cashew nut farming is emerging following the removal of Itigi-sumbu thickets. Large areas previously covered by thickets are being cleared for cashew nut farming. This trend is almost practiced from Manyoni to near Tura. Extensive farming is evident from Tabora to Isaka where large paddy farms characterize the project from west of Ipala to Isaka.

The observed clearance of Itigi thicket and miombo woodland within the ROW for the Lots 3 and 4 and adjacent areas for farming is creating barriers to wildlife movement and increasing risk of conflict between wildlife and pastoralists and farmers. Farming accounts for >40% of the land use within a 10 km corridor and this together with ongoing clearance of thickets and charcoal burning is unsustainable. The identification of strategic wildlife corridors needs to be identified that will link with the proposed underpasses for the project to provide safe movement for wildlife preventing collision with trains and potential conflict with local communities. The efforts of many stakeholders will be needed to co-ordinate planning and designation of land use so that the project ROW does not exacerbate existing issues of balancing community and wildlife requirements, but becomes the catalyst for improved short-, medium- and long-term planning by the government authorities in consultation with the local communities.



Figure 10-21: Paddy fields surrounded by miombo woodland at site 6 (February 2023)

10.4.6 Species richness, composition and abundance

Species richness and abundance were calculated in both thickets and miombo woodland to determine the available species and their abundance likely to be affected by the proposed undertaking. Plant species richness were established for specific component of the project and reflected in a way the varying vegetation types encountered during the assessment. Generally, the species abundance in the project area is high as reflected in number of species recorded (species richness) and abundance (number of individuals covering a particular section). Species richness was higher in Itigi thickets compared to miombo woodland. Similar, species densities were higher in the thickets compared to miombo comminated section.

It is important to note is that the abundance of individual species in miombo woodland recorded in lot 3 was lower than that recorded in lot 4. *Julbernardia globiflora, Brachystegia spiciformis, Terminalia sericea* and *Combretum collinum* dominated miombo type of vegetation. Whereas species like *Combretum longispicatum, Pterocarpus angolensis, Lannea schimperi, Phyllanthus engleri* were found to be abundant. The thickets had relatively uniform species composition stretching from Manyoni to Chaya with varying dominance at canopy layer.

Itigi thicket defining species such as *Baphia burttii*, *B. massaiensis*, *Burttii prunoides*, *Combretum celastroides*, *Grewia burttii*, *Pseudoprosopis fischeri*, *Tapiphyllum floridundum* were recorded in all sites covered with thickets.

The species dominance in canopy layer was shared between *Albizia petersiana, Vepris allenii* and *Combretum celastroides*. The flora baseline survey classified the following species *Diospyros fischeri, Oldfieldia dactylophylla* and *Bobgunnia madagascariensis*, as rare species.

10.4.7 Tree species composition and importance value index

A total of 68 tree species from 59 genera and 29 families were recorded. The dominant family was *Fabaceae* which represented 31% of all species, followed by *Combretaceae* 12%, *Loganiaceae* 6%, *Olacaceae* 4%, *Phyllanthaceae*, *Anacardiaceae*, *Annonaceae*, *Burseraceae*, *Capparaceae*, and *Apocynaceae* 3% each. Other Families represented less than 2% of all species. Most of the species recorded are species of typical Miombo woodland. The most dominant species are fast growing species in poor nutrient loose



soils; Combretum zeyheri (LC) and Terminalia sericea (LC). Common Miombo species such as Brachystegia spiciformis (LC) ranked third whereas Julbernardia globiflora (LC) ranked ninth. Other common Miombo species such as Isoberlinia angolensis,(LC) Brachystegia boehmii, Brachystegia longifolia, and Albzia species had few individuals. Some species such as Brachystegia bussei, Pterocarpus angolesis, Albizia vescola, Cassia abbriviata, Afzelia quanzensis and Azanza garckeana of the pristine woodland were not observed as most of the miombo woodland surveyed are highly affected by livestock grazing. Twenty dominant tree species are presented in Table 10-2 in order of decreasing important value index. The dominant tree species are classified under IUCN as Least Concern (LC) or not evaluated.

SN	Family	Species name	RDO	RD	RFR	IVI
1	Combretaceae	Julbernadia globifola LC	35.12	37.79	7.96	80.87
2	Euphorbiaceae	Pseudolachnostylis maproneifolia	7.89	14.65	8.85	31.39
3	Apocynaceae	Diplorhynchus condylocarpon LC	5.32	15.91	8.85	30.08
4	Fabaceae	Pericopsis angollensis	9.48	4.70	7.08	21.26
5	Combretaceae	Combretum mole	11.55	1.08	2.65	15.29
6	Fabaceae	Albizia antunesianaLC	4.77	1.08	5.31	11.16
7	Combretaceae	Combretum zeyheriLC	0.65	2.71	7.08	10.45
8	Fabaceae	Brachystegia bussei LC	6.56	1.08	5.31	11.16
9	Combretaceae	Terminalia mollis LC	2.89	1.63	4.42	8.94
10	Fabaceae	Brachystegia boehmii LC	2.88	1.81	3.54	8.23
11	Rubiaceae	Crossopteryx febrifuga LC	1.06	2.35	4.42	7.83
12	Combretaceae	Combretum adenogonium LC	0.96	1.45	4.42	6.83
13	Fabaceace	Pterocarpus angolensiLC	2.63	1.45	2.65	6.73
14	Ebenaceae	Diospyros kirkiiLC	1.81	1.08	3.54	6.44
15	Loganiaceae	Strychnos cocculoides LC	0.45	1.45	3.54	5.44
16	Combretaceae	Terminalia sericea	0.71	1.45	2.65	4.81
17	Olacaceae	Ximenia cafra	0.25	1.27	2.65	4.81
18	Araliaceae	Cussonia arborea	1.46	0.72	1.77	3.95
19	Fabaceae	Albezia versicolor	1.33	0.36	1.77	3.46

Table 10-2: Dominant tree species in order of decreasing important value index

		RSK	5	capi	1als	
SN	Family	Species name	RDO	RD	RFR	IVI
20	Anacardiaceae	Lannea schmperi	0.72	0.54	1.77	3.03

Note: RDO = relative dominancy; RD = relative density; RF = relative frequency; IVI= Important value index.

10.4.8 Plant Endemism

The Itigi thicket falls within the Zambezian regional centre of endemism (Baena et al, 2016). The vegetation baseline survey conducted recorded a number of endemic plants species majority from the Itigi thickets as listed in Table 10-3:. Plant endemism is also common to miombo woodland.

One of the endemics ("range-restricted") species observed in Itigi thickets was *Vepris allenii* which is listed under IUCN as endangered due to its numbers decreasing. The published sources refer to this species as "near endemic" to dry thickets of northern Mozambique, with possible occurrence in Tanzania. Although there is conflicting information, since it is not listed in the Flora of East Africa, this may be threatened species of conservation concern in Tanzania.

SN	Family	Species Name	IUCN	Ecoregion	Locality
1	Combretaceae	Combretum aureonitens	NT	Itigi-Sumbu	Itigi
2	Rutaceae	Vepris allenii	EN	Itigi-Sumbu	Itigi
3	Oleaceae	Schrebera trichoclada	LC	Itigi-Sumbu	Aghondi and Itigi
4	Fabaceae	Aeschynomene trigonocarpa	-	Itigi-Sumbu	Itigi
5	Combretaceae	Meiostemon tetrandrus	LC	Itigi-Sumbu	Itigi

Table 10-3: Endemic species recorded in Itigi thickets and miombo woodland

10.4.9 Rare and threatened plant species

The global conservation status of most species recorded during baseline survey on the project ROW have not been assessed by the IUCN and therefore rated "Not Evaluated". However, there are several recorded plant species with conservation status as defined by IUCN 2019 as presented in Table 10-4. The Near threatened *Dalbergia melanoxylon* was found to be locally abundant on Lot 3 at site 4 (February 2023) and also at site 14.

Table 10-4: List of plant species with conservation	n status identified in the project area
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SN	Family	Species Name	IUCN Status	CITES appendix No
1	Bombacacee	Adansonia digitata	LC	
2	Asphodelaceae	Aloe vera	LC	II
3	Fabaceae	Pterocarpus tinctorius	LC	II
4	Fabaceae	Dalbergia melanoxylon	NT	II
5	Euporbiaceae	Euphorbia tirucali	LC	II

VU= Vulnerable, EN = Endangered, CR = Critically Endangered, NT= Near Threatened, LC = Least Concern source, IUCN 2019 - 2022





Figure 10-22: *Dalbergia melanoxylon* NT was abundant at site 4 (February 2023), 40 stems were recorded in a 40 by 40 m plot (also occurred at Site 14)

10.4.10 Invasive species

The occurrence and spread of invasive species are another biodiversity concern. The level of degradation of the project area has attracted infestation of invasive species in different parts of the project area. During the flora baseline survey for the project ROW, in the dry season, five plant species were identified as invasive species; *Astripomoea hyoscyamoides, Leucaena leucocephala, Calotropsis procera, Bidens pilosa, Syzygium cumini,* and *Argemone mexicana*. The extent of spread is more on Manyoni side at chainage 552 +000 to 555 +000. Activities of the project area is low. Four of the species recorded are on the list of invasive species in the project area is low. Four of the species recorded are on the list of invasive species of Tanzania as per Global Biodiversity Information Facility (GBIF) database. The list of invasive species recorded from the project are presented in Appendix 4.

The extent of clearance for the project's ROW will most likely lead to a proliferation of invasive species occurring along the route as some are adapted to growing on disturbed ground and will therefore benefit from the site clearance works. These include species such as *Ricinus communis* (commonly known as the castor oil plant) which is native to tropical East Africa, but it has naturalized and become weedy in many tropical and subtropical areas around the world. It is usually found along riverbeds, railroads, roadsides, fields, pastures, or other disturbed areas. The castor bean is a fast-growing large shrub or small tree that is extremely toxic to humans. It can be fatal if only a few seeds are ingested and also causes contact dermatitis when the foliage is handled and so the potential for this species to proliferate along the cleared areas of the ROW is a concern due to its potential impact on local communities and particularly children.

The invasive species *Solanum campylacanthum*, is widespread from East Africa to Southern Africa growing on disturbed ground and at roadsides and was also found at several sites during the survey undertaken in February 2023. The invasive species *Xanthium strumarium* (cocklebur) is herbaceous annual plant with worldwide distribution. The seeds contain the glycoside carboxyatractyloside, which is highly toxic to animals and has been known to cause multiple deaths and illness among communities in Bangladesh that ate the plant. *Calotropis* is also a poisonous plant but with medicinal properties.



The prevention of widespread invasive species is therefore important to protect workers, communities and livestock as well as the native flora and fauna.



Figure 10-23: Invasive species *Solanum campylacanthum* and *Ricinus communis* recorded in site 1 (February 2023)



Figure 10-24: Invasive species *Xanthium strumarium* and *Calotropis procera* identified at site 12 (February 2023)

10.4.11 Habitats and fauna

The distribution and quality of fauna habitats varies throughout the project's ROW. Fauna habitats located within the ROW have been categorised into protected areas, Itigi thickets, forest habitats (including the forest reserves which are largely miombo woodlands), seasonal wetlands and other aquatic environment seasonal rivers. The importance of the key habitats in supporting fauna species in the areas are discussed in subsections below.

10.4.11.1 Wetlands

The project alignment within Lots 3 and 4 crosses some areas that are characterized as wetlands in categories including the marshes, rivers, riverine forests, inland drainage systems and flood plains (Ramsar Convention on Wetlands, 2018). Literature has also indicated that, the wetland areas along the alignment are characterized by high diversity of flora and fauna. Malongwe and Igombe Rivers are among very important rivers that are crossed by the alignment. The wetlands located within the project are of variable



habitat quality and a large part of it is cultivated. Highly disturbed wetlands are the springs in Mdunundu, Manyoni camp and Malongwe village that are already utilized as source of water for communities and are used as livestock grazing land during dry season. Accordingly, the flood plains in Kitaraka ward are habitats for birds and used as paddy farms.

Of major importance is that the wetlands in the areas are mainly seasonal. Although seasonal they still support important fauna in the wetland areas along the project. Surveys of seasonally wet areas undertaken in 2023 identified additional species, particularly amphibians that are characteristically found in these temporal habitats.

Birds are usually a dominant and diverse component of wetlands. Some of the wetland birds encountered during the dry season survey included: African jacana (*Actophilorns africanus*- IUCN LC), grey heron (*Ardea cinerea* - IUCN- LC), cattle egret (*Bubulcus ibis*-IUCN LC), and hamerkop - *Scopus umbrette* IUCN LC). A total of 105 bird species were encountered in the dry season from wetland areas within the alignment. The wetlands also harbour fish and other aquatic species.

Wetlands are also known to support a variety of species of amphibians, mammals, and reptiles. Amphibians and reptiles were partly sampled in few remnant pools (Figure 10-28: and Figure 10-28) because of the level of dryness in the areas. To supplement the obtained data literature review and discussions with communities have indicated that the wetlands harbour a number of fish species as well as amphibians and reptile species. A total of 11 amphibians have been recorded from the area traversed by the project (Howell 2004; and Hickman et al. 2007).

Mammals also utilize the wetlands and, in many cases, reside close to water sources. The majority of mammals which utilise habitats along the project alignment are generalists and use wetlands and terrestrial habitats (i.e. forests) for refuge and to forage. Their habitat usage is partly dependent on the flooding patterns and many mammals move to drier areas during heavy rain (Wakwabi et al. 2006).

Wetlands located in the ROW are highly unlikely to support a large diversity and abundance of large mammals, particularly those located within Igombe flood plains through to Bukene and Isaka because these areas are highly degraded with high levels of disturbance. The areas are typically farmlands therefore have less fauna. However, the Igombe River riparian vegetation does support leopard and elephant that both have a high conservation value. The National Red List for Tanzania (IUCN, 2022) has classed leopard and savannah elephant as vulnerable species although African savanna elephant *Loxodonta africana* was assessed for The IUCN Red List of Threatened Species in 2020 as "endangered" under criteria A2bd.







Figure 10-25: Wetland (including rivers and swamps) areas that are crossed by the project alignment in Lot 3 (left) and Lot 4 (right) Courtesy: UDSM ESIA (2023)





Figure 10-26: Geese and waders using wetland areas in Chaya during the ${\rm d} ry$ season



Figure 10-27: Springs and Wetland sites during scoping that were utilized and important sites for vegetable farming and fishing activity along the Lots 3 and 4 Courtesy: UDSM ESIA (2023)







The status at 780+000 km, which was predetermined as good site for amphibians

Figure 10-28: Dry season Lake Chaya site

The exceptional dry season dried up lakes and the wetlands and aquatic sampling could not be conducted extensively given the level of drought along the alignment. However, the existing literature indicates no records of threated species of fish or amphibians in the areas. It was recommended that some monitoring of existing fish, amphibian and other aquatic species be conducted during construction phase of the project. Key wetlands that could be included during wetland monitoring studies are shown in the following table.

Location		Description of the sites	
Chainage	District/ward		
564+000	Muhalala	Springs located at Mdundu ward are within the project. To be sampled for amphibians and other aquatic fauna	
568+000	Manyoni DC	Springs located near Manyoni camp are good sites for aquatic biota sampling including macroinvertebrates	
663+000	Chaya	Lake Chaya is a good bird watching area	
728+000	Malongwe	Springs located at Malongwe ward, Swakala village. Good site for amphibian and bird species sampling	
571+000 – 572+00	Manyoni	Lot 3 crossing at the springs. The areas are potential for amphibian, reptiles, small mammal and insect sampling. The area also had signs of elephant crossings	
625+000- 629+000	Kitaraka	Alignment crosses wetland/floodplains in Kitaraka ward	
854+000 - 854+200	Nzubuka	Nzubuka river that has existing erosion is a good site for biota sampling	

Table 10-5: Wetland sites recommended for sampling during monitoring phase



10.4.12 Agro-pastoral land

The agriculture land within Lots 3 and 4 falls under the modified habitat as per the PS 6. Agro-pastoral land, fallow land and plantations located within the Lots 3 and 4 are likely to support birds and small mammals that are adapted to modified habitats and disturbance. Largely, the rice farms from Bukene through to Isaka are rich in avifauna. So far, the areas are used as farmland for a large part in Lot 3 and for livestock keeping especially in the miombo woodland. Significant forest clearing is evident in both lots where one can see plots of farmland as shown on maps indicating land cover and use along the alignment. Of great concern is the large-scale cashew nut farming in Manyoni and Itigi districts that have attracted investors from outside the areas. Quite a large area has been cleared for cashew nut farming in Lot 3 as indicated on maps indicating land cover and use along the alignment. These threaten the wildlife populations utilizing the areas. This is more so for the farms that are within the wildlife corridor and dispersals areas.

10.4.13 Wildlife Corridors

A report by the Ministry of Natural Resources and Tourism (MNRT) has highlighted areas of importance for wildlife corridors in the country (MNRT, 2022). Some identified corridors traverse the railway alignment connecting Ruaha/Rungwa reserves and the Serengeti and Tarangire complex reserves. However, whilst the MNRT (2022) report does not provide definitive geographic crossing points, the dry and wet season surveys and community consultations report animal crossings at points between Lots 3 and 4.

During the wet season, mammal presence was established by direct observation, signs and interviews with the locals, especially the elderly. Most community members were aware of the presence of medium-sized and large mammals in their area. The communities mentioned livestock (cattle, goats and dogs), spotted hyaena (*Crocuta crocuta*), and jackals as the most common. From the wet season survey, some sites were considered the most viable corridors for wildlife (see figures for site locations and crossing points above).

Site No. 3 Aghondi Mabondeni. Location; S 5.74368, E 34.6403: This is an active possible elephant crossing point. The local community reported the presence of elephants about one week before the arrival of the survey team, which would be the last week of January 2023. Elephant footprints and old and fairly fresh dung were seen about 7 m away from the rail line. Usually, elephants move across human-settled areas at night, but in this particular area, they were seen during the day.





Figure 10-29: Elephant footprints recorded showing movement in a direction parallel to the rail line, possibly trying to find an easy spot for crossing

Site No. 4 Mhama Mmoja: Location; S 5.59621, E 34.23766. There was no evidence of elephant passage, although the local community confirmed occasional visits.

Site No. 5 Mhama Mmoja. Location; S 5.61932, E 34.30914: Elephants, kudu, lions and leopards, among other large mammals, were reported as common. Evidence showed an elephant brushing on a tree trunk and breaking branches. In addition, kudu dung and footprints of Duiker and Bushpig were found at the edge of a swamp, confirming an active corridor for large mammals in the area.



Figure 10-30: Tree trunk brushed by elephant

Site No. 6 Chaya: Footprints of antelopes were recorded, but no signs of elephant presence.

Site No. 8 Malonwe, Location S 5.469165592, E 33.68973215: Bush Pig, antelopes and aardvark dugout footprints were recorded. Elephant and the big predators (lion, leopard and hyaena) presence was established between Tura, Malongwe, Nyahua and Goweko.



The community was fearful of crossing the thickets and woodlands because of this. It was mentioned that in January 2023, a herd of about 30 elephants raided the farms in a settlement near Tura railway station.

The local communities find evidence of elephant activity in the mornings, and some confirmed that the movements occur quietly at midnight. Establishing exact crossing points for elephants along the rail line was difficult as they were reported not to have a definitive crossing point. Increased clearance of unprotected forests for agriculture and settlement would further lead elephants into the farms.



Figure 10-31: Clearing of forest in wildlife potential crossing areas

Site No. 9 Nyahua Location; S 5.389653, E 33.374954: This site location is impossible to reach during the wet season due to flooding of rivers to the east and a wetland to the west. The survey team sampled at the edge of a wetland 2 km west of site 9. At this sampling point, old elephant dung was recorded about 5 m from the railway line. The wetland is a potential habitat for migratory water birds and possibly a watering site for large mammals. Similar to site 8, site 9 lies between Malongwe and Tura and is seasonally visited by elephants. An old concrete block was observed close by, possibly marking the edge of Nyahua Forest Reserve. No anthropogenic activities were observed in the surroundings.

Sites 10 and 11 Nyahua: The area falls within the extended miombo woodland between Malongwe and Goweko villages. The area has beekeeping potential and large mammal crossing, but no signs of elephant signs were recorded during the survey. This stretch of forest is considered active for wildlife crossing, with the most recent sighting being in December 2022. No particular crossing point was confirmed, thus requiring further investigation along the line.





Figure 10-32: Photo taken near site 11, the potential end of a wildlife corridor between Malongwe and Goweko

Site 15 Nzubuka. Location S 4.76920, E 32.83105: The area has potential for elephant movement, confirmed by the local community and a pile of elephant dung near the railway line.

Site 16 Mambali. Location S 4.46799, E 32.88229: There are records of elephant movement across the area. Information from the local community establishes that elephants crossed the valleys commonly in the past (more than two years) following the foot of hills. The size of herds varied between 3 and 50 individuals. However, there was no sign of recent use of the corridor, possibly due to the extension of settlement and agricultural activities. This may require confirmation with long-term monitoring.





Figure 10-33: Photo taken near site 16 showing evidence of extended farming in recent years along elephant corridor





Figure 10-34: Maps indicating land cover and elephant crossing points along Lot 3 (left) and Lot 4 (right) Courtesy: UDSM ESIA (2023)



10.4.14 Summary of priority habitats and species within Lots 3 and 4

Considering the above key habitat types identified in the ROW and surrounding environment, it is evident that the area is somehow fragmented and degraded by human activities that include farming. Therefore, fauna species are under threat from habitat loss and other sources of anthropogenic disturbance. Nonetheless, the baseline assessment identified several priority habitats and species of conservation importance for the project.

A summary of the known features of priority habitats and species are presented in Table 10-6. The effective management of these priority biodiversity values is expected to be a key issue for the permitting of the project. Some of these habitats have also been identified as providing priority ecosystem services for the project.

Type of risk receptor	Priority biodiversity values	IUCN status	National threat status	Confirmed presence in ROW
	КВА	-	-	No
	IBA	-	-	No
Legally protected	Ramsar Sites	-	-	No
areas	Forest reserves	-	Т	Yes
	Wildlife Corridors	-	Т	Yes
	Game reserves	-	Т	Yes
	Game controlled areas	-	Т	Yes
Priority natural	Wetlands	-	Т	Yes
habitats (and fauna habitats)	Forest habitats	-	-	Yes
,	Itigi thickets	-	VU	Yes
	Leopard (Panthera pardus)	VU	VU	Yes
	Elephant (<i>Loxodonta</i> africana)	EN	VU	Yes
	Zebra (<i>Equus burchellii</i>)	NT	NT	Reported
Large Mammals	Lion (<i>Panthera leo</i>)	VU	VU	Reported
	Hippopotamus (Hippopotamus amphibious)	VU	-	Yes
	Spotted Hyena (<i>Crocuta</i> crocuta)	-	-	No
	Lesser kudu (<i>Tragelaphus imberbis</i>)	NT	NT	Yes
	Hooded vulture	CR	EN	Yes
	(Necrosyrtes monachus)			
Birds	Bateleur (<i>Terathopius</i> ecaudatus)	EN	EN	Yes
	Southern ground hornbill (<i>Bucorvus lead beateri</i>)	VU	VU	Yes

Table 10-6: Summary of identified priority habitats and species in the project



Type of risk receptor	Priority biodiversity values	IUCN status	National threat status	Confirmed presence in ROW
	Southern banded snake eagle (<i>Cicraetus fasciolatus</i>)	NT	NT	Yes
Herpetofauna	See wet season - herpetofauna list in Appendi 4.	LC	-	Yes

During the wet season (February 2023) the following mammals were observed and/or reported by local communities and are shown in Table 10-7

|--|

Mammals	Site No.	IUCN category
African Savannah Elephant (Loxodonta africana)	3 ,4, 5, 8, 16	EN
Lion (<i>Panthera leo</i>)	5, 8	VU
Leopard (Panthera pardus)	1, 5, 7, 8	LC
Hippopotamus (Hippopotamus amphibious)	6	VU
Kudu (<i>Tragelaphus</i> sp)	5	LC
Spotted Hyaena (Crocuta crocuta)	All sites	LC
Aardvark (Orycteropus afer)	5, 6, 7, 8	LC
Dwarf Mongoose (<i>Helogale parvula</i>)	1, 3, 5	LC
Banded mongoose (Mungos mungo) 1	1	LC
Yellow Baboon (<i>Papio cyanocephala</i>)	2, 3, 5, 6, 7	LC
Vervet monkey (Cecopithecus pygerythrus)	2, 3, 10, 11	LC
Back-backed Jackal (Canis mesomelas)	All sites	LC
Bush pig (Potamochoerus larvatus)	1, 8,10	LC
Common warthog (Phacochoerus africanus)	8	LC
Bush Duiker (<i>Sylvicapra</i> sp)	5	LC
Cattle (Bos taurus)	All sites	

10.5 Fauna species composition

10.5.1 Large and medium sized mammals

The field surveys conducted during the dry season identified direct and indirect evidence of a diverse number of mammal species along the alignment. More than 20 species were directly or indirectly encountered during the field survey of the alignment (see Table 10-8).







Figure 10-35: Large Mammals and/or their respective signs during dry season. Courtesy: UDSM ESIA (2023)

This is because the habitat types along the alignment are suitable habitats for wildlife species especially large to medium sized mammals. Generally, a good number and diversity of medium to large mammal species and/or their signs were sighted both during scoping and full ESIA exercises. The captures by camera traps were high despite the short duration of sampling (i.e. 20 days per site).



Figure 10-36: Habitats used along Lots 3 and 4 through walking transects Courtesy: UDSM ESIA (2023)

T1 indicates the project impact zone, T2 was 100 m away from T1 on the right, and T3 which was 100 m away from T1 on the left of the line.

A few of the species that were directly or indirectly (using animal signs) encountered are listed in the IUCN red list or to internationally recognized standards such as CITES. Most of the species that were encountered (either directly or indirectly) during the ESIA surveys were also reported during stakeholders' consultations and have been reported in the literature of the areas. Some species that were recorded were also recorded using



camera traps. Some of the large mammals recorded through direct and indirect signs of wildlife in Lots 3 and 4 include elephants, spotted hyaena, common duiker, African civet and Lichtenstein's hartebeest. Largely, the animals encountered are least concern according to IUCN categories. Elephants are listed as endangered under IUCN Red List and are considered to be threatened with extinction and adversely affected by trade under the CITES Appendix I. Hyenas are regarded as endangered when outside protected areas. Disturbances caused by human activities i.e. expansion of farms, expansion of unplanned human settlements and other developments, most habitats in the areas remain as islands hence wildlife in these areas are at high risk.

Table 10-8: Checklist of large to medium sized mammal species sighted in the walking transect along Lots 3 and 4 during ESIA study August 2022

S/N	Species	Scientific name	Order	Family	IUCN status	CITES appendix
1	Aadvark**	Orycteropus afer	Tubulidentata	Orycteropodidae	LC	Not listed
2	African civet**	Civettictis civetta	Carnivora	Viverrida	LC	Not listed
3	Banded mongoose	Mungos mungo	Carnivora	Herpestidae	LC	Not listed
4	Bushbuck	Tragelaphus scriptus	Artiodactyla	Bovidae	LC	Not listed
5	Common duiker**	Sylvicapra grimmia	Artiodactyla	Bovidae	LC	Not listed
6	Kirk's Dikdik	Madoqua kirkii	Artiodactyla	Bovidae	LC	Not listed
7	Dwarf mongoose	Helogale parvula	Carnivora	Herpestidae	LC	Not listed
8	Eland	Taurotragus oryx	Artiodactyla	Bovidae	LC	Not listed
9	Elephant	Loxodonta africana	Proboscidea	Elephantidae	VU	I
10	<i>Galago</i> spp	Galagidae	Primates	Galagidae	LC	Not listed
11	Ground squirrel	Marmotini	Rodentia	Sciuridae	LC	Not listed
12	Hartebeest	Alcelaphus buselaphus	Artiodactyla	Bovidae	LC	Not listed
13	Impala	Aepyceros melampus	Artiodactyla	Bovidae	LC	Not listed
14	Leopard	Panthera pardus	Carnivora	Felidae	VU	I
15	Lesser Kudu**	Tragelaphus imberbis	Artiodactyla	Bovidae	NT	Not listed
16	Zebra	Equus burchellii	Perissodactyla	Equidae	NT	Not listed
17	Porcupine	Hystrix Cristata	Rodentia	Hystricidae	LC	Not listed
18	Scrub hare	Lepus axatilis	Lagomorpha	Leporidae	LC	Not listed



S/N	Species	Scientific name	Order	Family	IUCN status	CITES appendix		
19	Serval cat	Leptailurus serval	Carnivora	Felidae	LC	Not listed		
20	Slender mongoose*	Herpestes sanguine	Carnivora	Herpestidae	LC	Not listed		
21	Small spotted genet*	Genetta genetta	Carnivora	Viverridae	LC	Not listed		
22	Spotted hyaena	Crocuta crocuta	Carnivora	Hyaenidae	LC	Not listed		
23	Steenbok*	Raphicerus campestris	Artiodactyla	Bovidae	LC	Not listed		
24	Vervet monkey	Cercopithecus aethiops	Primates	Cercopithecidae	LC	Not listed		
25	Water mongoose	Atilax paludinosus	Carnivora	Herpestidae	LC	Not listed		
26	Wildpig	Potamochoerus Iarvatus	Artiodactyla	Suidae	LC	Not listed		
27	Yellow baboon	Papio cynocephalus	Primate	Cercopithecidae	LC	Not listed		
1								

Source, field data, 2022; Note: Species with * were only sighted by camera traps, ** sighted both by camera traps and through walking transects, others were sighted though walking transects

Noteworthy, the field surveys generally indicated a low abundance of mammals in the study area. This may be partly due to human footprint including farming, hunting (poaching) and other related actions. During the survey, a number of wildlife snares and other traditional traps for small to large mammals were encountered on the sites. The existence of poaching could also be revealed through community level discussions that indicated that the representatives were most aware of the medium sized animals like duiker which were largely utilized as source of domestic meat. Some of the species that were reported by the interviewed communities are listed as vulnerable (VU), under IUCN Red List and in the CITES appendices I & II Annex. Such reported mammals include hippopotamus (Hippopotamus amphibius), giraffe and buffalo. These species are also considered vulnerable at the national and international levels. Although the survey team did not directly observe any hippopotamus during the survey, a local leader reported their presence around Malombe River during rain seasons. This was confirmed by the wet season survey in February 2023, which reported hippopotamus at site 6.

Table 10-9: Checklist of reported large and medium sized mammal by consulted individuals along Lots 3 and 4. Source: Field data, 2022

S/N	Species	Scientific name	Order	Family	IUCN status	CITES appendix
1	Buffalo	Syncerus caffer	Artiodactyla	<u>http://en.wikipe</u> <u>dia.org/wiki/Bov</u> <u>idae</u>	LC	Not listed



S/N	Species	Scientific name	Order	Family	IUCN status	CITES appendix
2	Elephant	Loxodonta africana	Proboscidea	Elephantidae	EN	I
		Giraffa	<u>http://en.wikip</u> <u>edia.org/wiki/</u> Even-	<u>Giraffidae</u>	VU	
3	Giraffe	camelopardalis	toed_ungulate			П
			<u>Artiodactyla</u>	http://en.wikipedi a.org/wiki/Bovid	LC	
4	Eland	Taurotragus oryx		ae		Not listed
5	Lesser kudu	Tragelaphus imberbis	Artiodactyla	Bovidae	LC	Not listed
6	Leopard	Panthera pardus	Carnivora	Felidae	VU	1
7	Lion	Panthera leo	Carnivora	Felidae	VU	I
8	Spotted Hyena	Spotted hyaena	Crocuta crocuta	Hyaenidae	LC	
9	Vervet monkey	Cercopithecus aethiops	Primates	Cercopithecidae	LC	Not listed
10	Hippopotamu s	Hippopotamus amphibius	Artiodactyla	Hippopotamidae	VU	

10.5.2 Bats

Bats are mammals of the order chiroptera, a Latin name meaning "hand-wing", and the only mammals naturally capable of true and sustained flight. Bats have about 1,240 species worldwide (about 70% of bat species are insectivores) making them the second largest order of mammals after that of rodents. Bats can see almost as well as humans. However, most bats use "echolocation" to help them find shelter, prey etc. (Gouge *et al.* 2015).

Bats are one of the most important, yet least understood, groups of animals in the world. Ecologically as well as socially, bats play important role on sustainability of ecosystems. Bats are pollinators, seed dispersers and primary predators of night-flying insects. For instance, a single *Myotis lucifugus* can catch more than 1,200 mosquitos in an hour. Despite their importance, bats have been less studied than other mammalian groups, because of the complexity involved in their trapping and identification.

Tanzania has variety of species including forest dependent Tanzanian woolly bat (endangered species threatened with loss of suitable habitat) and cave-dwelling bats (Hildegarde's tomb bat (*Taphozous Hildegardeae* - VU), trident bat (*Triaenops afer*), Mops (free-tailed bats) and horseshoe bats (*Rhinolophus* sp.) that are so far reported in the SGR Lots 1 and 2 of the Mwanza-Isaka alignment. So far, to a large extent, the bats central Tanzania are less documented. However, Trentin and Rovero (2011) reported presence of *Nycticeinops schlieffenii* in central Tanzania i.e. in Singida -Tabora regions.

During the dry season surveys along the Lots 3 and 4, only one site (at 36 m 0494301, 9440042) in Shaurimoyo quarry site indicated potential occupation by bats. Night sampling was conducted in the areas where only Wahlberg's epauletted fruit bat (Figure 10-37) (*Epomophorus wahlbergi*), family pteropoidae was captured. A total of 10 individuals were captured on 23 and 25 August 2022.





Figure 10-37: Wahlberg's Epauletted Fruit Bat (*Epomophorus wahlbergi*) captured from Shaurimoyo quarry site. Courtesy: UDSM ESIA (2023)



The Wahlberg's Epauletted fruit is recorded as LC by IUCN Red List. Despite the few encounters of bats along Lots 3 and 4, more sampling during project impact monitoring may contribute to increased number of species. This is because, so far, the world database has indicated 28 species of bats that are found in Tanzania among which a majority are widely distributed in the regions crossed by the Lots 3 and 4 alignment. It is worth noting however that a majority of the reported species in the study regions are LC Annex with a few that are also found in the area being near threatened (NT) including the *Eidolon helvum* and *Rhinolophus deckenii*. The NT species of bats could not be found along the project alignment probably indicating their absence in the vicinity of the project areas, although they may occur in the project's Area of Influence in large mature trees or quarry sites.

Twenty-eight species of bat have been reported in Tanzania and these are mainly classified by IUCN as least concern with the exception of several near threatened, one vulnerable (Pemba flying fox Pteropus voeltzkowi) and one endangered (Hildegarde's tomb bat Taphozous hildegardeae), however the latter is found in coastal areas and offshore islands.

10.5.3 Small mammals

Small mammals are very important bioindicators and ecosystem service providers among other key functions they perform. Small mammals weigh 5 kg or less. They have variety of species and very highly distributed worldwide (Lidicker, 2011). It is important to note that, the capture rate during survey study was low. This is probably because of the level of dryness of the areas during the study. e.g. among the sampled sites, in both regions crossed by the project alignment, all sites in Singida had some successful capture while Tabora sites were very poor. e.g. of the sites in Tabora, only Itulu quarry site got some individual small mammals collected. Ten species of small mammals were recorded during field surveys in Lots 3 and 4 using pit fall, Sherman and camera traps. All the species are categorized as least concern (LC) by IUCN Red List thus not threated by the project. It is worth noting that, the 20 days camera traps effort captured a good number of species including banded mongoose, slender mongoose and African Wildcat (Felis lybica) among others.

S/N	Location	Species Name	Scientific name	Frequency	Family	IUCN
1.	Manyoni Camp	<i>Tatera</i> sp (Bushveld gerbil)	Gerbilliscus leucogaster	6	Muridae	LC
2.	Manyoni Camp	<i>Mastomys</i> sp	Mastomys dolichurus	6	Muridae	LC
3.	Manyoni Camp	Ochre bush squirrel	Paraxerus ochraceus	1	Sciuridae	LC
4.	Aghondi Beekeepi ng reserve	Ochre bush squirrel	Paraxerus ochraceus	2	Sciuridae	LC
5.	ltulu Quarry Site	<i>Mastomys</i> sp	Mastomys natalensis	3	Muridae	LC

Table 10-10: List of small mammals collected through pit fall, Sherman's traps an	d
camera traps during ESIA study in Lots 3 and 4	



S/N	Location	Species Name	Scientific name	Frequency	Family	IUCN
6.	Itulu Quarry Site	<i>Grammomys</i> sp (Woodland thicket rat)	Grammomys dolichurus	2	Muridae	LC
7.	Itigi	Slender mongoose	Herpestes sanguines	2	Herpesti dae	LC
8.	Itigi	Water mongoose	Atilax paludinosus	2	Herpesti dae	LC
9.	Itigi	Banded mongoose	Mungos mungo	2	Herpesti dae	LC
10.	Itigi	Small spotted genet	Genetta genetta	4	Herpesti dae	LC

Source: Bayo (2019); Ssuuna (2020); and Kamungo (2021), LC = Least Concern in IUCN Red List

10.5.4 Birds

The data being used for this baseline report has included birds from the dry season and existing information which has indicated that Acacia, Brachystegia or Combetum woodlands of Nzega district harbour important bird species. Bird species found in the area include two species endemic to Tanzania, the Tanzanian, Red-billed Hornbill (Tockus ruahae) and Ashy Starling (*Cosmopsarus unicolor*) (Sinclair & Ryan 2010) and Yellow collared lovebird (*Agapornis personatus*) native to Arusha region. Other birds of national and international importance include Fischer's Lovebird (*Agapornis fischeri*), an East African endemic listed as Near Threatened, Hooded vulture (*Mecrosyrtes monachus*) listed as critically endangered, bateleur (*Terathopius ecaudatus*) and martial eagle (*Polemaetus bellicosus*) listed as Endangered, Tawny eagle (*Aquila rapax*) and Southern ground hornbill (*Bucorvus leadbeateri*) listed as Vulnerable (BirdLife International 2016, 2021 & 2022).

A total of 1135 birds in 109 species were recorded through point count transects whereas 99 were opportunistically counted in 55 species (Appendix 4) during study field surveys in August 2022. From all the surveys conducted of the project area, most species recorded are categorised as LC by the IUCN Red List of Threatened Species (IUCN, 2022). However, the new data from the areas has confirmed existence of various species already recorded from the areas in the previous studies that include southern ground hornbill and bateleur. The two species are listed as vulnerable and endangered under IUCN Red List respectively. Southern banded snake eagle (Cicraetus fasciolatus) is a near threatened IUCN Red Listed species that was also recorded during field surveys. It is important to note that, although most of the threated and endangered/vulnerable and migratory bird species were not sampled during this survey, this should not undermine the fact that they exist in the areas, thus the need to comply with the IFC PS and Equator Principles as well as national and other international safeguard standards to demonstrate no net loss of birds that are already listed as priority species by IUCN and other internationally recognized databases including BirdLife International is of paramount importance.

10.5.4.1 Bird distribution by habitat in Lots 3 and 4

An analysis of the bird species distribution by habitat has indicated that, there are more bird species in Lot 3 (especially in the Itigi thickets) compared to those in the miombo and acacia woodlands. Key areas with largest frequency of bird collection have been attached



(see Appendix 4). Generally, simple calculations indicate that, there are higher frequency of birds in terms of groups and numbers that were counted in Lot 3 (n = 1684) as compared to those in Lot 4 (n = 607). Again, the Itigi thickets (that are only found in Lot 3) had most records of birds as compared to other habitats followed by the miombo woodlands.



Figure 10-38: Bar charts indicating frequency of some bird species recorded in Lots 3 and 4. Courtesy: UDSM ESIA (2023)

Almost 3,000 birds from 120 species were recorded through point count transects and opportunistically during the dry season in August 2022. The wet season sampling through direct observation by using field binoculars and vocalizations, especially in closed vegetation, recorded 2,804 birds from 115 species and 47 families. Identification was confirmed using footprints and feathers and standard field guidebooks (Stevenson & Fanshawe, 2020; Sinclair & Ryan, 2003).

The birds recorded during both the dry and wet seasons are widely distributed and regarded as common in their ranges of distribution. From all the surveys conducted in the project area, the majority of species recorded are categorised as LC under the IUCN red list of threatened species (IUCN, 2022) with a few exceptions.

The endangered *Terathopius ecaudatus*, commonly known as Bateleur, was observed during the dry and wet seasons, and the near-threatened Southern banded snake eagle (*Cicraetus fasciolatus*) was observed during the dry season.

Three local endemics, the Tanzanian, Red-billed Hornbill (Tockus ruahae), the Ashy Starling (*Cosmopsarus unicolour*) and the Yellow-collared lovebird (Agapornis *personatus*), which is native to the Arusha region, were also seen. Furthermore, three Stork species, the African Openbill, Abdim's Stork and the Yellow-billed Stork, were observed feeding in seasonal wetlands and farmlands close to the alignment during the dry and wet seasons. These large birds are intra-African migrants that generally move in flocks of hundreds of individuals. These would be vulnerable to train-bird strikes at points where the train crosses the wetland areas, especially during the wet season.

Nzega district, of Tabora region, is reported to support birds included in the African-Eurasian migratory waterbird agreement (AEWA) such as the black-winged stilt (*Himantopus himantopus*), the Crowned plover (*Vanellus coronatus*), the Madagascar bee-eater (*Merops persicus*), the European bee-eater (*Merops apiaster*) and the Redbacked shrike (*Lanius collaris*). The Hooded vulture is also reported to migrate within the



alignment corridor, having been sighted at both Maswa game reserve (bordering the Serengeti national park) and Pugu Station southwest of Dar es Salaam. The presence of IUCN red listed species suggests the importance of the area for birdlife.

The diversity and number of birds in Lot 3 were higher than those in Lot 4 for the dry and wet seasons. An analysis of the bird species distribution by habitat has indicated that there are more bird species in Lot 3 than in Lot 4. The woodlands, which are more prominent in Lot 3 than Lot 4 could explain the observations. The Acacia, Brachystegia, and Combretum woodlands hosted slightly less birds compared to the Itigi thicket during the dry season. This was somewhat less evident during the wet season as the seasonal wetlands and farmlands also hosted sizeable bird populations. A full list of birds observed in the dry and wet seasons is shown in Appendix 4.

10.5.5 Reptiles

A review of published data has indicated that the project area may support up to 20 reptile species although during the dry season survey there was only one successful capture (see Figure 10-39) recorded from Singida and Tabora regions (Spawls et al. 2006; Wagner, 2014; Spawls et al. 2018). The limited success during the dry season could be attributed to increased drought conditions.



Figure 10-39: Sundevalls writhing skink (*Mochlus sundevallii*). Courtesy: UDSM ESIA (2023)

The 20 species that could occur in the area are listed as LC under IUCN Red List. No reptiles were observed during the wet season survey.



Table 10-11: Reptile species reported in the literature and their IUCN Status inLots 3 and 4

S/N	Location	Common name	Scientific name	Order	Family	IUCN status
1	Singida		Agama turuenss			LC
2	Aghondi Bee Reserve	Puff adder	Bitis arietans		Viperidae	
3	Aghondi Bee Reserve	Black mamba	Dendroaspis polylepis	Squamata	Elapidae	LC
5	Singida	Tropical spiny agama	Agama armata	Squamata	Agamidae	LC
6	Singida	African striped skink	Trachylepis striata	Squamata	Scincidae	LC
7	Singida	Red-lipped snake	Crotaphopeltis hotamboeia			LC
8	Tabora	Nyika gecko	Hermidactylus squamulatus	Squamata	Gekkonidae	LC
9	Tabora	Mwanza flat- headedd rock agama	Agama mwanzae	Squamata	Agamidae	LC
10	Tabora	Flap-necked chameleon	Chamaeleo dilepis	Squamata	Chamaeleoni dae	LC
11	Tabora	Black-necked spitting cobra	Naja nigricollis	Squamata	Elapidae	LC
12	Tabora	Boomslang	Dispholidus typus	Squamata	Colubridae	LC
13	Tabora	Leopard tortoise	Stigmochelys pardalis	Testudine s	Testudinidae	LC
14	Tabora	Egg-eating snake	Dasypeltis scabra	Squamata	Colubridae	LC
15	Tabora	Nile monitor	Varanus niloticus	Squamata	Varanidae	LC
16	Tabora	Sundevall's writhing skink	Mochlus sundevallii	Squamata	Scincidae	LC
17	Tabora	Olive marsh snake	Natriciteres olivacea	Squamata	Colubridae	LC
18	Tabora	Common bush snake	Philothamnus irregularis	Squamata	Colubridae	LC
19	Tabora	Warty thick-toed gecko	Elasmodactylus tuberculosus	Squamata	Gekkonidae	LC
20	Tabora	Whyte's water snake	Lycodonomorphu s whytii	Squamata	Lamprophiid ae	LC

Source: Spawls et al. (2006); Wagner (2014); Spawls et al. (2018)



10.5.6 Amphibians

Amphibian records during the dry season were limited to 13 individuals of the Natal Dwarf Puddle Frog (Phrynobatrachus natalensis) (See Figure 10-40), which were collected from Inara-Shauri-moyo quarry site (at 36M 494301 9440042). This species is classified as LC under IUCN Red List. Wet season sampling recorded 16 species of amphibians from 10 families. which complements the literature Source: reaion (https://www.inaturalist.org/check lists/49369-Singida-Rural-Check-List); & (https://www.inaturalist.org/places/tabora); Howell (2004); and Hickman et al. (2007) which reports 11 species. There was limited sampling when amphibians are most active, which is during the night. Sampled areas included standing waters, leaf litter in wooded areas, and listening to individual calls. Further information was gathered from collecting tadpoles and adult species adapted to a fully aquatic lifecycle. Seine nets used for aquatic sampling were also helpful in capturing frogs residing in ephemeral pools.



Figure 10-40: An individual of *Phyrynobatrachus natalensis* at Inala - Shaurimoyo quarry site. Courtesy: UDSM ESIA (2023)

Location	Common name	Scientific name	Family
Singida	Guttural toad	Sclerophrys gutturalis	Bufonidae
Singida	Water lily reed frog	Hyperolius pusillus	Hyperoliidae
Singida	Grey foam-nest tree frog	Chiromantis xerampelina	Rhacophoridae
Tabora	Crowned bullfrog	Hoplobatrachus occipitalis	Dicroglossidae
Tabora	Red-banded rubber frog	Phrynomantis bifasciatus	Microhylidae
Tabora	Tata frog	Mertensophryne taitana	Bufonidae
Tabora	Sharp headed reed frog	Hperolius microps	Hyperoliidae
Tabora	Peter's foam-nest tree frog	Chiromantis petersii	Rhacophoridae
Tabora	Sharp-nosed ridged frog	Ptychadena oxyrhynchus	Ptychadenidae
Tabora	Gong rock frog	Hyperolius glandicolor	Hyperoliidae

 Table 10-12: Amphibians recorded from Wet Season Survey (2023)



There were few permanent rivers and streams traversing the project alignment during the wet season survey. Generally, the rivers had muddy bottoms with sparse riparian vegetation and a few large trees. The flow conditions were mostly laminar or none, where the remaining water was held in shallow pools. Even wet season sampling was limited due to insufficient water to host aquatic species.

10.5.7 Fish

There are seasonal and permanent water bodies (rivers and wetlands) along the project alignment. These bodies host aquatic organisms, including fish and macro-invertebrates. During the dry season, data on fish species and their value was collected by sampling permanent water bodies at Lake Chaya (36M 537317 9405623; and 36M, 613328, 9380415) and Masola (36M 487406, 9507132) and interviewing community members. The communities reported the occurrence of *Oreochromis esculentus*, *O. niloticus*, *O. amphimels* and *Clarias gariupinus*, which have also been cited as occurring in the area by Bwathondi, 2002 and Chibwana et al. 2020. The dry season sampling effort only recorded *Oreochromis amphimelus* and *Clarias gariepinus*. *Oreochromis amphimelus* is listed as endangered (EN) according to IUCN Red List and is endemic to north-central Tanzania.

Wet season sampling was limited to the use of a small beach seine (about 10 m long, 10 mm mesh size). The nets were cast three times in each water body sampled. Five sites were visited only four of which had water (site 12 was dry). Seven species of fish were identified, but none were listed as endangered or threatened under the IUCN Red List. The fish species recorded included barb Cyprinids (*Enteromius* sp), Annual Killifishes (*Northobranchius* sp.), suckerfish (*Synodontis* sp.), African mud catfish (*Clarias* sp.) and cichlids (*Haplochromis* sp.). These species are known to survive in low amounts of water and with the exception of the African mud catfish none of these migrate to spawn. Furthermore, it was not confirmed that any specific habitat was critical for the perpetuation of species fishes which are of low economic importance. The seasonal nature of the water bodies suggests that fish from these areas are considered dependable source of protein.

	Site No.	Location	Fish species	Family
4	4	Mhama	Enteromius jacksonii	Cyprinidae
		moja	Enteromius apleurogramma	Cyprinidae
			Haplochromis sp	Cichlidae
			Northobranchius sp.	Cyprinidontidae
	7	Ikunga	Northobranchius sp	Cyprinidontidae
			Enteromius jacksonii	Cyprinidae
			Haplochromis sp	Cichlidae
ę	9	Nyahua	Northobranchius sp	Cyprinidontidae
			Enteromius jacksonii	Cyprinidae
			Clarias gariepinus	Clariidae
			Synodontis maculipina	Mochokidae
	15	Nzubuka	Northobranchius sp	Cyprinidontidae
			Enteromius jacksonii	Cyprinidae

Table 10-13:	Fish recorded	during the wet seas	son survev (Februa	v 2023)
				3/



Site No.	e Location Fish species		Family
		Synodontis gariepinus	Mochokidae
	Synodontis maculipina		Mochokidae
	Haplochromis sp		Cichlidae

The literature reports the occurrence of *Astatotilapia bloyeti* and *Oreochromis hunteri* (Lake Chala tilapia) in Tabora and Singida. These species are listed as data deficient and critically endangered under the IUCN red list respectively. Neither species was recorded during the dry and wet season sampling. However, IUCN considers *Astatotilapia bloyeti* to be endemic to the Pangani River in northeast Tanzania, whilst *Oreochromis hunteri* is endemic to Lake Chala on the northern border between Tanzania and Kenya. These are extremely unlikely to be in the Aol.

10.5.8 Macro invertebrates

Macroinvertebrates play an important role in aquatic ecosystems breaking down complex organic compounds and enabling mineralization and nutrient recycling. Macroinvertebrates are a source of food for fish. Benthic macroinvertebrates are useful indicators of change in sediment and water columns due to their sensitivity to pollution and sedentary nature (limiting their rate of escape), they may show the cumulative impacts of pollution. Unpolluted water bodies support large and diverse populations of macroinvertebrates and can be gauged by presence of the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) EPT taxa.

Wet season sampling of macroinvertebrates was done using a modified d-net with 0.3 m deep and 500 μ m mesh sizes attached to a metal frame with an area of 0.625 m² and a handle 1.48 m long. Three sub-sampling sites were randomly selected within each aquatic habitat (rivers and seasonal wetlands).

Table 10-14: Locations and co-ordinates for seasonal wetlands (sites 4, 6, 7, 9, 11, 12, 15)

	Coordinate Bystem: EP80:4326 - W08 84				
	# Habitat	Chanage	Category	Latitude	Longitude
	1 Familand with Acaca Woodland and Shutra	341	Farmand Shrube and Wabiliand	-5.735840318	35.09043
	2 Monto Woodand and Rigi Tholes	550	Farmland Stirubs and Woodland	-5.746297101	38 01225
	3 Ferniand with Potonial Wickle Elephant Crossing	385	Potential Webble Crossing	-5.744477303	34.64157
	4 Ferniand with Potential Seasonal Rowroad	641+700	Seasonal Riverbed and Weblands	-5.598301338	34,2378
	5 Itgi Thicket and Pond - Poternal Walle Conduct	733	Parantal Wettile Crossing	5.616663383	34 3094
	6 Seasonal Wetland and Fernand with sume Mumbo Woodland and Potential Within Control	182	Seasonal Riverbed and Wetlands	-5.572511835	34.06725
	7 Polantial River Bett with Busland and Wooldand	175	Seasonal Riverbed and Wetletids	-5 542432629	33.96
i.	8 Rgi Thicket, Ferniand and Polemai Westle Constar	908	Potential Wettile Crossing	-5.489165592	33.68973
í.	9 Seasonal Wetand, Nushua Foreit Reserve, Familand, Beekseping Area	7741	Seasonal Riverbed and Wetlands	-5.395261693	33.39306
£.	10 Mombo Wootland, Famianit and Shulte	759	Farmland Strubs and Wootland	-5:359459484	33,24165
É.	11 Femilient, Acece Woodland and Shruba, potential liver bed	763	Seasons Rverbed and Wetlends	-8.36876177	33,25883
í.	12 River Bed, Rol Thickel, Familying	Tat	Seasons Ryarbed and Wetlands	3-101368944	32,93988
í.	13 Fernianit, Acess Woodianda with shruke, Monto Woodiand	2113	Familant Shrubs and Woodland	-5.096335712	32.8510
£.	14 Ferniand, Azacia Woodland with Shruba and Rock Kopia	635	Famland Shrubs and Woodland	4 924832736	82,82934
E.	15 Rivertrad, Farmand any Povential Wildlife Creating	104	Seasonsi Riverbad and Webents	4.769105118	32 62771
í.	18 Formianti, Monitor Woodanit, Acada Shrubs and Potental Weblie Constor	Tag	- Potental Wildlife Crossing	4.482082858	32,88227
r.	17 Farmiand, Acada Woodland	107	Familand Shrides and Woodlater	4.029968013	32.87007
11					

A kick net technique was used to kick and sample macroinvertebrates from mud, stones, and other objects in water and those swimming in water columns. Each netting took approximately 5 minutes. Material netted was emptied into a white tray, large objects were removed using forceps, and the netted materials were filtered into a plankton net. The netted materials were emptied into specimen containers and preserved in 70% alcohol for laboratory identification and analysis. Specimens were sorted and identified using Gerber and Gabriel, 2002; Day et al. 2003.

Due to the paucity of published literature and taxonomic keys for Tanzania, specimens were assigned only to the lowest taxon within which they could be placed with certainty. From the six sites that were sampled, the pollution sensitive Ephemeropteran mayflies occurred only at Site 7 (lkungu) whilst Trichopteran caseless caddis were recorded at



sites 9 (Igigwa/Nyahua) and 12 (Ndetwa). There were sites with midges which are an indicator of disturbed environs. The results are shown in Table 10-15.

Site No.	Common name	Order	Family	Nos.
4	Dragonflies	Odonata	Aeshnidae	7
	Damselflies	Odonata	Coenagrionidae	6
	Crabs	Decapoda	Potamonautidae	3
	Pond snails	Stylommatophora	Lymnaeidae	4
	Back swimmers	Coleoptera	Notonectidae	13
	Predacious diving beetle	Coleoptera	Dytiscidae	3
	Pigmy backswimmers	Hemiptera	Pleidae	9
	Midges	Diptera	Chironomidae	2
	Water boatmen	Hemiptera	Corixidae	2
	water scavenger beetles	Coleoptera	Hydrophilidae	3
			Sub-total	52
7	Whirligig beetle	Coleoptera	Gyrinidae	17
	Back swimmers	Hemiptera	Notonectidae	6
	Caenflies	Ephemeroptera	Caenidae	5
	Mosquitoes larva	Diptera	culicidae larvae	4
	Dragonflies	Odonata	Libellucidae	5
	Damselflies	Odonata	Coenagrionidae	3
	Midges	Diptera	Chironomidae	1
	Small minnow flies	Ephemeroptera	Baetidae	8
			sub total	49
9	Giant water bugs	Hemiptera	Belostomatidae	1
	Dragonflies	Odonata	Aeshnidae	6
	Caseless caddisfly	Trichoptera	Hydropsychidae	7
	Pond skater	Hemiptera	Gerridae	6
	Predacious diving beetle	Coleoptera	Dystiscidae	5
	Dragonflies	Odonata	Libellulidae	15
	Back swimmers	Hemiptera	Notonectidae	13
			sub total	53
11	Back swimmers	Hemiptera	Notonectidae	3
	Predacious diving beetle	Coleoptera	Dytiscidae	5
	Midges	Diptera	Chironomidae	3
	Pond skater	Hemiptera	Gerridae	6
	Dragonflies	Odonata	Libellulidae	7

Table 10-15: Macroinvertebrates identified in wetland locations during the wet season



Site No.	Common name	Order	Family	Nos.
			sub total	24
12	Mosquitoes	Diptera	Culicidae	4
	Midges	Diptera	Chironomidae	4
	Caseless caddisfly	Trichoptera	Hydropsychidae	2
	Water boatmen	Hemiptera	Corixidae	3
	water scavenger beetles	Coleoptera	Hydrophilidae	4
	Dragonflies	Odonata	Aeshnidae	2
	Back swimmers	Hemiptera	Notonectidae	3
			sub total	22
15	Predacious diving beetles Whirligig beetles water scavenger beetles	Coleoptera	Dytiscidae	4
		Coleoptera	Gyrinidae	2
		Coleoptera	Hydrophilidae	1
		Hemiptera	Gerridae	3
	pond skater	Hemiptera	Notonectidae	5
	back swimmers	Odonata	Aeshnidae	2
	Dragonflies	Odonata	Gomphidae	1
	Dragonflies	Diptera	Chironomidae	1
	Midges	Basommatophora	Thiaridae	1
	Snails	Stylommatophora	Lymnaeidae	9
	Pond snails		sub total	29
			Total	229

10.5.9 Insects

Invertebrates form more than 96% of all animal species, with the majority being insects. The mega-diverse insect groups include beetles, butterflies and moths (order lepidoptera), two-winged flies (order Diptera) and wasps, bees and ants (order Hymenoptera). Insects have critical ecological roles, influencing agriculture, human health and natural resources.

Invertebrates are sensitive to human-induced environmental change. Different species exhibit varying tolerance to pollution and disturbance, making them good indicators for environmental change. Over 40 families of invertebrates were collected using insect pitfall traps in five locations during the dry season and sweep nets during the wet season sampling from seventeen locations. This suggests the habitats along the alignment host diverse groups of invertebrates. Prominent families encountered during the dry season include Blattidae, Formicidae and Anostostomitidae, represented by cockroaches, safari ants and crickets, respectively. From the wet season, the most common families were Acrididae and Formicidae, represented by grasshoppers and ants, respectively. The argentine ant from the Formicidae family was observed over both the dry and wet seasons and is regarded as among the most invasive species in the world.

Dry season sampling was quantitative in the six locations of Manyoni camp, Aghondi, Itigi Camp, Tabora Camp, Igombe River FR, and Nyahua FR. The highest number of


collections were from Aghondi Beekeeping Reserve (726 collections) followed by Igombe River FR (644 collections). Both Ahgondi Beekeeping Reserve and Igombe River FR are Miombo Woodland habitats.



Figure 10-41: Dry season collection of invertebrates from six locations along the project alignment

All species collected during both the dry and wet seasons are considered LC.

Table 10-16: Insects of	collected from Lots 3	3 and 4 dry season.	Courtesy: UDSM
ESIA (2023)			

No.	Name	Family	IUCN category	Frequency
1	Scarab beetle	Scarabaeidae	-	69
2	Ground beetle	Carabaeidae	LC	42
3	Rove beetle	Staphylinidae	-	1
4	Darkling beetle	Tenebrionidae	-	51
5	Jewel beetle	Buprestidae	-	1
6	True weevils	Curculionidae	-	4
7	Cricket	Anostostomitidae	-	343
8	Raspy cricket	Gryllacridae	-	1
9	Cricket	Gryllidae	-	1
10	Cricket (2 tail)	-	-	15
11	Flesh flies	Sarcophagidae	-	1
12	Vinegar flies	Drosophillidae	-	127
13	House flies	Muscidae	-	11
14	flies	Sciaridae	-	16
15	flies	Heleomyzidae	-	2

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		· sy constant

No.	Name	Family	IUCN category	Frequency
16	Syrphid flies	Syrphidae	-	1
17	Assassin bug	Reduviidae	-	57
18	Sunflower seed-bug	Pentatomidae	-	1
19	Damsel bug	Nabidae	-	2
20	Burrowing bugs	Cydnidae	-	1
21	bugs	Pyrrhocoidae	-	11
22	Argentine ant	Formicidae	LC	88
23	Dorylus- siafu	Formicidae	-	696
24	Common earwigs	Forficulidae	-	15
25	Wasp	Sphecidae	-	6
26	Termite	Fermitidae	-	1
27	Bee	Halictidae	-	1
28	Cockroach	Blattidae	-	58
29	Cockroach	Ectobiidae	-	69
30	Cockroach	Blaberidae	-	114
31	Stick insects	Heteronemiidae	-	7
32	Mantis	Mantidae	-	2
33	Grasshoppers	Acrididae	-	14
34	Spider	-	-	194
35	Millipede	-	-	21
36	Centipede	-	-	2
37	Scorpion	-	-	2

10.6 Ecological sensitivity and assessment of critical habitat

The extensive literature reviews and data gathering including baseline surveys undertaken in the dry season (June to August), early November (end of dry season) and February (wet season) has provided extensive data upon which to determine the sensitivity of habitats and support a review of IUCN Red List species including "endemic" range restricted species within Tanzania.

PS 6 (2012) and its associated Guidance Note 6 (2019) provide the basis for analysing sensitivity of habitats which are divided between modified, natural and critical habitat. The studies have identified extensive areas of "modified habitats", which are areas that may contain a large proportion of plant/animal species of non-native origin and/or where human activity has substantially modified an area's primary ecological functions and species composition.

Modified habitat seen along the project alignment comprising approximately 40% of land area within a 10 km buffer is principally associated with farming and agricultural practices following removal of woodland and thickets and wetlands to develop settlements, farmland and paddy fields. There are modified areas along Lot 3 concentrated in Manyoni and Itigi area and Lot 4 from Tabora to Isaka. The modified habitat in Manyoni and Itigi



largely has been contributed to by agricultural activities especially cashew plantations which is leading commercial farming in the area. The modification and loss of natural habitats has a potential to destroy the elephant crossings and dispersal areas thus threatening the viability of the existing elephant corridors in the long term.

Within the ROW and temporary sites, the modified habitats have been split between those of "high" and "low" conservation value, so for example Acacia and mixed bushland would be of high value while cropland will be classified as low value.

Natural habitats such as the Miombo Woodlands and unique Itigi Thickets support assemblages of plants/animals of largely native origin and retain their ecological functions and processes. They also include a number of IUCN vulnerable or endangered species providing a refuge for large wildlife. In addition, other largely natural habitats include Acacia Scrubland/Woodland, Mixed Bushland, Thickets and Rock Kopjes, although the latter can become isolated due to habitat fragmentation and being surrounded on all sides by agriculture.

Critical habitat defines the highest level of sensitivity and can be a subset of either modified or natural habitats, based on one or more of the five IFC criteria and/or the IUCN management categories that can also define critical habitat. In summary the critical habitat criteria are as follows and provide the basis for any critical habitat assessment:

- Criterion 1: Critically endangered (CR) and/or endangered (EN) species.
- Criterion 2: Endemic and/or restricted-range species
- Criterion 3: Migratory and/or congregator species
- Criterion 4: Highly threatened and/or unique ecosystems.
- Criterion 5: Key evolutionary processes.

Criterion 1

- a) 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 vulnerable (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 in GN72(a).
- c) as appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Criterion 2

Species that are assessed under criterion 2 are those that are considered to be endemic or restricted range.

a) areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

Criterion 3

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

a) 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.



b) areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

Criterion 4

The IUCN is developing a red list of ecosystems, following an approach similar to the Red List for threatened species.

- a) areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.
- b) other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

Criterion 5

This refers to key evolutionary processes including the following concepts:

- landscapes with high spatial heterogeneity 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, produce transitional habitat, which has been associated with the process of speciation and high species and genetic diversity
- edaphic interfaces are specific juxtapositions of soil types (e.g. 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 (e.g. biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This also includes biological corridors across altitudinal and climatic gradients and from "crest to coast"
- sites of demonstrated importance to climate change adaptation for either species or ecosystems are also included within this criterion.

10.7 Habitat mapping and critical habitat (CH) screening

A CH screening study was undertaken by RSK in December 2022 to supplement the ESIA studies undertaken up till then. This was achieved by fieldwork in November to survey the habitats and vegetation complexes using precise GPS co-ordinates, while collecting data on sightings of fauna and review of ecosystem services. The data was then used for ground truthing land cover maps using satellite Earth Observation data along the project alignment.

The landscape data was refined and split into natural and modified habitats based on the ground truthing and in line with IFC guidance for assessors to use a landscape--scale approach that considers ecological connectivity and sensitivities. This is developed into an ecologically appropriate area of analysis (EAAA) for each individual trigger species identified within the spatial scope of the project.

For this screening exercise, a standard AoI for the alignment was considered, using a standard buffer of 500 m from the alignment and identified borrow pit, quarry, and camp locations. When considering the overall area for the screening assessment, the Integrated Biodiversity Assessment Tool (IBAT) includes an additional 50 km buffer in every direction. Should sensitive species identified by IBAT be impacted by the hydrological environment, the species-specific EAAA could be expanded to include wider drainage catchments if required.

An initial data set was downloaded from the IBAT alliance website which draws on internationally accepted scientific databases and literature including the:



- IUCN Red List of Threatened Species
- World Database on Protected Areas (WDPA)
- World Database of KBA.

Where feasible these were supplemented by various sources including literature, government publications and NGO publications.

The AoI was uploaded as a shapefile to the IBAT website and a 50 km buffer applied to encapsulate all species with potential to occur within this area even if not known to directly overlap with the alignment or AoI.

Each species was assessed against the five critical habitat criteria to provide a shortlist of potential triggers species. The IBAT analysis identified a total, 1,474 species listed on the IUCN red list which overlap the 50 km buffer zone. For Lots 3 and 4, Table 10-17: summarises the number of species falling into each threat-level category. Table 10-18: provides a further summary of species in each taxonomic class and their potential to trigger critical habitat under each of Criteria 1, 2, 3 and 5. Criterion 4, concerning threatened and/or unique ecosystems, is not applicable at a species level but does apply to Itigi-Sumbu together with its endemic/restricted range species which qualify as a unique ecosystem.

The full list of potential CH triggers is not discussed in detail in this report since there is significant conflicting information between the databases, e.g. the eight species of plant listed do not occur on the IUCN Red List for Tanzania (2022) (Appendix 4). These are as follows: Eriosema youngii var. rufum -(CR); Aeschynomene goetzei -(EN); Monotes rufotomentosus – (EN); Rotheca myricoides subsp. ussukumae – (EN); Gossypium longicalyx – (VU); Indigofera burttii –(VU); Ipomoea macrosepala – (VU); Zanthoxylum trijugum – (VU). There are also plant species reported by UDSM in their surveys occurring in Itigi thicket which are listed on IUCN Red list as Endangered but are not shown in the IBAT Report.

In addition, there are iconic species such as Black Rhinoceros (3 sub-species) listed which have not been recorded for many years or reported by the Tanzanian authorities or communities and are for all reasonable purposes likely extinct within this region whilst surviving under the protection of National Parks in the north of Tanzania.



Table 10-17: CH triggers by IUCN category. Courtesy: RSK

Таха	CR	EN	vu	NT	LC	DD	Total
Mammalia	3	2	6	8	156	4	179
Reptilia	1	0	0	1	72	0	74
Magnoliopsida	1	3	4	2	206	0	216
Aves	4	8	7	7	480	0	506
Liliopsida	0	0	0	2	124	2	128
Malacostraca	0	0	0	1	8	0	9
Amphibia	0	0	0	0	38	1	39
Insecta	0	0	0	0	214	7	221
Lycopodiopsida	0	0	0	0	3	0	3
Polypodiopsida	0	0	0	0	4	0	4
Arachnida	Ó	0	0	0	4	0	4
Lecanoromycetes	Q	0	0	0	2	0	2
Actinopterygii	0	2	7	5	52	5	71
Gastropoda	0	0	0	0	12	1	13
Sarcopterygii	0	0	0	0	2	0	2
Bivalvia	0	0	0	0	3	0	3

Table 10-18: Critical triggers by IFC criteria. Courtesy: RSK

Таха	C1	G2	G3	C5	Total Potential Triggers
Mammalia	11	1	3	8	23
Reptilia	1	0	1	0	2
Magnoliopsida	8	0	0	0	8
Aves	19	1	168	13	201

Total	48	16	204	21	289
Bivalvia	0	0	0	0	0
Sarcopterygii	0	0	1	0	1
Gastropoda	0	0	0	0	0
Actinopterygii	9	10	21	0	40
Lecanoromycetes	0	0	0	0	0
Arachnida	0	0	0	0	0
Polypodiopsida	0	0	0	0	0
Lycopodiopsida	0	0	0	0	0
Insecta	0	1	6	0	7
Amphibia	0	1	0	0	1
Malacostraca	0	3	4	0	7
Liliopsida	0	0	0	0	0

 In certain cases, a single species may potentially trigger more that one criterion. As such, the total number of triggers and species in each taxonomic group are not necessarily the same.

10.7.1 Ecologically appropriate area of analysis (EAAA)

The EAAA is a new concept related to a project's ecological AoI that was introduced with the 2019 revision of PS 6, and is currently considered by IFC and EBRD as the basis for spatial delimitation of the area of analysis for the purpose of performing CHA (and identification of PBFs). Unlike most other "AoI" concepts, the EAAA concept is species-specific. Therefore, differently configured EAAA may be drawn for different species for the same project, based on the species' different ecological characteristics, especially movement patterns. EAAA considered for CHA should not be confused with other spatial delineations of the project area, or project's AoI for other purposes elsewhere within the project's ESIA and other documentation (e.g. the AoI considered for the evaluation of noise impacts)12.

The EAAA for a particular species or species group encompasses the total area within which the species or species group may be impacted by the project. The EAAA is based on habitat configurations, locations of ecological features, and the typical home range of species. The EAAA has been delineated for species and species-groups for which the

¹² The Project Study Area as determined during CHA Screening outlines the total spatial area within which potential species distribution overlaps are examined utilizing global databases. The Project Study Area is described in the CHA Screening Report.

The Area of Influence is specific to impacts e.g. the AoI for noise impacts on fauna may be inclusive of the noisegenerating activity footprint and a 500m buffer; whilst the AoI for Habitat Fragmentation impact may be much broader, encompassing a wider region than the impacting activity itself. The impact specific AoIs are discussed in relation to impacts and receptors within the ESIA.



possibility of criticality must be examined. The estimated population of the entire EAAA is used as the basis to determine if criticality has been met, in relation to the quantitative thresholds associated with some of the CH criteria, as described above.

10.7.2 Determining the EAAA

Defining the EAAA is an integral step in determining criticality. The critical thresholds must be measured against the population of the species present within the "EAAA", which on a practical level roughly translates into the full range covered by members of a population regularly utilizing or occurring within a particular area.

Therefore, to determine EAAA and assess criticality, the following steps must be followed:

- determine the largest Aol for the species based on the project's identified impacts and the species' ecology (e.g. habitat affiliation, dispersal, etc.)
- the next step is calculating the estimated population present within the EAAA in relation to the global population and comparing these ratios to the thresholds for determination of criticality status.

This is a relatively straight-forward concept when considering residential, sedentary populations. e.g. for a terrestrial species with limited mobility and specific habitat requirements, the largest applicable area of influence would amount to the full construction footprint (as the primary concern is direct loss and disturbance during construction). Based on this, the home range regularly occupied by the population probably does not exceed a buffer around the project boundaries. The size of the most appropriate buffer for a given species can be estimated based on the species' dispersal ecology (e.g. home range size). The EAAA would be considered as the project boundaries plus the buffer.

The entire project footprint need not be considered as part of the EAAA if a portion of that footprint contains habitat unsuitable for the species. This type of restriction of the EAAA is especially important when areal coverage of a species is used as a proxy for population size, as extrapolation of the population of a species occurring within a project's EAAA based on the entire area of the project would result in a significant exaggeration if only a small portion of the population within that EAAA in relation to the global population of the species, or the areal coverage of the species' EAAA in relation to the species global extent of occurrence (EOO), would then be compared to the critical thresholds.

Each species analysis section includes the reasoning followed to ascertain the EAAA, the likely population within the EAAA, and the final assessment of criticality.

The following summarizes the EAAA that has been applied for various taxa:

- for flora species, the EAAA has been delineated using the following factors: (1) known locations, (2) habitat requirements inclusive of soil type/substrate, and (3) contiguous tracts of connected habitat. The full AoI of the project on flora species is the starting point and the EAAA may include all or part of the AoI as well as extending beyond the AoI dependent upon the previously mentioned factors
- for bats, the EAAA has been set as the footprint of the project site, and a buffer of up to 1 km
- for breeding/resident birds: The total EAAA for this species has been applied as all suitable habitat within the project ROW as well as within a 5 km buffer. This should provide an adequate accounting of birds likely to regularly utilize the project area during breeding season
- for long-ranging mammals: The total EAAA, has been set to include the project footprint as well as connected uninterrupted terrestrial habitat suitable for the



species in question, generally extending approximately 20 km from the project area

- for herptiles: the total EAAA has been set to include the project area and connected habitat within 1 km
- for fish the total EAAA has been set to include the project area and connected habitat within 5 km.

10.7.3 Potential critical habitat triggers

Based on the IBAT screening of a 50km buffer for IUCN Endangered, Critically Endangered and Vulnerable species and data collected from dry and wet season surveys there are a lot of potential CH triggers but few provide confirmation of triggering criticality. This finding is also based on desk study research, surveys and consultations with the local communities.

The following summary table of species from IBAT and surveys are presented with key notes:

Common Name	Scientific Name	IUCN	Information including National status	Potential Triggers
Black Rhino	Diceros bicornis	CR	IUCN 2020, EOO for entire countries to avoid targeted poaching. Southern Tanzania last refuge was in Itigi Thicket (eradicated and extinct locally)	None
Eastern Black Rhino	Diceros bicornis ssp. michaeli	CR	IUCN 2020, Southern Tanzania last refuge was in Itigi Thicket (eradicated and extinct locally)	None
South- eastern Black Rhino	Diceros bicornis ssp. minor	CR	IUCN 2020 Southern Tanzania last refuge was in Itigi Thicket (eradicated and extinct locally)	None
African Savanna Elephant	Loxodonta africana	EN	IUCN, 2022, range residence, migratory, semi-migratory and near nomadic movement patterns in different regions of Africa. Confirmed multiple ROW migration crossing points	1, 3
African Wild Dog	Lycaon pictus	EN	Although found in Lots1&2, no observations and records in Lots 3&4. Ruaha Katavi landscape one of only 3 locations with > 500 adult wild dogs in Africa total estimated population of 3,000- 5,000) (WCS Tanzania).	1
Tanzanian woolly bat	Kerivoula africana	EN	Assessed IUCN 2019. It is endemic to Tanzania and is only found on the country's eastern coast in subtropical forests, known from 4 locations in area <500km ² . The nearest known location is at least 300km east of Manyoni.	1, 2

Table 10-19: Screening of Potential habitat triggers from surveys and literature search



Common Name	Scientific Name	IUCN	Information including National status	Potential Triggers
Pancake Tortoise	Malacochersus tornieri	CR	Population status unknown but appears to be localised dependent on microhabitat. Not recorded in Lot 3&4 surveys. IUCN 2018 indicates site at Tabora as one of eight sites	1
White- headed Vulture	Trigonoceps occipitalis	CR	Most recently assessed by IUCN 2021. Population (2016) <10,000 decreasing, on wide range of habitats up to 4,000m across Africa. Not recorded in Lot 3&4 surveys.	1
White- backed Vulture	Gyps africanus	CR	IUCN 2021 latest population estimate 27,000, decreasing, no recent population data. 14% of the circa 40,000 records on e- bird are in Tanzania, most commonly from the North, none from Tabora, north, south or east. Not recorded in Lot 3&4 surveys.	1
Hooded Vulture	Necrosyrtes monachus	CR	IUCN 2021, decreasing. Confirmed in ROW. 6% of almost 27,000 records on e-bird are in Tanzania. Rare and declining but widespread in open country, forest edge, and towns. However records mostly >50km from SGR.	1
Ruppell's Vulture	Gyps rueppelli	CR	IUCN 2021 no recent population estimates. 26% of the circa 10,000 records on e-bird are in Tanzania, almost exclusively in north along border with Kenya. None from Tabora, north, south or east. A few records east of Rungwa Game Reserve >50km from SGR.	1
Secretary bird	Sagittarius serpentarius	EN	24% of the circa14,000 records on e-bird are from Tanzania almost exclusively in north along border with Kenya. One or two records near Itigi.	1
Bateleur	Terathopius ecaudatus	EN	Confirmed in ROW. 14.5% of circa 33,000 records on e-bird are from Tanzania, predominantly from north west near border with Kenya and south east. A few scattered records west of Itigi, Goweko and Tabora (<0.05%).	1



Common Name	Scientific Name	IUCN	Information including National status	Potential Triggers
Lappet-faced Vulture	Torgos tracheliotos	EN	IUCN 2021, Population 6,500 decreasing 23% of circa 15,000 records on e-bird are from Tanzania almost exclusively in north, north-west along border with Kenya. Few records in south east, none within 50km of SGR.	1
Grey Crowned Crane	Balearica regulorum	EN	IUCN 2016 population 26,000 decreasing. 16% of the circa 20,000 records on e-bird are in Tanzania, almost exclusively in north from Arusha to Serengeti. A few records east of Rungwa Game Reserve >50km from SGR and a few from Tabora.	1
Egyptian Vulture	Neophron percnopterus	EN	IUCN 2021 <36,000 decreasing 0.3% of the circa 75,000 records on e-bird are in Tanzania, almost exclusively in north from Arusha to Serengeti. A few isolated records 25km south of Manyoni.	None
Steppe Eagle	Aquila nipalensis	EN	IUCN 2021 population 2016 <37,000 pairs, decreasing 2.8% of the circa 38,000 records on e- bird are in Tanzania, almost exclusively in north from Arusha to Serengeti. A few isolated records 25km south of Manyoni and scattered groups east of Rungwa Game Reserve.	1
Martial Eagle	Polemaetus bellicosus	EN	IUCN 2020 no population estimate, but widespread Tanzania and Malawi. 14.5% of the circa 14,000 records on e- bird are in Tanzania, almost exclusively in north from Arusha to Serengeti. A few isolated records 25km south of Manyoni and scattered groups east of Rungwa Game Reserve.	1
Madagascar Pond-heron	Ardeola idae	EN	IUCN 2021 population <2500 2016 13% of the circa 1,700 records on e-bird are in Tanzania, almost exclusively in north from Arusha to Serengeti. Also in Nyerere National Park in south east. None along SGR lots 3&4.	1
Cyprinidae	Enteromius quadralineatus	EN	IUCN assessed 2006 (2018) Endemic to the Malagarasi River,	1, 2



Common Name	Scientific Name	IUCN	Information including National status	Potential Triggers
			Tanzania. The EOO < 5,000km ² Prefers well oxygenated water.	
(Cichlidae)	Oreochromis amphimelas	EN	IUCN 2006 Alkaline rift valley lakes EOO <3,500km ² in 4 lakes in Tanzania. The area includes the central area crossing Manyoni and Itigi.	1, 2
(perennial herb)	Eriosema youngii var. rufum	CR	Assessed IUCN 2011 and IUCN SSC East African Red List authority 2020. Last seen 1994. The two known subpopulations (grassland) considered to be severely fragmented and listed as CR, possibly extinct. One location is west of Itigi just inside Tabora/Singida boundary.	1, 2
(shrub)	Aeschynomene goetzei	EN	Assessed IUCN 2011, and IUCN SSC East African Red List authority 2019. 3 known locations (forest habitat) in central south Tanzania. Grows in Brachystegia woodland. One location is circa 10km south of Manyoni.	1, 2
(hardwood tree/shrub)	Monotes rufotomentosus Related names (JSTOR Global Plants, Kew) Monotes magnificus Monotes africanus Monotes africana	EN	Small shrub or tree to 8m, found in Zambia, Tanzania and Mozambique. According to the Flora of Tropical East Africa this tree is found in <i>Brachystegia</i> woodland; 1395–1680(–1800) m. Also reported as widespread and locally dominant.	1, 2
(shrub)	Rotheca myricoides subsp. ussukumae	EN	Assessed IUCN 2007. Endemic to Tanzania. 5 known locations (shrubland/artificial, terrestrial) in north of country west of Serengeti close to Lake Victoria. The shrub grows on thickets and abandoned cultivation.	1, 2
Leopard	Panthera pardus	VU	IUCN 2015 (2022) Wide ranging across Africa and Asia although some populations can be fragmented. Highly adaptable and occurs where suitable prey. Found in both dry and wet season surveys crossing SGR	None
Lion	Panthera leo	VU	IUCN 2016 occur in most sub- Saharan countries covering 25% of savannah (8% of historical	None



Common Name	Scientific Name	IUCN	Information including National status	Potential Triggers
			range). Reported in dry season and found at 2 locations in wet season surveys at crossing points.	
(Cisticolidae)	Apalis karamojae	VU	Assessed IUCN 2017 estimate <20,000. Range restricted northern Tanzania (Serengeti, Wembere Steppe), eastern Uganda, Kenya localised	1
(killifish) seasonal	Nothobranchius angelae	VU	IUCN 2020 EOO 8,527km ² , but AOO <500km ² . Population unknown This species is endemic to north-central Tanzania. It is known from seasonal pools and marshes associated with the Bahi Swamp and associated drainage systems. Easternmost location near Itigi.	1, 2
(killifish) seasonal	Nothobranchius hoermanni	VU	IUCN 2020 EOO 8,000km ² , but AOO <500km ² Population unknown. Endemic to seasonal freshwater habitats in central Tanzania. It is currently known from ephemeral pools and marshes associated with the Mhwala system in the upper Wembere drainage, as well as the Wala system.	1, 2
(killifish) seasonal	Nothobranchius torgashevi	VU	IUCN 2020 This species is endemic to seasonal freshwater habitats in central Tanzania. It is currently known only from the area of the type locality, from a seasonal ditch along a road, in the Wembere River drainage in the endorheic Lake Eyasi basin in central Tanzania (40km south Itigi)	1, 2
(killifish) seasonal	Nothobranchius itigiensis	VU	IUCN 2021, EOO 8,000km ² , but AOO <500km ² . Known from 2 sites (EOO) of 24 km ² and area of occupancy (AOO) of 12 km ² . It is currently known from ephemeral pools and marshes associated with the upper Ruaha drainage and the Bahi Swamp area. The type locality, near Itigi, is associated with marshy terrain drained by the Mlumbi and Kisigo streams in the extreme	1, 2



Common Name	Scientific Name	IUCN	Information including National status	Potential Triggers
			northwestern headwaters of the Ruaha River system	
(killifish) seasonal	Nothobranchius taeniopygus	VU	IUCN 2020 EOO estimated 2,000km ² , AOO <500km ² . This species inhabits small seasonal wetland habitats within a restricted distribution, vulnerable to agriculture in wet/dry seasons e.g. rice cultivation	1, 2
(killifish) seasonal	Northobranchius seegersi	VU	IUCN not listed Three other Northobranchius spp of LC (N. neumanni, N. ottoschmidti, N. sonjae)	None

The assessment is further discussed below:

Mammals

No globally critically endangered mammals were recorded, however, African elephant (*Loxodonta africana*) and zebra (*Equus burchelii*) together with leopard (*Panthera padus*) and lion (*Panthera leo*) identified as present in the habitat of and surroundings the project within the EAAA. The large mammals are near threatened or vulnerable which do not quality for criterion 1, however since African elephant has been raised by IUCN from VU to EN, this is the only large mammal within the EAAA that could possibly trigger criticality.

Other large and small mammals listed or recorded are mainly classified as LC or vulnerable (VU) and would not therefore trigger criticality. African wild dog (*Lycaon pictus*) is listed within the IBAT review of 50 km buffer as being present but there is no record of the date or source of information. This species is listed under IUCN as endangered, however whilst it was reported in Lots 1 and 2, there are no known siting's for Lots 3 and 4.

Bats

No globally critically endangered bat was recorded in the EAAA, however, the study recorded two species of bats classified by IUCN as VU and near threatened (NT) in the surroundings of the project. Other bat species recorded are classified by IUCN as LC.

During the surveys in along the project alignment, only one site (at 36 m 0494301, 9440042) in Shaurimoyo quarry site indicated potential of bat existence of bats. Night sampling was conducted in the areas where only Wahlberg's Epauletted Fruit Bat (*Epomophorus wahlbergi*), family Pteropoidae was captured. A total of 10 individuals were identified between 23 and 25 August 2022.

Tanzanian woolly bat (*Kerivoula africana*) is assessed by IUCN as endangered under criterion B2ab (ii, iii) because its area of occupancy is estimated at 16 km² (the species has only been captured from four sites). The forests of the region are continuing to decline as it is converted to subsistence agriculture and is harvested as timber and firewood for local use. It is unknown whether this would occur within the Aol.

Hildearde's tomb bat (*Taphozous hildegardeae*) is listed as VU under criterion B2ab(i,ii,iii) because its area of occupancy (AOO) is estimated at 48 km² (based on 12 known roost caves across its distribution), a severely fragmented population, and continuing decline in the extent and quality of its cave roost and forest habitat, leading to the reduction of its EOO and AOO. It is not known whether this would occur within the AoI.

Birds



An extensive list of bird species from the CH screening and surveys has, excluding migrants, identified the following species that are listed as EDGE sp. and could possibly trigger criticality: secretary bird (*Sagittanius seropentarius*) EN; lappet-faced vulture (*Torgos tracheliotos*) EN; hooded vulture (*Necrosyrtes monachus*) CR; white-backed Vulture (*Gyps africanus*); CR Martial Eagle (*Polemaetus bellicosus*) EN and Grey crowned crane (*Balearica regulorum*) EN which were screened using IBAT tool with a 50 km buffer(RSK, 2022),

The only likely species that could trigger criticality under criterion 1 known to occur within the EAAA is bateleur (*Terathopius ecaudatus*) EN, which is widespread in occurrence although shown under IUCN as decreasing.

Herptiles

All species collected during dry and wet season surveys are listed as LC. The only species flagged by the IBAT screening within a 50 km buffer is the pancake tortoise (*Malacochersus tomieri*) listed as CR under criterion 1 and 2. There is no mention of this species within the desk studies, surveys or consultations with the communities and is unlikely to occur within the EAAA.

Fish

The IBAT screening lists two endangered species *Enteromius quadralineatus*, a cyprinid fish found in rivers in Tanzania and Burundi and *Oreochromis amphimelas*, which is a species of tilapia cichlid endemic to north–central Tanzania, where it is found in Lake Manyara and a number of other saline lakes. These species were not found during the surveys and are extremely unlikely to be within the EAAA of the project. They are unlikely to trigger criticality.

The killifish(Nothobranchius) were recorded at 4 sites during the wet season surveys from temporary wetlands but were not identified to species. These seasonal wetlands are the known locations for 5 endemic species which are classed as vulnerable under IUCN and have a very limited AOO. It is likely therefore that one or more species is likely to be present in temporary pools, ditches, wetlands close to the SGR ROW through Lot 3 and extending into Lot 4 from Tabora. These seasonal wetlands should therefore be protected as a precautionary approach whilst further surveys are recommended to confirm the number of species that are present.

Invertebrates

All taxa collected during the dry and wet seasons (terrestrial and aquatic) are regarded by the specialists as LC with no endangered species identified. The IBAT screening listed a number of species, but they are not classified by IUCN. Therefore based on information sources and surveys, there are no known invertebrate species within the EAAA that could trigger criticality.

Flora

Five plant species classified as endemic to Itigi thickets were identified by UDSM within the habitat and surrounding area. The species recorded are also restricted to central Tanzania. These are as follows: *Combretum aureonitens*, *Vepris allenii*, *Schrebera trichoclada*, *Aeschynomene trigonocarpa* and *Meiostemon tetrandrus*. However it would appear that there are differences between the various data bases which may be due to name changes or information coming from alternative sources that are not necessarily consistent. Since the range restricted species identified are associated with itigi thicket, and this has been identified by WWF as a critically endangered ecoregion, the trigger for criticality for this habitat is justified under Criterion 4 and in doing so it would provide umbrella protection to endemic or range restricted flora species. In addition to the above one critically endangered perennial herb (possibly extinct) and three shrubs (endangered)



have been identified within the 50km buffer mostly in Brachystegia woodland, reinforcing the need to protect woodland and itigi thicket.

10.7.4 Critical habitat summary

The review of all available information to assess CH triggers has identified the following as being most likely to meet the criteria:

- African elephant (Loxodonta africana)
- Bateleur (*Terathopius ecaudatus*)
- Itigi Thicket Eco-Region (including range restricted flora)
- these will require further analysis and follow up in the Biodiversity Action Plan (BAP) and confirmation of the final proposed status of protection under IFC guidance for establishing critical habitat.

10.8 Critical Habitat Assessment

The CHA Screening has identified several species and habitats that require further assessment to determine whether the project will trigger criticality under one or more of the five IFC criteria.

10.8.1 African Savannah Elephant (Loxodonta africana)

The following assessment is based on the *L. africana* only, which is classified under IUCN Red List as "Endangered" but excludes any reference to African Forest Elephant (*Loxodonta cyclotis*) which is classified as "Critically Endangered" but does not occur in Tanzania. (see Figure 10-42). The African (global) population of *L africana* is estimated to be circa 350,000 (2021) and occurs in 23 African countries, with Tanzania having the third highest population after Botswana and Zimbabwe (ref: *Global Conservation*, 2023).





Figure 10-42: Distribution of African Svannah and Forest Elephants (ref Global Conservation)

A survey of Ruaha National Park which includes Rungwa, Kizigo, and Muhesi Game Reserves (total 45,000 km²) Chase *et al*, (2016) reported approximately 16,000 elephants. The surveyed area is typically >100km from the SGR, with only the northern extent of Muhesi Game Reserve, coming to within 19.5km of the SGR Lot 3 alignment, providing linkage with the Swaga Swaga-Muhesi/Kigosi wildlife corridor. Both Kizigo and Muhesi Game Reserves form an extended wildlife area that connects with Swaga Swaga Game Reserve, which, at its closes point, is about 93km north of the SGR Lot 3 alignment.

The African Wildlife Foundation (annual report 2022) reported that since 2014, the elephant population in Tanzania has increased from approximately 43,000 to 60,000 individuals. Such estimates are based on regional surveys, most recently undertaken by Wildlife Conservation Society (WCS) and TAWIRI in association with TAWA and TANAPA (2022 census) using aerial surveying techniques over 20 days. An estimated 20,000 elephants were recorded in 90,000 km²) of the Katavi-Rukwa and Ruaha-Rungwa landscape, including parks, game reserves, and other protected areas. This indicates that in the protected areas that current elephant density is approximately 1 per 4.5km² (this is not a measure of carrying capacity, but a statement on current population densities). If this density is applied to the IFC criteria for triggering criticality within the EAAA, we can determine that a 5km corridor along the SGR Lots 3 and 4 covers an area of 4,200km², although >50% of this is already cropland or habitat unsuitable for elephants. Therefore this corridor would be unlikely to support more than 466 elephants (equivalent to 0.13% of the global population), whilst in addition, surveys undertaken in dry and wet seasons and consultations with local communities indicate that elephants move swiftly through this area and are not resident for any significant period of time. Since the movement of elephants has not been studied sufficiently to determine the precise population movements locally, nationally or crossing international boundaries, the EAAA



has been established as a 5 to 20 km corridor which is critical to their continued seasonal movements. However it is the 5km corridor which has been better studied in terms of habitat mapping, ground truthing and elephant surveys to understand its contribution to sustaining the national and global populations.

- Criterion 1 (a, b, c) is not triggered (0.13% of global population within 5km corridor and even with a EAAA of 20km, the threshold of >0.5% would not be exceeded as the overall habitat is fragmented by cropland preventing population density reaching that recorded in the optimum National Park landscapes, as reported in 2022.);
- Criterion 2 (endemism, range restricted) is not triggered as the savanna elephant is found in 24 countries in sub-Saharan Africa;
- Criterion 3 (migratory routes) even the most highly conservative case that all elephants in the Katavi-Rukwa and Ruaha-Rungwa landscape, had crossed the SGR, this would still be no more than 5.7% of the GP, which falls well below the 10% threshold. However, "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" is achievable based on the population estimates and so Criterion 3(b) does meet the threshold to trigger criticality.
- Criterion 4 (red list of ecosystems) is not triggered;
- Criterion 5 (key evolutionary processes) including "(biological corridors") is not triggered, note that TAWIRI (2023) has assesses 61 wildlife corridors within Tanzania and crossing international boundaries, but these fall partially or entirely outside of the AoI and the EAAA.

The conclusion based on Criterion 3(b) is that African Savannah Elephant does trigger criticality.

10.8.2 Bateleur (Terathopius ecaudatus)

The bateleur is listed as Endangered under criteria A2acde+3cde+4acde (IUCN 2020). It is a resident or nomadic bird of the partially open savannah country and woodlands within Sub-Saharan Africa up to 3.000metres. During breeding, it tends to require closed-canopy savannah-woodland habitats, including acacia savannah as well as mopane and miombo woodlands. It rarely occurs in heavily forested and mountainous habitats.

The bateleur takes both live and dead food, mostly mammals and birds but also some reptiles, carrion, insects and occasionally birds' eggs and crabs, foraging over a huge range (55-200 km²). The nest is built in the canopy of a large tree, and breeding is chiefly September-May in West Africa, throughout the year in East Africa and December to August in southern Africa. The population is not severely fragmented but the overall population is believed to be decreasing

Habitat loss and degradation, poisoning, poaching and disturbance are all likely factors in the reported decline in recent decades, but more research is needed to identify the root causes and the most efficient way to address them.

Bateleurs are a wide-ranging species but have shown strong declines. Per estimates from the 1990s, extrapolated from an average of 150km² (58sqmi) per pair, it was projected that the total population could have been around 180,000 birds including young ones. However, it is likely that the species numbers far lower than that. Currently, the IUCN estimates broadly from 10,000 to 100,000 total individuals. The numbers in Southern Africa have shown the most dramatic and drastic known reductions. At one time, the



species numbers at 2000-2500 pairs in the former Transvaal Province alone which was down to around 420 to 470 pairs by the 1990s.

The bateleur was observed infrequently during the dry season survey along the SGR route Lots 3 & 4 in 2022, most likely due to the large territory on average of 150km². Since there are no national or international surveys or estimates of Bateleur, the most useful data covering Africa and in particular Tanzania, can be taken from the *iNaturalist* website which has 2,110 records across Africa for this species, of which the highest numbers are South Africa (913), Kenya (230) and Tanzania (222). Other countries have <100 records, except Botswana with 143. The distribution of records across Tanzania indicates that most records are from the north of the country with none towards central southern area along the SGR route Lots 3 & 4 except for a single record at Tabora in February 2021. This is consistent with infrequent sighting of Bateleur during the 2022/23 surveys undertaken specifically along the SGR route.



Figure 10-43: iNaturalist (222 observations of Bateleur in Tanzania)

The potential impact of the SGR on the Bateleur would be from the loss of large trees required for nesting and the loss of habitat from clearance of the ROW, although the hunting territory of 55 to 200km² indicates that the loss of suitable habitat along the entire length of Lots 3 & 4 (circa 20km²) would not be significant to affect the hunting ability of one or more pairs. Even when applying an AoI of 5km from the ROW this would require extensive loss of habitat over 55 to 200km², along 10 to 40km sections of the SGR which is under the control of the Tanzanian Government and not TRC or Yapi Merkezi. Since the Bateleur population is far less impacted by habitat fragmentation than land mammals, the EAAA would also be in line with foraging and nesting territories. This information is assessed below as per IFC criteria to determine criticality.

- Criterion 1 (a, b, c) is not triggered;
- Criterion 2 (endemism, range restricted) is not triggered;
- Criterion 3 (migratory routes) is not triggered.

Scapilals.

- Criterion 4 (red list of ecosystems) is not triggered;
- Criterion 5 (key evolutionary processes) is not triggered.

The conclusion is that Bateleur does not trigger criticality.

10.8.3 Itigi-Sumbu Thicket

Itigi-Sumbu thicket grows on unique, highly specialized, and sensitive soils that once disturbed, by farming for example, suffer irreversible damage which prevents thicket regeneration. The thicket is a dry, primarily deciduous, impenetrable vegetation between 3 m and 7 m in height. Nearly 100 woody plant species are found here, some of which are endemic. The entire ecoregion is threatened by human encroachment and conversion to slash and burn agriculture.

The distribution of the thicket follows that of the duricrust soils. In regions where there is no duricrust, then miombo, mopane, or *Acacia* savanna woodlands dominate. Itigi thicket vegetation is generally deciduous during the 4 month dry period, although within the lower canopy some of the shrubs are evergreen. During the wetter seasons when leaves are developed, little sunlight penetrates to the ground, and there is a poorly developed herbaceous layer. Woody plant species characteristic of the thicket include *Baphia burtti, B. massaiensis, Combretum celastroides, Grewia burttii, Pseudoprosopsis fischeri,* and *Tapiphyllum floribundum*.

Stands of thicket occur in Tanzania close to its namesake town of Itigi and also in Zambia between Lakes Mweru Wantipa and Tanganyika. In all cases these thicket units are discrete and clearly demarcated from the surrounding mopane, miombo, or *Acacia* woodlands.

The rainfall is low; for example, at Manyoni in the Tanzanian Itigi it is around 700 mm per annum. Above the bedrock is a characteristic soil structure, consisting of seasonally well-aerated and well-watered sandy soils of 0.6 m to 3 m in depth that desiccate and harden during the dry season, with an impermeable duricrust of cement-like consistency beneath.

The Itigi thicket falls within the Zambezian regional center of endemism. The acidic duricrust soils allow otherwise rare plant species to dominate and outcompete species that are widespread in the surrounding woodlands. A few plants are endemic, although precise numbers are not known (ref: *one earth*, 2023).

Elephants use the thicket as an important refuge, as did black rhinos before they were eradicated by poachers. The two main areas of Itigi-Sumbu thicket in Zambia and Tanzania are shown in **Error! Reference source not found.** (Ref WWF, 2014).

Baena *et al,* 2016 maps the removal of Itigi thicket over 50 years, demonstrating that more than two thirds had been removed by 2000. The WWF Ecoregion was reporting 3,000km² remaining by 2014, although the expansion of farming and leaving urban settlements over the past decade has likely seen this reduced by two thirds leaving 1,000km² at the most in both Zambia and Tanzania.

There are no new studies in the public domain. However since WWF has transferred the Ecoregion updates to "*one earth*", they are reporting a total remaining area of 1,107ha in Tanzania, The Democratic Republic of Congo and Zambia (ecoregion ID 46) (ref: *one earth*, 2023. However, based on the survey information and review of satellite mapping undertaken for the SGR, the actual figure is approximately 170,000 ha in Tanzania (see Figure 10-44).

It is evident that almost all of the remaining Itigi thicket is to the north of Lot 3 SGR and this critical/endangered habitat lies outside of the protection afforded by designated sites such as the Muhesi and Rungwa Game Reserves. Baena et al, 2016 reported on the far greater loss of Itigi thicket in Zambia when outside of protected areas, which is clearly shown in neighbouring Zambia (see Figure 10-44).

The design review and updated mapping of the SGR ROW for Lots 3 & 4 together with the temporary facilities (stations, camps, laydown areas, quarries, borrow pits and dump sites) undertaken in August 2023 has identified areas of Itigi thicket which have been avoided, due



to facilities being cancelled, moved or camp areas being reduced in size by up to 25%. This has resulted in a slight reduction in the area of Itigi thicket directly impacted by the Project falling from 8% to 7.9% for Lots 3 and 4 combined.



Figure 10-44: Known areas of Itigi-Sumbu thicket in Zambia (red) and Tanzania (yellow) based on WWF terrestrial ecoregions (WWF 2014) adapted by 5 Capitals to show alignment of SGR Lot 3

The mapping of Itgi-Sumbu thicket deforestation over 50 years (between 1964 and 2015) reported by Baena *etal*, 2016, is shown in Figure 10-45 and demonstrates that almost a decade ago there was approximately 100km² remaining inside the Mweru Wantipa National on the western side of the lake, while three smaller patches remain outside of the NP protection to the east and north accounting for an additional area of approximately 75km².

The mapping has demonstrated the rate at which this habitat has been lost over 50 years and which has probably decreased even further during the past 8 years. The loss of this unique habitat which supports endemic plant species will require support from TRC to prevent the SGR becoming the catalyst for the remaining unprotected habitat to be lost due to associated expansion of croplands that would then take advantage of the improved SGR connections.

Overall, it has been calculated that the area of Itigi-Sumbu thicket removed by the SGR within Lot 3 is equivalent to 0.2% of the total remaining habitat in Tanzania and 0.1% globally. This is a significant loss of an endangered eco-region and is known to support endemic and range restricted plant species, which therefore trigger this being designated as "Critical Habitat" requiring compensation offsetting and Net Gain.





Figure 10-45: Itigi-Sumbu thicket deforestation map in and outside of Mweru Wantipa National Park showing the progressive loss of thicket through over 50 years

This information is summarised below as per IFC criteria to determine criticality.

- Criterion 1 (a, b, c) do not apply;
- Criterion 2 (endemism, range restricted) is triggered;
- Criterion 3 (migratory routes) is not triggered.
- Criterion 4 (red list of ecosystems) is triggered;
- Criterion 5 (key evolutionary processes) is not triggered.

The conclusion therefore is that Itigi-Sumbu Thicket does trigger criticality and will require measures to achieve Net Gain exceeding the predicted 351 ha planned to be removed by the SGR permanent and temporary structures, as well as the additional 2.56 ha (worse case) believed to have been removed before the satellite imagery mapping had been completed.

Proposed priority conservation actions proposed by *one earth* for Itigi-Sumbu thicket the next decade are:

- to promote protected area management to prevent encroachment of important refuge habitats;
- to promote sustainable agricultural practices; and
- further research and monitoring into the deforestation rates of the thickets using both remote sensing and ground truthing methods.



10.9 Elephant Crossing Points

An assessment of suitable elephant crossing points was undertaken during July and August 2023 for Lots 3 & 4 to identify optimal crossing locations linking natural and critical habitat on either side of the SGR route and comparing this with existing bridges and underpasses. The minimum height was set at 3.5m to accommodate the largest bull elephants (advice from TAWA) while 3.0m was considered to be suitable for cow elephants based on experience gained from the similar Kenyan SGR which cuts through the Tsavo East/West National Parks with the largest number of elephants in Kenya.

Yapi Merkezi Design Team provided a list of bridges, underpasses and culverts together with specifications that were considered to be suitable as crossing points for elephants. These were plotted on a GIS by 5 Capitals to assess the locations linking natural or critical habitats and demonstrating connectivity with similar habitats. The initial crossings proposed by YM for Lot 3 and Lot 4 are shown in Figures 10.46 and 10.47 respectively.



Figure 10-46 Lot 3 Initial Crossing points proposed by YM (July 2023)

5 Capitals overlaid the YM crossing points for Lot 3 onto the two crossing corridors (primary and secondary) linking Swagga Swagga (north of the SGR) with Muhesi Game Reserve which links to the national parks to the south and south west of the SGR. A total of six "optimal" crossing points were identified for Lot 3 and two for Lot 4, the latter having far fewer reported crossings. The elephant crossing corridors were also designated as primary or secondary based on the cumulative data on elephant sightings along the SGR corridor which had been collected by UDSM and RSK (dry seasons), 5 Capitals (wet season) and also taking account of elephant sightings by local communities (see Figures 10-48 and 10-49).

Following meetings with YM to discuss the "proposed" versus "optimal" locations, adjustments were made to the locations and these were then classified as "Good", Medium" or "Poor" depending on the suitability of habitat on both sides of the SGR and wider dispersal area and proximity to settlements. The distance from the optimal locations to the nearest alternative crossing points are 0.0 km to 3.3km (see Table 10-20). The revised figures are shown in 10-50



and 10-51, showing the distance between suitable bridge, underpass and culvert structures and optimal locations.



Figure 10-47 Lot 4 Initial Crossing points proposed by YM

10.9.1 Analysis of Alternatives

Meetings were held with the YM Design Team to discuss the proposals and the following was emailed to YM: We have been looking closely at the elephant crossings (underpasses/bridges) between Manyoni and Itigi in relation to the suitability for megafauna. A number of the crossing points are unsuitable as they link towns/communities/croplands or are crossing major highways or rivers. We have recorded those that are suitable but note that none of the crossings appear to be specifically located for megafauna, which would most safely cross from natural habitat and Itigi thicket We have therefore proposed some additional points for consideration by Yapi Merkezi design team. An additional reason why this issue is important is that the SGR alignment cannot be allowed to disrupt the established wildlife corridors linking Tanzania National Parks (via Game Reserves and National Forests).

The Swaga Swaga Wildlife Corridor from the north crosses the SGR near Itigi and links with the Muhesi Game Reserve and Nuaha National Park on the south side of the SGR. This in turn links with the Katavi National Park to the south west. These are areas with a high concentration of elephants that travel along these corridors and are highlighted as the corridors of highest value in Tanzania by TAWIRI's most recent report. Therefore bespoke crossing points need to be considered as the option to leave this area unfenced will not be viable as a single elephant casualty must be avoided where possible due to their critical status. The importance of this crossing zone should also be highlighted to TRC so they are aware of its important role in the Tanzanian Wildlife corridors network.

5 Capitals proposed six crossing points for Lot 3 (EC 1 to EC6) and two for Lot 4 (EC7, EC8) which are shown in the following figures.

Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA report 2040173-01 (03)





Figure 10-48 Lot 3 Proposed "Optimal" Crossing Points EC1 to EC6



Figure 10-49 Lot 4 Proposed "Optimal" Crossing Points EC7 to EC8





Figure 10-50 Lot 3 Revised Crossings with Suitability Class (August 2023)



Figure 10-51 Lot 4 Comparison of 2 "Optimal" with 4 Final Crossings (August 2023)



Risk of interference with wildlife movements is a significant concern as some of the chosen location for stations, Manyoni, Aghondi, Nyahua, Tura, Malongwe and Ipala are located in areas where wildlife movement and crossing has been noted.

The SGR alignment separates four major protected areas south of the project and one (Swagaswaga Game Reserve) linking with Mkungunero Game Reserve further north.

Elephants migrate from Muhesi Game Reserve to Swagaswaga Game Reserve via a wildlife corridor between Makutopora- Manyoni-Itigi. Elephants also migrate from Nyahua Mbuga Forest Reserve to Goweko Forest Reserve via Nyahua, Kizengi, Chaya and Tura Corridor.

The movement of elephants from Nyahua Mbuga goes all the way to Kigwa - Kisigo Forest and further west to llomelo and Igombe Forests where Ipala Station is located.

Experience from the Kenya SGR has demonstrated that the operational line has become a focus for illegal settlements which can compromise the viability of the planned elephant crossing points. In addition the use of elephant crossings by livestock can cause habitat impacts and soil erosion either side of the crossing whilst also allowing livestock to graze inside the national parks further impacting natural and critical habitat. It is important therefore for government to intervene and quickly remove illegal settlements that potentially compromise the safe passage of elephants across bridges and through culverts and underpasses which in turn creates additional safety risk for the rail passengers from elephants crossing in unfenced areas.

It is acknowledged that Yapi Merkezi's design team considered the elephant corridors for the location of the crossings while ensuring the technical feasibility of the project. Accordingly, for Lots 1 and 2, structures with a minimum height of 3 meters were deemed acceptable and this has been supported by findings on the Kenyan SGR.

The table below shows the underpass structures for lot 3 and 4 which includes the location and dimension of various crossings structures in relation to the "optimal" points (EC1 to EC8). The chainage for the "ecological crossings" can be compared with the crossings and those that are 3.5m or greater in heights are shown in green as "primary" crossing points whilst those in yellow are 3.0m in height and are secondary crossing points.

The precise location of the bridges and underpasses as shown in the following table has to take account of engineering design with regards to track gradient and other planned features such as crossing points for communities and livestock etc and existing road and infrastructure facilities. It was noted in particular that siting new culverts in natural and critical habitat can result in a greater loss of habitat to achieve safe entrance and exit gradients. As a result it was agreed with YM that crossing points were best located in areas exhibiting some level of clearance already whilst avoiding community crossings between villages. The results in summary are as follows:

• Lot 3

- Six (6) crossings suitable for bull/cow elephants referring to example from Kenya (>3m height), and
- Five (5) secondary crossings suitable for cow referring to BAP prepared for Lot 1 and 2 (=3m height).
- Lot 4
 - Four (4) crossings suitable for bull/cow elephants referring to example from Kenya (>3m height), and
 - Eleven (11) secondary crossings suitable for cow elephants referring to BAP prepared for Lot 1 and 2 (=3m height).



Table 10-20: Project crossing structures indicating the potential structures which may be used by elephants to cross the SGR (August 2023)

The Elephant Crossing Corridor Expected to be Used ***	Locations	Structure****	Width (m)	Height (m)
 LOT 3 Summary of crossings: Six (6) crossings suitable for bull/cow elephants referring to example from Kenya (>3m height), and Five (5) secondary crossings suitable for cow elephants referring to BAP prepared for Lot 1 and 2 (=3m height). 				
	572+948,239 572+968,839	BR_07 Start Chainage (Span=20,6m (Steel))* BR_07 End Chainage (Span=20,6m (Steel))*	20,6 20,6	~ 4,5 ~ 5
	573+400,000	UD_573-1 (4 (1x1))	1	1
	573+596,958	LS_04 (Dim=3.7 x 3mxm, L=22,45m)**	3,7	3
575+700 to	573+850,000	UD_573-2 (1 (1x1))	1	1
581+400	575+715,750	CU_575-1 (2x(3x1.5))	3	1,5
(EC1)	576+070,000	UD_576-1 (1 (1x1))	1	1
Proximity	577+621,780	CU_577-1 (2x(3x1.5))	3	1,5
BR07 2.75km	578+821,660	CU_578-1 (2x(3x1.5))	3	1,5
flooding)	580+566,560	CU_580-1 (1x(1.5x1.5))	1,5	1,5
	581+846,680	CU_581-1 (2x(2.5x2.5))	2,5	2,5
	582+116,780	CU_582-1 (2x(2.5x2.5))	2,5	2,5
	583+616,920	CU_583-1 (1x(1.5x1.5))	1,5	1,5
	584+497,550	CU_584-1 (1x(1.5x1.5))	1,5	1,5
587+700 to	587+451,680	CU_587-1 (2x(2x2))	2	2
589+900 (EC2)	587+690,487	UP-02 (Width=11m , L=13m)*	11	5
	588+516,340	CU_588-1 (1x(1.5x1.5))	1,5	1,5
Proximity	589+268,460	CU_589-1 (2x(1.5x1.5))	1,5	1,5
0P02 0.0Km	590+030,863	LS_07 (Dim=3.7 x 3mxm, L=12,1m)**	3,7	3
582+100 to	582+116,780	CU_582-1 (2x(2.5x2.5))	2,5	2,5
584+900 (EC3)	583+616,920	CU_583-1 (1x(1.5x1.5))	1,5	1,5
	584+497,550	CU_584-1 (1x(1.5x1.5))	1,5	1,5
Proximity BR08 0.4km (seasonal flooding)	585+318,284 585+338,884	BR_08 Start Chainage (Span=20,6m (Steel))* BR_08 End Chainage (Span=20,6m (Steel))*	20,6 20,6	~ 5 ~ 5



The Elephant Crossing Corridor Expected to be Used ***	Locations	Structure****	Width (m)	Height (m)
644+700 to 646+700	644+507,000 644+527,600	BR_11 Start Chainage (Span=20,6m (Steel))* BR_11 End Chainage (Span=20,6m (Steel))*	20,6 20,6	~ 7 ~ 7
(LC4)	645+419,850	CU_645-2 (2x(1.5x1.5))	1,5	1,5
Proximity	645+495	UD_645-1 (1 (1x1))	1	1
BR11 0.19km	647+010	LS_18 (Dim=3.7 x 3mxm, L=22,8m)**	3,7	3
618+400 to 619+900 (EC5)	615+035	UP-03 (Width=13,1m , L=13m)*	13,1	5
	615+080	UD_615-1 (1 (1x1))	1	1
	615+092	CU_615-1 (1x(2x2))	2	2
Proximity UP03 3.3km	615+858	CU_615-2 (2x(1.5x1.5))	1,5	1,5
	616+502	CU_616-1 (2x(1.5x1.5))	1,5	1,5
	617+772	CU_617-1 (2x(1.5x1.5))	1,5	1,5
	619+331	LS_12/CU_619-1 (Dim=3.7 x 3mxm, L=14,65m)**	3,7	3
	620+268	CU_620-1 (1x(1.5x1.5))	1,5	1,5
630+900 to	628+704	UP-3B (Width=11m , L=13,45m)*	11	5
636+100 (EC6)	629+225	CU_629-1 (2x(2x2))	2	2
(200)	630+485	CU_630-1 (2x(1.5x1.5))	1,5	1,5
Proximity	631+884	CU_631-1 (2x(1.5x1.5))	1,5	1,5
UP3B 2.2km	633+064,	LS_15/CU_633-1(Dim=3.7 x 3mxm, L=12,1m)**	3,7	3
	634+036	CU_634-1 (1x(1.5x1.5))	1,5	1,5
	634+732	CU_634-2 (1x(1.5x1.5))	1,5	1,5
	635+576	CU_635-1 (1x(1.5x1.5))	1,5	1,5
	636+372	CU_636-1 (1x(1.5x1.5))	1,5	1,5

LOT 4

Summary of crossings:

- Four (4) crossings suitable for male/female elephants referring to example from Kenya (>3m height), and
- Eleven (11) secondary crossings suitable for female elephants referring to BAP prepared for Lot 1 and 2 (=3m height).

887+329	CU 887-1 (2-5X3m)**	5,00	3,00
887+585	CU 887-2 (2-5X3m)**	5,00	3,00
887+697	CU 887-3 (2-5X3m)**	5,00	3,00



The Elephant Crossing Corridor Expected to be Used	Locations	Structure****	Width (m)	Height (m)
886+000 to 890+000 (EC7) Proximity BR04 1.75km BR05 0.0km	887+761	BR-04 (CENTER KM, T:11x3.5m, BOX BRIDGE)*	11,00	3,50
	887+870	CU 887-4 (2-5X3m)**	5,00	3,00
	887+929	CU 887-5 (2-5X3m)**	5,00	3,00
	888+750	LS-11 (T:3.70 x 3.00 m, L= m)**	3,70	3,00
	889+057	BR-05 (CENTER KM, L: 65.5m, STEEL) *	65,50	4,55
	889+725	CU 889-1 (1.5X1.5m)	1,50	1,50
	890+218	CU 890-1 (1.5X1.5m)	1,50	1,50
	890+632	LS-12 (T:3.70 x 3.00 m, L=11.05 m)**	3,70	3,00
875+000-	875+232	UP-05 (T:7.5 x 7.65 m, L=11.58 m)*	7,50	7,65
881+000 (EC8)	876+657	CU 876-1 (3x1.5m)	3,00	1,50
(200)	876+935	CU 876-2 (2-3x1.5m)	3,00	1,50
Proximity BR03 0.0km UP05 0.2km	877+340	CU 877-1 (5x3m)**	5,00	3,00
	878+265	BR-03 (CENTER KM, T:11x3.5m, BOX BRIDGE)*	11,00	3,50
	878+463	CU 878-1 (2-3x3m)**	3,00	3,00
	878+650	CU 878-2 (2-3x3m)**	3,00	3,00
	878+900	LS-09 (T:3.70 x 3.00 m, L= m)**	3,70	3,00
	879+585	CU 879-1 (3x1.5m)	3,00	1,50
	880+730	CU 880-1 (3x1.5m)	1,50	1,50

*Crossings suitable for male/female elephants referring to Example from Kenya (>3m height) **Secondary Crossings suitable for female elephants referring to BAP prepared for Lot 1 and 2 (=3m height)

*** This refers to the ecological crossings that are expected to be used by wildlife animals for traversing the SGR alignment.

**** Structures provided by Yapi Merkezi indicate the potentially feasible crossings which have structures three meters and above.

With regards to the table above, the final crossing points (11) for Lot 3 and 15 for Lot 4 are shown in Figures 10-52 and 10-53 respectively.





12.30 st kor Lot 4 - Planned Infrastructure Suitable for Elephant Crossings 100 Legend: Proposed Route Planned Infrastruct Elephant Crossings Primary Crossings Suitable for Male and Female Elephants Secondary Crossings Suitable for Pemale Elephants 1000 **Key Elephant Crossings Identified** Primary Elephant Crossing Corridor Secondary Elephant Crossing Corrido ŝ Assared 101 Checked KRW 35-00-3024 0 10 km Second second second 5 5 capilals 31.0077

Figure 10-52 Lot 3 – Final Elephant Crossing Point Structures August 2023

Figure 10-53 Lot 4 – Final Elephant Crossing Point Structures August 2023



10.9.2 Elephant Proof Fencing

Fencing of the SGR for Lots 3 & 4 needs to take account of lessons learnt for Lots 1 & 2 and operational experience to date including from the Kenyan SGR. Key recommendations from Kenyan experience, ("<u>Tracking and monitoring of elephant movements along the Standard Gauge Railway and highways in the Tsavo Ecosystem, Kenya (March 2016 – June 2017)</u>" and "<u>The effect of the new SGR on elephant movements in the Tsavo Ecosystem, Kenya (March 2016 – March 2018)</u>" which should be considered for Lots 3 and 4 are as follows:

- wildlife crossing points must be kept free of human interference which may arise from illegal settlements and/or excessive use of such crossings for livestock causing loss of natural habitat and soil erosion. It is recommended that camera traps or rangers stationed near designated crossing points are there to monitor impact on elephants using a designated crossing point.
- Since an average of 31% of elephants crossing the Kenyan SGR used the designated bridges, culverts and underpasses, the largest number of crossings were across the railway embankment in unfenced areas. Where long stretches of the SGR are fenced, the Kenyan experience recommends that there is some permeability in the fence line to prevent elephants becoming trapped within the double fencing on either side of the track.
- Where fence line terminates without a designated crossing, surveillance cameras should be installed to provide real-time data to a control center and relayed to train drivers approaching sensitive locations where elephants are in close proximity to the track. Train drivers should receive specialist training on sensitive locations (crossing points) and how to anticipate danger and avoid accidents involving megafauna, including elephants.
- Fencing need to be electrified to discourage elephants from breaking them down. Contingency plans need to be in place to address issue of power outages.
- It has also been observed that abandoned borrow pits fill up with water and are visited by elephants so where these are in close proximity to the track they bring elephants and other megafauna in close proximity to the danger from passing trains.

There are several wide crossing points in Lot 3 and specified points in Lot 4 and therefore it is recommended that a Workshop is held with the authorities including TAWA, TAWIRI, TFS and specialists/consultants representing TRC and Yapi Merkezi to fine tune the specific locations and lengths of elephant proof fencing to ensure maximum safety and effectiveness, while maintaining elephant migration through established wildlife corridors. The crossing points will also take into account known crossing points for other species including leopard, lion, zebra, hippopotamus and antelope, which will also be able to utilize crossing points that may be unsuitable for elephants.

- Elephant crossings will be logged into a database and reported to the authorities and TRC Operations.
- Areas fenced will require additional tree planting to provide adjacent corridors for elephants and other wildlife to navigate safely to the crossing point.
- Underpasses/crossing points will be preferably located no more than 1km from established routes and no more than 5km from known crossing points.
- Periodic monitoring of crossing points and collection zones by use of remote cameras to gather information on use of crossings and to ensure safety of crossing animals. This will be conducted in association with the authorities.
- Patrols and monitoring for snares that may be laid for any of the medium to large wildlife will be conducted.
- Cameras will be installed at the termination point of the fence line to monitor for large wildlife including elephants crossing the SGR to ensure that train operations apply caution at these points, slowing as necessary to avoid risk of accidents.
- In Lots 1 and 2, the contractor for the establishment of elephant proof fence, RUBS proposed the electrified fencing for lot 1 and 2. Regarding Lots 3 and 4, fences will most likely need to be electrified to be elephant proof, based on



experience along other railways in East Africa, and Lots 1 & 2. This will be discussed in Workshop with authorities, TRC, Yapi Merkezi and their specialists/consultants (see examples of proposed electrified fencing in Figures 4-1 to 4-5 below, courtesy of Rubis Technical Services).

- Fences will need to be built on wooden poles, as metal and reinforced concrete posts disseminate the electrical current into the earth and sufficient voltage cannot be maintained for elephant proof fencing.
- Fences need to be erected with numerous high tensile steel wires as elephants quickly learn to push down mesh wire fences. Confirm design in multi-agency Workshop.
- Fencing will require maintenance which needs to be sustained by TRC on an ongoing basis. Fence maintenance teams need to be established and resourced with the appropriate transport, equipment and training.
- Fences will need to be monitored on a regular basis to test their effectiveness and to aim for a target of "zero" elephant fatalities due to collision with trains, entanglement with the fencing or losses due to hunting or poaching. Any incidents or near misses must be recorded and a root cause analysis undertaken to prevent similar incidents in future.

The Gallagher Elephant Proof Electric Fence is shown in the following figure



Figure 10-54: Gallagher Elephant Proof Electric Fence







The choice of steel wire or electric fencing will need to take into account factors including the terrain, nearest culverts and livestock crossings and the proximity to local communities to ensure that the selected design is effective in keeping people and elephants safe. Where electrified fencing is installed this also has the advantage of 24/7 monitoring from a central control room that can provide real-time information for trains approaching a sector where an alarm has been triggered, indicating possible damage or breach to the fence. The central monitoring and alarm system is highly recommended for the known elephant crossing points.

Crossing points for lion and leopard, based on wet seasons observations (2023) show that there are multiple crossing structures (=/>2m in height) that would be suitable to safely cross the SGR line (see Figure 10-58 below). Within a 10km radius of each lion sighting there are 2 crossing points, while within 10km of the leopard sightings there are between 1 and 3 crossings.

According to IUCN, the main causes of decline in the lion population in parts of Africa, includes *indiscriminate killing in defence of human life and livestock, habitat loss, and prey base depletion*. The avoidance of increasing human-wildlife conflict due to habitat loss close to the SGR and at suitable crossing points supports the key requirement to control further habitat loss and fragmentation/severance of wildlife corridors.

IUCN report poaching as a key reason for decline of leopard across its range and so the access to suitable crossing points via Natural Habitats must be maintained together with monitoring by the Authorities to ensure that the crossings do not become a focus for illegal hunting of leopard, and potentially other megafauna such as Kudu.



Figure 10-56 Leopard and Lion Observations (February 2023) in relation to Crossings



10.9.3 Conclusions on Impacts of Fragmentation on Wildlife Crossings

- The movement of elephants and other megafauna along established corridors connecting National Forest Reserves and National Parks to the north and south of the SGR route must be a top priority for the Project, supported by government policy, in the short, medium and long term, with monitoring by the Wildlife Authorities supplemented by Community participation as a means of monitoring the achievement of this KPI.
- The achievement of safe crossing of the SGR corridor by elephants, lion leopard and other megafauna is another KPI which requires a careful balance between having suitable crossings within the known corridors and sufficient crossing points, allowing good access, whilst also limiting the free movement across any part of the line, which would otherwise lead to accidents and likely deaths of elephants. The experience in Kenya of the SGR crossing Tsavo National Parks has highlighted significant number of elephant deaths soon after it was commissioned since only one third of the elephant crossings were observed using designated safe crossing structures. This experience must therefore be applied to the Tanzanian SGR to maintain a high level of targeted monitoring during construction and commissioning to build the database of known crossings locations.
- The design process for assessing the location, number and size of elephant crossing points has been an iterative process and has taken account of the survey data and consultations as part of this ESIA and has established that suitable crossings are within 3.5km of known elephant locations. These will be suitable as they link or are adjacent to Natural /Critical Habitats, although a few may be less accessible during the wet season. In addition to proposed designated crossing points, there are additional structures suitable in terms of dimensions to allow passage by elephants under/over the SGR.
- To maintain designated crossing structures for the purpose for which they were designed, it will be vitally important for TRC policy supported by government intervention where necessary to prevent fragmentation of corridors and to prevent Natural and Critical habitats from being cleared for residential, and commercial uses, particularly farming. These actions will be critical in preventing fragmentation that will otherwise also lead to greater human-wildlife conflict.
- The fencing strategy has taken account of the experience gained in Lots 1 and 2 but should also consider the latest unpublished results from Kenya SGR observations and most recent reports where available. The strategy will then be developed through a Workshop involving TAWA and TAWIRI and other wildlife organisations and experts to ensure that local knowledge is fully applied in this respect. It is understood that 40km of elephant proof fencing is currently proposed for Lots 3 and 4, but the precise locations need to be discussed with local experts before the design is finalised. This will be particularly important in determining the length of sections to be fenced leading to a safe crossing point and the extent of Natural/Critical habitat cover to provide a refuge and safe corridor leading to the crossing point. It can be concluded that Lot 3 will require a greater extent of elephant proof fencing than Lot 4. It is fully expected that elephants will continue to cross in other areas too which will mean damage to normal railway safety fencing but this will provide valuable data to improve the definition of high risk areas which may then require retrospective elephant proof fencing, or can be controlled by managing train speed in such areas together with real-time camera monitoring systems.



10.10 Ecosystem services

A total of 44 questionnaires (see questionnaire Appendix 4) were administered in 33 out of 38 wards / villages along the project alignment. The respondents to the questionnaire were mainly ward / village officers (54.4%) and farmers (15.9%). Only a few pastoralists, students and small business owners were encountered and questioned. The selection of respondents was opportunistic following an introduction at the ward / village office. 86.4% of the respondents were male, and 13.6% were female. To enable collection of information informed by the experience of the respondent, attempts were made to solicit responses from individuals who had resided in the area for substantial periods of time. 66% of the respondents reported having resided in the areas from birth or for more than fifteen years, 18% have lived in the areas between five and fifteen years, and only 16% had lived in the area for less than five years.

The ecosystem services assessed are categorised as provisioning, regulating, cultural and supporting according to PS 6¹³. They are principally related to the construction phase due to the clearance of natural forest and thicket habitat for the ROW and the risks associated with loss or contamination of groundwater resources, loss of agricultural land and pasture and the barriers to free movement across the railway line.

10.10.1 Provisioning services

10.10.1.1 Forests

Forests are potential sources of fuelwood, medicinal herbs and shrubs and provide refuge to fauna. Tanzania has undertaken comprehensive land use planning, and mapping demonstrated in the land titles of its villages. 61% of the respondents indicated knowledge of forests in the area. Each village land use plan has designated land for conservation dependent on existing forest or potential for regeneration where it is degraded (Land Use Planning Act, 2007).

Approximately 17 natural forests (mainly miombo) under different management options were reported to occur in the vicinity of the proposed alignment. The management options for natural forests include village, district and central government. Village authorities can manage forests under the supervision of the TFS or village by-laws¹⁴. The district and central governments manage the other forests. Central government forest management is the most restrictive, permitting limited access to harvesting non-timber forest products (NFTPs) such as fuelwood, medicinal herbs and shrubs. Beekeeping was observed only in the forests of Aghondi, Kitopeni and Manyoni wards.

The respondents were aware of the conservation status of the forests around them, generally quoting the management under a village authority or the TFS. However, one

¹³ Ecosystem services are the benefits that people, including businesses, derive from ecosystems. Ecosystem services are organized into four types: (i) provisioning services, which are the products people obtain from ecosystems; (ii) regulating services, which are the benefits people obtain from the regulation of ecosystem processes; (iii) cultural services, which are the nonmaterial benefits people obtain from ecosystems; and (iv) supporting services, which are the natural processes that maintain the other services. IFC PS 6 (GN 2012 updated 2019).

¹⁴ Villages establish by-laws on permissible activity e.g. collection of fuelwood and medicinal herbs and shrubs. Management is done by a village environmental committee. Illegal harvesting can attract a fine of 50,000/= per tree.


respondent acknowledged that there were forests under village authority but supervised by TFS.



Figure 10-57: Knowledge of conservation status of forested land

10.10.1.2 Thicket

The Itigi thicket is a unique vegetation habitat of dense deciduous brush, with many endemic species and almost no transition zone with the miombo woodlands (see the map with Itigi thicket and wildlife). In addition to its high level of endemism, the thicket appears to host a significant population of large mammals during the wet season and possibly similar during the dry. The attraction to and dependence on it by fauna maybe a refuge or vegetation but needs determination by in-depth studies.

10.10.1.3 Grazing lands

The stretch of land between Lots 3 and 4 is frequented by pastoralists. Only a few of the villages are able to use the pastures for their own livestock. There are more herds from pastoralists during the dry season, and there is no dedicated pasture ground. Livestock grazes in open areas, woodlands and seasonal wetlands. Few farms are rented out to pastoralists after harvest such as in Kalumwa ward, and there are reports of illegal grazing in the Sikonge National Reserve, suggesting in times of drought and poor pasture, there is pressure on resources.

10.10.1.4 Agriculture

The main economic activity is farming which is seasonal. Crops grown include sunflower, maize, sorghum, green gram, lentils and rice. Other activities are commerce (in Manyoni), livestock, and beekeeping (mainly in Tabora wards).

10.10.1.5 Water sources

Most of the wards along the alignment have locally made deep (more than 10 m) or shallow (up to 10 m) water wells. These are the main source of water for domestic use. From Makutopora to Tabora, communities use rivers and reservoirs known as "magati ya



maji" that hold run-off from Lake Victoria and potable water for domestic purposes. Mgonandele river serves Makutopora ward, Aghondi ward has two wells within 100 m of the railway alignment, Kitopeni uses piped water and a local well, Itigi ward has water springs in Sokoni village, Nyatungo river serves Genge 48 ward, and Karangasi ward has a borehole.

The earthen dams filled with rainwater or damming seasonal streams and rivers irrigate vegetable gardens and livestock. There are minimal boundaries between farms/ vegetable gardens and riverbanks.

Water from the reservoirs, boreholes and piped systems are potable as they are generally treated. The water from locally dug deep, and shallow wells is less safe for drinking and has to be boiled to avoid waterborne diseases like diarrhoea. Makutopora has experienced an outbreak of waterborne diseases, and people died. Cases of diarrhoea have been reported from Goweko, Igalula, Uyui, and Ikomwa.

10.10.1.6 Regulating

Erosion and flooding

Some villages in the wards receive floods during the rainy season (December to March). 2019 was reported to have experienced extreme flooding, destroying infrastructure and homes. Kipondoda, Malongwe, Kayombo and Ikomwa wards reported flooding incidents from as far back as 1988 and as recent as 2019, though the flooding levels differed.

The short rains (December or January to March) cause the wards to experience semiarid conditions and low crop production. The long dry season results in water shortages and is observed to increase over the years, as cited by Mabondeni, Geng 48, Malongwe and Nyahua, which recall food shortages in 2020, 2021 and 2023.

Soil erosion during the rainy season has worsened in areas like the Muhalala ward, where roads and bridges are being constructed. In other areas like Makutopora, where the topography is rifted, erosion is due to the force of rainwater coming from the hills.

10.10.1.7 Supporting

Soil

Soil fertility in the wards is considered adequate by communities that make little use of implements. Soil types were quoted as being largely clay or sandy clays. Manure from cattle or chemical fertilizer is used on sandy clays in a few instances.

10.10.1.8 Cultural

Many respondents referred to having cultural sites in their areas (68.2%, See **Error! Reference source not found.**). Places of cultural value included graves of chiefs and witchdoctors, mountains, big trees, caves and grounds chosen for cultural practices. E.g. in Saranda, there is a place called Nkwita mountain; there is a German grave from when the MGR was built. The story narrated was that a German had to die for the railway to pass, as the local communities had not been consulted.

Cultural sites are visited for community, and individual purposes, such as outbreaks of diseases like COVID-19, hunger/drought, attacks from wildlife and lack of rain. Individual reasons for visiting cultural sites included clan elders seeking guidance, chiefs' family members and parents of twins. Knowledge of the cultural sites and their value was mainly with those who had resided in the area from birth or had access to this information passed down to them.



The forest reserve at Aghondi is a tourist attraction, attracting visitors who learn about beekeeping. The 3,000 ha reserve is also home to wild animals.



Figure 10-58: Knowledge of cultural sites

10.10.1.9 Impacts on ecosystem services

Clearance for alignment resulting in loss of habitat service for fauna, reduction in grazing grounds, reduced sources of firewood and construction materials for local communities residing in the area.

Clearance of the Itigi thickets will potentially add to the loss of indeterminate ecosystem services (in the absence of in-depth studies).

The embankment and fencing for the railway will reduce access to resources and services offered by nearby flora communities as the entire alignment will be fenced.

Clearance of the Itigi thicket potentially raises criticality and a requirement for in-depth studies and long-term monitoring due to the anticipated area of clearance and overall cover of this unique vegetation type.

The impacts predicted are local, long-term and significant. Mitigation measures must consider the following:

- facilitate access to resources across the ROW
- prepare and implement LRPs based on forest conservation that benefits communities
- prepare and implement a BAP
- restore habitat throughout the project area
- implement monitoring and evaluation programs to demonstrate minimum adverse impact beyond construction sites.

10.10.2 Reduction in habitat effectiveness for species of conservation concern

The potential for a reduction in habitat effectiveness for species of conservation concern is acknowledged as a significant risk. However, the primary cause has been the clearance of woodland and Itigi thicket in recent years for expansion of agriculture and the establishment of new pastures for grazing. In addition, temporary and permanent wetland



areas have been repurposed and brought under community management as paddy fields. This modified habitat is now the largest area of land-use within the ROW and its removal along the alignment will create pressure for expanding agriculture in remaining areas of natural and critical habitat. An LRP must therefore be established for the project that will assist communities in forest conservation management whilst allowing growth within the communities.

The project, for its part, needs to review all areas where Itigi thicket is planned to be removed due to the establishment of camps, quarries, borrow pits and laydown areas and any temporary access roads required for construction. The strategy must be one of avoidance of this habitat, which is a threatened ecosystem, as the surveys and studies have confirmed that this habitat is an important refuge and corridor for wildlife throughout the year and provides shelter and lessens the frequency of human wildlife conflicts with the local communities.

Since the loss of natural habitats and the potentially critical Itigi thicket will occur along the alignment within a 60 m corridor, the requirement for habitat restoration to achieve no net loss is essential to prevent there being a reduction in habitat effectiveness due to the project. The specific locations for forest planting and restoration measures undertaken for other habitats, including the thickets, will need to be discussed with all stakeholders to ensure that restoration is undertaken in the areas that will most benefit the species of conservation concern.

10.10.3 Human wildlife conflicts

The primary cause of the human-wildlife conflict is the growing human population and increasing landscape transformation from natural to cultivated village land, bringing people and wildlife into closer contact and increased competition for natural resources. The loss of natural habitat can bring elephants onto land to feed on crops creating conflict with the farmers, whilst loss of native prey for leopard and lions, can result in cattle or goats becoming an alternative source of food. This situation is continuing to worsen and will have additional pressure resulting from the clearance of agricultural land within the ROW.

It is essential that the LRP is developed to help the communities in signposting the way forward for sustainable agriculture and pastoralism within the carrying capacity of the land. This will require input from all the major stakeholders so will be ongoing even during the construction phase of the project. The LRP will need to highlight the importance of maintaining adequate wildlife corridors and identifying where agricultural land is already reducing such key corridors that conflict with wildlife will increase substantially unless alternatives areas are found.

There is also a risk of conflict between wildlife and construction workers during the construction phase of the project, particularly with large wildlife such as elephants but also smaller animals such as snakes, scorpions and spiders which can cause injury or even fatalities. The workforce will therefore require specific wildlife training sessions as part of the induction process. This will include actions taken to recognize signs of wildlife and what to do to minimize the risk of conflict. During seasons when interaction is most expected, it may be necessary to check for approaching elephants, lions, or leopard so that workers are aware of approaching danger or when necessary have stopped work while a group of elephants or lion pride pass by the site. Working at night will be limited where possible but will require additional measures to safeguard workers from large animals approaching under cover of darkness.

Providing that training, mitigation and management measures are fully implemented, the risk of conflict can be kept to a minimum. In the case of any near misses or actual interactions, these must be recorded in a site logbook and reported to the HSSE manager and E&S manager to undertake root cause analysis to avoid a repetition of the incident.



10.10.4 Biodiversity supply chain

The importance of biodiversity supply chain management cannot be understated for the project, particularly for the construction phase. This will require the EPC Contractor to manage tier 1 and potentially tier 2 suppliers in their supply chain to determine where resources and materials have been sourced and to demonstrate that they are not associated with illegal or unsustainable harvesting of forest timber and other supplies and materials required during the construction phase. This may include, e.g. communities cutting protected trees or removing trees from forest reverses ahead of the completed track so that they become low cost, convenient sources of timber for the continuing project works. Provision of hunting for bush meat and other resources harvested locally by others should also be avoided by the EPC and this should be disseminated to all workers during the induction training. In order to achieve the controlled management of suppliers, the EPC will be required to undertake a review of the suppliers and establish the source of materials. This process should be transparent and provide justification for selection of preferred suppliers. Those suppliers that can demonstrate forest stewardship certificates or similar should be the benchmark wherever possible. This process will require monitoring during the construction phase and be available for independent review when applicable.

10.10.5 Cumulative impacts

The cumulative impacts of the project on biodiversity include the growth of communities/villages expanding into towns, with expansion of agriculture and pastoralism with resulting land clearance of natural/critical habitat, due to communities taking advantage of the transport links to market and providing supplies to construction workers. This will require attention to detail in the LRP including consultation with stakeholders to ensure that there is a plan for sustainable land use that does not block wildlife corridors or remove wildlife refuge areas and damage wetland sites.

Provision of overhead power transmission lines (OHTL) within an adjacent corridor to the SGR will also require habitat removal, loss of farmland or fragmentation of existing habitats. This will also require upgrading of tracks for suitable access for the materials and construction of the lines. The design of the power lines should ensure that there is no risk of electrocution by raptors that may roost or nest on the pylons.

Expansion of business parks (close to the new stations and within rural areas having access to the project) should be on land which has already been degraded due to previous clearance of natural habitat and critical habitat (Itigi thicket). The new stations will also lead to upgrading or widening of existing roads potentially removing woodland or other natural habitats.

The loss of habitat between the MGR and project alignments which in places will leave at least 100 m of unused degraded land that has little value for wildlife but can become a major source of invasive plant species due to lack of management controls. This could potentially be used as farmland for local communities subject to the necessary safety provisions.

The overall control of cumulative impacts is largely in the hands of local government and district offices, which should adopt similar planning guidance to facilitate a consistent approach to new development, avoiding development creep into areas of natural or critical habitat without having considered alternatives and if none, then applying requirements for habitat restoration / compensation as applicable.

Scapilaly.

10.11 Assessment of effects and mitigation

10.11.1 Area of influence (Aol)

The AoI is the area within which the project activities may affect receptors. As different aspects carry differing spatial extents, the AoI varies considerably. The points below provide the AoI that was considered for each type of predicted potential impact.

The Aol for **habitat loss and direct mortality** impacts is inclusive of the full project construction and operation footprint, (60 m ROW) and including associated facilities, laydown areas, camps, borrow pits and quarries and any existing or new roads utilized for incoming and outbound traffic.

The AoI for **habitat degradation** impacts extends beyond the footprint of the project inclusive of a 500 m buffer, to account for the phenomenon of edge effect.

The AoI for **habitat fragmentation and disturbance** impacts extends beyond the footprint of the project inclusive of a 1 km buffer, to account for the phenomenon of barrier effect.

The AoI for **direct displacement** impacts extends beyond the footprint of the project inclusive of a 5 km buffer, to account for the secondary impacts of displaced wildlife into adjacent areas.

The Aol for **indirect displacement** or influence upon wildlife corridors for the large mammals including elephant, zebra, lesser kudu and lion, leopard and hyaena is necessarily far more extensive due to the size of their foraging/hunting territories and the migration patterns that require them to cross the project and therefore this is proposed to be a 20 km buffer.

Whilst the ongoing fragmentation of the natural habitats within this buffer is not a result of the project, this may have a cumulative effect in the future by indirectly encouraging further urbanisation and commercial agriculture across this aggregation and dispersal areas as wildlife approach suitable crossing points. An important measure to limit this is through the LRP for those communities that will lose land within the project.

The AoI for Introduced species / proliferation of species impacts extends beyond the footprint of the project inclusive of a 1 km buffer, to account firstly for potential major invasive spread and secondly, secondary impacts caused by displacement of less competitive fauna into adjacent areas.

10.11.2 Sensitive receptors

The following table outlines the sensitive ecological receptors identified in the project Aol.

Group	Receptor(s)	Justification	Value
Natural habitats	Miombo woodland	Miombo woodland is deciduous or semi- deciduous savanna woodland growing in well drained fertile soil. It is usually dominated by 19 defining tree species, such as brachystegia spp, julbernardia spp and isoberlinia angolensis, while other principal canopy species are afzelia quanzensis, anisophyllea pomifera, pterocarpus angolensis, pterocarpus tinctorius, erythrophleum africanum, faurea saligna, marquesia curatellifolia	High

Table 10-21: Sensitive ecological receptors



Group	Receptor(s)	Justification	Value
		and pericopsis angolensis. It also provides a refuge for wildlife including elephant, (loxodonta Africana), sable antelope (hippotragus niger) and historically black rhinoceros (diceros bocornis).	
	Itigi thickets	A unique habitat, the Itigi-Sumbu thicket ecotype consists of 100 species of woody shrubs, including endemic or range restricted species. It is a dry, primarily deciduous, impenetrable vegetation between 3 m and 7 m in height and provides a refuge for wildlife. It grows on unique, highly specialized, and sensitive soils that once disturbed do not regenerate. This ecoregion is defined by WWF (2022) as Critical/Endangered and is already significantly cleared and degraded in both Tanzania and Zambia.	Very High
	Rivers, seasonal / permanent wetlands	Wetlands include temporary and permanent marshes, rivers, riverine forests, inland drainage systems and flood plains. They vary in quality but in many cases are now modified habitats such as quarries and borrow pits which seasonally fill with water. They can still host a wide range of aquatic fain and flora and attractive for many species of wading birds. However due to 5species of range restricted/endemic Nothobranchius (killifish) (IUCN VU) occurring close to the SGR route and this genus being recorded in at least 4 of the wetland sites surveyed in 2023, this receptor has been raised from Medium to High sensitivity.	High
Flora	Threatened or range restricted flora	There are several species that have been observed in the Itigi Thickets and are a high priority with IUCN listing either as VU or endangered. It is likely that at least one of these could trigger criticality under criterion 1 or 2. These also support litigi thicket having high sensitivity.	High
	Non-threatened flora	Comprises IUCN LC, widespread common species	Low
Fauna	Elephant, leopard and lion	The African savannah elephant IUCN Red List class has been raised from VU to endangered. It is present throughout the project area and adjacent forest reserves, open areas and GCA. It has triggered criticality under IFC Criterion 3(a) areas sustaining >1% of global population of a migratory or congregatory species. Elephant and wildlife crossings points	Very high



Group	Receptor(s)	Justification	Value
		were identified through systematic sampling of the areas, confirmed through consultations with TFS, TAWA and local level authorities. The total crossing width in Lot 3 is approximated to be 68.43 km while that in Lot 4 is approximately 24.6 km. Lion and leopard are present in the project AoI and have been observed and reported at several crossing points. They can be considered iconic and of high priority for conservation. They are listed as VU due to decreasing populations.	
	Threatened birds (bateleur, hooded vulture)	The bateleur is IUCN endangered, and the hooded vulture is IUCN critically endangered	Very high
	Non-threated birds	Comprises IUCN LC species	Low
	Non-threatened mammals	Comprises IUCN LC species	Low
	Non-threatened herptiles	Comprises IUCN LC species	Low
	Non-threatened invertebrates	Comprises IUCN LC species	Low
	Non-threatened fish	Comprises IUCN LC species	Medium

10.11.3 Potential impacts, mitigation, management and residual impacts

10.11.3.1 Construction phase

Habitat loss

Clearing, grading, excavation and other earthworks during early construction stages results in habitat loss over the full construction footprint of the project, including temporary structures, lay-down areas and new and existing roads used for incoming and outbound traffic.

Habitat loss affects both vegetation and wildlife species that currently use the affected areas as well as overarching ecosystem function on a wider regional scale. Vegetation cannot re-establish in impermeable paving or compacted soils, and wildlife dependent upon natural features and resources cannot utilize the converted land which restricts available habitat regionally. Ecosystem function will be degraded as a result and this will result in a loss or reduction in ecosystem services to the communities through loss of vegetation, wood used for structures and charcoal burning, loss of fauna as thickets cleared, lack of grazing. This will be compensated by free access to resources along the project, together with livelihood restoration plans based on forest conservation methods.

The estimated habitat loss for the project is 4,429 ha including 950 ha of miombo woodland habitat and 350.61 ha of highly sensitive itigi thicket, representing 21.6% and 8% of the total project footprint, respectively. However Itigi thicket loss has been updated to a worst case of 353.17ha to account for clearance before the satellite imagery had been completed.

The quantification of critical and natural habitat loss was based on the RSK satellite imagery established between April and November 2022. Following a request for



information from YM on progress, including cleared areas, this was provided in an email from Gizem Gungor on 23rd February 2023 which stated that for Lot 3 "Clearing And Grubbing, Earthworks and Others (Service Roads and Mainline) is 0.73%". The email confirmed that there was no clearance re earthworks for Lot 4 at that time. There is no other information to assess the actual mix of habitats cleared in Lot 3 and therefore based on 0.73% clearance, we have assumed a worse case loss of Itigi thicket of 2.56ha. This assumed loss of Itigi thicket whilst the satellite imagery was still being assessed would result in a slightly higher total loss of 353.17 ha critical habitat loss equivalent to an addition of <1% (0.72%) which will require compensation offset to achieve NNL/NG.

While re-routing the project would be difficult at this stage, the relocation of borrow pit sites overlapping the itigi thicket shall be a top priority for Yapi Merkezi to reduce the area affected by 79 ha (borrow pits) and 62 ha for camps.

The role of recording a proposed inventory of habitat loss will be to capture the actual losses of habitats, so that the inventory will be included, and implemented through the BMP, to inform the measures for achieving Net Gain / No Net Loss which will be detailed in the BAP.

Habitat	Natural / Modified Habitat	Biodiversity Value	Area (ha)	Percentage Cover
Settlement	Modified	Low	42.00	0.95%
Mixed Bushland	Modified	High	54.47	1.23%
Borrow Pits and Quarries	Modified	Low to High	63.36	1.43%
Cleared Ground	Modified	Low	269.96	6.09%
Acacia Scrub/Woodland	Modified	High	660.41	14.91%
Monoculture Cropland	Modified	Low	1,981.5	44.73%
Bare Areas	Natural	Low	12.29	0.28%
Rock Kopje	Natural	Low	12.96	0.29%
Wetlands	Natural	High	32.90	0.74%
Itigi Thickets	Natural	Critical	353.17*	7.98%
Miombo Woodland	Natural	High	949.48	21.43%
Total			4,432.50	100.07%

Table 10-22: Lots 3 & 4 Habitat impacted by the Project (based on 2022 satellite data)

Note: the calculations are based on the satellite imagery between April and November 2022

* To account for early clearance of habitat (pre February 2023) a worse case loss of Itigi thicket of 2.56ha has been assumed – requiring Compensation Offset of 353.17 ha

The IBAT screening identified nationally protected Forest Reserves. Open areas and Game Controlled Areas within 1km of the SGR route alignment in Lots 3 &4. The satellite imagery showing the habitat types adjacent to the ROW were assessed for each of the areas and are shown in the following tables. This shows for example that in Goweko FR, there will be a loss of almost 20ha of Miombo Woodland and 30ha of wetlands, both highly sensitive natural habitats requiring specific mitigation measures to achieve NNL. In Wembere OA, almost 240 ha of Miombo Woodland will be lost from the ROW.



Table 10-23:Lot 3 Habitat Loss In Nationally Reserves as a Percentage of Total

Nationally Protected Areas	Designation	Total Reserve Area (Ha)	Area of Habitat Loss (Ha)	Habitat Loss (% of Total Reserve)
Goweko	Forest Reserve	41,593	77.21	0.19
Nyahua Mbuga	Forest Reserve	667,032	140.57	0.02
Chaya	Open Area	87,400	323.56	0.37
Msuluguda	Open Area	88,566	123.72	0.14
Wembere	Open Area	501,517	665.00	0.13
Wembere	Game Controlled Area	878,361	526.45	0.06
Total		2,551,560	1856.50	-
Overlap adjusted Total		-	1638.73	-
Area of overlapping protected areas		-	217.77	-

Notes: Within Wembere O.A, around 68Ha is also Goweko and around 132Ha is also Nyahua.

Additionally, within Nyahua around 18ha is also Goweko

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Habitat	Area in Ha	Percentage
Mixed Bushland	2.25	2.92%
Cleared Ground	2.089	2.71%
Miombo Woodland	19.44	25.18%
Bare Areas	0.24	0.31%
Monoculture Cropland	8.68	11.25%
Settlement	0.00	0.00%
Wetlands	29.71	38.48%
Acacia Scrub/Woodland	14.80	19.17%
Total	77.21	100.00

Table 10-23b: Nyahua Mbuga Forest Reserve Habitat Loss

Habitat	Area in Ha	Percentage
Mixed Bushland	3.21	2.28%
Cleared Ground	6.00	4.27%
Itigi Thickets	0.48	0.34%
Miombo Woodland	59.72	42.48%
Bare Areas	0.05	0.04%
Monoculture Cropland	37.32	26.55%



Settlement	0.00	0.00%
Wetlands	21.74	15.47%
Acacia Scrub/Woodland	12.04	8.57%
Total	140.57	100.00%

Table 10-23c: Msuluguda Open Area Habitat Loss

Habitat	Area in Ha	Percentage
Mixed Bushland	1.12	0.91%
Cleared Ground	6.07	4.91%
Miombo Woodland	8.80	7.11%
Bare Areas	0.48	0.39%
Monoculture Cropland	90.29	72.98%
Settlement	0.00	0.00%
Acacia Scrub/Woodland	16.95	13.70%
Total	123.72	100.00%

Table 10-23d: Wembere Open Area Habitat Loss

Habitat	Area in Ha	Percentage
Mixed Bushland	17.77	2.67%
Cleared Ground	41.36	6.22%
Itigi Thickets	14.69	2.21%
Miombo Woodland	239.10	35.95%
Bare Areas	1.57	0.24%
Monoculture Cropland	194.59	29.26%
Settlement	1.71	0.26%
Wetlands	31.81	4.78%
Acacia Scrub/Woodland	122.41	18.41%
Total	665.00	100.00%

Table 10-23e: Chaya Open Area Habitat Loss

Habitat	Area in HA	Percentage
Mixed Bushland	15.94	4.93%
Cleared Ground	28.07	8.67%
Itigi Thickets	66.00	20.40%
Miombo Woodland	75.59	23.36%
Bare Areas	0.00	0.00%
Monoculture Cropland	95.62	29.55%



Settlement	0.31	0.10%
Wetlands	1.09	0.34%
Acacia Scrub/Woodland	40.94	12.65%
Total	323.56	100.00%

Table 10-23f Wembere Open Game Controlled Area Habitat Loss

Habitat	Area in Ha	Percentage
Mixed Bushland	1.84	0.35%
Cleared Ground	23.04	4.38%
Itigi Thickets	169.23	32.15%
Miombo Woodland	94.61	17.97%
Bare Areas	2.25	0.43%
Monoculture Cropland	171.00	32.48%
Borrow Pits and Quarries	8.71	1.65%
Settlement	10.89	2.07%
Acacia Scrub/Woodland	44.88	8.52%
Total	526.45	100.00%

Table 10-24: Lot 4 Habitat Loss within Nationally Protected Areas

Nationally Protected Areas	Designation	Total Reserve Area (Ha)	Area of Habitat Loss (Ha)	Habitat Loss (% of Total Reserve)
llomero Hill	Forest Reserve	28,084	169.08	0.60
Igombe River	Forest Reserve	259,006	180.86	0.07
Total			349.93	

Table 10.24a: Ilomero Hill Forest Reserve Habitat Loss

Habitat	Area in Ha	Percentage	
Mixed Bushland	0.60	0.36%	
Cleared Ground	8.03	4.75%	
Miombo Woodland	81.50	48.20%	
Monoculture Cropland	48.53	28.70%	
Acacia Scrub/Woodland	30.41	17.99%	
Total	169.08	100.00%	



Habitat	Area in Ha	Percentage	
Mixed Bushland	0.29	0.16%	
Cleared Ground	13.27	7.34%	
Miombo Woodland	42.63	23.57%	
Monoculture Cropland	97.66	54.00%	
Acacia Scrub/Woodland	27.00	14.93%	
Total	180.86	100.00%	

Table 10.24b: Igombe River Forest Reserve Habitat Loss

As an overall summary, **Lot 3 Nationally Protected Reserves** will likely see the loss of the following critical and natural habitats:

- Itigi Thicket: 250.4 ha
- Miombo Woodlands: 94.61 ha
- Wetlands: 54.64 ha

As an overall summary, **Lot 4 Nationally Protected Reserves** will likely see the loss of the following critical and natural habitats:

•	Itigi Thicket:	0.0 ha
•	Miombo Woodlands:	178.8 ha
•	Wetlands:	0.0 ha

The above habitat losses are not significant in terms of the total reserve areas (see Tables 10-23 and 10-24) amounting to between 0.02% (Nyahua Mbuga Forest Reserve) and 0.6% (Ilomero Hill Forest Reserve). However in terms of habitat losses these require NNL and NG for natural and critical habitats respectively. Compensation adjacent to the reserves will not necessarily have a significant benefit as this will not be detectable in terms of the wider functions of the reserve ecosystem and ecosystem services. It is proposed therefore that compensation is offset and targeted into maintaining wildlife corridors which are being threatened by fragmentation and severance in order to maintain the critical movement of wildlife towards and across the SGR, particularly for elephants.

YM will be required to restrict the construction area as much as possible using the following principles:

- maintain works within the project ROW which is 60 m (30 m either side of the mid-point of track alignment) and prevent encroachment onto neighbouring land
- the access roads will be a width of 5 m. The allowed construction buffer must not exceed 5 m to each side of the permanent road footprint
- the allowed construction buffer for the stations, bridges and culverts will not exceed a 30 m buffer from the point of construction.
- no additional buffers are anticipated for temporary locations including camps, laydown areas borrow pits and quarries (but re-siting to avoid Itigi Thicket and Natural Habitats shall be a top priority for Yapi Merkezi).

Habitat loss is permanent, and the impact duration is beyond the project lifetime. Habitat loss is certain to occur over the full project area. The overall magnitude of habitat loss is anticipated to be moderate, but in the absence of alternative sites to avoid itigi thicket



locations, then the overall impact will be locally very high when removing itigi critical/endangered ecoregion and high when removing Natural Habitats.

PS 6 requires that there shall be no net loss (NNL) of natural habitats and net gain for potentially critical habitat such as itigi thicket. This must remain a key target consideration in all aspects of the project including its alignment, selecting temporary laydown areas and camps and for choosing borrow pit sites. A habitat balance sheet pre and post construction will provide a means to compare losses and the planned mitigation measures to restore/compensate. This will be updated by Yapi Merkezi by means of an inventory of critical and natural habitat losses to reduce predicted losses where possible and provide an accurate area for the NNL and NG balance sheet.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Critical habitat (itigi thicket)	Very high	Medium	Major	Likely	Major
Natural habitats (miombo woodland)	High	Medium	Moderate	Likely	Major
Natural habitats (wetland, permanent, seasonal)	High	Medium	Moderate	Likely	Major
Semi-natural habitats (mixed woodland, bushland)	Medium	Minor	Minor	Likely	Moderate

Table 10-25: Habitat loss pre-mitigation

Mitigation measures are proposed as follows:

- minimise the distance between the project and the existing MGR wherever possible to avoid a wide area of degraded habitat between the two railway lines
- maintain specified buffers for construction to minimise the project area
- prepare a post construction habitat restoration plan based on requirements of the BAP and consult with experts on best techniques for restoring itigi thicket. This should consider research and field trials to monitor restoration options. Restoration should also aim to enhance degraded habitats with planting of endemic or range restricted trees and shrubs to achieve NNL and where necessary NG
- for protected areas close to the project, seek to bring new areas under IUCN management measures so that they have conservation objectives and can be monitored for improvement in the future
- natural establishment of new seasonal wetland habitats from borrow pits and quarries.

To avoid and minimize habitat loss of the Itigi Thicket and Natural Habitats due to any temporary structure and/or additional land that may be required beyond the timeframe of this ESIA, the Project shall develop a Register for these habitats as part of the BAP that shall:



- Record geo-referenced locations of additional land and temporary structures that includes information on area coverage overlayed on an aerial image with Itigi Forest cover already delineated.
 - a) Record meetings with the design team to screen potential locations of additional land and temporary structures in relation to avoiding further loss of natural habitat from temporary facilities. Update the habitat loss figures where Itigi thicket and natural habitats scheduled for clearance has been avoided due to an alternative site. Meeting minutes to record reasons/criteria why alternative locations are not viable.
 - b) Undertake a survey prior to clearance of Itigi thicket and Natural Habitats (where no alternatives are viable) to document and photograph the tree/shrub/flora community and observations of use by elephants, megafauna and other animals and avifauna.
 - c) Record of calculated area of Itigi Thicket and Natural Habitats impacted for each parcel of additional land and temporary structure with a supporting inventory record of type of flora species, number of trees with their Diameter at Breast Height measured around 1 – 2m above ground.
 - d) As critical habitat, Itigi Thicket will require offsets to achieve a Net Gain and Natural Habitats will require No Net loss.
- Engage a biodiversity specialist to develop a methodology of restoration versus offsetting on another land parcel.
 - a) Develop a monitoring form to check the effectiveness of the restoration and/or offsetting methodologies.

Receptor	Value/ Sensitivity	Magnitude	Significance	Likelihood	Risk
Critical habitat (itigi thicket)	Very high	Low	Moderate	Occasional	Moderate
Natural habitats (miombo woodland)	High	Low	Minor	Occasional	Minor
Natural habitats (wetland, permanent, seasonal)	High	Low	Minor	Occasional	Minor
Semi-natural habitats (mixed woodland, bushland)	Medium	Minor	Minor	Occasional	Minor

Table 10-26: Habitat loss significance of mitigated loss

Habitat fragmentation impacts on wildlife corridors

Habitat fragmentation will occur through the removal of woodland and other natural habitats upon which much of the wildlife including elephants, leopard and southern ground hornbill depend as refuges and foraging and to move around safely. Currently, there is ongoing clearance and fragmentation due to the expansion of settlements, agriculture and cutting of trees for charcoal. This will be increased by the project for both temporary and permanent construction works. The report of illegal settlements and increased cutting of trees for charcoal is well documented for the SGR in Kenya resulting in fragmentation of habitats, severance of corridors and disturbance preventing planned use of SGR crossings by elephants and other megafuana including lion and leopard. This



will likely occur along Lots 3 &4 unless there is swift enforcement action from the authorities to prevent illegal occupation of the sites close to the SGR and crossing structures.

Vegetation clearance and construction activities in itigi thickets and miombo woodland in areas such as Goweko FR, part of Nyahua Mbuga forest, Ipala, Igombe and other forested areas outside the protected reserves will have a major negative effect resulting from fragmentation. Singida west and Tabora part of the project are relatively still pristine with a lot of miombo woodlands and itigi thickets. Opening these areas for the project activities requiring clearance that will lead to habitat fragmentation. However the impact of the SGR ROW through Nationally Protected areas will be insignificant on ecosystem function as the proportion of each reserve affected is <0.6% (worst case) providing that suitable connectivity across the SGR corridor is maintained through bridges, underpasses and culverts.

The project will reassess justification for the location of temporary sites and access, in doing so, to avoid natural habitats where feasible and reduce the amount of tree clearance. This was undertaken as part of a design review undertaken by YM and 5 Capitals during July to August 2023. The replanting of trees and reuse of soils with the local seedbank should be undertaken in areas that require infill to restore fragmented habitats and forest areas, thereby to restore wildlife corridors. This should take place locally within 1 km to 10 km buffer to provide suitable safe areas for wildlife. This should then facilitate safer crossing points over and under the alignment by enhancing tree and thicket cover in areas leading towards a crossing point. This is important as the adjacent alignment will have elephant proof fencing and prevent general uncontrolled crossing over the line.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Natural habitats (itigi thickets)	Very high	Medium	Major	Likely	Major
Natural habitats (miombo woodland)	High	Medium	Moderate	Likely	Major
Natural habitats (wetland, permanent, seasonal)	High	Medium	Moderate	Likely	Major
Semi-natural habitats (mixed woodland, bushland)	Medium	Minor	Minor	Likely	Moderate
Elephant	Very High	Medium	Major	Likely	Major
Leopard	High	Minor	Moderate	Likely	Moderate
Lion	High	Minor	Moderate	Likely	Moderate

Table 10-27: Habitat Fragmentation pre-mitigation

Mitigation measures are proposed as follows:

 stop all removal of Itigi thicket and natural habitat for temporary sites and offset with planting, where feasible, to achieve NG/NNL respectively, based on expert advice. If re-establishment of Itigi Thicket is not achievable, contingency plans



must be developed, described in the BAP, to support the ecosystem functions for wildlife and the communities based on a biodiverse community, likely involving mixed tree and shrub regeneration protected from unsustainable exploitation over grazing.

- Monitor and document habitat losses and replanting to demonstrate NNL for natural habitats and NG for critical habitat.
- Undertake a Workshop with TAWA/TAWIRI (and/or other relevant organisations) and other specialists to agree on the suitability of wildlife crossing and fencing strategy and that the details including scope, programme and budget for implementation of the mitigation strategy are then to be included in the BAP.
- design options to assess all feasible methods for safe wildlife crossing, including bridges, culverts and underpasses must take account advice from TAWA and TAWIRI and similar designs in East Africa where they have been successful. These should be located in close proximity to optimal crossing points (maximum 3.5km from natural habitats on both sides of the SGR and passable during the wet and dry seasons, no further than 3.5 km from the known crossing points.
- Alert authorities regarding the establishment of illegal settlements before they grow in number, to avoid habitat loss, soil erosion and disturbance to wildlife crossing the SGR.
- prepare and implement a BAP and supplementary plans, including BMP, Compensation Offset Plan, Restoration Plan etc.
- Compensation for loss of Itigi Thicket, (worse case 353.17 ha,) Miombo Woodland, (950 ha) and seasonal wetlands (32 ha) should be preferentially in sites which will reduce fragmentation of wildlife corridors.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Critical habitat (itigi thicket)	Very high	Minor	Moderate	Occasional	Moderate
Natural habitats (miombo woodland)	High	Minor	Moderate	Occasional	Moderate
Natural habitats (wetland, permanent, seasonal)	High	Slight	Minor	Occasional	Minor
Semi-natural habitats (mixed woodland, bushland)	Medium	Slight	Minor	Occasional	Minor
Elephant	Very High	Minor	Moderate	Occasional	Moderate
Leopard	High	Slight	Moderate	Occasional	Minor
Lion	High	Slight	Moderate	Occasional	Minor

Table 10-28 Habitat fragmentation post mitigation

Biodiversity loss: direct mortality and reduced survivorship

Clearing, excavation and earthworks



Clearing of existing vegetation will result in direct loss and mortality of small mammals, reptiles and potentially nesting birds that may be directly crushed during earthworks or may suffer stress-induced mortality. Impacts will arise from large scale machinery, vehicles and equipment to level and grade the site and to receive fill material to raise the site ahead of construction.

The baseline surveys have indicated however that the impacted fauna are all IUCN LC and therefore would have a moderate to minor impact on the species populations that are widespread and not range restricted. However, to prevent mortality and injury as much as possible, the EPC should take a number of measures that will manage this impact by site-specific planning and management of the works. **Error! Reference source not found.** identifies the risk pre-mitigation and potential mitigation measures are presented below with post mitigation risks in **Error! Reference source not found.**

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Threatened or range restricted trees/flora VU/EN	High	Medium	Moderate	Likely	Major
Elephant, leopard, lion EN/VU/VU	Very high	High	Major	Unlikely	Moderate
Threatened birds (bateleur, hooded vulture) VU/CR	Very high	Minor	Moderate	Unlikely	Minor
Non-threatened flora (LC)	Low	Minor	Minor	Likely	Moderate
Non-threatened Mammals (LC)	Low	Medium	Minor	Occasional	Minor
Non-threatened Herptiles (LC)	Low	Medium	Minor	Occasional	Minor
Non-threatened Fish (LC)	Medium	Medium	Minor	Occasional	Minor
Non-threatened Invertebrates (LC)	Low	Medium	Minor	Occasional	Minor

Table 10-29: Loss of biodiversity pre-mitigation

Mitigation measures that aim to minimise mortality and injury include the following:

- check the area to be cleared for any large animals to disperse into the surrounding area
- undertake site clearance from one location to allow smaller mammals and reptiles an escape route into similar habitat that is outside the site boundary
- working from one side towards the neighbouring habitat also ensures that all fauna such as duiker and other small antelope also have the opportunity to escape into an adjacent refuge
- scrub and other cleared plants should be left piled up overnight for remaining animals to escape during darkness
- develop a pre-clearance and pre-construction chance find procedure as part of the CESMP to provide a procedure for safe handling and removal of any remaining animals on site



- develop a roadkill management and monitoring plan (RKMMP) as part of the CESMP
- during site clearance there should be an ecologist on site to advise on safe removal of any burrowing fauna that remain or any animals that become trapped
- a Restoration Action Plan (in line with the BAP) will provide the restoration measures that will be undertaken for natural habitats, post-construction via seeding, re-planting, and landscaping with native, high-value species, monitoring and reporting requirements of the plan
- locations of elephant crossings will be logged into a database and reported monthly
- periodic monitoring of proposed crossing points and collection zones by use of remote cameras to gather information on use of crossings and to enable safe of crossing animals. This will be conducted in association with the authorities
- all EPC site staff and subcontractors will receive detailed training on the dangers of large mammals (including elephants) and hazardous animals such as snakes, bees, and scorpions
- specific mitigation measures for elephants and other large mammals will be detailed in the BAP.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Threatened or range restricted trees/flora VU/EN	High	Slight	Minor	Likely	Minor
Elephant, leopard, lion EN/VU/VU	Very high	Minor	Moderate	Unlikely	Minor
Birds (bateleur, hooded vulture) VU/CR	Very high	Slight	Minor	Unlikely	Minor
Non-threatened flora (LC)	Low	Slight	Negligible	Likely	Minor
Non-threatened mammals (LC)	Low	Minor	Minor	Occasional	Minor
Non-threatened herptiles (LC)	Low	Minor	Minor	Occasional	Minor
Non-threatened fish (LC)	Medium	Minor	Minor	Occasional	Minor
Non-threatened invertebrates (LC)	Low	Minor	Minor	Occasional	Minor

Table 10-30: Loss of biodiversity post mitigation

Vehicular collision

Small to medium sized wildlife such as to hare, hedgehog and rodents, tortoise, lizards, snakes and amphibians have a higher chance of mortality from vehicular and machinery collisions. This could also apply to raptors, which may scavenge from roadkill and low flying ground birds such as the southern ground hornbill.

During the construction phase the vehicle movements may have a significant effect on wildlife especially in areas that have indicated more active movements than others in



Manyoni, Itigi thickets and Aghondi Beekeeping Reserves. The areas are known to contain large groups of elephants and other large to medium sized mammals. As such, there will be potential for wildlife collisions in these areas, some of which may result in road kills, e.g. ground dwelling or low-flying bird species may collide with vehicles and machinery, particularly at dusk or dawn when birds are generally more active. Access roads to the site will also be a higher risk of collision for both small and large animals too.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Minor	Moderate	Remote	Minor
Birds (bateleur, hooded vulture) VU/CR	Very high	Minor	Moderate	Remote	Minor
Non-threatened mammals (LC)	Low	High	Moderate	Occasional	Moderate
Non-threatened herptiles (LC)	Low	High	Moderate	Occasional	Moderate

Table 10-31: Significance of vehicular collision pre-mitigation

The following mitigation measures will be implemented to reduce the risks from these impacts:

- strict speed controls which will be enforced by EPC HSE and Security teams, especially during the most active periods
- no driving permitted at night on access roads and on the project site under normal conditions
- keep a record of road kills and use toolbox talk training to raise awareness.
- ban against driving outside of delineated access roads and restricting driving and machinery operation to daylight hours
- the CESMP will include protocol for removal of any road-kill carcasses immediately upon observation to at least 10 m away from the access roads during the construction phase by the EPC Contractor
- with the above measures, the residual significance is presented in **Error!** Reference source not found.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Slight	Minor	Remote	Negligible
Threatened birds (bateleur, hooded vulture) VU/CR	Very high	Slight	Minor	Remote	Negligible
Non-threatened mammals (LC)	Low	Minor	Minor	Unlikely	Minor
Non-threatened herptiles (LC)	Low	Minor	Minor	Unlikely	Minor

Table 10-32: Vehicular collision post mitigation



Lighting

Lighting can impact nocturnal wildlife behaviour. It can act as an attractant, which can cause congregation and higher predation rates / change movement and migration behaviour; act as a repellent which causes displacement; or interfere with the circadian cycle and cause lower survivorship and reproductive success. However, lighting will be required only at specific work areas and not across the wider area or along access roads, thereby limiting lighting to relatively small areas, where night work is required. The premitigation significance and environmental risk are shown in **Error! Reference source not found.**

Table 10-33: Significance of littering pre-mitigation

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Minor	Moderate	Occasional	Moderate
Threatened birds (bateleur, hooded vulture) VU/CR	Very high	Slight	Minor	Occasional	Minor
Non-threatened mammals (LC)	Low	Medium	Minor	Occasional	Minor
Non-threatened herptiles (LC)	Low	Medium	Minor	Occasional	Minor

The following mitigation measures will be implemented to reduce the risk of these potential impacts:

- preparation and implementation of a waste management plan
- strict waste management supervision and controls under the HSE team
- zero tolerance for littering on site
- daily inspections and clean-up of litter by EPC/sub-contractor(s) responsible.

Table 10-34: Significance of littering post-mitigation

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Slight	Minor	Unlikely	Minor
Birds (bateleur, hooded vulture) VU/CR	Very high	Slight	Minor	Unlikely	Minor
Non-threatened mammals (LC)	Low	Slight	Negligible	Unlikely	Negligible
Non-threatened herptiles (LC)	Low	Slight	Negligible	Unlikely	Negligible

Biosecurity risks

Introduction of invasive species

The risk of invasive plant species spreading along the project alignment and on the temporary sites such as the camps and laydown areas is significant as many invasive



plant species have been recorded in both dry and wet seasons. This problem however has been encountered in Lots 1 and 2 and so measures to manage and contain this issue are in place and can be transferred to Lots 3 and 4.

Soil imports, intentional or via previously used excavation and earthworks equipment, may contain pathogens that can spread and infect native vegetation and fauna that do not have natural defence mechanisms.

Exotic seeds in soil imports can allow the spread of invasive, weedy species which outcompete native species. Secondary impacts may occur on wildlife which utilize the reduced native vegetation for foraging or shelter.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Critical habitat (itigi thicket)	Very high	Medium	Major	Unlikely	Moderate
Natural habitats (miombo woodland)	High	Medium	Moderate	Unlikely	Minor
Natural habitats (wetland, permanent, seasonal)	High	Minor	Moderate	Unlikely	Minor
Semi-natural habitats (mixed woodland, bushland)	Medium	Minor	Minor	Unlikely	Minor

Table 10-35: Significance of invasive plant species pre-mitigation

However, the following mitigation measures will be implemented to minimise the magnitude of these potential impacts:

- soil imports will be taken from local quarry or borrow pit as close to the site as reasonably practical to avoid risk of foreign seeds and invasive species
- soil imports from outside of the area will undergo checks to prevent accidental introduction of exotic species / pathogens
- plant and machinery will require an HSE certificate of inspection, issued by the EPC, before coming onto site and this will include necessary cleaning / washing to reduce risks of importing invasive species in mud taken from urban sites
- prior to project approval a site-specific invasive alien plants/weed survey should occur, and a weed risk assessment should be completed. The surveys should consider including invasive terrestrial/aquatic animals as well (birds, herptiles & mammals)
- develop invasive alien plant species (IAPS) monitoring, management and control plan as part of the CESMP. The purpose of this weed management and control plan should be to prevent and control the spread of noxious weeds and invasive plants during and following construction.



Table 10-36: Significance of invasive plant species post-mitigation

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Critical habitat (itigi thicket)	Very high	High	Moderate	Unlikely	Minor
Natural habitats (miombo woodland)	High	Medium	Moderate	Unlikely	Minor
Natural habitats (wetland, permanent, seasonal)	High	Slight	Minor	Unlikely	Minor
Semi-natural habitats (mixed woodland, bushland)	Medium	Minor	Minor	Unlikely	Minor

10.11.3.2 Operation phase

Habitat loss and fragmentation

No further land take is deemed to be required during the operational phase of the project. Therefore, the impacts of habitat loss and fragmentation as assessed during the construction phase are considered to be relevant for both the construction and operation phases of the project.

Biodiversity displacement / disturbance

Dispersal

Species may be displaced away from the project area because of operational disturbance, having indirect secondary impacts on adjacent territories via increased competition for resources compromising population stability and causing ecosystem imbalances.

Receptor	Value/ sensitivity	Magnitud e	Significance	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Medium	Major	Likely	Major
Non-threatened mammals (LC)	Low	Medium	Minor	Likely	Moderate
Non-threatened herptiles (LC)	Low	Medium	Minor	Likely	Moderate
Non-threatened invertebrates (LC)	Low	Medium	Minor	Likely	Moderate

Table 10-37: Significance of displacement

Measures will be taken to maintain wildlife corridors throughout the operation of the project which will require the following:



- elephant-proof fencing of the alignment for all known elephant crossing locations identified by project surveys including the UDSM surveys and locations identified by TAWA, TAWIRI and local government
- elephant crossings will be logged into a database and reported to the authorities and TRC operations
- areas fenced will require additional tree planting to provide adjacent corridors for elephants and other wildlife to navigate safely to the crossing point
- underpasses/crossing points will be located no more than 5 km from areas of known crossing
- periodic monitoring of crossing points and collection zones by use of remote cameras to gather information on use of crossings and to maintain the safety of crossing animals. This will be conducted in association with the authorities
- patrols and monitoring for snares that may be laid for any of the medium to large wildlife will be conducted
- cameras will be installed at the termination point of the fence line.

Noise and vibration

Operational noise can cause acoustic masking, disturbance and displacement and general reduction in survivorship and reproductive success in a variety of fauna. Most impacted are typically acoustic communicators such as bird and bat species. Vibration can cause elevated stress response in reptiles and could potentially cause collapse of burrows.

Receptor	Value/ sensitivity	Magnitude	Significance	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Minor	Moderate	Unlikely	Minor
Birds (bateleur, hooded vulture) VU/CR	Very high	Minor	Moderate	Unlikely	Minor
Non-threatened mammals (LC)	Low	Minor	Minor	Unlikely	Minor
Non-threatened herptiles (LC)	Low	Minor	Negligible	Remote	Negligible

Table 10-38: Significance of operational noise

Lighting

Night-time lighting can impact nocturnal wildlife behaviour. It can act as an attractant, which can cause congregation and higher predation rates / change movement and migration behaviour; act as a repellent which causes displacement; or interfere with the circadian cycle and cause lower survivorship and reproductive success. However, it is understood that only portions of the line will be lit, and that lighting will be directed towards the tracks rather than into the surrounding environment. The pre-mitigation and environmental risk are shown in Table 10-39.



Table 10-39: Operational lighting ecological impact pre-mitigation

Receptor	Value/ sensitivity	Magnitude	Significan ce	Likelihood	Risk
Elephant, leopard, lion EN/VU/VU	Very high	Slight	Minor	Unlikely	Minor
Threatened birds (bateleur, hooded vulture) VU/CR	Very high	Slight	Minor	Unlikely	Minor
Non-threatened mammals (LC)	Low	Slight	Negligible	Occasional	Minor
Non-threatened herptiles (LC)	Low	Slight	Negligible	Occasional	Minor
Non-threatened invertebrates (LC)	Low	Slight	Negligible	Occasional	Minor

The following mitigation measures will be in place, to minimise the magnitude of potential impact:

- maintain lighting that is fit for purpose and minimized as much as possible
- lights will be shielded to prevent skyglow, spill and glare.

Following implementation of the above mitigation measures the magnitude of impact is still considered to be 'slight' and therefore the above impact assessment is relevant for the post-mitigation scenario.

10.11.3.3 Decommissioning phase

The decommissioning of the project is extremely unlikely in the foreseeable future, since this project is a key pillar of the Tanzanian government's social and economic strategy for the country by providing a modern transport link that will allow rapid movement of people and freight between towns and cities, linking the coast to the inland areas when all five SGR Lots have been completed. The removal of some or all of the SGR in the future would most likely be associated with upgrading of the major transport corridor, as its complete removal would likely result in a major impact on its users that have become reliant upon this transport link. This would perhaps be similar to the current upgrading of the MGR, built in the early twentieth century, to be replaced by SGR for its ongoing effective and efficient use.

Decommissioning will require that the process is undertaken in accordance with all applicable environmental & social laws, regulations and standards that are applicable at the time, including national and international requirements. These cannot be predicted at this time other than to expect that all materials associated with the SGR, including buildings would likely require 100% re-use or recycling in line with the circular economy, such that that all wastes are treated as new resources. In the course of many decades, it is likely that the infrastructure including underpasses, culverts and track-side buildings may have become suitable for species to roost or nest. In addition, a new linear wildlife corridor that will likely develop over time as retained habitats such as itigi thicket and miombo woodland have received high level protection or have been restored, will be rich ecosystems for many species of flora and fauna. Their removal might be prevented by new laws, particularly if the ecosystem and related services have protected status or lie within expanded forest and wildlife reserves.

Decommissioning will require detailed social and environmental surveys to assess the new baseline which has developed over the extended timescale of operations, and this



would likely take several years depending on the wildlife using the crossing points that will have become habituated to these wildlife corridors. The overall decommissioning plan might need to be preceded by a strategic environmental assessment of national transport infrastructure, since its decommissioning would then increase pressure on other routes within the country and require a full assessment of the government's policies, plans and programmes,

The planning horizon for a decommissioning phase can therefore be expected to take a minimum of 3 to 5 years based on current strategic environmental assessment and ESIA requirements. The process at that time might require for the retention of some infrastructure or indeed the abandonment of the route which may have become a linear corridor for wildlife as well as a successful mechanism for allowing the connection of wildlife corridors of the future. Any consideration of decommissioning the infrastructure would need very detailed assessment of the predicted impacts linked to mitigation, management, monitoring and compensation measures.



11 SOCIAL BASELINE AND IMPACT ASSESSMENT

11.1 National socioeconomic context

The following sub-sections outline the socioeconomic landscape of Tanzania, including the country's administrative jurisdictions, demographic make-up, economic status, land access mechanisms and cross-cutting social development issues.

11.1.1 Geographical context

The United Republic of Tanzania comprises mainland Tanzania and Zanzibar, representing the largest country within the East African region. Located between latitude 1° and 12° south and longitude 29° and 41° east, the country is bordered by Kenya and Uganda to the north; Rwanda, Burundi and Democratic Republic of Congo to the west; Zambia and Malawi to the southwest; Mozambique to the south; and the Indian Ocean to the east. The Zanzibar archipelago consists of the main islands of Unguja and Pemba.

Tanzania has a total land area of about 94,508,700 ha, of which nearly 89 million ha is dry. Mainland Tanzania harbours some of Africa's main transboundary water resources, including the Indian Ocean along the country's eastern border, Lake Victoria along the northern border, Lake Tanganyika along the western border, and Lake Nyasa, which is located on the country's southwestern end. Mainland Tanzania also has the highest point in Africa – the snow caped Mount Kilimanjaro, which stands at 5,950 metres high.

About 44 million hectares (ha) of the total land area are classified as arable land, of which 24% are currently exploited for crop farming. An estimated 8.6 million ha of the country's arable land is utilized for smallholder agriculture, whereas medium and large-scale farming accounts for the remnant 1.5 million ha (URT 2014).

11.1.2 Administrative boundaries

The hierarchy of administrative boundaries for local governance in Tanzania extends from grass- villages and mtaa (streets), in rural and urban areas respectively. These units comprise higher-level wards that constitute wider divisions. The rural administrative framework culminates at the district level, whereas the urban framework advances to the municipality, township and city levels, beyond the division level. These councils are altogether subordinate to regional councils. Figure 11-1 below provides a non-exhaustive overview of the country's general administrative framework.



Figure 11-1: Administrative framework

The overarching President's Office Local Government and Regional Administration (PO-RALG) is responsible for the administration of all geographical jurisdictions, down to the village and mtaa level. The administrative framework, in its entirety, consists of three domains: central government, local government and parties. The central government of Tanzania is constituted by the ultimate authority, PO-RALG, and by the regional commissioner's offices, district commissioner's offices and district secretariats (in the order of decreasing jurisdiction). Nonetheless, some administrative powers are devolved to the country's local government, which consists of (i) district, municipal, town and city councils and their respective executive officers and executive officers, and (iii) village and mtaa councils and their respective executive officers.

Regarding the coordination of local development, the municipal/district executive directors are charged with the developmental agenda of their respective councils. The preparation and implementation of development plans must involve these officials not only for management purposes but also, for harmonization with other district/municipal plans. Thus, the Municipal/DCs, with their relevant officers, have the mandate to manage



and supervise developmental activities under various ministerial sectors. Administratively, the country is divided into 31 regions and 184 districts.

The project will cut across two regions falling within the country's central zone, namely Singida and Tabora. Within Singida, the project-affected districts are Manyoni and Itigi, whereas, in the Tabora region, the project will span the districts of Uyui, Sikonge and Nzega, as well as Tabora Municipal.

On the ministerial level, the focal ministry spearheading the project's implementation is the Ministry of Works, Transport and Communication, through the national railways operator, TRC. Both TRC and YM are expected to be engaging with respective local government authorities on all matters related to the project and, keep the central government structures in respective regions, districts and wards informed and engaged about the project.

11.1.3 Demographic trends

According to the 2012 national housing and population census report, the population of Tanzania increased from 23.1 million in 1988 to 43.6 million in 2012, with an average growth rate of 2.7% per annum. The proportion of the population aged below 15 years was about 44% while those aged 65 years and above were 4%, indicating that Tanzania has a younger population. The active labour force which constitutes a population aged between 15 and 64 is equivalent to about 53%.

An important feature of the population profile is its spatial distribution over the national territory. Overall, Tanzania is sparsely populated, with a mean population density of 51 persons per square kilometre. The majority (70%) of the population still lives in rural areas. The 2012 census report further indicates that the country's urban demographic had been expanding at a rapid rate of more than 5% per annum, over the three decades leading up to the census. This rapid growth has been caused mainly by rural-urban migration. The national population was also found to be concentrated in areas with relatively high agricultural potential, including the country's northern and southern highlands.

The most recent national housing and population census was carried out in 2022, however only a high-level summary report of the census findings has been published. According to the summary report, the country's population has risen to 61,741,120 residents since 2012, at an annual pace of 3.2%. Of the total enumerated residents, 30,053,130 are male and 31,687,990 are female. The population reported for the Singida and Tabora Regions was 2,008,058 and 3,391,679 respectively, with Tabora being the second most populous region nationwide, following Dar es Salaam.





Figure 11-2: Makutopora – Tabora (Lot 3) alignment and planned train stations

Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA report 2040173-01 (03)



Figure 11-3: Makutopora – Tabora (Lot 3) alignment and planned train stations

Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA report 2040173-01 (03)



11.1.4 Economy

Tanzania has recorded notable economic growth over the past decade, and recently attained lower middle-income economy status, as envisaged in the Tanzania Development Vision 2025 (URT, 2000). According to the National Account Statistics, real GDP growth maintained a rate of around 6.5% over the period 2008–2019.

According to the Bank of Tanzania Annual Report 2020/21, Tanzania continued to record positive economic growth, despite the challenges posed by the COVID 19 pandemic. In Tanzania mainland, real gross domestic product (GDP) growth was 4.8% in 2020 compared with 7% in 2019, avoiding a recession. The slow growth reflected the impact of the pandemic on economic activities, particularly those directly exposed to external shocks. In August 2021, the Bank of Tanzania (BoT) released its economic bulletin of June 2021 revealing that in the quarter ending March 2021, the economy of Tanzania grew by 4.9% compared with 5.9% in the corresponding quarter in 2020. Mining and quarrying recorded the highest growth of 10.2% attributed to an increase in the production of gold, coal, and gypsum.

The growth was driven by construction, agriculture, transport and storage, and mining and quarrying. The fastest growing sectors were construction, transport and storage, and information and communication. Agriculture sustained the largest share of GDP, at 26.9%, followed by construction (14.4%), wholesale and retail trade (8.7%) and manufacturing (8.4%). According to the latest summary report on the national GDP status, the national GDP rose to TZS. 42.9 trillion, by September 2022. This services industry was the largest GDP contributor at this time, with a GDP share of 41.2%. In the same year, agriculture accounted for 3.4% of the GDP.

According to the international labour force survey in Tanzania (2014), unemployment rates differ substantially by location. The rural areas have the lowest unemployment rate of 7.5% followed by other urban areas (excluding Dar es Salaam) at 16.5% and are highest in Dar es Salaam at 31.5%. The integrated labour force survey 2014 shows that unemployment rates are highest for persons below 35 years of age in all areas. The total number of employed youth (aged 15-34) according to the national definition is 11,007,809 while the unemployed youth are 1,463,182 about 10.0% of the total youth workforce (ILFS 2014). This high rate calls for the development of well targeted policies and programmes that address youth unemployment.

11.1.5 Agriculture and the rural economy

The agricultural sector has played an important role in the economic growth of Tanzania since its independence and accounts for approximately 65% of local livelihoods. The sector contributes about 28% of the country's GDP and about 24% of the total exports, and ensures food security in the country (FYDP3, 2021).

Tanzania has a total of about 7.1 million ha of high and medium potential land (2.3 and 4.8 million ha respectively) suitable for irrigation, supported by rivers, lakes, wetlands and aquifers. Of the 2.3 million ha classified as high potential, only 461,326 ha had improved irrigation infrastructure in 2015, accounting for only 1.6% of the total land with irrigation potential (MAFC, 2015). An estimated 55% of the land could be used for agriculture, and more than 51% for pasture. However, only about 6% of the agricultural land is cultivated, and the practice of shifting cultivation causes deforestation and land degradation on pastoral land.

It should be noted that the poverty rate of the rural area amounts to 31.3% while that of the urban area is 16%. In this sense, agriculture development plays an integral part not only in economic growth but also in poverty reduction in this country. However, the growth



rate of agriculture for the past several years (4-5%/year) has failed to achieve the national target (6-10%/year) and poverty reduction is also lagging behind (WB, 2019).

11.1.6 Access to finance

Tanzania has recorded significant growth in the level of financial inclusion, over the last decade. Financial services distribution in Tanzania the level of financial exclusion has almost been halved in 2017 since 2009. The level of usage of informal financial services narrowed from 29% to 7%, while the percentage of the adult population using formal financial services quadrupled in the same period. These achievements are a result of the rapid adoption and usage of electronic platforms offering financial services, mostly mobile money services, a flexible regulatory environment and massive investments by the private sector into distribution ecosystems and promotion. Despite these strides, the level of financial exclusion is still high, at 28% with the majority of those excluded being rural residents, smallholder farmers, youth and women. A big gap in the demand and supply of financial services in the market has also emerged, whereby the majority of the products offered by Financial Service Providers (FSPs) do not meet users' needs.

According to national financial framework, 2018 – 2022, only 60% of Tanzania women have access to financial services, 9% have access to informal financial services, and 30% remain without any access to financial services. Despite all efforts and initiatives to advance financial Inclusion in the country, women are still lagging in comparison with men. According to a study by FinScope Tanzania (2017), 30% of women are still excluded, relative to 26% of men. On the other hand, 70% of men have access to financial services, thus leaving a gender gap of 10 percentage points in terms of access to and use of financial services. This framework places emphasis on gender inclusion, aiming to narrow the gap by at least 90%, by the end of the implementation period. Some of the main reasons for the limited financial inclusion of women include:

- high level of financial illiteracy
- inappropriate services that do not meet women's needs
- lack of collateral registry for movable collaterals
- poor infrastructure to reach many women especially those in rural areas
- high cost of financial services due to inefficiencies in delivery channels
- stringent or lack of proportionate requirements for client on-boarding
- high lending rates in the financial sector
- predominance of cash-based economy and informal sector across the country
- absence of specific law for microfinance sub sector.

11.1.7 Socioeconomic vulnerabilities

Vulnerability can be defined as one or more conditions determined by political, physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of various hazards. Vulnerability is dependent on the level of resilience of individuals to cope with socio-economic or biophysical change, or shocks. Resilience is based on having access to the necessary resources (e.g. financial credits, assets such as crops, shelter, etc.) and physical/mental capacity (e.g. strength to relocate, skills to rebuild a business, etc.) to cope and adapt to change in the community. A study by Aikael et al, (2021) has shown a substantial regional variation in vulnerability. Most regions show vulnerable levels of around 30% with northern regions showing higher levels. However, regions with different poverty rates (e.g. Njombe at 15% and Geita at almost 40%) can have similar vulnerability levels. Dodoma and Shinyanga (project affected regions) exhibit the highest levels of



vulnerability (above 36%), while regions on the southern border, Mbeya and Dar es Salaam enjoy the lowest values of vulnerability.

According to a country participatory assessment (PPA) developed by the government (URT, 2001), extremely vulnerable groups in Tanzania, are likely to be members amongst children, people with disabilities, individuals carrying out high-risk jobs, elderly people, youths and women. These groups are most vulnerable to impoverishing forces, such as economic, environmental, social, cultural, health, life cycle, and governance (such as restrictive policies and regulations, poor governance and limited access to productive assets such as fertile land, or business space, etc.). Table 11-1 provides further details regarding vulnerability of these groups.

Vulnerable groups	Description of vulnerability		
Children	Usually below the age of 15 who are exposed to unique set of threats to their wellbeing. Children under five are mostly vulnerable to diseases, malnutrition, and inadequate care. Some of those aged 5 to 15 are vulnerable because they are homeless, are neglected and marginalized, and fend for themselves through begging, garbage rummage, and stealing. Working children, orphaned or not, mostly not attending school as well are subject to exploitation; often engage in risky and low pay jobs for their survival. Those working at home are not paid. Orphaned children often work and most of them fail to attend school, which increases their short and long term-vulnerability		
Persons with disabilities	Persons who are physically handicapped or mentally incapacitated. Disabled persons are usually unable to work for earnings, and depend on the work of others		
Youth	Unemployed youth, youth with unreliable income and son female youth who lack ownership and control of resources the they could use to generate income		
Elderly persons	Persons who are 65 years old and above. Vulnerability among the elderly is associated with a set of physical and social changes Some of these changes are inevitably a result of age, but others are a result of cultural attitudes, values, which influence the way a given community take care of the elderly people		
People living with long illness, for instance HIV/AIDS	Persons who suffer prolonged loss of physical well-being. This is caused by a number of communicable and non-communicable diseases, congenital diseases and defects, malnutrition, accidents and injuries, functional mental disorders, and chronic alcoholism and drug use. In addition to the burden of physical inability, such ill people often face stigmatism that result in subsequent decline in social capital.		
Women 1. Widows 2. Other women who are notable to support themselves	Vulnerable women often include marginalized widows and other women unable to support themselves due to a variety of economic and social processes		
Drug addicts and alcoholics	Adults engaged in excessive and regular alcohol consumption and young people at risk of drug abuse. Vulnerable young people often		

Table 11-1: Summary and description of extremely vulnerable groups



Vulnerable groups	Description of vulnerability
	live or work on the streets, in towns, do not attend school, earn a living from begging or sex work. Most alcoholics are adult males who may increase the vulnerability of women (through creating economic hardship for the family; and/or through increased domestic violence) as a result of their habit.

Source: The URT, The 2002/3 Participatory Poverty Assessment. Main Report. March 2003

Regarding the country's development status by UNDP measures, the human development index (HDI) is an average metric of basic human development progress on the three basic dimensions, namely (i) a long and healthy life, (ii) access to knowledge and (iii) a decent standard of living. Tanzania's scored value of 0.528 places the country in the low human development category—positioning it at 159 out of 189 countries and territories. Discounting the national HDI value for inequality, yields an adjusted value of 0.397, which represents a loss of 24.9% due to inequality in the distribution of the HDI dimension indices.

The multi-dimensional poverty index (MPI), another composite poverty metric introduced by UNDP, evaluates overlapping deprivations suffered by a country's population on three dimensions, namely health, education and standard of living. The totality of deprivation scores categorizes a national population into three categories; (i) percentage that is multidimensionally poor, (ii) percentage that is vulnerable to multi-dimensional poverty, and (iii) percentage that lives in severe multidimensional poverty. According to the latest available data, 55.4% of the country's population are multidimensionally poor while an additional 24.2% are classified as vulnerable to multi-dimensional poverty. Notably, 49.1% of the population live below the income poverty line (USD 1.9 per person per day). The breadth of deprivation (intensity) in Tanzania, which refers to the average deprivation score experienced by people in multidimensional poverty, is 49.3%. The MPI, which is the share of the population that is multidimensionally poor, adjusted by the intensity of the deprivations, is 0.273 (UNDP, 2017).

According to the national household budget survey report for the period 2017-2018, the proportion of dependents in Tabora and Singida was reported to be equivalent, at 0.53, with over a half of the resident population being economically inactive (i.e. minors below age of 15 and the elderly aged 64 years and above). The percentage of female households in Tabora and Singida was reported to be 25% and 33% respectively. It was further reported that the fraction of surveyed households who reported frequent food shortages was 20% for Tabora and 22% for Singida. The total household consumption per capita was reported to be TZS 423,218 for Tabora and TZS 354,533 for Singida. The survey also established that the incidence of extreme poverty in Tabora and Singida was 9.3 and 11.1 % respectively, whereas as the gini coefficient of income inequality was 0.4 for Tabora and 0.3 for Singida.

11.1.8 Gender context

Gender equality is a matter of fundamental human rights, as women are entitled to live with dignity and with equal civil liberties. As promulgated by the UN sustainable development agenda 2030, gender equality is also key to sustainable development and poverty alleviation. Women contribute to national economic growth, not only through direct engagement in income generation, but also through domestic labour that provides for the wellbeing of households and entire communities. In furtherance of international legal instruments on gender equity, notably the convention on the elimination of all forms of discrimination against women, the Government of Tanzania has instituted ministerial action towards gender mainstreaming, through the national gender and women's development policy and national strategy for gender development. Despite these



commitments, the elimination of gender inequalities and injustices has not been realized across the various social development spheres, nationally.

According to the global gender gap report issued by the world economic forum, Tanzania ranked 82nd out of 156 countries in terms of gender inequality in the year 2020. This ranking was based on evaluation criteria such as economic participation and opportunity, educational attainment, health and survival and political empowerment. Another UNDP led assessment of gender inequality placed Tanzania at 130 out of 155 countries with a rating of 0.5372, citing an appreciable improvement from a rating of 0.6523 in 1995. According to the study, some of the root causes accounting for Tanzania's gender disparities were the traditional and systemic power imbalances between women and men, women's lower economic participation and earnings, gender gaps between married men and women and gender stereotyping.

11.1.8.1 Educational attainment

According to the social institutions and gender index (SIGI) survey report published in 2021, the educational attainment of women and girls was found to be significantly lower than that of boys and men, as shown in Table 11-2. For perspective, the number of respondents who reported a complete lack of formal education was more than twofold greater for girls and women.

Education level	Attainment for male respondents (%)	Attainment for female respondents (%)
No formal education	9.4	20.4
Primary education (incomplete)	13.8	10.9
Primary education (complete)	57.9	56.5
Secondary education	16.8	11.1
Higher education	2.0	1.0

Table 11-2: Comparison of educational attainment reported by male and female respondents

Further, an earlier WB study shed some light on the gender gaps within the country's educational sector, highlighting that the main contributing factors for low educational attainment amongst girls and women include gender stereotyping, lacking sanitation facilities for menstrual hygiene, early child marriage, teenage pregnancy and the practice of expelling expectant girls from school on a permanent basis.

11.1.8.2 Employment and economic empowerment

As regards employment, the formal sector employment and earnings survey of 2017 (URT, 2017) indicated that the employment of men within formal and informal labour exceeds that of women by 26 percent and 30 percent respectively, as detailed in Table 11-3.

Table 11-3: Difference in the employment rate of men and women within formal and informal labour

Labour breakdown by age categories	Male representation (%)	Female representation (%)
	Formal employment	
Adults (36 years and older)	36.0	19.1


Labour breakdown by age categories	Male representation (%)	Female representation (%)		
Youth	26.9	17.9		
Total	62.9	37.0		
	Informal employment			
Adults (36 years and older)	30.4	18.5 16.4		
Youth	34.8			
Total	65.2	34.9		

According to the survey report, women engaged in formal labour were predominantly employed in public administration and social services (47%), manufacturing (15%) and accommodation and food catering services (11%). As for informal labour, women were chiefly employed in agriculture (41%) and manufacturing (25%).

The survey results also indicate that the majority of male and female workers alike earn between TZS 500,000 and TZS 900,000, with male workers out-earning female workers by an average three percent in the private sector and 18 percent in the public sector, respectively. An overview of female and male representation across different income brackets is provided in Table 11-4.

Monthly wage rate (TZS)	onthly wage rate Male representation I TZS) (%)		Total (%)	
Up to 100,000	6.5	8.6	7.3	
100,000 - 150,000	13.8	13.1	13.5	
150,000 - 300,000	20.8	18.1	19.8	
300,000 - 500,000	19.6	19.3	19.5	
500,000 - 900,000	20.8	22.1	21.3	
900,000 - 1,200,000	8.5	9.4	8.8	
1,200,000 - 1,500,000	4.5	5	4.7	
Above 1,500,000	5.6	4.4	5.1	

Table 11-4: Distribution of earnings by gender and income brackets

11.1.8.3 Access to land

Women's right to own and inherit land is one of the central issues related to women's economic empowerment. In rural areas, many women's livelihoods depend almost entirely on their land. While women have the same rights as men, under Tanzanians law, to own and control land, women rarely acquire land assets (UNA Tanzania, 2017). Customary practices in Tanzania often require women to access land through their fathers, brothers, husbands, or other men). Only 24% of Tanzanian women report that they own land alone or jointly with someone, while a mere 9% of women have sole ownership of land and residences (Tanzania National Bureau of Statistics, 2016). Only about 15% of Tanzania's privately owned land is under sole female ownership, while 47% is owned by men, and 38% is under joint male-female ownership (World Bank, 2013).



11.1.8.4 Access to healthcare

With regards to reproductive health, a recent study revealed that the maternal mortality rate in Tanzania, as of 2017, was 524 maternal deaths for every 100,000, and an alarming mortality rate of 1 in every 33 women was estimated for women during pregnancy, at childbirth, or during the two months after giving birth live births. Pregnancy and childbirth therefore represent the third leading cause of sickness-related mortalities amongst women, following malaria and HIV/AIDS. The top reported hurdles to healthcare access for women include limited financial capacity for treatment (50%), distance to the nearest healthcare facility (42%), lack of assistance in attending healthcare facilities as well as resource shortages and the lack of privacy within the facilities. According to the HIV Impact Survey report for 2016-2017, 4.9% of people aged 15 years, or more are infected with HIV, with prevalence amongst women (6.3%) being almost threefold higher than that of men (3.4%). The survey also suggested that of the female household heads across Tanzania, about 12% suffer from HIV/AIDS.

In addition, women have been shown to have less access to credit from formal financial institutions and social networks, with the exception of savings and credit cooperatives, which benefit women more.





11.1.8.5 Access to financial services

With regards to financial inclusion, women in Tanzania have a substantially lesser access to formal financing as compared with men, as they hold fewer formal rights to land (as collateral for loans), the lack of lending products offering alternative types of collateral, limited physical outreach of financial service providers and low awareness regarding financial services. According to a 2021 rural finance study led by the Food and Agriculture Organization, less women have access to individual fund saving facilities than men, as shown in Table 11-4.

11.1.8.6 Political participation

Tanzania has made notable strides in increasing women's political participation. The Constitution provides for affirmative action to rectify historical gender imbalances in



women's access to political decision-making bodies, such as parliament and local councils, through the reservation of special seats for women. To ensure a considerable representation of marginal constituencies, such as women, youth and disabled persons, the Government of Tanzania has established a quota system, which ensures 30% and 40%t quota for female parliamentarians in Tanzania mainland and Zanzibar respectively. About 37 parliamentary seats are currently held by women, and in 2021, Tanzania inaugurated its first female president.

11.1.8.7 Gender-based violence

With regards to GBV, in Tanzania, 40% of all women aged 15-49 years have experienced physical violence, while 17% have experienced sexual violence. For the same age bracket, 44% have experienced either physical or sexual violence by an intimate partner. Spousal violence prevalence is highest in rural areas, averaging 52%, relative to 45% reported in rural areas. The study also suggests that nearly 30% of Tanzanian girls experience sexual violence before the age of 18. While the penal code (2002) criminalizes GBV and the Law of Marriage (1971) prohibits spousal violence, the country's legislation does not outlaw marital rape and polygamy that is sustained by customary, Islamic and civil rights. The law also fails to penalize domestic violence against women. Furthermore, the customary inheritance law (i.e. the Local Customary Law Order of 1963) gives way to widowed women and orphaned girl-children being denied property inheritance, in favour of male heirs. In rural strongholds, the law continues to covertly override the other laws and constitutional provisions that allow widows to claim their inheritance upon the demise of a spouse (World Bank, 2017).

11.1.8.8 Autonomy in household matters

According to the national demographic health survey report for the period 2015-2016, married women have limited discretion over major household matters, mainly due to the country's patriarchal culture and traditional gender roles. As shown in Figure 11-5: Share of women with a say in key household decisions in Tanzania, <75% of women have a say in decisions concerning their own healthcare, major household purchases and visits to relatives. Decision-making power amongst married women was also positively associated with residence in urban areas, employment in off-farm labour, household income status and monogamous marriage.





Figure 11-5: Share of women with a say in key household decisions in Tanzania

The survey also indicated that only about 36% of women are allowed independent control of their finances, as shown in Figure 11-6: Distribution of control over married women's finances in Tanzania.



Figure 11-6: Distribution of control over married women's finances in Tanzania

11.1.8.9 Gender mainstreaming interventions

In bringing about gender equality the Government has developed the national development vision 2025, which, amongst other objectives, seeks to attain gender equality and the empowerment of women in all socio -economic and political relations, and culture, across the country, by the year 2025. Subsequent plans have been prepared to realize the Vision 2025 goals, which include among others, the poverty reduction



strategy (PRS) which identifies gender as crosscutting in all sectors. The government has also put in place several measures to combat all forms of violence against women. Such measures include a national plan of action (2001) to combat violence against women and children, which has been disseminated to stakeholders. The plan of action sets out strategies and activities to be implemented by various stakeholders.

11.1.9 Governance, human rights and security

The Government of Tanzania is a signatory to the UN's Universal Declaration of Human Rights and enshrined in its Constitution, the issue of adherence to and protection of human rights. Numerous rights and liberties are guaranteed and provided by the government in line with the human rights focus (e.g. the right to education, information, shelter political participation, participate in development activities of the nation, security, food, health and to livelihood assets e.g. land, forest, water finance etc). Tanzania has also made a commitment, both to its people and to the international community, to improve democratic governance. In its efforts to promote good governance and human rights, the Government of Tanzania established the commission for human rights and good governance (CHRGG) in 2001 by Articles 129-131 of the 1977 Constitution of the United Republic of Tanzania and the CHRGG Act, Chapter 391 of 2001. The CHRGG plays the dual role of an ombudsman and a human rights commission.

The CHRGG has a very broad mandate of promoting awareness of human rights and investigating violations. Since its creation, the commission has been active in several protective functions such as:

- it receives and investigates complaints and/or allegations of human rights violations and contravention of principles of administrative justice. It also conducts public hearings on the same and proposes compensations where appropriate
- it initiates proceedings on its own
- it handles individual complaints concerning the violation of human rights generally, with vested rights to investigate, conduct hearings and settle disputes. It also has the right to decide not to proceed with a complaint
- it promotes and advises by educating the public on human rights and good governance issues, carrying out research on human rights and good governance, and monitoring compliance with human rights standards and good governance principles
- it advises the government and other public organs and private sector institutions on specific issues relating to human rights and administrative justice
- it offers mediation and conciliation through alternative conflict resolution (Transparency International 2003).

In terms of human rights violation and security, various forms of crime are prevalent across the country. For the project-affected regions, the latest national crime and traffic accidents report (Tanzania Police Force, 2021) indicates that the total incidence of crime (including murder, rape, and human trafficking) in 2020 totalled 409 cases in Tabora and 66 cases in Singida. Less serious crime cases totalled an additional 14,636 and 12,821 cases in Tabora and Singida respectively. With regard to GBV, a total of 912 criminal cases were reported in Tabora, and 1,376 cases in Singida.

11.1.10 Education and literacy

Literacy in the United Republic of Tanzania is relatively high, at 71.8% in 2020, yet it is below the global average. The average for the sub-aharan Africa region in 2018 was 65.6%, while the global average is close to 85% (World Bank, 2019). While data for the



United Republic of Tanzania is incomplete and inconsistent, rates of primary school completion have generally followed a progressive upward trend. Roughly, 69% of adults in Tanzania completed primary school in 2018 (72% of women and 65% of men), matching the average for sub-Saharan Africa (World Bank, 2019b). Recently, Tanzania passed a decision to allow all girls who dropped out of school due to any reasons including early pregnancy, to resume classes and continue without being questioned. This has guaranteed girl child rights to education and, together with covering all the costs for primary and secondary education, is a reflection of the governments commitment to support education. The project may impact education infrastructure and disrupt classes or even create an environment where school kids may have to abstain from school in search of work or being diverted from going to school by men.

11.1.11 Health and safety

The health status of the population in Tanzania is slowly improving and life expectancy is increasing. The trends in child mortality and infant mortality are downwards, and Tanzania is expected to meet the targets of the MDG. The trends in neonatal mortality and maternal mortality are also downwards, but less, and not meeting MDG targets. While disease control programmes for HIV/AIDS, malaria and tuberculosis are quite successful in early detection and treatment, there is room for improvement in the area of prevention. Reproductive, maternal, neonatal, child, and adolescent health (RMNCAH) in general is performing less effectively than control of communicable diseases. Overall service utilisation is not reaching the required level. Non-communicable diseases are increasing, and unhealthy lifestyles are becoming more prominent.

Health and social welfare services are provided from the grassroots level up through higher levels of care, beginning with community health care, dispensaries, and health centres, and proceeding through district hospitals, regional referral hospitals, zonal referral hospitals, and the national hospital, all providing increasingly sophisticated and well-defined services. Due to constraints in human resources and supplies of medicines and health products, not all primary health services are of sufficient quality. In certain geographical areas, populations still live far away from health services. This is especially problematic in terms of maternal and infant care. The referral system does not always function as required, sometimes due to a lack of adequate transport to the next level of care or due to an inability at the referral level to provide adequate services. Figure 11-7 illustrates the hierarchy of public medical services provision in Tanzania.



Figure 11-7: Hierarchy of healthcare facilities in Tanzania

Health care delivery system in Tanzania, especially in rural regions and health facilities, was negatively affected following the economic recession that occurred in the 1970s and 1980s that led to a deterioration of health services. This prompted the Government of Tanzania to introduce cost-sharing in 1993 and subsequently instituted other financing alternatives such as a community health fund and a national health insurance. Consumer charges accompanied the institution of cost-sharing.

Even though some forms of health insurance provisions exist in the Tanzania health system, the coverage of commercial health insurance is extremely limited and there is an increasing trend of community-based pre-payment schemes. Insurance represents among the many and major challenges of health system in Tanzania. Therefore, the country is more known for its community health fund (CHF) schemes, with the initiation of compulsory health insurance in the early 2000s making it mandatory for all public servants to join the National Health Insurance Fund (NHIF).

With regard to communicable diseases, HIV/AIDS continues to constitute a growing share of national morbidity. While the Government of Tanzania has launched country-wide sensitization, diagnostic and treatment campaigns to curb the spread of HIV/AIDS by the dedicated agency of Tanzania commission for AIDS (TACAIDS), the number of HIV/AIDS sufferers rose to 1.7 million by 2019, and 27,000 related deaths were recorded in the same year. Prevalence among women is higher compared to men (6.2% versus 3.7%). The most recent round of the Tanzania HIV impact survey (2016-2017) established that the prevalence of HIV/AIDS was around 4.8% and 3.5% for Tabora and Singida regions respectively.

The sub-sections below present the socioeconomic profiles of the six main projectaffected districts and local communities based in and around the project corridor, drawing on the ESIA baseline survey results, stakeholder consultations and the most up-to-date literature sourced from publicly accessible platforms.

11.1.12 Land ownership and tenure system

The first formal initiative to legalize land use and ownership came in 1923 through the passage of the "Land Ordinance Cap 113" by British Colonial legislative assembly to guide and regulate land use and ownership in Tanganyika. Before this law, most of the land in Tanganyika was owned under customary tenure governed by clan and tribal traditions (HAKIARDHI, 2005). After independence, various laws and declarations were



enacted to reinforce decisions in land administration such as the Land Acquisition Act No. 47 of 1967 which gave the president powers to acquire land in any part of the Republic of Tanzania for the national interest. Other laws included the Village and Ujamaa Village Act of 1975, the Land Regularization Act of 1982 and the Local Government District Authorities Act No. 7 of 1982. All these laws had a bearing on the rights to land for the majority of small producers even though they did not transform the land tenure system into a better form than the previous one (HAKIARDHI, 2005).

In the 1990's land reforms marked a very significant turning point in the development and administration of land tenure system in Tanzania. However, National land policy of 1997 and the land Acts of 1999, (Land Act No. 4 and Village Land Act No. 5) still gave the president powers to own land for the Government rather than decentralizing it to the lower organs of people's representation like the village assemblies and DCs.

The current situation about ownership, control and management of land in Tanzania is that: land is vested in the President as trustee for and on behalf of all citizens of Tanzania. For the purposes of management only, all land is classified as general land, village land and reserve land. The President has powers to transfer land from one category to another. Reserve lands are forests, wildlife areas, etc., which constitute 28% of all lands. Village land is all land that falls under the jurisdiction of the existing 10,832 registered villages in the country which constitutes nearly 70% of all land.

The rest is mostly urban land and that land already under granted titles. The commissioner for lands is the sole authority responsible for the overall administration of all lands but has delegated his powers to authorized land officers at district/municipal level. The village councils manage all village land with advice from the commissioner for lands. The reserved lands are managed by statutory body's such as forest department wildlife division etc. (Tanzania land policy and genesis of land reforms 2012).

In the context of land acquisition, demographics with the least security of land tenure in Tanzania include semi-nomadic communities, women and the population living in extreme poverty. Semi-nomadic communities include traditional pastoralists and communities comprising the country's indigenous peoples (IPs). These constituencies employ livelihood strategies that involve (i) an expansive and/or shifting use of land and land-based resources, (ii) collective ownership of relatively undeveloped land that presents little competitive pressure from competing land-uses, as well as (iii) little to no development of seasonally used land. While the legal context for land tenure seeks to enable an equitable land access, a number of pitfalls have emerged, which have failed to resolve land insecurity of semi-nomadic groups.

The national land policy and associated legislation promote private land tenure on nonreserved land. While the Village Land Act recognizes collective (communal) land ownership rights, such rights are granted in prior consideration of village land-use plans. Land-use plans within rural jurisdictions tend to down-prioritize semi-nomadic and pastoral land use, in favour of competing land-usages that are established under private tenure and/or deemed to be more economically productive and/or environmentally sustainable. Pastoralist communities and IPs have historically suffered extensive land alienation for the expansion of conservation areas and industrial development (Care International, 2016). Phase II of the national agricultural sector development programme (2018-2023) seeks to commercialize smallholder agriculture and improve the management of rangelands. However, this transition has proven challenging for traditional nomads who uphold dynamic and subsistence land-use.

The land policy and the Village Land Act in particular recognize customary land rights on the basis of certain pre-conditions, which largely qualify sedentary land users. Migration and rotational land-use is, however, the hallmark of Tanzania's semi-nomadic population. Under the legal regime, nomadic communities' customary claims to land are often



invalidated by a failure to (i) demonstrate historical ownership of the land due to their traditional migration, and (ii) establish permanent (structural) developments on the land.

Women are also prone to land insecurity, particularly in the context of land inheritance. The legal framework of Tanzania comprises the constitution, statutes, case law, and customary and Islamic law. Women's constitutional right to equitable land ownership is embodied in the Land Act, Village Land Act and the Law of Marriage. While the formal legal system protects widowed women's rights to inheritance of marital property, this entitlement is infringed by customary practices within patrilineal societies that account for 80% of the country's population. Where married women are widowed, these customs vest the right to inheritance in the male heirs of a given clan in the interests of ensuring male leadership within the clan. Such dispossession is prevalent within the country's rural parts, where women have limited resources and awareness to invoke judicial agencies (Ellis et al, 2007).

Low-income residents are also land-insecure, due to their limited financial means to acquire formal land rights, particularly within urban locations, where a growing demand has driven inflation within real estate markets, and customary land tenure is not legally recognized. As established by the ESIA socioeconomic survey, while a master plan has been developed for Tabora municipal, the enforcement of land zoning and monitoring of informal settlement has been limited. In the remainder of the project-affected districts, land surveys and land-use plans have been implemented for a minority of the villages.

11.2 Socio-economic context: affected districts and communities

The sub-sections below present the socio-economic profiles of the six main projectaffected districts and local communities based in and around the project corridor, drawing on the ESIA baseline survey results, stakeholder consultations and up-to-date literature sourced from publicly accessible platforms.

11.2.1 Manyoni District

11.2.1.1 Administrative boundaries

Manyoni district is one of seven districts constituting Singida region. It covers an area of 14,118 km², accounting for 28.6% of the total regional area. The district is bordered by (i) Ikungi and Chemba districts to the north, (ii) Itigi district to the west, (iii) Iringa district to the south, and (iv) Bahi district to the east. Administratively, the district is divided into a total of 19 wards, 58 villages and 279 hamlets.

The project area extends across 13 villages within Manyoni district, namely: Makutopora, Sukamahela, Saranda Mdununde, Chang'ombe, Majengo, Kipondoda, Aghondi, Mabondeni, Kitopeni, Itigi Mjini/ Mlowa, Kitaraka and Kazikazi.

11.2.1.2 Population and demography

At the time of the 2012 population and housing census, the district of Manyoni covered an administrative division, which was subsequently (in 2016) autonomized as Itigi district. The population census enumerated a total of 296,763 residents within Manyoni district, of whom 146,030 were male and 150,733 were female. A total of 58,464 households were recorded, with an average size of 5 persons. Based on the population growth rate established by the census, the district population was projected to reach 232,633 by 2020.

Most households surveyed within the district's affected villages reported a household size not exceeding five members, as shown in Figure 11-8.

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Figure 11-8: Distribution of sampled surveys by household size in Manyoni District

11.2.1.3 Ethnic make-up and culture

The main ethnic groups within Manyoni District include the Gogo, Sukuma, Nyaturu, Nyiramba, Sangu, Kimbu, Maasai, Barbaig and Taturu. In general, resident communities share a knowledge of Swahili, patriarchal customs, as well as the dominance of Islamic and Christian faith.

11.2.1.4 Local economy and livelihoods

According to the official district profile report, the most recently documented GDP of Manyoni district is TZS 92,973,386,600 (recorded in 2015). The economy of Manyoni District is primarily dependent on agriculture, which accounts for 65% of the district's GDP and 80% of local livelihoods. The industry and service sectors have also contributed to the district's expanding economy. As shown by the baseline survey, over 70% of interviewed household heads identified crop farming as their households' primary source of income, with the second most prevalent primary livelihood being small businesses. In addition, about 75% of the household heads indicated that their secondary income is derived from crop farming, while about 30% of the household heads reported a lack of secondary livelihoods.

The majority (85%) of surveyed households reported a monthly income range of TZS 50,000 to 250,000.





Figure 11-9: Distribution of surveyed households by primary income sources in Manyoni District

Agriculture

About 6% (847 km²) of the district's total land areas has been classified as arable, with 55% of the land utilized for crop production. Both cash and food crops are produced locally, with the latter being dominant. The major food crops grown in the district include sorghum, bulrush millet, maize, sweet potatoes, beans, paddy, and cassava, whilst cultivated cash crops include sunflower, sesame, groundnuts, tobacco, cow peas and yellow grams. In 2018, cash crop production within the district generated a gross revenue of TZS 63,476,950,000.

Droughts and limited agricultural infrastructure are amongst the main constraints to the productivity of the district's crop cultivation sector. With lacking water resources to enable rudimentary (traditional) irrigation, a shortage of extension service manpower and limited usage of agricultural equipment for mechanized farm work, only 1,318 ha of irrigable land are currently exploited, of the 9,250 ha with irrigational potential.

Agricultural activities in Manyoni district also include livestock rearing, which comprises cattle, goat, sheep, donkey, pig and poultry breeding. In 2019, the estimated area of pastures in the district totalled 236,100 hectares, all of which were fully utilized for grazing. By 2018, the district was reported to have a total of five slaughter slabs. Pastoral communities belonging to the country's IP demographic include the Maasai, Barbaig and Taturu.

Cattle	Goats	Sheep	Donkeys	Pigs	Poultry	
208,649	135,122	54,548	4,612	3,352	312,011	

Fishing is carried out on a subsistence basis across the district, due to the limited availability of wetlands and low levels of precipitation. The major dams utilized for fishery include Mwanzi, Kilimatinde, Chibumagwa, and Sumugai/Bahi.

Beekeeping is also widely practiced in the district, with a total of 55,853 beehives reported in 2019, of which 55,703 were traditional. The latest available annual totals for beekeeping products include 150 tonnes of honey and 16 tonnes of beeswax produced in 2020. Despite the deforestation associated with agriculture and urbanization, beekeeping is evident along project, particularly within Itigi and Tabora municipal areas.



The recently established Aghondi beekeeping reserve is subject to partial displacement, depending on the final design of the railway corridor.



Figure 11-10: Beehives in Manyoni District

Local industry

With primary production based around agriculture, the district's nascent industrial sector largely comprises miscellaneous agricultural processing facilities, comprising 2.3% of the regional industrial sector (by number of industrial establishments). Table 11-6 provides the latest available statistics for industrial production across the district.

Table 11-6: Industries operating in Manyoni District

Agro-processing industries		Other types of industries					
Oil Milling processing machines		Timber processing	Carpentry	Bicycle repair	Welding	Tailoring	Food processing
10	220	10	257	95	30	271	10

Other productive sectors

As shown by preliminary results of the ongoing resettlement-oriented socioeconomic surveys, numerous project-affected residents also engage in the harvesting and extraction of natural resources. These livelihoods include small-scale charcoal production, collection of firewood, foraging for edible and medicinal plant products and honey, as well as artisanal stone mining and crushing.

11.2.1.5 Public infrastructure and access to social services

Transportation

Manyoni District has an extensive network of roads. An overview of existing roads, with categorization by size and surface condition is provided in Table 11-7.



Table 11-7:	Road network	, by grade	in Man	voni District
		t by graac	III Man	yonn District

Road categories	Total distance (km)
By surface condition	
Tarmac	7
Gravel	356
Earth	668
Total	1,032
By size	
Trunk	84
Regional	214
District	-
Feeder	439
Urban	593

Manyoni District's rail transit is based on the existing central railway line connecting Dar es Salaam to Mwanza (up north) and Kigoma (out west). Table 11-8 provides an overview of the district's railway service capacity for cargo and civilian transport.

Table 11-8: Railway transit capacity in Manyoni District

No. of stations	Cargo services (Tonnes)	No. of passengers
5	2,296	4,473

A total of six air strips operate in Manyoni District, serving local flights associated with touristic and medical services. Table 11-9 provides an overview of the air transportation facilities and annual traffic for the district.

Table 11-9: Overview	of air strips and	respective traffic in	Manyoni District
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Ward	No. of airports	No. of airstrips	No. of passengers	
Manyoni	-	2	63	
Solya	-	1	7	
Makutopora (Dabia)	-	1	3	
Nkonko	-	1	4	
Majiri (Mahaka)	-	1	2	
Total	-	6	79	



Telecommunication

A number of telecommunication service providers operate within Manyoni District, as shown in Table 11-10.

Year	Land lines service provider	No. of telephones network towers	No. of internet centres	Mobile phones service providers	No. of post offices
2019	1	29	6	6	1

Table 11-10: Summary of telecommunication services in Manyoni District

Energy

According to the 2012 population and housing census report, the dominant sources of energy for domestic use are firewood (83.5%) and charcoal (15.5%). Table 11-11 provides a district-level overview of household energy sources, as reported on the most recent (documented) population and housing census.

Table 11-11. Distribution of population by energy source										
Hou	Use of energy sources (% of population)								Tota	
seholds	Electricity	Paraffin	Gas	Firewood	Charcoal	Wood/Farm Residual	Coal	Animal Residual	Not Applicable	~
58,464	0.2	0.3	0.1	83.5	15.5	0.1	0.1	0.1	0.1	100

Table 11-11: Distribution of population by energy source

The ESIA baseline survey indicates that the majority (72%) of households within the project-affected communities depend on firewood for cooking, with less than 5% of the households using electricity.



Figure 11-11: Distribution of surveyed households by source of energy for cooking in Manyoni District



Education

The district's educational sector includes centres for pre-school, primary, secondary and tertiary education.

According to the district's most recent statistics, by 2019, a total of 68 public primary schools and one private primary school were established within Manyoni. In the same year, gender parity was reported for primary schools, with totals for boys and girls being 23,749 and 23,522 respectively. The most recently reported primary school completion rate (for the year 2018) was 58.5%. Besides academic performance, the main reasons for failed school completion are truancy, teen pregnancy, the nomadic lifestyle of pupils' families, long distances within wide service areas and child mortalities.

Further, in 2019, secondary schools within the district included 16 government schools and three government schools. In the same year a total of 2,850 boys and 3,224 girls were enrolled into secondary school. According to the latest district report, the most secondary schools within the district are beset by a shortage of basic facilities including staff quarters, toilets, dormitories, libraries, laboratories and furniture, which is partly attributable to sharp rise in enrolment as a result of a district-wide sensitization efforts by the DC. The completion rate reported for 2018 is 74% for boys and 79% for girls.

With regard to tertiary education, the district hosts Kilimatinde Nursing School and RC Mission Vocational Training School. As stated in the district report, in 2018, a total of 2,080 adult learners were attending two adult education centres in the district, with a total of 78 instructors. Given the paucity of information on current literacy rates, the most available literacy information derives from the district's latest (documented) population and housing census, which showed that about 63% of the district's population (above the age of 5 years) was literate in at least one language (English and Swahili).



Figure 11-12: Distribution of surveyed households by educational attainment in Manyoni District

With regard to the project-affected community, the ESIA baseline survey indicates that the majority of interviewed household heads have not attained education beyond the primary level, and less than 5% of the household heads have acquired higher education. The survey also shows that about 57% and 29% of pupils are located within 1 km of their primary and secondary schools respectively.

Health care

Table 11-12: provides an overview of the most recently reported healthcare facility statistics within Manyoni District. Healthcare facilities within the district are in short supply, with the ration of doctors to the population being 1: 18,487 and the ratio of hospital beds to the population being 1: 469.



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Tahla	11_12	Counte	of modical	eorvico	nrovidore	within	Manvo	ni Dietrict
Iable	11-14.	Counts	or method	301 1100	providers	WILIIII	wanyo	II DISTINCT

Hospitals		Health centres			Dispensaries			
2015	2019	Change	2015	2019	Change	2015	2019	Change
2	2	-	2	2	-	33	33	-

The district's community health fund is a voluntary community based financing scheme whereby households pay contributions to finance part of their basic health care services to complement the Government health care financing efforts for each year. The specific objectives of the fund are to:

- mobilize financial resources from the community for provision of health care services to its members
- provide quality and affordable health care services through a sustainable financial mechanism
- improve health care services management in the communities through decentralization by empowering the communities in making decisions and by contributing on matters affecting their health.

By 2018, the number of households served by the fund grew to 3,467, following an extensive sensitization campaign.

Morbidity

Table 11-13: presents the most recent publicly available statistics on the incidence of diseases in Manyoni District. According to the district profile report, the top five diseases in 2018 were respiratory infections, diarrhoea, pneumonia, malaria and skin diseases.

SN	Diagnosis	< 5 years				5+ years			
		М	F	Total	%	М	F	Total	%
1	Respiratory infections	12,685	13,495	26,180	53	13,332	17,744	31,076	49
2	Diarrhoea	3,536	3,550	7,086	14	1,962	2,270	4,232	7
3	Others	1,091	1,114	2,205	4	3,465	3,988	7,453	12
4	Pneumonia	2,201	2,242	4,443	9	1,642	2,064	3,706	6
5	Malaria	2,583	2,681	5,264	11	5,617	5,289	10,906	17
6	Skin diseases	745	849	1,594	3	764	626	1,390	2
7	Intestinal worms	724	773	1,497	3	1,197	1,408	2,605	4
8	Eye conditions	409	394	803	2	371	416	786	1
9	Emergency surgical condition	374	346	720	1	127	113	240	0
10	Anaemia	44	28	72	0	431	801	1,232	2
Total		24,392	25,472	49,864	100	28,908	34,719	63,626	100

Table 11-13: Incidence of diseases in Manyoni District, 2018



With regard to project-affected communities, diseases cited as most common in the ESIA socioeconomic survey are diarrhea and diabetes.

Water supply and sanitation

Due to the climate and topographic context, boreholes are the main source of water in Manyoni district. In 2019, a total of 128 boreholes, 123 hand-dug wells, 32 chaco dams, 27 rainwater harvesting points and 3 springs were recorded across the district. Water extraction technologies employed for rural water supply included 19 rainwater collection systems, 48 hand-pump wells, eight diesel powered pumps, seven wind powered pumps, five electrical pumps, and two gravity water distribution systems. By 2019, about 30.3% of the district's rural population had access to clean water supply systems. In the same year, rural water supply services were managed by a total of 58 village water committees.



Figure 11-13: Public water tap at Chang'ombe in Manyoni District

Regarding urban water supply, by 2019, sources of water in the district's urban centres included a total of eight boreholes, four hand dug wells, one rainwater harvesting system and one charco dam. The majority (eight) of the urban water schemes were powered by electrical pumps, whereas only one scheme was powered by a windmill. In the same year, 54.2% of the local population had access to the water supply schemes.

The baseline survey of project-affected communities indicates that the majority (33%) of surveyed households rely mainly on unprotected wells for water supply, other utilized sources being protected wells, piped water supply schemes, springs, rivers and rainwater harvesting.

No conventional wastewater treatment plants have been established within Manyoni District. A minority of the district's households utilize septic tanks for sewage disposal, whereas the larger population relies on traditional and ventilated pit latrines. In the absence of recent information on local sanitary facilities, the district's sanitation department report refers to the 2012 census, which established that 33% of the population utilized traditional pit latrines, 30% used ventilated pit latrines, 0.6% used flush toilets and 22% did not own any toilet facilities at the time of the census.



Figure 11-14: Distribution of surveyed households by water source in Manyoni District

11.2.1.6 Socio-economically vulnerable groupings

Women

Given the patriarchal culture of Manyoni District, gender disparities have prevailed within the district's productive sectors and socio-political arena. As shown in Table 11-14 the district profile indicates that women are under-represented across technical and managerial labour tiers, and within the district's political sphere.

Table 11-14 Women's participation in managerial, political, professional and technical professions; Manyoni District, 2019

	Manage	erial	Profess technici	Professionals/ technicians		Politics (MPs, Councillors)		Total	
Year	Male	Female	Male	Female	Male	Female	Male	Female	
2019	14	5	1,250	884	19	9	1,283	898	

The district's administration has launched several grass-roots level initiatives to progress women's empowerment in terms of economic, educational, and political participation. These initiatives include measures to alleviate women's domestic and child-care constraints to economic involvement, including sensitization to family planning and the establishment of day-care centres. By 2019, a total of 14 child-care centres were established within the district, which were attended by a total of 5,895 pupils. The establishment of child-care services to aid women's economic emancipation has been complemented with the institution of community-based, co-operative organizations to facilitate women's financial access.

Table 11-15 Total number of women-only credit groups in Manyoni district

No of groups	Total membership	No. of groups loaned	Total Ioaned (TZS)	Total recovered (TZS)	Total Ioaned by NGOs (TZS)	Total recovered loans by NGOs (TZS)
112	1,158	11	16,000,000	763,000	1,300,000	-

Youth

Local government authorities within Manyoni District have also assisted the mobilization of community-based, co-operative organizations to aid financial access for the district's



economically active youth. By 2019, a total of 32 active savings and credit co-operative societies (SACCOSs) exclusively dedicated to young entrepreneurs were registered within the district, with a total membership of 603. In the same year, a dedicated financial contribution totalling TZS 13,500,000 was mobilized by the DC in efforts to incentivize youth-driven enterprises.

No. of groups	Total membership	No. of groups Ioaned	Total Ioaned (TZS)	Total recovered loans (TZS)	Total Ioaned by NGOs (TZS)	Total recovered loans by NGOs (TZS)
32	2,299	11	13,500,000	500,000.00	-	-

Table 11-16 Active youth economic groups; Manyoni District

Vulnerable groups in project-affected communities

Of the households surveyed within the project-affected communities, 43% were provisionally identified as vulnerable. The leading areas of socioeconomic vulnerability amongst the households is elderly and female household headship, as shown in Figure 11-15: Distribution of surveyed households by vulnerability category in Manyoni District.



Figure 11-15: Distribution of surveyed households by vulnerability category in Manyoni District

11.2.1.7 Social security and access to credit facilities

Existing social security schemes and instruments within Manyoni District include the following:

- national pension scheme, namely national social security fund (NSSF), for the collection and disbursement of pension funds for residents with formal employment in the private sector
- civil service scheme, namely public service sector security fund (PSSSF), for the collection and disbursement of pension funds for residents employed in public service
- productive social safety net II (PSSN II) program (2020 2023) providing monetary support and public employment for target communities



• community-based credit facilities, including (but not limited to) SACCOS.

At the time of this assessment, official statistics for the coverage of the social security programs within the district were not available. Nevertheless, the district report indicates that by 2018, a total of 19 active SACCOSs were listed within Manyoni, with a total membership of 3,739 (1,943 males and 1,198 females), as detailed in Table 11-17.

Number of SACCOSs (Registered)	Male	Female	Total	Total Funds SACCOS A/C as at 31/12/2 018	Total loaned to members (Tshs)	Total recovered loans by members (Tshs)	Beneficiaries
19	1,943	1,198	3,739	837,901,578	4,314,073,925	978,695,332	Agriculture, Livestock and Trade

Table 11-17 Local participation in SACCOS in Manyoni District, 2018

An additional ten CBOs oriented towards social development were recorded within the district, with a total membership of 571. These financial aid agencies serve to address other areas of need within local communities, including enterprise development, education, healthcare, and HIV/AIDS assistance in particular.

11.2.1.8 Land-use and tenure

The rural landscape of the project's AoI in Manyoni comprises residential clusters interspersed with crop farms, bushland and thickets. Commercial zones are also present, particularly within the district centre. Based on preliminary data from the ongoing resettlement surveys, public infrastructure within the area includes the existing MGR line, places of worship, institutional premises, graveyards, and water wells. Most of the private property within the area is used for permanent residence, with formal and informal ownership rights.

11.2.1.9 Housing quality

Structurally, the housing within the project-affected communities largely includes buildings made of cemented floors, mud walls and iron sheet and thatch roofing. A small proportion of resident buildings have cemented floors, unburnt clay brick walls and iron roofing.

11.2.2 Itigi District

11.2.2.1 Administrative boundaries

Established in 2015, Itigi District is one of seven districts constituting Singida Region. It covers an area of 17,436 km², accounting for 35% of the total regional area. The district is bordered by (i) Uyui and Ikungi Districts to the north, (ii) Sikonge District to the west, (iii) Chunya and Iringa Districts to the south, and (iv) Manyoni District to the east. Administratively, the district is divided into a total of 13 wards and 39 villages and 174 hamlets.

The project area extends across six villages within Itigi district, namely: Karangasi, Tura, Malongwe, Kizengi, Genge sita and Mpumbuli.



11.2.2.2 Population and demography

The 2012 national population and housing census enumerated a total of 112,565 residents within the area that presently forms Itigi district, of whom 88,947 were male and 90,936 were female. A total of 21,028 were recorded, with an average size of five people. Based on the population growth rate established by the census, the district population was projected to reach 140,600 by 2020.

In the course of the ESIA, the majority of households surveyed within the district's affected villages reported a household size of one to five and over ten members, as shown in Figure 11-16.



Figure 11-16: Distribution of surveyed households by size in Itigi District

The population of Itigi District is dominated by the tribes of Gogo, Taturu and Nyaturu, with a smaller proportion of Sukuma, Nyamwezi and Kimbu peoples. Resident communities share a knowledge of Swahili and patriarchal customs, with a dominance of Muslim and Christian faiths.

11.2.2.3 Local economy and livelihoods

According to the district's official profile report, the district's GDP for the year 2018 was not established. Nevertheless, the report indicates that the district's economy chiefly comprises agricultural production.

As shown by the ESIA baseline survey, over 80% of interviewed household heads identified crop farming as their households' primary source of income, with the second most prevalent primary livelihood being small businesses. In addition, about 82% of the household heads indicated that their secondary income is derived from crop farming, and none of the household heads reported an absence of secondary livelihoods.





Figure 11-17: Distribution of surveyed households by income source in Itigi District

Furthermore, all of the surveyed households reported a monthly income range of TZS 50,000 to 100,000.

Agriculture

With regard to crop farming, of the total 78,200 ha of arable land, 31,459 ha was under cultivation by 2018. The tonnage of food crop and cash crop production in the same year totalled 31,040 t and 11,191 t respectively. Limited records indicate that less than half of arable land with irrigation potential is irrigated for the cultivation of paddy and miscellaneous horticultural crops.

With respect to livestock rearing, by 2018, the DC reported a total inventory of 133,129 cattle, 48,805 goats, 11,266 sheep, 2,923 pigs, 1,215 donkeys and 93,660 poultry. Of the total 94,222 ha available for grazing, 61,900 ha were utilized in the same year. Total revenue generated by livestock sales across the district amounted to TZS 3,657,180,000.



Figure 11-18: Cattle rearing and grazing land in Itigi ward

Industry and commerce

Despite a paucity of detailed information, the DC reported a host of local small to medium scale industries and enterprises in the year 2018. The inventory of establishments



includes those dealing in carpentry, maize milling, rice milling, gypsum milling, sunflower oil processing, dairy production, welding and handcraft production.

Other productive sectors

Furthermore, local livelihoods associated with forestry resources includes charcoal production and beekeeping. By 2018, the district generated a revenue of TZS 143,843,070 from its charcoal trade. In the same year, a total of 3,007 traditional beehives and 379 modern beehives were enumerated, although the amount of income from the production of honey and wax was not established. Information on the district's mining sector is scant, however, official statistics indicate a total of 27 small-scale miners and 15 medium-scale miners for the year 2018, most of whom are employed in the extraction of gypsum.

As shown by preliminary results of the ongoing resettlement-oriented socioeconomic surveys, numerous project-affected residents also engage in the harvesting and extraction of natural resources. These livelihoods include small-scale charcoal production, collection of firewood, and foraging for edible and medicinal plant products and honey.

11.2.2.4 Public infrastructure and access to social services

Transportation

According to the district profile report, by 2018, the road network of Itigi consisted of 320 km of collector roads, 87 km of community roads and 460 km of feeder roads, totalling a total length of 867 km. Local transportation infrastructure is also reported to include the Dar es Salaam to Kigoma and Isaka MGR railway. Locally, railway transit was reported to accommodate about 7,490 passengers and 450 t of cargo, via Itigi train station.

Telecommunication

The district is well covered in terms of telecommunication services. The district report indicates that mobile and land line service providers in the district include Tigo, Vodacom, Airtel, Zantel and Halotel.

Energy

The district's official profile report indicates that the number of residents will access to the district's electrical grid totalled 1,071 in 2018. The ESIA baseline survey undertaken further indicates that the majority (94%) of households within the project-affected communities depend on firewood to for cooking and none of the households use electricity.

Education

The educational sector of Itigi District comprises numerous pre-schools, primary schools, secondary schools and tertiary education institutions.

With regard to primary education, by 2018, the DC reported a total of 38 governmentowned and three private primary schools, and an annual enrolment of 13,643 boys and 12,154 girls for the public schools and 436 boys and 378 girls for private schools. The main causes for dropouts in the same year were truancy and early pregnancies. Further, a total of 706 boys and 713 girls completed primary school in 2018. The DC also reported a considerable deficit of classrooms, school toilets, desks and teachers' house for the schools.

With regard to secondary education, the DC recorded a total of 11 government-owned and one private secondary school were enumerated in the district, by 2018. An annual



enrolment of 39 boys and 43 girls was recorded in the same year for public schools, and 29 boys and 49 for the private school. The number of boys and girls that completed secondary education in 2018 was 13 boys and 19 girls respectively for public schools, and 13 boys and 21 girls for the private school. Secondary schools in the district are confronted with a similar shortage of facilities as that reported for primary schools, and further deficit is reported for libraries, laboratories, dormitories and teachers. As regards adult education, the DC reported a total of five adult education centres by 2018, and a total enrolment of 159 for the same year.

The ESIA baseline survey indicates that the majority of interviewed household heads have not acquired formal education, and less than 15% of the household heads have completed tertiary.



Figure 11-19: Distribution of surveyed households by educational attainment in Itigi District

Health care

According to the district profile report, by 2018, the local healthcare sector included one hospital, two health centres and 17 dispensaries. The district's healthcare workforce was reported to consist of traditional birth attendants, village health workers, community health workers and traditional medical practitioners. Based on recently recorded hospitalization rates, the size of the local healthcare labour was reported as being insufficient.

Morbidity

Table 11-18 presents the most recent publicly available statistics on the incidence of diseases in Itigi district. According to the district profile report, the most common diseases in 2018 were respiratory infections, diarrhea, malaria, skin infections and urinary tract infections. Malaria, pneumonia, heart disease and HIV/AIDS accounted for the majority of mortalities recorded in the same year.

No.	2018						
	Disease	Incidence					
1.	Upper respiratory tract infection	34,666					
2.	Malaria	14,795					
3.	Diarrhea	3,666					
4.	Pneumonia	2,279					

Table 11-18: Top ten reported diseases in Itigi district, 2018



No.	2018						
	Disease	Incidence					
5.	Non-fungal skin infection	1,617					
6.	Intestinal worms	1,477					
7.	Pelvic inflammatory disease	1,036					
8.	Eye disease	938					
9.	Fungal infection	795					
10.	Sexual transmission infection	645					

With regard to HIV/AIDS, a total of 242 and 379 men and women respectively were diagnosed with the condition in the year 2018. Diseases cited as most common within the project-affected communities (as reported in the ESIA socioeconomic survey) are diarrhea, and urinary tract infections.

Water supply and sanitation

As stated in the district's official profile report, by 2018, sources of water in the rural parts of Itigi district included 11 charco dams, 33 shallow wells, 15 rainwater harvesting systems, 41 boreholes, four seasonal rivers, three dams and 12 piped water schemes. Water abstraction is largely powered by hand pumps, however, windmills and electrical pumps are also utilized for water pumping. In total, about 53% of the district's rural population was reported to have access to clean water in the same year.

With regard to the district centre, the district profile report indicates that by 2018, water sources included one charco dam, four shallow wells, four rainwater harvesting systems, three boreholes, four lakes and one piped water scheme. Water abstraction from these sources is powered by windmills, electrical pumps and hand pumps. In the same year, the percentage of the district's central population with access to clean water was reported to be 18%.

The ESIA baseline survey of project-affected communities indicates that the majority (53%) of surveyed households rely mainly on unprotected wells for water supply, other utilized sources being boreholes and piped water supply schemes.



Figure 11-20: Distribution of surveyed households by source of water in Itigi District

With regard to sanitation, only 93% of resident households had in-built toilet facilities. Of these, 31% had improved flush toilets. No sewerage systems and wastewater treatment plants had been established in the district by 2019.



11.2.2.5 Socioeconomically vulnerable groupings

Of the households surveyed within the project-affected communities, 53% were provisionally identified as vulnerable. The leading areas of socioeconomic vulnerability amongst the households is elderly and female household headship, as shown in Figure 11-21.

11.2.2.6 Social security and access to credit facilities



Figure 11-21: Distribution of surveyed households by vulnerability category in Itigi District

According to the district profile report, the district's social support schemes include a total of 56 womens groups with a total membership of 450. In 2018, these groups received financial loans totalling TZS 21,000,000. The groups represent economic guilds for women specializing in micro-enterprises, horticulture, agriculture, poultry, tailoring, handcrafts, pottery, bakery and food catering.

Further, the district report cited a total of 74 youth-oriented economic groups with a total membership of 75. These groups were likewise assisted with credit totalling TZS 23,590,000 in 2018. The groups represents economic guilds specialized in a host of micro-enterprises, transportation service and horticulture.

With regard to community-based finance facilities, the DC reported a total of three SACCOS with a membership totalling 589 men and 390 women, as well as a total of 93 village community banks (VICOBA), with a sum of 435 male and 1,737 female members.

11.2.2.7 Land-use and tenure

The rural landscape of the project's AoI in Itigi district comprises residential clusters interspersed with crop farms, bushland, thickets and woodland. Commercial zones are also present, particularly within the district centre. Based on preliminary data from the ongoing resettlement surveys, public infrastructure within the area includes the existing MGR line, places of worship, institutional premises, graveyards, and water wells. Most of the private property within the area is used for permanent residence, with formal and informal ownership rights.

11.2.2.8 Housing quality

Structurally, the housing within the project-affected communities largely includes buildings made of clay floors, mud walls and iron sheet roofing. A small proportion of



resident buildings have cemented floors, unburnt clay brick walls, and thatch and mudmade roofing.

11.2.3 Uyui District

11.2.3.1 Administrative boundaries

Uyui district is one of the seven districts constituting Tabora region. It covers an area of 11,806 km², accounting for 15% of the total regional area. The district is bordered by (i) Nzega and Igunga Districts to the north, (ii) Tabora Municipal to the west, (iii) Sikonge and Itigi Districts to the south, and (iv) Ikungi District to the east. Administratively, the district is divided into a total of 30 wards and 156 villages.

The project area extends across a total of seven villages within Uyui District; namely Kamama, Goweko, Kimungi, Tambuka Reli, Kawekapina, Igalula and Ipululu.

11.2.3.2 Population and demography

In 2012, the national housing and population census enumerated a total of 396,623 residents within Manyoni District, of whom 196,446 were male and 200,177 were female. A total of 60,230 households were recorded, with an average size of 6 persons. Based on the population growth rate established by the census, the district population was projected to reach 510,675 by 2019.

The majority of households surveyed within the district's affected villages reported a household size of six to ten members, as shown in Figure 11-22.



Figure 11-22: Distribution of surveyed households by size in Uyui District

11.2.3.3 Ethnic make-up and culture

The population of Uyui District consists of mainly Nyamwezi peoples, with a smaller representation of the Gogo, and indigenous minorities including the Taturu and Sandawe. Resident communities share a knowledge of Swahili and patriarchal customs, with Nyamwezi people being a largely Muslim section.



11.2.3.4 Local economy and livelihoods

Information on the present GDP of Uyui District was not available at the time of this assessment, and the current district profile references a precedent GDP level of TZS 139,954,514 (recorded in 2010). Agriculture represents the district's economic mainstay, accounting for 85% of local livelihoods.

The remainder of local production comprises miscellaneous enterprises, which altogether generated a total of TZS 399,892,753 in 2018.

As shown by the baseline survey, over 85% of interviewed household heads identified crop farming as their households' primary source of income, with the second most prevalent primary livelihood being small businesses. In addition, about 86% of the household heads indicated that their secondary income is derived from crop farming, and none of the household heads reported a lack of secondary livelihoods. The majority (94%) of surveyed households reported a monthly income range of TZS 50,000 to 100,000.



Figure 11-23: Distribution of surveyed households by primary income source in Uyui District

Agriculture

Official statistics indicate that a total of 56,761 households within Uyui District engaged in crop farming, in 2018. The cultivation of tobacco is predominant, with a district revenue contribution of 75%. Other crops grown locally include maize, paddy, cassava, groundnuts, cassava and cotton.

Table 11-19 Crop	production	in Uyui District	
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Сгор	Production in 2018				
	Area farmed (ha)	Harvests (Tonnes)			
Maize	47,040	61,152			
Paddy	17,600	44,000			
Millet	12,702	10,652			
Sweet potatoes	13,440	33,600			
Cassava	5,850	11,750			
Pulses	8,238	2,648			
Total for food crops	104,867	163,752			

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Сгор	Production in 2018	
	Area farmed (ha)	Harvests (Tonnes)
Tobacco	4,661	7,327
Ground nuts	7,200	5,040
Sunflower	3,360	2,016
Cotton	2,726	2,726
Total for cash crops	17,947	17,109
Grand total	122,814	180,860

The agricultural sector of Uyui District further includes livestock rearing, as detailed in Table 11-20. In 2019, the estimated area of pastures in the district totalled 236,100 ha, all of which were fully utilized for grazing. Pastoral communities within the district include residents belonging to the Taturu indigenous tribe. These pastoral communities practice transhumance whereby livestock is herded towards distant water- and pasture-holding areas, at the start of the dry season. One instance of this seasonal livestock migration is that which involves the pastoral shift from the villages of Kazikazi, Karangasi, Itigi, Tura and Loya, towards Lake Chaya, which provides grazing refuge following the onset of dry spells in the villages.

Table 11-20 Livestock rearing in Uyui District

Livestock	Total for 2018
Cattle	441,090
Donkeys	964
Goats	152,180
Sheep	72,118
Pigs	742
Chicken	582,805
Ducks	106,812

Other agricultural activities in Uyui District include fishery and beekeeping. Official statistics indicate that by 2018, a total of 682 households were employed in fish farming, and 1,130 residents practised beekeeping. Further statistics on the district's bee-keeping industry are provided in Table 11-21.

Table 11-21 Beekeeping in Uyui District

Year	Number of beehives		Number of
	Traditional	Modern	Deekeepers
2017/2018	10,166	3,054	1,130
Production			
Honey	Revenue (TZS)	Beeswax	Revenue (TZS)
60,460 litres	604,600,000	6,347 kg	63,470,000



Other productive sectors

The remainder of the district's economy includes miscellaneous enterprises, which generated an annual revenue contribution of TZS 399,892,753 in 2018. A total of 1,200 entrepreneurs were registered in Uyui, in the same year.

As shown by preliminary results of the ongoing resettlement-oriented socio-economic surveys, some of the locals engage in the harvesting and extraction of natural resources for subsistence and local trade. These livelihoods include small-scale charcoal production, collection of firewood, foraging for edible and medicinal plant products and honey, as well as artisanal stone mining and crushing.

11.2.3.5 Public infrastructure and access to social services

Transportation

The road network within Uyui District features a 140 km trunk road linking Itigi district to Tabora municipal, as well as district, regional and feeder roads that connect the district to the neighbouring districts of Sikonge, Nzega and Ikungi. The district is also traversed by the existing central railway line running between Dar es Salaam and Tabora municipal.

No air strips have been established within the district, and the nearest airport is located within Tabora municipal.

Telecommunication

With regard to telecommunication coverage, the district is served by operators including Tanzania Telecommunication Company Limited (TTCL) Vodacom, Airtel, Tigo, Halotel and Zantel.

Energy

Official and up-to-date information on the district-wide sources of energy in Uyui District was not available at the time of this assessment. An earlier study (2013) by the economic and social research foundation reported that while some of the district's population has access to the national electrical grid, alternative energy sources for domestic use include firewood, paraffin and natural gas.

The ESIA baseline survey indicates that the majority (81%) of surveyed households within the project-affected communities depend on firewood for cooking and none of the households use electricity.







Education

The district's educational sector includes centres for primary, secondary and adult education. The socioeconomic survey enumerated a total of 117 primary schools within the district, all of which are government-owned, with the exception of one institution, which is operated by a faith-based organization. According to the most recent available statistics, a total of 8,111 pupils were attending primary school in 2018, of whom 3,980 are male and 4,131 are female. An insufficient total of 702 teachers was recorded in the same year.

Further, a total of 19 secondary schools have been established in Uyui, 18 of which are public schools. A total of 8,158 pupils attended secondary school in 2018, of whom 4,078 are male and 4,080 are female. The number of teachers reported in the same year totalled 327. In addition, a total of 64 adult learning centres were reported as being active in 2018, with a total attendance of 558 learners.



Figure 11-25: Distribution of surveyed households by educational attainment in Uyui District

The ESIA baseline survey indicated that the majority of interviewed household heads have not attained education beyond the primary level, and none of the household heads has completed tertiary education.

Health care

In 2018, healthcare facilities within Uyui District include one government-owned health centre as well as 43 public and 5 private dispensaries. No hospitals had been established within the district, and a shortage of medical services was reported. The in-patient



capacity of the resident health centre was 29, and a total deficit of 276 healthcare workers was reported in the same year.

Morbidity

Table 11-22 presents the most recent publicly available statistics on the incidence of diseases in Uyui District. According to the district profile report, common diseases in 2018 were respiratory infections, diarrhea, Malaria and skin diseases.

S/n	Patients under 5 years of age		Patients over 5 years of age	
	Diseases	Incidence	Diseases	Incidence
1	Malaria	29,322	Malaria	13,878
2	Respiratory infection	7,330	Respiratory infection	2,456
3	Diarrhoea	4,523	Diarrhoea	1,112
4	Skin diseases	931	Skin diseases	678
5	Worms	832	Urinary tract infection	976
6	Blood deficiencies	547	Blood deficiencies	398
7	Fungal infections	234	GDS	378
8	Small injuries	131	PID	354

Table 11-22: Top ten reported diseases in Uyui District, 2018

Regarding project-affected communities, diseases cited as most common in the ESIA socio-economic survey are diarrhoea, urinary tract infections and HIV/AIDS.

Water supply and sanitation

Sources of water in Uyui District include charco dams, freshwater springs, shallow wells, boreholes and rainwater harvesting systems. In 2018, only 36.6% of the local population had access to clean water supply, relative to the target of 75%. The district administration has instituted measures for the protection of local freshwater resources, including the conservation and restoration of resident forest reserves, sensitization of local communities to sustainable water consumption and the formulation of by-laws for water resource management. In the same year, a water supply scheme was underway, which was set to establish an additional 13 boreholes in the villages of Ishihimulwa 2, Kasisi B 1, Gilimba 2, Loya Mlimani 1, Goweko 1, Makazi 2, Ikongolo 1, Utura 1, Songambele 1 na Nkutu 1. Table 11-23 provides an overview of the most recently reported water sources within the district.

Water source	Quantity
Hand-pump boreholes	239
Rainwater harvesting storage tanks	68
Freshwater springs	24
Charco dams	1
Piped water supply schemes	6



The baseline survey of project-affected communities indicates that the majority (62%) of surveyed households rely mainly on unprotected wells for water supply, other utilized sources being protected wells and piped water supply schemes.





11.2.3.6 Socio-economically vulnerable groupings

Of the households surveyed within the project-affected communities, 31% were provisionally identified as vulnerable. The leading areas of socioeconomic vulnerability amongst the households is elderly household headship and chronic disease, as shown in Figure 11-27.



Figure 11-27: Distribution of surveyed households by vulnerability category in Uyui District

11.2.3.7 Social security and access to credit facilities

The socio-economic survey established that resident CBOs dedicated to social development initiatives include:

- Mbola Millennium village project, which is geared towards lifting target communities out of poverty, in line with the UN sustainable development goals
- TASAF program which enables district- and village leadership to address abject poverty through the design and implementation of need-based interventions



• Uyui paralegal centre, which offers legal support for low-income residents who cannot afford access to judicial systems.

11.2.3.8 Land-use and tenure

The rural landscape of the project's AoI in Uyui comprises residential clusters interspersed with crop farms, miombo woodland, bushland and thickets. Commercial zones are also present, particularly within the district centre. Based on preliminary data from the ongoing resettlement surveys, public infrastructure within the area includes the existing MGR line, places of worship, graveyards, and water wells. Most of the private property within the area is used for permanent residence, with formal and informal ownership rights.

11.2.3.9 Housing quality

Structurally, the housing within the project-affected communities largely includes buildings made of clay floors, mud walls, and iron sheet and thatch roofing. A small proportion of resident buildings have cemented floors.

11.2.4 Tabora municipal

11.2.4.1 Administrative boundaries

Tabora Municipal is one of seven districts constituting Tabora region. It covers an area of 1,615 km², accounting for 2% of the total regional area. The municipal is encompassed by Uyui district but bordered by Nzega district to the north. Administratively, the district is divided into a total of 29 wards, 41 villages and 134 mitaa.

The project area extends across 15 mitaa within Tabora municipal, namely: Itulu, Ndevelwa, Inala 1, Kazima, Ifucha, Maili tano, Kidatu B, Timkeni, Uyui, Kakulungu, Nzubuka, Izugamiwa, Kakola, Magoweko and Kiwembe.

11.2.4.2 Population and demography

The 2012 national housing and population census enumerated a total of 226,999 residents within Tabora Municipal, of whom 111,361 were male and 115,638 were female. A total of 55,719 households were recorded, with an average size of 5 persons. Based on the population growth rate established by the census, the district population was projected to reach 301,145 by 2019.





Figure 11-28: Distribution of surveyed households by size in Tabora Municipal

11.2.4.3 Ethnic make-up and culture

The ethnic make-up of Tabora Municipal predominantly comprises Nyamwezi and Sukuma peoples, with minority groups including Waha, Wagogo, Wanyiramba, Wachagga and Wafipa.

11.2.4.4 Local economy and livelihoods

According to the district's official profile, the most recently documented per capita income of Tabora Municipal is TZS 1,551,651 (recorded in 2017). The economy of urban Tabora is primarily dependent on agriculture, which yields an 18% contribution to the local economy and employs over 50% of the resident population.

As shown by the baseline survey, over 70% of interviewed household heads identified crop farming as their households' primary source of income, with the second most prevalent primary livelihood being small businesses. In addition, about 75% of the household heads indicated that their secondary income is derived from crop farming, while about 10% of the household heads reported a lack of secondary livelihoods.

Furthermore, all of the surveyed households reported a monthly income range of TZS 50,000 to 100,000.





Figure 11-29: Distribution of surveyed households by primary income source in Tabora Municipal

Agriculture

In Tabora Municipal, commercial and subsistence agriculture is widespread and dominant within the area's per-urban reaches. Table 11-24 provides the most up-to-date official statistics for crop production within the municipal. In 2018, a total of 26,552 resident households engaged in crop farming.

Crop	Cultivated area (ha)	Harvest (tonnes)	
Food crops			
Maize	7,376	7,689	
Rice	2,385	2,980	
Cassava	5,036	8,098	
Beans	187.9	168	
Sweet potatoes	3,408	7,670	
Sorghum	140	104	
Cash Crops			
Tobacco	550	608	
Groundnuts	5,986	3,868	
Sunflower	2,004	1,634	

Table 11-24 Production of crops in Tabora Municipal

The bulk of crop farming in urban Tabora is reliant on the following irrigational schemes:

- Kakola dam, serving about 32 ha at Magoweko in Kakola ward
- Inala dam irrigation scheme Ndevelwa ward, serving 250 ha of farmland
- Cheko dam in Uyui ward, anticipated to irrigate about 200 ha after its expansion
- Iyombo irrigation scheme in Tumbi ward, set to irrigate 200 ha.


Local agriculture further includes livestock rearing, albeit to a smaller extent, due to the low productivity of indigenous animal breeds, erratic dry spells, lack of veterinary facilities and extension services. Table 11-25 provides an overview of the most recently reported livestock statistics in urban Tabora.

Livestock	Quantity
Cattle	73,331
Goats	33,539
Sheep	7,931
Pigs	13,741
Donkeys	235
Poultry	1,036,314

Table 11-25 Livestock category totals recorded for Tabora Municipal, 2018

Due to the area's largely arid climate, pastoralist communities encroach on forested areas to establish fresh pastures for their livestock. In 2018, some 52,549 resident households were reported to engage in fish farming, which makes up about 3% of Tabora's GDP. Fishery establishments are based around Igombe dam and the rivers of Ugalla and Walla, with a minority of aquaculture undertaken using constructed ponds. Beekeeping is also prevalent in the municipal, particularly within the wards of Uyui, Ndevewa, Ifucha, Ntalikwa, Kabila, Tumbi, Kalunde, Kakola, Ikomwa and Misha. In 2015, the production of honey and beeswax within the district totalled 600 kg and 31 kg respectively.

Local industry

While the district economy is centred on agriculture, industrial production is an increasingly large contributor to the local GDP. In 2015, the municipal's small-scale industries accounted for 15% of the local economy. Table 11-26: provides the latest available statistics for industrial establishments within urban Tabora.

No.	Name	Ward	Location	Ownership
1	Tabora textile mills	Mbugani	Mwanza Road	Private
2	Tabora timber supply	Mapambano	Kiloleni industrial area	Private
3	Azimio collage (SIDO)	Mapambano	Kiloleni industrial area	Government
4	Tabora Misitu products	Mapambano	Kiloleni industrial area	Private
5	Elimu Bahari printers	Kanyenye	Boma Road	Government
6	Frontex Associate printers	Gongoni	Market Street	Private
7	Tanzanian railway corporation locomotive workshop and sawmills	Isevya	Railways side	Government
8	SIDO	Mbugani	Mbugani industrial area	Government

 Table 11-26: Industries operating in Tabora Municipal



No.	Name	Ward	Location	Ownership		
9	TLTC tobacco	Mpela/Usule/Kilo leni	Kiloleni industrial area	Private		
10	Alliance One	Mapambano	-	Private		
11	JTI tobacco	lsevya	-	Private		
12	Mihan gas depot	Malolo	Malolo industrial area Priv			

Commerce

Between 2015 and 2018, wholesale and retail businesses constituted up to 35% of the urban Tabora's GDP. The expansion of financial services within the municipal has spurred the growth of small to medium enterprises. Some of the main financial institutions in the municipal include TPB, CRDB, Exim Bank, DTB, NBC, Access Bank and NMB. Other financial institutions include: Four insurance companies and microfinance institutions such as Pride, Tunakopesha Limited, Bayport, Western Union and FINCA Tanzania.

Table 11-27 provides an overview of formally registered enterprises within Tabora Municipal in 2018.

No.	Type of business	Quantity
1	Retail shops	2000
2	Sub-wholesale	30
3	Wholesale	11
4	Pharmacy	8
5	Milling machines	95
6	Second-hand clothes shops	170
7	Lodges	150
8	Hardware & building material	60
9	Stationaries	80
10	Contractors	10
11	Garage & workshop	25
12	Filling stations	10
13	Spare parts	40
14	Agriculture inputs	50
15	Cereals (agriculture crops)	30
16	Bar	56
17	Grocery	125
18	Medical stores shops	70
19.	Service industries	150
20.	Local brews	25

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Other productive sectors

As shown by preliminary results of the ongoing resettlement-oriented socio-economic surveys, numerous project-affected residents also engage in the harvesting and extraction of natural resources. These livelihoods include small-scale charcoal production, collection of firewood, and foraging for edible and medicinal plant products and honey.

11.2.4.5 Public infrastructure and access to social services

Transportation

Regarding road transport, Tabora Municipality has a total road network of 542 km, which is distributed between trunk roads (60 m wide), district roads (30 m), local distributor roads (20 m), neighbourhood access roads (15 m) and plot access roads (10 m). Most of the roads radiate from the central business district (CBD) to other parts of the municipality. Financing for the construction and maintenance of the municipal road network is provided by the Road Fund Board. Due to limited funding, rehabilitation for the municipal's main roads is not always carried out annually.

Road categories	Total distance (km)		
By surface condition			
Tarmac	122		
Gravel	141		
Earth	279		
By size			
Trunk roads	118		
District roads	85		
Local distributors	127		
Access roads (residential, industrial and shopping areas)	212		

Table 11-28: Road network by grade in Tabora Municipal

Regarding railway transport, Tabora Municipal is traversed by the central railway line linking Dar es Salaam to the country's northern (Mwanza) and Western (Kigoma) regions. The railway is an integral part of the municipal's economic infrastructure, providing low-cost transportation services for passengers and cargo. Nevertheless, existing railway operations across the district are constrained by dilapidated infrastructure and shortage of maintenance equipment.

Tabora airport is situated about 8 km away from the CBD, with a total area of 881 ha, and a runway measuring 1.9 km in length and 30 m in width. The airport is operational throughout the year, with daytime flights linking urban Tabora to Dar es Salaam and Kigoma, up to three times a week.



Telecommunication

Land-based and cellular telecommunication service providers operating within the municipal include TTCL, Vodacom, Airtel, Tigo and Zantel.

Energy

In Tabora Municipality, the national power grid (operated by TANESCO) is the principal energy source for domestic, commercial and industrial purposes. Most establishments in the municipal's CBD have reliable access to power throughout the year. A district-wide socio-economic survey conducted in 2015 indicated that about 70% of resident households had access to the central power supply service, whilst the remaining 30% used other sources of energy, which included firewood, paraffin and natural gas.

The baseline survey undertaken indicates that the majority (62%) of surveyed households within the project-affected communities depend on firewood to for cooking and none of the households use electricity.



Figure 11-30: Distribution of surveyed households by source of energy for cooking in Tabora Municipal

Education

The district's educational sector includes centres for pre-school, primary, secondary and tertiary education. By 2018, a total of 80 primary schools were operational within the district, 75 of which were government owned. In the same year, a total of 23,173 and 23,670 children were enrolled into primary school. School attendance was reported to range between an average of 95% in the CBD and 75% in the municipality's peri-urban periphery. The main cited reasons for school absenteeism and drop-outs were long commutes, early marriage and household relocation associated with shifting cultivation and pastoralism.

Municipal records also indicate that a total of 32 secondary schools were established within the area by 2018, of which 23 were government owned. The total secondary school enrolment reported in the same year was 9,239 students, which was concentrated around the central (urban) parts. In addition to secondary educational facilities, the district hosts three large university colleges, and an additional six smaller colleges, most of which specialize in agriculture and public service.

The baseline survey indicates that the majority of interviewed household heads have not attained education beyond the primary level, and less than 5% of the household heads have completed tertiary education.



Figure 11-31: Distribution of surveyed households by educational attainment in Tabora Municipal

Health care

In total, 43 healthcare facilities have been established within Tabora Municipal, which includes three hospitals, two health centres and 38 dispensaries. Of the three resident hospitals, two are government-owned, and one is under the ownership of a faith based organisation (FBO). Of the two resident health centres, one is government-owned, while the other is a private facility. Of the 38 cited dispensaries, 28 are government-owned, five are private and the additional five are operated by FBOs. With regard to the sector's manpower, the facilities are understaffed with 260 medical workers, requiring an additional 138 professionals to meet the national health sector resourcing guidelines.

Morbidity

While recent official statistics on the morbidity of Tabora Urban were not available at the time of the assessment, diseases cited as most common in the ESIA socioeconomic survey are diarrhoea and urinary tract infections.

Water supply and sanitation

Of the 29 wards in Tabora, 19 have access to existing water distribution scheme, to varying extents. In 2020, the estimated water demand for Tabora Municipality was 25,000 m³/day, and 72% of the local population had access to water supply services. The growth of municipal population and expansion of settlements beyond the CBD have led to an increased demand for water, and the municipality's administration is planning to introduce a high-capacity water supply scheme drawing from an intake facility in Lake Victoria. The main existing sources of water within Tabora include (i) Kazima dam, (ii) Igombe Dam and (iii) Kitete wells.

The utility charged with water supply in Tabora Municipal is the Tabora Urban Water Supply Authority (TUWASA). The utility currently serves five service areas extending across 19 wards, as detailed in Table 11-29.

No.	Zone name	Area / Ward
1	A	Chem chem, Malolo, Mbugani, Skanda, Kidongo chekundu and part of Ng'ambo
2	В	Gongoni, Kanyenye, Kitete, Itetemia and Ng'ambo

Table 11-29: Operational water supply schemes in Tabora Municipal



No.	Zone name	Area / Ward	
3	С	Cheyo, part of Isevya and Mpela	
4	D	Isevya, Kiloleni, Ipuli, and Mtendeni	
5	E	Misha, Itaga, Kalunde and Tumbi	

The baseline survey of project-affected communities indicates that the majority (56%) of surveyed households rely mainly on the municipal piped water scheme for water supply, other utilized sources being boreholes and unprotected wells.



Figure 11-32: Distribution of surveyed households by water source in Tabora Municipal

The existing sewerage network in Tabora mainly serves educational institutions and commercial establishments in Gongoni, Kanyenye and Chem Chem Wards. In all, only 2% of local establishments are connected to the system, with the remainder of the settlements utilizing on-site sanitation systems such as free-standing pit latrines and septic tank systems for flush-toilets. A socio-economic survey conducted in the municipal in 2015 established that about 41% of resident households use traditional pit latrines, 20% use improved pit latrines, while 39% rely on soak away pits and septic tanks.

11.2.4.6 Socio-economically vulnerable groups

Of the households surveyed within the project-affected communities, 32% were provisionally identified as vulnerable. The leading areas of socioeconomic vulnerability amongst the households is female household headship, chronic disease and disability, as shown in Figure 11-33.



Figure 11-33: Distribution of surveyed households by vulnerability category in Tabora Municipal

11.2.4.7 Social security and access to credit facilities

A total of 77 co-operative CBOs have been registered in Tabora Municipal to facilitate commercial development and poverty alleviation, including 11 agricultural marketing co-operative societies (AMCOS), 46 SACCOS, 9 retail associations, 11 service associations and one beekeeping association.

Additionally, Tabora Municipal Council has, in association with humanitarian NGOs, established a number of foster homes and special needs training centres for disadvantaged community members including orphaned children, elderly dependents and disabled residents. Table 11-30 provides official statistics on the number of relief centres recorded in the year 2020.

Institutions	Location	Occupation / attendance			
		Male	Female	Total	
Foster homes for	SFS Ipuli	37	-	37	
children	Cheyo	3	5	8	
	Kazima-Ifucha (TCFDT)	6	2	8	
	Igambiro Islamic Centre Misha	11	29	40	
Foster homes for children and elderly dependents	St. Theresia Gongoni	18	24	42	
Shelter for the disabled and elderly	Amani Ipuli erly		50	90	
Training institutions dedicated to disabled residents	Furaha Primary School Gongoni	N/A	N/A	N/A	

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Humanitarian NGOs operating within Tabora Municipal include Africare, Tabora Development Foundation Trust (TDFT), Concern for the Elderly, Tabora Youth Advisory Group, Health of Aids and Family Planning Tabora (HAFATA), People living with HIV/AIDS TABORA (PLHATA), Tabora Carers for People Living with HIV/AIDS (TACAPHA), Tumaini Development Association (TUDEA), Association of the Centre for Social Services (CESOSE) and the Anglican church of Tanzania. In addition, NGOs extending dedicated assistance to vulnerable women include Umoja wa Wajane Tabora Mjini and Tupendane Women Group.

11.2.4.8 Land-use and tenure

The rural landscape of the project's Aol in Tabora Urban comprises residential clusters interspersed with crop farms, bushland, thickets and patches of woodland. Commercial zones are also present within the municipal. Based on preliminary data from the ongoing resettlement surveys, public infrastructure within the area includes the existing MGR line, places of worship, graveyards, and water wells. Most of the private property within the area is used for permanent residence, with formal and informal ownership rights.

11.2.4.9 Housing quality

Structurally, the housing within the project-affected communities largely includes buildings made of cemented and clay floors, mud walls and iron sheet roofing. A smaller fraction of resident buildings have thatch roofing.

11.2.5 Sikonge District

11.2.5.1 Administrative boundaries

Sikonge District is one of seven districts constituting Tabora region. It covers an area of 27,873 km², accounting for 37% of the total regional area. The district is bordered by (i) Uyui District to the north, (ii) Urambo and Mlele Districts to the west, (iii) Songwe and Chunya Districts to the south, and (iv) Itigi District to the east. Administratively, the district is divided into a total of 20 wards and 71 villages.

The project area extends across one village within Sikonge District, namely Nyahua.

11.2.5.2 Population and demography

The 2012 national population and housing census enumerated a total of 179,883 residents within Sikonge District, of whom 88,947 were male and 90,936 were female. Based on the population growth rate established by the census, the district population was projected to reach 250,862 by 2022.

The majority of households surveyed within the district's affected villages reported a household size of six to ten members, as shown in Figure 11-34.

RSK Scapilals



Figure 11-34: Distribution of households by size in Sikonge District

11.2.5.3 Ethnic make-up and culture

The Nyamwezi make up the majority of Sikonge District's resident population. In general, resident communities share a knowledge of Swahili, patriarchal customs, as well as the dominance of Islamic faith.

11.2.5.4 Local economy and livelihoods

The economy of Sikonge District is centred on agriculture, which accounts for about 80% of the district's GDP. Other notable contributors to the district's economy mining, wood processing and micro-enterprises.

As shown by the baseline survey, over 75% of interviewed household heads identified crop farming as their households' primary source of income, with the second most prevalent primary livelihoods being small businesses and employment in civil service. In addition, about 88% of the household heads indicated that their secondary income is derived from crop farming, and none of the household heads reported a lack of secondary livelihoods.

Furthermore, all of the surveyed households reported a monthly income range of TZS 50,000 to 100,000.



Figure 11-35: Distribution of surveyed households by primary income source in Sikonge District

Agriculture

The total reported area of arable land in Sikonge District is 140,465 ha, of which only 84,678 ha (60%) is currently exploited for agriculture. A large proportion of local crop farming is undertaken on a subsistence basis, albeit the cultivation of tobacco is carried out commercially. The district's crop farming sector is challenged by limited irrigation infrastructure, lack of agricultural machinery and constrained access to agricultural inputs, such as fertilizer and pesticides. Of the 1,550 ha with irrigation potential, only 375 ha is irrigated for the cultivation of crops such as paddy, maize and vegetable, by a total of three irrigation schemes. The district's predominant crops include paddy, maize and cassava. In 2021, about 130,026 t of food crops were harvested within the district. The reported yield of tobacco in the same year was 6,585 t.

Livestock rearing represents the second largest section of local agriculture, with a base consisting of 373,298 cattle, 130,710 goats, 20,150 sheep, 3,124 pigs, 608 donkeys, 1,060,800 chicken and 12,544 ducks. Furthermore, a total of 38,275 resident households were reported to engage in fishery in 2018. Fishing is based around the rivers of Koga, Kululu, Uluwa na Walla, whereas fish farming is carried out in the constructed ponds within Ulyanyama, Utyatya, Uluwa na Igumila. In 2021, a total of 6,555 residents were reported to partake in beekeeping, and the production of honey in recent years has averaged 2,000 t.

Local industry

Sikonge DC is also towards developing the district's nascent industrial sector, and industrial zones measuring a total area of 1,390 ha have also been earmarked for prospective investment. In 2021, the district's first honey processing facility was operationalized. Primary production within the district notably includes small-scale and artisanal mining of gold and aggregates in Kitunda and Inyonga East. In 2021, the DC reported a total of 63 effective gold mining licenses.

11.2.5.5 Public infrastructure and access to social services

Transportation

At present, transportation in Sikonge District is largely limited to road transit. To date, the road network in the district measures a total length of 1,364 km. Table 11-31 itemizes the extent of the road network by the national road size categories.



Road categories	Total distance (km)
Trunk roads	335
Regional roads	217
District roads	400
Feeder roads	412

Table 11-31: Road network by grade in Sikonge District

Energy

Power sources available to Sikonge's local population include the national electrical grid and off-grid systems drawing on fuel and solar energy. By 2021, only 15% of the district's residents had access to the central power supply, and a large portion of the population was reported to use charcoal and firewood for domestic heating and cooking.

The baseline survey undertaken indicates that the majority (78%) of households within the project-affected communities depend on firewood for cooking, and none of the households use electricity.



Figure 11-36: Distribution of surveyed households by energy source in Sikonge District

Education

By 2021, the DC reported a total of 98 primary schools, 94 of which are government owned. The total reported count of primary school learners was 5,660, which included 28,420 boys and 28,093 girls. The primary schools were understaffed, with a shortage of 154 teachers. In the same year, the district also had a total of 21 secondary schools, which hosted a sum of 6,435 students, including 3,014 boys and 3,421 girls. Secondary schools were also reported as being short of 44 teaching staff, according to national public education guidelines. All of the schools fall under the DC's ownership, with the exception of two institutions.



Figure 11-37: Distribution of surveyed households by educational attainment in Sikonge District

Health care

By 2021, a total of 37 healthcare facilities were operational within the district, which include two hospitals, four health centres and 31 dispensaries. In the same year, the DC reported a shortage of 17 health centres and 416 medical staff, by national public healthcare guidelines.

Morbidity

While recent official statistics on the morbidity of Tabora Urban were not available at the time of the assessment, the most prevalent diseases reported by households engaged in the ESIA socioeconomic survey are gastrointestinal infections such as diarrhoea.

Water supply and sanitation

In 2021, a district-wide survey established that 39% of the resident population has access to clean water. In the same year, the DC enumerated a total of 425 water distribution points, hand-pump 60 boreholes and 181 shallow wells.

The baseline survey of project-affected communities indicates that all of the surveyed households rely on unprotected wells for water supply.

11.2.5.6 Socio-economically vulnerable groups

Of the households surveyed within the project-affected communities, 22% were provisionally identified as vulnerable. The only areas of socio-economic vulnerability amongst the households are elderly household headship and chronic disease, as shown in Figure 11-38.



Figure 11-38: Distribution of surveyed households by vulnerability category in Sikonge District

11.2.5.7 Social security and access to credit facilities

Banking service providers within Sikonge District include NMB, TPB and CRDB Bank. In addition, a total of 12 SACCOS operate within the district, providing joint savings and credit arrangements to secure the welfare of registered members. In the period 2020 – 2021, the district provided financial assistance (loans) amounting to TZS 120,000,000, TZS 92,000,000 and TZS 8,000,000 for 22 women societies, 16 youth societies and two disabled persons societies.

11.2.5.8 Land-use and tenure

The rural landscape of the project's AoI in Sikonge district comprises residential clusters interspersed with crop farms, grassland, and patches of open woodland. Commercial zones are also present within the district and village centres. Based on preliminary data from the ongoing resettlement surveys, public infrastructure within the area includes the existing MGR line, graveyards, water wells and a CBO office. Most of the private property within the area is used for permanent residence, with formal and informal ownership rights.

11.2.5.9 Housing quality

Structurally, the housing within the project-affected communities equally includes buildings made of clay and cemented floors, and both iron sheet and thatch roofing. The ESIA baseline survey indicated that all sampled households were made of mud walls.

11.2.6 Nzega District

11.2.6.1 Administrative boundaries

Nzega District is one of the seven districts constituting Tabora Region. It covers an area of 7,319 km², accounting for 10% of the total regional area. The district is bordered by (i) Kahama and Shinyanga Districts to the north, (ii) Uyui District to the west, (iii) Tabora Municipal and Uyui Districts to the south, and (iv) Iganga District to the east. Administratively, the district is divided into a total of 46 wards and 179 villages and 17 mitaa.



The project area extends across a total of 25 villages within Nzega District, namely Ibelafinga, Ugembe, Kilino 'A', Buhulyu, Isagenhe, Kidete, Zugimlole, Luhumbo, Mogwa, Ilole, Bukene, Usongwanhala, Kayombo, Malolo, Nawa, Mahene, Mwino, Nkindu, Sojo, Wella II, Buduba, Ilalo, Iboja, Gulumba and Bulunde.

11.2.6.2 Population and demography

In 2012, the national housing and population census enumerated a total of 502,252 residents within Nzega District, of whom 245,003 were male and 257,249 were female. The district's average household size was reported to be six persons. Based on the population growth rate established by the census, the district population was projected to reach 648,054 by 2019.

The majority of households surveyed within the district's affected villages (as part of the ESIA) reported a household size of one to five and over ten members, as shown in Figure 11-39.



Figure 11-39: Distribution of surveyed households by size in Nzega District

11.2.6.3 Ethnic make-up and culture

The Nyamwezi tribe accounts for the majority of the population within Nzega District, with a lesser representation of Wasukuma and Waha. Resident communities share a knowledge of Swahili and patriarchal customs, with Nyamwezi people being a largely Muslim demographic.

11.2.6.4 Local economy and livelihoods

As shown by the baseline survey, over 90% of interviewed household heads identified crop farming as their households' primary source of income, with the second most prevalent primary livelihood being employment in civil service. In addition, about 95% of the household heads indicated that their secondary income is derived from crop farming, while about 3% of the household heads reported a lack of secondary livelihoods.



Figure 11-40: Distribution of surveyed households by primary income source in Nzega District

Furthermore, all of the surveyed households reported a monthly income range of TZS 50,000 to 100,000.

Agriculture

Crop farming employs about 75% of the district's population. The vast majority of farmers are smallholders with limited irrigational facilities and basic implements. Other constraints within the cultivation sub-sector include a lacking soil fertility, drought and pest induced crop failure, and poor transportation infrastructure for access to commercial value chains and markets. Cereals and maize in particular are cultivated extensively for food production. Locally grown cash crops include paddy, cotton and tobacco.

Mining

The economy of Nzega District is notably inclusive of mining activities. The district hosts over 26 gold-mining companies. Statistics related to the local gold extraction sub-sector were not available at the time of this assessment. The district also has reserves of Zircon, Garnets, Tourmaline, and Ruby.





Figure 11-41: Small-scale gold mining activities in Wella 2 and Mahene villages in Nzega District

Other productive sectors

Fishing activities are undertaken on a small-scale basis and make an insignificant contribution to the district economy. Kilimi and Uchama dams located in Nyasa division are the main water bodies used for fishery and water supply for Nzega Town.

Beekeeping is another important economic activity in the district, especially in Bukene, Puge and Nyasa divisions. Despite its importance, the sector is still underdeveloped due to lack of know-how and modern technology. There are few or no modern beehives compared to tradition beehives. This situation has contributed to low production of honey and bees – wax within the sector. Beekeeping production levels could be raised if beekeepers are assisted to enable them to change from using traditional to modern beehives which are more efficient in honey production. This could be achieved through improved extension services and where possible the provision of micro-credits to beekeepers as seed money.

As shown by preliminary results of the ongoing resettlement-oriented socio-economic surveys, some of the locals engage in the harvesting and extraction of natural resources for subsistence and local trade. These livelihoods include small-scale charcoal production, collection of firewood, foraging for edible and medicinal plant products and honey, as well as artisanal stone mining and crushing.

11.2.6.5 Public infrastructure and access to social services

Transportation

With regards to road transit, the district has a road network totalling 1,046 km in length. The table below provides an overview of the road grades within the district. About 20% of the road network is navigable throughout the year.

Road grade	Length (km)
Tarmac	55
Gravel	149.5
Earth	644.5

Table 11-32: Road grades within Nzega District

The district is traversed by the existing central (Dar es Salaam-Isaka-Kigoma) railway, with a total three resident train stations located in Isagembe, Bukene and Igusule.

Energy

The ESIA baseline survey indicates that the majority (85%) of households within the project-affected communities depend on firewood to for cooking, and none of the households use electricity.





Figure 11-42: Distribution of surveyed households by source of energy for cooking in Nzega District

Education

Up-to-date information on the inventory of educational institutions in Nzega District was not available at the time of this assessment. According to district office consultations, by 2018, Nzega district had 146 primary schools and 24 secondary schools. Truancy is the main reason for dropouts in the district. The rate of dropouts increased by 47.7% between 2000 and 2009, with more male dropouts recorded.

The ESIA baseline survey indicates that the majority of interviewed household heads have not attained education beyond the primary level, and none of the household heads has completed tertiary education.



Figure 11-43: Distribution of surveyed households by educational attainment in Nzega District

Healthcare

Nzega District offers two hospitals, four health centres and 42 dispensaries. The district's healthcare sector has a shortage of medical personnel. The deficit has risen following the implementation of the primary health services development program, which was aimed at increasing the number health centres within the district.



Morbidity

According to the district's official profile report, malaria is the most common disease within the district, accounting for 52% of registered cases amongst children under the age of five, and 39% for other cases in 2022. Other major diseases include acute respiratory infections, eye infections, and intestinal worms.

With regard to project-affected communities, diseases cited as most common in the ESIA socioeconomic survey are diarrhoea, typhoid, urinary tract infections and respiratory infections.

Water supply and sanitation

The district has a relatively limited watersheds owing to its flat topography. Groundwater is thus the main source of water for the majority of the district's residents. According to the district's official profile report, 79% of rural residents and 54% of urban residents rely on unprotected wells for water supply. About 15% of the rural population has access to protected wells.



Figure 11-44: Shallow well in Mbogwe Village, Nzega District

The ESIA baseline survey of project-affected communities indicates that the majority (72%) of surveyed households rely on unprotected wells for water supply, other utilized sources being boreholes, a piped water supply scheme, spring, river and rainwater harvesting.





11.2.6.6 Socio-economically vulnerable groups

Of the households surveyed within the project-affected communities, 53% were provisionally identified as vulnerable. The leading areas of socioeconomic vulnerability amongst the households is elderly and female household headship, as shown in Figure 11-46.



Figure 11-46: Distribution of surveyed households by vulnerability category in Nzega District

11.2.6.7 Social security and access to credit facilities

Numerous resident NGOs and CBOs serve to buttress the economic welfare of lowincome communities. With regards to commercial financing, SACCOS provide credit access to the vast majority of low-income households and small entrepreneurs. Some of the SACCOS derive their funds from formal financial institutions, such as banks. By 2022, a total of 20 SACCOS had been registered within the district.

Cooperatives are also useful in the marketing of agricultural produce and other commodities locally and within nearby markets. To date, a total of four consumer



cooperatives and 47 marketing cooperatives have been established with memberships totalling 432 and 2,866 respectively.

11.2.6.8 Land-use and tenure

The rural landscape of the project's Aol in Nzega District comprises residential clusters interspersed with crop farms, open woodland, bushland and thickets. Commercial zones are also present, particularly within the district centre. Based on preliminary data from the ongoing resettlement surveys, public infrastructure within the area includes the existing MGR line, graveyards and water wells. Most of the private property within the area is used for permanent residence, with formal and informal ownership rights.

11.2.6.9 Housing quality

Structurally, the housing within the project-affected communities largely includes buildings made of clay floors, mud walls, and iron sheet and thatch roofing. A small proportion of resident buildings have walls made of clay bricks.

11.3 Social impacts identified and assessed: construction phase

11.3.1 Involuntary resettlement due to land acquisition

The project's construction phase will involve the establishment of temporary and permanent facilities that will be functional during the project's construction and/or operational phases. The physical footprint of these facilities overlies a myriad of existing landholdings, land-based assets and resources, under private and communal ownership. The imminent expropriation of occupied and utilized land parcels within the project corridor therefore triggers the involuntary displacement of various existing land rights holders.

Table 11-33 provides a collective overview of the spatial extent of the project's core and ancillary facilities. The counts and land-take requirements for these facilities are tentative and presented for indicative purposes, pending the completion of the project's detailed design.

Project Facility	Land-Take (m²)			
	Lot 3	Lot 4	Total	
Railway embankment	19,487,722	7,990,566	27,478,288	
Stations, freight, passing loop and siding	116,019	93,526	209,545	
Railway fence	1,177,300	483,656	1,660,956	
Marshalling yards	0	406,556	406,556	
Workshops	0	12,153	12,153	
Catenary system	344,072	155,510	499,582	
TPS and ATS	3,822	27,900	31,722	

Table 11-33: Provisiona	I counts and land	-take areas for the	e project's planned fa	cilities
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Capilaly	North and a

Project Facility	Land-Take (m²)		
	Lot 3	Lot 4	Total
Sleeper production and storage	359,344	0	359,344
Access roads	450,000	109,707	559,707
Rock quarry sites	2,680,475	1,112,194	3,792,669
Borrow pits and dumping sites	8,421,211	3,918,110	12,339,321
Labour camps	1,982,000	486,568	2,468,568
Total	35,021,965	14,796,446	49,818,411

The chain of planned facilities extends across a total of two administrative regions and six constituent districts, with a longitudinal span of 534 km. The chainage cuts across a predominantly rural geographic mosaic, which includes open land, forest reserves, farmland, commercial centres, residential zones, and burial sites. The sub-sections below elaborate on the socio-economic receptors subject to expropriation-based displacement and associated impacts.

Analytical Scope and Limitations

As detailed in Section 4, the project's broader development will require the establishment of associated facilities including (but not limited to) an overhead transmission line, truck parking yards, bus terminals, utility installations and dry ports. The scope of this assessment is notably exclusive of these facilities.

Furthermore, certain statistical analyses cited in this section are cumulative and provisional given the active status of the RAP census, socio-economic and asset surveys. The interim analyses serve to inform the livelihoods impact assessment constituting this ESIA. The Project's final RAP will provide complete and definitive information pertaining to land acquisition and resettlement planning.

The assessment and mitigating provisions presented in this section take stock of the survey results and consultation outcomes quoted in various related E&S safeguard documents including the nationally approved ESIA report, Resettlement Policy Framework (RPF), Resettlement Action Plans (RAP), Full IP Plan, and the Human Rights Due Diligence (HRDD) report. Where holding data gaps and discrepancies were noted across published reports, primary databases were cross-checked for triangulation purposes.

Approach for Delineating Area of Influence

For the purposes of the livelihoods impact assessment, a full-scale and uniform Area of Influence (AOI) for the project's resettlement impacts was defined using a corridor approach, whereby a buffer width was set to delimit the full geographical sweep of the impact.

The rounds of resettlement census and asset surveys completed at the time of this assessment established the locations of all the households subject to physical and economic displacement. The farthest PAH location (associated with a planned construction quarry site) recorded 40 kilometres east of the railway centreline marked the



maximum width of the impact buffer. The same buffer width was subsequently applied to both sides of the railway, throughout its longitudinal extent.

Upon further analysis to stratify the full-scale buffer based on the density of affected households (and impact gradient), a six kilometres' distance from the buffer axis was determined to be the 99th percentile of the full (maximum) buffer width. The 99th percentile was also shown to cover the totality of PAHs impacted by the project's Right of Way. On this basis, a core buffer was derived from the full-scale buffer, to enable the (i) identification of an impact zone continuum vis-à-vis discrete/ isolated impact locations along the alignment, and (ii) subsequent development of a streamlined Stakeholder Engagement Plan (SEP).

The analysis further established that a total of 44 PAHs fall outside of the core AOI. These PAHs are situated within a total of three household clusters located 6.5 km, 8 km and 40 km from the SGR centreline, in the villages of Gulumbari, Kakola, Nzubuka and Usongwala.

Thus, according to this delineation, the total number of potentially displaced households (3,648) falls within the full-scale AOI, the vast majority of potentially displaced households (3,604) falls within the core AOI, whilst a total of 44 potentially displaced households can be accounted outliers that fall beyond the core AOI (but within the full-scale AOI).

11.3.1.1 Physical displacement due to loss of residential land and establishments

The RAP-stage socioeconomic census and survey for the project was ongoing at the time of this assessment. Interim survey information nonetheless indicates that physical displacement will be triggered across all six districts. The cumulative number of households subject to physical displacement totalled 566, most of which is attributed to the project's ROW (82%).

Interim survey results further indicate that the majority of the households (69%) are wellestablished, with a local presence exceeding 5 years. Crop farming represents the principal livelihood reported by about 79% of the households, with the remainder of the surveyed population primarily employed in livestock rearing and small-to-medium scale enterprises (SMEs). Recent development studies and the ESIA-stage socio-economic survey consistently indicate that a large fraction of the affected communities comprises low-income households whose primary and secondary earnings are derived from various forms of agricultural production. The studies also show that subsistence agriculture is prominent within the affected communities, with small-scale farms, gardens and livestock sheds situated within residential plots. The current residential location of these communities is closely tied to the centrality of their agricultural livelihoods, with regard to the availability of arable land, irrigational water resources, agricultural inputs, value chains and extension services, specialized financial cooperatives and security of land tenure.

In regard to the existing security of tenure amongst surveyed landowners who are subject to physical displacement, about 27% of the project affected households (PAH) indicated that they do not have official documents to demonstrate legitimate claims to their landholdings. In all, 59% of the PAH surveyed in relation to physical displacement reported that they do not own additional land plots outside of the Project's physical footprint. These statistics suggest that a sizeable fraction of the households bear the risk of being excluded from compensation and resettlement assistance under the regulatory regime of eminent domain, by virtue of their illegitimate tenure and with no fallback property of their own.

As detailed in Section 11, about 32% of surveyed households reported elderly, disabled, chronically sick, destitute and indigenous household members and/or female or child household headship. With a limited income earning capacity, meagre access to mainstream social services, and little to no welfare recourse, such household groupings



are predisposed to impoverishment and severe hardship from economic shocks. For vulnerable PAHs in particular, social disarticulation from physical displacement entails the loss of social networks, local kinship and customary endowments that constitute the households' economic lifeline. Thus, withdrawal of residential land without sufficient indemnity poses a disproportionally high risk of landlessness and homelessness for PAH with an inherent vulnerability based on institutional marginalization and subjugation.

Overall, households potentially impacted by physical displacement bear the risk of subsequent landlessness, homelessness and destitution, on account of the following:

- incomplete socio-economic census and survey of PAH eligible for compensation related to physical displacement due to faulty land-take demarcation and/or exclusion of absentee PAH and/ or marginalization of eligible PAH with undocumented customary rights to residential landholdings (e.g. deemed rights of occupancy), in resettlement planning and implementation this particularly applies to nomadic and transhumant PAH recognized as IP, as the legal framework for land tenure is set to favour the acquisition of land on a sedentary and individual basis, and therefore disadvantages entities that seek to own and/or utilize land collectively, seasonally and with little to no permanent land developments
- flawed valuation resulting in the understatement of cash compensation entitlements for the loss of residential land plots, buildings and fixtures. Flawed valuation can be defined as that which undercuts the full replacement value of affected land and non-land (immovable) assets, such that (i) displacementrelated losses, (ii) transactional costs for procurement of replacement assets and (iii) transitional expenses leading up to the restoration of pre-project income status are not fully defrayed
- once-off disbursement of cash compensation payments without the delivery of basic financial management trainings to PAH with a low-income background, little to no banking experience, and limited knowledge of real estate procurement and investment means to insure against financial dependency;
- provision of cash or in-kind compensation without supplementary assistance and associated implementation monitoring to provide for transitional re-establishment costs and losses
- potential dispossession of female members of physically displaced households, through the establishment of new customary rights of occupancy on resettlement sites in rural jurisdictions that are strongholds for patrilineal customary and Islamic law, and/or possibly through spousal (gender-based) intimidation and/or violence.

Impact significance (pre-mitigation)

Table 11-34 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub- impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance	
Main impact – ir	Main impact – involuntary resettlement due to land acquisition			
Physical displacement due to loss of	Can be characterized as negative, direct,	Affected households residing within land earmarked for construction zones and transit corridors – may incur	Major	

Table 11-34: Receptor sensitivity and impact significance rating



Impact / sub- impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
residential land and establishments	long-term, irreversible, local and high in	homelessness and a drastic change in living conditions and welfare. Rated as highly sensitive.	
	magnitude.	Sub-set of receptors above with pre- project socioeconomic vulnerability (including IPs and informal landowners/ land-users) – more likely to incur homelessness and a drastic change in living conditions and welfare, due to historical marginalization, legally disputable rights to residential property and little to no wherewithal for the absorption of financial shocks. Rated as very highly sensitive.	

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

11.3.1.2 Economic displacement due to loss of productive land/resources and economic establishments

A cumulative analysis based on the ongoing RAP study indicates that economic displacement will be triggered in all six districts, with a total of 3,335 relevant PAH enumerated at the time of this assessment. About 73% of this impact is attributed to the project's ROW.

Potential economic displacement can be categorized as (i) total displacement resulting from a full withdrawal of economically significant landholdings and/or land-based assets and resources, and (ii) partial displacement resulting from a partial withdrawal of economically significant landholdings (with residual landholdings being economically viable). The former sub-impact potentially applies to physically displaced households that stand to incur a loss of access to pre-project livelihoods, due to residential re-establishment on distant replacement property. This secondary impact can be expected to occur in cases where physically displaced households resort to resettlement sites that are not situated within an economically viable distance from pre-project livelihood locations, in default of replacement property (of equivalent value and conditions) close to the livelihood locations.

The series of socioeconomic surveys undertaken as part of the project's ESIA and RAP have established that local production with the affected communities is centred on agriculture and SMEs. Crop farming accounts for the majority (82%) of affected livelihoods, with the remainder of potentially impacted income sources largely distributed between miscellaneous SMEs and livestock keeping. Households with agrarian holdings reported the cultivation of staple crops including maize, millet, paddy, sweet potatoes and cashew nuts, while those with pastoral holdings mainly reported cattle, goat, pig and poultry husbandry. Approximately 53% of the households subject to economic displacement acknowledged having at least one alternative source of income. Over 50% of the PAHs earn a monthly income lower than TZS 100,000, and nearly a third (28%) of these households live in extreme poverty (i.e., below the national poverty line).



Drawing on the latest information from the developing RAP survey, about 77% of household heads within the PAHs surveyed are challenged by pre-existing socioeconomic vulnerabilities, mainly old age, chronic disease and physical disability. Taking into account the households' long-standing presence in the project area, potential economic displacement can have a substantially detrimental impact on fragile livelihoods within the area. With regard to the existing security of tenure, cumulative results of the RAP surveys indicate that at least 55% of the PAH subject to economic displacement do not have formal ownership of the land associated with their affected livelihoods.

Prominent risk factors for the collapse of project-affected livelihoods and diminution of associated income streams include the (i) exclusion and/or marginalization of PAHs eligible for resettlement compensation and assistance, (ii) valuation principles that undermine the full replacement value of economically relevant physical assets and income streams, and (iii) generic compensation and livelihood restoration strategies that fail to address special and differential needs of PAH. An expansive discussion of these considerations is provided in sub-section 11.3.1.1 above. Additional risk factors that specifically apply to the loss of income and upkeep potential due to project-induced economic displacement include the following:

- for PAH with affected livelihoods in the natural resources industry (primary production), in-kind compensation offering land assets and land-based assets or resources that are of lower productive potential relative to withdrawn property; or failure to assist and monitor the development alternative livelihoods where land of equivalent productivity is not available for immediate indemnity
- for PAH with affected livelihoods in the enterprise industry, procedural exclusion of PAH whose SMEs do not operate formally from due compensation at full replacement value; and/ or in-kind compensation in locations with a lower profitability potential in relation to withdrawn property, taking into account relevant markets, service providers and value chain linkages
- for PAH with affected institutional (wage-based) employment, lack of supplementary assistance to provide for losses in a reasonable intervening period (transitional time) leading up to re-employment; or a systemic exclusion of such PAH from assistance for the development of alternative livelihoods for targeted constituencies such as farmers and pastoralists
- for all categories of economically displaced PAH, a loss of social capital from the disintegration of economically significant social networks including communitybased financial resource guilds, specialist associations and extension service providers.

In default of compensation, households subject to economic displacement have a generally limited coping capacity, particularly low-income households that have limited access to credit within their SACCOs. The risk of landlessness also means that such households potentially lack requisite collateral (i.e. land assets) for access to formal financing.

Impact significance (pre-mitigation)

Table 11-35 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.



Table 11-35: Receptor sensitivity and impact significance rating for economic displacement

Impact / sub- impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Main impact – in	voluntary resettlement o	ue to land acquisition	
Economic displacement due to loss of productive land/resources and economic establishments	Can be characterized as negative, direct, long-term, irreversible, local and high in magnitude.	Affected households owning and/or utilizing economic establishments and economically important resources that are located within land earmarked for construction zones and transit corridors – may incur landlessness and a radical change in livelihoods and income status. Rated as highly sensitive. Sub-set of receptors above with pre-project socioeconomic vulnerability (including IPs) – more likely to incur landlessness and a radical change in livelihoods and income status, due to historical marginalization, legally disputable rights to commercial property and little to no wherewithal for the absorption of financial shocks. Rated as very highly sensitive.	Major

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a moderate status.

11.3.1.3 Severance of access to ecosystem services for mobile traditional livelihoods (pastoralism, shifting cultivation, foraging, beekeeping, and wood harvesting)

The socioeconomic survey undertaken as part of the ESIA identified a range of livelihood domains that exist in and around the project's Aol. Survey findings indicate that the majority of residents within the project-affected districts are sedentary crop farmers, whilst a minority of the affected communities subsist and capitalize on mobile livelihoods that are intertwined with extensive natural resource bases. These livelihoods include transhumant pastoralism and semi-nomadic hunting and gathering. The traditional nature of these practices also means that they are limited to certain tribal communities and well-preserved ecosystems. A distinct commonality amongst community groupings employing these livelihood strategies is their preference for arid and semi-arid ecosystems presenting little to no crop farming competition and primary settlements based around permanent, remote water sources.

The baseline survey identified a number of pastoralist communities, most of which belong to indigenous tribes, namely the Maasai, Barbaig and Taturu. Besides organizing the daily transit of livestock between settlements and grazing areas, herders in IP communities practice transhumanism which involves long-range seasonal rotations of herds across arid and semi-arid landscapes in search of rainfed pastures and water sources. With the onset of the dry season and depletion of locally available livestock feed, the herds are



migrated to distant locations offering unexhausted grassland and high-yielding surface water sources (e.g. towards Lake Chaya). In some cases, transhumance involves a coordinated translocation towards nearby idle farmland (post harvesting), which gives crop farmers the benefit of weeding and provisioning of organic fertilizer. Open rangeland is nonetheless ideal for transhumant herders, as it allows for the incremental burning of grazing fields to stimulate fresh nutritive regeneration and eradicate infectious pests. Besides the search for animal feed and water, pastoralists organize cyclic, long-distance livestock transit to access advantageous marketplaces, and, in some cases, to avoid potentially catastrophic livestock disease outbreaks.

The survey also established the presence of semi-nomadic hunter-gatherers nearby the project's AoI, some of whom are also internationally recognized as indigenous peoples (e.g. the Sandawe-Hadzabe). These communities rely on extensive foraging grounds for gleaning plant-based products of nutritive, medicinal, ceremonial or construction value, opportunistic hunting, and scavenging game meat nearby wildlife corridors. As outlined in Section 11.2, the importance of ecosystem services in the context of local livelihoods is relatively high in the project-affected districts of Manyoni, Itigi and Uyui, where Taturu, Sandawe and Maasai settlements are situated.

A subsequent severance impact survey constituting the project Severance Management Plan (SMP) was carried out in 45 of the 48 affected villages along the railway corridor. The study confirmed the presence of IP (i.e., Maasai, Barbaig, Taturu and Sandawe) communities within 15 affected villages in the districts of Manyoni, Itigi, Sikonge and Tabora. The IP population in affected villages totalled 3,644, with the male residents accounting for 41% of this count. An exception to this census is the population of outlying Sandawe communities in Uyui District, which was not established at the time of this assessment.

The project alignment will cut across stretches of forest, bushland, and open rangeland, and thereby introduce a physical barrier across ecosystems of essential importance to communities with a critical dependence on natural resource-based livelihood strategies of a conservative, communal and dynamic nature. For this set of land-users, the barrier effect of the project's right of way potentially imposes the following impacts:

Loss of access to scarce livelihood resources

(i) IP communities

Marginal community groupings with a predominant reliance on transhumant herding and rudimentary foraging will be subjected to a permanent restriction on access to undeveloped land with ecosystem services that provision their staple food resources and commodities (i.e. livestock feed, water sources, fuelwood, plant products etc.). The availability of these services is already constrained by inhibiting factors such as topography, erratic climate trends, legal bars, and the expansion of human settlements.

The railway embankment and fencing will impede daily herding and foraging commutes, which amplifies the risk of these necessitates becoming increasingly scarce, on a community level. This curtailing effect can take on a greater Aol during extreme climatic events (e.g. droughts), at which time resource shortages are likely to prompt an expansion or shift of herding and foraging movements. In the construction phase, exclusion zones and roadblocks, particularly those associated with the railway embankment, can substantially disrupt daily herding by blocking stock routes without the provision of conveniently situated, makeshift livestock crossings.

Sandawe communities located nearby the SGR railway corridor are traditionally dependent on vegetated ecosystems, for a variety of food resources which supplement their present-day diets. These communities widely forage fruits, tubers and honey, and practise opportunistic game hunting on a less frequent basis, besides other extensive



livelihood activities, such as beekeeping, fuelwood collection, and hardwood/ thatch harvesting for construction purposes.

With regard to broader community welfare, the outcomes of the SMP survey indicate that at least one pharmacy is available within the project-affected villages, on average. However, medical centres are mostly centralized at the ward level and therefore less accessible to the project-affected IP communities, for advanced healthcare services including specialized diagnostics and in-patient treatment. Traditional herbalism has therefore prevailed within IP communities, and certain medicinal plants are sought within well-preserved pockets of native vegetation. Certain ecosystem features (e.g., remote groves, trees, caves and rocks) also constitute the tangible cultural heritage of IP communities, as they hold spiritual value for traditional rituals and burials. The establishment of a fenced railway corridor across areas of natural habitat and the redundancy of pre-existing, at-grade crossings along adjacent MGR sections will therefore encumber wide-ranging hunter-gatherer activities and traditional rites which span the impact corridor.

Overall, a permanent limitation of normative and adaptive livelihood mobilities can inflict impoverishment and radical economic displacement upon transhumant and foraging land users, whose economic resilience is stifled by widespread vestiges of systemic marginalization, land alienation and persecution. This risk poses broader repercussions, such as increased communal strife over pastoral encroachment of active farmland and informal child labour within alternative economic sectors.

(ii) Non-IP communities

Preliminary results of the SMP survey indicate that a total of seven tribes engage in herding, on a subsistence and commercial basis. These tribes include the Sukuma, Nyaturu, Nyamwezi, Yanzi, Tusi and Gogo. Settlements belonging to these tribes are situated throughout the railway corridor, and a total of 179,487 livestock (mainly cattle, goats, and sheep) have been reported within affected villages. Non-IP herders use a number of stock routes to access pastures and natural water sources (e.g., rivers and springs), some of which intersect the SGR railway corridor.

Long-range herding traditions practised by non-IP pastoralists, particularly agropastoral Sukuma communities, include an indigenous pasture management scheme known as 'Ntigili', whereby afforested or wooded pastures are reserved for grazing and fodder harvesting in the dry season. Beyond pastures and salt licks, ecosystem services exploited by non-IP communities based around the railway corridor include the provision of water sources (e.g., natural springs and rivers), fuelwood, construction materials, and medicinal plants.

Compromised social cohesion

The various sections of project-affected communities are bound by kinships with an instrumental role in various aspects of local socio-economic development, such as employment, inter-marriage, hamlet security and cooperative financial support mechanisms. The fragmentation of resident communities due to the project alignment can thus undermine the communities existing social cohesion. This fallout can disrupt the communities existing social networks and informal leadership structures, and thereby cause a broader departure from pre-existing social norms. The fragmentation of resident IP communities potentially bears more significance, as these communities command a level of socio-political autonomy, and place customary emphasis on age- and gender-differentiated roles at the household and communal levels. Additionally, transhumant pastoral communities exhibit intricate interdependencies in their livelihood strategies, which involve reciprocal livestock exchanges, trading and breeding arrangements amongst households and wider intra-communal organizations. A physical divide can



therefore impair the normal social functioning of such collectivist, resource-constrained communities.

Impact significance (pre-mitigation)

Table 11-36 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Main impact –	involuntary resettlement	due to land acquisition	
Severance of access to ecosystem services for mobile traditional livelihoods	Can be characterized as negative, direct, long-term, irreversible, local and high in magnitude.	Affected households and entire communities located within 5 kilometres of the Lot 3-4 alignment with solitary livelihoods that require unrestrained mobility daily (i.e. pastoralists and hunter gatherers) – may incur curtailed or terminated access to distant pastures, water sources and wild produce, and a radical change in income earning means, living conditions and general welfare. Currently disadvantaged given their historical persecution and land alienation due to (i) legal hurdles associated with acquisition of land for livelihoods that are natural resource based, shifting and communal, (ii) lacking rights to land traditionally used for communal settlements, herding and foraging, and (iii) limited wherewithal and formal education to cope with permanent livelihood losses. Rated as highly sensitive.	Major

Table 11-36: Receptor sensitivity and impact significance rating

Impact significance (pre-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a moderate status.

11.3.1.4 Severance of access to social services, commercial centres, and private property

Preliminary RAP survey results indicate that public property registered under a total of 77 institutions will be displaced by the project across the six affected districts. This property largely includes buildings for schools, churches, mosques, cattle dips, community-based organizations (CBOs) and local government offices. Potentially impacted public and CBO buildings within the project area are located in the villages/mitaa of Itigi Mjini, Kitopeni, Mabondeni, Karangasi, Tura, Tambuka Reli, Nyahua, Magoweko, Buduba, Kayombo, Usongwanhala, and Bukene.The surveys have also provisionally identified shallow wells belonging to local community members.



The decommissioning of public and utility assets for the establishment of the project can result in a severe disruption of social services, which may paralyze productive activities, create dire water deficits on a household level, and jeopardize the livelihoods and general welfare of affected service users.

Furthermore, the railway infrastructure planned along the SGR corridor varies on the basis of design factors such as topography, hydrology, and co-located strategic infrastructure. Elevated railway sections will be constructed across valleys, whilst at-grade portions will be established for the most part of the alignment.

According to the most available design information, the following linear infrastructure will be established along the railroad:

- Railway embankment, which will be raised to an average 2.5 metres above ground level.
- Razor-wire railway fencing with a height of 2.1 metres above ground level.

The above structures will preclude the establishment of level crossings and obviate the pre-existing utility of at-grade crossings along adjacent MGR line sections. Pedestrian crossings in the standing project design include underpasses, overpasses, livestock crossings and bridges exclusively. At the time of this assessment, a total of 32 overpasses, 27 underpasses, 36 bridges and 83 livestock crossings were approved as part of the developing project design.

While the SGR corridor will align with the existing MGR line to minimize the scale of physical and economic displacement, the SGR infrastructure (i.e., embankment and complete fencing) will introduce an extensive barrier across local communities with potentially intercepted access routes. The barrier effect of the SGR line will therefore constrain and/or sever access of closely situated residents to social service facilities (i.e., schools, pharmacies, healthcare centres, water supply facilities, public transit stations/terminals, local government offices), commercial centres (e.g., marketplaces, retail outlets, institutional offices), income-generating property (e.g., private farmland and other commercial establishments) and places of worship (e.g., mosques, churches and sacred sites) that were formerly accessible via numerous designated and custom atgrade crossings along the adjacent MGR line sections. At the time of this assessment, the inventory of salient public facilities located nearby the SGR railway corridor is distributed across the villages of Makutupora, Mabondeni, Itigi Mjini, Kitaraka, Igalula, Kidatu 'B', Timkeni, Kakola, Nzubuka, Kayombo, Malolo and Mahene.

Due to the loss and/or relocation of potentially displaced public infrastructure and railway crossings, affected households and entire residential clusters may be confronted with more time-consuming, laborious and/or costly access routes to original or alternative establishments including (but not limited to) schools, clinics, workplaces, agricultural marketplaces, water sources, places of worship, burial sites, and associated commute/travel patterns. A similar impact potentially applies to PAPs that stand to lose convenient access to private productive landholdings (e.g., farmland and retail outlets) from their residential locations. Added distances to these essential locations will impinge upon the productive time, household economies, general welfare, and quality of life of potentially impacted households.

At the time of the SMP survey, certain communities reiterated a request for the establishment of conveniently situated crossings along stock routes towards important livestock marketplaces and transit stations. The working list of livestock and pedestrian crossing locations requested through SMP surveys completed at the time of this ESIA is presented in the table below.



Table 11-37: Locations of requested livestock and pedestrian crossings (village-level)

Manyoni	1. Makutupora
	2. Sukamahela
	3. Saranda
	4. Mdunundu
	5. Aghondi
	6. Mabondeni
	7. Kitopeni
	8. Itigi Mlowa
	9. Itigi Mjini
	10. Kitaraka
	11. Kitopeni
Uyui	12. Karangasi
	13. Tura
	14. Malongwe
	15. Kizengi
Itigi	16. Igalula
Tabora	17. Nzubuka
	18. Kiwembe
	19. Izugawima
	20. Ugembe
	21. Mwino
	22. Timkeni
	23. Kidatu 'B'
	24. Kakola
Nzega	25. Luhumbo
	26. Ilole
	27. Mogwa
	28. Bukene
	29. Usongowanhala
	30. Mahene
	31. Nawa
	32. Buduba
	33. Malolo
	34. Kayombo

The map series below provides an overview of pedestrian, vehicular and livestock crossings planned with the project-affected wards, in relation to public facilities and commercial centres within project-affected communities along the railway corridor. However, the mapping of strategic public/ communal facilities was not complete at the time of this assessment, for an elaborate analysis of severance impacts based on the current project design.





Figure 11-47 Distribution of railway crossings relative to key public/ communal facilities along the Lot 3 SGR alignment (Section I)



Figure 11-48 Distribution of railway crossings relative to key public/ communal facilities along the Lot 3 SGR alignment (Section II)



Figure 11-49 Distribution of railway crossings relative to key public/ communal facilities along the Lot 4 SGR alignment (Section I)



Figure 11-50 Distribution of railway crossings relative to key public/ communal facilities along the Lot 4 SGR alignment (Section II)



Impact significance (pre-mitigation)

Table 11-38 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Main impact –	involuntary resettlem	ent due to land acquisition	
Relocation of public property and utility assets and severance of access to social services	Can be characterized as negative, direct, long-term, irreversible, local and high in magnitude.	Households or entire residential clusters located within 5 kilometres of the Lot 3-4 alignment15 with a reliance on social service and/or commercial centres displaced and/or physically isolated by the Project (including schools, health centres, water distribution points, boreholes, wells, farmland, places of worship etc.). Affected entities potentially have little to no alternatives for continued service, productive assets and resources, and are therefore subject to relatively time-consuming, laborious and costly travel patterns for subsequent access. Rated as very highly sensitive. Utilities and LGA departments with ownership of project-displaced public assets that are essential to the delivery of social services. The entities are potentially tasked with immediate relocation and reinstatement of displaced infrastructure. Rated as very highly sensitive.	Major

Table 11-38: Receptor sensitivity and impact significance rating

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a moderate status.

11.3.1.5 Relocation of graves

Based on preliminary information drawn from the ongoing resettlement surveys, a total of 865 graves fall within the project's physical footprint and will therefore require relocation. Some of the most sensitive graves recorded within the area are those belonging to the

¹⁵ The 5-km AoI is based on a precautionary analysis drawing on the (i) spatial extent median of villages crossed by the Lot 3 and 4 railway alignment and (ii) high-level accessibility information in the socioeconomic baseline sections of the Lot 3 and Lot 4 RAP reports.



Taturu – an indigenous tribe. Located in Itigi town, these graves are sacred sites of immense cultural value to their tribal community, as they are the resting place of the late Taturu chiefs. The ESIA-stage baseline socioeconomic survey involved consultations with the community attached to the sacred site, where it is believed that any disturbance to these graves would be an unprecedented act of dishonour, which could bring a grave misfortune. As such, the community requested for the railway alignment to be shifted away from the burial site.

Impact significance (pre-mitigation)

The matrix below provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Main impact –	involuntary resettle	ment due to land acquisition	
Relocation of graves	Can be characterized as negative, direct, short-term, irreversible, local and medium in magnitude.	Households and entire communities who have custodianship and/or attach spiritual value to graves that fall within the project's construction zones or transit corridor (and therefore require relocation). Rated as having low sensitivity.	Moderate
		Sub-set of receptors above with pre- project socio-economic vulnerability (including IP) – more likely to incur lacking access to traditionally favourable burial locations (at sacred sites) and a significant change in cultural or spiritual practices. Rated as highly sensitive.	

Table 11-39: Receptor sensitivity and impact significance rating

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation and broader recommendations

The following mitigation measures and broader potential recommendations should be given consideration in the management of socio-economic impacts pertaining to involuntary resettlement. Due to the ongoing status of the RAP campaign, these commitments are generic in substance, but serve to scope the minimum requirements, based on relevant information available at the time of the assessment.

- subsequent stages of detailed design will take into consideration any emergent opportunities to reduce the scale of land-take for physical and economic displacement
- detailed resettlement planning will follow the guidance provided in the project's Resettlement Policy Framework (RPF)
- the assessment of impacts associated with physical and economic resettlement within the project's affected communities and host communities within any major



resettlement sites potentially selected by TRC will be implemented by way of dedicated RAP. The RAP will build on the underpinnings of the RPF and address any gaps between local legislation and binding social performance standards (i.e. PS 1, 5, and 8)

- the assessment of physical and economic displacement impacts within the totality of land to be acquired under eminent domain will be based on a full-scale RAP census, socio-economic survey, and asset survey, which will seek to identify all permanent and seasonal land-use within the extent of potentially acquired land. Further, the surveys will cover land and land-based assets and resources with private, communal, or public ownership or utility
- the RAP census and asset surveys will be implemented immediately before and after (respectively) the institution of a cut-off date, and customary rights to land will be given due consideration in consultation with village / mtaa leadership. The cut-off date for the asset surveys will be announced within local communities, to minimize potential livelihood impacts on any subsequent opportunistic settlers who will not be considered eligible for compensation based on spurious claims
- considering the full inventory of potentially impacted land rights holders, the RAP will make adequate provisions for compensation entitlements and supplementary assistance in the form of bespoke livelihood restoration programs (e.g., capacity development for livelihood recovery, facilitation of formal access to replacement/ alternative land, credit facilities for SME, and project employment), and transitional support (e.g., pre-construction crop harvests, retrieval of salvageable assets, and extended support for vulnerable PAHs)
- physically and/or economically displaced entities will be offered both cash and inkind compensation. Vulnerable PAH (including IP groups) and PAH whose affected livelihoods are centrally dependent on land and natural resources will be offered in-kind compensation by default
- Where permanent land-take results in sizeable¹⁶ losses of grazing areas for pastoral communities, TRC will facilitate legal access to residual and/or alternative pastural land will be secured through contextually appropriate instruments, such as joint village land-use plans, by-laws, formal land sharing agreements, collective customary rights of occupancy, community-based forest management schemes and/or environmental easements, in collaboration with village councils, district/municipal administration and other competent authorities
- resettlement measures will include measures to ensure a full and equitable delivery of resettlement benefits to married men and women residing in joint households
- compensation for potentially impacted physical assets and income streams will be provided prior to the onset of impacts and at full replacement value
- crossing points for potentially affected households' and communities' access to social service, commercial centres and worship sites across the SGR corridor will be established in close consultation with the communities and their respective local leadership structures and TARURA. The developing design will be optimized to ideally allow for an average interval of 500 metres to 1 kilometre in well-developed and densely populated areas (wherever possible), and SGR crossings will be established for all redundant MGR line crossing locations

¹⁶ Any emergent instances of extensive land-take resulting in a significant residual impact on pastoral livelihoods where communal pressure on common pastures is high (in advance of displacement/ severance).


- the planning and siting of livestock crossings will follow a participatory process, whereby local leadership and pastoralist communities are collectively engaged to determine critical requirements for temporary (construction-phase) and permanent livestock crossings, and the availability of backstopping pastural and water resources
- Livestock crossings for IP- and non-IP pastoral communities will be established as close as possible to pre-project (MGR-phase) livestock crossings, major livestock trade centres (marketplaces) and transit stations
- All strategic SGR crossings will be planned with reference to requisite crossing locations inventoried in the project SMP and local land-use plans. Key proposed crossing locations include (but are not limited to) those enumerated in Section 11.3.1.4 of this report
- the planning and siting of pedestrian crossings and bridges will follow a participatory process, whereby local communities, local leadership and TARURA are collectively engaged to determine critical requirements for temporary (construction-phase) and permanent pedestrian and vehicular crossings, and the location of alternative social/ communal infrastructure as relevant
- an Indigenous Peoples (IP) Plan and overarching Severance Management Plan (SMP) will be developed and implemented to ideally avoid and otherwise mitigate against project-associated severance impacts on affected communities based around the SGR line
- The SMP will include efforts to identify social receptor groupings with potentially significant, residual access severance impacts, in relation to a complete map of key social service, transit, commercial and common property centres, and any private productive landholdings cut-off from the residential locations of PAHs
- The SMP will provide specific mitigation alternatives for project-affected communities where additionally proposed (strategic) crossings cannot not be feasibly incorporated into the time-sensitive railway design, in consultation with affected communities and competent authorities (i.e., local leadership, utilities, TARURA etc.)
- any physical or economical displacement involving impacting on IP will be avoided as a priority, and where avoidance is not feasible, FPIC will be obtained from the affected IP over the course of resettlement planning. The compensation strategy will prioritize the provision of replacement assets or resources, over cash compensation complemented with the development of alternative livelihoods
- The relocation of graves will follow mandatory requirements established in the Graves Removal Act (1969), including the provision of due notices to relevant authorities and custodians, allocation of burial sites for reinterment, reburial/cremation, and provision of placatory compensation as applicable.
- all graves subject to displacement will be relocated, in consultation with formal village / mtaa leadership, spiritual leaders and affected community members (custodians), in a manner that is dignified and culturally acceptable to affected persons. Relocation efforts for sacred graves belonging to IP groupings will not be initiated without ruling out alternatives to enable avoidance, or otherwise without obtaining the FPIC of affected community members
- the RAP will further provide for the monitoring and evaluation of resettlement commitments, which will be developed over the course of resettlement planning, to ensure that any shortfalls in implementation outputs, outcomes and impacts relative to pre-set KPIs are identified and remediated
- the SEP for the project will be aligned with the RAP program to inform potentially affected entities and their respective communities about the land acquisition and resettlement process



- the external project GRM and relevant sensitization efforts will also be aligned with the RAP and LRP program to collect grievances pertaining to land acquisition and resettlement on platforms that are accessible to all local constituencies and free of manipulation, interference, intimidation, service charges and restrictions on arbitration, judicial recourse and choice of confidentiality
- the GRM will include at least one female CLO (per Lot) to enable dedicated channels for reporting gender-sensitive issues.

11.3.2 Incidental damage to private and public property

The project's construction cuts across urban and rural human settlements that include property ranging from dwellings, commercial and institutional premises, to farmland, utility infrastructure, and collector, feeder and community roads. Adjacent settlements are most dense alongst railway sections traversing the district centres and Tabora Municipality.

The project's construction phase will involve a varied range of construction operations, including off-site quarrying, haulage of abnormal construction loads (i.e. materials, waste and equipment), on-site civil works, and disposal of construction waste. A number of specific construction activities present a high risk of inadvertent physical damage to privately owned and public property, outside of the areas demarcated for construction works. Drawing on relevant incidents from precedent (Lot 1 and Lot 2) SGR developments, such activities include (but are not limited to):

- a) blasting within quarry sites, which can introduce ground-borne vibration with a damaging impact on nearby built-up structures. While the proximity of quarries to neighbouring buildings and blasting intensity represent principal risk factors, another consideration is the predisposition of any nearby buildings to seismic shocks on account of low-grade construction materials (e.g. mud and clay), prior exposure to seismic events and waterlogging. Besides severe destructive vibration, blasting presents the risk of damage by fly-rocks to nearby, rudimentary buildings
- b) high-intensity compaction works can also generate ground-borne vibration at a magnitude that can result in discernible damage to built-up structures. Similarly, the probability of these damages occurring is primarily dependent on the intensity of ground compaction and intervening distance to nearby buildings. The risk is likewise higher for buildings with compromised structural integrity from other underlying factors (as detailed in the point above)
- c) ground excavation works can also result in accidental damage to public and private property. Such damages can occur in instances where marginal deviations from excavation perimeters encounter underground utility assets (e.g. piping and cabling) or adjacent buildings
- d) civil works involving the alteration and/or construction of drainage systems potentiate inadvertent stormwater overflows that can extend towards nearby establishments such as farms, residential and commercial plots. Buildings afflicted by repeat flood events within flood-prone zones carry a disproportionate risk of flooding in relation to project works and can be rendered uninhabitable
- e) intensive discharge of aggregates and debris within laydown areas and dumping sites can cause inadvertent damage to nearby property, such as farms, graves, pathways, and buildings, especially in instances where the property boundaries are inconspicuous and immediately adjacent to stockpiling sites
- f) traffic-related property damage, which includes potential damage to private property due to accidental impact by off-roading incidents involving project vehicles, or accidental damage to overhead cabling during the transportation



of high-rise (bulky) equipment. This impact also includes potential damage to district-level roads and culverts due to the passage of heavy haulage vehicles.

Accidental damage resulting from the above-mentioned activities can result in potential loss of productive assets, resources, and income. Where residential facilities are involved, such accidents can culminate in a severe deterioration of housing conditions and a loss of shelter. Depending on the severity of impact, affected residents can be subjected to a disruption of essential social services (e.g. water and electricity supply), homelessness and severe hardship resulting in household impoverishment.

Impact significance (pre-mitigation)

Table 11-40 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Incidental damage to private and public property	Can be characterized as negative, direct, short-term, reversible, local and medium in magnitude.	utilities and LGA departments with ownership of strategic public infrastructure that is essential to the delivery of social services. The entities are potentially tasked with immediate reinstatement (maintenance and/or reconstruction) of accidentally damaged facilities. Rated as moderately sensitive. households with residential and/or commercial establishments located close to construction zones. community sections with a reliance on sensitive public assets, with little to no alternatives for continued service, considering the climatic and developmental context of the project-affected affected districts. Rated as moderately sensitive.	Moderate

 Table 11-40: Receptor sensitivity and impact significance rating

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be implemented to manage socio-economic impacts pertaining to incidental damage to private and public property. Management measures pertaining to compensation will be implemented according to the compensation principles discussed in Section 11.3.1.

• site selection for the establishment of any new quarry sites will prioritize candidate sites that are situated as far as possible from residential areas, particularly those with low-quality housing and a history of relatively frequent seismic events



- the EPC Contractor will demonstrate the recruitment of licensed blasting service providers, and the delivery of induction trainings for new quarrying personnel to demonstrate (i) safe explosives handing procedures and the use of experientially developed work methods (prescribing optimal configuration, dimensions and direction of blast holes) to minimize blasting-related impacts on nearby settlements
- best efforts will be made to develop and maintain a fixed blasting schedule that does permit blasting events outside of daytime work hours
- continuous stakeholder engagement on the part of the EPC Contractor will involve the delivery of blasting notices to nearby receptors, particularly prior to blasting programs resuming or changes to the blasting program
- a visual inspection survey will be conducted before the start of blasting activities, to facilitate future investigation into structural damage attributed to blasting works. The survey will be repeated following the termination of blasting works to identify any unreported damages, for the same purposes
- where low-quality housing is situated close to compaction zones, similar inspection surveys will be carried out before and after the completion of compaction works
- clearance surveys based on visual inspections and consultations with local authorities (and where necessary, radar equipment) will be undertaken for excavation and stockpiling zones (and their 10 m buffers) to identify any buried and above-ground structures, for avoidance and relocation, as appropriate
- clearance surveys for stockpiling zones will be completed with barricading or other means of demarcation to increase the visibility of dumping or laydown site boundaries
- a clearance and navigability survey will be carried out along transit corridors to be used for the transportation of abnormal loads
- detailed design of drainage systems will consider flood-risk and areas prone to flooding identified in Hydrological assessments for Lot 3 and Lot 4 (MITYMIAL-GL00X-G-HY-REP-0002-1 and TAI-YMI-AL-GL00X-G-HY-REP-0002-0, respectively
- the temporary blockage of public drainage channels for construction works will be scheduled for dry periods (to the extent possible), and drainage bypasses will be constructed where necessary
- all grievances, claims and observations pertaining to incidental damages associated with construction activities will be recorded and investigated by expert representatives from the EPC Contractor's relevant construction units, local government authorities and utility companies (as appropriate). Follow-up valuation will be undertaken by a qualified government valuer and due monetary or in-kind compensation will be issued at full replacement value
- local communities surrounding the project's construction will be familiarized with the external GRM for the Project, to enable grievances pertaining to land acquisition and resettlement to be collected on platforms that are accessible to all local constituencies and free of manipulation, interference, intimidation, service charges and restrictions on arbitration, judicial recourse, and choice of confidentiality.

11.3.3 Strain on public infrastructure and resources

Despite broad-based development programming and progressive public investment under the National Development Vision 2025 and various ministerial strategies, the



population growth and demand for basic social services within the six project-affected districts have outpaced the augmentation of social infrastructure.

Most existing medical service centres and educational institutions within the districts have remained understaffed, with a chronic shortage of provisions such as educational materials, classroom facilities, medical supplies and hospital beds. As regards water supply, the socioeconomic survey undertaken as part of the ESIA indicates that less than 20% of the rural population along the project corridor has access to piped water supply schemes, except for Tabora Municipal, where about 56% of respondents reported access to piped water services, due to the area's relatively urban context. The remainder of residents rely on alternative sources such as rivers, springs, shallow wells, boreholes and rainwater, some of which fail to meet communal demand in the dry season. Electrical supply is also out of reach for most of the rural population, as over 90% of survey respondents reported a primary reliance on charcoal and firewood for energy-intensive activities such as cooking.

The socio-economic survey also revealed a dearth of centralized waste management facilities, with resident establishments resorting to the use of unlined dumping sites, composting and open burning for solid waste, and the establishment of pit latrines and septic tank systems for the disposal of municipal and domestic sewage. The expansion and upgrading of public road networks have targeted trunk, regional and collector road connections for the most part, with remnant sections offering moderate to low navigability.

Planned construction work and facilities demand an estimated 14,262,908 (litres of water, and 220,891,000 litres of diesel. The construction phase is also set to employ a peak workforce of ~7,000 people for Lot 3 and ~4,000 for Lot 4, and will require the establishment of seven labour camps. While some of the workers will be accommodated within the camps, others will reside within locally available rental facilities. The project will create a multiplicity of skilled and semi-skilled jobs that will attract jobseekers based within the host districts, regions and other urban centres across the country. In addition to waged employment, the project will create commercial opportunities in terms of supporting services and increase access to productive resources (e.g. through the establishment of boreholes, quarry sites etc.). This demand will spur the in-migration of professional/formal job seekers, informal laborers, entrepreneurs, economic scavengers and commercial sex workers. The total influx of outsiders into the project area can place an unmanageable burden on the limited social infrastructure within the project-affected districts and neighbouring districts offering added capacity. Potentially vulnerable sections of the infrastructure include medical service providers, water and electricity supply utilities, wastewater treatment facilities, waste management facilities, fuel stations and low-tier district roads. An overwhelming pressure and associated failure of the already inadequate infrastructure can result in the disruption of social services at the ward and district levels. Suspended access to basic services can further lead an interruption of various productive activities and consequent economic losses within affected service areas.

Beyond foreseeable pressures on utility infrastructure, the project's inordinate water demand may lead to the overexploitation of surface and groundwater resources that are critical to the livelihoods of resident communities lacking access to piped water schemes. High-volume groundwater abstraction can create substantial drawdown around community wells and shallow wells, which may prolong water collection time and lessen time for other productive activities, for neighbouring residents. Direct extraction from communal water sources such springs and seasonal rivers can also create adverse water shortages for communities without alternative water provisioning. This impact can be particularly severe in the context of the project area, considering the arid climatic regime and the size of the underserved population (including indigenous settlers) that relies solely on natural water sources to meet their domestic and economic demand for water. Some of these community segments are particularly vulnerable by virtue of their water-



intensive livelihoods (e.g. livestock rearing, paddy farming and aquaculture). Protracted water deficits within communities with no physical and/or financial access to back-up sources can result in extreme hardship due to economic shocks from subsequent livelihood interruptions and an increased disease burden from a deterioration of sanitary conditions.

The wave of new settlers seeking to benefit from the project's economic opportunities may also create a greater demand for accommodation facilities on a temporary (leasehold) or long-term basis (purchase). This trend can intensify competition for rental housing and permanent land tenure.

Impact significance (pre-mitigation)

Table 11-41 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Strain on public infrastructure and resources	Can be characterized as negative, indirect, medium-term, reversible, local and high in magnitude.	Households or community sections with a primary dependence on public infrastructure and service providers for the provisioning of key living and economic necessities (e.g. water supply, electricity, fuel, housing, food products), most of which is currently inadequate. Rated as highly sensitive.	Major

 Table 11-41: Receptor sensitivity and impact significance rating

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be implemented to manage socio-economic impacts pertaining to the potential burden on public infrastructure and resources. An elaboration on some of the key measures referenced in this section is provided in Section 18 (Surface and ground water), Section 14 (Waste management) and Section 21 (Traffic).

- a water resources assessment will be undertaken before the start of construction works, which will involve consultations with affected communities LGA and the local basin offices concerning the capacity of existing water sources in relation to recent consumption trends and added abstraction
- water abstraction permits will be obtained prior to the establishment of new boreholes or intake facilities from springs, and rivers and dams
- in areas with extreme seasonal or constant water scarcity (i.e. few sources, low aquifer recharge rates and little to no baseflows in the dry season), alternative sources situated further away from water-insecure communities will be prioritized



- organized access to newly established project boreholes will be given consideration in areas with low access to clean water, or where the Project requires the decommissioning of communal wells
- dewatering during excavation works will be controlled and minimized, in areas where high resultant drawdown can impinge on the yield of nearby community wells
- the project will involve continual water conservation efforts, including the use of water-saving toilets and faucets, maintenance checks to identify and prevent water distribution system losses, and rainwater harvesting where possible
- the implementation of soil, surface water and groundwater pollution prevention and control measures (i.e. including the isolation of waste and chemical storage areas, controlled handover to waste management contractors and effective spill response procedures etc.) to avoid and mitigate accidental contamination of unprotected water sources, rivers, and streams)
- on-site wastewater treatment plants will be established within construction labour camps (where possible) to minimize the strain on municipal wastewater treatment plants
- consultations will be held with utilities, road agencies and hospitals regarding the capacity of existing public infrastructure (e.g. electrical grids, roads and hospitals) and the best alternatives and/or backstopping facilities to meet the project requirements
- off-grid power sources will be utilized during periods of power shortages and power rationing
- the EPC Contractor will establish welfare facilities (i.e. project clinics) with a capacity to provide basic medical services prior to referral to well-equipped private hospitals (or regional hospitals in default of private hospitals nearby construction camps)
- commuting assistance (in the form of staff buses and cars) will be provided to workers based within a considerable radial distance from construction sites, to reduce the pressure on accommodation facilities within communities closest to the Project area
- Local recruitment will be maximized particularly for semi-skilled labour, to minimize the pressure on local accommodation, educational, healthcare and water supply facilities.
- the EPC Contractor will establish dedicated management plans for to address potential pressures on sensitive social infrastructure and resulting impacts on local users. These plans include the water management plan, waste management plan, soil management plan, traffic management plan, influx management plan, community health safety and security management plan
- the external project GRM and relevant sensitization efforts will be implemented to collect grievances pertaining to a critical pressure on public facilities and common resources on platforms that are accessible to all local constituencies and free of manipulation, interference, intimidation, service charges and restrictions on arbitration, judicial recourse and choice of confidentiality.

11.3.4 Spread of communicable diseases and increased local morbidity

According to the most recent epidemiological surveys launched by the Government of Tanzania and official district profile reports, the most prevalent diseases within the project-affected districts include malaria, various respiratory infections, water-borne and water-based infections, skin infections, and chronic conditions, such as HIV/AIDS. Underlying contributors to the local morbidity with the project-affected districts include



inadequate diagnostic services and limited access to clean water. In terms of crossinfection rates, some of the morbidity can be further attributed to the high household sizes reported for the regions of Singida and Tabora.

The control and eradication of the HIV/AIDS epidemic stands as a matter of priority on the national health sector strategy agenda. Through the dedicated agency of TACAIDS, the Ministry of Health and Social Welfare has made notable strides in furthering policy-guided efforts to increase public awareness around HIV/AIDS prevention and treatment, and to widen the outreach of quality of HIV/AIDS testing and treatment services. Nevertheless, the prevalence of HIV/AIDS remains high, with the number of female sufferers being over twofold greater than that of men. Recent studies also report a notably high incidence of HIV/AIDS infections within the country's rural reaches, where the condition is stigmatized, and relevant public awareness is limited. This applies to the project-affected regions of Tabora and Singida, where the prevalence of HIV/AIDS has been reported to be at least 4.8% and 3.5% respectively.

The influx of a predominantly male construction workforce with relatively high earnings into areas within low-income and largely rural communities poses the risk of an increased local incidence of HIV/AIDS. Potential surges in HIV/AIDS transmission can result from a close interface between migrant construction workers and host communities within the project area. Cross-infections are likely to occur from the intermixing of migrant, well-paid workers with resident women. High prevalence groups that pose the most concern include migrant and resident commercial sex workers, as well as long-haul truck drivers. Elevated morbidity within project-affected communities can also ensue from an increased incidence of other communicable diseases linked to construction-related dynamics. Potentially concerning disease groupings include:

- malaria, which can take on a higher incidence due to the introduction of mosquito breeding grounds, such as stagnant water pools within pits and depressions resulting from construction works
- other water-borne diseases, including diarrhoea, typhoid, cholera, dysentery, which can erupt because of faecal contamination of domestically utilized surface waters (e.g. shallow wells and rivers) by spills or improper disposal of construction camp sewage
- respiratory infections, such as tuberculosis and COVID-19, which can break out due to overcrowding and close interactions within public spaces.

The precipitous in-migration of workers from relatively urban origins is also likely to change the local disease profile, with an increased prevalence of non-communicable diseases such as hypertension, diabetes, cardio-vascular disease and cancer. This epidemiological shift can accentuate the deficiencies of existing healthcare providers.

Impact significance (pre-mitigation)

Table 11-42 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub- impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Spread of communicable diseases and	Can be characterized as negative, indirect, long-	Residents within host communities located nearby construction zones and camps, some of whom will interact with construction laborers or co-habit local	Moderate

Table 11-42: Receptor sensitivity and impact significance rating



increased	term,	residences with construction laborers	
local morbidity	irreversible, local	who will not be accommodated within	
	and high in	construction camps. Local	
	magnitude.	communities are currently beset by a	
		shortage of medical facilities and water	
		supplies for sanitation purposes, and	
		low earnings paired with little to no	
		health insurance. Rated as moderately	
		sensitive.	
		low earnings paired with little to no health insurance. Rated as moderately sensitive.	

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be implemented to manage potential rise in the incidence of communicable diseases within project-affected communities:

Implement the YM Communicable Diseases Management Plan which includes measures for:

- trainings focused on communicable diseases and HIV/AIDS will be delivered to all construction workers upon induction, and refresher trainings will be provided periodically
- worker trainings on HIV/AIDS prevention and control will be complemented with sensitization to HIV/AIDS testing and the dissemination of condoms within labour camps
- local communities will receive regular sensitization to HIV/AIDS and other communicable diseases, which can become increasingly prevalent due to the influx of migrant workers and potential infections from congregation and close interaction within working areas, camp sites and off-site accommodation facilities and public spaces
- the EPC Contractor will liaise with LGAs in the implementation of HIV/AIDS awareness creation and testing campaigns and collaborate with partner the regional medical officer (RMO) and council HIV/AIDS coordinator (CHAC), and relevant NGOs
- project workers showing symptoms of sickness will be given medical leave and directed to the project's welfare facilities or hospitals for testing and treatment as appropriate. Workers with serious respiratory diseases will be quarantined or provided with face masks as necessary, to reduce the spread of air borne infections that can spread to host communities
- labour camps will be designed according to accommodation condition requirements specified in local legislation and the IFC/EBRD guidelines (as part of safeguarding workers and community members from communicable infections), and routine inspections and audits will be undertaken to demonstrate compliance
- construction sites will be routinely monitored for ponding sites and pools of stagnant water (which provide breeding grounds for malarial vectors), with immediate filling or draining for any construction-rendered features with stagnant water
- construction workers must receive trainings and management plans and procedures for the proper management of construction wastewater, including



sewage to prevent the contamination to receiving environments such as shallow groundwater or rivers

- the project's code of conduct will proscribe the use of alcohol, drugs and commercial sex activities within labour camps and working areas, which can reduce the spread of sexually transmitted infections (STI) within host communities
- project workers based within labour camps will be subject to restrictions on movement outside of labour camps and working areas.

11.3.5 Health, safety and security incidents within local communities

The project's construction phase poses a multitude of direct health and safety hazards pertaining to the various aspects of construction work, as well as indirect health, safety and security (HSS) risks related to project-induced demographic changes. Further to the salient impacts discussed in Section 11.3.4 above, the project raises a broader range of community HSS risks, which are presented in the following sub-sections.

11.3.5.1 Community health and safety hazards within the project's construction areas and transit corridors

Areas designated for construction activities pose a variety of common H&S risks including slips, trips and falls, burns, electrocution, injury from moving/falling objects, explosion, heat stress, asphyxiation, poisoning from exposure to hazardous chemicals, etc. Such risks are typically attributable to inadvertent instances of equipment failure, dangerous disposition of objects, improper material storage, misuse or non-usage of PPE, and non-compliance with precautionary method statements (operating procedures). Demarcation and physical isolation of risk-presenting construction zones is a key public safeguard, as community members are predisposed to significant H&S incidents given their lack of construction H&S awareness and PPE. Nevertheless, unauthorized public access and associated injury, acute sickness or fatality is an inherent risk that requires pre-emptive management. Drawing on lessons from precedent projects, H&S provisions for potentially affected communities must give particular attention to the following priority risks:

- traffic-related accidents. Construction works for large-scale linear projects entail substantial increases in vehicular traffic along public roads and project-dedicated access roads. The emergence of large traffic volumes carries the risk of significant H&S incidents including vehicular collisions, collisions between trains and project vehicles on at-grade MGR crossings, and vehicle impacts involving pedestrians. Such accidents can transpire due to non-compliance with traffic safety rules, failure of poorly serviced vehicles, poor visibility or road conditions, reckless behaviour of intoxicated or disoriented road users, and lack of warning systems at at-grade intersections between project access roads and the existing MGR line. Traffic-related hazards also include the risk of mass or severe casualties from high-impact accidents involving the transit of fuel and explosives.
- risk of drownings in water-filled borrow pits. Borrow pits are often designated for multiple projects and typically established without fencing, to allow for unlimited vehicular access. Over time, borrow pits expand in their dimensions and accumulate water from precipitation and stormwater flows. Water-filled borrow pits are generally deemed as unsafe environments and are therefore not frequented by members of the general public. However, exceptions may occur in instances where children, disoriented individuals and water collectors visit borrow pit sites with the intention of exploring the excavated landscape, swimming in the impounded waters or abstracting water. Such cases pose the grave risk of drowning fatalities.



- dust conditions. Construction activities such as transit along service roads, cut and fill operations, as well as the operation of concrete batching plants generate a significant amount of air-borne dust. Continual dust dispersal within these hotspots can adversely affect the respiratory health of closely situated communities. This impact, coupled with impaired visibility and associated H&S risks, can degrade the living and working conditions of affected communities.
- another public H&S risk inherent to extensive construction works is the incidental exposure of community members to noxious, toxic, corrosive, ignitable, explosive and toxic substances. One exposure pathway is soil, groundwater and surface water contamination as a result of poor solid and liquid waste storage and handling practices, or the failure of waste collection, storage, transportation and treatment equipment and facilities. The absence of hazardous waste and centralized sewage management facilities in the area poses the risk of negligent waste disposal and the overburdening of waste storage facilities. Another pathway potentially involves the pilfering or retrieval of project property such as fuel stock, contaminated chemical storage containers, used oils and spent equipment parts (e.g. batteries, etc.) by economic scavengers for domestic or commercial purposes. This can result in injury from the mishandling of hazardous materials or acute poisoning from exposure to contaminants via skin contact, inhalation, and ingestion of contaminated liquids (e.g. through use of chemical containers for food/water storage).

Table 11-43 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation impact risk significance
Main impact –	Health, safety and se	ecurity incidents within local communities	
Community health and safety incidents within the project's construction areas and transit corridors	Can be characterized as negative, direct, long-term, irreversible, local, likely and high in magnitude, and therefore classed as major. The level of likelihood for this impact can be considered likely, and the 'major' impact would therefore translate into a major H&S risk.	Residents within host communities located nearby the Project's construction zones (including quarry sites and waste and wastewater disposal areas) and transit corridor. Rated as highly sensitive. Children within host communities located nearby the project's construction zones and transit corridor, particularly those attending schools situated close to project- dedicated access roads. This group is predisposed to major H&S incidents in the absence of close supervision and special sensitization and is rated as highly sensitive.	Major

 Table 11-43: Receptor sensitivity and impact significance rating



Provided the mitigation commitments at the end of Section 11.3.5 for the full duration of the risk, the risk significance will be reduced to a minor status.

11.3.5.2 Potential criminal and abusive offence towards local community members around the project's main and ancillary facilities

The project's construction phase will involve extensive work over an estimated duration of four years. The breadth and scale of construction phase activities are anticipated to proliferate employment and commercial opportunities within communities based around the project, and thereby expand local cash-based economies.

The rise in commercial activity and local income levels, and a growing economic divide within the communities is likely to drive an uptrend in criminal activity. Criminal incidents that are expected to increase at the height of construction include theft within local households and business centres, as well as personal violence, harassment and intimidation. In the context of the project, social groupings with a propensity to use force in perpetrating crime or addressing illicit offences and misdemeanour, include the project's poor and unemployed youth, particularly those with delinquent backgrounds, as well as the project's security personnel respectively. The project may employ poorly trained security workers, who can inflict excessive force on community members in the event of minor misdemeanours, borderline incidents and self-defence from undue assault. Security personnel can also abuse their powers and commit acts of crime and intimidation against community members on a more covert and corrupt basis. Furthermore, the intermix of foreign workers and native residents on public platforms within project-affected communities may entail events, which may instigate hate crimes and racially motivated transgressions.

Competition for scarce basic resources and escalated community tensions can also culminate in harassment and criminal acts of aggression. This is likely to occur in areas where water, food and land insecurity are more prevalent. Further, land-related strife and associated hostility within affected communities can ensue from the potential entry of opportunistic settlers seeking to benefit from the ongoing resettlement campaign, farmland encroachment by pastoral communities with severed access to rangelands, and a persistent overexploitation of direly burdened communal water sources.

Impact significance (pre-mitigation)

Table 11-44 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation risk significance
Main impact – Health,	safety and security in	cidents within local communities	
Potential criminal and abusive offence towards local community members around the project's main and ancillary facilities	Can be characterized as negative, indirect, medium-term, irreversible, local and medium in magnitude, and	Residents within the project's affected communities, particularly those located close to construction camps and/or potentially engaged in commercial activities related to the project. Rated as moderately sensitive.	Moderate

Table 11-44: Receptor sensitivity and impact significance rating

RS	5 capilo	nly 💐
therefore classed as moderate.		
The level of likelihood for this impact can be considered occasional, and the 'moderate' impact would therefore translate into a moderate H&S risk.		

Provided the mitigation commitments detailed below are implemented for the full duration of the risk, the risk significance will be reduced to a minor status.

11.3.5.3 Potential GBV and SEA

The advent of a male-dominated construction workforce, which includes high-earning migrant workers can exacerbate the existing imbalance of power between men and women within the project-affected communities. Prevalent gender bias and stereotyping rooted in the communities' patriarchal culture can result in the financial exploitation of women employed in the project's formal and informal supply chain. Socio-economically vulnerable women engaging in various service sectors face potential sexual exploitation, harassment and assault from project workers. On construction projects, workers who are most often associated with acts of aggression against women include security guards and long-haul truck drivers, as they are more likely to encounter women in isolated conditions (i.e. away from crowded locations and/ or during night shifts). Moreover, a dominant fraction of the male workforce includes migrant men with circumscribed work routines and lack of conventional socialization. A dominant fraction of the male workforce includes migrant men with circumscribed work routines and a lack of conventional socialization. A dominant fraction of the male workforce includes migrant men with circumscribed work routines and a lack of conventional socialization. A dominant fraction of the male workforce includes migrant men with circumscribed work routines and a lack of conventional socialization. A dominant fraction of the male workforce includes migrant men with circumscribed work routines and a lack of conventional socialization. This creates an especially high risk of sexual exploitation of locally based women, some of whom may gravitate towards project-spurred micro-enterprises.

Women at a higher risk of exposure to project related GBV and SEA include women belonging to marginalized groups (i.e. extremely poor, indigenous, refugees etc.), as they typically incur social ostracism, possess little to no wherewithal for judicial remedies, and are disproportionally dependent on menial work rendered by large projects. Commercial sex workers are also predisposed to GBV and SEA due to their social persecution and the demeaning attitudes held towards them, particularly within conservative and patriarchal societies. In addition, adolescent, out-of-school female youth (including young mothers) are vulnerable to sexual exploitation by project employees who may offer them money and other privileges in the interest of sexual advances.

Impact significance (pre-mitigation)

Table 11-45 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Table 11-45: Receptor sensitivity and impact significance rating

Impact /	Impact	Sensitivity of relevant receptors	Pre-
sub-impact	characterization		mitigation



			impact significance
Main impact –	Health, safety, and secu	rity incidents within local communities	5
Potential GBV and SEA	Can be characterized as negative, indirect, medium-term, irreversible, local and medium in magnitude.	Women within the project's affected communities, particularly those located close to construction camps and/or potentially engaged in commercial activities related to the project and those who are socio-economically vulnerable. Rated as moderately sensitive.	Moderate

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be undertaken to prevent and mitigate health, safety, and security incidents within project-affected communities:

- all project workers will receive induction and refresher trainings on various aspects of construction health and safety that are of relevance to community and public health and safety
- project traffic will be limited to dedicated access roads to the extent possible
- project traffic will be subject to differential speed limits and the speed of all project vehicles along sections of roads within settlements will not exceed 30 km/hr
- in addition to speed limits, speed bumps will be installed along access road sections cutting across sensitive communal locations (e.g. schools, pedestrian and livestock crossings etc.).
- public access to the project's dedicated service/access roads will be restricted to the extent possible
- project access roads located nearby schools will be fenced
- traffic control measures such as the stationing of flagmen and installation of traffic signage and reflective barricades will be implemented on sections of the Project's transit corridors with an interface between project traffic and non-project road and railway traffic
- periodic traffic H&S risk assessments will be carried out for the entirety of the project's transit corridor to identify high-risk zones requiring additional traffic safeguards (e.g. sections of project access roads along (i) major settlements and transport stations, (ii) at-grade pedestrian crossings and road junctions and (iii) at-grade MGR line intersections)
- creation of local awareness around construction-related health and safety hazards will be implemented through routine community H&S sensitization (via school assemblies, community meetings and door-to-door engagements), and periodic traffic safety campaigns involving local traffic police (for large settlements)
- project vehicles will be serviced regularly to prevent breakdown and failure that can potentiate traffic accidents involving members of the general public



- recruitment of project drivers will involve qualifying criteria such as licenses attained, adequate experience, familiarity with traffic H&S safety, visual tests and professional references
- alcohol testing will be undertaken for project drivers
- speed monitoring efforts will include on-site speed checks using radar equipment, and the engagement of a fleet management services provider for GPS speed tracking for high-risk and long-distance trips
- night-time trips will be limited to the extent possible, and journey management plans will be prepared and approved for any such trips
- dust suppression measures, including but not limited to watering service road surfaces (using water bowsers), covering trucked aggregate loads, implementation of various speed controls (including speed bumps) and the location of concrete batching plants downwind of unavoidable community receptors and with a sufficient buffer
- restriction of public access to all construction zones by means of fencing, barricading and prominent signage and notice boards
- the EPC Contractor will carry out a dedicated risk assessment for all borrow pits that will be established as part of the Project. Based on the risk level for each borrow pit, the Contractor will consider site-specific mitigation strategies such as structural measures (e.g. low-cost fencing or barriers and warning signposts) and on-site monitoring/ surveillance (e.g. security patrols, temporary guard posts)
- any new borrow pits established solely for the project will be adequately rehabilitated in consultation with relevant LGAs
- construction workers will receive trainings and management plans and procedures for the proper management of construction wastewater, including sewage to prevent the contamination to receiving environments such as shallow groundwater or rivers
- institution of a code of conduct for all project workers
- induction and refresher training will be delivered to the project's security personnel, in line with the UN Code of Conduct for Law Enforcement Officials and Voluntary Principles on Security and Human Rights
- the recruitment of the project's security workers will involve screening for past offences involving violations of protocols on the use of force (including abuse of power, GBV etc.)
- the EPC Contractor will develop a gender policy or policy statement (that may be incorporated into an overarching HR/E&S Policy), as part of the ESMS that is to be developed for the project. The policy will underscore the definition and prohibition of gender-based exploitation, harassment, and violence
- thorough induction trainings on gender-based exploitation, harassment and violence are delivered to all new project workers, and periodic refresher trainings on gender-based exploitation, harassment and violence will be given to all project workers
- the EPC Contractor will demonstrate that any directly engaged sub-contractors abide by its gender policy statements, code of conduct and related procedures. Contract agreements will include clauses on proscription of gender-based exploitation, harassment and violence, and binding implications for noncompliance (e.g. reprimands, performance bonuses, penalties etc.)
- for all reported cases of GBV or SEA committed within local communities, the EPC contractor will extend immediate professional, survivor-centred, and free-ofcharge support to the victims, with efforts to maintain their safety, dignity, and



volition with regards to confidentiality and legal action. Support to victims of GBV or SEA will include medical, psychological, and financial support, as well legal advisory assistance, and the engagement of law enforcement authorities, for official investigation and prosecution, at the will of GBV victims

- the project developer and EPC Contractor will institute external GRMs that will include at least one female CLO (per Lot) and other focal points (e.g. LGA community development officials and gender desk of local police force units) to demonstrate that dedicated channels exist for reporting gender-based exploitation, harassment, and violence
- the EPC contractor's CLOs will undertake routine awareness creation and trainings to sensitize local communities to the project's gender policy commitments, appropriate reporting channels for gender-based exploitation, harassment and violence, as well as the support services coordinated by the EPC Contractor in the event of any such violations being reported
- the EPC contractor will mobilize adequate HSS teams for the Project, which will include training personnel, inspectors, traffic controllers and medical aid providers, amongst other personnel
- the external project GRM and relevant sensitization efforts will be implemented to allow grievances pertaining to HSS incidents and the violation of human rights within host communities to be collected on platforms that are accessible to all local constituencies and free of manipulation, interference, intimidation, service charges and restrictions on arbitration, judicial recourse and choice of confidentiality
- the EPC contractor will prepare a security management plan, community health safety and security plan, communicable diseases management plan, waste management plan, soil management plan, traffic management plan, emergency preparedness and response plan and sub-contractor and supplier management procedure, in consultation with the relevant LGA departments and the local police force.

11.3.6 Transient inflation within local communities

Results of the ESIA-stage socio-economic survey indicate that over 90% of residents within the project-affected communities earn a monthly revenue lower than TZS 250,000. The residents' low-income status is manifested in the widespread prevalence of smallholder, subsistence agriculture. The project's construction phase will create a drastic expansion of local markets, with a steep demand for construction materials, sustenance products (including fresh produce), and miscellaneous support services that can be sourced from local communities at a relatively low cost.

The sharp and sustained increase in demand for locally available products and services potentially triggers the commercialization of subsistence-oriented economies characterizing most of the project-affected communities. The responsive transition to a cash-based economy is likely to entail the emergence of profit-maximizing markets. While these markets may benefit the project organization and well-established SMEs, the resultant rise in local living costs poses conversely adverse implications for the remainder of the project-affected communities. Food and housing inflation can have a crippling effect on the micro-economies of financially insecure households.

Impact significance (pre-mitigation)

Table 11-46 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.



Table 11-46: Receptor sensitivity and impact significance rating

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Transient inflation within local communities	Can be characterized as negative, indirect, medium- term, reversible, local and medium in magnitude.	Local residents within the project's affected communities (most of whom have a low-income status), particularly those who are socioeconomically vulnerable. Rated as moderately sensitive.	Moderate

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be undertaken to manage the risk of projectinduced inflation within project-affected communities:

- the external project GRM and relevant sensitization efforts will be implemented to collect grievances pertaining to project-induced inflation within host communities on platforms that are accessible to all local constituencies and free of manipulation, interference, intimidation, service charges and restrictions on arbitration, judicial recourse and choice of confidentiality
- if 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
- commuting assistance (in the form of staff buses and cars) will be provided to workers based within a considerable radial distance from construction sites, to reduce the demand and pricing of accommodation facilities and essential commodities within communities closest to the project area.

11.3.7 Increased truancy and drop-out rates within local communities

Regarding educational attainment within the project-affected communities, the baseline survey has shown that while enrolment rates have generally increased within recent years, truancy and drop-outs are not uncommon. The withdrawal of children and adolescents from school has been attributed to teenage pregnancy, early marriage, employment and the relocation of agricultural households.

The advent of the project and associated explosion of income earning opportunities presents the potential for increased truancy and a higher proportion of out-of-school youth within the host communities. Young employment seekers may opt to forgo school attendance in hopes of securing quick returns from project-induced economic opportunities (e.g. vending, food catering and hospitality), particularly those within the informal sector. The absorption of youth into the labour market at the expense of their school attendance potentially undermines their educational attainment, skills base for specialized occupations and long-term economic performance. The influx of male workers for long periods of isolated work also potentiates the risk of workers making close advances towards vulnerable adolescent schoolgirls, who may opt out of school to pursue early marriage or incur unplanned pregnancy and disciplinary expulsion from school.



Table 11-47 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Increased truancy and drop-out rates within local communities	Can be characterized as negative, indirect, medium-term, reversible, local and medium in magnitude	Minors resident within the project's host communities and affected districts, particularly those who are based close to main construction camps and/or live within socio-economically vulnerable households. Rated as moderately sensitive	Moderate

Table 11-47	: Receptor	sensitivity	and impact	significance	rating
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Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be undertaken to manage a potential drop in educational participation by resident minors seeking project employment:

- the EPC Contractor will undertake public announcements (in collaboration with relevant LGAs) and community meetings to publicize employment eligibility and the Project's zero tolerance to child labour
- in accordance with the Project E&S and HR policy, the EPC Contractor will include child labour as a tender qualification criterion for candidate subcontractors, cascade child labour prohibitions down to second tier subcontractors and carry out periodic sub-contractor audits and supply chain screening to demonstrate the absence of child labour. These provisions for these processes will be set out in a sub-contractor and supplier management plan
- continual engagement of local communities, including school assemblies to sensitize adolescent schoolgirls to the risk of teenage pregnancies.

11.3.8 Disruption of local customs

As shown by the socio-economic survey, affected communities within the project area comprise multiple ethnic groups, which are bound by patriarchal customs, prevailing religious values and a fluency in Swahili. The communities' ethnic profile includes a total of six tribes that meet the internationally accepted definition of IP. These groupings exhibit well-preserved traditions, partial socio-political autonomy, communal attachment to historically claimed land and natural resources bases, and distinct lingual heritage.

The project-induced in-migration of employment seekers, entrepreneurs, petty traders and other economic opportunists will diversify the cultural fabric of local communities based around the project corridor. Expatriate workers recruited by the EPC Contractor will be based in dedicated labour camps. Due to capacity constraints for on-site accommodation, however, a considerable fraction of blue-collar Tanzanian laborers will settle within the camps' surrounding communities. Additionally, camp-based workers will



be allowed to leave the labour camps during designated off-days. This raises the likelihood of workers interacting with the host communities, in pursuit of essential household products and recreational activities.

While the cultural distance between local inhabitants and newcomers from other parts of the country may not present extreme cultural shocks, the influx of foreign labour is likely to result in cultural fissures that may engender tensions between foreign and local residents. These tensions may be compounded by stiff competition for limited communal resources and facilities. Moreover, the intermingling of the different ethnic groups within the project area may lead to cultural influences which may erode long-standing traditional values of the host communities, with a negative knock-on effect on social cohesion.

Furthermore, the settlement of migrant, well-to-do project laborers amidst the low-earning local majority may heighten the prevalence of social pathologies such as prostitution, alcoholism, drug use, smoking and unplanned parenthood. These vices may in turn stimulate various forms of abuse and criminality discussed in Section 11.3.5 above. Overall, the potentially disruptive cultural dynamics brought on by project-related demographic alterations can compromise the social welfare and cohesion of local communities.

Impact significance (pre-mitigation)

Table 11-48 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub- impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Disruption of local customs	Can be characterized as negative, indirect, medium-term, irreversible, local and moderate in magnitude.	Local residents within the Project's host communities, including groupings with distinct cultural identities (e.g. IPs). Rated as having medium sensitivity.	Moderate

Table 11-48: Receptor sensitivity and impact significance rating

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the impact, the impact significance will be reduced to a minor status.

Mitigation

The following mitigation measures will be undertaken to manage the potential disruption of local customs within project-affected communities:

- compulsory induction training will be provided to all migrant project workers, with a focus on the cultural context of the host communities and the country at large, and the code of conduct with regard to local cultural sensitivities
- the EPC contractor will employ CLOs who will perform sensitization engagements within the host communities to create local awareness surrounding the influx of foreign workers, potential cultural differences and related grievance redressal
- EPC contractor will adopt a zero-tolerance policy and code of conduct regarding unacceptable behaviour of project employees within host communities, with a clear set of disciplinary procedures and punitive measures for non-compliance



 the external project GRM and relevant sensitization efforts will be implemented to collect grievances pertaining to adverse cultural impacts are on platforms that are accessible to all local constituencies and free of manipulation, interference, intimidation, service charges and restrictions on arbitration, judicial recourse, and choice of confidentiality.

11.3.9 Employment creation and capacity transfer

Unemployment is a persistent economic setback for the project-affected communities and the wider regions of Singida and Tabora. Amongst the unemployed are the youth, who account for the bulk of the national population and represent an economically important demographic in terms of potential demographic dividends. The working population within project-affected areas also includes older residents, with limited employability that is ascribed to the lagging development of rural markets, poor infrastructural and financial access to productive resources and limited educational attainment. Interim results from the ongoing RAP-stage socio-economic survey suggest that <20% of residents based along the project have attained secondary and higher education.

As detailed in Section 4, the project's construction phase is set to employ a peak workforce of ~7,000 people reached for Lot 3, and ~4,000 for Lot 4, 80% of whom are anticipated to be Tanzanian nationals. Beyond the extension of skilled and semi-skilled employment on a direct basis, the project will engage numerous local service providers and petty traders, and thereby incentivize the formalization of local SMEs. In addition to the transient economic boom from a surge in demand for local offerings, the project is anticipated to catalyse longer-term local economic development within its commercial area of influence. Furthermore, the dissemination of transferable and specialist skills over the course of construction-phase employment will enable capacity transfer that will boost the employability of local recruits and create spill-over benefits for other developments within the project-affected districts and the country at large.

Impact significance (pre-mitigation)

Table 11-49 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Employment creation and capacity transfer	Can be characterized as positive, direct, medium-term, irreversible, national, and high in magnitude	The economy of the project- affected regions, districts, and local working-age residents within the project's host communities, particularly those who are based nearby main construction camps and/or those without formal employment. Rated as having high (national) value	Major

Table 11-49: Receptor sensitivity and impact significance rating

Enhancement measures

The following enhancement measures will be undertaken to enhance local employment and capacity transfer:



- based on the project's E&S and HR policy, the EPC Contractor will develop a local recruitment plan that will guide the procurement of skilled and semi-skilled labour at the local, regional and national level (in order of decreasing priority). The plan will also identify (i) newspaper advertisements, (ii) announcements and postings by relevant LGAs and vocational training institutions and (iii) construction camp guard posts, as means to engaging suitably qualified local candidates
- the EPC Contractor will continually engage with local communities to announce employment opportunities for locally available labour
- construction-phase recruitment will apply employment criteria demonstrating capacity for related work (e.g. educational attainment, professional experience, fitness for work, ethical track record etc.), with a default preference for Tanzanian nationals. The local recruitment plan to be developed for the Contractor's technical assessment and training centre will institute an employment process that is free of discrimination on the grounds of gender, ethnicity, religion, income status and other attributes of no bearing on job requirements. The plan will also define provisions to ensure that local candidates are given preferential consideration in a priority sequence starting with the host village / mtaa level
- the local recruitment plan will prescribe a default procurement of construction goods and services at the local, regional, and national level (in order of decreasing priority), and the development of a database including suitably qualified local suppliers
- all project workers will receive on-the-job training for the dissemination of specialist and transferable skills over the course of their employment
- the EPC Contractor will offer career development programs such as internships, mentorships and professional development plans for various tiers and sections of construction labour.

11.4 Social impacts identified and assessed: Commissioning phase

The impact analysis and mitigation commitments presented in the following sub-sections are centred on project facilities that are within the scope of this ESIA report. An interim discussion of the key risks and safeguards in relation to the remainder of the project's planned facilities (e.g., the Overhead Transmission Line (OTL)) is nonetheless provided, due to the paucity of relevant design information at the time of this assessment.

Upon the completion of construction works for the project's planned facilities, the EPC Contractor will undertake a commissioning campaign that will primarily entail authoritative inspection and acceptance testing of delivered railway system components, as well as subsequent handover to the project developer, for the start of commercial operation. The following sub-sections outline the objectives and aspects of the project commissioning, to provide context for associated hazards to public health and safety and potential impacts on project and third-party property.

i. Pre-Commissioning

Pre-commissioning will comprise initiatory testing, which will serve to establish that the project facilities and constituent equipment units are constructed, procured and installed in full conformity with the technical specifications and safety standards stipulated in approved design documents.



These audits will involve observations and measurements for static facilities and equipment, without appraisal energization. Target facilities include (but are not limited to) civil railway infrastructure, trackwork, power supply systems, catenary system, and subsidiary buildings.

ii. Commissioning

Commissioning will involve advanced testing, which is aimed at ensuring that that the project facilities and constituent equipment units meet the structural, electrical, mechanical and safety performance requirements under standard operating conditions, as stipulated in pertinent approved design documents.

This round of testing will entail isolated and integrated appraisals and involve the energization and low to medium speed mobilization of locomotives. Target facilities include (but are not limited to) power supply systems, catenary system, signalling and telecommunication systems, as well as locomotives.

iii. Trial Run/ System Performance Test

Following precursory rounds of appraisal to validate operability to basic performance requirements, a round of full-on, integrated testing will be completed to ensure the functionality of the project facilities and constituent equipment at maximum design capacity and in full conformity with contractually established technical specifications and safety standards.

This round of testing will entail the movement of unmanned test trains at maximum speed. All the facilities integrating into the railway system will be included in this appraisal, and the functionality of various interfaces will be assessed simultaneously.

11.4.1 Traffic-related H&S incidents and property damage

During construction, civil works, track laying and ballasting will be carried out sequentially and incrementally along the length of the SGR alignment. Following the completion of construction, commissioning will be initiated. The commissioning phase will involve the movement of trains at different speeds along the full extent of the railway (by Lot). Ultimate trial runs will entail the dispatch of test trains at full speed. Due to the lengthy duration of construction works and idle periods during subsequent demobilization, frequent incidents of trespassing may occur within at-grade sections of the railway at the project's construction stage, particularly within densely populated areas and pastoral hotspots.

Uncontrolled trespassing may extend into the project's commissioning stage. In the absence of sufficient local sensitization to commissioning-phase H&S risks and precautions, the movement of SGR test trains at unprecedented speeds may expose unsuspecting or incautious trespassers to the risk of accidents involving collision with the fast-moving trains, within at-grade railway sections. The risk of such accidents is relatively high in areas where locals and children in particular congregate, such as schools, market centres, bus terminals, village centres and places of worship. Test runs may also attract crowds of onlookers (and juvenile trespassers in particular), which may likewise result in collisions with at-grade sections, considering risk factors such as the kinematic envelopes of high-speed test trains.

Motorcyclists located around poorly serviced and congested roads may also attempt malpractices such as speeding along the SGR embankment or attempting to cross the railway line, along at-grade sections.

Additionally, commissioning activities involving the movement of test trains are subject to the occurrence of accidents involving derailment. This risk is particularly high for highspeed test runs along railway curves, other risk factors being mechanical failure, track



defects and human error. O&M training (prior to handover) at the system performance test stage of project commissioning potentially carries a significant risk of accidents from human error. Commissioning-phase derailment incidents, particularly those within urban areas and rural commercial centres, are likely to result in catastrophic property damage and casualties within impact areas.

Beyond H&S risks related to impact with moving test trains, the energization of various power and catenary system components presents the risk of electrocution to any trespassing individuals who may come into deliberate or accidental contact with live conductor surfaces. This hazard also warrants extensive local sensitization, as the discharge of high-power AC current through electrical systems is, by default, not apparent to the general public within nearby communities. Furthermore, the movement of vehicles along the project's service roads during commissioning, following rounds of demobilization and periods of little to no project traffic, creates further potential for injurious and/or fatal road accidents and associated damage to third party property.

Impact significance (pre-mitigation)

Table 11-49 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation risk significance
Traffic-related	H&S incidents and pr	operty damage	
Traffic- related H&S incidents and property damage	Can be characterized as negative, direct, long-term, irreversible, local, likely and high in magnitude, and therefore classed as major. The level of likelihood for this impact can be considered occasional, and the 'major' impact would therefore translate into a major H&S risk.	 Railway service users/ passengers. Rated as highly sensitive. Pedestrians, road users and railway O&M personnel (in and around the railway gauge and associated clearance zones). Rated as highly sensitive. Railway operator (project developer). Rated as moderately sensitive. 	Major

Table 11-50: Receptor sensitivity and impact significance rating

Risk significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the risk, the risk significance will be reduced to a minor status.



Mitigation

The following measures will be undertaken to manage the risk of public health, safety and security incidents along the railway line during commissioning and operation:

- institution of a project-specific Safety Management System (SMS). The system will comprise a Safety Policy and guiding objectives, plans and procedures for the continual identification, assessment and management of risks and hazards, targets for compliance with safety standards, investigation procedures for accidents, incidents and near-misses to identify causal factors and corrective preventative action, emergency preparedness and response plans, safety performance reporting and audits, as well as the delivery of relevant trainings and awareness creation for all relevant staff.
- development and implementation of a project-specific Community Health, Safety and Security Management Plan integrating into the Commissioning Safety and Emergency Response Plan, as part of the project-specific Safety Management System (SMS)
- development and implementation of an operations-phase Waste Management Plan and Hazardous Waste Management Plan
- establishment of a railway fence punctuated by safe and adequate crossing points17 along the SGR line, prior to the start of the project's commissioning phase, to prevent trespassing by pedestrians and other road users, and associated accidents involving mobilized test trains.
- implementation of traffic and electrical safety campaigns within local communities to publicize the program for the railway testing and commissioning, as well as associated safety hazards and precautions, prior to commencement of the project's commissioning activities
- coordination with national and regional media, to expand the outreach of public announcements regarding the launch of the project's commissioning phase, and related precautions for public safety
- installation of prominent signage, warning lights and/or voice alarms to deter pedestrians and other susceptible road users from trespassing on the railway line, particularly along congregation hotspots, such as railway stations, bus stations, marketplaces and schools, to prevent accidents involving collision with oncoming trains

11.5 Social impacts identified and assessed: Operational phase

11.5.1 H&S incidents within local communities

11.5.1.1 Traffic-related H&S incidents and property damage

Globally, railway transport ranks amongst the safest means for civilian transport and freight. Nevertheless, railway transit is inherently subject to the occurrence of health and safety incidents to passengers, railway O&M personnel, and to road users potentially situated in and around railroads and associated clearance zones. Railway accidents can be generally categorized as follows:

¹⁷ Overpasses, underpasses, bridges and livestock crossings.



- Collision of trains with rail vehicles.
- Collision of train with obstacles within the clarence gauge.
- Train derailment.
- Fire outbreak in rolling stock.
- Release of hazardous materials and associated fire/ explosion in the event of derailment.

Further, typical causes of railway accidents include (but are not limited to) the following:

- Mechanical failure (e.g., faulty braking equipment).
- Track defects (i.e., rail damage in form of gaps).
- Track misalignment (including track buckling).
- Damaged train wheels and axles.
- Wrong side signalling failure and erroneous (manned) signalling.
- Excessive speed.
- Human error of rolling stock and signalling system operators.
- Trespassing on/ infringement of railway gauge and clearance zones.

To date, no significant incidents have been reported within operational sections of the SGR railway (i.e., Lot 1 SGR service area). However, a number of fatal railway accidents have occurred within the MGR railway network over the past three decades. In 2002, a railway disaster occurred along the MGR line in Igandu, Dodoma, as a result of brake failure, reverse rolling stock motion downhill and ultimate collision with an oncoming cargo train. The crash claimed the lives of some 281 passengers and an additional 600 casualties. In 2022, yet another severe derailment took place in Malolo, Tabora, with a death toll of four and 132 reported casualties. Following official investigation, the accident was attributed to damage caused by vandalism. In addition, a total of four accidents were reported along the MGR line between 2017 and 2022, in the regions of Kigoma, Morogoro and Dar es Salaam.

Post commissioning, the project's operational phase presents the risk of significant accidents and economic losses, which may culminate in catastrophic injury, fatalities, and damage to private and public property located in and around clearance zones. Mass casualties and sickness can also ensue from the uncontrolled release of hazardous materials into the environment (leakages, spills and gaseous emissions), fire outbreak, deflagration and explosive impact, in the event of derailment or grossly flawed handling and transportation of HAZMAT freight.

Impact significance (pre-mitigation)

Table 11-51 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation risk significance
Main impact – H&S incidents within local communities			
Traffic-related H&S incidents and property	The impact can be characterized as negative, direct,	 Railway service users/ passengers. Rated as highly sensitive. 	Major

Table 11-51: Receptor sensitivity and impact significance rating



Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation risk significance
damage (including accidents involving the release of hazardous materials cargo)	long-term, irreversible, local, and high in magnitude, and therefore classed as major. The level of likelihood for this impact can be considered occasional, and the 'major' impact would therefore translate into a major H&S risk.	 Pedestrians, drivers, and residents within impact zones (in and around the railway gauge and associated clearance zones). Rated as highly sensitive. Railway operator (project developer). Rated as moderately sensitive. Commercial entities (i.e., logistical businesses and other affected enterprises). Rated as moderately sensitive. 	

Provided the mitigation commitments detailed below are implemented for the full duration of the risk, the risk significance will be reduced to a minor status.

11.5.1.2 Other H&S incidents

Based on the design information available at the time of this assessment, the Project's O&M phase will entail the operation of various planned facilities, including train stations, rolling stock, railway tracks, railway crossings, railway fencing, marshalling yards, workshops, railway powerline, truck parking yards, bus terminals and dry ports. Further to traffic-related risks discussed above, rail passengers and local establishments located nearby operational facilities are potentially vulnerable to the following hazards:

• Mismanagement of general waste

General (non-hazardous) waste will be generated by regular operation and maintenance activities within railway stations, train cabins, bus terminals, and dry ports. Fly-tipping, unfettered littering, and inadequate facilities for sanitation and management of waste, and related pest infestation present the risk of infections/ disease to passengers and local communities.

• Mismanagement of hazardous materials and waste

Variable quantities of hazardous waste will be generated within operational facilities, including marshalling yards, workshops and truck-parking yards. This waste stream includes liquid waste, such as spent lubricants, hydraulic fluids, coolants, paints, solvents, and spill-contaminated stormwater/ runoff, as well as solid waste (i.e., contaminated containers, residue etc.). Bulk storage of hazardous materials may also take place within the Project's associated dry ports. Inadequate provisions for the storage and transfer of hazardous materials (including waste), and consequent human exposure (i.e., through contaminated water sources, direct skin contact etc.) pose several risks to human health, including acute poisoning and a host of chronic medical conditions.

• Electrical hazards



The Gallagher elephant-proof electric fencing around targeted wildlife crossings will be electrified along a minimum height of two metres above ground level, to minimize the risk of electrocution for pedestrians/ local community members. Nevertheless, certain contingencies, such as accidental contact with live conductors along damaged fence sections or vertical encroachment (attempted access to elevated live conductors) can result in mild to moderate electrical shocks, depending on the amperage of the electric fence. The probability of such incidents occurring is notably low, and the amperage of elephant-proof electric fencing is typically set within 5 milliamps¹⁸ (far below lethal current threshold¹⁹).

The hazards above should be managed throughout the Project's O&M phase, to prevent injury, illness, and other potentially severe third-party H&S incidents.

Impact significance (pre-mitigation)

Table 11-51 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation risk significance
Main impact – H	I&S incidents within loca	I communities	
Other H&S incidents	The impact can be characterized as negative, direct, long-term, irreversible, local, and medium in magnitude, and therefore classed as major. The level of likelihood for this impact can be considered occasional, and the 'major' impact would therefore translate to a moderate H&S risk.	 Railway service users/ passengers. Rated as highly sensitive. Residents in mitaa and villages located nearby the railway marshalling yard, workshops, and dry ports. Rated as highly sensitive. Residents in mitaa and villages located nearby wildlife crossings with elephant-proof fencing. 	Moderate

Table 11-52: Receptor sensitivity and impact significance rating

¹⁸ World Bank. 2020. Guide for Implementing Community-Based Electric Fences for the Effective Mitigation of Human-Elephant Conflict.

¹⁹ United States (US) National Institute for Occupational Health and Safety. 2002. Electrical Safety: Safety and Health for Electrical Trades.



Provided the mitigation commitments detailed below are implemented for the full duration of the risk, the risk significance will be reduced to a minor status.

Mitigation

The following measures will be undertaken to manage the risk of public health, safety and security incidents along the railway line during commissioning and operation:

- institution of a project-specific Safety Management System (SMS). The system will comprise a Safety Policy and guiding objectives, plans and procedures for the continual identification, assessment and management of risks and hazards, targets for compliance with safety standards, investigation procedures for accidents, incidents and near-misses to identify causal factors and corrective preventative action, emergency preparedness and response plans, safety performance reporting and audits, as well as the delivery of relevant trainings and awareness creation for all relevant staff
- establishment of a railway fence punctuated by safe and adequate crossing points20 along the SGR line, prior to the start of the project's commissioning and operational phases, to prevent trespassing by pedestrians and other road users, and associated accidents involving moving trains
- implementation of traffic and electrical safety campaigns within local communities in advance of major O&M activities for the project
- installation of prominent signage, warning lights and/or voice alarms to deter pedestrians and other susceptible road users from trespassing on the railway line, particularly along congregation hotspots, such as railway stations, bus stations, marketplaces and schools, to prevent accidents involving collision with oncoming trains
- routine inspection of railway infrastructure to detect any structural and mechanical damage/ faults for due maintenance, and implementation of investigation procedures for instances of vandalism of railway O&M assets
- Health and safety risk management systems will place key focus on preventing accidents attributable to human error, by instituting measures such as automation of operations subject to human error where possible, regular trainings where such tasks are operated manually (including near misses and lessons learned), recruitment of suitably qualified personnel, frequent inspections for alcohol and substance abuse, as well as efforts to ensure the absence of working conditions that can impair performance/ vigilance on high-risk operations (e.g., protracted work shifts and worker fatigue)
- provision of adequate sanitation facilities within train cabins, train stations and associated bus terminals (including hand-washing facilities, cleaning and disinfection services etc.)
- establishment of adequate facilities for the collection and storage of general (nonhazardous) waste, including waste bins, solid waste storage sheds, septic tanks etc.
- establishment of adequate facilities for temporary storage of hazardous materials and waste, with appropriate roofing, impermeable base/lining, containment

²⁰ Overpasses, underpasses, bridges and livestock crossings.



vessels/ structures, drip trays, and spill response kits to prevent the contamination of ambient soil, groundwater and surface water

- installation of smoke alarms, fire response equipment and fire hazard (including no-smoking) signage, as well as the establishment of internal (trained) fire emergency response teams and third party fire response service providers
- Use of licensed waste management contractors (or internal departments where appropriate) for transfer and disposal of general and hazardous waste to designated third-party facilities for waste recycling, treatment and disposal
- installation oil/water separators for drainage systems within marshalling yards and workshops where water-intensive clean-up is carried out (as necessary)
- restriction of unauthorized (public) access to on-site waste and hazardous material storage facilities (e.g., skip containers, warehouses) through prominent signage, container labels/manifests, access controls, surveillance and local sensitization (of affected communities)
- operational-stage sensitization of local communities located nearby wildlife crossings to the maintenance program and electrical safety precautions for elephant-proof electrical fencing
- installation of prominent, precautionary signage along the elephant-proof electrical fences
- implementation of a maintenance program including regular maintenance checks and timely repairs for elephant-proof electrical fencing nearby human settlements.
- development and implementation of a project-specific Community Health, Safety and Security Management Plan integrating into the Operational Safety and Emergency Response Plan, as part of the project-specific Safety Management System (SMS)
- development and implementation of a project-specific Hazardous Materials Transportation Procedure that is aligned with the project-specific Operational Safety and Emergency Response Plan and the Railways (Handling and Transportation of Dangerous Goods and Substances) Regulations, 2018. The Procedure will define provisions by the railway operators as well as third parties (cargo transit agencies) to ensure the classification of hazardous materials according to the internationally recognized UN numbering system for cargo/ customs screening, proper labelling, packaging, storage, transporting and handling in line with the Regulations.
- development and implementation of an operations-phase Waste Management Plan and Hazardous Waste Management Plan. The plans shall provide adequate preventative and mitigation measures for solid and liquid waste streams from various O&M operations including (but not limited to) servicing and refurbishment of rail wagons, railway tracks, mechanical and electrical maintenance, as well sanitary activities within trains and train stations

11.5.2 Security incidents within trains and train stations

Official crime statistics reported for Tabora and Singida show that theft is commonplace within various parts of the region. Crowded conditions within trains and train stations are potentially conducive to security incidents, which may include robbery, larceny and sexual abuse. Poorly illuminated paths and spaces around train stations can also increase the risk of physical attacks or sexual abuse towards passengers walking or waiting in solitude. A recent global study (Gallup, 2012) demonstrates that three in five women have experienced sexual harassment on public transport. The perceived and actual risk of



violence and harassment can circumscribe women and girls' mobility and equal access to workplaces, service centres and markets.

Impact significance (pre-mitigation)

Table 11-53 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / risk	Impact / risk characterization	Sensitivity of relevant receptors	Pre- mitigation risk significance
Public health,	safety and security in	cidents along the railway line	
Security incidents within trains and train stations.	Can be characterized as negative, indirect, long-term, irreversible, local, occasional and medium in magnitude, and therefore classed as moderate.	Passengers using the railway transit services, and women in particular. Rated as moderately sensitive.	Moderate
	The level of likelihood for this impact can be considered occasional, and the 'moderate' impact would therefore translate into a moderate H&S risk.		

Table 11-53: Receptor sensitivity and impact significance rating

Impact significance (post-mitigation)

Provided the mitigation commitments detailed below are implemented for the full duration of the risk, the risk significance will be reduced to a minor status.

Mitigation

The following measures will be undertaken to manage the risk of public health, safety and security incidents along the railway line during commissioning and operation:

- establishment of dedicated security offices and surveillance cameras within train stations to identify and address illicit activities
- establishment of security checks on of train trips and/or prominent display of prohibited activities (pictorial and/or written warnings) and penal measures for non-compliance
- furnishing of train stations to light the platforms and access tracks during evening and night-time hours
- establish codes of conduct, reporting protocols and remedial action to address GBV and SEA for operational staff and passengers



11.5.3 Augmented haulage, public transit and associated economic growth

Currently, Tanzania offers two corridors for railway transit, namely the central railway corridor and the Tanzania-Zambia railway corridor, which link the national commercial capital to cities and townships in the country's northern, western and southwestern hinterland. The country's central railway corridor is a strategic transit and logistics base of national and regional economic importance. Besides providing local connectivity with the benefits of low transit cost and a relatively high capacity for in-land freight, the railway line connects a total of five land-locked countries to the port of Dar es Salaam, a gateway to high value global trade flows.

While the capacity of the existing MGR railway spanning the corridor has been underutilized as a result dilapidated infrastructure and logistical constraints from multi-modal linkages, the introduction of a relatively efficient and modern SGR railway is anticipated to boost regional and international trade flows.

Upon full commencement of operations, the SGR line is anticipated to lower cargo transportation costs between the Dar es Salaam port and neighbouring countries by an estimated 30% whilst enabling freight volumes as large as 35 million tons per year. This efficiency will contribute to national economic growth by facilitating commercial and industrial development within the country's central, western, and northern regions, reducing the current pressure on trunk and regional roads connecting to these regions, and enabling a significant increase in annual tax returns from the port of Dar es Salaam.

Impact significance (pre-mitigation)

Table 11-54 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Augmented haulage, public transit and associated economic growth	Can be characterized as positive, direct, long-term, irreversible, national and high in magnitude.	The national economy as well as the population of regions and districts with direct railway access. Rated as having high (national) value.	Major

Table 11-54: Receptor sensitivity and impact significance rating

Enhancement measures

The project's national economic input can be enhanced by implementing sustained efficiency of the railway infrastructure through an effective operation and maintenance program, optimising logistics and minimising costs associated with transit delays due to lengthy asset servicing.

11.5.4 Creation of employment opportunities and capacity development

The project's operational phase will create a range of work opportunities for Tanzanian nationals. Jobs will include railway and locomotive engineers and technicians, train dispatchers, ticketing officers, porters, security guards and other maintenance staff. The operations phase and commissioning in particular will also involve the delivery of specialist occupational trainings such as those on information technology systems, business models, maintenance, marshalling, logistics, operations and safety.



Table 11-55 provides an overview of the impact characterization, corresponding receptor sensitivity, and the overall impact significance rating in the absence of mitigation.

Impact / sub-impact	Impact characterization	Sensitivity of relevant receptors	Pre- mitigation impact significance
Creation of employment opportunities and capacity development	Can be characterized as positive, direct, long-term, irreversible, regional and medium in magnitude	Qualified labour and youth within the project-affected districts, regions, and Dar es Salaam. Rated as having moderate (local to national) value	Moderate

Table 11-55: Receptor sensitivity and impact significance rating

Enhancement measures

The project benefits in terms of employment and skills development can be enhanced by the delivery of on-the-job trainings and institutional provision of professional development programs for employees and young graduates, including internships, mentorships and professional development plans for various related occupations.

Full details of the characterisation and assessment of impacts, and mitigations identified are also included in the Aspects and Impacts Matrix in Appendix 7.



12 CULTURAL HERITAGE BASELINE AND IMPACT ASSESSMENT

12.1 Background

A cultural heritage resources study was done for the initial Lots 3 and 4 ESIA by UDSM in 2022 (updated 2023), which covered aspects of archaeology, palaeontology and ethnography. The UDSM study focused on cultural heritage resources through the collection of primary data as well as secondary data. The data collection methods used included:

- key informant interviews
- paleoanthropological (archaeological and palaeontological) surveys
- paleoanthropological limited excavations (shovel test pits or STPs) at limited locations

UDSM also conducted a review of secondary data which included conceptualising the project location in terms of existing knowledge (publicly available literature) on the palaeontology, archaeology and historical, to ascertain the likelihood of encountering cultural heritage resources. The literature review also enabled the UDSM to provide a summary and expert opinion of the significance and importance of cultural heritage resources, shouldwill they be discovered in the project area.

According to the UDSM: "The importance of cultural heritage depends on chronology of the cultural heritage, socio-cultural beliefs/attachments of cultural heritage to local communities, proximity of the cultural heritage to the core project area (including the embankment, borrow pits, quarry sites (TPS and TAP) and concentration or amount of the cultural heritage that may warrant likelihood of cultural heritage to be relocated elsewhere. They encompass uniqueness/rarity of cultural heritage in relation to the archaeological/palaeontological and non-cultural heritage resources of Tanzania." The UDSM rated different types of cultural heritage as: low importance (LI), high importance (HI), and very high importance (VHI). UDSM further recommended that all VHI cultural heritage sites shouldwill be avoided or salvaged/rescued (Table 12-1).

Number	Name	Significance	Importance	Location
1	MSA cultural heritage sites	Archaeological	VHI	Possibly in Singida, Tabora regions
2	Late stone age (LSA) cultural heritage sites	Archaeological	VHI	Possibly in Singida, Tabora regions
3	IA cultural heritage sites	Archaeological	VHI	Possibly in Singida and Tabora regions
4	Ritual cultural heritage sites	Ritualistic	HI	All spotted sites in Manyoni, Uyui and Nzega districts
5	Traditional dances grounds	Traditional	HI	Possibly in Nzega district

Table 12-1: Significance and Importance of cultural heritage in the project area (source: UDSM ESIA, 2023)



Number	Name	Significance	Importance	Location
6	Graves and graveyard	Religious	VHI	e.g. Kitopeni, Manyoni District, Malongwe and Igalula in Uyui District
7	Worshipping cultural heritage sites (churches and mosques)	Religious	VHI	In all Lots 3 and 4 areas

The full UDSM study can be found in the UDSM do ESIA Report (10 February 2023).

A follow up cultural heritage study was commissioned in 2023 by RSK and conducted by Dr Elgidius Ichumbaki from the University of Dar es Salaam, Tanzania as part of the Bankable ESIA process. The study employed three strategies: desk-based review of literature, site field visits, and post-field follow-up for data analysis.

The desk-based studies included reviewing the following documents:

- the Government of Tanzania's legal and policy issues about archaeology and cultural heritage, including living heritage
- the previous ESIA studies and other project documents supplied by the client
- published and grey literature about the archaeology and cultural heritage of regions and districts where the railway line will cross
- other key documents that inform about the culture of the people, colonial history, chiefdom, developmental projects, and other related matters of the area where the railway line will cross.

The field survey involved two approaches: meeting and talking with relevant stakeholders and conducting site surveys of sampled locations. The stakeholders and the field crew met and held discussions with local government leaders, traditional healers, cultural officers in the districts and key or respected elders in some of the nearby villages where the railway line crosses. These stakeholders helped identify areas with potential cultural heritage sites, especially ritual sites, locations of graves and ancient settlements. They were also instrumental in providing narratives, histories, myths, and practices, which, in one way or another, helped to connect them with locations where cultural heritage sites would be located.

Site visits/surveys were mainly through ground walkovers to understand the type of archaeological materials exposed during the site cleaning. Due to accessibility problems and the short timeframe, walking along the entire alignment was impracticable. Site visits/surveys were mainly through ground walkovers at sample locations to understand the type of archaeological materials exposed during the site cleaning. Due to accessibility problems and the time frame, walking along the line was not practicable. The vehicle-aided survey involved stopping at spots along the alignment every 20 and 30 km and walking 6 to 8 km from each spot. Table 12-2 provides a summary of the accomplished tasks and implementation strategies.

Table 12-2: Summarised tasks and implement	ation strategy
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Phase	Tasks for gap-filling and methodology
Desktop study	 Reviewing the published and unpublished references on the cultural heritage of the project area – achieves, libraries, internet



Phase	Tasks for gap-filling and methodology
	information, and reports of previous assessments shall be used to accomplish this purpose
	 Virtual and physical consultations with the ministry, region, district, and local authorities regarding state of the art on cultural heritage in the project area
	 Use Google Earth and available maps to identify potential cultural heritage sites within the project's footprints
	 Identification of legal and policy documents guiding cultural heritage management in Tanzania.
Field visits for ground truthing and locating new sites –both tangible and intangible	 Field visits are made to conduct surveys across the route and identify localities with signatures of cultural heritage GPS points for each identified heritage site are recorded Certain artefacts located at various sites are examined to understand their types based on what is already established by previous studies.
Examination identified sites and artefacts	 The nature, extent, distribution, and chronology of artefacts are examined Locations or site coordinates are recorded to produce maps Images or drawings of the artefacts are produced.

The findings of both studies are integrated in the following sections. The detailed impact identification, characterisation and assessment of significance is contained in Appendix 7 (aspects and impacts matrix).

12.2 Institutional, legal and policy frameworks for cultural heritage in Tanzania

Although the cultural heritage sector in Tanzania is a cross-cutting issue, specific institutions, laws and policies are mandated to care for cultural heritage. At the ministry level, two ministries deal with cultural heritage. These are the MNRT and the Ministry of Culture, Arts and Sports (MCAS). Whereas MCAS deals with intangible cultural heritage (ICH -- rituals, shrines, traditional practices, indigenous knowledge, etc.), MNRT deals with tangible and movable cultural heritage. The two ministries (MCAS & MNRT) have institutions, laws and policies to manage and care for tangible and intangible cultural heritage assets, e.g. while MCAS has a Department of Culture, Arts and Sports (DCAS) in all the Districts in Tanzania, the MNRT operates through various departments and institutions scattered across the country. Despite MNRT having various institutions looking after tangible cultural heritage assets, only the Department of Antiquities and National Museum of Tanzania are legally mandated to care for immovable and movable cultural heritage, respectively.

Policy-wise, specific policies guide activities related to cultural heritage, including Cultural Policy (1997) and Cultural Heritage Policy (2008), complementing each other, or operating interchangeably. Whereas MCAS coordinates implementation of the 1999 policy, the MNRT oversees the implementation of the 2008 policy. Among other things, both policies are central to assessing impacts to cultural heritage for the current project, e.g. Sections 4.2.3 and 4.6.2 of the 2008 policy require that cultural heritage impact assessment (CHIA) studies precede all major development projects involving excavations and that the developer meets all costs for undertaking such studies.

Although Tanzania has no specific guidelines or procedures for undertaking CHIA studies, multiple laws and policies mention the necessity of salvaging and protecting



cultural heritage (both tangible and intangible) during developmental projects. The laws include the Antiquities Act No. 10 of 1964 (Cap 333), the Antiquities Amendment Act No 22 of 1979, the Grave (Removal) Act No 9 of 1969, as published in the Government Gazette (G.N. No. 102 of 1970) and the Founders of the National Honouring Procedures Act No. 18 of 2004.

In addition to the above-mentioned local laws and policies, there are multiple UNESCO Conventions that Tanzania has ratified. These include the 1972 UNESCO Convention on the Protection of World Natural and Cultural World Heritage Sites and the 2003 Convention on the Safeguarding of Intangible Cultural Heritage. Both local and international laws and policies mandate and require Tanzania to comply with international standards when implementing projects such as the SGR.

12.3 Cultural heritage of the project area from the national database and other documentary sources

The project crosses three regions: Singida and Tabora, and inclose proximity to Shinyanga region (where Lot 5 connects to Lot 4). In these regions, the project crosses seven districts: Manyoni, Itigi, Uyui, Tabora Urban, Nzega and Kahama. The current national database shows that the regions through which the project crosses have six gazetted national monuments, 4 in Tabora, 1 in Singida and 1 in Shinyanga. Unfortunately, the database provides general information of the monuments without telling the respective district and exact locations of these cultural heritage assets. A follow up on this issue, through interrogating the regions and district cultural officers revealed that these national monuments do not fall within the project alignment.

Documents housed in the national archive about histories of the respective districts crossed by the project alignment mention colonial government and chiefdom activities that need recognition. One key chiefdom mentioned, for which the area is named after a particular leader is Chief Aghondi. ethnographic data and local narratives at Itigi confirm the significance of this chiefdom in the area. The area where chief Aghondi lived is called 'Utemini' which means 'to the chiefs.'

Other relevant documents consulted are those which detail the history of Tabora Urban; an area with important cultural heritage markers ranging from wars of resistance against colonialism to liberation struggles in the 1950s and 1960s.

Details are provided in the literature review from the USDM cultural heritage study regarding further palaeontological, archaeological and historical context if needed.

12.4 Field visits and recorded cultural heritage sites

This section describes field visits and stakeholder engagement conducted along the Lot 3-4 route. A summary of engagements is included in Table 12-4.

12.4.1 Archaeological sites

12.4.1.1 Makutopora

Between 537 km and 538 km (UTM 0732474/9362609), the survey team recorded an archaeological site with several artefacts, including **Acheulean** hand-axes, pieces of ceramics, grinding stones, daub and slag assemblages (see Figure 12-1). The materials are spread over a wide area exactly earmarked for a bridge. The area had a few major baobab trees, but these have been cut to clear the way. During interviews with local people, some mentioned a major baobab tree nearby the river source to be a ritual site where they conducted spiritual practices. The ritual site is called 'katavi' in Cigogo or


'sokwe mtu' in Kiswahili to mean a chimpanzee. The local collaborator Ms Paulina Ibuzi mentioned that during the ritual practices, people slaughter cattle and sheep as part of the offerings. Various songs and dances are performed nearby this baobab tree. Although this spiritual site is away from the railway line, people are concerned that the blasting of rocks at a proposed bridge site is likely to annoy the ancestors who care about the river source. The people thus propose pleasing the spirits by slaughtering cattle to inform them about the project.



Figure 12-1: A hand-axe stone tool (left) and grinding stone recorded at Makutopora (right)

12.4.1.2 Sukamahela

The team recorded multiple grinding stones in a farm close where the railway line will cross in ljembe hamlet, Sukamahela ward (0723913/9364163). Other artefacts recorded include pastles, daub and local ceramics. The artefacts (Figure 12-2:) are at the basement of Ndogwe hill that is proposed as one of the quarry sites.



Figure 12-2: Various pieces grinding stones recorded at Sukamahela

12.4.1.3 Utemini – Itigi town

Between 610 km and 611 km (UTM 0664397/9368867), there are two ritual trees, several graves, decorated pieces of ceramics and glasses. The site has tangible (pottery, glasses, built graves) and intangible (narratives about chiefs, ritual trees, spiritual practices taking place under the trees) heritage. Utemini means 'to the chief'; the area named Utemini indicates that locals respect and value it. The recorded ceramics are decorated with thick, bevelled, and fluted rims, a unique characteristic of the **Iron Age** period (Figure 12-3:). Two family members, Joha Agondi and Sudi Agondi narrated the importance of the chiefdom to the people and the necessity to document the history and rescue cultural materials associated with their chiefdom. They further informed that the



British colonial administrators respected chief Agondi to the extent of building groundwater wells which still exist in the area today. These local narratives are supported by documents in the National Archives in Dar es Salaam which document Aghondi as one the influential local chief during the German colonial rule.



Figure 12-3: A few decorated ceramics and tombs belonging to Chief Aghondi family

12.4.1.4 Gulumbai quarry sites

This is the only major rocky hill in the village identified for quarrying activities. Local people use a part of the hill to mine building materials. The Roman Catholic Church uses one side of the hill for pilgrimage activities and erected a cross to mark the area. Surveys on the hill basements (east, west, south, and north) recorded scatters of lithic and ceramic materials. There are also drilled/shaped stones which might have been either for temporary water storage or salt making. A few underground caves the local people mentioned to have been used for ritual activities do also exist (Figure 12-4).

12.4.1.5 Ilalo UTM

A locality earmarked as a quarry site in Ilalo village (0489387/9563912) has scattered Later Stone Age artefacts at. These are lithic tools made up of quartz / quartzite spread on the area and can easily be observed on the surface (Figure 12-5). The presence of stone tools made from volcanic rocks, such as chert, signifies that the sight might have been settled by stone age people who travelled several miles to source stone tool-making materials. Finding these stone tools is not surprising because similar lithic artefacts made from quartzite and chert were recovered from a mining site at Buzwagi (Masao 2018). Outside this area, nothing was recorded on the other quarry-earmarked sites.

12.4.1.6 Mahene

In a locality where the proposed railway line will cross there are scatters of LSA materials (UTM 0486062/9550814). The materials are not on the surface but underground, about 10-20 cm depth. The artefacts recorded were observed on a pit the local people hypothesize was exposed by the TRC surveyors (Figure 12-6).

12.4.1.7 Malololo

At Izima hamlet in Malolo village, exactly where the railway line crosses, the team recorded scatters of local ceramics, the majority of which have decorations (Figure 12-7). Also, the area has grinding stones, a few pieces of imported ceramics (certainly European) and graves.



12.4.1.8 Izuga Wino (Nzubuka)

At Izuga Wino village, where the proposed workers camp will be located (UTM 0483937/9479253), some families practice healing and other ritual practices. They have multiple ethnographic objects (Figure 12-8) that would be important to study, rescue, or conserve. One of the families, for example, has multiple traditional cereal storage containers, arrows, wood-carved containers, large baskets, beads tied on animal skin, etc and all these are linked to ritual practices they conduct. A survey on the area recorded grinding stones, local ceramics and other ethnographic materials. A nearby locality earmarked for a borrow pit at UTM 0483568/9479570 has scatters of local ceramics with unique decorations.



Figure 12-4: A rock with a cave where people do rituals (A), scatters of lithic artefacts (B & D) and a remain of what could have been used as water storage.



Figure 12-5: Selected lithic artefacts observed at a proposed borrow pit in Ilalo village



Figure 12-6: A few stone tools of Later Stone Age recorded at Mahene relini



Figure 12-7: A few pieces of decorated ceramics recorded at Malolo village in the area where the project alignment crosses





А

В



С



Figure 12-8: Some selected ethnographic objects (A-D) and a few decorated ceramics recorded at the proposed workers camp at Izuga Wino



12.4.1.9 Unono Village in Kakola

At Kakola village in Unono hamlet, there are few cultural materials including grinding stones and a few ceramics. At the basement of the proposed quarry/borrow pit there are traditional wells where locals obtain water to feed their domesticates. The presence of multiple traditionally built 'canoes' (Figure 12-9) and stone tools indicate the cultural significance of the area.



Figure 12-9: Canoe-like cultural objects used to store water for domesticates in Unono hamlet

A summary of the sites identified by the UDMS is included in Table 12-3.

12.4.2 Historical sites (source: UDSM ESIA, 2023)

Several graves were found along or near the project alignement. At the planned Itigi station, there is chiefdom by Aghondi family with graves of former chiefs, they include Chief Handu Aghondi and other chiefs' graves (Chief Laboja Musa Aghondi and Chief Aghondi Mwayola) at Utemini hamlet in Itigi Mjini. At Kazikazi, there is the Wayanzi chiefdom with graves of former chiefs of Wayanzi. Furthermore, near the planned project alignment at Kitopeni village in Manyoni District, there is a grave of Mnyang'ombe' who was a traditional leader of Wataturu.

In terms of intangible cultural heritage in the project area, the results of the UDSM study revealed that there are graves and graveyards that were found along the project alignmen, access roads, stations and planned quarry and borrow pit sites. The graves are used for African traditional worshipping and other resources, such as wells are used for African tradition religious rituals.

The uncovered ritual sites are characterised into three different forms:

- graves of Chiefs and or Sub-Chiefs with or without trees are used for worship
- graves at a hill are used for rituals
- trees, particularly the locally called msabida or sabida by Wabarbaig and Wataturu is highly important for African traditional religious rituals and water springs are also used for African traditional religious ritual while also serving as a domestic water source for the communities and cattle.

Additionally, the study uncovered ethnographic materials that included graves and graveyards for homesteads and communities, e.g. along the project alignment at Kitopeni village two homesteads have a total of nine graves. Moreover, the planned station at Tura village will traverse graveyards for Moslem and Christian communities. Other places with graveyards for communities include Malongwe and Igalula villages in Uyui District, Tabora Region.



"Several areas that were slave trade passages were mentioned that are within the project area like Manyoni, Itigi township, Tura, Kazikazi, Karangasi and all along through to Tabora Municipality", and "two key informants and excavations were carried along the slave trade routes at Karangasi hamlet and Tura ward in Uyui District". It was noted that "excavations never yielded material objects/artifacts documenting the history of the areas, including those pertaining to slave trade. Thus, based on history of the area, the project executions shouldwill consider possibility of serendipitous encounter of material objects and / or human remains that document the history of the country together with aspects on slave trade along central Tanzania that may be within the planned project alignment" (UDSM ESIA, 2023).

A summary of the sites identified by the UDMS is presented in Table 12-3:. More detail, including photographs are included in the USDM ESIA (2023).

12.4.3 Palaeontological sites (source: UDSM ESIA, 2023)

No palaeontological resources were uncovered during site visits but, as described in the USDM ESIA (2023) there is still a moderate likelihood of unearthing such resource during clearance and earthworks. Monitoring of construction during these activities for cultural heritage resources shouldwill be done and a chance find procedure prepared and followed shouldwill anything be unearthed.

12.4.4 Intangible cultural heritage (source: UDSM ESIA, 2023)

Intangible cultural heritage reported on by the UDSM included:

- graves of Chiefs and/or Sub-Chiefs with or without trees are used for worship at the planned project area, e.g. in close proximity with MGR at Itigi Station as well as Kazi Kazi village in Manyoni District, and at Buduba along with Wela villages in Nzega district
- at Kiwembe hill (Ikongolo ward in Nzega District), there are graves for Chief Shimba Nkulu and his family. The grave area is used for rituals. The hill is the site of a proposed stone quarry for stone materials for construction
- at Wella village (Nzega district) a Chief's grave is located at the area planned for quarrying. There is also a gold mining license/right allocated in the area, and many artisanal gold miners are busy digging for gold. Like most areas in Nzega district, Wella and Sojo villages are full of laterite – spread at some places as bedrock, which is a good source of nickel
- at Mkonze hamlet, Mdunundu village, Saranda ward, Manyoni District, the ESIA study uncovered a water spring and trees, particularly a tree locally called msabida or sabida by Wabarbaig and Wataturu is highly important for African traditional religious rituals, while the water spring caters for water for domestic use and cattle.

"All uncovered chiefs' graves and places for African traditional religious rituals are important intangible heritage or living heritage resources in the project area. As already unveiled, some will be affected with the project alignment itself or at quarry sites and/or accessory roads like at Kazi Kazi village where the Contractor's pavements at two grave areas have affected chiefs' graves that are used by concerned Wayanzi ethnic groups for their African traditional religious rituals.

Additionally, the study uncovered ethnographic materials that included graves and graveyards for homesteads and communities, e.g. along the planned project alignment at Kitopeni village two homesteads have a total of nine graves. Moreover, the planned station at Tura village will transverse graveyards for Moslem and Christian communities). Other places with graveyards for communities include Malongwe and Igalula villages in Uyui district, Tabora region" (UDSM ESIA, 2023).



12.4.5 Indigenous peoples

Indigenous People's Cultural Heritage is summarised below. Refer to Section 13 for more information on IP and geographic location of IP communities and resources identified thus far.

12.4.5.1 Sacred sites

During the focus group meeting and key informant interviews, the Wataturu ethnic group was discovered to be closely attached to land though the performance of rituals. Two types of sacred sites exist and practised by the Wataturu include Bung'eda and Sabida, which are potentially impacted by the project together with other potential sites for African traditional religious rituals. The two types of sacred sites are:

- grave mound
- traditional ceremony related to the grave

The Wataturu ethnic group communities are found in Itigi, Aghondi villages and Manyoni. Concerns from the Wataturu community include the fact that they have never had to relocate any graves for any reason. There is a fear that it would be going against their 'sleeping Chiefs' will and the Wataturu may be punished for this. They are of the view that the proposed project alignment and station should be moved instead.

12.4.5.2 Rain making rituals

The Wataturu ethnic group are famous in rainmaking African traditional religious rituals. Wataturu consider rainmaking as a powerful way of claiming their attachment to land and spiritual powers from the ancestors, especially those buried (in land). Rainmaking rituals are performances over Bung'eda of the deceased prominent leader after slaughtering a black lamb and prayers are conducted with the aim of asking for rainfall or forgiveness in case the community wronged their ancestors.

The concerns raised during discussions in Aghondi, Kitopeni villages as well as at Utemini hamlet in Itigi Mjini were directly linked to this and that Wataturu from Manyoni (in Singida Region) and Igunga (in Tabora Region) visit Bung'eda in Itigi town, especially when there is prolonged drought. They reported that the last rainmaking rituals were performed in 2021, and it rained immediately after performance of African traditional religious rituals.

IP are addressed in more detail in Section 13.



Area name and location	Type of cultural heritage found	Required interventions	Source (project phase)
Makutopora to Sukamahera UTM0732474/9362609 UTM0723913/9364163	Stone Age culture, neolithic and artefacts indicative of early faming activities. Makutopora is a Stone Age site that might have continued to be habited until recently when abandoned. This is due to the presence of artefacts, including hand-axes, ceramics, grinding stones, daub, slags, and ritual baobabs. Spiritual practices still occur at a baobab tree close to a river. Igembe to Sukamahera - scatters of grinding stones at the basement of the quarry site near Ndogwe hill. A few pastels, ceramics and daub were recorded on Mr xx (name redacted) farm nearby the railway route.	Rescuing of all the key artefacts on the project footprint Monitoring of land disturbance activities for chance find	RSK ESIA, 2023
Aghondi to Itigi Mjini (Urban)/ Utemini UTM0664397/9368867 -5.70785,34.484824 -5.707091,34.484436 -5.708472,34.483815 611+506.230 and 611+106.230	Decorated local ceramics of different periods, narratives of local chiefs, historic wells, ethnographic objects of historic importance. ceramics with different decorations, and various pieces of glass Iron Age site within Agondi chiefdom. The area has two ritual trees, multiple graves (Chief Handu Aghondi and other chiefs' graves, including Chief Laboja Musa Aghondi and Chief Aghondi Mwayola) Among the graves, two are said to be of historical leaders in the Wataturu tribe. Under the trees, ritual practices still take place annually and various dances, singing and animal sacrifices accompany these. Potential slave trade route.	Rescuing of all key artefacts and ethnographic objects in the area, including potential slave trade route artefacts Conduct sampled excavations to record the cultural history of the area to be disturbed by the project. Record all relevant narratives about the history of chief Aghondi Work with the chiefs' families to relocate chiefs' graves Record all relevant narratives about the history of chief Aghondi	UDSM ESIA 2022 and 2023, RSK ESIA 2023

Table 12-3: Recorded cultural heritage sites and brief description

		R	
Area name and location	Type of cultural heritage found	Required interventions	Source (project phase)
Kitopeni UTM 0674881/9366655	An area for holding ritual meetings to discuss common community issues such as marriage, deaths, etc. The tree, locally known as Msogomazi, which is now dry, is looked after by a clan named Maswaga Ngalasi and the current (February 2023) caretaker is Maria Maswaga. Communities are happy to relocate for their meetings/rituals provided a special offering is made (they need black cattle, sheep, honey, milk and local brew or money for the same value). In the area, no artefacts of archaeological importance were recorded. The project alignment will hit two homesteads and nine graves for their loved ones.	Collect and document narratives on rituals, practices Work with the chiefs and the families of the deceased to relocate chiefs' graves	UDSM ESIA 2022 and 2023, RSK ESIA 2023
Kitopeni, Sanjaranda ward, Manyoni district -5.736723; 34.602053 KP 597	Chief Mnyang'ombe's grave for rituals At Kitopeni village, there is a grave of Mnyang'ombe' who was a traditional leader of Wataturu. People undertake African traditional religious rituals on various disasters and other unsolved issues. The grave is located almost 200 m away at southern part from the proposed project alignment.	Avoid grave disturbance and provide adequate crossings in this area for those traveling to the site for rituals.	UDSM ESIA 2022 and 2023
Tabora Mjini (town)	Narratives and histories of struggle for independence and histories of slavery and slave trade.	Collect and document narratives of slavery and slave trade, as well as struggles for independence.	UDSM ESIA 2022 and 2023, RSK ESIA 2023
Izuga Wino UTM0483937/9479253 and UTM 0483568/9479570	Ethnographic objects associated with spiritual practices and local ceramics of between 17th and 19th century.	Work with local authorities to acquire relevant/unique ethnographic objects. Document narratives of traditional ritual practices by traditional healers impacted by the project.	RSK ESIA 2023

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		R Basel	
Area name and location	Type of cultural heritage found	Required interventions	Source (project phase)
Gulumbai (quarry site) UTM0495850/9525043 UTM 0495937/9524612 UTM 0496089/9524995 UTM 0496092/9524743	Later Stone Age artefacts.	Collect key lithic artefacts scattered on the surface that quarrying activities would impact. Record locations, record relevant information and rescue key artefacts such as observed storage stone vessels. Conduct limited test excavations to understand vertical extension of the Stone Age cultures alongside rescue strategies.	RSK ESIA 2023
Kazi Kazi UTM 0631910/9384010	 Scatters of few ceramics probably of 17th through 20th century. Two graves, one is marked by stones but the location of another is unclear. An old person points at a nearby locality but has no clear grounds why such locality. According to the local chief namely Omary Mohamed (Mzee Mnyelemi) the two graves belong to Isuli (deceased king/chief) and Isanze (deceased Queen or princes). Wayanzi Chiefs' Graves at Kazikazi in their farm yards at two spots. There are five graves with the pavement of two access roads. There is also a ritual tree within a sacred grove. 	Collect key lithic artefacts scattered on the surface that quarrying activities would impact. Record locations, record relevant information and rescue key artefacts such as observed storage stone vessels Work with the Chief to relocate graves if required Collect and document narratives on rituals and practices	UDSM ESIA 2022 and 2023, RSK ESIA 2023
llalo borrow pit. UTM0489387/9563912	Later Stone Age lithic artefacts -Recorded scatters of LSA materials scattered on a large landscape The artefacts are mainly of quartz/quartzite, but others are chert	Rescue key lithic artefacts scattered on the surface. Conduct limited test excavations to understand vertical extension of the Stone Age cultures alongside rescue strategies	RSK ESIA 2023

Area name and location	Type of cultural heritage found	Required interventions	Source (project phase)
Mahene relini quarry site UTM0486062/9550814	Later Stone Age lithic artefacts scatters of lithic materials made up of quartz/quartzite. The majority are not visible on the surface but plenty in the sub- surface of between 10-20 cm. Also recorded these on several localities where previous digging were conducted.	Conduct limited test excavations to understand vertical extension of the Stone Age cultures alongside rescue strategies	RSK ESIA 2023
Izima hamlet, Malololo village	Ceramics of between 17th and 19th century, European wares and grinding stones	Rescue key artefacts visible on the surface. Conduct limited test excavations to understand vertical extension of the ceramic artefacts alongside rescue strategies.	RSK ESIA 2023
llole village, Mogwa ward, Nzega district	Cluster of graves that include the grave of one former sub- chief at the proposed project alignment at Ilole village. The place is important for rituals.		UDSM ESIA 2022 and 2023
Mahene village, Mwamala ward, Nzega district	Grave and tamarind tree used for rituals through Cheyo Sub- Chief under Chief Mashimbi in Mwakalundi chiefdom.		UDSM ESIA 2022 and 2023

		R Bass	
Area name and location	Type of cultural heritage found	Required interventions	Source (project phase)
Buduba village, Mwamala ward, Nzega district	Two clusters of chiefs' graves and traditional forest reserve At Buduba village, there are two places with fig trees and graves of chiefs including their relatives that are used for African traditional religious rituals. The area covers fields for almost 5 ha. Buduba village has traditional forest reserve areas known in Kisukuma as ngitili that serve both people at Buduba and Sojo villages. They are used for roof thatching from July to September and pasture for their cattle from September to November.		UDSM ESIA 2022 and 2023
Mlimani hamlet, Wela village, Igusule ward in Nzega district	Grave for rituals At Mlimani hamlet, Wela village, there is a place for rituals The place has a grave of Mhega who was a sub-chief of the area. Of special note is that the EPC contractor has earmarked Wela hill as the quarry site. However, all areas are currently being mined for gold by artisanal miners. The Village Executive Officer informed that there is also a business person with a mining license at a certain location. The area has thickets and scattered acacia trees. The area could be potential for nickel mining due to laterite bedrock and boulders spread all over the place.	Work with the Chief to relocate graves Collect and document narratives on rituals, practices.	UDSM ESIA 2022 and 2023

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		R (Coord	
Area name and location	Type of cultural heritage found	Required interventions	Source (project phase)
Malongwe village, Uyui district, Tabora region 700+000 Igalula village, Uyui district, Tabora region 786+000 Tura village, Tura ward, Uyui district, Tabora region 686	Community graveyards The project alignment will hit graveyards for Moslem and Christian communities, e.g. such graves are located at Tura, Malongwe and Igalula villages, all in Uyui district, Tabora region. At Tura village, the planned station will hit community graves.	Consult with communities to relocate graves Collect and document narratives on rituals, practices.	RSK ESIA 2023
Mkonze hamlet, Mdunundu village, Saranda ward, Manyoni District	A water spring and trees, particularly a tree locally called msabida or sabida by Wabarbaig and Wataturu is highly important for African traditional religious rituals, while the water spring caters for water for domestic use and cattle.	Site to be further investigated as part of the future IPP.	RSK ESIA 2023



Table 12-4: Stakeholders engaged as part of the cultral heritage study

Stakeholders engaged as part of the cultral heritage study

Villager, Makutopora

Villager, Sukamehela, a farm owner near Ndogwe hill earmarked for quarry

Community Relations Officer (CRO), Makutopora—Tura, Yapi

Community Relations Officer (CRO), Makutopora—Tura, Yapi

Culture, Arts and Sports Officer, Itigi District

Village Executive Officer, Itigi Urban (Utemini area)

Grandson of the late Chief Agondi, Utemini hamlet

Granddaughter of the late Chief Agondi, Utemini hamlet

Community Relations Officer (CRO), Tura—Tabora, Yapi

Village Executive Officer, Kitopeni village, Itigi District

Renowned traditional healer, Gang 48 & Kazi Kazi village, Uyui District

Village chairman, Tura village, Uyui District

Headmaster, Tabora Boys School, Keeper of Mwalimu Nyerere legacies in Tabora

Tabora Region Officer, Culture, Arts and Sports

Conservator of Antiquities, Dr Livingstone Monument in Tabora

Current Chief of Unyanyembe in Tabora, He holds a reputable history of the region chiefdom and contribution to fighting German and British colonialism in Tabora

Officer for Culture, Arts and Sports in Nzega District where the campsite of Bukene and borrow pits will be established

Village chairman of Ilalo village, where the proposed quarry site and borrow pits will be established

Village executive officer of the Mahene village, where a proposed quarry/borrow pit is located

Village chairman of the Mahene [relini] village, where a proposed quarry/borrow pit is located

Village Executive Officer, Malolo village where the proposed quarry/barrow pit is located. An archaeological site is also found in this village.

Malolo Village Chairman. It is a village where the proposed quarry/barrow pit is located. An archaeological site is also found in this village at Izima.

Pastoralist, traditional healer and resident of Izuga Wino where the camp will be established. He will be relocated from his current resident, the area that has ethnographic objects

Village Executive Officer of Izuga Wino where the proposed campsite and borrow pit will be located



Stakeholders engaged as part of the cultral heritage study

Ag. Ward Executive Officer of Nzubuka ward where the proposed campsite and borrow pit will be located

Ward Executive Officer in Kakola ward

Village chairman in Unono hamlet, close to a proposed quarry site

Kakol Village chairman close to where the quarry site is located at the basement of which there are cultural materials



This section provides a summary of the IPP, which includes a description of the

13.1 International standards and national regulations

13.1.1 Definition of Indigenous Peoples: International Perspective

IFC PS 7 states that indigenous peoples may be referred to in different countries by such terms as "indigenous ethnic minorities," "aboriginals," "hill tribes," "minority nationalities," "scheduled tribes," "first nations," or "tribal groups".

Indigenous people are a distinct social and cultural group possessing the following characteristics in varying degrees:

- **self-identification** as members of a distinct indigenous cultural group and recognition of this identity by others
- collective **attachment to geographically distinct habitats** or ancestral territories in and to the natural resources in these habitats and territories
- customary cultural, economic, social, or political institutions that are separate from those of the mainstream 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.

Despite their cultural differences, indigenous peoples from around the world share common problems related to the protection of their rights as distinct peoples. Indigenous peoples have sought recognition of their identities, way of life and their right to traditional lands, territories and natural resources for years, yet throughout history, their rights have often been violated, and they are often among the most marginalised 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.

13.1.2 Indigenous Peoples in the African Context

In Africa, the concept of indigenous peoples has received criticism. It has been opined that the term Indigenous is not relevant in an African context because all Africans are indigenous and have been on the continent before colonialism and were mistreated and subjected to subordination during that time (ACHPR & IWGIA, 2005). Others argue that it is relevant particularly if used for marginalised groups in Africa to address some forms of inequality.

The report of the African Commission's Working Group of experts on indigenous populations highlights that indigenous peoples' culture and ways of life differ considerably from mainstream communities and are under threat of extinction, their survival depends on access and rights to their lands and natural resources, they often live in inaccessible and geographically isolated regions, and they may suffer from discrimination and various forms of political and social marginalisation. The report further shows that African people using the term indigenous people are hunter-gatherers, and pastoralist (IWGIA, 2005).



The Africa Commission on Human and People's Rights (ACHPR) indicates that no single definition can accommodate all the features of indigenous populations. The commission insist on consideration of a number of main features to identify the indigenous peoples in Africa. These include:

- self-identification
- a special attachment to and use of their traditional land whereby their ancestral land and territory have a fundamental importance for their collective physical and cultural survival as peoples
- a state of subjugation, marginalisation, dispossession, exclusion, or discrimination because of different cultures, ways of life or mode of production than the national hegemonic and dominant model.

The IWGIA states that indigenous people strive to maintain traditional livelihoods, culture and spiritual connection that intricately depend on communal ownership of land and natural resources (IWGIA, 2012).

13.1.3 Requirements for Indigenous Peoples in the ESIA: PS7

The Equator Principles and the IFC PS7 requirements for Indigenous peoples with regards to the ESIA process include the following:

13.1.3.1 Avoidance of negative impacts

An ESIA shouldwill identify all indigenous peoples in a project's AOI, assess all potential negative and positive project impacts on the indigenous peoples, and develop strategies to try to avoid, remedy or compensate for these impacts. The impact assessment process shouldwill ensure respect for the Indigenous peoples and preserve the culture, knowledge, and practices of the indigenous peoples.

The affected indigenous peoples should be involved in the development of measures to avoid, mitigate, reduce or remedy adverse impacts. Traditional or local knowledge can help identify solutions or alternatives that the project proponent may not be aware of.

13.1.3.2 Consultation and participation

During the ESIA, an ongoing relationship should be developed with the indigenous peoples affected by the project and maintained throughout the project's lifecycle, based on Informed Consultation and Participation (ICP). The engagement process should include stakeholder analysis and engagement planning, disclosure of information, consultation, and participation. Engagement should occur freely and voluntarily, without external manipulation, interference, coercion, or intimidation. Sufficient time for decision-making processes should be allowed.

Indigenous peoples' representative bodies and organisations (e.g. councils of elders or village councils), as well as members of the affected indigenous peoples' communities should be included in the engagement process.

A grievance mechanism should be implemented in a culturally appropriate manner and in consultation with the affected indigenous peoples' communities.

13.1.3.3 Free prior and informed consent

Indigenous communities may be particularly vulnerable to the loss of, alienation from or exploitation of their land and access to natural and cultural resources. In recognition of this vulnerability, the project proponent should obtain the Free Prior and Informed Consent (FPIC) of the affected indigenous people's communities when these assets may be impacted by a project.



The concept of FPIC is derived from the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which is an international instrument with broad support that embodies a convergence of common understanding about the rights of Indigenous peoples. As defined in Equator Principle 4, FPIC builds on and expands the process of ICP, ensures the meaningful participation of indigenous peoples in decision-making, and focuses on achieving agreement. It does not confer veto rights on individuals or sub-groups.

FPIC is understood as:

- **Free**: any consultation with indigenous people along the SGR line (Lot 3 & 4) will be done without any form of intimidation, manipulation, coercion and in other ways that may influence or make indigenous people feel insecure when sharing their views.
- **Prior:** all information provision, discussions and consent will take place before commencement of Project activities.
- **Informed:** TRC and its contractors will ensure that Project information is accessible, clear, consistent, and delivered in culturally appropriate language and format.
- **Consent:** TRC and indigenous communities impacted by the Project will establish a dialogue to address or seek solutions in a mutual respectful manner and in good faith in terms of all the aspects of the Project. This means that indigenous people will freely decide their mode of participation including their own traditional representative or other customary institutions. Consent is a collective decision given according to their customs and traditions.

FPIC is a process that should be established through good faith negotiation between a project proponent the affected indigenous peoples' communities.

FPIC is required in the following special circumstances:

- Impacts on land and resources subject to traditional ownership or under the customary use of Indigenous peoples. Frequently, lands used by indigenous people are traditionally owned or under customary use. While Indigenous peoples may not possess legal title to these lands as defined by national law, their use of these lands, including seasonal or cyclical use, for their livelihoods, or cultural, ceremonial, and spiritual purposes that define their identity and community, can often be substantiated and documented.
- Relocation of indigenous peoples from lands and natural resources subject to traditional ownership or under customary use. If such relocation is unavoidable the project proponent should not proceed with the project unless FPIC has been obtained.
- Significant impacts on critical cultural heritage. Significance of cultural heritage should be assessed in cooperation with the affected indigenous communities. It may include traditional knowledge which is intangible and includes knowledge, innovations and practices including folklore or traditional cultural expressions that have remained in use for sacred or ritual purposes (sacred groves, sacred bodies of water or waterways, trees or rocks). This potentially includes priority ecosystem cultural services.



For impacts arising from the above special circumstances, IFC PS7 puts forth a process aimed at reaching an agreement with the indigenous peoples' communities impacted by the project, which involves:

- documenting the negotiation process that was mutually agreed to by the project proponent and the affected indigenous communities
- documenting the outcome of the negotiation process, evidencing agreement between the project proponent and the affected indigenous communities.

13.1.3.4 Project benefits

Where possible the project proponent should promote sustainable development benefits and opportunities for indigenous peoples in a culturally appropriate manner.

Various factors including, but not limited to, the nature of the project, the project context and the vulnerability of the indigenous peoples will determine how these communities should benefit from a project. Identified opportunities should aim to address the goals and preferences of the indigenous peoples including improving their standard of living and livelihoods in a culturally appropriate manner, and to foster the long-term sustainability of the natural resources on which they depend.

It is important to make a distinction between the benefits linked to the mitigation of negative impacts of the project and the broader opportunities, such as employment and economic opportunities the project may provide. Where these broader opportunities exist, it is good practice to assist the indigenous communities to realise such opportunities.

13.1.4 Indigenous Peoples in the Tanzanian Context

According to IWGIA and later consistently featuring in the regional and international justices and development institutions such as the African Commission, the World Bank and its agencies, UN and its agencies, the indigenous peoples in Tanzania constitute the following ethnic groups: Datoga (Barabaig, Taturu) Maasai, Hadzabe and Akie.

These groups self-identify as indigenous peoples and meet the criteria of vulnerability described above. The Datoga (Barabaig, Taturu) and Maasai practice pastoralism, while the Hadzabe and Akie are predominantly hunter-gatherers. However, in recent times due to increased strict conservation laws prohibiting hunting, this group has been forced to diversify their livelihoods by adopting other activities such as agro-pastoralism.

In Tanzania, as in many African countries, the term indigenous peoples has been contested. Since independence, Tanzania has made efforts to de-emphasise ethnic differences and to promote the peaceful co-existence of ethnic groups. Identifying some groups as indigenous above others is a sensitive issue.

Tanzania has no specific legislation or policy regarding Indigenous peoples. However, the ACHPR, which identifies indigenous peoples based on the fundamental UN principles, is recognised by Tanzania, which has ratified the ACHPR's report on human and peoples' rights.

In 2012, the notion of indigenous peoples was adopted through the government's Tanzania Social Action Fund (TASAF), who compiled a Draft Indigenous People Policy Framework for its programme, recognising the presence of indigenous peoples.

The framework is intended to be flexible, allowing the level of detail to vary depending on the specific project and the nature of impacts to be addressed. The framework requires the following elements for a project:

• a summary of the social assessment



- a summary of results of FPIC with the affected indigenous communities that was carried out during subproject preparation and that led to broad community support for the subproject
- a framework for ensuring FPIC with the affected indigenous communities during subproject implementation
- an action plan of measures to ensure that the indigenous peoples receive social and economic benefits that are culturally appropriate, including, if necessary, measures to enhance the capacity of the subproject implementing agencies
- when potential adverse effects on indigenous peoples are identified, an appropriate action plan which includes measures to avoid, minimise, mitigate, or compensate for these adverse effects
- the cost estimates and financing
- accessible procedures appropriate to the subproject to address grievances by the affected indigenous communities arising from subproject implementation. When designing the grievance procedures, the availability of judicial recourse and customary dispute settlement mechanisms among the Indigenous peoples are taken into account
- mechanisms and benchmarks appropriate to the subproject for monitoring, evaluating, and reporting on the implementation of the IPP. The monitoring and evaluation mechanisms should include arrangements for FPIC with the affected Indigenous peoples' communities.

13.1.4.1 Traditional / customary land

IFC performance standard states that PS7 is triggered if a project impacts 'traditional lands belonging to indigenous communities. In Tanzania, village land and the customary nature of land use and ownership are recognised by the Land Act No. 4 of 1999 and the Village Land Act No. 5 of 1999. The law confers land management responsibilities to village governments and in turn, individuals and groups (including pastoralists and hunter-gathers). This means that individuals and groups within the village can acquire certificates of customary rights of occupancy (CCRO).

The National Land Policy 1997 recognises collective forms of land ownership and use, such as pastoralism, and such forms can be protected through the provision of village land and communal/group CCROs. The policy states that in the case of livestock movements, coordinated planning is needed to ensure that stock routes are provided and protected.

Other important laws that recognize pastoralism as a form of land use, and that need to be secured and protected, include the Livestock Policy of 2006, Grazing Land and Animal Feed Resources Act, 12 of 2010 and Land Use Planning Act, 6 of 2007.

13.2 Indigenous people in the project area: socio-economic context

Socio-economic and cultural aspects common to all local communities in the project Aol are described in the project ESIA. This section presents the indigenous groups in the project Aol and characteristics particular to these indigenous communities.



13.2.1 Administrative structures and governance in the project Aol

The President's Office – Regional Administration and Local Government (PO-RALG) is responsible for the administration of the regions, districts/municipalities, divisions, wards and villages.

The Singida and Tabora Regions, where the project will be crossing indigenous communities, are headed by Regional Commissioners.

The Manyoni, Itigi, and Uyui Districts are headed by District Commissioners. Under the districts, there are Wards which are headed by Ward Executive Officers (WEO). The smallest administrative units are the villages which are managed by Village Executive Officers (VEO). The village assembly, which is a legal organisation established under Section 24 of the Local Government (District Authorities) Act No. 7 of 1982, is headed by the village chairperson elected by the residents of the village for a five-year term. The village assembly approves all matters pertaining to the village, presented by the village council and local government.

During the May site visit, village chairperson and VEO indicated the presence of sub villages (see Table 13-1) in their villages. Note that in Tura, the VEO explained there were unofficially registered sub-sub villages as well. Each sub-village is governed by a sub-village leader who reports to the VEO. Indigenous people who live in these sub villages report to the sub-village leader.

This arrangement represents the central government structure down to the village level. However, there is also the decentralisation set up which falls under the local government structure. At the Municipal/District level, there is the Municipal/District Executive Director who deals with all development issues in the respective councils. All development activities planned and implemented must be routed through them.

Thus, the Municipal/DCs, with their relevant officers, have the mandate to manage and supervise developmental activities under various sectors representing the sector ministries, for this Project, the sectoral ministry is the Ministry of Works, Transport and Communication through the TRC.

13.2.2 Indigenous groups in the project Aol

The AOI is divided into two spheres based on the proximity to the proposed SGR line of settlements (towns, villages, and sub-villages) which include indigenous peoples (IPs):

- A primary sphere of influence which includes settlements where IPs have been identified and which are crossed by the proposed SGR line. IPs living in these settlements are most susceptible to direct (positive and indirect) impacts by the project in terms of livelihoods and wellbeing (e.g. loss of pasture and other natural resources). The IP study found that only Lot 3 of the project passes through village lands traditionally and customarily occupied, owned, and used by the Datoga (Barabaig and Taturu), Sandawe, and Maasai IP. No indigenous peoples were identified for Lot 4. The regions, districts and villages where the IP were identified are presented in Table 13-1 and Figure 13-1.
- A secondary sphere of influence which includes IPs living in settlements located outside of the primary sphere villages and which are not crossed by the proposed SGR line. IPs living in these settlements may be impacted indirectly by the Project (i.e. influx, job opportunities) These include IPs who are pastoralists and who may travel long distance and whose access to pasture land might be restricted during the project. It should be noted that during the site visit efforts were made to identify such IPs. During the IP study, it was identified that no nomadic indigenous



groups who could have been impacted by severance to grazing lands and other resources were crossing the project area

Table 13-1: Indigenous peoples in the project Aol

Region	District	Ward	PAC	Sub- village ²¹	Indigenous groups
			Makutusara	Walanchinza	Taturu and Sandawe
		макишрога	макицирога	Dabia ²²	Maasai
	Manyoni		Saranda	Sanjandugu	Taturu, Sandawe and Maasai
		Saranda	Mdupupdu ²³	Kati	Barabaig
Singida			Maananaa-°	Mbwekoo	Sandawe
Sirigiua		Aghondi	Aghondi		Taturu, Sandawe and Maasai
	Itigi	Sanjaranda	Kitopeni		Taturu and Sandawe
		Itigi	ltigi town	Itigi Mjini	Taturu
		Kitaraka	Kitaraka		Taturu, Sandawe and Maasai
		NIIdi dka	Kazikazi		Taturu and Sandawe
	Uyui	Uyui	Karangasi	Mihama, Majengo, Chaya and Karangas center	Taturu and Sandawe
Tabora		Tura	Tura ²⁴	Bwawani, Mizanza, Makopo, Tura center	Taturu and Sandawe
	Kizengi	Kizengi	Malongwe		Sandawe

Source: RSK, May 2023

²¹ The list of sub-villages is not exhaustive. For Karangasi and Tura, not all sub-villages include IPs

²² Other Indigenous groups may also live in Dabia (located in Lot 2) but this was not recorded

²³ Mdunundu also includes Gengeni which is a sub-village with no IPs

²⁴ Tura also includes the following sub sub villages (not officially registered): Msimba, Matale, Makungu, Tambuka, Mayego, Mapuge, Majengo, Manoleo. Taturu live in small numbers in these sub sub villages which are away from each other





Figure 13-1: Indigenous communities in the project Aol

Yapi Merkezi Insaat ve Sanayi Anonym Sirketi SRG Lot 3 & 4 ESIA report 2040173-01 (03)



13.2.2.1 Taturu

According to Taturu representatives, the Taturu have been living in Singida/Tabora regions for several generations (e.g., since 1720s in Kitopeni and 1800s in Aghondi). They arewidely referred to as Datooga (or Tatooga) often consider themselves to be the oldest known tribe in Tanzania.

The Taturu keep goats, sheep, donkeys and chickens, however cattle are the primary and most important domestic animal kept. Every part of the cow (including its meat, fat, blood, milk, hide, horns, tendons and dung) either have practical or ritual purpose amongst the tribe (Joshua Project, 2023). The tribe was formally nomadic and depended largely on milk products, only moving whenever the needs of their cattle dictated; today, many farm a plot of land, growing maize, or smaller quantities of beans and millet.

The Taturu have a reputation as "fierce warriors" and in past tradition, young men had to prove themselves by killing an "enemy of the people" (those not of Taturu decent), or wild animals such as elephants, lions or buffalo (Joshua Project, 2023). Traditional dress is colourful, with reddish, patches, leather dresses, bead work and brass bracelets and necklaces (Joshua Project, 2023). The Taturu are famous for their rainmaking rituals. They consider rainmaking as a powerful way of claiming their attachment to land and spiritual powers from the ancestors, especially those buried.

Today, many Taturu farm a plot of land, growing maize, or smaller quantities of beans and millet. In the Project AoI, the Taturu also grow sunflower

13.2.2.2 Barabaig

The **Barabaig** people migrated south to East Africa from the Nile Valley in North Africa more than a thousand years ago. They are organised into clans made up of descendants who can trace their lineage to a single ancestor. Each clan or dosht has a clan head who convenes the clan's affairs through a clan council.

Cattle are central to Barabaig life. They provide milk, meat, and occasionally blood for sustenance, skins for clothing, horns as drinking vessels, dung for building. Cattle are also traded through sale or barter to obtain everything else the Barabaig need. Traditionally, the Barabaig did not grow crops, but they now cultivate farm plots and grow vegetables in gardens near their homesteads mainly for self-consumption. The Barabaig also herd sheep and goats and keep chickens. Goats are both traded and consumed, and sheep have an important role as sacrifice in rituals. But it is cattle that dominate their lives and influence their culture. Cattle are the currency of life and bind society through inheritance, gifts and loans, payments, fines and sacrifice.

13.2.2.3 Maasai

The **Maasai** arrived in Tanzania from South Sudan. The Maasai have the age set system of social organisation. Traditional Maasai lifestyle centres around their cattle which constitute their primary source of food. A man's wealth is measured in cattle and children. A man who has plenty of one but not the other is considered to be poor.

All of the Maasai's needs for food are met by their cattle. They eat their meat, drink their milk daily, and drink their blood on occasion, while cattle urine is used for medicinal purposes. Bulls, goats, and lambs are slaughtered for meat on special occasions and ceremonies. Though the Maasai's entire way of life has historically depended on their cattle, more recently with their cattle dwindling, the Maasai have grown dependent on food such as sorghum, rice, potatoes and cabbage.



13.2.2.4 Sandawe

The **Sandawe** have a strong hunting and gathering tradition but are currently also. herders and agriculturalists and currently grow their staple crops of millet, sorghum and maize and keep cattle, sheep and goats (Pauls, 2023). The Sandawe, have a tradition of mutual cooperation in such things as hoeing and threshing, homebuilding and organising informal parties to hunt. The Sandawe practice an insular and spiritual culture with an emphasis on animism.

Traditional clothing of the Sandawe includes hika-grass, feathers and hides, and cosmetic practises including shaved hair, earlobe piercing and face tattooing (Pauls, 2023).

13.2.3 Population

Indigenous population figures were available for a number of villages. These are presented in Table 13-2 below. The table shows that the IP are in the minority in all the villages for which data is available. In some villages the IP are a very small minority.

peoples represent the minority in all the villages for which data is available. In some villages, indigenous groups represented a very small minority. For example, in Aghondi, the indigenous population composed of Taturu, Sandawe and Maasai households represent 20% of the total village population. In Makutupora, Taturu and Sandawe households represent 1% of the village population.

During the field work conducted in May 2023, RSK Social Team established that most indigenous people were well integrated in the community, spoke Kiswahili and interacted harmoniously with members of other ethnic groups of their localities. It is only in Tura that three of the Taturu women did not speak Kiswahili. Compared to other Taturu women engaged with, it seems they have a more traditional lifestyle and were less integrated into the community.

Mixed marriages between indigenous or non-indigenous people were common. In Kitopeni, Taturu men reported that 30 years ago, mixed marriages with non-Taturu were not possible. This is no longer the case. However, efforts are still being made by the Taturu to preserve their culture. Nowadays, when the bride is from a different tribe and is willing to accept the Taturu culture, a Taturu woman is allocated to oversees her integration into the Taturu culture. In Mdunundu, the meeting participants explained that mixed marriage is possible but not between the Barabaig and the Sandawe who consider each other as relatives. It is said that when these tribes came to Tanzania, they fought against each other. To stop the fights, they were made relatives by both drinking cow/human milk mixed with blood using straws. Because of this, they cannot inter-marry.



Table 13-2: Population in the Project AOI

	General	Estimated number of indigenous households**					IP	% of the general
Village	Population (including IP)*	Taturu	Sandawe	Maasai	Barabaig	Total	Population*	population*
Makutupora	3,518	50	10	0	0	60	30	1%
Saranda	5,540	10	10	1	0	21	1002	18%
Mdunundu	1,444	0	21	0	6	27	320	22%
Aghondi	1,306	8	1	1	0	10	255	20%
Kitopeni	4,127	86	2	0	0	88	81	2%
Itigi town	4,511	450	0	0	0	450	690	15%
Kitaraka	N/D	20	20	15	0	55	N/D	N/D
Kazikazi	7,032	4	1	0	0	5	N/D	N/D
Karangasi	3,811	16	5	0	0	21	N/D	N/D
Tura	34,300	10	1	0	0	11	N/D	N/D
Malongwe	6,307	0	20	0	0	20	104	2%
Total number of I	nouseholds	654	91	17	6	768		

Sources: * UDSM ESIA Report, February 2023. ** Site visit, May 2023. N/D means no data.



13.2.4 Indigenous peoples' decision-making structures

The Maasai, Barabaig, Sandawe and Taturu peoples have their own decision-making processes and political institutions to manage their tribal affairs.

Both Maasai and Barabaig communities are patriarchal, men and women have separate roles, social responsibilities, and powers in the community, with men assuming decision-making powers collectively and through an age set system. Under this system, groups of the same age are initiated (circumcised) into adult life during the same open-initiation period; the age-class thus formed is a permanent grouping, lasting the life of its members. They move up as a group through a heirarchy of grades, each lasting approximately 15 years, including those of junior warriors (Morans), senior warriors, and junior elders, until they become senior elders authorised to make decisions for the tribe. Morans are the soldiers and assume responsibilities as guardians of the community properties including land and livestock.

Women play an important role in terms of Maasai and Barabaig ceremonies, cooking, building traditional houses, fetching water, milking cows and providing moral support to friends and family. More significantly, women's role is important in traditional events such as initiation, child naming, wedding ceremonies, and spiritual events. As women get older their role in the community increases, in particular in terms of traditional and ritual related issues.

Decisions in the Datoga community are made by a group of elders. The Datoga women are custodians of cultural and spiritual knowledge, providing direction for their community.

The tribal leaders of the Taturu in the Project AOI are based in Itigi which is regarded as the chiefdom of the Taturu. In some of the PACs, Taturu also have their own local tribal leaders (e.g., Aghondi and Tura) who report to the Itigi leaders when they cannot resolve issues themselves. For example, in Kazikazi, key informants explained that a husband who is mistreating his family, is to be judged by the Itigi leaders.

In Aghondi, FGD with Taturu representatives indicated that local tribal leaders perform rainmaking rituals, resolve conflicts between Taturu members, provide medicine and treat Taturu people. In Kitopeni, it was explained that the Taturu had their own court made up of elders.

Except for the Sandawe living in Mdunundu, the Sandawe living in the Project AOI do not have tribal leaders.

The above indigenous governance structures serve to address issues internal to the indigenous groups. When engaging with other tribes or people external to the area, such as the Project, the indigenous people report to the overall village leadership (e.g., village chairperson and/or village executive officer (VEO), which is not necessarily of their indigenous tribe). During the engagements with the indigenous groups in May 2023 it was repeatedly stated that they prefer to communicate with the outside world through the village authority.

13.2.5 Land

In all villages land is in owned by individuals, village governments, or institutions such as schools and churches. Land is mainly inherited through a customary land tenure system and is sometimes associated with a particular family (genealogy). Village councils can allocate land to individuals.

Indigenous peoples in the AoI consider land they occupy, and have traditionally used, as communally shared natural resources such as pastures, stock routes, and medicinal plants. Generally, land ownership, use, and access (part of village land) are customarily managed.



Land use conflicts occur in various forms, including conflict between farmers and livestock keepers, conflict between communities and public institutions that own land for public infrastructure.

During the May 2023 site visit, interviewees reported that in addition to using communal village land for grazing they had individual right of occupancy of parcels of land for farming purposes - on average 2 - 3 parcels of land of ten acres (or four hectares). No difference was reported in terms of area of land owned between the different indigenous groups and other tribes. It is common for households to rent land when the area of land they own is not sufficient to meet their needs.

13.2.6 Livelihood strategies

The Project AOI where the Indigenous communities are located is part of a wide rangeland ecosystem that has supported livestock and wildlife over the years. Both sides of the SGR track include settlements, crop land, water points and grazing land. Table 13-3 provides a summary of the different livelihood activities pursued by the different indigenous groups.

Number of		Livelihood activity					
Indigenous Groups	villages with indigenous groups	Livestock rearing	Crop farming (including vegetable gardening)	Beekeeping	Hunting		
Taturu	9	100%	100%				
Sandawe	10	20%	100%	30%	10%		
Barabaig	1	100%	100%				
Maasai	3	100%	100%				

Table 13-3: Livelihood activities conducted by the different indigenous groups

From the table it can be seen that:

- the Taturu, Barabaig and Maasai are involved in livestock rearing and crop farming in all the villages
- all the Sandawe are involved in crop farming, but there are only two villages (Malongwe and Mdunundu) where the Sandawe engage in livestock rearing. Beekeeping is mostly conducted by the Sandawe living in Mdunundu, Karangasi and Malongwe. Only the Sandawe of Malongwe hunt wildlife.

In a few PACs, meeting participants in May 2023 pointed out that livelihood activities conducted by non-indigenous and indigenous peoples are very similar. In Kazikazi, the Taturu reported to be engaged in the same activities as the Yanzi people. Likewise, the Taturu living in Itigi reported undertaking similar activities to other non-IP tribes (except for the fact they do not own businesses/shops).

Across the indigenous communities the livelihoods widely practiced by women include milk trading, craft, and bread making and selling. In the absence of husbands (in case of these being deceased), women may inherit livestock and a small plot of land designated for young animals, but this is usually transferred to sons when they reach the age of 18 years old. During the FDG with women, the following activities were reported: collecting firewood and water, crop farming and cattle keeping (not grazing).



13.2.6.1 Livestock rearing

The main livelihood strategy of the Taturu, Maasai and Barabaig is pastoralism. They mostly keep cattle (see Figure 13-2), goats and sheep for food (meat, and milk), dowry and cash. Other animals kept are chicken and donkeys for carrying water, food, firewood and building materials. In Makutopora and Aghondi, the Taturu interviewees indicated that they own between 30 and 50 cows/goats and around thirty sheep.



Figure 13-2: Cattle observed near Saranda

Most Taturu keep their livestock in enclosures near their homestead and release them for grazing around their villages during the day (between 10am and 6pm). Most cattle herders cross the SGR line daily to graze their herds, except for those in Aghondi, Kitopeni and Malongwe, where most of the livestock rearing is undertaken on one side (north or south) of the SGR only (see Appendix 10 for PAC profiles).

Taturu men in the PACs on the west of Itigi along the SGR line such as Kitaraka, Karangasi, Tura and Malongwe may spend months (and up to a year) with their livestock away from home in search for good pasture.

In Tura, livestock keepers use two forest reserves during the rainy season (between November and June): one located near Makopo (which is a sub-village of Tura) in the north and the Nyahua Mubua Forest Reserve in the south (see Figure 13-1) Malongwe, livestock keepers use the Sikonge Game Reserve in the south.

Seasonal movements of livestock in search for water is also common in the area. For example,

- in Makutupora, men take their livestock to a water spring called "Mgonandele" which is close to Walanchinza (a sub-village of Makutupora located approximately 4.5 km from Makutupora centre) during the dry season (see Appendix 10).
- Lake Chaya (located in Chaya which is a sub-village of Karangasi) is used by livestock keepers of Karangasi and Kazikazi because it provides water throughout the year.

Men are the main cattle herders, whilst women do the milking. However, if men are not available, women and children (> 15 years old) take care of grazing the herd.



Cattle are not usually consumed by the cattle herders but are either sold in the villages or sold at the nearest local markets. The principal markets in the Project AOI are found in Manyoni (on Saturdays), Itigi and Chaya (on Tuesdays) which is a sub-village of Karangasi. The FGD with Taturu representatives indicated that chicken is the most commonly consumed meat. In Karangasi, Taturu livestock keepers explained that when away from home for a long period of time, they rely on milk (usually mixed with maize flour and water) and blood from their animals for sustenance.

Challenges for livestock keepers reported during the FGD included:

- Lack of grazing of land. The most common mitigation strategy adopted by livestock keepers is paying farmers to use their post-harvest fields (e.g., Mdunundu and Aghondi). This also provides crop farmers with weeding services and provisioning of organic fertilizer for their lands (5 Capitals, 2023). The other strategy consists of migrating temporarily to areas further away from the villages for periods of time (e.g., Tura) where temporary shelters are set up.
- Conflicts with livestock keepers from other tribes. In Tura, male Taturu reported that conflicts between the Sukuma and Taturu in the Nyaua Game Reserve were not uncommon.
- Theft of animals (Kazikazi). To mitigate this, livestock keepers either employ herders or engage their children older than 15 years to look after the animals.
- Diseases (Tura): Such as lumpy skin disease transmitted by insects. To manage this challenge, livestock keepers purchase medicine to spray their animals.

13.2.6.2 Crop farming

Crop farming, which is a relatively new activity for the Taturu, Maasai and Barabaig has become more important due to the shortage of grazing land which is due to:

- population increase: people from other tribes bring in livestock
- the conversion of grazing land to privately owned farming land.

Crop farming (including vegetable gardening) was reported to be undertaken by all the indigenous households who were interviewed during the site visit. The principal crops such as maize, sunflower, millet, which are also grown by the non-indigenous tribes, are planted and harvested during the rainy season: planting occurs between January and April and harvesting is undertaken three months later (usually in May and June). In Kitaraka, it was reported that men are responsible for preparing the land and planting the seeds whilst women do the weeding. Both men and women (including children if not at school) take part in harvesting the crops.

Sunflower and maize are grown to make oil and flour respectively which are then sold (see Figure 13-3 which shows typical equipment found in the PACs). In Karangasi and Tura, the Taturu reportedly sell the millet for the production of traditional alcohol.

Other crops grown include groundnut (Mdunundu, Karangasi and Malongwe), rice (Saranda and Makutopora), sweet potato (Aghondi and Kitaraka) and cassava (Kitaraka).

Vegetable gardening is undertaken by women only. Typical vegetables grown include tomatoes, spinach, onions.





Figure 13-3: Sunflower oil (left) and maize flour (right) mills in Saranda

13.2.6.3 Beekeeping and hunting

KIIs with Sandawe representatives indicated that hunting of small animals and collection of wild foods and honey to supplements their diet still forms part of their livelihoods. While honey forms part of their diet, it is also used for sale.

Beekeeping is a cash activity only conducted by the Sandawe in Mdunundu, Kitaraka, Tura and Malongwe. Next to the Aghondi Bee Reserve (managed by the Tanzania Forest Services or TSF) people collect honey in a small area managed by the community. Honey is also collected In the in Nyaua Game Reserve.

In Malongwe, interviewees reported that some households can own up to 1,000 beehives (see example of beehives in Figure 13-4) as a beehive can last up to 10 years and each year new beehives are built by the beekeepers during the rainy season. Honey is collected during the dry season between June and December. Although women can own beehives, they do not collect honey themselves and rely on men to do so. Men start beekeeping at the age of 18 usually with around 100 beehives and accumulate beehives through the years. They indicated that if more forested areas were available to them, they would have more beehives. The Sandawe living in Saranda reported having abandoned beekeeping because of the lack of forests.

Honey is sold in local markets (Lola), but customers can also buy honey directly from the beekeepers themselves at the village. The price of 1L of honey varies depending on the agreement between the buyer and seller.

Hunting is an activity traditionally undertaken by the Sandawe and Taturu. Sandawe living in Saranda and Kitaraka reported to no longer hunt because this activity is now illegal, and the population of animals has decreased due to the disappearance of their habitat (forest). Only the Sandawe of Malongwe reported to still hunt animals such as rats, rabbits, and dik-diks using bows and arrows. Due to the low number of animals, hunting (by themselves or with other hunters) may last several days before they catch an animal. In Makutupora, women Taturu reported that, although it is illegal, some of their husbands still hunt.





Figure 13-4: Beehive hung from a tree branch in Mdundundu

13.2.7 Culture, Spiritual and Sacred Sites

Data collected to date provides some insight into the cultural and spiritual lives of the Indigenous peoples in the Project AOI.

13.2.7.1 Chiefdom graves

Several Taturu traditional elders and chiefs are buried in graves located in the Project AOI, which represent important tangible and intangible cultural heritage sites amongst the Taturu community. For example, the grave of Chief Aghondi, a prominent Taturu elder after whom the village of Aghondi was named, is located amongst five other chiefdom graves in Itigi Mjini, along the SGR line. The graves are regularly visited by their descendants and various members of the Taturu community to pray and perform rainmaking rituals.

13.2.7.2 Sacred trees

A number of sacred trees were identified in the Project AOI, which are considered important spiritual and sacred sites amongst indigenous communities of the region. For example, in Kitopeni, a centuries-old Msogomazi tree is regularly used by indigenous people for a wide range of ceremonies and spiritual practices, including weddings and rainmaking rituals. Under these scared trees, indigenous people of the region also pray to their ancestors for protection or health and gather to make majors decisions for their village and community.



Table 13-4 below shows the four cultural heritage sites used by the indigenous people which were recorded date by YM within the SGR RoW25. Note that one site is located in Kitopeni whilst the 3 other sites (in close proximity to each other) are located in Itigi. Detailed maps (including GPS coordinates) as well as minutes of the consultations with the IPs (including list of items to provide for the ceremonies) are provided in Appendix 10.

²⁵ Other sites used by non-indigenous groups and located within the SGR RoW have been identified by YM. Some sites have also been identified by YM, but their users have not been identified yet.



Table 13-4: Recorded IP cultural heritage sites within the SGR Right of Way (RoW)

PAC	Location (chainage)	Picture	Description	Consultation
Kitopeni	600+150		Sacred tree (locally known as Msogomazi) which has been used for hundreds of years by the communities of Kitopeni, Aghondi and Mandondi for ritual meetings to discuss community issues such as marriage, deaths, etc. The tree is looked after by a clan named Maswaga Ngalasi and the current (February 2023) caretaker is Maria Maswaga.	20/11/2022 Communities are happy to relocate their sacred tree provided a special offering is made for the ceremony (they need black cattle, sheep, honey, milk and local brew or money for the same value).
Itigi	611+000		6 graves in which 6 Taturu chiefs (Mangwela, Aghondi, Handu, Alakboga, Benjwaa and Mnyane) are buried.	22/01/2023 Communities are happy to relocate for their meetings/rituals provided a special offering is made (they need black cattle, sheep, honey, milk and local brew or money for the same value). The site has tangible heritage including decorated pieces of ceramics, pottery and glasses
ltigi	611+075			



PAC	Location (chainage)	Picture	Description	Consultation
itigi	611+075		One sacred tree. Under the tree (locally known as Dira Ya Mtemi), ritual practices still take place annually and various dances, singing and animal sacrifices accompany these.	Same as above.


13.2.8 Health

The ESIA discusses the health concerns and infrastructure of the PACs in the Project AOI.

Common health issues reported by the indigenous communities include malaria, Human Immunodeficiency Virus (HIV) / Acquired Immunodeficiency Syndrome (AIDS), urinary tract infections (UTIs), skin diseases (skin rashes), tuberculosis, flu, cough, and fever. In Makutupora, Sandawe women mentioned that people sleep with mosquito nets and malaria was treated at the local clinic. HIV was reported in most PACs and meeting participants were aware of the treatment. In Itigi, the village chairperson perceived an increase in HIV/AIDS, which he perceived to be linked to an increase in sex work (prostitution) and other sexual relationships due to influx of labour associated with increased number of construction work .

Discussions with indigenous communities indicate that dispensaries and health centres used by the communities in the Project AOI are also used by most indigenous households. Medicinal plants are, however, still an important part of the healthcare of the indigenous communities and plants are used traditionally to treat both communicable and non-communicable diseases.

The continued use of medicinal plants is attributed to the lack of health care services close to indigenous people settlements. During the 2023 May field visit, medicinal use of wild plants and roots was reported in most PACs.

- in several PACs it was reported that roots were boiled for cough relief (Aghondi and Mdunundu), stomach pain relief (Karangsi) and fertility/pregnancy issues (Kitaraka and Karangasi).
- Taturu men in Saranda explained that roots could only be collected by the men because it requires strength.
- in Kitopeni, a Taturu man reported that a third of Taturu men prepare traditional medicine and that his ancestors told him in his dreams what medicine he needed to make.
- in Makutupora, a Sandawe woman explained that she used burnt baobab fruits to treat eyesight problems (see Table 13-5)





Figure 13-5: Baobab fruit used for eyesight issues (Makutupora)

• a Maasai from Kitaraka explained that the Maasai have traditional medicine for all types of diseases, but for these to be successful the patient needs to have faith in the remedy.

Although Indigenous groups still rely on traditional medicine, its use is becoming less important. Sandawe women in both Tura and Malongwe reported not using traditional medicine at all. In Mdunundu, whereas 10 years ago, people from their tribe used mostly traditional medicine, today they use a combination of traditional medicine, and the health clinic services in the village or from Manyoni hospital.

In Makutupora, Kitopeni and Kitaraka, Sandawe and Taturu women reported that women tend to go to the nearest hospitals for their first pregnancies. Table 13-5 provides a list of health facilities including hospitals used by IPs in the Project AOI.

PAC	Description
Saranda	There is one health centre located in the centre of Saranda (see PAC profile)
Makutupora	There is one health centre located in the centre of Makutupora (see PAC profile). The condition of the health centre was reported to be poor because it lacks medicine. Pregnant women who need a C-section go the hospital in Kilimatinde, near Manyoni.
Mdunundu	There is a small health clinic in the village which is used only for children's health problems (cough, flu etc.). For more serious diseases and for adults, people need to go to the government hospital in Manyoni. Note that a health centre, close to the government office, is currently under construction (see PAC profile).
Aghondi	There is one health facility in Aghondi. People also go to Manyoni or Itig government hospitals which are in good condition.
Kitopeni	There is a health centre in the centre of Kitopeni (see PAC profile) which people go to for minor health issues. For more serious health problems people go by car to Manyoni or Itig government hospitals which are in good condition.
ltigi town	There are two hospitals in Itigi (see PAC profile): Saint Gaspar Referral Hospital (approximately 1km north of the existing SGR line) and one government hospital (located approximately 100m north of the proposed MGR line). The Taturu primarily use the government hospital. The main reasons reported for going to the hospital were child delivery services.
Kitaraka	There is no health facility in Kitaraka, but a health centre located close to the government office is under construction as part of YM CSR (see PAC profile). Therefore, people go to Itigi government hospital.
Kazikazi	There is no health facility in Kazikazi. People usually go to the Itigi government hospital.
Karangasi	There is a health centre in the centre of Karangasi (see PAC profile) which people use for minor health issues and consider to be in average condition. For more serious health issues, they go to the Itigi government hospital.
Tura	In Tura, there are two health facilities (see PAC profile): a private dispensary and government health center. Both are located in the centre of Tura, approximately 200m from each other and north of the SGR and MGR lines.
Malongwe	There is a health centre in the centre of Malongwe (see PAC profile) who was founded by Gaspar, an American priest who lives in the area. The Sandawe consider it to be in great condition and to be sufficiently staffed.For more

Table 13-5: List of health facilities reported by IPs

		SK
PAC	Description	
	serious diseases and surgery, they go to the Saint Gaspar Referral Hospital of Itigi	

From the table, it can be seen that there is no health facility in Kitaraka. There are hospitals in Manyoni and Itigi.

13.2.9 Education

In Tanzania, education is split between pre-primary, primary, secondary and higher education. The ESIA discusses literacy, scholastic achievements and educational infrastructure of the villages in the Project AOI. Household survey results indicated that 72% of those surveyed have basic primary education, whilst 6.3% have completed secondary education; and an estimated 1.4% are educated at university level.

FGD with women representatives (Taturu, Sandawe and Maasai) indicated that all the children from the age of 4-5 years go to school. An informal meeting with the headmaster of Mdunundu primary school revealed that even though only 40% of the children in the village attend to school, most indigenous children attend school because indigenous households want to make sure their children receive an education.

All the PACs have primary schools (see example Figure 13-6), however, in some cases, children need to walk for long hours to reach school (e.g., Barabaig children living in Kati which is a sub-village of Mdunundu).





Figure 13-6: Aghondi primary school

Table 13-6 provides the list of schools available to the indigenous communities. The table shows that secondary schools are only available in Saranda, Itigi, and Tura. Note that there is one secondary school under construction in Kitaraka. Children from Malongwe and Karangasi attend the Tura secondary school.

Table 13-6: List of schools used by IPs

PAC	Schools
	There is one primary school located in the centre of Saranda (close to the existing SGR line).
Saranda	There is one secondary school (see PAC profile) located between the existing SGR line and proposed MGR line (approximately 1.8km from the centre of Saranda).
Makutupara	There is one primary school located in the centre of Makutupora.
макишрога	There is one secondary school located south from the center of Makutupora.
Mdunundu	There is one primary school located in the centre of Mdunundu (see PAC profile). For the secondary school, children attend Muhalala secondary school which is approximately 6.5km from Mdunundu centre (see PAC profile)
Aghondi	There is one primary school located in the centre of Aghondi north of the SGR and MGR lines (see PAC profile)
Kitopeni	There is one primary school located in the centre of Kitopeni north of the SGR and MGR lines (see PAC profile)
	There are several schools in Itigi including:
ltigi town	One primary school located between the existing SGR line and proposed MGR line (see PAC profile)
	One secondary school located approximately 1km south of the MRG line (see PAC profile)



PAC	Schools
	The Handu secondary school (see PAC profile) located on the outskirt of Itigi (approximately 2.8 from Itigi train station). Part of the school land is within the SGR RoW.
Kitaraka	There is one primary school located in the centre of Kitaraka (see PAC profile) There is one secondary school which is under construction (see PAC profile) Both schools are located north of the existing SGR line and proposed MGR line, approximately 3.8 km apart from each other.
Kazikazi	There is one primary school located in the centre of Kazikazi north of the existing SGR line and proposed MGR line (see PAC profile)
Karangasi	There is one primary school located in the centre of Karangasi (see PAC profile). The school is located with the SGR RoW and will be demolished. A new site, located approximately 1.2 km from the existing school, has been identified (see PAC profile). Children go to Tura secondary school.
Tura	There are a primary and secondary schools in Tura, located in the centre and approximately 400m away from each other. Both schools are located north of the existing SGR line and proposed MGR line
Malongwe	There is one primary school located in the centre of Malongwe. For the secondary school, children go to Tura and parents rent houses for them.

Apart from Tura, most young female interviewees reported to have gone to school know how to read and write. Older women in Makutupora and Aghondi indicated that because they had to help their parents with livestock keeping, they did not attend school. In the past, it was common for children to not attend school.

13.2.10 Security

No security issues particularly facing indigenous peoples were reported during the meetings conducted in May 2023. In Makutupora, Sandawe women explained that there were no issues or conflicts between indigenous peoples and other tribes. The Sandawe like any other indigenous tribes are well integrated in the communities. Women in Makutupora and Kitopeni indicated that Taturu and Maasai carry sticks which they can use if they feel threatened or need to defend someone. Disputes between livestock keepers and farmers can happen but are usually easily resolved with the support of the elders. Petty theft, mainly by unemployed youth, was reported by women in Malongwe and Kitopeni.

13.3 IP Impact assessment

The ESIA report provides a full project description, and an assessment of the project impacts on the people in the project AoI including IP. This chapter discusses the impacts of the project on IP in the project AoI in particular and should be read in conjunction with the ESIA full impact assessment. The assessment details impacts of various project activities and footprints on the indigenous communities and their resources during the different phases of the project. The key aspects that may have significant impacts on the indigenous communities include:

- tracks, embankments, auto transformer stations (ATS), traction power stations (TPS) and catenary
- stations, freight and marshalling yards
- construction camp sites, sleeper production and cement batching plants
- quarry sites, borrow pits dumping sites and access roads



 associated facilities such as access roads to stations, trucks parking yards, bus terminal, water distribution systems and dry port.

The project phases consist of:

- mobilisation
- construction
- operation.

Note that impact characterisation and assessment, as well as mitigation measures, are include in the sections below and in the aspects and impacts matrix in Appendix 7.

13.3.1 Positive impacts

13.3.1.1 Employment opportunities

Construction of project components such as tracks, embankments, ATS, PTS, stations, bridges, culverts, access roads, and other related infrastructures, will require a significant number of people. Direct employment will be in the form of unskilled laborers and skilled laborers and consist of both locals and expatriates. During this period some of the employment opportunities, including provision of local security, may be open to IP. Employment opportunities may exist during the operational phase, but to a lesser extent.

Skills reported during the FGD with men in the indigenous communities include driving, masonry, carpentry (Maasai), security guard (Barabaig) whilst women indicated their skills included sewing, weaving, braiding hair, making shoes, bracelets, necklaces, and clay pots. In Saranda, indigenous people explained they were pleased with the Project, mainly because it will provide job opportunities.

Employment may enhance the material standard of living of the indigenous households of which a member is employed.

Retrenchment after temporary employment may however have a negative impact on the affected households if traditional livelihood strategies have been neglected during the period of employment due to lack of capacity in the household. Employment of a household member may also impact on the traditional lifestyle and the dynamics in the household.

Enhancement measures

To enhance this positive impact, the existing project TRC-YM Recruitment Policy and Technical Assessment and Training Centre Principles document must be updated to include the following measures:

- include a requirement for prioritisation of a representative portion of employment opportunities for the indigenous community members (with relevant skills), including security guards
- a fair and transparent recruitment process outlined as part of the recruitment management plan for all openings. Ensure appropriate channels to advertise employment opportunities to the Indigenous communities
- YM and local authorities to advertise opportunities as early as possible to allow for potential candidates to apply and prepare their skillsets for local opportunities
- where appropriated provide capacity building/ training for indigenous community members to enable their participation in the labour force for the project both during construction and operation
- where the employment is temporary (construction phase), this must be clearly communicated to employees, including to applicants



- to avoid livelihood problems for indigenous households after retrenchment, encourage households to continue traditional livelihoods in parallel to employment. Where appropriate provide access to NGOs that can provide livelihood support
- facilitate that temporary and permanent labour is benefiting from labour conditions in line with ILO labour standards, including those employed by contractors
- ensure that temporary and permanent labour is benefiting from labour conditions in line with ILO labour standards, including those employed by contractors. (See ESIA human rights impacts).

13.3.1.2 Marketing of livestock and livestock produce

The construction and operation phases of the Project may create opportunities for indigenous people to sell livestock and other local produce, such as milk, meat and honey. This could particularly benefit women as they are the main salespersons in the household. The marketing opportunities would increase incomes of the households who sell the produce with a potential positive impact on their material standard of living.

During the May 2023 site visit, the Maasai who live in Dabia (Makutupora) explained they were already selling milk to YM employees in and around Makutupora in an informal manner.

Enhancement measures

To enhance this positive impact, the following measures will be taken:

- develop and implement specific targets for local procurement of indigenous people
- inform indigenous pastoralists (including the women) about the marketing opportunities for their specific products and services
- establish an agreement between the project and livestock markets in the project vicinity for procurement of animal products for use by the project and inform livestock keepers about this agreement
- establish quality control measures / minimum requirements that the project will adhere to when purchasing fresh produce for the produce to be purchased and communicate these to the indigenous pastoralists. Where appropriate and feasible assist the indigenous pastoralists to meet the quality control standards

13.3.1.3 Improvement of transport of livestock and livestock produce

facilitate the transport of livestock and other local produce to markets and points of sale, thereby enhancing sales opportunities.

During the May 2023 site visit, the Sandawe women who attended the meeting in Mdunundu explained that the Project will have positive impacts on the community, including the transport of local goods and the potential opening of small businesses. In Malongwe, the Sandawe men were positive about the Project and understood the benefits, including the sale of local honey to Dar es Salaam. The women found it more difficult to understand the benefits of the Project on women, and suggested to implement projects for women such as soapmaking trainings, etc.

Enhancement measures

To enhance this positive impact the following measures are recommended:

• TRC to set affordable railway transport costs to attract more users



- TRC must collaboration with relevant government and private agencies to improve feeder roads in rural areas connecting to the SGR line
- the Livelihoods Restoration Plan (LRP) that will be developed by TRC as part of the RAP must include livelihood development programmes that specifically consider women, indigenous peoples and other vulnerable groups.

13.3.1.4 Increased water sources for livestock and people

During the construction phase and potentially the operational phase, quarry sites, and borrow pits might be used by indigenous and other livestock keepers as sources of water for livestock and people.

During the May 2023 engagement, the rehabilitation of borrow pits was reported by the Maasai who attended the meeting in Makutupora. They explained that the borrow pits which were created during the construction of the MGR line were still used to this day as a source of water. In the same meeting, one Taturu male mentioned the importance of making them safe especially for the children. Similar discussions took place in Itigi where the meeting attendees explained they were aware of the creation of a borrow pit near the government office. They explained they did not want this borrow pit to be used as a water source, but would like a borrow pit to be created somewhere else.

Enhancement measures

To enhance this positive impact the following measures will be taken:

- update the TRC-YM Excavation Safety Procedure to include measures for rehabilitation of borrow pits and quarry sites for safe use by livestock, in particularly with reference to slopes that allow people and livestock to exit a borrow pit easily if accessed
- ensure that the "Environmental, Traffic and Construction Safety Awareness Training" requirements in the TRC-YM Community Health, Safety and Security Management Procedure are implement and include campaigns to livestock keepers and school children from pastoral communities.

13.3.2 Negative impacts

13.3.2.1 Potential accidents involving indigenous people and their livestock

The Aol (except for the urban areas) is considered by the indigenous peoples as grazing areas and contains access routes between winter and summer pastures.

During the project mobilisation and construction phases there will be movement of vehicles transporting materials and machines on access roads and there will clearing of sites and constructions activities in this pastoral access area. This may create risks of accidents and injuries for indigenous pastoralists and their livestock. In particular the quarries and borrow pits can cause a risk for livestock and their keepers.

In addition, livestock and their keepers may trespass the project activities and risk contamination with hazardous materials.

According to a meeting participants during the May 2023 site visit, both animals and members of the community have allegedly had accidents with YM cars.

Mitigation measures

To mitigate the potential increased risks of accidents and injuries in the AoI used by IP and their livestock the project will put the following mitigation measures in place:



- communicate with village and IP leaders so they are aware of project implementation activities. The SEP for the IP to include appropriate strategies to keep the IP informed
- ensure that the "Environmental, Traffic and Construction Safety Awareness Training" requirements in the TRC-YM Community Health, Safety and Security Management Procedure are implemented and include campaigns to livestock keepers and local school children from pastoral communities
- put TRC-YM GRM described in the TRC-YM Stakeholder Engagement and Grievance Procedure in place and ensure that is appropriate for the indigenous communities and communicate it widely to the IP
- ensure that all project workers in camp site areas are trained on the GM and on how to communicate this to the IP in the project Aol
- ensure safety and proper maintenance of vehicles and machinery prior to use to ensure it is in safe condition
- implement the TRC-YM Traffic Management Plan for the project
- erect warning signage at all high-risk Project activities
- ensure that the TRC-YM Community Health, Safety and Security Management Procedure is enforced, including the procedures "generic" requirements for preventing or minimising exposure with hazardous materials.

13.3.2.2 Restricting access to livestock routes and pastures

The project AoI (except for the urban areas) is considered by the IP as grazing areas and contains access routes between winter and summer pastures. According to discussion during the ESIA, indigenous and other livestock keepers indicated that most of the area proposed for the project is a key strategic area for livestock movement.

The mobilisation, construction and operational phases of the project will restrict access to livestock routes and pastures by IP and other livestock keepers. Mobilisation and construction phases will increase vehicle movement and construction activities (embankments, stations, borrow pits, dumping areas, access roads, camps, marshalling yards etc) preventing people and livestock from crossing these areas.

The operational phase will permanently impact the routes as the railway track will be fenced. Crossings planned for the alignment may increase the distances travelled by pastoralists, if these crossings are not culturally appropriate.

The Itigi camp will take approximately 123.55 acres (500,000 m²), and Itigi sleeper production plant will also take approximately a total of 49 acres (200,000 m²). IP and livestock keepers consider this area as key strategic area for livestock movement as it is also close to MGR livestock crossing. It will therefore have impacts on livestock movements hence changes of stock routes and increased distance.

Mitigation measures

To mitigate the restriction of free movement of IP and their livestock in and across the project AoI, the project will put the following mitigation measures in place:

- construction of appropriate livestock crossing/underpasses and culverts along the proposed alignment after full consultation with the IP. (These are shown in Appendix 10 (PAC profiles))
- ensure that the TRC-YM GRM is in place and is appropriate for the indigenous communities, and ensure it is widely communicated to the Indigenous people.



Crossings have been negotiated with local communities, including indigenous communities. The minutes of the meetings and a summary of the negotiations is provided in Appendix 10. During the meetings conducted in May 2023, attendees confirmed their consent about the location and type of proposed crossing points which will be set up along the SGR line and the use of 2m-by-2m culverts as alternative crossings.

13.3.2.3 Destruction and loss of pasture and other natural resources

Indigenous peoples consider the Project AOI as part of their wide rangelands, used for grazing, watering their livestock and collection of natural resources including firewood, building material, wild foods and medicinal plants. As described in 13.2.6.1, with the increase in the amount of land devoted to agriculture in and around the PACs, pastoral land is under pressure. Appendix 10 (PAC profiles) provides examples of areas where natural resources are collected by IPs.

The Project mobilisation, construction and operational phases, will impact on the availability of such natural resources as a result of land acquisition for the Project footprint.

Interviews with indigenous people affirmed that some of the medicinal plants in and close to the Project AOI will be affected, however, these are regarded as plentiful around the villages except for those plants considered sacred and located in sacred sites, such as near water sources and ritual trees. For example, the Taturu consider the "Sabida" tree as sacred.

The Sandawe peoples indicated that their beehives /beekeeping activities may be disturbed.

Mitigation measures

To mitigate the impact on natural resources used by the IP the following mitigation measures will be put in place:

- the LRP that will be developed by TRC as part of the RAP must include livelihood development programmes that specifically consider women, indigenous peoples and other vulnerable groups
- ensure project GRM is widely communicated to the Indigenous people.

13.3.2.4 Severance of access to social facilities and water sources for both people and livestock

Communal facilities, such as education and health facilities, churches and water sources used by the indigenous peoples for their livestock may be located on either side of the railway track. For example, according to the meeting held with indigenous people in Makutupora in May 2023, the SGR line will traverse routes leading to the Mgonandele water spring in Walanchinza26 (see PAC profile).

Some of these social facilities and water sources were recorded during the May site visit and are shown on the PAC profiles (see Appendix 10) for health facilities and schools located in the PACs respectively.

²⁶ a sub-village of Makutupora



Mitigation measures

To mitigate the impact on access to facilities and water sources relied upon by the IP in the project AoI the following mitigation measures will be put in place:

- a RAP and LRP in line with IFC standards, ensuring that women's needs are addressed as well as men's needs
- appropriate crossing/underpasses /overpasses along the proposed SGR line after full consultation of the Indigenous people (See Appendix 10)
- ensure the project GRM is widely communicated to the indigenous peoples.

13.3.2.5 Destruction and contamination of livestock water points

The SGR will traverse water bodies including rivers, standing water, such as boreholes and water springs. Due to construction activities such as excavations, site clearance, vehicles movements and transportation of project materials, water points and sources used by indigenous peoples and other livestock keepers may be destroyed or contaminated. Some of the key sources of water that will be potentially affected include the ljembee River and a cattle trough and water well in Itigi town (see Appendix 10).

Mitigation measures

To mitigate the impact of destruction or contamination of water sources relied upon by the indigenous peoples in the project AoI the following mitigation measures will be put in place:

- avoid destruction and contamination of livestock water points where possible
- restrict disposal of spoil material near water points
- assessment of the impacts of loss of access to water sources specific to each of the affected indigenous people communities in a participatory manner with the affected communities and development of appropriate compensation/ mitigation measures in a LRP
- a GM that is appropriate for the indigenous communities and ensure it is widely communicated to the Indigenous people.

13.3.2.6 Livestock attracted to garbage and food waste

During the construction phase there will be increased movement of vehicles, site clearance and transportation of project materials. All these activities involve high numbers of labourers hence production of waste especially plastic bags and food waste may be discarded in the areas where livestock move through or graze.

Livestock may be attracted to the garbage and waste if not well managed, which could have a negative impact on their health.

Mitigation measures

To mitigate the impact of potential waste pollution the following measures will be put in place:

- ensure the TRC-YM Waste Management Procedure is implemented, and waste is collected (including litter), stored and transported with consideration for livestock and other animals
- protect and fence of waste disposal sites
- safety and awareness raising of workers in relation to livestock activities near or around their activities.



13.3.2.7 Potential spread of invasive alien species in grazing areas

The mobilisation and construction phases of the project will involve movement of vehicles and machines from one locality to another which may contribute to spreading of invasive plant. Invasive species tend to dominate other plant species and may impact on the pastures and the health of livestock.

Mitigation measures

To mitigate this potential impact TRC/YM must prepare an alien species risks assessment and management plan, including measures for:

- identification of project sections affected by invasive species or those at high risk of infestation
- Procedure for eradication of invasive vegetation
- restriction of disposal of spoil material to designated sites only
- screening of all sources of construction materials for risk of invasive species.

13.3.2.8 Impact on indigenous peoples' livelihoods and wellbeing due to potential influx of people

The operational phase will enhance transport into the project area potentially bringing more people into the area. The influx into the area may have a negative impact on the wellbeing of the indigenous communities and their traditional lifestyles. This may include the following:

- improved standards of living of those benefitting from the project through employment or procurement may influence land speculation and cause general inflation
- influx of project workers and people moving into the area as a result of better transport facilities may add pressure on natural resources, including crop and grazing land, firewood, timber products and water
- labour sourced outside of the project area and housed in the camps may show disrespectful behaviours towards the indigenous men and women, this may also lead to an increase of gender-based violence and harassment (GBVH) cases.

Mitigation measures

To mitigate the impact on the indigenous communities in the project AoI the following mitigation measures will be put in place:

- include a requirement for prioritisation of a representative portion of employment opportunities for the indigenous community members (with relevant skills), including security guards in the TRC-YM Recruitment Policy and Technical Assessment and Training Centre Principles
- ensure the TRC-YM Code of Conduct for Project employees, employed during mobilisation and construction includes requirements for culturally appropriate engagement with Indigenous peoples
- ensure the TRC-YM Influx Management Strategy for the project, considers the needs and concerns of the Indigenous peoples
- ensure the TRC-YM GRM is appropriate for the indigenous communities and ensure it is widely communicated to the Indigenous peoples
- ensure the RAP provides for appropriate compensation for loss of assets or access to resources to affected indigenous communities



- TRC should as far as possible select alternative sources of water away from sensitive areas and community sources
- TRC in collaboration with the district councils and the indigenous peoples to facilitate land use plans in areas commonly used by Indigenous peoples and livestock keepers
- districts councils and TRC in collaboration with available NGOs to promote use of alternative sources of energy and building materials
- TRC to liaise with relevant NGOs in terms of enhancing agricultural production projects.

13.3.2.9 Disturbance of livestock and livestock keepers

Shocks and vibration as a result of blasting during construction activities can lead to noise and dust, hence disturb communities and animals in surrounding areas.

Understanding the fact that the location of workers camp and sleeper production plant is within the stock corridor and very close to indigenous peoples' settlements, disturbance from drilling and blasting activities may occur. Information collected during the ESIA study and the May 2023 site visit indicate that livestock are looked after during the day by children, and during weekends primary school kids from these communities are assigned that role, women are also involved in taking care of livestock. Therefore, blasting and drilling will disturb livestock, children, and women taking care of livestock.

Mitigation measures

To mitigate the impact of shocks and vibrations the following mitigations will be put in place:

- issue a drilling and blasting calendar and communicate it with the IP in a culturally appropriate manner
- engage with school children particularly targeting primary schools

Note that the ESIA includes mitigation measures for blasting, dust and noise impacts.

13.3.2.10 Increased spread of HIV/AIDS and COVID-19 infections

The Project will employ people from the Project AOI and the broader region, as well as some skilled and specialist labour from elsewhere in Tanzania and internationally.

With a relatively small level of non-local labour required, there is a limited risk of introduction of communicable diseases. Although the Project has planned to establish workers' camps, thereby avoiding the risk of spread of disease amongst workers, however, there is a potential for workers' interactions with communities, particularly during weekends when workers can be allowed to go to the nearby villagers or other towns for entertainments, hence contribute to the spread of communicable diseases that are already present in the villages and districts.

HIV/AIDS and sexually transmitted diseases (STDs) are of concern due to their prevalence in the Project AOI and generally across Tanzania. The Project could contribute to the spread of these diseases through interaction between Project workers and community members, including the use of sex workers by the Project.

During the fieldwork in May 2023 in Mdunundu, a Sandawe woman indicated that one of the negative impacts could be the influx of people and the spread of diseases into their village. The spread of diseases including HIV was also reported by the village chairperson during the meeting in Itigi.



Mitigation measures

To mitigate the potential risks of HIV/AIDS and COVID-19 the following measures will be implemented:

- awareness campaigns on HIV/AIDS and other communicable diseases
- voluntary counselling and testing (VCT) centres for HIV/AIDs at the workplace
- qualified health professionals to lead on the management of communicable diseases risk during construction
- screening programmes for communicable diseases such as HIV/AIDS, tuberculosis (TB) based on the prevailing risk profile
- worker induction and Project training and awareness campaigns including Sexually Transmitted Disease and HIV/AIDS. Condoms must be made available to Project workers.

13.3.2.11 Relocation of graves sacred sites

Local indigenous communities respect and utilise various objects or places for rituals. Activities during mobilisation and construction may contribute to destruction of ritual sites (such as trees, forest, and rocks) used by local communities. Sites which may directly be impacted by the Project are listed in Table 13-4. More sites may be identified as more sections of the SGR alignment are being surveyed for cultural heritage sites.

According to the RAP (TRC, 2023) developed for Lot 3, cultural heritage consultations have also confirmed that a total of 92 graves will be affected by the SGR Lot 3 railway components, mostly in private graveyards.

Mitigation measures

To mitigate the potential impact the Project will have on graves, the RAP includes appropriate processes for avoidance of relocation/ protection of the graves. TRC will pay the owners of the graves and arrange for the relocation of all graves before the construction activities commence as stipulated in the Graves relocation Act of 1969. Beliefs and traditions in the Project area allow graves to be relocated if it is done in a culturally sensitive way.

In terms of sacred sites, once a sacred site is identified within the SGR RoW (see Table 13-4 for information on the sites identified in Kitopeni and Itigi), a co-joint site visit between the YM CLOs, the village traditional elders and the Local Government Authorities is organised. The site visit is followed by a discussion around the relocation of the site and the items (e.g., sheep, cattle, honey) to be provided by YM to the community to conduct the cultural heritage ceremony.

13.3.2.12 Potential gender-based violence and sexual exploitation and abuse

The advent of a male-dominated construction workforce, which includes migrant workers can exacerbate the existing imbalance of power between men and women within the Project-affected indigenous communities. Prevalent gender bias and stereotyping rooted in the communities' patriarchal culture can result in the financial exploitation of women employed in the Project's formal and informal supply chain. On construction projects, workers who are most often associated with acts of aggression against women include security guards and long-haul truck drivers, as they are more likely to encounter women in isolated conditions (i.e., away from crowded locations and/ or during night shifts).

Mitigation measures

To mitigate this potential impact the following will be put in place:

• implementation of the TRC-YM Code of Conduct for all Project workers



- YM/TRC must develop a gender policy or policy statement (that must be incorporated into an overarching HR/E&S Policy), as part of the ESMS has been developed for the Project. The policy should underscore the definition and prohibition of gender-based discrimination, exploitation, harassment, and violence
- thorough induction trainings on gender-based discrimination, exploitation, harassment and violence are delivered to all new project workers, and periodic refresher trainings on gender-based exploitation, harassment and violence should be given to all project workers
- YM must demonstrate that any directly engaged sub-contractors abide by its gender policy statements, code of conduct and related procedures. Contract agreements will include clauses on proscription of gender-based exploitation, harassment and violence, and binding implications for non-compliance (e.g. reprimands, performance bonuses, penalties etc.)
- TRC and YM must institute external GRMs that will include at least one female CLO (per Lot) and other focal points (e.g. LGA community development officials and gender desk of local police force units) to demonstrate that dedicated channels exist for reporting gender-based discrimination, exploitation, harassment, and violence
- YM's CLOs will undertake routine awareness creation and trainings to sensitize local communities to the Project's gender policy commitments, appropriate reporting channels for gender-based exploitation, harassment and violence, as well as the support services coordinated by YM in the event of any such violations being reported.

13.4 Implementation Plan

The implementation of the IPP will be integrated with the overall environmental and social management of the Project. The mitigation measures for the impacts on the Indigenous Peoples and the ongoing stakeholder engagement as well as the respective responsibilities for those tasks are summarised below. This IPP has to be read in conjunction with the overall environmental and social management plan which includes mitigations for all impacts potentially affecting people in the Project AOI, including Indigenous Peoples.

13.4.1 Mitigation of Impacts

Table 13-7 presents a summary of the impacts for which FPIC is required.

Table 13-7: Impacts for which FPIC is required



Impact	Responsibilities and mitigations	
Impacts on land and natural resource	ces	
Restricting access to livestock routes and pastures	 TRC will consider changing the Project design and assess all viable alternatives to avoid the need for access restrictions. TRC will design and implement livelihood development programmes that specifically target Indigenous Peoples. TRC will ensure these programmes are aligned with government or private sector existing programmes in some areas. YM will design appropriate crossings points for Indigenous Peoples and their livestock along the proposed SGR line 	 YM and TRC will ensure that full in disclosed about Project activities a impacts on people's rights and live culturally appropriate way. YM and TRC will implement the GM the indigenous communities and widely communicated to the Indigenous communities and the indigenous communities and widely communicated to the Indigenous communicated to the Indigenous communities and widely communicated to the Indigenous communities and widely communicated to the Indigenous communities and the indigenous communicated to the Indigenous communi
Severance access to water sources for both people and livestock	• YM will design and construct appropriate crossings points for Indigenous Peoples and their livestock along the proposed SGR line	 YM and TRC will develop compensation/ mitigation measures access to specific livestock routes, p water sources. YM will consult the village gove
Destruction and loss of pasture and other natural resources	TRC will provide fair compensation to affected Indigenous Peoples and provide benefits for livelihood restoration or enhancement that benefit the community at large.	 Indigenous Peoples to identify key medicinal plants that are not available in the area for protection or avoidanc YM and TRC will ensure that whe plants will be identified by Indigence
Destruction and contamination of livestock water points	 YM will avoid destruction and contamination of livestock water points and restrict disposal of spoil material near water points. YM will rehabilitate borrow pits and quarry sites for safe use by livestock. YM will provide a safety awareness campaign to livestock keepers and school children from pastoral communities. 	their management will follow an FPIC
Impacts on cultural heritage		
Relocation of graves and sacred sites	 TRC will undertake appropriate processes to avoid relocation/ protection of the graves are affected and arrange for the relocation of all graves before the construction activi 1969. 	and sacred sites TRC will pay the owners of the ties commence as stipulated in the Graves relo



13.4.2 Ongoing engagement with Indigenous Peoples

YM will be implementing a stakeholder engagement plan for the Project which includes stakeholder engagement with the Indigenous Peoples (5 Capitals, 2023a). As identified during the May 2023 meetings with the Indigenous Peoples, they indicated that they want to be included in the overall stakeholder engagement process. The stakeholder engagement will include:

Ongoing discussions on compensation and livelihood restoration activities in line with the RAP. Measures to address impacts relating to land, natural resources and cultural heritage (and for which FPIC is required) are outlined in Table 13-7 along with the entity (e.g. YM or TRC) which is responsible for their implementation.

- Notifying stakeholders of construction activities including the timelines
- Communication of emergency preparedness and action plan (See SEP)
- Communication of GBV and SEA/SH Prevention and Response (See SEP)
- Implementation of grievance mechanism (See SEP)

To ensure that relations with the Indigenous stakeholders are maintained during planning and construction, YM Health, Safety, Environmental and Social (HSES) manager will be supported by the environmental and social engineers and four (4) CLOs for lot 3. The implementation of stakeholder engagement activities (including the grievance mechanism) relating to land acquisition and compensation (including involuntary resettlement, livelihood restoration, valuation procedure and compensation payments) falls under the responsibility of the social department of TRC.

To ensure that ongoing meetings with the Indigenous Peoples is effective and appropriate the following will be implemented:

arranging future meetings with Indigenous Peoples will be done through traditional and community leaders and Indigenous Peoples representatives (including women representative). A prior notice and information will be provided to the leaders about the engagement schedule and purpose of the meetings. These recommendations have also been identified in the 6 step FPIC process that have been followed for the SMP.

Meetings will be held preferably between 11am and 3pm, because Indigenous Peoples may have to travel far (between 5 and 15km) to reach the village centre where meetings are usually held. Meetings will be held with Indigenous Peopless at the sub-village/hamlet level.

Engagement with Indigenous Peoples will be structured around culturally appropriate engagement platforms that have been recommended by traditional leaders. These are presented in Table 13-8.

To ensure FPIC is obtained from indigenous peoples:

- TRC and YM will ensure that meetings with Indigenous Peoples are free from any form of intimidation that may act as an obstacle to informed participation of the Indigenous Peoples.
- TRC and YM will ensure that Indigenous Peoples are engaged about the Project on an informed and equitable basis and that the grievance mechanism is accessible to all Indigenous Peoples. This means that capacity gaps (due to low level of literacy amongst the older generation within the affected communities including Indigenous Peoples – see section Error! Reference source not found.) are identified and addressed.



Table 13-8: Indigenous Peoples culturally appropriate engagement platforms

IP group	Culturally Appropriate Engagement Platforms
Sandawe	Elders Committee/Influential women
Maasai	Traditional Leaders/Age set committee Women's Council
Barabaig	Council of Elders/ Women's Council/Youth
Taturu	Council of Elders/ Women's Council/Youth

Source: SMP (TRC, 2023a)

TRC will be responsible for the preparation and implementation of the Operational Phase SEP and ensure that engagement with Indigenous Peoples is continuous and regular during this phase and to ensure FPIC is maintained.

13.4.3 Sharing Project benefits with Indigenous Peoples

As described in section 9.4.1.7, where possible the project proponent will promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. TRC will ensure that Indigenous Peoples are prioritized in terms of Project benefits.

Indigenous Peoples will be benefitting from:

- Employment opportunities. A representative portion of employment opportunities will be prioritized for the indigenous community members
- capacity building/ training to enable their participation in the labour force for the Project both during construction and operation
- local procurement. Indigenous Peoples will be informed about the marketing/procurement opportunities for their specific products and services and an agreement between the Project and livestock markets for procurement of animal products for use by the project will be made.
- improvement of transport of livestock and other local produce. This includes setting affordable railway transport costs and collaborating with relevant government and private agencies to improve feeder roads in rural areas connecting to the proposed SGR line
- rehabilitation of borrow pits and quarry sites
- livelihood development programmes specifically targeted at Indigenous Peoples. The LRP for Lot 3 will consists of four (04) capacity development programmes designed to restore and/or improve livelihoods in the Project area (TRC, 2023). This includes a livestock service provision programme which is specifically targeted at Indigenous Peoples and whose goal is to enhance livestock keeping as source of income generation among PAHs
- Corporate Social Responsibility (CSR) programmes the content of which will need to be further discussed with the Indigenous Peoples.



14 WASTE AND WASTEWA AND ASSESSMENT

14.1 Background

Waste generation and management measures were presented in the UDSM draft ESIA (2022) and included an assessment of the project waste within the national and local context. Opportunities and constraints to the use of existing private and government waste services and infrastructure was also assessed. A gap assessment of the UDSM draft ESIA highlighted a few aspects needing consideration and included in their assessment. The updated, final ESIA by the UDSM (2023) closed many of the identified gaps. The text below therefore summarises and adapts the information provided in the USDM final ESIA (2023) and includes RSK's assessment of waste and wastewater aspects and impacts.

14.2 National context

Management of solid and liquid waste remains a major environmental and public health challenge in Tanzania, as in many developing countries. Contributing factors of inadequate waste management include continuously increasing waste volume; inadequate and poor waste management infrastructure; proliferation of unplanned settlements; limited budget allocation; and poor enforcement of laws and regulations. Consequently, a significant proportion of the waste ends up in the environment causing pollution, including emissions of GHG and contributing about 40% of the national disease burden (IGWMT, 2020).

There is limited and unreliable data for waste generation and waste disposal in the country. The investment guide on waste management in Tanzania of 2020 (IGWMT, 2020) states that existing estimates indicates that the country generates about 12.1 - 17.4 million tonnes of solid waste per year (0.66 - 0.95 kg per capita per day) and more than 119 million m³ of wastewater per year (which is an average load of municipal wastewaters of between 120 and 180 L per capita per day). Whereas the national environmental statistics report of 2017 states that indicative solid waste generation rate ranges from 0.1 - 1.0 kg per capita per day; and the national solid waste management strategy of 2018 having taken a reference of Dar es Salaam reports a generation rate of 1 kg per household per day. By 2016, only 10 towns/cities had sewerage systems, and even then, they covered a very small proportion of the population (only 20% of total urban population).

As much as 80 to 90% of solid waste generated in urban areas is not collected and most of the domestic waste, which accounts for about 60% of the total solid waste generated daily, is disposed of by burning or burying (NESR, 2017).

The average composition of municipal solid waste (MSW) includes garden and wood waste (30%), food waste (37%), papers (11%), plastic (7%), glass (4%), metal and tin (1%), textiles (2%) and ash (8%), of which 50 - 70% is organic (biodegradable). In addition, other waste fractions that may be encountered include e-waste, used lead acid batteries and waste tyres.

Major sources of solid waste include households, 75% and 57% as reported by IGWMT (2020) and NESR (2017) respectively. Other sources include industries and commercial areas (20%), institutions (0.5%), markets (3.5%), and street sweeping (0.5%). The national waste generation is growing at an estimated rate of about 5% per year (IGWMT, 2020). Construction waste accounts for about 13.3% (NESR, 2017).



There is an inadequate capacity for management of liquid waste from different sources in the country, resulting into indiscriminate discharge of liquid waste into water bodies and in the environment threatening human health, ecosystem integrity and biodiversity (VPO, 2013).

Technology for disposal of domestic liquid waste is mainly pit latrines and septic tank systems. About 90% of the urban population depend on on-site sanitation systems: pit latrines (80%) and septic tanks (10%) as their excreta disposal facility. The figures are less in rural areas (VPO, 2013).

Medical waste management in the country is poor. Disposal methods comprise of open pit burning (50%) and burying (30%) (Manyele and Anicetus, 2011).

Plastic waste management is poor. The per capita plastic waste generation is around 5.6 kg/year which is lower than the world average of 29 kg/year. However, only about 34% of the plastic waste is collected and about 95% of the plastic waste is mismanaged and ends up in water ways, including the oceans, rivers, and lakes (IUCN, 2021). Tanzania produces an estimated 14,800 t of waste per day, 48% of which is plastic (UDSM ESIA, 2023). Plastic wastes are generated from packaging materials, water bottles and containers. While most plastic types are recyclable (i.e. PET and HPDE), the most used packaging materials and carries bags (i.e. low-density polyethylene, LDPE and polypropylene, PP) are technically difficult to recycle, thus ending up in dumping sites. The polyvinyl chloride (PVC) used in pipes and conduits are not recyclable in normal processes. Although the use of non-recyclable plastics (i.e. of size less than 30 microns) was banned in Tanzania in 2019, the bags are still dominating waste dumps, water ways and the aquatic environment. Plastic bags are still the common means for packaging of food stuff in many urban centres. Fortunately, the recyclable plastic waste business is booming in industrialised urban centres in Tanzania. Recently, eight brewing companies in Dar es Salaam joined forces to form the Polvethylene Terephthalate Recycle Company (PETCO), an initiative to collect and recycle 12.5 million tons of plastic waste in Tanzania (The Guardian, 04 July 2022).

Final disposal for solid wastes is mainly open dumps with few operating as controlled dumps and even fewer engineered landfills. The open dumps involve indiscriminate disposal of wastes and limited capacity and measures to control operations including those related to the environmental protections. There is no limit of wind-blown litter, odour, leachate and gases.

The common types of waste generated in health care facilities in Tanzania include infectious waste, pathological waste, sharps, pharmaceutical waste, genotoxic waste, coagulated blood waste and expired medicines and drugs. The waste produced during health-care activities have a higher potential for infection, injury, and are more hazardous in nature than any other type of waste. Inadequate and inappropriate handling of health-care waste may have serious public health consequences and a significant impact on the environment. A study on existing medical waste management (MWM) systems in Tanzanian hospitals (Manyele, 2011) revealed that the generation of medical waste is increasing, attributed by increased population and poor MWM systems as well as expanded use of disposables in health care facilities. It identified the main disposal methods to comprise of open pit burning (50%) and burying (30%) of the waste. A large proportion (71%) of the hospitals used dust bins for transporting waste from generation points to incinerator without plastic bags. Most hospitals have low incineration capacity, with few having fire brick incinerators. The 2021 study concluded that hospital waste management in Tanzania is poor.

The responsibility of management of solid waste is vested in the LGAs i.e. cities/district/municipalities. This is a legal obligation in accordance with the Local Government Act 1982 section 55 (g) and the Environmental Management Act of 2004 sections 114 - 138. Solid waste management is coordinated at district/municipal level, under the department of solid waste management and sanitation.



The Water Supply and Sanitation Act 2018, Section 20, gives the Urban Water Supply and Sanitation Authorities responsibility of development, provision, and maintenance of water and sanitation works.

The Environment Management (Hazardous Waste Control and Management) Regulations of 2021 assign the ministry responsible for environment the responsibility to oversee management of hazardous waste including licensing and transboundary movement.

TRC and YM are ultimately responsible for obtaining the applicable permits and that the regulations are adhered to, during construction, operation and decommissioning of the SGR project. The permitting requirements are outlined Table 14-1: Permitting requirements for Lots 3 and 4.

Permitting requirement	Project action	Status			
Environment (Solid Waste Man	agement) Regulations 2009 as amo	ended in 2016			
Regulation 9 any person dealing in solid waste as manager of transfer station shall apply for a permit to local authority	apply to local authorities which have jurisdiction at each campsite to get permit for the waste management areas check the contracted waste management contractor engaged to collect domestic waste has the relevant permit from local authority	waste management procedure states permits are in place			
Regulation 11 licence to own or operate solid waste disposal site	apply to local authorities which have jurisdiction at each campsite to get permit for disposal site	waste management procedure states permits are in place			
Environment Management (Ha 2021	zardous Waste Control and Manage	ement) Regulations of			
Part v in-country movement of hazardous waste	check the contracted waste management contractor engaged to collect scrap metals, waste oil, tyres and used batteries has relevant valid permits	already stipulated in the waste management procedure			
Regulation 61 management of chemical waste according to Industrial and Consumer Chemicals (Management and Control) Act	check the contracted waste management contractor engaged to collect paint and chemical containers has the relevant valid permits from government chemist laboratory agency	already stipulated in the waste management procedure			
The Environment Management Waste) Regulations 2021	(Control and Management of Elect	rical and Electronic			
Regulation 53 responsibility of consumer channel e-waste is to permitted dealer or manufacturer/product agent take back chain	check the contracted waste management contractor engaged to collect e-waste or related scrap metals and plastics has relevant valid permits	already stipulated in the waste management procedure			

Table 14-1: Permitting requirements for Lots 3 and 4



Permitting requirement	Project action	Status							
Public Health Act, 2009									
Regulation 92 handling and disposal of healthcare and other wastes	check clinic staff and medical waste contractor has the relevant permit from the ministry of health	already stipulated in the waste management procedure							
Water Supply and Sanitation A	ct of 2019								
Regulation 19 appointment of service provider	check the contracted sewage removal contractor is permitted by the local water supply and sanitation authorities	already stipulated in the waste management procedure							

14.3 Project area context

14.3.1 Solid waste

Source and nature of wastes: The main source of solid waste in the study area is domestic activities. Thus, the nature of waste is organic and highly decomposable. Data from socioeconomic profiles of the DCs indicate that 70% of municipal waste is organic (including food waste, paper and yard waste). The remaining non-organic wastes include plastic, glass, tin etc.

Waste recycling and processing: None of the LGAs in the study area reported to engage in any form of waste sorting, recycling, or processing. However, there are several individual people engaged in the collection and transportation of papers, plastic wastes and scrap metals in the streets, offices, collection points and dumping areas. No data on waste processing could be gathered from the study area. Papers wastes such as boxes and print papers are consumed locally, in the manufacture of envelops, wraps, and other packaging, especially by food vendors.

Information from the district authorities in Manyoni, Itigi, Tabora, Uyui, Nzega Sikonge and Nsalala suggest that the main sources of plastics in the project areas are from water bottles, food stuff bottles (i.e. cooking oils), hair and skin products, and carrier & packaging bags. Plastic wastes could continue to be a problem in the study areas, especially because there are no recycling facilities in the area. The portion of plastics and scrap metals on the other hand, are stored in informal collection points, usually near the main roads, where they can be easily collected by passing trucks. The collected materials are sold at the collection points, to licensed transporters (usually the recycling companies or agencies) to processing facilities in Dodoma, Mwanza and Dar es Salaam.

14.3.2 Final disposal

The district/municipal authorities operate either open dumps or controlled dumps for the final disposal of solid waste. The open dumps involve indiscriminate disposal of wastes and limited measures to control operations including those related to the environmental protections. There is no control of wind-blown litter, odour, leachate and gases.

14.3.3 Wastewater

According to the districts/municipality water supply and sanitation authorities (WSSA), only a few water authorities have proper wastewater and sludge treatment facilities. Onsite pit latrines and septic tank cum soakaway systems are predominant in management of sewage with limited desludging, which usually end up in designated municipal unlined disposal pit or at the solid waste dumpsites. There are no systems for industrial waste treatment and disposal.



14.3.4 Hazardous waste

The main sources of hazardous wastes in the study area are from small industries e.g. workshops and garages and healthcare facilities. Generated hazardous wastes are burned or incinerated at the facility (i.e. district hospitals) or disposed in open pits and dumpsites. Interviews with the municipality and district officers revealed that the authorities have no facilities and do not directly offer hazardous waste management services even though they are aware of limited collection of waste oils and used batteries.

A summary of waste management information in the study areas as well as a checklist of available facilities and services are presented in Table 14-2 and Table 14-3 as adapted from the UDSM ESIA (2023).



Table 14-2: Summary of waste management facilities in the study area (Source: UDSM ESIA)

Authority	Solid waste management	Liquid waste management	Future plans by Government
Manyoni DC	Solid waste management: the council reports to be overwhelmed by the generation of solid waste materials which ended up by being disposed by methods that lead to further pollution. The amount of solid waste generated in the council is estimated to be 30.5 t/day and it is only 2.5 t/day (8.3%) that is removed and hauled to the crude dumpsite and this takes into account solid waste collected from 3 constructed immovable transfer stations only. The remaining solid waste generated, is crudely dumped in improvised refuse pit and open places particularly where these immovable transfer stations are not available. Collection and transportation of solid waste from these 3 immovable transfer stations and few open areas to a crude dumping site located about 3 km from town centre, is done by a 1.5 t council tractor, which operates tipping mechanism. The council plan to relocate the crude dump to a designated site in Minarani area, about 7 km form the town centre.	Liquid waste disposal is done in on on-site sanitation facilities (i.e. pit latrines). Pit emptying relies on contractors or cess pit- empties. About 600 m ³ of liquid waste is produced in the council per day. Liquid waste is collected by private cesspit emptier (hired from Dodoma), which disposes the` waste in a designated area at Minarani. The Minarani ponds are abandoned quarry sites, located 7 km from the town centre. The pits are unlined, and the waste is reported to percolate the soils just a few days after disposal. This implies a high potential for ground water contamination.	Seeking funds for building waste incinerators in Manyoni urban, purchase proper waste collection vehicles, improve and increase the number of transfer stations and construct a dumping site at Minarani area.
Itigi DC	Estimated less than 50% of generated solid waste is collected by the district. 76.9% of urban wards have access to waste collection facilities. The urban community disposes waste in collection facilities while in the rural areas solid waste is either burned of buried. The MGR station within the district are among the main source of litter.	The most common sanitation facilities pit latrine, followed by septic tank systems (used in areas where there is adequate water supply). When the pit is full, the latrine is shifted to another location as long as space is available. Often people refrain from using emptying services, because of the high cost for those services. For those who can afford cesspit empties the service is hired from Manyoni, or elsewhere.	Has acquired land for future construction of solid waste disposal facility and waste stabilization ponds.



Authority	Solid waste management	Liquid waste management	Future plans by Government
Tabora Urban MC	Tabora municipality produces 120 t of solid waste per day and has an average SW generation rate of 0.5 kg/cap/day. The Municipality practices crude dumping at a site near Tabora School. The main problems facing the solid waste disposal system is lack of enough trucks to meet the daily demand. The available three (3) trucks are old and often in disrepair. Waste collection from the generation points is transported to designated collection points (by individuals and CBOs), to collection points, where it is transported to the dumping site by MC trucks. Currently the Council has a capacity to collect only 47% of the total solid waste generated per day. As a results, waste accumulates at collection points, while some is disposed into natural drainage channels and along the streets with little coordinated remedial action. The council is willing to supervise waste collection and disposal activities by YM. During the operation phase, the DC in collaboration with TRC will collect solid wastes from the stations. The same arrangements exist at the MGR station, whereby the Municipal truck collects waste from the Tabora station.	The existing sewerage system covers 1.3% of MC, and mainly serves educational institutions and several commercial buildings in Gongoni, part of Malolo, Kanyenye and Chemchem Wards. Total liquid waste produced per day is about 12,620 m ³ . Out of these only 2% of waste have access to the main sewer and about 98% of the total households are served by on site sanitation facilities such as septic tanks and pit latrines. Other liquid waste is handled by cesspit empties. The Municipality has two such facilities, and it charges TZS. 40,000 per trip for individuals and TZS 50,000 per trip for institutions and hotels.	The Council has in its plan to establish a controlled dumping site, thus has acquired land Ngambo ward, in Wanzale sub ward about 3 - 4 km from the MC.
Uyui DC	Solid waste is collected in urban centres, only from commercial centres. The waste is collected by wheelbarrows and disposed of in abandoned borrow pits. The district has no designated dumping site. In households, Solid wastes is disposed on site by burning/burying.	The district has no sewerage system. Thus, onsite sanitary facilities are in use under the Uyui DC supervision. Cesspit empties are used for emptying septic tanks, where the effluents are disposed in abandoned pits and quarry sites.	The DC has acquired a piece of land at Mswa area in Isikizya ward, 35 km from the district centre designated for construction of liquid waste stabilisation ponds and solid waste dump.
Sikonge DC	There is a designated municipal waste dump at Mkolile sub ward, in Misheni Ward, where they practice crude dumping. Collection of MSW is	The district has no sewerage system. Thus, onsite sanitary facilities are in use under the Sikonge DC supervision. Cesspit empties	The Council has acquired a 7 acres piece of land, designated for construction of liquid waste



Authority	Solid waste management	Liquid waste management	Future plans by Government		
	done using two tractor trucks, which collects about 10 t a month, amounts to 54% collection in the two wards. The Nyahua ward, which is traversed by the SGR line, has no SW collection services.	(hired from Tabora MC) are used for emptying septic tanks, where the effluents are disposed in waste stabilisation ponds in Tabora MC.	stabilisation ponds and solid waste dump.		
	There are no waste recyclers in DC. However, there are a few individuals in Komanya area, dealing with collection of plastic wastes and scrap metals. Collected recyclable wastes are transported by private trucks to a processing facility in Mwanza City.				
Nzenga DC	The main source of solid waste is domestic waste. Solid waste is only collected in a few urban centres, to designated collection points within the centres, where it is burned or buried. In urban centres, households manage their own waste by burning or burying in the backyard. SWM experience from the EACOP project: the contractor used own SW trucks for transporting solid waste to a designated waste dump in Nzenga MC.	The common sanitation facilities are pit latrines with a small percentage of households using septic tank systems. Cesspit empties (hired from Nzega or Tabora MC are used for emptying septic tanks. The Nzega WSSA responsible for liquid waste management, however, there is no sewer systems or centralized liquid waste management facility. Wastewater is disposed in abandoned quarry sites.	To purchase equipment for solid waste transportation and damping site management includes 3 trucks, 1 Excavator, 1 wheel loader, 1 bulldozer and weighing bridge.		



Table 14-3: A checklist of available solid waste and liquid waste management facilities and services in the project area (source: UDSM ESIA)

		Liqui mana	d waste gement	:	Solid v	waste m	anagen	nent									
ality		,			te	ted	d for		Collec	tion of	SW	SW p	oroces	sing	SW di	sposal	Hazardo us waste
Region name	District / municip	Sewerage system available	Treatment plant available	Council cesspit empties	SW generation ra (kg/c,/day)	Total SW genera (ton/day)	% of SW collecte disposal	SW compaction	Collected by LGA alone	Involving PPP	Nos. of waste trucks owned by DC/MC	Recycling offorts	Energy recovery	Waste processing	Dumpsite available	type of dump	Hazardous waste disposal facility or service available
Singida	Manyoni DC	NO	NO	NO (private hire available)	0.5	30.5	8.3%	NO	YES	NO	1 (1.5 tons) tractor	NO	NO	NO	YES	Crude dumpin g	NO
Tabora	Sikonge DC	NO	NO	NO (hires from Tabora)	0.2	0.35	54%	NO	YES	NO	2 tractors (1 not in operation	NO	NO	NO	NO	Crude dumpin g in abando ned pits	NO
	Tabora (U) MC	YES	YES (WS P)**	NO (private hire available)	0.6	120	43%	NO	YES	NO	3 trucks in poor condition	NO	NO	NO	YES	Crude dumpin g	NO
	Uyui DC	NO	NO	NO (private hire available)	ND	ND	0%	NO	YES	NO	No trucks	NO	NO	NO	NO	Crude dumpin g in abando ned pits	NO



		Liquid waste management		Solid waste management													
	ality				te	ted d for			Collection of SW		SW processing			SW disposal		Hazardo us waste	
Region name	District / municip	Sewerage system available	Treatment plant available	Council cesspit empties	SW generation rat (kg/c,/day)	Total SW generat (ton/day)	% of SW collecte disposal	SW compaction	Collected by LGA alone	Involving PPP	Nos. of waste trucks owned by DC/MC	Recycling offorts	Energy recovery	Waste processing	Dumpsite available	type of dump	Hazardous waste disposal facility or service available
	Nzega DC	NO	NO	NO (private hire available)	0.6	ND	ND	NO	YES	NO	No trucks	NO	NO	NO	NO	Crude dumpin g in abando ned pits	NO



14.3.5 Waste management at the MGR located in the project area

The MGR has 15 stations between Manyoni and Tabora, of various capacities. In between, there are four halts. The main sources of solid wastes for the MGR are from activities such as foods and drinks vending, and paper works in the offices (i.e. ticketing). Each of the major MGR stations have at least one staff assigned for cleaning and waste management issues. TRC has installed waste collection bins at the stations, for use by food vendors and passengers. Except for the Tabora station, solid waste and liquid wastes management is done onsite. Collected solid wastes are either burned or buried on site, while liquid waste is disposed of in septic and soak away systems. For Tabora station, solid waste is also disposed of in septic tank soak away systems and is emptied by cesspit empties from the Tabora WSSA

14.3.6 Capacity of district/municipalities to support waste management in the project sites

14.3.6.1 Solid waste

Analysis of SWM facilities in the LGAs suggest that the authorities **do not have enough facilities to support the project** in management of its generated wastes. Most of the LGAs are only capable of collecting less than 50% of waste generated. They have inadequate personnel both at management and operational level; waste collection equipment (dump/compactor trucks or tractor and trailers); dispose wastes and its mixed form in crude dumpsites with no loaders, graders, or compactors for dumpsite management. These dumps are not fenced or guarded and can be accessed freely by scavengers for picking waste and some cases community members (children) and livestock. Scavenging animals can also be found.

Manyoni and Tabora councils has designated crude waste disposal sites, which could be improved and used for dumping of residual non-hazardous wastes from the camps but this may be economically unviable for the project. Plastics and scrap metals are collected by individual people and sold to recycling companies operating outside the study area. The companies collect such wastes from collecting points established along the main roads and in individual premises and transport them to recycling industries in Mwanza, Arusha and Dar es Salaam or waste aggregators in Dodoma. These companies can be used to serve the project if they meet the required local permitting and health and safety standards.

It is recommended that TRC liaises with the local municipalities and join forces in **improving the existing dumpsite operations** as services are needed in the longer term to also support project operational wastes. Alternatively, they should **invest in composting** to manage domestic putrescible wastes to recover nutrients, which will leave a very small fraction of nonbiodegradable wastes which can be loaded in the MGR and transported to sanitary landfills in Dodoma (Chidaya Landfill).

14.3.6.2 Liquid waste

Apart from Tabora, which has 1.3% sewer coverage, the rest of the districts/municipalities do not have a sewerage system. Further, even the sewerage systems in Tabora does not extend to the project area. Thus, the contractor **should construct onsite liquid waste management facilities**. For environmental sustainability, it is recommended to install a system that will allow recycling of treated wastewater i.e. up flow anaerobic sludge blanket (UASAB) + wetland system. Effluents from a proper functioning wetland can be recycled for lawn irrigation at the camping site.



14.3.6.3 Hazardous & medical wastes

There is no government or commercial centre for hazardous waste management in the study area. According to the environmental officers of the DCs, available hazardous waste management facilities are combustion chambers and incinerators installed at the regional/district hospitals and health care facilities, especially for medical wastes. However, the performance of these facilities has been classified as poor (UDSM ESIA, 2023), thus the project could not rely on their services.

14.3.7 Availability of waste management services outside of the project area

There are some permitted hazardous waste management contractors in Mwanza and Dodoma regions. The contractor should subcontract specialised registered companies for hazardous waste management at all sites. The contractor should collect and contain all hazardous waste on site, following local standard and the IFCs EHS guidelines on hazardous materials management. Specialized domestic waste collection companies are available in the neighbouring regions of Dodoma and Mwanza, including the Green Waste Pro Company and GIN Investment. Many permitted waste contractors, which meet project standards are available in Dar es Salaam and provide services countrywide and at remote sites, which have the capacity to handle all types of the wastes generated by the project. Services that are available in nearby regions are listed in Table 14-4.

Waste type managed	Available waste management services	Dedicated equipment			
 oil waste medical waste e- waste plastics sewage solid waste 	 general waste handling, segregation, and recycling removal and transport of recyclables in skip or container to vendor - replaced with empty skip removal and transport of mud skip and contents to vendor - replaced with empty mud skip removal, transportation, and treatment of waste. oil if cannot be recycled contained in provided international bulk container (IBC) or designated waste oil tanker sucker truck and operator for septic tank emptying e- waste management 	 incinerator with ash disposal service steel drums for oily rags and cloths / clothing wheelie bins coloured for segregation and collection - minimum capacity 240 L segregated waste 10 m³ skip or 20-foot container - minimum capacity 10 m³ mud skip minimum 4 m³ capacity waste compactor 			

Table 14-4: Waste management services available in the neighbouring regions (source: UDSM ESIA)

14.4 **Project waste generation**

Different types of waste are expected to be generated during the lifecycle of the project. It is important for the contractor to make an agreement with one or more licenced waste management facilities to manage waste and safely collect, transport and dispose of waste produced throughout the project lifecycle.



The waste at the workshops and camps shall be segregated and collected at a temporary waste collection area. The waste needs to have separate storage segments (i.e. scraps metals, tyres, plastic, wooden material) and another one for hazardous waste hydrocarbons (i.e. waste oils, oil filters etc).

The waste generated during the project's construction, operation and decommissioning phases should be managed in accordance with the waste management process outlined in Figure 14-1 below.



Figure 14-1: Waste management process

Furthermore, the waste hierarchy outlined in Figure 14-2 below should be followed. The waste hierarchy is used to evaluate processes that protect the environment alongside resource and energy consumption from most favourable to least favourable actions, it also highlights an order of preference to reduce and manage waste.



Figure 14-2: Waste hierarchy

Ultimately, all waste generated during the project will be temporarily stored in a dedicated waste management area (WMA) and transported off site for reuse/recycling or treatment and disposal.

The types of waste to be generated during the lifecycle of the project are outlined in the following section. Table 14-5 and Table 14-6 provide the estimated volumes/weights of solid and liquid wastes that will be generated throughout the project.



Table 14-5: Solid waste types and estimated quantities during the project phases (Source, UDSM ESIA)

Sn	Waste type	Source	Quantity/ volume	Potential for material recovery	Waste management		
1.0	Pre-construction	n phase					
1.1	Overburden soils and biomass	Site clearing and excavation works	68,300,000 m ³	Reuse as fill where possible on disturbed sites	Unwanted soils lacking good bearing capacity shall be dumped in designated dumping areas within the quarry sites		
1.2	Demolition wastes	Demolition of about 794 housing structures made of mud, grass and brick in Manyoni, Uyui, Sikonge, Tabora Urban and Nzega	About 190 t	40% - 60% can be recycled (Wang et al. 2004)	PAPs to recover materials remains could be used as fill materials during for access roads		
2.0	Construction p	hase					
	Solid waste		1	1			
2.1	Construction wastes (concrete, damaged materials)	Civil & non civil construction activities	276,307 t 1 - 10% of construction materials becomes waste (Wang et al. 2004). 5% adopted	Recycling of valuable fractions	sorting separation and proper storage on site, recycling of useful materials on site. recyclables will be collected by selected dealers. non recyclables will be disposed in designated waste dumps		
2.2	Office waste	Office activities (filling, paper works etc)	5 t/month adopted from a range of 5 - 10 tons per month (based on experience from Lots 1 and 2)	High potential for recycling	sorting separation and proper storage on site, to be sold to local collectors		
2.3	Food wastes	Food wastes Lot 3		Energy recovery on site (i.e. compost)	compost reactors will be established on site compost shall be used as soil conditioner on site		
2.4		Lot 4	566.7 kg/day (based on generation rate of 0.3 kg/c/d and av. population data for Lot 4)	Energy recovery on site (i.e. compost)			
2.5	Yard wastes & litter	Yard sweeping	To be established o	luring construction phase	yard waste is 100% decomposable, thus could be humped to decompose litter shall be sorted and managed accordingly		
2.6	Hazardous wa	ste					
	Garage and	Waste oils, grease, rugs	7-10 m ³ per	None	stored in specialise containers on site, to be removed by subcontracted bazardous waste		
	wastes	Filters	1,000 - 1,250 filters per month	Recyclable	specialist/contractor		
		Waste tyres	5,000 - 6,000 tyres per year				
		Batteries	800 -1000 batteries per year				
2.7	Chemical contaminate d soils	Oils and chemical spills	Not established	None	contaminated soils shall be removed from the site and treated as hazardous waste as required by the law garage areas shall be paved to contain and control any spills, and avoid runoff contamination		
2.8	Medical Chemicals, infectious waste wastes & sharp objects		2- 5 kg/patient/day (Manyele, 2011)	None	stored in specialise containers at the dispensary, to be disposed in waste incinerators at the district/municipal hospitals (in Kiteto District Hospital). The contractor has signed an agreement with Kiteto District hospital which will allow the project to treat medical and infectious wastes in their incinerator		
2.9	Human waste sludge	Sanitation facilities	Not established	Could be treated by the local water supply authorities (WSA) and used as soil conditioner	sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirement sludge disposal has to be consistent with protection of public health and safety, and conservation and long-term sustainability of water and land resources		
3.0	Operation phase	se					
3.1	Mixed Vendor and passenger at project stations (Lots 3 and 4)		s Vendor and passenger at project stations (Lots 3 and 4) 1,100,000 customers and generation rate of 0.3 kgcustomer/d		SWM system shall be established for the stations sorting, separation, reuse, recycling & energy recovery shall be adopted recyclables shall be sold to certified contractors		

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Sn	Waste type	Source	Quantity/ volume	Potential for material recovery	Waste management
			ay for Lots 3 and 4		
	General office wastes (papers, packaging) Plastic wastes (bottles & bags)		-	About 0.5 t/day (general office) About 0.6 t/day (plastics)	sorting, separation, reuse, recycling & energy recovery shall be adopted recyclable papers and plastics shall be sold to certified contractors. Non-recyclables shall be disposed in designated solid waste dumps in respective LGA
3.2	Scrap metal (marshalling yard and workshops)	Train maintenance activities	2-5 m ³ per month	None	
3.2	Hazardous wastes (oils, lubricants, contaminate d rugs)	Train maintenance activities	2 - 5 m ³ per month	None	stored in specialise containers on site, to be removed by subcontracted hazardous waste specialist registered by the government
3.3	Human waste sludge	Sanitation facilities	Not established	Septic tanks. Resultant sludge could be treated by the local water supply authorities (WSA) and used as soil conditioner	sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirement sludge disposal has to be consistent with protection of public health and safety, and conservation and long-term sustainability of water and land resources

Table 14-6: List of waste types estimated quantities and management of wastewater during the project phases

SN	Waste Streams		Volumes estimated	Liquid waste management				
1.0	Pre-construction and construction phase							
1.1	Camp sites	Sewage from sanitation facilities in residences, & office	Lot 3 - 257 m ³ /day Lot 4 – 136 m ³ /day (Based on assumptions that 80% of water supplied becomes wastewater, and a per capital consumption of 90 L/cap/dday), and average Nos of workers for Lots 3 and 4)	design and operation of sewage management systems at the stations and camps wastewater shall be treated in upflow anaerobic sludge blanket (UASB) in series with a wetland system wetland effluent, meeting land discharge standards (TZS 860 2019), could be used for lawn irrigation at the camping sites				
		Sewage from sanitation facilities in kitchen and cafeteria	Lot 3 - 200 m ³ /day Lot 4 – 105 m ³ /day (Based on assumptions that 80% of water supplied becomes wastewater, and a per capital consumption of 70 L/cap/day), and average Nos of workers for Lots 3 and 4)					
		Sewage from sanitation facilities in dispensary	 0.32 m³/day Lot 3 0.16 m³/day Lot 4 (Based on a 20 L/patient/day, and an average of 10 patients/day for 2 the dispensaries in Lot 3, and 1 in Lot 4) 					
		Sludge	About 1 t/year	sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirement sludge disposal has to be consistent with protection of public health and safety, and conservation and long-term sustainability of water and land resources				
1.2	Batch plant	Spent water	Up to 95% of washing water becomes waste. Exact amount to be established based on water supply	onsite treatment in decantation tanks recycling in the batch plant or washing (studies suggest 50% dilution with fresh water) recycle residues in concrete works (i.e. in works without structural purpose)				
2.0	Operation phase							
2.1	All SGR stations in Lots 3 and 4	Sewage from sanitation facilities	168.7 m ³ /day. (Based on estimated passenger fleet of 1,100,000 people/year (equivalent to 3013 people per day) and per capital consumption rate of 70 L/cap/day)	maintenance of sanitation facilities wastewater shall be treated in upflow anaerobic sludge blanket (UASB) in series with a wetland system wetland effluent, meeting land discharge standards (TZS 860 2019), could be used for lawn irrigation at the camping sites sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirement sludge disposal has to be consistent with protection of public health and safety, and conservation and long-term sustainability of water and land resources				

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14.5 Environmental impacts related to generation and management of waste

Various liquid and solid wastes will be generated by the different project activities, which have a potential to impact the receiving environment and health of both humans and animals positively and negatively. The identified impacts are listed below and rated in detail in **Section 21** of this document.

14.5.1 Economic impact

The need for waste management services and the valuable materials recovered from wastes will positively impact the economy due to the increase in business for the waste service providers and raw materials for industrial production. For example, scrap metals is the main raw material in steel production and waste oils is the main source of cooling.

Most recycling facilities and waste contractors with the relevant permits and the capacity to meet project standards are in the big towns/cities e.g. Mwanza and Dar es Salaam, thus an increase in materials recovered from waste will have a national benefit. This will extend for the whole duration of the project but will be highest during construction and then taper off during operations.

The management measures to enhance this benefit include:

- application of the 4R principles in management of all waste streams to recover recyclable and reusable materials
- prioritisation of waste management service providers according to their proximity to the project.

14.5.2 Impacts to air

Putrescible materials contained in food waste when decaying produces sulphide gases, which cause an odour. This impact will be realised close to where the waste is stored if not removed timeously and where domestic wastes are disposed with no application of daily cover. Odour will also be present at the domestic wastewater treatment plant due to biodegradation of the sewage, i.e. if there is obstruction or overflow in the sewer system, if the effluent used to irrigate the camp gardens is not adequately treated, and if WWTP sewage is disposed.

Open burning is one of the methods utilized to manage wastes in the communities and the local dumpsites some of which will be utilised by the project. Volatile organic compounds will also be released from wastes containing hydrocarbons. If the project is to utilise incinerators onsite or send its wastes to be treated offsite by incineration it will emit noxious and greenhouse gases into the atmosphere.

Odour nuisance will extend only a limited distance, usually not more than 100 m from the respective facility where waste is stored/treated. However, emission of GHG has a global impact. This impact will extend for the whole duration of the project but will be highest during construction and then taper off during operations. Refer to Section 19 on GHG for further information.

Management measures include:

- siting of WWTP such that it is downwind of camp facilities and adjacent communities and optimise operation and treat the water to acceptable effluent standards
- incinerator to be installed onsite will meet relevant local and appropriate international standards for stack emissions



- due diligence inspection to be conducted at the selected waste contractor facilities to verify that the incinerators that will be used to treat project waste are designed and operated such that they consistently meet stipulated emission standards
- liquid hydrocarbons will be kept in airtight containers.

14.5.3 Impacts to land

Waste disposed on land leach nutrients and hazardous substances like oils and heavy metals impacting not only the land but water resources. This may lead to blocking of pores within soils limiting natural microbial activities, introduction of inert materials e.g. non-biodegradable plastics and fabrics into the soil changing soil structure, introduction of heavy metals, acids, alkalis and other chemicals which are poisonous to the microbes and affect soil productivity. These harmful elements in the soil can be up taken by plants and transported up the food chain causing secondary impacts to human and animal health. In addition, effluent and sludge from WWTP and wastewater from industrial areas e.g. batching plant, heavy vehicle maintenance, may be disposed in the receiving environment. However, degradation of food and domestic sewage provides a good source of nutrients that can be used to fertilize land.

The impact of leaching of substances from the waste will be local due to the limited amount of waste that will be stored or disposed daily.

Management options include:

- segregation of hazardous wastes and storing them in leak proof containers
- waste management area constructed in a way that prevents waste being exposed to weather
- implementing the waste management procedure that states only domestic non-hazardous wastes will be sent to disposal sites
- hazardous wastes will only be handed over to permitted waste contractors who have undergone a due diligence process.
- overburden soils and biomass from site clearing and excavation works and demolition waste left on bare land will negatively impact the nutritional content and potential for natural habitat regeneration. There are opportunities to reuse these waste spoil soils in designated dumping areas within the quarry sites and burrow pits. The Waste Management Plan will include procedures to
 - record locations of excavated soils with quantities, the soil type and indication of pre-existing invasive plant species.
 - quarterly checks of the spoil soil storage locations and management of erosion risks and invasives.
 - record of meetings that has identified and scheduled burrow pits and quarries that will no longer be used during construction.
 - record of meetings with respective government authorities agreeing on the quarries and burrow pits that will be rescheduled in the rehabilitation and approval for the use of the waste spoil in each location for rehabilitation.
 - measures to control the transfer and use of spoil soil to pre-approved areas creating unwanted waste piles.
 - demolition wastes from about 794 housing structures made of timber, mud, grass and brick in Manyoni, Uyui, Sikonge, Tabora can be reused by community members and used to resurface community footpaths and roads.


- record the nature of demolished waste per location, estimated quantities, locations stored.
- measures to remove hazardous waste e.g. items that can cause risks to injuries, tetanus, etc.
- records of meeting with respective village, ward leaders on the distribution of the reusable waste and proof of information shared to communities on agreed date and locations where the reusable materials will be distributed from.
- records of meeting with respective village and ward leaders on the use of hard rubble to resurface identified footpaths or roads, including outlined roles and responsibilities between contractor, community leaders and any other third party.
- records of completion including pictures, date, quantity distributed/reused number of people who took reusable waste, locations where hard fill was used.

14.5.4 Impacts to water resources

Hazardous substances including heavy metals, nutrients, pathogens and hydrocarbons contained in wastes can reach water bodies through spills, improper waste dumping, disposal of effluent from WWTP and wastewater from industrial areas e.g. batching plant and heavy vehicle maintenance. These substances may secondarily impact water resources from leachate and runoff arising from waste storage, treatment, and disposal sites. In addition, waste soil stacking and dumping may block surface water courses and add to sediment loading due to lose sands/silts.

Management options include:

- locating waste soil dumps away from watercourses as narrated in the offsite management procedure
- segregation of hazardous wastes and storing these in leak proof containers
- waste management area constructed in a way that prevents exposure to weather
- implementing the waste management procedure that states only domestic non-hazardous wastes will be sent to disposal sites
- hazardous wastes will only be handed over to permitted waste contractors who have undergone a due diligence process.

14.5.5 Impacts to health and safety

Food waste left to rot provides breeding sites for pathogens. Domestic sewage contains faecal matter, which exposes pathogens, especially those of the human waste, onto land and water where they can be transmitted to either host vectors or new patients. Medical wastes contain infectious matter. Also waste provides physical hazards due to containing sharp objects e.g. broken glass, needles etc.

Management options include

- medical wastes will be segregated by the clinic personnel and stored accordingly at the clinic
- segregation of wastes will be done primarily at the generation points and then secondary sorting at the waste management area to avoid the release of hazardous substance with disposal of non-hazardous at the local disposal facility
- waste sites must be fenced



• closed systems will be used to transfer sewage to WWTP that will be installed at all camps to treat sewage to permissible standards.



15.1 Noise and vibration predictions

15.1.1 Construction

Table 15-1 presents the predicted unmitigated construction noise levels during the construction phase of the works. 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 Appendix 5.

Task	Construction	Noise level (dB L _{Aeq,T}) at range of setback distances (m)						
	activity	10	50	100	200	300	400	500
1.1	Site clearance	80	66	60	54	50	48	46
1.2	Site establishment	78	64	58	52	48	46	44
1.3	Access route	81	67	61	55	51	49	47
1.4	Earthworks and civil*	86	72	66	60	56	54	52
1.5	Signalling and telecommunications	79	65	59	53	49	47	45
1.6	Track and ballast laying	78	64	58	52	48	46	44
1.7	Track works	76	62	56	50	46	44	42
1.8	Catenary works	82	68	62	56	52	50	48
1.9	Ballast distribution	83	69	63	57	53	51	49
1.10	Ballast tamping	84	70	64	58	54	52	50
1.11	Rock breaking	83	69	63	57	53	51	49
2.1	Quarry operations	82	68	62	56	52	50	48
2.2	Foundations (piling)	89	75	69	63	59	57	55
2.3	Foundations (concreting)	83	69	63	57	53	51	49
2.4	Steel and framework	78	64	58	52	48	46	44
2.5	M&E installs	79	65	59	53	49	47	45

Table 15-1: Predicted construction noise levels (dB LAeq,T)

* Includes the plant required for borrow pit works.

The predicted noise levels are simply a distance correction between the construction area and the considered noise sensitive receptors. 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 predicted noise levels indicate that construction works have the potential to exceed the criteria at up to 500 m from the considered alignment.



15.1.2 Operational noise

15.1.2.1 Train movements

Predicted noise levels associated with proposed operations along the alignment are presented in Table 15-2. The table presents noise predictions for the worst-case hour (IFC standards) and 16 hr/ 8 hr average (TZ standards) for both the mainline and station approach scenarios.

Distan ce (m) from	IFC criteria mainline scenario		IFC criteria station approach scenario		TZ criteria mainline scenario		TZ criteria station approach scenario	
sourc e	LrD	LrN	LrD	LrN	LrD	LrN	LrD	LrN
	[dB(A)]		[dB(A)]		[dB(A)]		[dB(A)]	
10	68	68	65	65	64	64	62	61
25	64	64	61	61	60	59	57	56
50	60	60	57	57	56	55	53	53
75	57	57	55	55	53	52	51	51
100	55	55	53	53	51	50	49	49
200	52	52	49	49	48	47	45	45
300	51	51	47	47	47	46	44	43
400	49	49	46	46	46	45	42	42
500	48	48	45	45	44	43	41	41
1000	42	42	40	40	38	38	36	35

Table 15-2: Predicted operational noise levels (dB LAeq,T)

Noise levels across the study areas as a result of train movements will be a maximum of 68 dB(A) at a distance of 10 m during the daytime period. This will reduce to 48 dB(A) at 500 m, and then to 42 dB(A) at 1 km. The Tanzanian criteria is exceeded at receptors less than 100 m distance from the alignment, whereas the IFC criteria is exceeded at receptors less than 200 m from the alignment. The number of receptors within these distances is presented within the operational section (see Appendix 5).

15.1.2.2 Stations – fixed plant

Limits for fixed plant have been determined based on IFC absolute limits. The fixed plant proposed as part of the stations is currently unknown, as such plant noise limits have been provided below and should be achieved through design. It should be noted that the limits are cumulative and are not limits for each individual plant item. This is presented in Section 15.2.1.4.

15.1.2.3 Quarry blasting

Based on the formulae and site constants set out in AS 2187.2, Table 15-3 illustrates the ground vibration levels predicted at the nearest receptor locations.



Table	15-3:	Blasting	- ground	vibration
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Conditions	Quarry location	Approx. distance to receptor (m)	Predicted PPV (mm/s)
	Manyoni	376	<1
	Mgandu	133	<2
	Tura	535	<1
Average $(K_{\sigma} = 1140, a = 1.6)$	Goweko	1015	<1
(g,,	Itulu	348	<1
	Ikomwa	1064	<1
	Mwino	2172	<1
	Manyoni	376	<1
	Mgandu	133	<7
	Tura	535	<1
Worst-case $(K_{\sigma} = 5000, a = 1.6)$	Goweko	1015	0
	Itulu	348	<2
	Ikomwa	1064	<1
	Mwino	2172	<1

The predicted PPV for the recommended maximum MIC (5 kg) is predicted to give rise to ground vibrations of less than 5 mm/s therefore moderate significant adverse effects are likely to occur at nearby receptors. This is to be revised during detailed design phase where further information regarding blasting will be made available.

15.2 Impact assessment

15.2.1 Noise

The noise associated with each project phase has been predicted through specific computational noise modelling software or spreadsheet calculations (see above methodologies).

15.2.1.1 Construction impact assessment

The noise impacts associated with the construction phase can be found in Appendix 5. Although receptors are predicted to be exposed to levels classed as a significant impact, the duration of activities and the transient nature of the project will mean that these levels will be experience for very short periods of time. Noise control measures will be implemented (See Section 15.3.1). However, the inherent nature of construction means short term impacts are likely and typically accepted.

15.2.1.2 Commissioning phase

The noise from the commissioning phase will be equivalent or lower than the noise from the operational phase. Therefore, reference should be made to the operational assessment.



15.2.1.3 Operational phase

Based on the noise levels presented in Table 7-10, the number of receptors exposed to levels considered to be of significant effect are presented in Table 15-4. This is presented for both Tanzania and IFC standards (different averaging periods).

Summary of exceedances (i.e. significant effect) to criteria based on section (determined by night-time)							
	Exceedances Pre-mitigation						
District		TZ	тz				
	IFC	(Cat 2 – assumes all residential)	(Cat 1 – more stringent criteria for health care etc)				
Manyoni							
(534+979 to 655+200)	5411	4155	5206				
Uyui 1							
(655+200 to 738+000)	1545	1511	1545				
Sikonge							
(738+000 to 760+200)	357	357	357				
Uyui 2							
(760+200 to 798+500)	1731	1726	1731				
Tabora Urban							
(798+500 to 848+700)	747	698	741				
Uyui 3							
(848+700 to 858+300)	308	266	302				
Nzega							
(858+300 to 949+400)	2048	1492	1894				
Total	12147	10205	11776				
ı olai	69.00%	58.20%	67.20%				

Table 15-4: Operational noise assessment summary

Based on the model, the initial appraisal shows that where the IFC standard is used for determination of significance, 69% of receptors within the 200 m study area would be impacted. This drops to 58% using the Tanzanian standards (assuming all residential sensitivity). This shows over 10,000 receptors to be impacted as a result of rail operations. Figure A7.1 and A7.2 in Appendix 5 shows a visual representation of the premitigation scenario. Mitigation is considered in Section 15.3.



15.2.1.4 Fixed plant - stations

It is anticipated that the typical fixed plant units required would include, but not limited to air handling units with external air condensers.

The current detail surrounding the fixed plant requirements at each of the stations and placement is not yet known at the stage in the design. Therefore, limits for fixed plant have been determined based on the IFC and Tanzania standard criteria at the nearest noise sensitive receptors.

The fixed plant limits have been presented in Table 15-5. It should be noted that the provided limits are cumulative limits for fixed plant at the noise sensitive receptors.

Table 15-5: Stations – fixed plant noise limits (at receptor based on LAeq,T)

Fixed plant	TZ standard	IFC standard
Combined fixed plant level at each station	42 dB(A) Leq,T	45 dB(A) Leq,T

These limits can be readily achieved through design. Noise mitigation measures have are in Section 15.3.

15.2.1.5 Substations

Noise associated with the proposed TPS substations has been calculated based on assumptions as presented in Section 7.8.7.3. Exceedances of the IFC night-time criteria are presented in Table 15-6.

Phase	Lot	Location	Approx. miles + chainage	45 dB L _{Aeq, T} threshold setback distance for TZ (m)	Number of receptors exceeding criteria	45 dB L _{Aeq, T} threshold setback distance for IFC (m)	Number of receptors exceeding criteria
		Sukamahela	550+00	45	0	32	0
	3	Kitopeni ¹	600+200		2		2
		Mgandu	652+400		0		0
Operational		Tura	702+200		0		0
substations		Rubuga	752+400		0		0
		Ndevelwa	805+500		0		0
	4	Ikomwa	850+400		0		0
		Mwino	890+250		0		0
		Mahene	930+150		0		0
¹ There are c	urrent	ly receptors wit	hin the footp	rint for the pr	oposed subst	ation at this I	ocation.

Table 15-6: Stations – substations predictions

¹ There are currently receptors within the footprint for the proposed substation at this location. Therefore, should it be confirmed that the receptors are located within the footprint of a substation, they will be relocated.

Based on the above predictions, it is likely there will be exceedances of the IFC nighttime criteria at Kitopeni. Mitigation measures are considered in Section 15.3. In general,



based on the assumption for substation plant emissions, where the substation is located more than 32 m from a receptor, impacts will be negligible.

15.2.1.6 Demobilization and decommissioning phase

Noise associated with the demobilisation phase is likely to closely resemble the predictions and impacts from the construction phase and therefore no further assessment has been undertaken at this stage. Decommissioning is not anticipated in the foreseeable future.

15.2.1.7 Traffic

There is the potential for project traffic to change the noise environment in two ways, through:

- an increase in construction and operational traffic on existing roads
- new traffic noise source on new temporary and permanent roads.

Traffic data for the majority of the roads through Tanzania is not available and therefore it is impractical to undertake a 'typical' quantitative noise assessment of existing roads.

As a result, a generic assessment has been undertaken for road upgrades and the use by construction traffic of new haul roads and using the general principles for traffic noise presented in Section 7.8.7.5. This covers the roads associated with the alignment and construction facilities for the construction phase only.

Table 15-7 shows the potential change in noise level as a result of construction traffic on existing roads. This looks beyond the existing road upgrades and assumes that construction traffic will use the wider road network.

Although the changes in traffic noise further afield are much less than local changes (i.e. magnitude impacts will be much smaller), a change is still possible.

Facility type	Vicinity ¹	Traffic flow assumptions ³	Potential numerical change, dB ⁴	Perception ²	Significance
Construction	Local	Approximately 225 trucks. Maximum 5 movements in any single hour across a road segment No night movements	<3	Change barely noticeable	Not significant
	Area	Approximately 50 trucks No more than 2 trucks along a road segment in a single hour	<1	Imperceptible	Not significant
Operational	Local	Approximately 50 trucks No more than 2 trucks along a road segment in a single hour	<1	Imperceptible	Not significant

Table 15-7: Traffic noise predictions



Facility type	Vicinity ¹	Traffic flow assumptions ³	Potential numerical change, dB⁴	Perception ²	Significance
	Area	Approximately 50 trucks No more than 2 trucks along a road segment in a single hour	<1	Imperceptible	Not significant

NOTES: ¹The extent for local traffic is 2 points and for area traffic is 3 points. Area traffic is further than the local road network and is assumed to be coming from greater distances than the local area for the project.

² <3 dB change barely noticeable, 5 dB change perceived by most people, 10 dB change perceived doubling of loudness, 20 dB change perceived quadrupling of loudness (based on general acoustic principles).

³The total construction traffic does not take into account workforce movements. 'Truck movement' numbers are considered for local road impacts where 'truck numbers' are considered for the area as there is a high likelihood of return trips by trucks along the same roads for the local area in a single day whereas this is unlikely to be the case for trucks coming from further afield.

⁴Based on theoretical assumptions in Section 7.8.7.5.

The noise associated with project construction traffic movements along new (access/haul roads) and existing roads will not result in a significant impact. The existing noise environment around the proposed haul and access routes will increase. Increases in noise magnitude are likely to be very high in areas with proposed new roads. However, given the short-term nature of construction, the impact is not ranked as significant.

It is unlikely that new haul roads which will remain after the construction phase, the change in noise associated with the operational traffic will be less than 1 dB, therefore the impacts will therefore not be significant.

15.2.2 Vibration impact assessment

15.2.2.1 Construction impact assessment

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 Table 15-8 using the methodology in Section 7.8.8.1.



Magnitude ¹	Corresponding vibration PPV (mm/s)	Distance from activity (m²)	Number of receptors	Significance
Negligible	<1	>50	>10,000	Not significant
Low	1.01–5.00	15–50	>500	Not significant
Medium	5.01–10.00	2–15	0	Significant
High	10.01–15.00	<2	0	Significant

Table 15-8: Rock breaking and ripping - vibration predictions

Table 15-8 shows that rock breaking would be suitable along the alignment as significant impacts will not be expected at any sensitive receptors, assuming no breaking is undertaken within 15 m of a receptor. The predictions and outcome for rock breaking and ripping are also applicable to construction of other infrastructure (where rock breaking is required) with no significant impacts anticipated.

Within 50 m receptors may still perceive vibration form rock breaking activities (based on the hammer weights identified in Section 7.8.8.1). 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.

15.2.2.2 Decommissioning phase

The decommissioning phase of the project will closely resemble the construction phase, but in reverse. There is a potential for a greater amount of breaking activities however the conclusions in Section 15.2.2.1 will still be applicable.

15.2.2.3 Traffic

The use of existing and proposed unsealed roads during the construction phase increases the potential for vibration-induced damage to structures along the roads.

Unsealed roads are more susceptible to damage and deterioration (the creation of ruts, corrugations and potholes) compared with sealed roads. The movement of heavy trucks and buses along the unsealed roads accelerates their deterioration and increases the potential for higher magnitude vibration events from uneven and abnormal load and axle movement.

Therefore, for the purpose of this study, it is assumed that where damage to a sealed or unsealed road is within 10 m of a sensitive structure, there is the potential for vehicle movement to generate vibration through interactions between the axle and vehicle structure, suspension or load movement. The magnitude of the vibration is hard to quantify but has the potential to be generated at a magnitude which causes early signs of structural damage on the lightest of structures.

15.2.2.4 Commissioning phase

The commissioning phase of the project is considered similar to the operational phase. Therefore, please reference Section 15.2.2.5.



15.2.2.5 Operational phase

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, the risk of high levels of vibration is limited. Vibration form train movements will be negligible due to the >30 m separation distance between the track and receptors. Therefore, the purpose of the assessment operational vibration has been scoped out of the assessment.

15.3 Mitigation and management

15.3.1 Construction (including quarries and borrow pits)

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 a banksman or other means, 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
- temporary barriers/hoarding (>1.8 m in height) to be use for long term construction compounds
- temporary barriers/hoarding (>1.8 m in height) to be use for construction works within 100 m of receptors
- permanent operational barriers to be installed on site first where practical so they can benefit the construction works within the corridor
- preparation of a detailed construction noise and vibration management plan (CNVMP).



Residual effects

With consideration to the above during the construction phase, noise may still be elevated. However, impacts are considered minimal due to the short term and transient nature of the works.

15.3.2 Operational noise

15.3.2.1 Rail

The following approach will be applied to determine the optimum mitigation scheme to reduce adverse impacts experienced by noise sensitive receptors affected by the works:

- verification of noise-sensitive status of identified receptors which may be adversely affected by the proposed railway operation
- refinement of the operational model to consider topographical changes such as cuttings, embankments, or tunnels within the alignment
- calculation of the benefit of noise barriers or additional earthworks located close to the noise source (e.g. no more than 5 m from the track centreline) to reduce noise at potentially affected properties
- review of barrier feasibility considering non-acoustic limitations, including driver sightlines, railway infrastructure (e.g. signals) and access requirements for crossings and maintenance
- cost-benefit analysis of required mitigation structure extents relative to affected properties identification of properties eligible for noise insulation, compensation or resettlement as an alternative to source-based mitigation (see outline approach in Figure 15-1).

Due to the large number of buildings which may experience adverse impacts from noise from rolling stock, an initial appraisal of a suitable mitigation approach has been based on a test operating case where receptors would otherwise have unobstructed line of sight to the railway. This considers the benefit of providing two-metre-high noise barriers or earthworks at a distance no greater than 5 m from the centre of the railway track.

Barriers are not required across the whole alignment but in densely populated areas, Figure A8.1 and A8.2 (Appendix 5) provide an indication as to where barriers would be required. However, the length of exact location of barriers will be dependent on the above procedure. In areas of low population, it is considered more appropriate to target receptor mitigation (noise insulation) rather than source mitigation (barriers). Receptor mitigation can be designed to match or better the performance of source mitigation and can be a substitute were considered cost effective.

Table 15-9 identifies the remaining number of identified buildings which may experience an exceedance to IFC and Tanzanian noise criteria resulting from rolling stock noise. From this appraisal, it is demonstrated that following adequate acoustic screening exceedances to Tanzania standards are likely to be experienced at buildings within ten metres of the scheme alignment. Exceedances of the IFC criteria are likely to be at a number of properties within 50 m of the project alignment. In all cases the exceedances are likely to be experienced only at night. Exceedances of this criteria would be considered as a 'significant impact'.



Summary of exceedances to criteria based on section (determined by night-time)						
	Exceedances					
	Mitigated					
District		тz	TZ			
	IFC	(Cat 2 – assumes all residential)	(Cat 1 – more stringent criteria for health care etc)			
Manyoni						
(534+979 to 655+200)	781	111	469			
Uyui 1						
(655+200 to 738+000)	268	31	158			
Sikonge						
(738+000 to 760+200)	178	12	112			
Uyui 2						
(760+200 to 798+500)	285	7	129			
Tabora Urban						
(798+500 to 848+700)	178	18	113			
Uyui 3						
(848+700 to 858+300)	46	0	18			
Nzega						
(858+300 to 949+400)	378	72	262			
Total	2114	251	1261			
IUIAI	12.10%	1.40%	7.20%			

			and the second sec
Table 15-9: Operational	noise assessment	summary	(mitigated

Table 15-9 shows that even with the provision of barriers along strategic sections of the alignment, up to 2114 receptors may be exposed to noise levels classed as 'significant'. These would drop to 251 if the Tanzania residential criteria is applied rather than IFC.

The next phase of mitigation would be to treat the above receptors with a series of noise insulation upgrades (building envelope performance upgrade and potential upgraded ventilation system). This would be determined by a review of individual affected receptors (i.e. existing acoustic and structural survey) to determine what can be applied.

Aa an alternative to noise insulation, there are several receptors within close proximity to the alignment and may benefit form resettlement.



Residual effects

With consideration to the above at detailed design phase, noise levels are expected to be controlled to levels below significant effect at surrounding receptors during the operation of the project.





Figure 15-1: Optimisation of mitigation strategy

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15.3.2.2 Fixed plant - stations

At this stage the location and layout/plant (typically air conditioning units) arrangement 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 should be considered through detailed design of fixed plant at stations:

- sympathetic site layout (i.e. use of structures as barriers, increase plant separation distance from receptors)
- boundary barriers (>2 m closed boarded wooden fence or equivalent in masonry/earth bund with minimum 15 kgm2 surface density). Where applicable optimised for spectral plant emissions
- low noise plant choice
- acoustic enclosures or locate plant internally
- locate flues/exhausts on alternate side to receptors.

Residual effects

With consideration to the above at detailed design phase, noise levels are expected to be controlled to levels below significant effect at surrounding receptors.

NB. PAVA systems have not been considered as part of the assessment.

15.3.2.3 Substations (TPS)

At this stage the location and layout/plant arrangement for substations have yet to be confirmed however through intelligent design and plant choice, impacts from substations can be controlled. The following should be considered through detailed design of fixed plant at substations:

- sympathetic site layout (i.e. use of structures as barriers, increase plant separation distance from receptors – greater than 32 m subject to review of source emissions)
- boundary barriers (>2 m closed boarded wooden fence or equivalent in masonry/earth bund with minimum 15 kg/m2 surface density). Where applicable optimised for spectral plant emissions
- low noise plant choice
- acoustic enclosures.

Residual effects

With consideration to the above at detailed design phase, noise levels are expected to be controlled to levels below significant effect at surrounding receptors.

15.3.2.4 Marshalling yards / sidings

At this stage the location and layout arrangement for the marshalling yard and sidings have yet to be confirmed however through intelligent design, sympathetic layout and development of operational noise management plans, impacts can be controlled. The following should be considered through detailed design of marshalling yards and stations:

- sympathetic site layout (i.e. use of structures as barriers, increase locomotive separation distance from receptors
- boundary barriers (>2 m closed boarded wooden fence or equivalent in masonry/earth bund with minimum 15 kg/m2 surface density). To be located between closest receptors and the marshalling yard/sidings (subject to detailed assessment of final design/operational scenario)



- low noise plant choice for any fixed plant
- loading/unloading of wagons to be undertaken during daytime periods only
- locomotives not to be left idling
- preparation of operational noise management plan for sidings and marshalling yard incorporating good practice.

Residual effects

With consideration to the above at detailed design phase for the marshalling yard and sidings, noise levels are expected to be controlled to levels below significant effect at surrounding receptors.

15.3.2.5 Decommissioning / demobilization

Noise associated with the demobilisation of construction phase temporary structure, plant etc is likely to closely resemble the predictions and impacts from the construction phase. Therefore, noise control measures will resemble those implemented for construction. It is unlikely that project decommissioning will occur in the long-term future.

15.3.2.6 Commissioning

Noise associated with the commissioning phase is likely to closely resemble the predictions and impacts from the operational phase. Therefore, noise control measures will resemble those implemented for rail operation.

15.3.2.7 Quarry blasting

There is little detail around the nature of the proposed quarry operations. The majority of quarries will use standard rock breaking/ripping activities; however, blasting will also be used. For this assessment a maximum instantaneous charge (MIC) for explosives of 5 kg has been assumed. As a result of this, significant effects are not predicted however the following good practice should be followed:

- a blast management plan will be developed for any blasting proposed at any project phase. This will include justification for blasting over alternate methods, predictions of vibration across the wider area an identification of potential vibration at sensitive receptors within a set offset distance (depending on MIC). Offset distance for receptor identification will be based on receptor specific criteria following identification of structure type (i.e. through a conditions and structural survey). The blast management plan will be prepared by a competent person
- reference to the GRM will be included within the management plan. Should complaints be made to the site management in relation to blast noise or vibration from a specific blast or blasts then these shall be investigated within a set timeframe and, where necessary, measures to control the effects shall be implemented
- ground vibration and air overpressure will be monitored at the receptors closest to the blasting to be undertaken. This will provide certainty in prediction of impacts and provide a greater understanding of site-specific propagation to enable refinement of working limits and control of adverse impacts. The monitoring should be undertaken to the requirements of Tanzanian Standard TZS 1471: 2018. On completion of each monitoring exercise a brief report should be prepared to include the following:
 - o date, time and location of vibration monitoring



- peak particle velocity in each of the three planes of measurement in mm/s
- air overpressure in dB
- o instrumentation used
- brief details of blast monitored to include its location, number of holes, maximum instantaneous charge, and total charge weight
- o weather details
- o person who undertook the monitoring.

Residual effects

With consideration to the above at detailed design phase for any quarry blasting, vibration levels are expected to be controlled to levels below significant effect at surrounding receptors.

15.4 Uncertainty / limitations

It is accepted that uncertainty may arise from all levels of measurement and assessment and reasonably practicable steps have therefore been made at all stages with the aim of reducing uncertainty within the assessment outcome. Potential sources of uncertainty within this noise and vibration assessment are discussed in the following sub-sections.

15.4.1 Receptor identification

The noise sensitive receptors adopted within the assessment have been derived from vector mapping data extending to approximately 200 m each side of the proposed scheme. In many cases it has not been possible to identify if the buildings are considered to be noise sensitive, or if multiple polygons provided within the drawing are to be considered as single or multiple receptors.

Identified receptors on the border of Kahama and Nzega have been omitted from this assessment on the basis that they will be more directly affected by Lot 5 and therefore mitigation requirements will be captured within the appropriate scheme.

15.4.1.1 Construction phase assessment

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.

15.4.1.2 Operational phase assessment

Plant noise emission levels for input to the operational noise assessment have been assumed based on the information provided by the project design team. Where possible, library data for similar equipment has been used to most accurately represent the type of plant in use. Where unavailable (i.e. for TSF substations), the assumed noise levels should be adopted as a working limit for each plant item. This will serve to limit the potential for uncertainty within the source data to influence the outcome of the assessment.

For the assessment of rolling stock noise, assumptions have been made regarding speed profiles. This will be subject to fluctuation as trains accelerate / decelerate through various sections.

No consideration has been given to the impact of increased noise and vibration at switches and crossing points at this stage.



It has been assumed that the track radius in all sections will be >500 m therefore no corrections for track curvature are required. This is based on information provided for Lot 4 (no equivalent data available for Lot 3).

Rolling stock movements per hour / day have been based on the provided Lot 4 timetable. These are assumed consistent across Lot 3, which is currently available in draft only.

15.5 Conclusion

The assessment indicates that with the adoption of best practice for construction, strategic installation of barriers, noise from construction activities can be reduced and impacts are limited due to the short term and transient nature of activities.

The operation of the proposed development will introduce a number of new noise sources which could potentially influence the acoustic environment at surrounding noise sensitive receptors. To account for this, a noise prediction model was prepared which considers various activities taking place across the site throughout the different operational phases of the development. The operational noise levels at the surrounding receptors were predicted and assessed. Through careful implementation of strategic mitigation, both at source and receptor noise from all operational scenarios can be reduced to levels classed as 'not significant'.



16 AIR QUALITY BASELINE AND IMPACT ASSESSMENT

16.1 Identification of potential impacts for assessment

Construction activities can be a significant source of PM into the atmosphere, and they can have a significant temporary influence on air quality. Land clearance, ground excavation, cut and fill activities, and the construction of a specific facility may all be associated with PM emissions during the construction.

The principal air quality impacts during both the construction phase are likely to be:

- fugitive emissions of dust and particulate matter from construction activities
- exhaust emissions of combustion gases from plant and vehicles on site and on the local road network.

The railway will be electrified and the principal impacts during the operational phase are likely to be:

- exhaust emissions from increased road traffic associated with stations
- exhaust emissions from diesel Locomotives in marshalling yards
- fugitive emissions from loading of quarried materials at quarries.

16.2 Identification of air quality parameters

Based on the potential impacts, the following air quality parameters are considered the most relevant:

- airborne particulate matter (PM10 & PM2.5)
- oxides of nitrogen (NOx) and nitrogen dioxide (NO2)
- carbon monoxide (CO)
- ozone (O3)
- vapour phase volatile organic compounds (VOC).

16.3 Assessment criteria

16.3.1 World Health Organisation (WHO) Air Quality Guidelines, 2000 & 2005

The WHO air quality guidelines (AQG) 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 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 16-1.



Pollutant	Averaging time	Interim	target		AQG
Particulate matter,	Annual	35	25	15	10
PM _{2.5} , μg/m ³	24-houra	75	50	37.5	25
Particulate matter, PM ₁₀ , μg/m³	Annual	70	50	30	20
	24-houra	150	100	75	50
Ozone, O ₃ , µg/m ³	8-hour _a	160	-	-	100
Nitrogen dioxide,	Annual	-	-	-	40
µg/m ³	1-hour	-	-	-	200
Sulphur dioxide,	24-houra	125	50	-	20
µg/m³	10-minute	-	-	-	500

Table 16-1: Relevant WHO air quality guidelines 2005 & interim targets

^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.

16.3.2 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 PM and 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 16-2.

Pollutant	Averaging time	Interim target		AQG		
		1	2	3	4	
Particulate matter, PM _{2.5} ,	Annual	35	25	15	10	5
µg/m³	24-hour _a	75	50	37.5	25	15
Particulate matter, PM ₁₀ ,	Annual	70	50	37.5	25	15
µg/m³	24-hour _a	150	100	75	50	45
Ozone, O ₃ , µg/m ³	8-hour _a	-	-	-	-	100
	Annual	-	-	-	-	60
Nitrogen dioxide, µg/m ³	Annual	-	-	-	-	10
	24-hour _a	-	-	-	-	25
Sulphur dioxide, µg/m³	24-hour _a	-	-	-	-	40
Carbon monoxide, CO, mg/m ³	24-hour _a	-	-	-	-	4

Table 16-2: Relevant WHO Air Quality Guidelines 2021 & interim targets

^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.

16.3.3 East African Community standard (EAC)

The East African Community (EAC) standard includes requirements that apply at the property line as well as three columns of requirements that depend on whether the area is classified as "industrial," "residential, rural and other," or "restricted." There are no additional definitions for these categories.

16.3.4 Standards comparison and selection

A comparison of the Tanzanian, East African and WHO guidelines is presented in Table 16-3 below. 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 9.4.6 for explanation of the 2005, 2021 and interim WHO guideline levels).

Polluta nt	Avera ging Period	Air quality standard - ambient air concentration (μg/m³)						
		TZ GL	TZ L 11	EAC ¹²	WHO 2000/2005	WHO 2021	Project	
	Annual	100 ¹	-	150/100/-	40	10	10	
NO ₂	1 month	-	-	-/160/-	-	-	-	
	24 hr	-	150 ²	100/200/-	-	25	25	
	8 hr	-	120 ²	-	-		120	
	1 or 2- hour	-	-	-/400/-	200	-	200	
	10 mins	-	-	-/1,000/-	-	-	1000	
Oxides	Annual	-	-	80/60/15	-	-	15	
of nitrogen NOx	1 month	-	-		-	-	-	
(as NO ₂)	24 hr	-	-	150/80/30	-	-	30	
	1 hr	-	-		-	-	-	
	10 mins	-	-		-	-	-	
	8 hr	-	10,000	5/2/1 x10 ³	10,000	-	10,000	
CO (mg/m ³)	1 hr	-	30,000	10/4/2 x 10 ³	30,000	-	30,000	
	24 hr	-	60,000	-	-	4,000	4,000	
	15 min	-	100,000	-	100,000		100,000	



Polluta nt	Avera ging Period	Air quality standard - ambient air concentration (μg/m³)					
		TZ GL	TZ L 11	EAC ¹²	WHO 2000/2005	WHO 2021	Project
DM	Annual	-	-	70/50/50	20	10	25 (WHO IT4)
PIVI 10	24 hr	60–90 ⁷	100 ⁸	150/100/ 75	50	45	50 (WHO IT4)
	1 hr	-	200 8	-		-	200
Fine PM _{2.5}	Annual	-	-	35/-/-	10	5	25 (WHO IT2)
	24 hours	-	-	75/-/-	25	15	50 (WHO IT2)
	Peak seaso n	10–100	-	-		60	60
O ₃	8 hr ⁴	-	120	120/10/-		100	100
	1 hr	-	-	200/ 260 ¹⁰ /-		-	200
VOC	24 hr	-	-	6,000		-	6,000

16.4 **Review of existing air quality data**

16.4.1 Tanzanian air quality monitoring networks

No publicly available long-term ground-level ambient air quality monitoring in Tanzania were available.

16.4.2 Baseline air quality data presented in the 2022 ESIA

A limited programme of baseline air quality monitoring was carried out between 14 August and 15 September 2022 at 20 locations selected to represent sensitive receptors, with reference to Tanzanian standard 837 (Part 1): 2011 for air quality monitoring points.

Monitoring was carried out for 24 hours at each location using an indicative instrumentation, namely an aeroqual series 500 and a portable multi RAE lite wireless portable multi gas monitor. These instruments are not equivalent to the reference methods and the data must be regarded as indicative, with a relatively high uncertainty to the absolute values, but they are a practical, proportionate approach to the challenges obtaining baseline air quality data in remote locations. The data are summarised in Table 16-4 below.



Location	24-hour average indicative baseline pollutant concentrations, 2022 ESIA						2 ESIA	
	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³	NO₂ (µg/m³	CO (µg/m³)	SO ₂ (µg/m³)	O ₃ (µg/m ³)	H ₂ S (µg/m³)	VOC (µg/m³)
SR1, Makutopora	17	6	6	0	0	42	0	0
SR2, Manyoni	16	8	96	1397	0	54	0	0
SR3, Aghondi	14	7	69	0	0	54	0	0
SR4, Mabondeni	21	10	52	0	0	48	0	0
SR5, Kitopeni	13	6	48	798	0	46	0	0
SR6, Itigi	14	7	90	0	0	52	0	0
SR7, Tura quarry	38	13	77	1557	0	40	0	1996
SR8, Tura station	14	7	23	0	8	48	0	0
SR9, Nyahua	12	6	44	0	0	50	0	0
SR10, Goweko	36	12	92	1397	42	42	0	1996
SR11, Igalula	12	9	24	0	28	48	0	0
SR12, Taboras south	13	7	44	299	50	28	0	0
SR13, Tabora SGR station	34	11	92	1596	82	46	0	0
SR14, Kakurungo	29	12	26	0	40	38	0	0
SR15, Kakola	33	2	60	1197	0	56	0	0
SR16, Nzubuka	19	10	44	0	40	54	0	0
SR17, Bukene	15	12	52	0	0	66	0	0
SR18, Malolo	14	12	46	0	40	48	0	0

Table 16-4: Summary of baseline air quality data collected for the 2022 ESIA

Yapi Merkezi Insaat ve Sanayi Anonym Sirketi (YM) SGR Lots 3 and 4 ESIA report 2040173-01 (03)



Location	24-hour average indicative baseline pollutant concentrations, 2022 ESIA								
	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m ³	NO₂ (µg/m³	CO (µg/m³)	SO₂ (µg/m³)	O₃ (µg/m³)	H₂S (µg/m³)	VOC (µg/m³)	
SR19, Mahene	15	11	48	0	0	42	0	0	
SR20, Buduba- Igusule	17	11	66	0	0	40	0	0	
Criterion	50	25	25	4000	40	100	150	6000	

Little detail is provided on the monitoring methodology, or quality assurance/control, therefore confidence in the results is limited, and the data represent a 'snapshot' of conditions at the time of sampling and may not be representative, however taken at face value they represent information on existing air quality conditions at locations relevant to the project.

The data suggest that particulate matter concentrations during the survey would meet the 24-hour criteria, though some results were elevated, notably at Tura quarry and Kakola.

Nitrogen dioxide concentrations during the survey would generally meet the 24-hour criterion at rural and background locations, but some exceedances and elevated concentrations were recorded in urban areas. Carbon monoxide concentrations during the survey would all meet the relevant 24-hour criterion but again showed elevated concentrations in urban areas. Sulphur dioxide concentrations during the survey were generally low at rural and background locations, but some exceedances and elevated concentrations were recorded in urban areas. Ozone concentrations all met the criterion. No hydrogen sulphide was detected.

16.4.3 Other sources of information on ambient air quality from other projects

RSK has carried out ambient air quality monitoring at other locations in Tanzania as part of commercial consultancy. This monitoring was carried out over approximately three months from November 2017 to February 2018. The monitoring was carried out at 28 locations across the north of Tanzania, from Dar es Salaam to the north of Dodoma to near Bukoba and are likely to represent similar regional background pollutant concentrations.

The data are summarised in Table 16-5. The mean is the average of all 28 locations and 4 periods, and the maxima and minima are averaged for each of the 28 locations.

The overall mean pollutant concentrations meet the relevant WHO guidelines and are consistent with conditions expected at rural background locations, but the maxima for ozone, and PM_{10} and $PM_{2.5}$ exceed the WHO guidelines, reflecting the variability and importance of natural sources of emissions of these pollutants.



Parameter	Mean concentration (µg/m³)	Minimum concentration (µg/m³)	Maximum concentration (µg/m³)
NOx	3	1	5
NO2	3	1	5
SO2	4	1	39
O3	73	39	147
СО	1	0	2
T-VOC	359	12	2871
Benzene	1	1	3
PM10	14	5	34
PM2.5	13	4	33

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	o. Oummary		onuns an q	fuancy mor	mornig m	nontherm	ranzama

16.5 Confirmatory short term air quality monitoring for the project

To confirm and corroborate the existing air quality data, a limited programme of additional monitoring was carried out in spring 2023.

16.5.1 Monitoring locations

Monitoring was carried out at locations selected to represent exposure to potential process and roads traffic emissions associated with the project. The receptors are listed in Table 16-6 and shown on the plan presented at Figure 16-1, below.

Receptor code with grid references	Receptor name/ location	Current and planned land use
SR-1; 5.758743°S, 34.836952°E	Manyoni Station	Residential
SR-2; 5.728287°S, 34.578768°E	Aghondi Pri. School	Educational
SR-3; 5.71175°S, 34.49503°E	Itigi Station	Institutional (educational & Government offices)
SR-4	Kazikazi Station	Residential (Station)
SR-5; 5.495502°S, 33.845933°E	Tura Station	Residential
SR-6; 5.440880°S, 33.644052°E	Malongwe	Residential
SR-7; 5.371373°S, 33.287028°E	Nyahua Station	Residential
SR-8; 5.328757°S, 33.151937°E	Goweko Station	Mixed (commercial, residential, station)
SR-9	Igalula Station	Residential
SR-10	Tabora Station	Mixed (Residential, station)

Table 16-6: Monitoring locations





Figure 16-1: Monitoring locations, high level

BS EN 13528-3:2003 makes the following general points about micro-siting of diffusion tubes, however they are also relevant to other monitoring techniques and will be applied for all parameters in this study:

- ideally, sampling points should be at least 1 m away from buildings or other major obstructions to avoid local perturbation effects
- the measuring height should be between 1.5 m and 4.0 m. Heights >2.5 m will discourage theft and vandalism
- the immediate vicinity of trees, bushes, etc. should be avoided to minimize the influence of the local environment or to minimize effects from troublesome insects.

16.5.2 Monitoring methods

Ambient concentrations of nitrogen oxides, nitrogen dioxide, ozone and VOC (including benzene, toluene, ethylbenzene, xylenes and any remaining 'top 5' most abundant non-target compounds) were sampled using passive diffusion tubes, transported, deployed (for a period ranging from 8 to 13 days) and analysed in accordance with BS EN 13528 :2002. Diffusion tubes were supplied and analysed by a UK accredited laboratory.

Travel (field) blanks were deployed onsite for quality control and quality assurance (QA/QC) purposes and were analysed at an accredited laboratory as per the widely



accepted guidance (e.g. the guidance provided by the department for environment, food and rural affairs (DEFRA), UK). In addition, laboratory blanks were also maintained as per the QA/QC standards. Tubes were deployed in duplicate in Round one.

Carbon monoxide (CO) was measured using a calibrated, TSI 'Q-Trak' handheld direct reading instrument for approximately one hour at each monitoring location.

Particulate matter was monitored using a TSI 'DustTrak' nephelometer which is capable of logging indicative concentrations of PM_{10} and $PM_{2.5}$, particulate matter simultaneously PM_{10} and $PM_{2.5}$ monitoring were carried out for approximately one hour at each monitoring location. 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.

16.5.3 Monitoring Results

16.5.3.1 PM₁₀ Particulate Matter

The PM_{10} and $PM_{2.5}$ concentrations measured during the monitoring period are summarised below in Table 16-12. All but one of the PM_{10} concentrations measured are within the WHO 24-hour guideline, and the majority would be within the annual mean Interim Target 4, though there are some marginal exceedances. All but one of the PM2,5 concentrations measured are within the WHO 24-hour guideline, and the majority would be within the annual mean Interim Target 2, though there are some marginal exceedances.

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} , PM2.5 particulate matter are consistent with the expected range for rural background in Tanzania.

	Monitoring duration (date, time)	ΡΜ _{2.5} , μg/m³	ΡΜ ₁₀ , μg/m³
SR-1	15/02/2023, 12:31- 13:33	18	19
SR-2	16/02/2023, 14:40- 15:42	13	14
SR-3	16/02/2023, 09:46- 10:50	23	24
SR-4	19/02/2023, 12:12- 13:15	7	7
SR-5	01/03/2023, 10:48- 11:49	4	4
SR-6	01/03/2023, 12:48- 13:50	4	5

Table 16-7: Measured PM₁₀ and PM_{2.5} concentrations



	Monitoring duration (date, time)	ΡΜ _{2.5} , μg/m ³	ΡΜ ₁₀ , μg/m³
SR-7	02/03/2023, 11:51- 12:54	7	8
SR-8	02/03/2023, 13:59- 15:00	29	30
SR-9	03/03/2023, 11:09- 12:10	No data	No data
SR-10	04/03/2023, 11:33- 12:35	18	19
Project criterion	-	Annual: 25 (WHOIT2) 24 hr: 50 (WHO IT2)	Annual: 25 (WHO IT4) 24 hr: 50 (WHO IT4)

16.5.3.2 Carbon Monoxide (CO)

The carbon monoxide concentrations measured during the monitoring period are summarised below in Table 16-12. Low concentrations of carbon monoxide were occasionally detected, but the results are well within the WHO guideline and consistent with expectations for a rural background location in Tanzania.

Table 16-8: Measured CO	concentrations
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	Monitoring duration (date, time)	CO, ppm
SR-1	15/02/2023, 12:31-13:33	0
SR-2	16/02/2023, 14:40-15:42	0
SR-3	16/02/2023, 09:46-10:50	0
SR-4	19/02/2023, 12:12-13:15	0
SR-5	01/03/2023, 10:48-11:49	0
SR-6	01/03/2023, 12:48-13:50	0
SR-7	02/03/2023, 11:51-12:54	0
SR-8	02/03/2023, 13:59-15:00	0
SR-9	03/03/2023, 11:09-12:10	0.5
SR-10	04/03/2023, 11:33-12:35	0.7



	Monitoring duration (date, time)	CO, ppm
Project criterion	-	8-Hr:10 (WHO)

16.5.3.3 Nitrogen Oxides (NOx), µg/m3

The NOx concentrations measured during the monitoring period are summarised below in Table 16-12. Concentrations presented are the mean of duplicate measurements. The concentrations measured were all within the EAC standard.

	Monitoring duration (date, time)	NOX, μg/m3
SR-1	15/02/2023, 12:31-13:33	18.7
SR-2	16/02/2023, 14:40-15:42	13.7
SR-3	16/02/2023, 09:46-10:50	10.8
SR-4	19/02/2023, 12:12-13:15	8.6
SR-5	01/03/2023, 10:48-11:49	9.4
SR-6	01/03/2023, 12:48-13:50	7.4
SR-7	02/03/2023, 11:51-12:54	7.6
SR-8	02/03/2023, 13:59-15:00	13.0
SR-9	03/03/2023, 11:09-12:10	5.4
SR-10	04/03/2023, 11:33-12:35	
Project criterion	-	Annual: 15 (EAC)

16.5.3.4 Nitrogen Dioxide (NO₂), µg/m3

The NO_2 concentrations measured during the monitoring period are summarised below in Table 16-12. Concentrations presented are the mean of duplicate measurements.

The concentrations of nitrogen dioxide are within the WHO annual mean guideline, are similar to each other and consistent with expectations for rural background in Tanzania.



	Monitoring duration (date, time)	NO2, μg/m3
SR-1	15/02/2023, 12:31-13:33	10
SR-2	16/02/2023, 14:40-15:42	7.0
SR-3	16/02/2023, 09:46-10:50	6.7
SR-4	19/02/2023, 12:12-13:15	6.1
SR-5	01/03/2023, 10:48-11:49	5.3
SR-6	01/03/2023, 12:48-13:50	3.5
SR-7	02/03/2023, 11:51-12:54	2.9
SR-8	02/03/2023, 13:59-15:00	8.0
SR-9	03/03/2023, 11:09-12:10	5.0
SR-10	04/03/2023, 11:33-12:35	
Project criterion	-	Annual: 10 (WHO)

Table 16-10: Measured NO ₂ conce

16.5.3.5 Ozone (O3), µg/m3

The ozone concentrations measured during the monitoring period are summarised below in Table 16-12.

The concentrations of ozone would not exceed the WHO 8-hour or 'peak season' guidelines, though the periods are not strictly comparable, and are consistent with expectations for rural background in Tanzania.

Table 16-11:	Measured	O ₃	concentrations
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	Monitoring duration (date, time)	Ozone, O3 μg/m3
SR-1	15/02/2023, 12:31-13:33	27.9
SR-2	16/02/2023, 14:40-15:42	37.8
SR-3	16/02/2023, 09:46-10:50	32.8
SR-4	19/02/2023, 12:12-13:15	48.4



	Monitoring duration (date, time)	Ozone, O3 μg/m3
SR-5	01/03/2023, 10:48-11:49	51.0
SR-6	01/03/2023, 12:48-13:50	57.7
SR-7	02/03/2023, 11:51-12:54	57.6
SR-8	02/03/2023, 13:59-15:00	59.3
SR-9	03/03/2023, 11:09-12:10	41.3
SR-10	04/03/2023, 11:33-12:35	
Project criterion	-	Peak Season: 60 (WHO)

Table 16-12: Measured O₃, CO, NO_X,NO₂, PM₁₀,PM_{2.5} concentrations

Location	Ozone, O3 μg/m3	CO, ppm	NOX, µg/m3	NO2, µg/m3	ΡM10, μg/m3	ΡM2.5, μg/m3
SR-1	27.9	0	18.7	10	19	18
SR-2	37.8	0	13.7	7.0	14	13
SR-3	32.8	0	10.8	6.7	24	23
SR-4	48.4	0	8.6	6.1	7	7
SR-5	51.0	0	9.4	5.3	4	4
SR-6	57.7	0	7.4	3.5	5	4
SR-7	57.6	0	7.6	2.9	8	7
SR-8	59.3	0	13.0	8.0	30	29
SR-9	41.3	0.5	5.4	5.0	No data	No data
SR-10		0.7			19	18
Project Criterion	Peak Season: 60 (WHO)	8-Hr:10 (WHO)	Annual: 15 (EAC)	Annual: 10 (WHO)	Annual: 25 (WHO IT4) 24 hr: 50 (WHO IT4)	Annual: 25 (WHOIT2) 24 hr: 50 (WHO IT2)

16.5.3.6 Volatile Organic Compounds (VOC)

The concentrations of the 'target' VOC, benzene, toluene, ethyl benzene, and xylenes ('BTEX') measured during the monitoring period are summarised below in Table 16-12.

A number of non-BTEX compounds were detected in the 'top 5 most abundant non target' screen. These are listed in the laboratory certificates of analysis at Appendix 8. A number



of the compounds were present in many of the samples, for example hexanedioic acid, bis(2-ethylhexyl) ester and 2,4-Di-tert-butylphenol. These compounds are components of plastics and re likely to be contaminants from the air-tight plastic containers used to transport the tubes and prevent hydrocarbon contamination in transit. Benzaldehyde, acetic acid, decanal and nonanal were detected in several samples. These compounds are likely to be artefacts generated by the reaction between the TENAX sorbent and ozone and are not likely to be bona-fide pollutants of ambient air at the sites.

Concentrations of VOC sampled were low, consistent with expectations for a rural background site and several orders of magnitude below the East African Community standard for VOC and do not suggest a significant impact from hydrocarbon pollution.

Location	Compound	Concentration, μg/m3
SR-1	Benzene	0.7
	Toluene	1.3
	Ethylbenzene	0.1
	m/p-Xylene	0.5
	o-Xylene	<0.00014
SR-2	Benzene	<0.00015
	Toluene	0.3
	Ethylbenzene	<0.00014
	m/p-Xylene	<0.00030
	o-Xylene	<0.00015
SR-3	Benzene	0.4
	Toluene	0.4
	Ethylbenzene	<0.00013
	m/p-Xylene	<0.00028
	o-Xylene	<0.00014
SR-4	Benzene	<0.00019
	Toluene	0.3
	Ethylbenzene	<0.00017
	m/p-Xylene	<0.00037
	o-Xylene	<0.00018
SR-5	Benzene	0.2
	Toluene	0.9

Table 16-13: BTEX VOC concentrations, µg/m³



Location	Compound	Concentration, µg/m3
	Ethylbenzene	<0.00012
	m/p-Xylene	<0.00026
	o-Xylene	<0.00013
SR-6	Benzene	0.3
	Toluene	0.9
	Ethylbenzene	<0.00014
	m/p-Xylene	<0.00030
	o-Xylene	<0.00015
SR-7	Benzene	0.3
	Toluene	<0.00016
	Ethylbenzene	<0.00015
	m/p-Xylene	<0.00033
	o-Xylene	<0.00017
SR-8	Benzene	0.9
	Toluene	1.2
	Ethylbenzene	<0.00013
	m/p-Xylene	0.4
	o-Xylene	<0.00014
SR-9	Benzene	0.3
	Toluene	0.4
	Ethylbenzene	<0.00017
	m/p-Xylene	<0.00037
	o-Xylene	<0.00019
SR-10	Benzene	-
	Toluene	-
	Ethylbenzene	-
	m/p-Xylene	-
	o-Xylene	-



16.5.4 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 several sources, limited site-specific monitoring campaigns carried out in 2022, and spring 2023, and approximately three months of monitoring in rural northern Tanzania in winter 2017 to 2018, to minimise as far as practicably the potential for seasonal bias.

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.

16.5.5 Conclusion on baseline

Existing 'baseline' air quality was assessed in terms of pollutants relevant to the proposed development and nearby sensitive receptors. The baseline assessment draws on data from several sources, a limited site-specific monitoring campaign carried out in spring 2023, measurements presented in the 2022 ESIA report, and approximately three months of monitoring in rural northern Tanzania in winter 2017 to 2018, to minimise as far as practicably the potential for seasonal bias.

Concentrations of carbon monoxide, oxides of nitrogen and nitrogen dioxide, ozone and VOC were mostly within the relevant guideline and consistent with expectations for a rural background location in Tanzania. The PM_{10} and $PM_{2.5}$ concentrations measured are within the WHO 24-hour guideline, and the majority would be within the annual mean Interim Targets, though there are some marginal exceedances of these.

The particulate matter data represent a limited dataset, of day-time measurements and are therefore likely overestimate 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, nevertheless the data represent evidence that the existing, 'baseline' concentrations of PM₁₀ and PM_{2.5} particulate matter are consistent with the expected range for rural background in Tanzania.

The full baseline study report is included as Appendix 8.

16.6 Potential impacts identified

Potential impacts on air quality identified are presented in the following sub-sections.

16.6.1 Construction phase impacts

Fugitive dust from enabling works, earth works and construction of the railway affecting amenity.

Fugitive dust from enabling works, earth works and construction of the railway affecting PM_{10} and $PM_{2.5}$ concentrations and increased risk to human health.

Reduced air quality due to increased exhaust emissions of combustion gases from plant and vehicles on site and on the local road network.

16.6.2 Operational phase impacts

Reduced air quality due to increased exhaust emissions of combustion gases due to increased road traffic associated with stations and locomotives in marshalling yards. Fugitive dust affecting amenity due to loading of quarried materials to freight trains at



quarries. Fugitive dust affecting PM_{10} and $PM_{2.5}$ concentrations and increased risk to human health due to loading of quarried materials to freight trains at quarries. Potential air quality impacts associated with the project are assessed in Section 21.

16.7 Mitigation measures

16.7.1 Construction phase mitigation

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 (2014) guidance divides site-specific mitigation measures are divided into general measures applicable to all sites, and measures specific to earthworks, construction and track out. 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 'medium risk' 'general' site mitigation measures have been recommended.

Mitigation measures

- Implement the ESMP and the ESMS-Pollution Prevention Plan and ensure it includes the following mitigation measures:
 - control site speed limits on dusty roads and use dust suppression methods (such as spraying)
 - siting of activities away from receptors, access gates to be located at least 10 m from receptors where possible
 - minimisation of drop heights and avoidance of materials handling in high wind conditions
 - ensuring the project Grievance Mechanism is highlighted in signage at all project sites
 - plan site layout so that machinery and dust causing activities are located away from receptors as far as possible
 - o avoid site runoff of water or mud
 - 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 reused on-site cover as described below
 - o cover, seed, or fence stockpiles to prevent wind whipping
 - meet relevant non-road mobile machinery (NRMM) emission standards, where practicable
 - o switch off all vehicles engines when stationary no idling vehicles
 - avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable
 - o prohibit bonfires or burning of waste materials
 - re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable
 - only remove the cover in sections (not all at once) and progressively rehabilitate to minimise exposed cleared surfaces
 - cover vehicles entering and leaving sites to prevent the loss of dust causing construction materials during transport


- inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable
- access gates to be located at least 10 m from receptors where possible.

Monitoring

- Implement the following measures:
 - 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 soiling checks of surfaces such as street furniture, cars, and windowsills within 100 m of site boundary, with cleaning to be provided if necessary
 - $\circ\,$ consider dust deposition, dust flux, or real-time PM_{10} continuous monitoring in particularly sensitive areas, operational phase mitigation

No significant operational phase impacts on local air quality are anticipated during the operational phase and is considered to be negligible.



17 LABOUR AND WORKING CONDITIONS

There are various regulations, standards and guiding principles that may be applicable for the project's environmental and social management performance. Principally these must be derived from International Financial Institutions (IFI's), more specifically IFC PS 2 (labour and working conditions), as well as in-country laws and regulations. The most pertinent project requirements and guidelines that are applicable to the project are indicated in the methodology and governance requirements sections above.

Employment on the site will vary depending on the stage of construction and programme of works scheduled by the contractor/s. The total workforce estimates are not possible to determine at this point as the turnover rate of the project is undetermined. A better consideration in terms of potential impacts is to consider the magnitude/size workforce at its maximum. For the project, workforce peaks towards the end of the first year and remains high throughout the second year of construction with a max of ~7,000 people reached for Lot 3, and ~ 4,000 for Lot 4. At some point, however, construction of the two Lots will be running at the same time, perhaps in slightly different construction phases, and the maximum that will need to be effectively managed from a workforce, labour and human rights point of view, as well as an OHS point of view (see Section 20), is likely to be closer to ~11,000 people (refer to Table 4-2 for estimated workforce numbers).

It is currently estimated that 80% of the workforce will be local Tanzanians and 20% expatriate. Local labour will (as far as possible) be sourced from villages along the project alignment. Most, but not all, of the work force will be accommodated at the project's construction camps, which will typically include houses, dormitories, canteen / mess halls, materials warehousing, water tanks, a clean water treatment plant, generators, workshop and maintenance area, laboratory, fuel storage areas, offices, clinic, recreational areas, parking areas and a precast and working area. Those not residing in the campsites will however frequently be in attendance at camp for administrative activities (meetings, training, human resources, etc.) or working in workshops, collecting/delivering equipment and machinery. Large scale procurement of services and materials for the construction of the project is anticipated, as is the additional high-volume procurement needs for domestic goods and services (food and beverage, household items, medical supplies and services, personal care items, office equipment, etc.). This will generate beneficial economic activity in the host communities and nearest supply areas (towns) but may also create scarcity of critical goods and services in the host communities, as well as create inflation on such goods and services due to increased demand. There is no guarantee that inflation created during the construction phase, which is temporary, will adjust back to near normal levels once construction is completed. A detailed economic analysis of how the project will change the economic landscape of the area should be conducted and the effects on vulnerable communities, both positive and negative, should be critically examined and interventions to improve resilience to negative impacts and opportunities to take advance of positive impact should be developed. This should be initiated and adopted at the government level. These efforts could help to improve the sustainability and social net-positive scorecard for the project.

Based on the PS 2 specialist's extensive knowledge of, and experience in the implementation of international best practice (fit for purpose) systems, policies and procedures related to labour and working conditions, as well as his knowledge of labour challenges specifically relevant to Tanzania, the key risks/impacts were identified. Additional labour related risks identified by the UDSM were also considered and are listed below. Additionally, a HRRA was prepared for the project by 5 Capitals (Appendix 9) and human rights risk associated with labour and working conditions have also been included for assessment:

socio-economic disruption /enhancement



- increase in demand for goods and services (including accommodation) creating scarcity and subsequent increase in cost of living, conflict with local community due to competition for jobs
- job opportunities, economic growth, indirect food and nutrition security (through improved incomes), human capital development (skills and experience acquisition)
- health, safety and security
 - o increase in spread of HIV and other communicable diseases
 - conflict with local communities, reputational damage to client/Proponent
 - accommodation, services, and facilities for workforce physical and psychological impacts on workers due to sub-standard camp and other accommodation facilities. Secondary impact on receptor communities such as crime and social abuse
- community-workforce interactions
 - interaction of workforce with the local communities undesirable behaviours negatively influencing/impacting communities, reputational damage to client/proponent
 - expatriates (20% of workforce) conflict with local communities due to cultural differences with expatriates living in camps and or accommodation within local communities
 - expatriates (20% of workforce) conflict in the workplace due to the risk of language barriers between expatriate managers/supervisors and their subordinates, as well as cultural differences and differences in work/supervisory practices
- worker dissatisfaction due to substandard and erratic work allocation and employment and being uninformed of work conclusion. May result in go-slow or downing of tools, protest action (and related time / cost impacts to the project)
- labour violations, infringement of rights of employers and workers, gender equity, youth empowerment leading to labour violations, gender discrimination and unfair and illegal labour practice due to ineffective policy and control with respect to worker rights and awareness and education of worker rights, worker grievance mechanisms
- discrimination and inequality (especially against women and vulnerable groups) and GBVH and SEA in the workplace, camps and other project accommodation and work areas.

Existing policies and plans that will be used by the project (YM documentation) were reviewed against the backdrop of related requirements as stated above and within the context of international best practice (fit for purpose) systems, policies, and procedures, as well as labour challenges specifically relevant to Tanzania. Additionally, labour related grievance procedures were examined in terms of international requirements, as well as the Tanzanian Employment and Labour Relations Regulations (2017). This documentation was reviewed to establish in-built/existing mitigations to address the above impacts within the projects plans and procedures. An overview of the review is below, and the assessment of impacts and presentation of mitigation measures is provided in Section 21 and the ESMP.



17.1 ESIA Lots 3 and 4 upgrade: Review of labour relations documentation

The following tables are a list of observations corresponding to various sections and pages in the labour relations policies and procedures adopted by YM. Although recommendations for compliance have been identified, some points of clarity have also been detected, wherein improvements have been suggested.

17.2 Human resource policy (YM)

Section (S) Page # (P)	Comments and recommendations
S1 & S3, P4.	The introduction and the scope of this document seems to be contradictory in terms of whom it applies to. Needs to be adapted to the project specific context
S4.1, P4. S30, P14.	It is recommended that this is aligned to, or reference S7(4) Employment and Labour Relations Act (ELRA) of 2019 The Tanzanian code of good practice GN 42 S30 (1) requires every employer to develop and publish in the workplace a plan to prevent discrimination and promote equal opportunity
S25, P11. S37 (9), P23.	A disciplinary code (rules) was submitted for review, but no disciplinary procedure , although it is mentioned in s37 (9) that a disciplinary procedure will be discussed during site orientation. It is recommended that if the procedure does not yet exist, it is to be developed in line with guidelines provided in the Tanzanian Code of Good Practice GN 42 S11
S26, P12.	A grievance procedure prescribed in the schedule to the employment and labour relations (code of good practice) rules, 40. (1) 2007 shall be included in the workplace employment policy, practice, rules or regulations and be displayed in a conspicuous place. It is recommended that timelines for resolution are attached to each step of the process
S26, P12.	Due to the cyclical nature of the project, there will be a number of demobilisations taking place, which could pose a huge risk for the project if not managed correctly and a clear demobilization procedure needs to be in place to mitigate against interruptions by a workforce that perhaps do not understand project type employment and why they were not permanently employed. The demobilization procedure should inter alia address issues such as demobilization planning, communication/notification, final wage calculations and dues, final pay slips, etc.
S32, P14.	Although it is mentioned that the guidance note by the IFC and EBRD regarding processes and standards of worker accommodation is referred to, it is recommended that a camp management and monitoring document be developed to address issues like grievances, camp committees, religious and cultural requirements (e.g. related to food, worship) etc.
ους (α <i>)</i> , Γ 14.	if not yet considered, consideration should be given to the possible negative impact of allowing especially expatriates to freely mix with the local population after hours

Table 17-1: Recommendations for human resource policy



Section (S) Page # (P)	Comments and recommendations
P1. Contract of Employment	Remove personal details from employment contract example – e.g. names, remuneration, etc.
Contract of Employment: S10 (7.4).	"compassionate" leave – should allow for leave to be taken in case of the sickness of a child and not only in case of bereavement (e.g. death of a child)

17.3 Disciplinary rules (also referred to generally as a disciplinary code)

Table 17-2: Recommendations for disciplinary code

Rule No (#)	Comments and recommendations			
#1. and various others in the last column.	It is suggested that the phrase "After that termination through fair disciplinary hearing", be replaced by "after that the employee will have to attend a formal disciplinary hearing of which the outcome could be the termination of employment"			
#11.	Sanctions not filled in			
#17.	Should "chat" not rather read "Khat" (a stimulant)?			
#34, and various others.	No deductions from pay shall be made without the employee's written consent, unless prescribed by law, collective agreement, wage determination, court order or arbitration award. An employer may make a deduction from the employee's wage for loss or damage suffered subject to the provisions of S28(2). ERLA, No 6 of 2004, S28			

17.4 Grievance mechanism registry training

Table 17-3: Recommendations for grievance registry training

Section (S)	Comments and recommendations
General	Comments made regarding S26, P12. Of the human resource policy also refers to this document. "A grievance procedure prescribed in the schedule to the employment and labour relations (code of good practice) rules, 40. (1) 2007 shall be included in the workplace employment policy, practice, rules or regulations and be displayed in a conspicuous place. It is recommended that timelines for resolution are attached to each step of the process". The document under review is seen as a training presentation, albeit not on a grievance procedure that was submitted for review



Section (S)	Comments and recommendations
S7.	"Every first week of the month the grievance boxes will be opened". grievances need to be attended to ASAP; therefore, grievance boxes will need to be opened daily
S8.	Grievances need to be closed ASAP and 30 days is too long, hence also the need for a detailed, step by step grievance procedure with timeframes for each step

17.5 Recruitment policy and technical assessment and training centre principles

Table 17-4: Recommendations f	for recruitment po	olicy and training	a centre principles
	for recruitment p	oncy and training	g centre principies

Section (S)	Comments and recommendations
II. S8 (d).	It is suggested that some information regarding the "cultural fairness" of the personality tests used is included in this write-up
II. S9.	This recruitment policy describes mainly the recruitment of semi-skilled and skilled people through the YM-TAT centre and just in passing mentions that unskilled recruitment (recruitment of indigenous people) is done through the LGA's. It is recommended that an unskilled recruitment procedure is developed to ensure fairness as well as equal distribution of recruitment through the affected project communities
II. S6 (e).	It is recommended that priority must , and not may be given to residents of project affected settlements to foster good relations with those communities and to strengthen the company's social license to operate
II. S11 (c).	This section seems to conflict with S4 P57 of the human resource policy regarding referrals from existing employees?
Annexure A: Job descriptions	Review job titles such as "foreman" to ensure gender neutrality. "Office Boy" in addition to not be gender neutral could also in certain cultural contexts be viewed as derogatory and disrespectful. Office assistant or office helper could for instance be considered as substitute titles
General	Communication and community awareness on recruitment of all categories should also be held in communities which could potentially be responsible for influx into the projected affected area and job seekers congregating at gates

17.6 Code of conduct

The purpose of the code of conduct procedure is to establish a common set of ethical standards and legal principles for employees, which they need to exhibit when dealing with the employer, employer's representatives, project stakeholders, communities, and towards each other.

The code of conduct procedure covers the following:

- roles and responsibilities of different project personnel (i.e. project manager, personnel manager, personnel chief, lawyers, subcontractors, and security personnel)
- application (provides the process to the application of the Code of Conduct Procedure, including training on the Code of Conduct awareness)



- monitoring and auditing (provide the process on the monitoring and inspection of the application of the code of conduct procedure)
- consent conditions
- records (provides the process to the documenting and record keeping of implementation of the code of conduct procedure)
- workflow
- distribution list (this section makes provision for the distribution of all approved procedures and all other documents to all related departments.

YM's code of conduct procedure was reviewed, and it was found compliant with labour conditions and no mitigation measure or recommendations were proposed. The code of conduct procedure is printed and posted where all employees are able to easily access it.

17.7 HIV/Aids policy and communicable diseases management plan

Thousands of people will be employed during the life cycle of the project in the project AoI and broader region. This will include skilled and specialist labour from all over Tanzania and overseas. This non-local labour component is relatively small and therefore only poses a limited risk of introduction communicable diseases. While there is a risk of new introductions of Covid-19 by project employees undertaking international travel *en route* to site, national requirements for vaccination of travellers reduced this risk substantially.

Potential worker's interaction with communities outside of work hours cannot be completely prevented and thus could contribute to the spread of communicable diseases that are already present within the districts and regions. Since Tanzania and the project AoI has a high prevalence of HIV/AIDS and STDs, the project could contribute to the spread of these diseases through interaction between project employees and the local community, including sex workers.

The employment of local labourers and traders will increase for them to increase their disposable income leading to increased use of sex workers, particularly in urban areas and thus increasing the risk of transmission of HIV/AIDS and STDs with limited medical care readily available for treatment.

The impacts on the potential increase in the spread of HIV/AIDS, STDs, Covid-19, and other communicable diseases are addressed in the YM HIV/Aids policy and communicable diseases management plan. The capacity of YM and TRC to implement these must be investigated in relation to the large workforce that will need to be manged in terms of this issue.

17.8 Influx management strategy

Recommendations in terms of the implementation of the project influx management strategy include:

publication of the recruitment strategy of the project. This should be done in areas considered to be the sources of labour influx. The aim is to explain the process and requirements for labour related purposes to manage the expectations of job seekers

publication of the projects policy on prevention of child labour to reduce interest of underaged jobseekers and prevent truancy and drop-out

through statistics from the National Bureau of Statistics (NBS) on inflation, local inflation around YM's camps should be monitored and YM should identify measures to prevent/reduce the impacts



of potential inflation on the prices of goods and services around the camps as well as enhance economic opportunities for communities living adjacent to the camps

the prices of goods available in camps should be cheaper than those sourced locally or just outside the gate

consideration should be given to an above average rise in the cost of living for local communities due to influx, demand, and possible scarcity of certain goods (e.g., if the project procure large quantities of certain items (stock) for camps locally) and an economic assessment conducted to identify interventions to prevent/reduce impacts and enhance economic opportunities.

17.9 Gender equity

According to the ESIA undertaken by UDSM (2023) gender equity is limited in the project area due to cultural practices, relative low levels of education, poverty and limited participation in decision making at all levels.

The potential impacts from the lack of gender equity in terms of labour force include:

- unfavourable allocation of jobs due to gender or ethnicity
- underpayment of women due to their gender.

To include gender equity and women's participation in the project, the TRC and YM could consider conducting a gender study in terms of labour needs. The study needs to include the methodology to be used, characterise employment in terms of women and men as well as categorise them by blue collar and white-collar jobs.

17.10 Child labour and school drop-out (source: UDSM ESIA, February 2023)

IFC PS 2 aims to protect workers and vulnerable workers such as children and requires the client not to employ children in any manner that is exploitive or likely to be hazardous and interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development if employed as per respective government provisions. There are procedures to follow to consider the rights of the children. Prevalence of child labour in the project area is persistent in industries such as, farming (e.g. tobacco growing), livestock grazing and artisanal mining.

Potential impacts relating to child labour and school dropout have been considered and mitigation measures provided.

17.11 Loss of employment at the conclusion of the construction phase

According to the UDSM ESIA (2023), at the end of construction of the project, contracts with workers will terminate. Construction contracts are relatively short term in nature and the employment period for individual workers may not all extend throughout the construction period of three years. On completion of the construction works, workers will need to find alternative employment. This will be a challenge for those who reside or remain in the project area, where employment opportunities are limited.

Inexperienced labourers' and first-time employee households will have a high vulnerability due the contract termination because they would have become accustomed to receiving a regular and steady income and the loss of this may increase the vulnerability of their households if alternative income streams are not found. The multiplier effect associated with the indirect employment opportunities generated will also end. Receptors in general are considered to have medium vulnerability to this impact.



Impacts relating to the loss of employment at the conclusion of the construction phase have been considered and mitigation measures provided.



18 HYDROLOGY AND HYDROGEOLOGY BASELINE AND IMPACT ASSESSMENT

18.1 Hydrology requirements

Table 18-1: Applicable regulatory and lender requirements

Applicable legislation	Relevance			
Environmental Management (Water Quality Standards) Regulations, 2007	The regulations protect human health and conservation of the environment, enforce minimum water quality standards prescribed by the National environmental standards committee, and enable all discharges of pollutants consider the ability of the receiving waters to accommodate contaminants without detriment to the uses specified for the waters concerned. The project will discharge pollutants and therefore the project will comply with the water quality standards and obtain necessary licences and authorisations and comply with conditions thereof.			
Water Resource Management Act, No.11, 2009	This Act regulates the extraction and utilization of water from water sources. It provides guidance for management of surface and underground water resources and stipulates that a permit is required for water diversion, dams, storage, abstraction, use and discharges. The abstraction of water and discharge permits will be obtained from the basin water board (water officer) at the relevant basin water board offices. The water basin authorities are part of the Ministry of Water and Irrigation. The Act states that facilities must be installed for the collection and treatment of effluents. Taking samples and discharge of effluents in			
	receiving water is forbidden without consent by the basin water board. The project will obtain necessary approvals/permits and will comply with the provision of this Act.			
The Water Resources Management (Water Abstraction, Use, and Discharge) Regulation, 2010	The regulations regulate surface water and groundwater use and discharge permitting under the provisions of the Water Resources Management Act, No.11, 2009. The project will need to abstract water from underground water sources, discharge and manage effluent. The project will obtain necessary licences and authorisations for discharge and comply with conditions thereof.			
IFC, 2007, Environmental, Health and Safety Guidelines for railways	When rail crossings of watercourses are unavoidable, maintain water flow and fish access by utilizing clear-span bridges, open- bottom culverts, or other appropriate methods. Where sensitive habitats cannot be avoided by rail alignment, construction of bridges should be considered to span at-risk areas (e.g. wetlands). Storage tanks should have appropriate secondary containment as discussed in the general EHS guidelines, including procedures for the management of containment systems.			



18.2 Hydrology area of Influence

The AoI for the construction phase includes:

- the project footprint at the location where the project crosses a watercourse or waterbody
- surface waterbodies downstream of any project infrastructure and construction facilities
- the Aol 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.

18.3 Surface water bodies

The project alignment crosses the Lake Tanganyika Basin and internal drainage basin (IDB). Most of the rivers in the corridor are seasonal rivers, draining to these two river basins. In the IDB, the project crosses Bahi swamp and Lake Eyasi catchments. Apart from the seasonal rivers, the project also crosses several wetlands and flood plains from Makutopora to Isaka. There are also several dams in the project area at varied distances from the project alignment.

Name of the river/steam	 Infrastructure	Location	Chainage	 Description
Wala	2 bridges (BR- 21 and BR- 21A)	Tabora MC	799+000	Perennial river
lgombe	Bridge?	Nzega DC	890+350	Perennial river
Mwigombo	BR-11	Nzega DC	KM889+057	Perennial river
Manoga	BR-15	Nzega DC	KM931+700	Seasonal river
Chona	Bridge	Uyui DC	713+677	Seasonal river

Table 18-2: Surface water bodies crossed by the rout
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Name of the river/steam	Infrastructure	Location	Chainage	Description
Junguni	Bridge	Manyoni DC	547+000	Seasonal river
Nyahua	Livestock crossing	Sikonge DC	745+000	Seasonal river
Springs in Mdunundu	Railway ROW	Mdunundu		Wetland
Manyoni camp	Railway ROW	Malongwe	568+000	Wetland
Malongwe village	Railway ROW	Malongwe	728+000	Wetland

During the June to October dry season surface water supplies are scarce and often contaminated. Surface water is therefore an important and vulnerable resource in the Aol. The biggest portion of the project area is made up of seasonal streams which only contain water during the dry season. These rivers therefore are not suitable for sustainable water supply. The total annual rainfall in the semi-arid areas of the project area is in the order of 600 mm to 800 mm in Dodoma, Singida (Manyoni district) and in parts of Tabora regions. The Dodoma part of the project area is under the most severe conditions as it receives an average of 600 mm/year (Haysom, 2006; Shemsanga et al. 2018).

18.4 Surface water quality

Field sampling was undertaken in August 2022 at eight locations during the dry season (UDSM ESIA, 2023).

18.4.1 Potential impacts and mitigation measures

The project comprises the construction of embankments, culverts, underpasses, overpasses, stations, freight yards, marshalling yard, bridges, livestock crossings, quarries and borrow pits. Other components of the project include workshops, camp sites, sleeper production plant and batch plants. Potential impacts to surface water may arise during the construction and operation of these components.

Potential generic and location-specific impacts are identified and described by aspect and project phase (construction or operation).

18.4.1.1 Construction phase

Generic impacts

Erosion

Impact: Erosion of river or channel banks, scour, sediment contamination of surface waters

Direct impacts from erosion-causing and sediment-generating activities may occur during construction, including from vegetation removal, topsoil stripping and benching.



When bare soil is exposed to rain splash, fine particles may seal the surface, reducing the infiltration rate below the rainfall rate, causing sheet overland flow and sheet soil erosion. Where sheet flow is concentrated, rills and gullies may be eroded. Where runoff from a site reaches a watercourse, the flow rate may increase above baseline conditions and sustained higher flow rates may increase channel bed and bank erosion, channel instability and suspended sediment.

Sediment suspended in runoff from construction areas may be transported to downstream receptors. It may also be released to watercourses during soil handling, using vehicles in watercourses and during excavation.

Sediment reduces light levels within the water column and can therefore have an indirect impact on aquatic biodiversity (see biodiversity receptors). High suspended sediment concentrations can also make watercourses unsuitable as drinking water sources. However, at watercourses where vegetation is present this will act as a sediment filter, reducing suspended sediment concentrations.

Activities with similar direct impacts, include the excavation of the route, wet and dry open-cut watercourse crossings, and the excavation of trenches for building foundations and services.

Open-cut crossings may affect the stability of the bed and banks of watercourses formed in uncohesive alluvial material. Natural processes of channel erosion and deposition may be exacerbated, resulting in an indirect impact on agricultural land.

Many watercourses in the AoI are protected from erosion by riparian vegetation.

The pre-mitigation impact for erosion and increased suspended sediment in watercourses during construction is graded as low in significance because of the minor magnitude, short duration and local extent of the potential impact; surface water sensitivity is medium.

The potential impacts associated with increased erosion and suspended sediment to affect highly sensitive watercourses are included in Appendix 7.

Management of waste and accidental release of oil or chemicals

Impact: Contamination of surface water

There is the potential for direct impacts on surface water quality in receiving watercourses from the following sources:

- the management of solid and liquid waste generated during the construction process
- the accidental release of oil or chemicals during construction.

The principal potential contaminants associated with the construction activities are:

- fuel and lubricating oils
- hazardous waste
- paints and solvents
- high pH runoff from concrete batching areas.

Surface water contamination may increase downstream substance concentrations with indirect impacts on water supplies for domestic use (see social receptors), aquatic biodiversity (see biodiversity receptors) and agricultural land (see land-based livelihoods receptors).

Most rivers assessed have good water quality and therefore have moderate or high sensitivity to contamination depending on the density of settlement in their catchments.



Most rivers are used as sources of water for washing, bathing, fishing and watering of livestock.

The pre-mitigation impact for the management of liquid waste and surplus water, and the accidental release of oil or chemicals in watercourses during construction is graded as low in significance because of the minor magnitude, short duration and local extent of the potential impact; surface water sensitivity is medium.

The contamination of highly sensitive watercourses is identified as a potential impact and assessed and presented in Appendix 7.

Impeded Flow in Watercourses

Impact: Deterioration of water quality

During the construction of watercourse crossings, the contractor may need to temporarily impede flow. There is potential for direct impact on water quality, mainly because of downstream scour, which can increase turbidity and suspended-sediment concentrations with indirect impacts on water supplies for drinking and domestic use (see social receptors), aquatic biodiversity (see biodiversity receptors), channel morphology (see above) and possibly agricultural land (see land-based livelihoods receptors).

The pre-mitigation impact for water-quality deterioration at sites of impeded flow during construction is graded as moderate in significance because of the medium magnitude, short duration and local extent of the potential impact; surface water sensitivity is medium.

The potential for reduction in the quality of highly sensitive watercourses is and assessed and included in detail in Appendix 7.

Altered drainage pattern

Impact: Flooding

Surface flooding may occur in new areas if the drainage pattern is altered. This may occur where stockpiled soil redirects floodwaters from the normal flow direction. On sloping ground, the route excavation may intercept groundwater and alter drainage patterns.

Specific locations where the drainage pattern may be altered are not known.

The pre-mitigation impact for flooding from an altered drainage pattern during construction is graded as moderate in significance because of the medium magnitude, short duration and local extent of the potential impact; surface water sensitivity is medium.

The potential for flooding of highly sensitive watercourses is identified as a project impact and assessed (Appendix 7).

18.4.1.2 Operation phase

Generic impacts

Management of waste and accidental release of oil or chemicals

Impact: Contamination of surface water

There is potential for a direct impact on surface water quality from the following sources:

- the management of solid and liquid waste generated during operations
- the management of black water (e.g. sewage) and grey water
- the accidental release of oil or chemicals during refilling of storage tanks, storage, handling of these materials and tank maintenance.



All the watercourses have good water quality and are therefore sensitive to contamination. Most rivers are used as sources of water for a predominantly rural population and their livestock.

Surface water contamination may increase downstream substance concentrations with indirect impacts on aquatic biodiversity (see biodiversity receptors) and agricultural land (see land-based livelihoods receptors).

The pre-mitigation impact from the management of liquid waste and the accidental release of oil or chemicals during operation is graded as low in significance because of the low magnitude, short duration and local extent of the potential impact; surface water sensitivity is medium.

The potential for contamination of highly sensitive watercourses is identified ad assessed and the results presented in Appendix 7.

Mitigation measures

Erosion

Impact: Erosion of river or channel banks, scour, sediment contamination of surface waters

The soil management plan and reinstatement plan will include procedures to reduce and control erosion and compaction through measures developed for soil handling and management, topsoil stripping and storage, sediment interception, a strategy for tree removal and replanting and progressive, active, habitat restoration where required. Additionally, location specific method statements for open-cut watercourse crossings will be prepared where necessary; requirements such as segregation of bed and bank material; retention of as much riparian vegetation as possible and maintaining environmental base flows downstream of water crossings will be included.

Management of waste and accidental release of oil or chemicals

Impact: Contamination of surface water

The soil management plan, reinstatement plan and the waste management plan will include measures that contribute to the management of impacts from waste management and accidental releases.

An environmental and social evaluation of treated effluent discharge locations will be undertaken; treated effluent which is not reused will be preferentially discharged to land. Grey water will be separated from black water, treated in accordance with the project environment standards, treated wastewater will be reused where possible or discharged as per permit conditions. Kitchen facilities will be fitted with industry standard grease traps. In the event of a spillage of hazardous materials a trained rapid response team will be mobilised to contain, clean and remediate spills. Spill response equipment will be available at all work sites. The storage of hazardous materials will be restricted to designated hazardous materials storage areas at least 50 m from surface waters; storage will be covered, bunded (no drainage valves/holes) and have impermeable floor. A refuelling procedure will be developed to address mobile and static refuelling, spill prevention techniques and training.

Impeded flow in watercourses

Impact: Deterioration of water quality



The biodiversity management plan, soil management plan and the pollution prevention plan will include measures that collectively contribute to the management of water quality deterioration.

Vehicles and equipment will cross watercourses after installation of appropriately sized temporary culverts and bridging structures. During open-cut river crossings, bed and bank material will be stored away from active water channels and, where necessary, river crossing method statements will be developed. Bathing or washing clothes, vehicles and equipment by project employees will be prohibited in watercourses.

Altered drainage pattern

Impact: Flooding and sedimentation of hydraulic crossings (Culverts)

The construction of drainage systems along the alignment might alter the natural flow of water in the area. This might involve changes in water accumulation, direction, or velocity, which can have implications for nearby ecosystems, water quality, and flood risk.

The impermeable surface of the railway tracks and associated infrastructure can cause an increase in surface runoff, which may overwhelm existing drainage systems and result in localized flooding.

Siltation of culverts can lead to reduced drainage capacity, increased water pressure during heavy rain, and potential flooding of tracks. This poses a risk to the stability of the railway infrastructure.

Inadequate planning or design of drainage systems along the railway route can exacerbate drainage issues, leading to water stagnation, erosion, and sedimentation.

Mitigation measures

The reinstatement plan will describe where measures will be implemented to mitigate these impacts. The following mitigation should be considered as well:

- Proper Drainage Planning: Conduct comprehensive studies to understand existing drainage patterns and design drainage systems that minimize disruption to natural water flow. This includes proper sizing and placement of culverts and other drainage structures.
- Green Infrastructure: Incorporate green infrastructure such as vegetated swales, retention ponds, and permeable surfaces to manage stormwater runoff effectively and reduce the impact on drainage patterns.
- Sedimentation Control Measures: Implement sediment control measures such as erosion control blankets, silt fences, and sediment traps to prevent sedimentation in culverts and adjacent water bodies.
- Regular Maintenance: Establish a robust maintenance schedule to inspect and clean culverts and drainage structures regularly to ensure proper functioning and minimize sediment buildup.
- Natural Channel Restoration: Where feasible, undertake restoration projects to restore natural water channels and mitigate the impacts of the railway project on drainage patterns.
- Community Engagement: Engage with local communities and stakeholders to gather knowledge about local drainage issues and incorporate community feedback into drainage design and mitigation measures.



18.5 Groundwater area of influence

The groundwater AoI during the project construction and operational phase will encompass aquifers:

- affected by project groundwater abstraction
- that may be affected by planned discharges and spills and leaks of fuels and chemicals by the project.

During construction, the Aol will include aquifers crossed by the right-of-way and aquifers from which groundwater will be abstracted for the infrastructure and other construction activities. During the operational phase, the Aol will include aquifers crossed by the project.

18.6 Groundwater systems

The hydrogeological map of Tanzania indicates that the main aquifers along the project alignment are basement complex and unconsolidated sedimentary formations. Recharge generally occurs through fracture zones, faults, or lineaments. The aquifers are described below (Ligate et al. 2021).

- a shallow zone of unconfined near-surface sands and/or nodular-tubular ferricretes, underlain by clay, receiving plentiful wet-season recharge. Water in this horizon is at risk of contamination, in particular from pit latrines. Springs can also occur along the base of valley slopes at the junction between these sands and the valley floor clay-rich 'mbuga' type soils. The unconsolidated sedimentary aquifer is mainly alluvial deposits found along river valleys and flood plains. Borehole yields vary depending on lithology. The thickness of unconsolidated aquifers is usually not well defined, but the water table depth tends to vary between 10 and 20 m
- a semi-confined to confined zone beneath the near-surface clay layer, consisting of fractured and weathered basement rock, which may contain significant quantities of groundwater. The thickness of weathering is often greatest along valley sides, thinning towards the central parts of valleys. Permeability in this horizon decreases with depth, often reflected in the declining yields of shallow boreholes as water levels fall during the dry season. Groundwater quality in this zone is largely controlled by interaction with rock minerals
- fracture zones within basement rock, which can store significant quantities of groundwater, but which may receive limited recharge. Boreholes constructed within fracture zones often have high initial yields which may decline with time as abstraction exceeds recharge. Water quality may be poor due to excessive mineralisation over long residence times. Valleys generally develop along existing fracture zones, and so this type of aquifer is likely to be found preferentially in valleys. Valley bottoms are generally capped by clay-rich soils, which inhibit recharge. The basement aquifers are typically up to 50 m thick.

18.7 Groundwater quality

Field sampling undertaken by UCB in August 2022 (UCB, 2022) included sampling from 12 shallow wells and boreholes. The laboratory testing results indicate that all concentrations are below the Tanzanian Standard TZS 789:2008 (Drinking (Potable) Water – Specification) and the WHO DWS (Guidelines for Drinking-water Quality (2011)) with the exception of phosphate in boreholes and shallow wells in the Uyui, Risolo, Nyau,



Mdunundu, Kakurungu and Mtuni. The reported levels are above 2.2 mg/L which is the upper limit of phosphate concentration in water.

The boreholes and shallow wells around the corridor are used for domestic water supply and livestock in the respective villages.

18.8 Potential impacts and mitigation measures

The project comprises the construction of embankments, culverts, underpasses, overpasses, stations, freight yards, marshalling yard, bridges, livestock crossings, quarries and borrow pits. Other components of the project include workshops, camp sites, sleeper production plant and batch plants. Potential impacts to groundwater may arise during the construction and operation of these components.

Construction phase:

Generic impacts:

Management of waste and accidental release of oil or chemicals

Impact: Contamination of groundwater

Potential direct impacts on groundwater quality may occur due to the storage, transportation, treatment and disposal of solid and liquid waste, chemicals and fuel. These impacts on groundwater quality may lead to indirect impacts associated with the need to use alternative water sources or restricted access to existing sources such as increased costs with consequent impacts on livelihoods (see socio-economic and health receptors).

The pre-mitigation impact of waste management and accidental release of oil or chemicals during construction is graded as moderate in significance because of the medium magnitude, short duration and local extent of the potential impact; groundwater sensitivity is medium.

The potential for contamination of highly sensitive groundwater receptors is identified and assessed (Appendix 7).

Abstraction of groundwater

Impact: Decreased water level due to abstraction for project use

The abstraction of groundwater to supply the project may have a direct impact on the water table near the well through drawdown, which may have an indirect impact on the yield of nearby boreholes and wells. In all the districts that the route traverses, groundwater is the most important source of public water supply, so abstraction in districts where the project abstraction points are located may indirectly affect communities (see socio-economic and health receptors) and ecosystems (see biodiversity receptors).

Abstraction boreholes have been drilled at several locations along the route and several more are proposed. These are shown in **Table** 4-18 along with existing local wells identified to date within a 5 km radius of the route.

The pre-mitigation impact for the abstraction of groundwater during construction, based on currently available information on the planned abstraction is graded as moderate in significance because the magnitude is ranked as medium, the duration is transient, and the extent is local; sensitivity is ranked as medium. This grading of significance is not final, and this aspect will require further assessment once the complete data related to abstraction points is provided (site-specific).



The potential for contamination of highly sensitive groundwater receptors is assessed and presented in Appendix 7).

Operation phase:

Generic impacts:

Management of waste and accidental release of oil or chemicals

Impact: Contamination of groundwater

Potential direct impacts on groundwater quality may occur due to the storage, transportation, treatment and disposal of solid and liquid waste, chemicals and fuel. These impacts on groundwater quality may lead to indirect impacts associated with the need to use alternative water sources or restricted access to existing sources such as increased costs with consequent impacts on livelihoods (see socio-economic and health receptors).

The pre-mitigation impact of waste management and accidental release of oil or chemicals during construction is graded as minor in significance because of the minor magnitude, medium duration and local extent of the potential impact; groundwater sensitivity is medium.

Abstraction of groundwater

Impact: Decreased water level due to abstraction for project use

The abstraction of groundwater to supply the project may have a direct impact on the water table near the well through drawdown, which may have an indirect impact on the yield of nearby boreholes and wells. In all the districts that the route traverses, groundwater is the most important source of public water supply, so abstraction in districts where the project abstraction points are located may indirectly affect communities (see socio-economic and health receptors) and ecosystems (see biodiversity receptors).

The pre-mitigation impact for the abstraction of groundwater during construction, based on currently available information on the planned abstraction is graded as minor in significance because of the minor magnitude, medium duration and local extent of the potential impact; groundwater sensitivity is medium. This grading of significance is not final, and this aspect will require further assessment once the complete data related to operation phase abstraction points is provided (site-specific).

Mitigation measures

Management of waste and accidental release of oil or chemicals

Impact: Potential for groundwater contamination if disposal is uncontrolled

The waste management plan, pollution prevention plan and natural resource management plan will include measures that collectively contribute to the management of impact from the management of solid and liquid waste and accidental releases.

Grey water will be separated from black water, treated in accordance with the project environment standards, treated wastewater will be reused where possible or discharged as per permit conditions. Kitchen facilities will be fitted with industry standard grease traps. The waste management plan will identify requirements for waste collection, storage, transfer and disposal. An environmental and social evaluation of treated effluent discharge locations will be undertaken; treated effluent which is not reused will be discharged to land.



In the event of a spillage of hazardous materials a trained rapid response team will be mobilised to contain, clean and remediate spills. Spill response equipment will be available at all work sites. The storage of hazardous materials will be restricted to designated hazardous materials storage areas at least 50 m from surface waters; storage will be covered, bunded (no drainage valves/holes) and have impermeable floor. A refuelling procedure will be developed to address mobile and static refuelling, spill prevention techniques and training.

Management of waste and accidental release of oil or chemicals

Impact: Contamination of groundwater

The pollution prevention plan, waste management plan and the emergency preparedness and response plan will include measures to manage solid and liquid waste and accidental releases during construction; relevant measures are outlined above.

Management of black and grey water

Impact: Contamination of groundwater

The waste management plan and the pollution prevention plan will include measures that collectively contribute to the management of impact from management of black and grey water.

Grey water will be separated from black water, treated in accordance with the project environment standards, treated wastewater will be reused where possible or discharged as per permit conditions. Kitchen facilities will be fitted with industry standard grease traps. Contingency will be provided for wastewater treatment plant maintenance.

Abstraction of groundwater

Impact: Decreased water level due to abstraction for project use

The natural resource management plan and water management plan will describe measures that will be undertaken to evaluate the potential impact on local groundwater abstraction points, such as the undertaking of hydrogeological assessments; if significant impacts are predicted by these assessments, then alternative borehole locations will be considered; the water quality and sustainability of water abstracted from either new or existing boreholes will be monitored.

18.9 Water consumption assessment

Water consumption assessment involves evaluating the amount of water required for various activities associated with the project, as well as identifying potential sources of water supply and assessing the impact of water usage on the environment. Here's an outline of the process:

18.9.1 Identification of water usage activities

Water plays a critical role in various construction and operation phase of the project. Water usage activities during the construction of the Standard Gauge Railway (SGR) typically encompass a range of essential tasks necessary for project implementation including:



- **Earthwork and Excavation**: Water is often used to soften soil and facilitate excavation processes, particularly in areas with compacted or dense ground conditions.
- **Concrete Production**: Water serves as a crucial ingredient in concrete mixtures used for constructing railway foundations, bridges, culverts, and other structures along the railway route.
- **Dust Suppression**: Construction activities can generate significant amounts of dust, especially in dry and windy conditions. Water is applied to roads, construction sites, and other areas prone to dust generation to minimize airborne particles and maintain air quality.
- **Compaction**: Water is applied during compaction processes to enhance the effectiveness of soil compaction, ensuring stable foundations for railway tracks, embankments, and other infrastructure components.
- **Equipment Cooling and Cleaning**: Water is utilized for cooling machinery and equipment, as well as for cleaning construction vehicles, tools, and site facilities to maintain operational efficiency and safety standards.
- Worker Hygiene and Comfort: Provision of water for drinking, handwashing, and sanitation facilities is essential to ensure the health and well-being of construction workers on-site.
- Landscaping and Vegetation Establishment: Water is required for irrigation purposes to establish vegetation, particularly along embankments, cuttings, and areas adjacent to the railway tracks, to mitigate soil erosion and enhance visual aesthetics.
- **Concrete Curing**: Water is applied to freshly poured concrete to prevent premature drying and maintain proper hydration, ensuring the strength and durability of concrete structures.
- **Temporary Camp Facilities**: Water is needed for various daily activities within construction camps, including cooking, cleaning, and personal hygiene.
- Community outreach and Engagement: Water may be needed for community outreach initiatives, such as providing drinking water stations or supporting local water conservation projects, as part of corporate social responsibility efforts.

During the operational phase of the Standard Gauge Railway (SGR), water usage activities primarily revolve around the maintenance and daily operations of the railway infrastructure. Some of the key water usage activities during this phase include:

- **Track Maintenance:** Water is used for track cleaning and maintenance activities to remove debris, dirt, and vegetation that may accumulate on the railway tracks, ensuring smooth and safe train operations.
- **Dust Control:** Similar to the construction phase, water may be used for dust suppression along the railway tracks and at railway stations to minimize airborne particles and maintain air quality, especially in dry and dusty conditions.
- **Fire Suppression:** Water is essential for firefighting purposes to extinguish any fires that may occur along the railway tracks or at railway facilities, such as stations, depots, and maintenance yards.
- **Station Facilities:** Water is required for various facilities within railway stations, including restrooms, drinking fountains, cleaning, and maintenance of platforms, waiting areas, and other amenities for passengers and staff.



- **Train Washing:** Water is used for washing and cleaning trains to maintain their appearance, hygiene, and operational efficiency, ensuring a comfortable and pleasant experience for passengers.
- Landscaping and Vegetation Management: Water may be needed for irrigation purposes to maintain landscaping, vegetation, and greenery along the railway corridor, contributing to environmental aesthetics and biodiversity conservation efforts.
- **Facility Maintenance**: Water is utilized for general cleaning, maintenance, and sanitation purposes within railway facilities, including workshops, storage yards, administrative buildings, and staff accommodations.
- **Cooling Systems:** Water is essential for cooling systems in train engines, equipment, and other machinery to prevent overheating and ensure optimal performance and reliability during train operations.
- **Emergency Response**: Water may be required for emergency response and rescue operations in the event of accidents, derailments, or other incidents along the railway route.

18.9.2 Estimation of water requirement

Based on the project activities, quantification of water requirements for each activities based on factors such as project duration, area of construction and operational demand is necessary for reasons such as resource planning, sustainability, regulatory compliance, risk management, cost control and project feasibility. It ensures that water resources are used responsibly and sustainably throughout the project lifecycle.

The table below summaries the projected full capacity daily water requirement for lot 3 ad 4.

Activity	Sub-Activity	Lot 3	Lot 4
Domestic		85 m³/day	85 m³/day
Construction	Dust Suppression	2730 m³/day	No Data
	Concrete	81.5 m³/day	21.7 m³/day
Total		2896 m³/day	106.7 m³/day

Table 18-3: Proi	iected Water Red	uirement During	Construction Phase
	joolog maloi not	fan en en barnig	

Note:By the time of preparation of this updated ESIA report, Operation and Maintenance water requirement data was not made available for review.

18.9.3 Assessment of water sources

The following water sources were identified by the time of writing this updated ESIA report, where some are currently in use, some are not active. The table below summaries the project water sources, their status, type of usage, flow rate, and source capacity.



Table 18-4: Project Water Sources Information

SECTIONS	ID	LOCATION	КМ	E	N	REMARKS	Type of usage	Flow Rate It / sec	Sources Capacity m3/day	Estimated Quantity m3/day	STATUS
			_								
	EW WW 1	EARTHWORKS	535+000	732925.672	9360443.95 4	Completed	Construction	5.00	432.00	-	Non- Active
	EW WW 2	EARTHWORKS	546+000			Planning					
	EW WW 3	EARTHWORKS	555+000			Planning					
1 -000)	MRQ WW1	MANYONI ROCK QUARRY	567+000	707440.906	9362754.82 4	Completed	Construction	2.00	172.80	-	Non- Active
CTION	MRQ WW2	MANYONI ROCK QUARRY	567+000	707152.000	9362253.00 0	Completed	Construction	3.00	259.20	-	Non- Active
SEC 534+98	MC WW1	MANYONI CAMP SITE	569+000	704975.711	9361990.20 4	Completed	Domestic	3.00	259.20	-	Non- Active
i)	MC WW2	MANYONI CAMP SITE	569+000	705298.000	9361515.00 0	Completed	Domestic	1.25	108.00	-	Non- Active
	EW WW 5	EARTHWORKS	580+000			Planning					
	EW WW 5-2	EARTHWORKS	590+000	684667.000	9364007.00 0	Completed	Construction	1.40	120.96	-	Non- Active
ION 2 +000- 000)	EW WW 6	EARTHWORKS	597+000	677540.000	9365902.00 0	Completed	Construction	1.25	108.00	-	Non- Active
SECT (595+ 655+	EW WW 7	EARTHWORKS	606+000	668863.610	9368206.42 0	Planning					



SECTIONS	ID	LOCATION	KM	E	N	REMARKS	Type of usage	Flow Rate It / sec	Sources Capacity m3/day	Estimated Quantity m3/day	STATUS
	EW WW 8	EARTHWORKS	614+000	660563.480	9370183.58 0	Planning					
	IC WW 1	ITIGI CAMP SITE	618+400	657491.798	9371361.81 4	Completed	Domestic	2.77	239.33	60.00	Active
	IC WW 1 A	ITIGI CAMP SITE (RE-DRILL)	618+400	657472.170	9371348.71 0	Completed	Domestic	2.50	216.00	-	Non- Active
	IC WW 1 B	ITIGI CAMP SITE	618+400	656770.000	9371463.00 0	Completed	Domestic+P otable	4.00	345.60	75.00	Active
	IC WW 2	YAPIRAY ITIGI PRODUCTION AREA	620+000	655498.899	9372773.90 1	Completed	Construction	2.77	239.33	165.00	Active
	EW WW 9	EARTHWORKS	624+610	652518.948	9374980.61 4	Completed	Construction	5.00	432.00	-	Non- Active
	EW WW 10	EARTHWORKS	628+080	649557.822	9376765.18 7	Completed	Construction	4.00	345.60	-	Non- Active
	EW WW 10A	EARTHWORKS	629+800	648378.000	9377271.00 0	Completed	Construction	1.40	120.96	-	Non- Active
	EW WW 11	EARTHWORKS	638+504	639812.425	9379877.20 1	Planning					
	EW WW 12	ITIGI ROCK QUARRY	645+000	633732.480	9383719.56 6	Completed	Construction	0.90	77.76	-	Non- Active
	EW WW 13A	EARTHWORKS	650+500	629162.000	9384040.00 0	Completed	Construction	0.90	77.76	-	Non- Active
E	EW WW 13	EARTHWORKS	654+000	625749.690	9384167.04 0	Planning					



SECTIONS	ID	LOCATION	KM	E	N	REMARKS	Type of usage	Flow Rate It / sec	Sources Capacity m3/day	Estimated Quantity m3/day	STATUS
	EW WW 14	EARTHWORKS	662+000			Planning					
	EW WW 14A	EARTHWORKS	668+700	611796.000	9384564.00 0	Completed	Construction	1.94	167.62	-	Non- Active
	EW WW 15	EARTHWORKS	669+000	611775.000	9384571.00 0	Completed	Construction	1.90	164.16	-	Non- Active
	EW WW 16	EARTHWORKS	678+000	603334.700	9387962.76 0	Planning					
(00	TUC WW 1	TURA CAMP SITE	681+000	60138.473	9388982.71 3	Completed	Domestic	0.90	77.76	-	Non- Active
ION 3 .715+0	TUC WW 2	EARTHWORKS	681+000			Planning					
SECT 5+000	TCS WW 1	TURA ROCK QUARRY	682+000	599975.640	9389673.56 0	Planning					
(65	TCS WW 2	TURA ROCK QUARRY	682+000	599847.380	9390306.89 0	Planning					
	EW WW 32	EARTHWORKS	690+000	591454.350	9392215.81 0	Planning					
	EW WW 33	EARTHWORKS	701+600	582100.730	9394857.57 0	Planning					
	EW WW 18	EARTHWORKS	710+000	573357.670	9396741.28 0	Planning					
	EW WW 19	EARTHWORKS	714+000	570195.800	9399039.66 0	Planning					
SECT ION 4 (715+ 000-	EW WW 20	EARTHWORKS	724+000	560524.210	9400496.34 0	Planning					



SECTIONS	ID	LOCATION	KM	E	R	REMARKS	Type of usage	Flow Rate It / sec	Sources Capacity m3/day	Estimated Quantity m3/day	STATUS
	EW WW 21	EARTHWORKS	734+000	550316.000	9401738.05 0	Planning					
	EW WW 22	EARTHWORKS	748+000	537516.000	9405354.00 0	Completed	Construction	2.25	194.40	-	Non- Active
	NC WW 3	NYAHUA CAMP SITE	750+000			Completed	Domestic	0.20	17.28	-	Non- Active
	EW WW 23	NYAHUA CAMP SITE	750+000	534467.898	9405792.06 2	Completed	Domestic	1.50	129.60	-	Non- Active
	NCS WW 2	NYAHUA ROCK QUARRY	762+000	524898.510	9409484.00 0	Planning					
	EW WW 24	EARTHWORKS	762+000	523198.990	9408734.15 0	Planning					
	EW WW 25	EARTHWORKS	767+800	518398.931	9410502.75 7	Completed	Construction	2.40	207.36	-	Non- Active
	EW WW 26	EARTHWORKS	784+000	504703.640	9419122.61 0	Planning					
	EW WW 27	EARTHWORKS	797+455	493302.120	9426183.25 0	Completed	Construction	1.30	112.32	-	Non- Active
l 5)+044)	EW WW 28	EARTHWORKS	803+500	488621.130	9429434.94 0	Planning					
CTION 00-830	EW WW 37	EARTHWORKS	805+000	487326.000	9430276.00 0	Completed	Construction	2.00	172.80	-	Non- Active
SE (785+0	809RQ WW2	809 KM ROCK QUARRY	809+000			Planning					
	TPRO WW 1	YAPIRAY TABORA	812+000	483789.234	9434638.56 7	Completed	Construction	1.60	138.24	125.00	Active



SECTIONS	ID	LOCATION	КМ	E	N	REMARKS	Type of usage	Flow Rate It / sec	Sources Capacity m3/day	Estimated Quantity m3/day	STATUS
		PRODUCTION AREA									
	TPRO WW 2	YAPIRAY TABORA PRODUCTION AREA	812+000	483728.000	9434887.00 0	Completed	Construction	1.50	129.60	-	Non- Active
	TPRO WW 3	YAPIRAY TABORA PRODUCTION AREA	812+000	483686.000	9434528.00 0	Completed	Construction	1.10	95.04	-	Non- Active
	EW WW 29	EARTHWORKS	814+000	483913.000	9437353.00 0	Completed	Construction	2.00	172.80	-	Non- Active
	TC WW 1	TABORA CAMP SITE	816+000	485053.233	9439167.16 4	Completed	Domestic+P otable	7.00	604.80	130.00	Active
	EW WW 35	EARTHWORKS	821+000	486164.200	9444394.92 0	Planning					
	EW WW 30	EARTHWORKS	824+000	485592.720	9446938.28 0	Planning					
	EW WW 36	EARTHWORKS	828+000	483542.830	9449130.73 0	Planning					
	BH-1	BUKENE	918+000	486835.802	9535547.44 3	Completed	Construction	0.95	80.00	5.00	Active
LOT - 4	BH-2	BUKENE	918+000	487058.143	9535728.90 6	Completed	Domestic	0.95	80.00	45.00	Active



18.9.4 Water consumption impact

Impacts: The impacts that the proposed water usage will have on the environment are the following:

- **Increased Demand:** Construction activities and operational needs of the SGR project require significant quantities of water, leading to increased demand in areas where water resources are already scarce.
- Water Stress: High water demand from the project may exacerbate water stress in surrounding areas, especially if local communities and ecosystems rely on the same water sources for their livelihoods and survival.
- **Depletion of Groundwater:** Extraction of groundwater for construction purposes, such as dust suppression and concrete production, can lead to depletion of aquifers, impacting local water availability and potentially causing land subsidence or saltwater intrusion in coastal areas.
- **Surface Water Contamination:** Runoff from construction sites and operational areas may carry pollutants such as sediment, chemicals, and debris into nearby surface water bodies, degrading water quality and harming aquatic ecosystems.
- **Social Impacts:** Competition for water resources between the project and local communities may lead to social conflicts, particularly if marginalized groups are disproportionately affected by water shortages or pollution.
- **Climate Change Resilience:** The SGR project's water consumption may contribute to climate change resilience challenges, as climate variability and extreme weather events could exacerbate water scarcity and impact project operations and infrastructure.

Mitigation

To mitigate these water consumption impacts, effective water management strategies should be implemented throughout the project lifecycle. These may include adopting water-saving technologies, promoting water reuse and recycling, implementing erosion and sediment control measures, conducting regular monitoring of water quality and quantity, and engaging with stakeholders to address concerns and ensure sustainable water use practices.

Further details of water consumption assessment are provided in Appendix 12, where demand of water in relation to the community near the project is indicated.



19 GREENHOUSE GAS AND CLIMATE CHANGE RISK ASSESSMENT

19.1 Greenhouse gas assessment

19.1.1 Existing environment/baseline

19.1.1.1 Study area

The baseline conditions include the existing GHG emissions, before the construction and operation of the project.

The alignment for Lot 3 covers approximately 1,776 ha, along the 295 km route that comprises the Makutopora to Tabora section. The track route corridor for Lot 4 covers approximately 993 ha, along the 165 km route that comprises the Tabora to Isaka section. The route for both Lots comprises a mixture of forest, farmland and shrub. 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.

19.1.1.2 National GHG emissions

With regards to the national GHG context, Tanzania submitted its updated nationally determined contribution (NDC) in July 2021, whereby emissions were calculated as 112,738 ktCO₂e in 1994 and 153,556 ktCO₂e in 2014.

Tanzania's NDC provides a graphical figure displaying relative contribution of sectors to national GHG emissions, from historical records and projected 2030 business as usual (BAU) scenario (Figure 19-1). The largest source of GHG emissions is from land-use change and forestry (~47%), followed by agriculture (~26%), energy (~13%), waste (~13%) and industrial processes (~1%). The total GHG emissions are quantified in this figure, but the percentage contribution of each sector has been estimated from the graph to provide the data in Figure 19-1, and therefore, these numbers will not be entirely accurate.

Furthermore, the graph labels state the historic data pertains to 1994 and 2014, whereas the caption states it is for 1990 and 2010. This, alongside several different contradictory figures throughout the report, means these figures should be treated with caution. For the purposes of this review, the data as per Figure 19-1 of the NDC has been used. The stated source of this data, "Tanzania GHGs Inventory Report and MRV System 2018", is not available to view online.





Figure 19-1: Relative contribution of sectors to Tanzania's national GHG emissions, taken from Tanzania's NDC disclosure 2021

Tanzania has 35.3 million ha of forests, one of the highest forest covers in Eastern and Southern Africa. The forests are a carbon sink, absorbing all emissions produced at national level and more, making Tanzania a net GHG sink (URT 2014). However, Tanzania's primary contribution to GHG emissions is through deforestation and forest degradation, where deforestation is estimated to be approximately 469,420 ha/year²⁷.

19.1.1.3 Future national GHG emissions

Tanzania's NDC included a commitment to reduce greenhouse gas emissions economywide between 30 to 35% relative to the BAU scenario by 2030. Within Table 19-1the derived values for the 30% and 35% reduction in emissions have been calculated equally across all emissions sources. However, as part of the NDC, four priority areas for reductions were defined as energy, transport, forestry and waste management based upon their potential in GHG emissions reductions.

Emission category	GHG emissions (ktCO₂e) in year								
	1994	2014	2030 BAU	2030 30% reduction	2030 35% reduction				
Land use, land use change and	75,534	72,171	65,841	46,088	42,796				

Table 19-1: Relative contribution of sectors to national GHG emissions, as per Tanzania's NDC

27 URT (2019) United Republic of Tanzania Third State of the Environment Report https://www.vpo.go.tz/uploads/publications/en-1592550740-

State%20of%20Environment_Third%20Report%202019.pdf.



	GHG emissions (ktCO ₂ e) in year								
Emission category	1994	2014	2030 BAU	2030 30% reduction	2030 35% reduction				
forestry (LULUCF)									
Waste	11,274	19,962	46,088	32,262	29,958				
Agriculture (incl. livestock)	21,984	39,925	61,451	43,016	39,943				
Industrial processes and product use (IPPU)	-	1,536	2,195	1,536	1,427				
Energy (incl. transport)	3,946	19,962	43,894	30,726	28,531				
Total	112,738	153,556	219,469	153,628	142,655				

Emissions from transport are included with the energy category, and combined they comprised approximately 13% of total national emissions in 2014 (approximately 19,962 ktCO₂e). Under a BAU scenario they are expected to comprise approximately 20% of national emissions in 2030 (approximately 43,894 ktCO₂e), predominantly due to an expected decrease in emissions from land use, land use change and forestry (LULUCF). 2030 emissions targets for energy (incl. transport) comprise a reduction of 13,168 – 15,363 ktCO₂e compared to a BAU scenario under the 30% or 35% **reduction** scenario, leading to total targeted emissions of 30,726 - 28,531 ktCO₂e emissions from this sector.

19.1.2 Potential impacts identified

Activities that emit GHG during the construction phase are identified as:

- land clearing that will result in the release of carbon stored within vegetation and soil
- combustion of fuel during construction activities, such as use of excavators, generators, concrete mixers etc.
- associated embodied GHG emissions from construction materials i.e. those upstream emissions created by the manufacture, processing and transport of construction materials used on-site
- activities that emit GHGs during the operational phase are identified as:
 - o electricity consumption to power trains on the railway
 - o electricity consumption for operation of stations and other infrastructure
 - o transmission and distribution losses though the electricity network
 - o combustion of diesel for powering shunt locomotives.

19.1.3 Impact assessment methodology

Project-specific methodology is provided below, and generalised methodology for the GHG assessment is detailed in section 7.10.



19.1.3.1 Methodology (Construction)

Construction fuel emissions have been estimated based upon projected diesel consumption, with an assumption of 145,000,000 litres of diesel needed for construction of Lot 3 and 75,891,000 litres of diesel needed for construction of Lot 4 (Table 19-2).

Table 19-2: Total construction fuel emissions

	Data (litres)	Emissions factor (Defra, 2022)	Emissions (tCO ₂ e)
Diesel consumption	220,891,000	2.6988	596,141
Total			596,141

Emissions during the construction phase as a result of land use change due to land clearing have also been estimated. RSK has estimated that a total of 449 and 251 ha will be cleared for the construction of the Lot 3 and 4 respectively. This is based upon the length of the track and assumed 15 m width clearance within the 60 m construction servitude corridor, and area of clearance needed for associated buildings and infrastructure. The current baseline carbon stocks have been estimated from within the living biomass on regional data for the Eastern and Southern Africa region28, and the average forest land cover in Tanzania (51.6%29) has been applied as typical for the site area (Table 19-3).

Table 19-3: Total land use change emissions

	Emissions per ha forest (tCO ₂ e)	% coverage	Emissions (tCO ₂ e)
Forest	164.3	51.6	59,283
Agricultural land	49.5	48.4	16,753
Total			76,036

Relevant scope 3 emission sources from construction have been identified as the embodied carbon from construction materials. Aligned with PAS 2080 (BSI, 2016) the scope 3 sources associated with the construction phase, that are not already accounted for in scope 1 and 2 inventory, include:

- embodied GHG emissions associated with the 'cradle to gate' of the construction materials (A1-3)
- transportation of materials to the project (A4)
- transportation of construction waste and away from the project and disposal (C2 & C4)
- these emissions are detailed in Table 19-4

28 FAO. 2020. Global Forest Resources Assessment 2020: Main report. Rome. https://doi.org/10.4060/ca9825en

29 https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=TZ. Yapi Merkezi Insaat ve Sanayi Anonym Sirketi (YM) SGR Lots 3 and 4 ESIA report



- A1-3 emissions were largely modelled using the Rail Carbon Tool30, which uses industry best practice. However, to estimate A1-3 emissions associated with the cables, data from a publicly available Environmental Product Declaration for a medium voltage three core underground cable was used31
- lifecycle stages A4, A5, C2 and C4 were also modelled using the Rail Carbon Tool. The following assumptions were applied:
 - data associated with the delivery of material has been estimated assuming international delivery for steel and cables, with local delivery assumed for other materials
 - the transportation and disposal of waste has been calculated based upon average distance to local dump sites
 - o end of life disposal process for materials was allocated to landfill.

Table 19-4: Total embodied emissions associated with construction materials

Construction process	Emissions (tCO ₂ e)
Embodied GHG emissions associated with the 'cradle to gate' of the construction materials (A1-3)	1,276,186
Transportation of materials to Site (A4)	51,071
Transportation of construction waste away from site and disposal (C2 & C4).	6,838
Total	1,334,096

19.1.3.2 Methodology (Operation)

The emissions across the lifecycle of the project are determined assuming a project life of 60 years.

The estimations of GHG emissions associated with the electricity to power the operation of the Proposed Development are based upon electricity consumption data for the trains (Table 19-5) and the power ratings provided for stations (Table 19-5). It is assumed stations are operational 24 hours a day, for 365 days per year.

³⁰ British Safety and Standards Board, Rail Carbon Tool, available at: https://www.railindustrycarbon.com/Account/LogOn?ReturnUrl=%2f.

³¹ Hellenic Cables S.A., Environmental Product Declaration, 2022, Available at:

https://api.environdec.com/api/v1/EPDLibrary/Files/ebc7cfbb-4014-4f8d-72d2-08da954a8add/Data [Accessed March 2023].



			Electricity consumption		Transmission and distribution losses		
	Energy consumption per day (kwh)	Energy consumption per year (kwh)	Emissions factor (kgCO2e/ kWh32)	Emissions (tCO2e) per year	Emissions factor (kgCO2e/kWh33)	Emissions (tCO2e) per year	
Assuming 100% Main Rolling Stock	581,140	212,116,100	0.336049804	71,282	0.1048	22,230	
Assuming 100% Alternative Rolling Stock	665,772	243,006,780	0.336049804	81,662	0.1048	25,467	
Assuming 50/50 main and alternative rolling stock	623,456	227,561,440	0.336049804	76,472	0.1048	23,848	

Table 19-5: Annual GHG emissions associated with trainline electricity consumption for Lots 3 and 4

Table 19-6: Annual GHG emissions associated with station electricity consumption for Lots 3 and 4

			Electricity consumption		Transmission and distribution losses		
Facilities	Power (kW)	kWh per day (assume 24hr)	kWh per year (assume 365 days)	Emissions factor (kgCO ₂ e/kWh: UNFCCC, 2021)	Emissions (tCO₂e)	Emissions factor (kgCO ₂ e/kWh: Defra 2017 Africa average)	Emissions (tCO ₂ e) per year
Stations	1728	41,462	15,133,776	0.336049804	5,086	0.1048	1,586

In addition to electricity, diesel will be required for shunt operations in freight stations, workshops and marshalling yards, as detailed in Table 19-7.

³² UNFCCC (2021) Harmonized IFI Default Grid Factors 2021 v3.2 https://unfccc.int/climate-action/sectoralengagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies.



Lot	Shuntloco.km/year	Diesel consumption per km (litres)	Annual diesel consumption (litres)	Emissions factor (kgCO ₂ e/litre ³⁴)	Emissions (tCO ₂ e)
Lot 3	109,500	9	985,500	2.6988	2,660
Lot 4	109,500	9	985,500	2.6988	2,660
Total					5,319

Table 19-7: Annual GHG emissions from diesel consumption for shunt operations

No significant maintenance or replacement emissions (PAS 2080: B2 and B4) were anticipated within the 60-year design life. To account for the emissions for annual maintenance and repair of track and infrastructure, maintenance and replacement emissions were estimated by applying a 1% uplift to the embodied GHG emissions (PAS 2080: A1-3), as shown in Table 19-8.

Table 19-8: Emissions associated with operational maintenance and repair

Operational maintenance and repair emissions	Annual emissions (tCO ₂ e)	Total emissions (tCO₂e)
Maintenance and replacement emissions (B2 & B4)	213	12,762

19.1.4 Assessment of potential impacts

19.1.4.1 GHG Assessment

This assessment has used estimations, benchmarks and industry averages. Whilst every care has been made to adhere to the GHG Protocol's core principles of relevance, completeness, consistency, transparency and accuracy, the following values are approximate and can be useful to understand the order of magnitude of GHG emissions and savings.

Tahlo	19-9.	Total	GHG	omissions	for the	lifosnan	of the	nroioc	t (60 ·	voare)	
i abie	13-3.	TOLAI	впв	ennissions	ior the	mespan	ortine	projec	ι (ου	years)	1

Category	Phase	Comprising sources	Emissions over project life (tCO2e)	% of scopes 1, 2 and 3 emissions
	Construction	Land clearing	76,036	1
Scope 1 (direct emissions)	Construction	Fuel consumed for construction phase	596,141	7
	Operation	Fuel consumed for operation phase	319,160	4

 ³⁴ Defra (2022) GHG Conversion Factors for Company Reporting.
 Yapi Merkezi Insaat ve Sanayi Anonym Sirketi (YM)
 SGR Lots 3 and 4 ESIA report
 2040173-01 (03)



Category	Phase	Comprising sources	Emissions over project life (tCO2e)	% of scopes 1, 2 and 3 emissions
		(diesel used for shunt locomotives)		
Scope 2 (indirect	Operation	Electricity to power trainline	4,588,319	53
emissions through purchase of energy)	Operation	Electricity to power stations	305,142	4
Scope 3	Operation	Transmission and distribution losses of electricity to power trainline and associated infrastructure	1,485,613	17
(other indirect emissions)	Construction	Embodied carbon from construction materials	1,334,096	15
	Operation	Embodied carbon from infrastructure repair and replacements	12,762	0.1
TOTAL scope	1 & 2 emissions	5,884,797		
TOTAL scope	1, 2 & 3 emissio	8,717,267		

Scope 1 emissions comprise the direct emissions from land use change and diesel consumption during construction and fuel consumed during operation; scope 2 emissions comprise the consumption of electricity for trains and stations during the operation phase. Relevant and material scope 3 emissions sources have been identified as the embodied carbon from construction materials and embodied carbon from infrastructure repair and replacements throughout the project operation. In addition, due to the large electricity consumption associated with the operation phase of the project, the transmission and distribution losses from the consumed electricity has been identified as a material and relevant scope 3 source. As shown in Figure 19-2, across the 60-year lifespan of the project most emissions fall under scope 2 (68%), followed by scope 3 (18%) and then scope 1 (14%).




Figure 19-2: Summary of project GHG emissions by scope (scope 1, 2 and 3 emissions across 60-year project lifespan)

As shown in Figure 19-2: Summary of project GHG emissions by scope (scope 1, 2 and 3 emissions across 60-year project lifespan) emissions from electricity to power the trainline comprise the largest emissions source (53%). This is followed by transmission and distribution loss from all purchased electricity (17%), embodied emissions from construction materials (15%), fuel consumed during construction phase (7%), fuel consumed during operation (shunt locomotives: 4%), electricity to power stations (3%), land clearing (1%) and the embodied emissions from infrastructure repair and replacement (<1%).





Figure 19-3: Summary of project GHG emissions by activity (scope 1, 2 and 3 emissions across 60-year project lifespan)

As displayed in Figure 19-3, most emissions comprise operation-related emissions (72%), predominantly due to the electricity consumption needed to power the trains. Construction-related emissions comprise 28% of total emissions from the 60-year life of the proposed development.



Figure 19-4: Summary of project GHG emissions by phase (scope 1, 2 and 3 emissions across 60-year project lifespan)

19.1.4.2 Significance – GHG magnitude

The annual scope 1 and 2 emissions for the construction and operation of the project are displayed in Figure 19-5 and Table 19-10.





Figure 19-5: Annual GHG emissions (scope 1, 2 and 3) displayed by project phase and scope

Based upon the magnitude criteria presented in Table 19-10 annual scope 1 and 2 construction-related emissions are classed as large during the first three years of construction $(100,000 - 1,000,000 \text{ tCO}_2\text{e}$ annually). For the fourth year it is anticipated that Lot 3 will be fully constructed and operational, and Lot 4 will be completed halfway through the year, and operational for the remaining half of the year. In this scenario combined scope 1 and 2 emissions are still classed as large $(100,000 - 1,000,000 \text{ tCO}_2\text{e}$ annually). Once construction is finished, annual scope 1 and 2 emissions from the operation of the proposed development are moderate $(25,000 - 100,000 \text{ tCO}_2\text{e}$ annually).

If scope 1 and 2 emissions exceed 25,000 tCO₂e annually IFC and EP4 guidelines call for the quantification of these emissions on an annual basis. The estimated annual scope 1 and 2 emissions exceed this threshold, totalling 86,877 tCO₂e. Therefore, annual GHG assessments must be undertaken to quantify emissions, in accordance with internationally recognized methodologies and good practice such as the GHG Protocol or ISO 14064 (Part 1 and 2)..

GHG emissions from all material scope 1 and 2 sources will be quantified using primary project activity data (e.g., kilowatt-hours of electricity consumed, or litres of fuel combusted) where possible. Secondary data - in the form of estimates, extrapolations, modelling, benchmarks, industry averages or other proxy sources – may be used when reliable primary data is not available.

An emissions factor will then be applied to estimate the GHG emissions from that activity. An emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Factors from reputable sources will be used, for example, from government publications, independent agencies, and scientific research journals.



It is mandatory hence, TRC will disclose the estimated GHG emissions publicly, on an annual basis, through corporate reports or disclosure mechanisms.

	Construction Y1	Construction Y2	Construction Y3	Construction Y4 / operation	Operation Y1 and onwards
Total scope 1&2:	203,101	203,101	203,101	119,235	86,877
Total scope 1,2&3:	605,597	605,597	605,597	261,981	111,850

19.1.4.3 Significance – GHG impact

Whilst IFC and EP4 guidelines focus on quantification of scope 1 and 2 emissions (i.e. direct emissions and those indirect emissions from purchased energy), relevant and material scope 3 (i.e. other indirect) emissions have been assessed here when determining the overall net emissions gain or loss. This is because the GHG savings of the project in the form of displacing passenger travel and transport of freight by combustion vehicles a saving of indirect GHG emissions.

The project will facilitate the transportation of 1.7 million passengers and 17.7 million tonnes of freight annually. Aligned with the ESIA methodology for Lots 1 and 2 Table 19-11 displays the equivalent emissions from passenger and freight transport by internal combustion engine, if passengers and freight travel the entire length of the Lots 3 and 4 track (i.e. 414 km) for each journey.

Table 19-11: Estimated emissions from equivalent transport via internal combustion vehicles, assuming passengers and freight travel the entire length of the project

	Capacity	Annual distance travelled	Emissions factor (kgCO₂e/unit)	Emissions (tCO2e)
Passengers	1,700,000 passengers	703,800,000 passenger.kms	0.085335 (average car, unknown fuel, assuming 2 passengers per car: Defra 2022)	60,059
Freight	17,700,000 tonnes	7,327,800,000 tonnes.kms	0.10445 (all HGVs, average laden: Defra 2022)	765,389
Total				825,447

Passenger travel across the project is likely to be between the major cities (Dar Es Salaam –Dodoma ~450 km; Dodoma – Tabora ~380 km; Tabora – Isaka ~120 km). The average lengths of these journeys comprise approximately 75% of the length of the project alignment. Freight, on the other hand, is more likely to be internationally bound or sourced, and may travel approximately 90% of the length of the project. Table 19-12 displays the estimated emissions from equivalent transport via internal combustion vehicles applying these assumptions.



Table 19-12: Estimated emissions from equivalent transport via internal combustion vehicles, with assumptions applied to journey length

	Capacity	Annual distance travelled	Emissions factor (kgCO₂e/unit)	Emissions (tCO2e)
Passengers	1,700,000 passengers	527,850,000 passenger.kms	0.085335 (average car, unknown fuel, assuming 2 passengers per car: Defra 2022)	45,044
Freight	17,700,000 tonnes	6,595,020,000 tonnes.kms	0.10445 (all HGVs, average laden: Defra 2022)	688,850
Total				733,894

The annual scope 1, 2 and 3 emissions of 111,850 tCO₂e, and annual potential GHG savings of 733,894 tCO₂e result in net GHG emissions reductions of 622,044 tCO₂e annually (Table 19-13). Therefore, the total construction emissions (2,006,272 tCO₂e) are offset after 3.2 years of project operation.

Table 19-13: Annual GHG savings from operation of the proposed development

Annual GHG emissions	Annual emissions (tCO₂e)
Annual GHG emissions (scope 1,2 &3) from operation of project	111,850
Annual GHG emissions from equivalent transport via internal combustion vehicles	733,894
Annual GHG savings through operation of the project	622,044

As part of its NDC submitted in 2021 Tanzania has set a target to achieve 30 - 35% GHG emissions reduction by 2030 relative to a BAU scenario. This equates to total GHG reductions of 65,841 - 76,814 ktCO₂e across all sectors, and reductions of 13,168 - 15,363 ktCO₂e more specifically in the energy and transport sector.

Assuming the proposed development is operational by 2030, the annual GHG savings of 622,044 tCO₂e contribute to 4.0 - 4.7% of GHG reductions needed in the energy and transport sector, and 0.8 - 0.9% of GHG reductions needed across all sectors to meet Tanzania's NDC commitments.

Aligned with IEMA guidance, this project is assessed to achieve emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory and has minimal residual emissions. The project is playing a part in achieving the rate of transition required by nationally set policy commitments and is therefore assessed as having a negligible effect that is not significant.

19.1.5 Environmental and social management plan

It is unavoidable that GHG emissions will occur during the construction of the project, namely due to the emissions from land clearance, energy required for light, heat and power for construction plant and equipment, as well as the embodied energy associated with resources and materials used. The minimization of vegetation loss, alongside careful and conservative consumption of energy alongside appropriate selection of raw materials should be the priority to mitigate against excessive GHG emissions.



A series of specific mitigation measures should be included within the construction and environment management plan, as detailed in Table 19-14.

Impact	Mitigation
Construction	
Emissions associated with land clearing	• Minimise the area of land clearance, e.g. investigate minimising the construction servitude corridor width where possible, keep the size of borrow pits, quarries, and dump sites to a minimum where possible.
	 Avoid redundantly large area demands (borrow pits, and quarries) by considering material needed.
	• Productive use of vegetation after clearance e.g. where land clearance causes the felling of trees, liaise with appropriate organisations to ensure re-use of timber where possible (for construction and/or fuelwood). Where plants of value are cleared, they can be provided to local communities for re-use as part of their circular economy.
Emissions associated with the use of on-site fuel for construction	 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
	 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
	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.
Embodied emissions associated with the materials used for construction	• 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.
	 Optimise transport logistics for efficient journeys of materials to site
	•

Table 19-14: Recommended construction GHG mitigation measures

Emissions due to the operation of the proposed development arise predominantly due to the electricity consumption needed to power the trainline and associated infrastructure. A number of mitigation measures are detailed in Table 19-15.



Impact	Mitigation
Operation	
Emissions associated with electricity consumption to power trains and	• electricity for overhead lines may by necessity be reliant on electricity from the national grid, which may be sourced from a greater proportion of renewable energy in the future. However, the implementation of renewably sourced electricity should be investigated where-ever possible for the immediate-term
signais	 prioritise the procurement of efficient locomotives
	 minimise the idling times of locomotives
	 promote fuel efficiency for operation of the locomotives, including efficient driving guidelines.
Emissions associated with electricity consumption to power stations	 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.
Embodied emissions associated with repair and replacement of infrastructure	 the use of locally sourced and/or produced materials optimise transport logistics to ensure efficient journeys of materials to site.

Table 19-15: Recommended operation GHG mitigation measures

19.1.6 Cumulative impact assessment

GHG emissions are inherently cumulative, as all emissions have the same per-unit impact on the same ultimate receptor: the impact is climate change, or global warming, caused by the radiative forcing effects of GHG in the atmosphere, and the affected receptor is the global climate and all the ecosystems and biomes that depend on it.

The sensitivity of the global climate to fluctuations in GHG emissions is always considered 'high', and so the significance of effects is determined by the magnitude of the impact.

Climate scientists predict impacts based on global emission scenarios – the balance of GHGs emitted and absorbed (fixed or stored) over a defined period – and the resultant changes in levels of GHG concentrations in the atmosphere. It is impracticable to attribute a particular impact to a particular emission.

Global efforts to mitigate climate change are primarily based on reducing net emissions of GHGs on a burden-sharing basis among nations. For this reason, project GHG emissions/savings have been compared against Tanzania's national GHG emission budget in the context of its commitment under the Paris Agreement.

The proposed development may contribute to annual GHG reductions of 622,044 tCO₂e. Other electrified public transport projects and their associated infrastructure would be highly likely to result in total emissions savings by reducing individual passenger travel and freight transport in vehicles with combustion engines. The cumulative effect of this project, alongside other similar projects, would be significantly positive and contribute towards climate change mitigation and Tanzania's NDC commitments.



19.2 Physical climate change risk assessment

As stated in EPIV, a Climate Change Risk Assessment (CCRA) is required for Category A and, as appropriate, Category B projects. For these projects, the CCRA is to include consideration of relevant climate-related 'physical risks' as defined by the Task Force on Climate-Related Financial Disclosure (TCFD).

Consequently, this section presents analysis related to the physical risks of climate change as defined by the TCFD. This includes acute (event-driven) risks, as well as chronic risks (those due to longer-term shifts in climate patterns). Following TCFD guidance, the potential financial impacts of physical climate risks and possible adaptations (risk mitigation measures) are also outlined.

19.2.1 CCRA approach

This CCRA includes the following steps:

- hazard analysis, including observations of past change and future climate change projections through to 2100 (Section 19.2.2)
- climate-related risks assessed construction (including earthworks, access to site, use of materials and equipment, workforce) and operations (Section 19.2.3)
- potential financial impacts associated with climate risk presented at a high level (note that detailed cost-benefit analysis has not been undertaken) (Section 19.2.4)
- potential adaptation (risk mitigation) options that the project could consider (Section 19.2.5).

19.2.1.1 Geographical coverage

The CCRA will cover the physical location of sites associated with Lots 3 and 4. Lot 3 runs between the cities of Makutopora and Tabora. Lot 4 runs between Tabora and Isaka. More specifically, the CCRA will cover Manyoni District in Singida and Uyui, Sikonge, Tabora Urban and Nzega Districts in Tabora. Of particular importance to this CCRA is the project's proximity to river basins. A major section of the track is located at IDB. An intermediate section (between 600 - 640 chainage) crosses Rufiji Basin and the last part of the line in the western section (770 - 833 chainage) is in the Lake Tanganyika Basin.

19.2.1.2 Time horizons and climate scenarios

This CCRA evaluates the period from 2023 through 2100. This time horizon was selected for its ability to capture the planned lifetime of the project. Where possible, the CCRA presents scientific evidence of climate projections in line with a low (SSP1-2.6) and high emissions (SSP5-8.5) scenario.

This CCRA uses the scenario-based approach taken by the intergovernmental panel on climate change (IPCC) in their sixth assessment report (AR6) on the physical science basis of climate change. AR6 assessed projected temperature outcomes under a set of five scenarios referred to as the shared socio-economic pathway or 'SSP'. SSPs are illustrative scenarios of projected socioeconomic development up to 2100. They qualitatively describe alternative socio-economic developments that may affect mitigation goals by considering factors such as policy, technological developments, population growth, land use and GDP. The SSPs are coupled with representative concentration pathways (RCPs), which provide time-dependent projections of atmospheric GHG concentration. In total, five SSP-RCPs are available for use in climate risk assessments, as shown in Table 19-16.



SSP- RCP	Description of scenario	Estimated warming Very likely range (°C)		
		Short-term (2021- 2040)	Mid-term (2041-60)	Long-term (2061- 2100)
SSP1- 1.9	Most optimistic: emissions reach net zero by 2050.	1.2 to 1.7	1.2 to 2.0	1.0 to 1.8
SSP1- 2.6	Next best/low emissions: emissions reach net-zero after 2050.	1.2 to 1.8	1.3 to 2.2	1.3 to 2.4
SSP2- 4.5	Middle of the road: emissions reach net-zero by 2100.	1.2 to 1.8	1.6 to 2.5	2.1 to 3.5
SSP3- 7.0:	Medium/high emissions: emissions roughly double from current levels by 2100.	1.2 to 1.8	1.7 to 2.6	2.8 to 4.6
SSP5- 8.5:	High emissions: Current CO2 emissions levels roughly double by 2050.	1.3 to 1.9	1.9 to 3.0	3.3 to 5.7

Table 19-16: IPCC's SSP-RCP scenarios

19.2.1.3 Data sources

Publicly available models, climate data and literature in scientific journals were used to show projected changes to climate and to demonstrate potential project related impacts. Data sources include:

- data from the coordinated regional Climate downscaling experiment (CORDEX). CORDEX is responsible for coordinating the regional climate downscaling models through global partnerships
- CMIP6 and CMIP 5 the coupled model intercomparison projects (CMIP) feature new state-of-the-art climate models that drive CORDEX climate change experiments
- WB climate change knowledge portal (2022) with climate projections based on CMIP6
- the global facility for disaster reduction and recovery's (GFDRR) think hazard tool
- scientific data from future climate for Africa (FCFA), a UK Gov funded research and development programme that has been enhancing scientific knowledge and prediction of African climate
- data and analysis included in the IPCC AR6 (2022)
- Tanzania's Second National Communication (NC2) to the UN Framework Convention on Climate Change (UNFCCC) submitted in 2014
- peer-reviewed scientific papers that focus on climate impacts for Tanzania, as well as impacts for railway infrastructure more broadly.



19.2.1.4 Limitations and uncertainty

There are inherent limitations and uncertainty within the CCRA process. These include:

- data availability for observed trends is very poor for the region at all scales (national and district level). There are significant gaps in meteorological records, especially at District level. Knowledge of past rainfall and temperature in Tanzania is constrained by sparse weather stations and data gaps
- there are substantial uncertainties about future climate change in Tanzania. The main uncertainties come from the fact that previous studies of regional or local climate patterns are based on global climate model (GCM) simulations which have coarse spatial resolutions
- many of the studies considered in this report explore only a small number of future scenarios and not the full range of scenarios as presented in Table 19-16. Similarly, projections within each scenario do not always account for all timescales up to 2100
- the RCP coupled with shared socio-economic pathways (SSP-RCPs) were developed for IPCC AR6, which was released in 2021. Consequently, climate research is yet to incorporate this new approach into research design. Where projections that are in line with the SSP-RCPs are not available, projections in line with the RCPs are used
- as with all CCRAs, there is a degree of professional judgement involved in the risk assessment process.

19.2.2 Hazard analysis

Building on the baseline climate risks presented in Section 19, this section details the key climate hazards in Tanzania. A climatic hazard is an event, or combination of climatic events, which has potentially harmful outcomes. These potential harmful outcomes are detailed in Section 19.2.3.

Using the latest scientific data on climate change in Tanzania from the WB climate change knowledge portal (2022), the IPCC AR6 (2022), and the GFDRR think hazard tool, a preliminary hazard screening exercise identified three main climate hazards to be included in an in-depth hazard analysis. These are raising mean temperatures extreme heat events, precipitation, rainfall events leading to flooding, wildfires and landslides.

Wind hazards are not included in this CCRA. Over Southern Africa a future significant increase in wind speeds and wind energy potential is expected (*medium confidence*), however any increase is unlikely to be over 1% of current speeds (IPCC AR6, 2021). Similarly, there is low confidence of a general increasing trend in extreme winds across Southern Africa in a majority of regions by the middle of the century even in high-end scenarios.

Table 19-17 presents an overview of current hazards at the district level along with a rating of the likelihood of each hazard affecting the project area. Likelihood is rated as 'very low', 'low', 'medium' and 'high'. Climate change is likely to alter the frequency and nature of hazards. The extent to which this happens will depend on the scenarios and timeframes presented in Table 19-16. Details how future climate change is likely to manifest at the regional level are presented in Table 19-17.



Region	District	Extreme heat event	Extreme rainfall /river flooding	Water scarcity	Wildfire	Landslid e
Singida	Manyoni	Med	Low	Very low	High	Very low
Tabora	Uyui	Low	Med	Low	High	Very low
	Sikonge	Low	High	Very low	High	Very low
	Tabora Urban	Low	High	Very low	High	Very low
	Nzega	Low	Low	Low	High	Very low

Table 19-17: Current hazard ratings at the district level

Source: Disaster Reduction and Recovery (GFDRR) ThinkHazard (2022)

19.2.2.1 Increased average mean temperatures

Observations

There has been an observed warming of mean air temperatures and extreme heat in Tanzania. Mean annual temperature has increased by 1°C since 1960, an average rate of 0.23°C per decade or roughly 0.03°C per year (McSweeny et al, 2010). The increase in night-time temperatures has been more pronounced than daytime temperatures. While the number of cold nights has decreased significantly, there is no discernible decrease in the number of cold days.

Data from FCFA (2017) shows a seasonal dimension to temperature rise. The increase has been most rapid in January and February (JF) and slowest in June, July, August and September (JJAS). **Error! Reference source not found.** shows the observed and annual seasonal temperature for Tanzania between 1976-2005. The season are March to May (MAM), October to December (OND) and October to March (ONDJFM). The dotted lines show a liner trend of 0.03°C increase for all seasons.





Figure 19-6 : Observed and annual seasonal temperature for Tanzania (1976-2005)

Source: FCFA (2017)

Projections

There is high confidence under all scenarios that mean temperatures across Africa will increase (Tristos et al. 2021). In the near term (2020-2039) temperatures are expected to rise by less than 1°C under all scenarios and for both Regions (Table 19-18). By the end of the century (2080-2099) temperatures could rise by as much as 4°C for both Regions under SSP5-8.5. There is strong agreement between the models which suggests the projections are robust (FCFA, 2017). Figure 19-7 illustrates how temperatures are projected to rise in Tanzania (at the national level) under a number of scenarios with respect to the 1995-2014 reference period.





Figure 19-7: Projected mean temperature for Tanzania (Ref period 1995-2014), multimodel ensemble

Source: World Bank CCKP (2022)

Table 19-18: Projected mean-temperature anomaly (annual) (in °C) for Tanzania; (Ref	
Period: 1995-2014), multi-model ensemble	

Region	Scenario	Time frame				
		2020-2039	2040-2059	2060-2079	2080-2099	
Singida	SSP2-4.5	0.74	1.34	1.84	2.1	
	SSP5-8.5	0.78	1.8	2.89	4.08	
Tabora	SSP2-4.5	0.73	1.31	1.83	2.1	
	SSP5-8.5	0.78	1.8	2.83	3.97	

19.2.2.2 Extreme heat events

Observations

Extreme heat is currently classified as a low hazard for Tabora meaning that there is between a 5% and 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the next five years. For Singida, extreme heat is classified as a medium hazard meaning that there is greater than a 25% chance of one period of prolonged exposure to heat within the next five years (GFDRR, 2022).



There has been an observed increased in extreme heat events in Tanzania. Analysis by FCFA (2017) show that hot days, where the temperature exceeds 30°C, are increasing. The average number of hot days in Tanzania has increased significantly in DJF to an additional 8.2% of hot days between 1960 and 2003.

Projections

There is high confidence under all scenarios that extreme temperatures across Africa will increase (Tristos et al. 2021), including medium to high confidence of extreme heat waves (based on CMIP6 and CORDEX model runs). All climate models show an increase in the number of hot days (Tmax > 35° C). In the near term (2020-2039), under all future emissions scenarios, Singida could experience by around 4 more hot days each year. In the long term (2080-2099), under a high emissions future (SSP5-8.5), this could rise to 63.62 more hot days each year (Table 19-19). For Tabora, in the near term (2020-2039), under a low emissions future, hot days may increase by 8.17 days a year. In the long term (2080-2099), under a high emissions future (SSP5-8.5), this could rise to 80.75 more hot days a year.

Region	Scenario	Time frame				
		2020-2039	2040-2059	2060-2079	2080-2099	
Singida	SSP2-4.5	3.85	6.25	8.63	8.11	
	SSP5-8.5	3.63	13.34	34.78	63.62	
Tabora	SSP2-4.5	8.17	13.26	18.86	17.34	
	SSP5-8.5	9.37	23.11	43.85	80.75	

Table 19-19: Projected Number of Hot Days (Tmax > 35°C) Anomaly (Annual) for Tanzania (Ref. Period: 1995-2014) Multi-Model Ensemble

19.2.2.3 Precipitation

Observations

Data on perception includes water scarcity and extreme rainfall events. It should be noted that the severe lack of station data over the southern Africa region leads to large uncertainty in the estimation of observed rainfall trends and low confidence in changes in extreme rainfall (Creese and Washington, 2018). Consequently, trends in rainfall across Tanzania need to be treated with caution.

Tanzania experiences significant differences in rainfall amounts (from 300-1200 mm/year) across the country. This is because elevation and distance from the equator affects seasonality (the timing of wet seasons and dry seasons) and variability (changes over time, e.g. from year to year) (FCFA, 2017).

Trend analysis of available rainfall data at a country level shows overall decreasing annual precipitation from 1961 to 2016. This negative trend is strong for central and western Tanzania, including Tabora and Singida. The overall decline in annual perception hides seasonal averages; precipitation during the short rains season has increased indicating that the overall drying trend in Tanzania is a result of negative anomalies during the long rains (Borhara et al. 2020).



Projections

Projections of future rainfall in Tanzania are mixed with little agreement between models. Out of 34 models roughly one third project lower rainfall and two thirds higher rainfall (FCFA, 2017). Furthermore, flood events that result from rainfall are subject to substantial modelling uncertainty, largely due to the uncertainty associated with spatial distribution of future precipitation.

There is strong agreement between models that the mean number of rainy days will decrease and strong agreement that the amount of rainfall on each rainy day ('rainfall intensity') will increase. This suggests that rainfall will become more variable rainfall, with a higher likelihood of both dry spells and intense rainfall events that are associated with flooding (FCFA, 2017).

For Tanzania, changes in rainfall are dependent on location. Data from the CMIP6 2020-2039 show that under a low emissions future (SSP2-4.5) precipitation is projected to increase by 0.1% in Singida and 5.46% in Tabora in the near-term (2020-2039) (Table 19-20). In the long-term (2080-2099) a slight decrease of -1.27% is projected for Singida with a very slight increase of 0.04% for Tabora. Under a high emissions future (SSP2-8.5) precipitation is projected to increase by 1.76% in Singida and 7.44% in Tabora in the near-term (2020-2039). In the long-term (2080-2099) an increase of 4.56% is projected for Singida with a larger increase of 17.48% in Tabora. A recent study from the Bahi (Manyoni) catchment in the Internal Drainage basin (IDB), using data from CMIP6 suggests microclimates within the catchment are important (Hersi et al. 2023). In the 2080s, under a high emission scenario, the mean annual rainfall of the catchment was predicted 4.3% in the northern part and to increase by 25.4% in southeastern part.

Region	Scenario	Time frame					
		2020-2039	2040-2059	2060-2079	2080-2099		
Singida	SSP2-4.5	0.10	-2.8	1.22	-1.27		
	SSP5-8.5	1.76	-0.23	3.85	4.56		
Tabora	SSP2-4.5	5.46	-1.03	-1.26	0.04		
	SSP5-8.5	7.44	7.44	11.76	17.48		

Table 19-20: Projected precipitation percent change anomaly (annual) (%) for Tanzania; (Ref. Period: 1995-2014), multi-model ensemble

To understand potential flood risk, extreme precipitation events need to be considered. As the earth warms, the potential of air to carry moisture increases, and, along with it. the potential for heavier precipitation events. Areas where precipitation is expected to significantly decline will not see a trend towards heavier rainfall and return periods of large events will decrease.

There is limited analysis of flood return periods for within Tanzania. Analysis of the Rufiji basin using an ensemble of six regional climate model simulations from CORDEX suggests an increasing trend of return level values across all scenarios (Näschen, et al, 2019). By 2060, under a high emissions scenario (RCP8.5) a 1:100-year flood could become a 1:25 year flood and a 1:25 year flood could become a 1:10 year flood. This is like the regional level projects that suggest an average increase in return periods across large African river basins; the frequency of flood events with a current return period of 100 years is projected to increase to 1 in 40 years at 1.5°C and 2°C global warming, and 1 in 21 years at 4°C warming (Alfieri et al. 2017).



19.2.2.4 Wildfires

Observations

Wildfire in Tanzania is common and is often linked with agricultural practices, e.g. farmers clearing vegetation in preparation for planting crops, by hunters to flush out prev and by livestock keepers to stimulate fresh grass for grazing (Katani et al. 2014). On average, there are 11 million ha burned annually (ranging between 8.5 and 12.9 million ha; equivalent to between 9% and 14 % of the total land area (Rücker and Tiemann, 2012). Wildfire hazard for all districts (Manyoni, Uyui, Sikonge, Tabora Urban and Nzega) is classified as high, with a greater than a 50% chance of encountering weather that could support a significant wildfire that is likely to result in both life and property loss in any given year (ThinkHazard! 2023). The main fire season occurs from June to July. Despite a global increase in wildfire, there are no clear trends in wildfire prevalence for Tanzania (FAO, 2013).

Projections

Wildfire is difficult to predict because anthropogenic factors are a key driver of fire risk. However, it is generally accepted that climate change is likely to play a greater role in determining wildfire regimes alongside human activity (medium confidence) (IPCC, AR6, 2022). As described in Section 19.2.2.4 and Section 19.2.2.3 it is likely that the frequency of fire weather (i.e. high temperature and greater variance in rainfall) will increase. Where there are a greater number of days with weather that could support fire spread it is likely the fire season will increase in duration and severity (Engelbrecht et al. 2015). No clear projections of wildfire frequency or intensity exist for Tanzania.

19.2.2.5 Landslides

Observations

Heavy rainfall is the main trigger of landslides. Landslides in Tanzania are likely underreported. A review of the literature and publicly available reports revealed no recent landslides in Tabora or Singida Regions. However, it should be noted that small landslides may not be reported, and records may be poor or missing. Landslide hazard for all districts (Manyoni, Uyui, Sikonge, Tabora Urban and Nzega) is currently classified as very low. This means that localized landslides are a rare hazard phenomenon (ThinkHazard, 2023). There is no available data on direction of trends for landslides in Tanzania.

Projections

Climate change is likely to alter slope stability through changes in precipitation and/or temperature. However, multiple non-climatic factors, including local geological conditions determine the likelihood and frequency of a landslide. Climate models do not make projections of landslides. The risk of a landslide can, to some extent, be inferred from historic and projected data on rainfall and temperature. Consequently, there may be an increased risk of landslides for both regions. Borrow pits and quarry sites are most vulnerable.

19.2.3 **Climate-related risks**

This section details how the climate hazards outlined in Section 19.2.2 manifest into climate-related risks that may affect the materiality of the project. Climate-related risks at pre-construction, construction and operations are considered.

In total, 19 risks across all project components have been identified. For ease of understanding throughout the document, risks are named from R1 to R19 (where R=risk). Yapi Merkezi Insaat ve Sanayi Anonym Sirketi (YM) 499



19.2.3.1 Pre-construction

R1: Exacerbation of vulnerability of climate-affected people due to land acquisition

There is potential for the project to exacerbate food insecurity because of land acquisition and resettlement. As discussed previously, most of the population in both Tabora and Singida rely on agriculture for food and income. Common food crops include maize, rice, cassava, beans, sweet potato, sorghum. Cash crops include tobacco, groundnuts, and sunflower. Agriculture is typically rain-fed and, therefore, constrained by low and variable rainfall and high temperatures. Food insecurity is high in both Singida, and Tabora, where between 45% and 55% of households are food insecure. Climate change is likely to affect food insecurity e.g. projections suggest that, under a wetter future, maize yield will decline by 12% in Tabora by 2050 (Arndt et al, 2012). There is a risk that the project will not improve the livelihoods and standards of living of displaced persons in the long-term if the impact of climate change on replacement land is not accounted for.

19.2.3.2 Construction

R2: Exacerbation of pressure on water resources for rural households

During construction, water will be needed for concrete production, compaction, dust suppression and use in camp sites. Water will be obtained from rivers along the project's central railway route via permits obtained from the respective basin boards. Boreholes will be drilled where surface water is unavailable or insufficient. There is potential for the project to contribute to water scarcity at the household and farmer level. It is recognised that the project-affected districts are water abundant, however, water planning and management at the national level means that fewer than 50% of people in rural areas have access to improved water sources (World Bank, 2018; Allegretti and Greene 2022). In the future, under climate change, water availably may be further reduced.

R3: Exacerbation of soil erosion from construction activities

Soil disturbance during construction activities poses a threat to food security and may contribute to ecological degradation and water pollution. Construction involves a lot of earth movement that can damage topsoil. In addition, changing land levels through grading leads to wind and water erosion. Erosion can damage topsoil, which is rich in organic matter, soil enzymes, and microorganism which are needed for plant growth. Soil erosion rates in areas affected by construction activity may be up to 40,000 times greater than pre-construction conditions (Reynold *et al*, 2007). Soil erosion is a particular issue in areas affected by climate change where changes in temperature and precipitation may increase erosion rates and lead to a decline in crop productively and food security.

R4: Increased exposure of staff to heat-related illness

Raising temperatures, coupled with heat waves, are expected to result in heat-related illness (HRI) and a loss of working hours. HRI includes work-related injuries such as heat stroke. Hot temperatures, along with heat energy from construction equipment, and the use of PPE such as long-sleeved cotton jumpsuits, rubber or leather boots, hard hats and safety glasses increases the susceptibility of construction workers to HRI. Temperature extremes affect health by compromising the body's ability to regulate temperature. This can lead to heat cramps, heat exhaustion, heatstroke, and hyperthermia. It may also worsen chronic conditions such as cardiovascular disease, respiratory disease, cerebrovascular disease, and diabetes-related conditions (WHO, 2018). For the construction sector in Tanzania extreme heat resulted in an estimated 0.64% reduction in total working hours in 1995. By 2030, the share of total working hours lost is the construction sector projected to rise to 1.12% (ILO, 2019). For the SGR, construction will



be complete 2025/6, so risks associated with many of the longer-term temperature increases will be avoided.

R5: Reduced operational efficiency of machinery

Operational efficiency of machinery is impacted by extreme heat. e.g. for every 3°C rise in air intake temperature, engine power of a diesel generator will be reduced by 1% (Issa et al, 2020). Other risks from high temperatures include damage to communications and substation equipment, drying out of points equipment, shrinkage and premature ageing of wiring, increased risk of fires damaging cable runs and overheating signalling equipment rooms (Dora, 2021).

R6: Worker health and safety risks during flood/wildfire event

Extreme events such as floods and wildfire present an immediate risk to human populations, including the workforce. Health impacts associated with wildfire include burns, injuries, and heat-related illnesses (e.g. dehydration, heat stroke), possibly resulting in death. Smoke inhalation also presents a significant risk to health. Wildfire smoke can carry many kilometres and cause impacts away from the source. Wildfire smoke contains gases and fine particles that are hazardous to human health. Particulate matter can exacerbate or cause illnesses including asthma, heart attacks and lung cancer. Health impacts associated with flooding include drowning (especially in relation to flash flooding), injury and infectious diseases.

R7: Logistics and supply chain to site during flood/wildfire event

Sudden events such as wildfire or flooding affects the ability of employees to commute and access the project site resulting in a potential delay to operations. Disruptions to public transport are highly significant for commuters across Tanzania (Rentschler et al, 2021). In an average Tanzanian firm, about 69% of workers use the bus as their main mode of transport to work. This is followed by walking (20%, motorbike (5%), and bike (2.6%). About 41% of firms reported that damage to public transport infrastructure prevented workers from coming to work following a flood, including low intensity flooding during the rainy season (Rentschler et al. 2021).

Nearly all transportation modes (e.g. roads, transit, aviation, etc.) are vulnerable to extreme events such as floods and fire. During and following flood events, the structural integrity and the safety of transport infrastructure is compromised. Physical impacts include potholes or unpassable bridges that have economic consequences such as travel delays. Consequently, transport disruptions are key drivers of indirect losses for firms (Rebally et al, 2021). When roads are flooded and there are no feasible alternatives, workers are unable to come to work, and delivery of supplies and products is delayed, with cascading impacts through the entire supply network.

R8: Wildfire events caused by the project

An increase in hot and dry days may lead to an increase in the number of days that support wildfire. There is potential for the trains to start wildfires during construction and operations. During construction, the most common causes of wildfire are activities such as grinding and welding. During operations, inadequately maintained spark arrestors, faulty brakes and maintenance activities may contribute to wildfire.



19.2.3.3 Operations

R9: Damage to infrastructure/assets during wildfire event

Lineside fires, whatever their cause, can cause extensive damage to equipment, buildings, and other track side furniture. Fire can melt signalling equipment and damage the tracks causing major disruption to services. OLE equipment can also be affected.

R10: Heat-induced track buckling

Rails in direct sun can be around 20°C hotter than the air temperature. When steel rails heat, they expand and can start to buckle. Buckling leads to an increased incidence of temporary speed restrictions, which leads to downgraded performance, e.g. in southeast of England around 0.5 extra days per summer season are affected by temporary speed restrictions. By the 2040s, this is projected to increase by a factor of four (Dora, 2021).

R11: Drought creating potholes under track

Long periods without rain, coupled with high temperatures, can cause the ground underneath rail tracks to dry and shrink. The problem is exacerbated by trees and other vegetation sucking up water. This can create pothole-like defects. Potholes are a particular issue in clay soils that absorbs a lot of water and then shrinks when it is dry (Network Rail, 2022). Introducing temporary speed restrictions is often required in order to reduce force on the track.

R12: Heat stress to steel in bridges by thermal expansion

Rising temperatures may place increased stress on steel bridges with an increased potential for damage or collapse. Heat stress can cause buckling and cracking, which in may be exacerbated from the weight of trains. Additionally, expansion joints that allow the structure to expand and contract with temperature may become filled by sediment causing expansion restriction.

R13: River flooding affecting bridges

Bridge scour is the removal of sediment such as sand and gravel from around river bridge foundations due to hydraulic action. It is the foremost cause of bridge failure worldwide. Scour is affected by a variety of factors, including position and characteristics of the structure, flow conditions and the characteristics of riverbed, channel, and floodplain. These factors are subjected to high levels of uncertainty (Dikanski et al. 2014). More precipitation causing river flooding can increase the likelihood of scour affecting vulnerable river bridges. In the current design, flood return periods have been calculated for a 1:100-year event for large river bridges and for a 1:50 year event for bridges and structures over 2 m wide. Railway bridges are designed and assessed for a 200-year RP event. This means that the design river discharge for large bridges has a 1:100 (1%) probability of exceedance in any given year and for other bridges a 1:50 (2%) probability of exceedance. As described in Section 0, climate change is likely to increase flood return periods. Under a high emissions scenario, it is possible that a 1:100-year flood becomes a 1:25 year flood. Consequently, the current design may not be resilient under a changing climate.

R14: Flooding leading to track-inundation

As the potential for flooding increased it is possible that the track will become inundated and damaged, with the potential for medium or large-scale wash away of the track. Several areas of the track are on low lying land within drainage basins. The most remarkable is a nearly flat section of 30 km between Malongwe and the Nyahua siding where several minor drainage structures and a couple of larger structures cope with high



flow events. There has been history of MGR overtopping at this location. The extent to which the project is vulnerable to inundation depends on the level of flood protection measures, especially in low lying areas with bank erosion.

R15: Sag in overhead power lines

In hot weather, the overhead lines that provide power to the trains can expand and sag. To avoid damaging the lines, or pulling them down, temporary speed restrictions are applied, or trains are cancelled until repairs can take place. Fixed tensioned OLE is designed to operate in temperatures between -18 to +38°C. Temperatures over 38°C could lead to thermal expansion of the line resulting in sag. OLE design specifications can be exceeded with air temperatures below 38°C as OLE temperatures can be much higher than air temperatures (Palin et al, 2013).

R16: Extreme precipitation causing landslips

The future risk of landslips caused by large monthly rainfall is unclear. Across Tanzania very wet day frequencies are projected to increase with an increased risk of surface flooding. The area's most susceptible to landslips include borrow pits and quarries. At some locations borrow areas were dug immediately adjacent to the embankments that were under construction (side cutting). The presence of these pits has pre implicated in some previous embankment failures. Further analysis would be required to quantify the impacts and future vulnerability of heavy rainfall events on project infrastructure.

R17: Logistics and supply chain to site during flood/wildfire event

The climate related risks detailed in R6 on logistics and supply chain to site during the construction phase also apply here especially with regard to maintenance and repair. Given that the operations phase is a longer phase than the construction phase, the risk rating is higher as it takes into account operations in the long-term when climate impacts are likely to be felt more acutely,

R18: Wildfire events caused by the project

See R7, noting that during operations, inadequately maintained spark arrestors, faulty brakes and maintenance activities may contribute to wildfire.

R19: Precipitation related power outages

The project will be powered by energy from the grid through the TANESCO. To increase capacity, Tanzania is investing in several power generation projects, including the 2,115 MW Julius Nyerere Hydropower Plant (JNHPP). Hydropower performance, expressed as the annual likelihood (in %) of failing to meet JNHPP's monthly generation target, is affected by changes in hydrological patterns and extreme weather events. A study by Siderus et al. 2021 in the Rufiji River basin shows that under recent (1981–2010) climate conditions a failure to meet targets would occur once in 30 years (3.3%). Under a high emissions future, using the driest projection, a failure to meet the target may occur less than every two years (60%). These figures are supported by analysis by the International Energy Agency (IEA) (2020) who suggest the average capacity factor of African hydropower plants is likely to decrease by approximately 3% between 2060-99 compared to the baseline period (2010-19). It should be noted that there is deep uncertainty in the hydrological models used to understand how precipitation affects run off.

19.2.4 Potential financial impacts of climate risk

In line with EP4 guidance, this section presents the potential financial impacts of the climate-risks that have been identified in Section 19.2.3. Potential financial impacts are



identified at pre-construction, construction, and operations phases. Impacts are outlined in Table 19-21.

Project componen t	Climate-related risk	Potential financial impact				
Pre-construction	R1: Exacerbation of vulnerability due to land acquisition	 reputational risk could lead to reduced client and employee loyalty, loss of social licence to operate and divestment (note that under EP4 guidelines, only the project-related financial impacts of climate change are considered in this CCRA. 				
	R2: Exacerbation of water pressure on water resources for rural population	• reputational risk could lead to reduced client and employee loyalty, loss of social licence to operate and divestment (note that under EP4 guidelines, only the project-related financial impacts of climate change are considered in this CCRA.				
	R3: Exacerbation of soil erosion from construction activities	 reputational risk could lead to reduced client and employee loyalty, loss of social licence to operate and divestment (note that under EP4 guidelines, only the project-related financial impacts of climate change are considered in this CCRA. 				
	R4: Increased exposure of staff to heat related illness	 reduced staff productivity leading to increased costs from efficiency reduction Costs associated with delay to construction during down time on extremely hot days litigation costs associated with long-term worker health impacts 				
	R5: Reduced operational efficiency of machinery	 increased operating costs reduced productivity leading to increased costs from efficiency reduction 				
	R6: Worker health and safety risks during flood/wildfire event	 costs associated with delay to construction during down time litigation costs associated with long-term worker health impacts 				
	R7: Logistics and supply chain to site during flood/wildfire event	 cost associated with transport difficulties, supply chain interruptions workers unable to access site leading to increased downtime 				
Construction	R8: Wildfire events caused by SGR	 costs associated with delay to construction during down time costs associated with remedial action (repairs and replacement of assets) 				

Table 19-21: Potential financial impacts	of climate-related risks
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Project componen t	Climate-related risk	Potential financial impact			
		 litigation costs associated with damage to public and private assets, and potential for litigation related to personal injury/ loss of life reputational risk following loss of life/injury/damage to assets could lead to reduced client and employee loyalty and investor divestment (note that under EP4 guidelines, only the project-related financial impacts of climate change are considered in this CCRA. 			
	R9: Damage to infrastructure during wildfire eventR10: Heat induced track bucklingR11: Drought creating potholes under trackR12: Heat stress to steel in bridgesR13: River flooding affecting bridgesR14: Flooding leading to 	 costs related to the change in frequency and severity of delay through emergency speed restrictions and temporary suspension of railway operations more frequent/intense asset maintenance programmes with associated capital cost changes to depreciation rates and premature asset write-off additional unplanned capital investment, including increased expenditure to replace damaged assets. increased insurance premiums and potential for reduced availability of insurance on assets in "high-risk" locations increased capital costs for remedial work following damage to asset write-offs and early retirement of asset costs related to the change in frequency and severity of delay through emergency speed restrictions and temporary suspension of railway operations 			
erations	R17: Supply chain and logistics R18 : Train cause	see R6see R7			
do O	R19: Precipitation related power outages	 costs related to the change in frequency and severity of delays 			

19.2.5 Adaptation measures

This section presents adaptation (risk mitigation) measures that could be consider by the project. The CCRA uses the IPCC definition of adaptation: "the process of adjustment to



actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities."

Potential adaptation measures are outlined in Table 19-22.

Project componen t	Climate related risk	Potential adaptation (risk mitigation measure)		
Pre-construction	R1: Exacerbation of vulnerability due to land acquisition	TRC could consider how they can support furthe research into the impacts of climate change in Tanzania TRC could support creation of opportunities for local employment as livelihood diversification away from climate sensitive livelihood sectors (e.g. farming)		
	R2: Exacerbation of water pressure on water resources for rural population	Reduce water loss from evaporation, leaks, and waste		
	R3: Exacerbation of soil erosion from construction activities	 Some soil erosion will be inevitable. To minimize erosion, TRC could: Use construction phasing where the land is cleared one area at a time as needed, in contrast to clearing the whole site, Plan excavations for periods of minimal rainfall so soil is not exposed during rain Cover disturbed soil with vegetation or mulch Reduce soil compaction by limiting use of heavy machinery 		
Construction	R4: Increased exposure of staff to heat related illness	The Health and Safety Management Plan states that employees shall have access to cool potable water; shaded areas shall be provided for rest periods; and First Aid equipment will be provided on site including treatment for dehydration e.g. electrolytes. The TRC could further examine Occupational Safety and Health plans including development of heat-health action plans, and health and safety regulations such as: compulsory labour rest times on hot days appropriate dress codes changes to working hours information and monitoring campaigns.		



Project componen t	Climate related risk	Potential adaptation (risk mitigation measure)			
	R5: Reduced operational efficiency of machinery	Assess possibility of using heat sensitive equipment in cooler parts of the day (i.e. not between 1-3 pm)			
	R6: Worker health and safety risks during flood/wildfire event	Update ERP Look at evacuation plans / flood management plan Consider developing occupational wildfire smoke protection rules			
		Consider measures to ensure key personnel are onsite before potential travel disruptions due to flooding			
	R7: Logistics and supply chain to site during flood/wildfire event	strong relationships with multiple suppliers to secure priority services at pre-determined prices Provide additional storage capacity for products and raw materials in case of disruption to supply Identify multiple transport routes			
		infrastructure Engage with government and transport providers to ensure infrastructure is resilient under a changing climate			
	R8: Wildfire events caused by SGR	Implement fire hazard reduction plan and the fire preparedness plan, including: Requirement that official personnel be responsible for spotting and reporting fires or smouldering areas Ensure that any vegetation control measures are followed by removal of combustible materials			
	R9: Damage to infrastructure during wildfire event	Review of maintenance regimes to include extreme temperatures Technical modification to facilities to allow operation during warmer average temperatures			
	R10: Heat induced track buckling	Update relevant policies, procedure, guideline, critical risk control standard			
Operations	R11: Drought creating potholes under track	Monitor sites where potholes might be of concern and consider removing trees/vegetation that are absorbing water and drying out embankments Consider replating drought resistant trees at distance from railway			



Project componen t	Climate related risk	Potential adaptation (risk mitigation measure)				
	R12: Heat stress to steel in bridges	Review of maintenance regimes to include extreme temperatures Technical modification to facilities to allow operation during warmer average temperatures Update relevant policies, procedure, guideline, critical risk control standard				
	R13: River flooding affecting bridges	Improve scour resilience during routine renewal of scour protection systems (design life c 20 years) Design future bridges to withstand climate				
	R14: Flooding leading to track- inundation	change / consider flood models that account for 1:50 year flood event when assessing final designs Consider planting rows of drought-resistant trees				
	R154: Sag in overhead powerlines	Ensure overhead lines have auto-tension systems with balance weights or springs to adjust to different temperatures				
	R16: Extreme perception causing landslide	Maintain register of where side/borrow pits have been excavated and infilled. Include this in site inspections. Consider planting of slopes to provide stability/reinforcement.				
	R17: Supply chain and logistics	See R6				
	R18: Train cause wildfire events	See R7				
	R19: Precipitation related power outages	Develop contingency planning for power outages SGR trains will have inbuilt power-saving systems to keep them charged for more than a one hour during power cuts.				

19.2.6 Summary

This CCRA has not identify any vulnerabilities severe enough to halt development of the project. It is important to recognise that rail operators in Tanzania and the African continent more broadly already operate in extreme conditions and at the boundaries of engineering capability. Additionally, many of the future risks identified in this report may already have been accounted for in the project design.

By the end of the life of the project, climate hazards are unlikely to have manifested in a way that presents a high-risk. Nevertheless, special attention should be paid to the evolving science especially on climate projections. It will be important for TRC to continue to assess climate risk throughout the lifetime of the project.



As with all companies operating in extreme environments, the physical impacts of climate change should be included on the corporate risk register and the commitments register. It is also recommended that a project adaptation management plan is developed before the start of construction and operation, and before financial close. It is advised that during the operations phase adaptation management plans are reviewed and amended if deemed necessary until the end of the loan period. Additionally, the implications of climate change could be assessed across the business model. Companies should disclose the assessment results to existing and potential investors and to wider stakeholder groups.



20 OCCUPATIONAL HEALTH AND SAFETY

20.1 National and project context

The construction sector is one of the most hazardous sectors globally, as well as in Tanzania. The construction sector in Tanzania employs 9-11% of the workforce yet is responsible for 25-42% of workforce fatalities (on par with the average of 25-40% of global fatalities). The Tanzanian construction sector accounts for the highest proportion (23.7%) of the injuries and fatalities recorded across all economic sectors. Notably, when combined with the portion of injuries and fatalities of the transportation sector (the second highest of the economic sectors) this equates to 44.3% of work-related injury and fatality. The project should therefore be considered an extremely high-risk project from a H&S perspective (Aloyce *et al.* 2022). Several factors contribute to the current high levels of incidents.

At the surface it appears that the main cause of accidents and fatalities is due to individual unsafe practices and negligence regarding safety procedures by workers. Further investigation by Aloyce et al. (2022) revealed that low levels of training and experience are a significant contributing factor, however even when detailed training is provided and safety rules are in place, there are still additional factors at play. Key organisational mechanisms (such as policy statements) are either not put in place or not implemented. The construction sector also relies on labour-intensive methods requiring a large workforce, which is more difficult to manage and results in negligence and non-compliance with H&S rules. Management can often neglect safety in favour of working fast or without H&S rules to meet deadlines. The industry is regulated however the labour force is often informally recruited as wage-for-labour workers without contract and are not protected from losing their jobs and may be reluctant to advocate for safety to management.

H&S management of the project will need to pay special attention to demonstrating policy commitment, sufficient systems and processes, extensive training and adoption of H&S rules and procedures, best industry practices, and novel approaches to manage that large workloads are integrated into the projects existing H&S management systems.

20.2 Types of hazards potentially associated with the project

The construction of a new railway line that includes stations, bridges, culverts, and vehicle/livestock crossings etc. presents significant 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 general public, comply with Tanzanian H&S legislation and LAS, as well as to ensure that the moral and ethical requirements of all interested parties are met.

Table 20-1 illustrates the major activities during the construction and operational phase of the project.



Construction activity	Operational activity
Rail lines	Rail and infrastructure maintenance
Culverts & drainage	Train operation
Tunnels	Station operation
Bridge and overpasses	Crossings (vehicle, pedestrian & livestock)
Elevated structures	
Crossings (vehicles, pedestrians, livestock)	
Stations	
Electrical supply	
Signals and communications	
Stone quarrying	
Sand mining	
Community re-location	
Road and traffic diversions	
Blasting	
Excavation	

Table 20-1: Construction and operational activities that may cause H&S hazards

The hazards associated with the activities identified in Table 20-1 need to be managed effectively, thus a detailed hazard/risk assessment is currently in process by YM. It is recommended that an external audit (by an independent consultant or the Lender) of the H&S management system be conducted regularly to demonstrate that the H&S management system complies with relevant legal and governance requirements, provides sufficient interventions to mitigate the specific organisational / operational issues identified in Table 20-4, meets compliance targets and demonstrates material, timeous improvements to the system in response to H&S monitoring results/statistics.

The current H&S Management Plans that has already been developed will be enhanced by addressing the additional issues identified in this chapter of the ESIA.

The various types of hazards that can be associated with the project are described in Table 20-2.

Category	Examples of hazards that could be encountered
Physical	Noise, illumination, temperature extremes, vibration, mechanical hazards, electrical, falling objects, confined spaces, non-ionising radiation, ionising radiation, moving machines, working at heights, fires, explosions, engulfment, moving trains and other heavy mobile equipment, animal and

Table 20-2: Examples of potential hazards per hazard category



Category	Examples of hazards that could be encountered			
	vehicle crossing at train lines, rock falls, failure of lifting equipment etc.			
Chemical	Dusts, mists, vapours, gasses etc.			
Biological	Water and airborne pathogens and associated diseases, sexually transmitted diseases, vector borne diseases etc.			
Technology (failure)	Failure of complicated mechanical, electrical and electronic systems. This includes failures caused by operators of the equipment.			
Social & psychosocial	General violence, GBVH, SEA, community protests, social and work stress, community relocation stress, etc.			
Ergonomic	Repetition, awkward posture, forceful motion, stationary positions, direct pressure, work stress, person machine interface, control equipment design etc.			
Natural phenomena	Lightning, floods, high winds, dangerous animals (snakes etc), outdoor heat and cold etc.			

20.3 High level risk assessment

To gain a broad perspective of the hazards and risks that need to be addressed in the design of a H&S management system a high-level risk assessment was conducted using a simple low, medium and high-risk rating system (based on professional judgement). This is presented in Table 20-3. This was used to assist in the identification and characterisation of impacts and determination of mitigation measures. Impact assessment and mitigations identified are included in the Aspects and Impacts Matrix in Appendix 7.

Phase	Activity Hazard	Physical	Chemical	Biological	Technology (Failure)	Social & Psychosocial	Ergonomic	Natural Phenomena
	Rail line	High	Medium	Low	Medium	Low	Medium	Medium
	Bridge and overpasses	High	Medium	Low	Medium	Low	Medium	Medium
	Culverts and drainage	High	Medium	Low	Medium	Low	Medium	Medium
	Tunnels	High	Medium	Low	Medium	Low	Medium	Medium
Construction	Elevated structures	High	Medium	Low	<mark>Medium</mark>	Low	Medium	Medium
	Crossings (vehicle, pedestrian & livestock)	High	Medium	Low	Medium	Low	Medium	Medium
	Stations	High	Medium	Low	Medium	Low	Medium	Medium
	Electrical supply	High	Low	Low	Medium	Low	Medium	Medium

Table 20-3: High-level risk assessment



Phase	Activity Hazard	Physical	Chemical	Biological	Technology (Failure)	Social & Psychosocial	Ergonomic	Natural Phenomena
	Signal & communication	High	Low	Low	Medium	Low	Medium	Medium
	Quarrying	High	High	Low	Medium	Low	Medium	Medium
	Sand mining	High	High	Low	Medium	Low	Medium	Medium
	Community re-location	Low	Low	Low	Low	High	Low	Medium
	Road & traffic diversions	Medium	Low	Low	Medium	Low	Medium	Medium
	Blasting	High	High	Low	Medium	Low	Medium	Medium
	Excavating	High	High	Low	Medium	Low	Medium	Medium
Operation	Rail and infrastructure maintenance	High	Medium	Low	Low	Low	Medium	Medium
	Train operation	High	Medium	Low	High	High	High	Medium
	Station operation	Medium	Low	Low	High	Low	Low	Medium
	Crossings (vehicle, pedestrian & livestock)	High	Low	Low	High	Low	Low	Medium

20.4 Health and safety management systems

To mitigate high level risks identified in Table 20-3 above, the project H&S management system should be implemented. Furthermore, the management system must meet the following requirements:

- address all local Tanzanian legislative requirements including the project specific regulatory authorisations and requirements
- meet any specific H&S requirements that the lender may attach to the project finance
- meet the IFC EHS general guidelines (specifically IFC guidelines 2, 3 & 4)
- meet the IFC EHS guidelines for railways
- address any issues raised during the public participation process.

It is recommended that the H&S management system be designed around the requirements of ISO 45001:2018 as this system is internationally recognised and can be customised to include all the different requirements as identified above. The core strategy to manage the H&S risks is as follows:

- identify the current Tanzanian H&S legal requirements
- identify the various requirements of all interested parties
- conduct a detailed hazard identification and risk assessment process of each of the project's activities
- design a H&S management system that addresses the identified risks and meets the overall goals and meets the IFC guidelines (general & railways).



20.5 Health and safety management system design

The health and safety performance will be driven by a H&S policy that will provide direction and motivation to ensure the organization's goals are met. The design of the H&S management system should follow the ISO 45001:2018 model as shown in Figure 20-1. The numbers in brackets are the ISO 45001:2018 clause numbers. Figure 20-2 provides the H&S policy hierarchy required for an effective H&S system. The management policy should include the elements outlined in Figure 20-1, which relate to planning, implementation and continuous review and improvement of the system, i.e. the "Plan-Do-Check-Act" (PDCA) process.



Figure 20-1: H&S management system model recommended in ISO 45001:2018



Figure 20-2: H&S system hierarchy



Table 20-4: Key elements of an H&S management systems planning, implementation
and continuous review and improvement

PDCAia (Section) Procedure description		IFC H&S Guideline	ISO 45001 Clause	Addessed in current H&S plan	
Context of the organisation	Manual management system structure and scope	-	4.1 – 4.4	Yes	
Loodorahin (naliay	H&S policy	-	5.2	Yes	
and organizational roles, responsibilities and authorities)	Organizational roles, responsibilities, and authorities (includes consultation and participation of workers)	-	5.1 & 5.3 & 5.4	Yes	
	Actions to address H&S risks and opportunities	General 2	6.1.1 & 6.1.2 & 6.1.4	Yes	
Planning	Compliance obligations (legal and other such as IFC, community etc)	-	6.1.3	No	
	H&S objectives and planning actions	-	6.2	No	
	Resources, competence and awareness	General 2.2	7.1 & 7.2 & 7.3	Yes	
Do (support and	Internal and external communication (including stakeholder engagement and communication and grievance management)	General 2.2	7.4	No	
operation	Documented information	-	7.5	No	
	Operational planning and control	-	8.1	Yes	
	Emergency preparedness and response	General 3.7	8.2	Yes	
	Monitoring, measurement, analysis and evaluation	General 2.9	9.1.1	Yes	
(performance	Evaluation of compliance	-	9.1.2	No	
evaluation)	Internal audit	-	9.2	No	
	Management review	-	9.3	No	
Act (improvement)	Nonconformity, corrective action and continual improvement	-	10.1 – 10.3	No	
Additional procedures	Noise and vibration management		8.1	Yes	



PDCAia (Section)	Procedure description	IFC H&S Guideline	ISO 45001 Clause	Addessed in current H&S plan	
	Rail line construction H&S specifications	General 4.2 & 4.3 railways guideline	General 4.2 & 4.3 railways guideline		
	Hazardous chemical substances management	General 2.4	8.1	Yes	
	Community health and safety (including worker influx)	IFC PS 4	8.1	No	
	Gender based violence / sexual exploitation and abuse	IFC PS 2	8.1	No	
	Contractor management	General guidelines	8.1	Yes	
	Labour management (including local employment and worker accommodation)	IFC PS 2	8.1	No	
	Transportation and traffic management	General 3.4	8.1	No	
	Site clearance and rehabilitation	IFC PS 5 & 6	8.1	No	
	Security management	General guidelines	8.1	No	
	Silica monitoring and medical surveillance (disease prevention)	General 3.6	8.1	No	
	Working at heights & confined space entry	General 4.2	8.1	Yes	
	Use & control of explosives	General 3.5	8.1	Yes	
	Hazardous energy control (electrical lockout, suspended loads etc)	General guidelines	8.1	Yes	
	Hazardous substance storage, use and control & transport Mining & quarry safety Scaffolding and formwork safety	General 3.5	8.1	Yes	
		Mining guideline	8.1	Yes	
		-	8.1	No	
	Structural safety of project infrastructure	General 3.2	8.1	No	
	Rail line operations	Railways 1.1	8.1	No	



PDCAia (Section)	Procedure description	IFC H&S Guideline	ISO 45001 Clause	Addessed in current H&S plan
	Bridge, tunnel culvert, crossing construction safety procedure	General 3.2	8.1	Yes
	Personal protective equipment	General 2.7	8.1	Yes
	General facility design	General 2.1	8.1	No
	Control of physical and biological hazards	General 2.3 & 2.5	8.1	Yes
	Radiation hazards	General 2.6	8.1	No
	Specialized hazardous environments	General 2.9	8.1	No
	Community re-location procedure	IFC Performance Standard 4	8.1	No
	Managing pedestrians, traffic and animals at crossings	General guidelines	8.1	No
	Transport of dangerous goods by rail or road near local communities	General guidelines	8.1	No
	Protecting communities living close to a rail line.	Railways guideline	8.1	No
	Drug and alcohol policy	General guidelines	8.1	Yes

20.6 H&S mitigation measures

The mitigation hierarchy for H&S risks and impacts is provided in Figure 20-3 and the most significant risks on the project should be managed through elimination as a priority, followed by substitution, engineering controls and admirative controls.





Figure 20-3: H&S system hierarchy

The hazard register that will be developed by the project will include a description of the hazard, the potential consequence, and the risk. Furthermore, the mitigation measures will be identified using Figure 20-3 above as a guide.

20.7 Applicable legislation

The following list of legislation has been identified. As part of the H&S management system design a legal register will be developed that lists all applicable legislation. The most important applicable H&S legislation is listed below:

- The United Republic of Tanzania The Occupational Health and Safety Act (2003)
- The United Republic of Tanzania The National Health Policy (2003)
- The United Republic of Tanzania The Public Health Act (2009)
- The United Republic of Tanzania The Industrial and Consumer Chemicals Act (2003)
- The United Republic of Tanzania The Noise and Vibration Regulations (2011)
- The United Republic of Tanzania The Explosives Act (1963)
- The United Republic of Tanzania The HIV 7 Aids (Prevention and Control) Act (2008)
- The United Republic of Tanzania The Employment & Labour Relations Act (2004)
- The United Republic of Tanzania The Mining Act & Regulations (2010)
- The United Republic of Tanzania The Railways (Safety Standards of Infrastructure & Rolling Stock) Regulations (2018).

The H&S management system will be designed around these legal requirements as well as the other requirements that will be identified during the project.

The control of hazards associated with a project of this nature is extremely complex. It is highly likely that hundreds of hazards will be identified and controlled at the activity and task level. A well designed, implemented, and managed H&S management system will meet the goals of protecting all workers and other vulnerable persons.



21 TRAFFIC

21.1 Road classification

The functional classification for paved and gravel roads in the AoI and the greater Singida and Tabora regions as provided by the Tanzania National Roads Agency (TANROADS) is presented in Figure 21-1 below.

21.1.1 National roads

National roads are paved and unpaved trunk roads that link two or more regional headquarters, or international roads that link regional headquarters and another major city, town, or major port outside of Tanzania.

The project intersects the B129 national road at 567 +400 km where there is a quarry and crosses road B141 at 572+300km km in Manyoni. It further crosses B141 at 614+100 km and 615+000 km, at 787+100 km in Uyui, 808+600 km, 814+200 km near the Tabora camp and at 817+00, 823+500 km, 818+700 km, 826+700 km, 930+000 km.

21.1.2 Regional roads

Regional roads are secondary roads that connects a trunk road and district or regional headquarters and district headquarters.

The SGR crosses district roads between 573+700 km and 573+800 km, at 587+500 km and 587+700 km, 592+800 km, 688+500 km in Tura and 712+500 km.

21.1.3 District roads

District roads are collector roads linking a district headquarters and a division centre, these roads are within the urban area carrying traffic predominantly originating and destined out of town and links either regional or trunk roads.

SGR crosses district roads at 590+600 km at 608+500 km, and 608+600 km.

21.1.4 Feeder roads

Feeder roads are roads within the urban area that link the collector roads and other minor roads within the vicinity and collects or distributes traffic between residential, industrial, and principal business centres of the town.

The project crosses the feeder road at 599+900 km and at 600+900 km, 820+900 km and 821+500 km.

21.1.5 Community roads

Community roads are within the village or a road that links one village to another. The project crosses smaller community roads at various pints throughout the alignment.




Figure 21-1: Trunk and regional roads network (source: TANROADS RMMS knowledge centre, March 2018)



21.2 Construction phase

During the construction phase, some additional traffic will be generated for bringing in construction material and equipment as well as transportation of workers. The traffic will primarily come from Dar es Salaam, using trunk and regional roads. Although the train stations are located outside of urban areas, the below potential impacts need to be considered.

The potential impacts identified for the construction are listed below:

- impact on the road network due to the transportation of workers and construction materials, however, this will not be permanent
- generation of dust emissions during construction
- abnormal loads vehicles need to be considered in respect of the road dimensions as they could slow down traffic
- pedestrians and motor cyclists will be at greatest risk of serious injury from collisions with moving construction vehicles
- land acquisition will restrict access to access routes such as agricultural lands or pastures and social services
- access routes can be interrupted due to the temporary closure of site for removal of redundant features and obstructions
- the road construction activities will interfere with the normal way of life of the local communities including movement across the road for domestic animals and increased risk of traffic accidents during construction
- traffic congestion during construction in peri-urban and urban areas
- increased traffic accidents
- activities associated with quarrying will result in increased truck traffic between aggregate extraction and processing activities.

The existing Traffic Management Plan for the project must be implements and the Proponent must ensure that adequate measures for the following are included/updated:

- identification of all access routes and roads
- location of quarries and borrow pits
- identification of sensitive receptors (schools, kindergartens, medical centres etc.) and commitment to avoid / limit traffic in these locations in the phase of access routes and roads identification
- risk assessment of each of the access routes and roads used, with identification of high-risk locations
- structuring of a comprehensive set of control and mitigation measures for traffic management and control, based on each individual risk assessment
- structuring of a comprehensive training program for drivers and community traffic safety awareness.

Impact assessment and mitigations identified are included in the Aspects and Impacts Matrix in Appendix 7.

21.3 Operational phase

It is not envisaged that the traffic will increase during the operational phase, as construction would have been concluded. Section 11.5.1 defines traffic risk for operation phase as a major and determines mitigation measures. Impact assessment and mitigations identified are included in the Aspects and Impacts Matrix in Appendix 7.



21.4 Cumulative traffic impacts

No cumulative impacts are envisaged as the project will decrease road traffic due to increased use of the railway. However, monitoring should continue throughout the life cycle of the project to identify and implement interventions should they be required.



22 ENVIRONMENTAL AND SOCIAL IMPACTS

The IFC PS1 (S5) requires proponents to establish and maintain an environmental and social management system (ESMS) to govern its activities in relation to the project receiving funding. To establish a good ESMS, measures commensurate to the nature and scale of the impacts and AoI of the project. This requires ESIA process to be undertaken that will identify, characterise, and analyse potential impacts and generate mitigation and/or management measures and actions, and evaluate the significance of residual impacts under a post-mitigation scenario (PS 1-GN 23).

22.1 Impact assessment methodology

Impacts associated with the project were identified by subject matter and assessed in terms of the magnitude of the impact, sensitivity of the receptor and the likelihood of the impact occurring. Determination of the magnitude of identified impact and sensitivity of receptors was guided by rating categories with defined criteria that wholistically characteristics of the project and the specific impact, including:

- whether the impact is positive or negative, direct or indirect, reversible or irreversible
- the duration of the impact (short-, medium-, or long-term)
- the scale of the impact (local/community, regional, national, or international scale)
- whether the is resilient or vulnerable to the project activities, how easily it can absorb changes, or recover from impacts.

The full impact methodology is included in Appendix 6.

22.2 Potential impacts identified

This section summarises the impact assessments from the specialist sections above. For more information on the characteristics of each impact, refer to the respective sections above. Detailed mitigation measures to avoid, reduce, mitigate or offset/compensate for impacts are included in the ESMP, and summarised in Section 23.

Impacts are separated into positive and negative and into the construction and operational phases. Pre-construction and design activities are not considered to have impacts different to, or of higher magnitude than the construction phase and should be considered to be addressed by the construction impacts tables. Similarly, demobilisation impacts are also considered similar to/ included in the construction impact tables.

Commissioning is considered to have similar impacts to the construction phase, since both include the movement of vehicles, machinery, equipment etc. along the alignment. Moreover, by commissioning, all required structures to protect the safety of people and animals during operation should have been constructed (such as crossing, signalling), thus potential impacts of commissioning are considered covered by the construction phase impacts, as well as in the operational phase impacts.

22.2.1 Positive impacts

Positive impacts of the project include employment opportunities, increased incomes and potential for business and trade between the project and communities, including for IPs. The effect is moderate to major and could be substantially enhanced through measures such as procurement policies that support providers of goods and services from the local



communities, and communities and/or suppler development programmes. Notably, there will be a major positive impact of net GHG emissions reduction in the wider area, due to facilitating passenger and freight transport by rail, rather than road vehicles, which will contribute significantly towards climate change mitigation and Tanzania's NDC commitments (contributing 4.0 - 4.7% of GHG reductions needed in the energy and transport sector).



Table 22-1: Positive impacts (construction and operation)

Aspect (Infrastructure and activities)	E&S theme	Sub-theme/ topic/ issue	Impact	Impact significance/ enhancement effect (considers significance and likelihood)
Construction phase				
Construction activities	Social	Livelihoods	Economic empowerment - employment creation and capacity transfer	Major
Construction activities	IP	Livelihoods	Economic empowerment - employment opportunities	Major
Construction activities	IP	Livelihoods	Economic empowerment - demand for livestock and local produce due to increased demand for food for labour force	Moderate
Quarries and borrow pits	IP	Water resources	Establishment of quarry sites and borrow pits during the construction phase - provides potential new water sources for livestock and people, provided water is potable	Moderate
Operational Phase				
Railway service operation	Social	Socio-economic	Economic upliftment augmented haulage, public transit and associated economic growth	Major
Railway service operation	Social	Socio-economic	Job creation and capacity building - creation of employment opportunities and capacity development	Major
Railway service operation	IP	Socio-economic	Railway transport services (presence of a railway and access routes) - direct positive benefit of enhanced transport route network. positive secondary impacts of increased access to and stimulation of markets for livestock and local produce	Moderate
Quarries and borrow pits	IP	Water resources	Creation of new water sources for livestock and people - due to presence of quarry sites and borrow pits during the operation phase	Minor



Aspect (Infrastructure and activities)	E&S theme	Sub-theme/ topic/ issue	Impact	Impact significance/ enhancement effect (considers significance and likelihood)
Railway service operation	IP	Socio-economic	Employment opportunities	Minor
Operational - general	IP	Socio-economic	Economic growth - enhancement of Markets for livestock and local produce due to improved railway network	Minor
Railway operation	GHG and CCRA	GHG	Net GHG emissions decrease in the wider area, due to facilitating passenger and freight transport by rail, rather than road vehicles	Major
Operational - general	Cultural heritage	Socio-economic	Improved means of transport for diverse population	N/A
Operational - general	Cultural heritage	Cultural heritage	Relocation of cultural materials in close proximity to cultural centres and museums	Major



22.2.2 Negative impacts – construction phase

Around a quarter of the negative impacts identified were found to have a pre-mitigation impact risk rating (which is a combination of impact significance and likelihood of impact occurring) of no effect, negligible or minor. All of these impacts have mitigations and monitoring measures within the ESMP that will manage these impacts satisfactorily, as well as monitor should any impact occur that was not reasonably foreseeable at the ESIA stage. These have been listed in Appendix 7.

Of the remining impacts, those that had an impact risk of moderate or major – all but three can be mitigated to an impact risk of minor, negligible or no effect. Specific mitigation measures required in order to mitigate these impacts to an acceptable level are included in Appendix 7 and the stand alone ESMP.

In terms of the three impacts that will remain moderate even after mitigation are presented in Table 22-2. These relate to Itigi thickets. Itigi thickets grows on unique, highly specialized, and sensitive soils that once disturbed, by farming or development, would suffer irreversible damage that prevents thicket regeneration. Therefore, the likelihood of rehabilitation of disturbed areas is low unless soils can be restored, and development footprint is kept to a minimum. This habitat is also essential habitat for a diverse range of species and is a corridor for large mammals, thus viaducts or similar intervention that allows connectivity of the habitat across the ROW must be investigated. Rehabilitation targets must be set and monitored to reduce the potential impact from moderate to low. Should rehabilitation targets not be met, an offsetting mechanism will be required to improve or formalise protection of Itigi thickets and/or expand its range (through rehabilitation) in other areas where soil disturbance has not occurred/is less.



Table 22-2: Negative impacts (construction phase) with moderate residual impact

ASPECT (Infrastructure and activities)	E&S theme	Sub-theme/ topic/ issue	Impact	ASPECT (Infrastructure and activities)	E&S theme	Sub- theme/ topic/ issue	Impact	RECOMMENDED MITIGATIONS /ENI
Enabling Works (Site clearance, vegetation clearing, stripping, grubbing, stockpiling)	Biodiversity	Habitat Loss	• Habitat Loss - Natural Habitats - Itigi Thickets	Major	Major	Moderate	Moderate	Implement the measures in the section 'Rehabilitation/Restoration' in the YM E the below mitigations identified in the E maintain works within the project ROW of track alignment) and prevent encroa the access roads will be a width of 5 m exceed 5 m to each side of the perman- the allowed construction buffer for the
Enabling Works (Site clearance, vegetation clearing, stripping, grubbing, stockpiling)	Biodiversity	Habitat Loss and Fragmentation, Ecosystem Structure and Function, Ecosystem Processes	 Direct Impact of Habitat Loss and Fragmentation due to removal of woodlands and other natural habitats (Itigi Thickets). Secondary Impact to Ecosystem Processes - Impacts on Wildlife Corridors (Refuge Areas for Southern Ground Hornbill Impact on Foraging Ground for Elephant and Leopard) 	Major Moderate	Major Major	Moderate	Moderate	30 m buffer from the point of construction buffer for the s 30 m buffer from the point of construction areas borrow pits and quarries (but re- considered)minimise the distance betwe possible to avoid a wide area of degrade ensure that specified buffers for constru- minimised prepare a post construction Habitat Ree BAP and consult with experts on best to consider research and field trials with to restoration should also aim to enhanced range restricted trees and shrubs to act Gain for Protected Areas close to the SGR, so Management Measures so that they has monitored for improvement in the future natural establishment of new seasonal avoid removal of Itigi Thicket where feas for management of Itigi Thicket consult with local authorities including conservation and afforestation program planting to reduce fragmentation and re Restoration Plan for NNL/NG design options to assess all feasible m located no further than 5 km from the k

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- ns titled 'Vegetation and Topsoil Removal' and Biodiversity Management Plan, which includes ESIA:
- / which is 60 m (30 m either side of the mid-point achment onto neighbouring land
- n. The allowed construction buffer must not nent road footprint
- stations, bridges and culverts will not exceed a ion.
- r temporary locations including camps, laydown siting to avoid Itigi Thicket should be highly veen the SGR and the existing MGR wherever ded habitat between the two railway lines
- ruction are maintained so that the footprint is
- estoration Plan based on requirements of the techniques for restoring Itigi thicket. This should to monitor restoration options
- e degraded habitats with planting of endemic or chieve No Net Loss and where necessary Net
- seek to bring new areas under IUCN ave conservation objectives and can be re
- l wetland habitats from borrow pits and quarries asible and implement requirements of the BAP
- TFS, TAWA and LGAs to establish a nme and to identify most suitable areas for tree estore wildlife corridors as part of the Habitat
- nethods for safe wildlife crossing, these should be known crossing points



22.2.3 Negative impacts – operational phase

Around a half of the negative impacts identified were found to have a pre-mitigation impact risk rating (which is a combination of impact significance and likelihood of impact occurring) of no effect, negligible or minor. All of these impacts have mitigations and monitoring measures within the ESMP that will manage these impacts satisfactorily, as well as monitor should any impact occur that was not reasonably foreseeable at the ESIA stage. All the remining impacts, those that had an impact risk of moderate or major under a pre-mitigation scenario, can be mitigated to an impact risk of minor, negligible or no effect. These have been listed in Appendix 7.

Specific mitigation measures required in order to mitigate these impacts to an acceptable level are included in Appendix 7 and the stand alone ESMP. Some mitigation measures require further studies or preparation of specific management plans, and these are summarised in Section 23. The assessment categories and ratings for each individual impact are available in an Excel tool called aspects and impacts matrix. This will be an important tool to understand what changes in magnitude, receptor sensitivity or likelihood need to be brought about by each specific mitigation in order to achieve a minor or lower impact risk, and these should form part of setting up the CESMP and performance targets.



23 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

An environmental and social management plan (ESMP) for the project has been developed in accordance with the following requirements:

- Environmental Management Act No. 20, (2004), Cap 191
- Tanzania EIA and Audit Regulations 2005, amended in 2018
- IFC PS 1.

The ESMP entails the plan for managing impacts during the different phases of the project and integrates all mitigation measures recommended by the UDSM ESIA Lots 3 and 4 (where appropriate) as well as findings of the current RSK ESIA Lots 3 and 4 study.

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.

23.1 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 procedures in the existing YM ESMS
- roles and responsibilities for implementing the ESMP
- mitigation measures.

23.2 Key recommendations of the ESIA

The ESMP for the project is a standalone document that addresses environmental and social impacts. Below are some of the key recommendations that it covers. Please refer to the detailed ESMP for detailed mitigation measures for the specific environmental and social themes.

- inclusion of the condition that should it not be possible to rehabilitate Itigi thicket satisfactorily due to its sensitive nature, an offset will be required to preserve remaining thicket and reinstate it in areas where soils have not been disturbed, still in sufficiently good condition to support this habitat type
- invasive alien species management plan

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- construction and operation habitat restoration plan, with specific measures for wetlands, Miombo woodlands and Itigi thickets. Measures for not net loss as a minimum should be included but net gain should be an objective and could be made a key performance indicator.
- prepare and implement a RAP and LRP, as well as severance management plan
- water resources assessment including hydrocensus for ground water, with monitoring and measures for ground water and surface water
- prohibition of child labour as a tender qualification criterion
- safety management system (SMS) for the project's operational phase and the preparation of a safety plan
- influx management plan
- add cultural heritage management plan to chance find procedure, recruit cultural heritage monitors (CHM) and prepare cultural heritage management plan
- GRM
- waste management plan
- provide voluntary counselling and testing (VCT) centres for HIV/AIDs at the workplace
- develop/update a local employment policy and strategy
- siting of WWTP such that it is downwind of camp facilities and adjacent communities
- develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- policies and plans need to be reviewed to be specific to Lots 3 and 4 in relation to HIV&AIDS policies, child labour, influx management, HR policy, recruitment policies, local social development
- develop a soil management plan and reinstatement plan
- develop a pollution prevention plan
- develop a natural resource management plan
- hazard/risk assessment (considering the size of the project, there is a higher chance of hazardous incidents).



24 CUMULATIVE IMPACT ASSESSMENT

24.1 Introduction

This chapter assesses cumulative impacts. Cumulative impacts 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).

24.2 Approach and Methodology

Cumulative impacts have been 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 24-1. This approach is described in more detail in the sections below.

Figure 24-1: IFC cumulative impact assessment process



Source: IFC (2013)

It should be noted that the GPH suggests that government and regional planners have ultimate responsibility for CIA.

24.2.1 Defining the area of influence (Step 1)

For the CIA, the same AOI is used as the project impact assessment described in the previous chapters.

The temporal boundary of the CIA is the lifetime of the project as this is the duration of potential impacts on receptors.

In addition, a precautionary study area around the project area in the five districts (Manyoni,

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Uyui, Sikonge, Tabora Urban and Nzega) traversed by lots 3 and 4 of the SGR has been used to identify third party projects that have the potential to lead to cumulative impacts. The study area, as shown in



, is a radius of approximately 10 km around the SGR project footprint.

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.





Figure 24-2: CIA study area around the project site for identifying third party projects

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24.2.2 Stakeholder engagement (Step 2)

Stakeholder engagement has been carried out with national, regional, district and community level stakeholders (see Chapter 8 and Appendix 3). The output from this engagement has been used to identify environmental and social concerns and potential sources of cumulative impact in the AOI and study area.

24.2.3 Valued components (Step 3)

The IFC GPH defines valued components (VCs³⁵) as "environmental and social attributes that are considered important in assessing risks", (IFC, 2013). These attributes may be:

- physical features, habitats, wildlife populations (e.g., biodiversity)
- ecosystem services
- natural processes (e.g., water and nutrient cycles, microclimate)
- social conditions (e.g., health, economics), or
- cultural aspects (e.g., traditional spiritual ceremonies).

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, see Table 5.3 of the SEP, Appendix 3.

A list of the identified VCs used for the CIA are presented in Table 24-1. The baseline condition of each VC included in the previous chapters above. Note, not all the receptors included in Chapters 10 - 21 have been included in the CIA, only those that meet the criteria outlined above.

The thresholds, limits of acceptable change, or preferred condition required by the GPH are defined in Table 24-1 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.

³⁵ Also known as receptors



Table 24-1: VCs considered in the CIA

vc	Reason for inclusion	Threshold / limit of acceptable change / preferred condition		
Physical environment				
Air quality	The health and wellbeing of humans and biodiversity is associated with the ambient air quality in the project area. Generation of dust in particular was a concern raised by stakeholders, see Appendix 3.	No project environmental standard (see Section 16.4.3) is exceeded from the combined effects of the project and other developments.		
Climate	This VC is the global climate, including greenhouse gas emissions.	Tanzania's ability to meet its emission reduction target published as part of the UNFCCC's Paris Agreement is not impacted.		
Noise	The health and wellbeing of humans and fauna is associated with the ambient sound level in the project area.	No project environmental standard (see Section 15) is exceeded from the combined effects of the project and other developments.		
Surface water	Surface water bodies are located within the SGR AOI. Access to water sources raised as a concern by stakeholders (see Appendix 3).	No impact to pre-construction channel morphology and stability, water quality and drainage patterns.		
Biodiversity				
Legally protected, internationally or nationally recognised areas	Areas that are internationally or nationally recognised or legally protected within the project AOI such as: national parks; wildlife, forest and game reserves; Ramsar sites and key biodiversity areas; important bird areas; endemic bird areas; wildlife management areas; and alliance for zero extinction sites.	The limit of acceptable change is there will be no impacts to the integrity or ecological function of a protected area from the combined effects of the project and other developments.		
Habitats, flora and fauna species of conservation importance	Flora and fauna species of conservation importance within the project AOI include species that are IUCN (or national equivalent) critically endangered, endangered, vulnerable, protected, keystone, migratory, congregatory, endemic or	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.		



vc	Reason for inclusion	Threshold / limit of acceptable change / preferred condition
	range-restricted species or trigger critical habitat under PS6.	
Socioeconomic		
Economy	Presence of projects in the AOI may directly or indirectly impact economic activities and conditions, such as via job creation, imports and exports of project-related goods, and influx of new populations (e.g., workers from other regions, or foreign workers). Employment expectations were raised during the stakeholder engagement (see Appendix 3).	The preferred condition is for the standards of living of communities in the AOI to be equal to, or better than, before construction.
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, see Appendix 3.	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.
Infrastructure and services	Physical and social infrastructure such as access to utilities, waste services, roads, and education services	The limit of acceptable change is defined as return to the original condition of social infrastructure and services before construction.
Health, safety and security	Includes health and personal safety affected by the project from traffic and road use, and security affected by presence of workers, new populations, and security arrangements. Welfare includes social cohesion and community stability. This was raised as a concern by primary stakeholders, see Appendix 3.	The preferred condition is no increase disease, no overburdening of the health care system including the result of traffic accidents, 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.
Indigenous people	Presence of projects in the AOI may directly or indirectly impact the Indigenous Peoples' way of life; this was a particular concern raised during stakeholder engagement, see Appendix 3, and is considered by IFC PS 7.	The preferred condition is for the standards of living of Indigenous People in the AOI to be equal to, or better than, before construction.



VC	Reason for inclusion	Threshold / limit of acceptable change / preferred condition
Tangible and intangible cultural heritage	Tangible cultural heritage sites and intangible cultural heritage valued by communities in the AOI including cultures and traditions. Both tangible and intangible cultural heritage were raised as a concern by stakeholders, see Appendix 3.	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.
Ecosystem services	Ecosystem services will be covered as appropriate in	n the VCs presented above.



24.2.4 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 study area, as defined in Section 24.2.1, 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.

24.2.4.1 Associated facilities

IFC PS 1 (IFC 2012a) defines associated facilities as:

"facilities that are not funded as part of the project, would not have been constructed or expanded if the project did not exist and without which the project would not be viable".

IFC Guidance Note 1 (IFC 2012b), clause 52 states that:

"... the client should normally have some commercial leverage on the operators of such [associated] facilities. Where such leverage allows, undertakings can be secured from these operators to operate their facilities consistent with the applicable Performance Standards. In addition, the client should identify its own actions, if any, that could support or supplement the actions of the operators of the associated facilities."

One associated facility has been identified; this is the 220 kV transmission line single circuit that is due to be constructed alongside the SGR alignment. The transmission line's power source will be the existing Kinyerezi powerplant and the power will be discharged into substations along the route. The line will have a right of way (RoW) of 35 m, with 17.5 m from each side of the centre line. The proponent is Tanzania Electric Supply Company Limited (TANESCO). See Section 3.3.1 for further details.

Tanzania Railways Corporation (TRC) and TANESCO are both Tanzania state-owned companies and the Government of Tanzania is in the position to control or dictate actions to TANESCO. Therefore, with government support, TRC has requested TANESCO to formally confirm that the management of environmental and social impacts for the transmission line will be in line with international standards. Based on the information provided by TRC at the time of writing, TANESCO will be receiving funding from the World Bank and it is therefore assumed that the project will be developed in line with the World Bank standards.

24.2.4.2 Past and present activities

Existing third-party facilities and activities are assumed to be covered by the ESIA baseline (see Sections 10 - 21). Lots 1 and 2 of the SGR have been constructed and are not considered as part of the CIA.



24.2.4.3 Third party developments

Planned third-party developments have been identified (within the study area defined in Section 24.2.1) based on the IFC definitions that projects are reasonably defined, reasonably predictable or foreseeable³⁶.

Third-party developments were identified by:

- review of district development plans and national development plans, for example the GoT Ministry of Finance and Planning's National Five-Year Development Plan (2021/22–2025/26) (2021)
- review of international finance institutions' (IFI) websites for projects receiving or applying for funding
- review of other publicly available information on key developments in the region, such as websites of known developers and the press
- consultation with stakeholders and with TRC.

Table 24-2,

³⁶ Definition of projects that are "reasonably defined", taken from IFC Performance Standard 1 (IFC, 2012a). Definition of projects that are "reasonably predictable" or that are "foreseeable future developments", taken from the IFC GPH.



Figure 24 3: and **Error! Reference source not found.** present 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:

- **East Africa Crude Oil Pipeline (EACOP)** The EACOP pipeline route crosses the northern part of Lot 4 in Nzega District. Information regarding the exact location and progress on the pipeline is sensitive and confidential. Further detail is provided in Table 24-2 below.
- Tanzania Intermodal and Rail Development Project (TIRP II) the second phase of the TIRP II is planned to upgrade the existing Dar es Salaam Isaka meter gauge railway (MGR) infrastructure, including track renewal, upgrading of stations and facilities, among other elements. TIRP II will be implemented in the existing operating railway infrastructure within a stretch of 970 km network, but only in sections that were not covered during the first phase of TIRP (TIRP I).

The Government of Tanzania National Five-Year Development Plan, 2021/22–2025/26 (Ministry of Finance and Planning, 2021) describes several infrastructure projects in the vicinity of the project site, however, at the time of writing they have not been taken into consideration in the CIA due to lack of project detail provided. This is also the case for several projects identified on IFI websites (e.g. World Bank). See Table 24-2 for a list of projects screened out of the CIA.

24.2.4.4 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.

Induced development identified in Section 11.3.7 includes economic opportunities such as vending, food catering and hospitality.

24.2.4.5 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 Sections 10 - 21.



Table 24-2: Identified associated facilities and third party projects

Project	Proponent	Location (Ward, District)	Description (including timescale)	Source	Screening
Associated facilitie	es				
Transmission line	Tanzania Electric Supply Company Limited (TANESCO)	Parallel to Lots 3 & 4 route (exact position to be defined)	Construction of a 220 kV transmission line single circuit alongside the SGR alignment. The transmission line's power source will be the existing Kinyerezi powerplant and the power will be discharged into substations along the route. The line will have a right of way of 35 m, with 17.5 m from each side of the centre line.	Project overview (Section 3.3)	Screened in
Third party projec	ts – screened into CIA				
East African Oil Pipeline (EACOP)	TotalEnergies	Crosses Lot 4, Nzega District	EACOP is a 1,443 km crude oil export pipeline that will transport Uganda's crude oil from Uganda to the Chongoleani peninsula near Tanga port in Tanzania. It will have a peak capacity of 246,000 bbls/day. EACOP crosses the Uganda – Tanzania border between Masaka and Bukoba, past Lake Victoria, following its western border, traversing Tanzania, passing close to Kahama, Singida, Kondoa, into Tanga. In Tanzania, the pipeline, 1,147km long will traverse 8 regions and 25 districts. The pipeline right of way required for the construction phase is 30 metres wide. A main camp pipeyard (MCPY) is located approximately 30 km from the closest SGR construction camp in Nzega District.	EACOP (n.d.)	Screened in
Second Tanzania Intermodal and Rail Development Project (TIRP II) – upgrades to	United Republic of Tanzania (borrower), Tanzania Railways Corporation (TRC), National Irrigation Commission	Railway along the Dar es Salaam to Isaka	The project aims to improve safety, climate resilience and operational efficiency of the railway along the Dar es Salaam to Isaka segment in Tanzania. The project involves upgrading the existing Dar es Salaam – Isaka (970 km) central corridor meter gauge railway (MGR) infrastructure. The upgrading includes bridges and	World Bank (2024)	Screened in



Project	Proponent	Location (Ward, District)	Description (including timescale)	Source	Screening
existing meter gauge railway (MGR) infrastructure	(NIRC) (implementing agency)		culverts, formations, ballasting, track renewal, stations and facilities and associated activities within the Central Railway Network in stages. Specifically, Tanzania Intermodal and Rail Project II (TIRP II), will be implemented in the existing operating railway infrastructure within a stretch of 970 km network but only in sections that were not covered during TIRP I. TIRP II is in the pipeline phase of financing with the IFC. Under TIRP I, a total of 570 km out of 970 km of the railway track and 374 bridges were rehabilitated along Dar as Salaam – Isaka railway infrastructure through TIRP in year 2020.		
Third party project	ts – screened out of th	e CIA			
Eastern and Southern Africa - Accelerating Sustainable and Clean Energy Access Transformation (ASCENT) Program	Rural Energy Agency	Throughout rural areas of Tanzania	The ASCENT program involves three pillars: Pillar 1: Regional and National Platforms to Accelerate Energy Access will finance technical assistance, tools, and capacity building. Pillar 2: Expanding Grid Electrification will finance investments and associated technical assistance for (i) grid densification and expansion, including cross-border electrification; (ii) grid reinforcement, upgrading, and variable renewable energy (VRE) integration investments, including battery storage, where required, to support electricity access expansion; (iii) grid connections, including ready boards, internal wiring, access to appliances, and productive uses; and (iv) utility strengthening. Pillar 3: Scaling Distributed Renewables and Clean Cooking.	World Bank (2023)	Project screened out as not reasonably defined as per IFC definition



Project	Proponent	Location (Ward, District)	Description (including timescale)	Source	Screening
TZ-Rural Electrification Expansion Program	United Republic of Tanzania (borrower), Rural Energy Agency (implementing agency)	Throughout rural areas of Tanzania	The Program Development Objectives are (a) to increase access to electricity in rural areas; and (b) to scale up the supply of renew able energy in rural areas while strengthening sector institutional capacity.	World Bank (2022a)	Project screened out as not reasonably defined as per IFC definition
Sustainable Rural Water Supply and Sanitation Program	Ministry of Finance and Planning (borrower), Ministry of Water (implementing agency)	Throughout rural areas of Tanzania	The project development objective is to increase access to rural water supply and sanitation services in participating districts and strengthen the capacity of select sector institutions to sustain service delivery.	World Bank (2022b)	Project screened out as not reasonably defined as per IFC definition
Development of Special Economic Zones and Export Processing Zone	Unknown at time of writing	Manyoni	The development of Export Processing Zones (EPZ) is planned in Singida (Manyoni). The private sector will be encouraged to invest in these zones. This is a target in the development plan for 2025.	Ministry of Finance and Planning (2021)	Project screened out as not reasonably defined as per IFC definition
Construction and rehabilitation of airports	Unknown at time of writing	Tabora	Construction and rehabilitation of regional airports in Tabora. The aim is to improve airport facilities to international standards. This is a target in the development plan for 2025. Construction of a passenger lounge, perimeter fence and car parking area is planned (IPP Media, 2020).	Ministry of Finance and Planning (2021), Daily News (2022), IPP Media (2020)	Project screened out as not reasonably defined as per IFC definition





Figure 24 3: Location of third projects and associated facilities screened into the CIA – Lot 3

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Figure 24-3: Location of third projects and associated facilities screened into the CIA – Lot 4

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24.2.5 Impact assessment (Step 5)

For an impact to be assessed as cumulative, the Project AOI and the source of cumulative impact AOI must overlap, and the impacts must occur in the same timescale.

Where available information on SCIs 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. The cumulative impact assessment is presented in Section 24.4.

24.2.6 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 TRC has a high degree of control or influence over mitigation/management) and management of impacts outside of TRC's control (because other third-party projects are the main cause of the cumulative impact). Figure 24-4, 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.





Source: 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 24-4 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.

24.2.6.1 Management of impacts where TRC has control

As recommended in this ESIA, TRC has committed to undertake an extensive range of management and monitoring activities as part of this ESIA. Management and monitoring measures have been developed that will be sufficient to ensure cumulative impacts can be managed in accordance with 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 23 that are within TRC's control are sufficient to manage the cumulative impact, no further action is recommended.

24.2.6.2 Management of impacts outside of direct TRC control

Where significant potential cumulative impacts are identified but action from other parties is required to manage the cumulative impact, TRC 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 24.4.

24.2.6.3 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 takes into account the typical limitations that a project developer may face in this type of evaluation, including:

- uncertainty regarding the execution of future projects
- incomplete information about other projects and activities (for example, if the information is not available in the public domain).



24.3 Cumulative impact assessment

24.3.1 Introduction

Cumulative impacts are those from activities or events which individually may not be significant but may produce significant impacts on the same receptor(s) when combined with impacts arising from different sources that have an overlapping sphere of influence to the activities and events under consideration. Such effects may arise due to their proximity in space or time, or because a certain receptor is particularly sensitive.

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 24-3. 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 taken into account, 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.

	Associated facility and third party development				
vc	Transmission Line	EACOP	TIRP II (MGR)		
Air quality	x	x	х		
Climate	x	x	х		
Noise	x	x	х		
Surface water	x	x	х		
Legally protected, internationally or nationally recognised areas	x	x	x		
Habitats, flora and fauna of conservation importance	x	x	-		
Economy	x	x	X		
Land and livelihoods	x	x	-		
Infrastructure and services	X	X	X		

Table 24-3: Cumulative impacts interaction table



	Associated facility and third party development			
vc	Transmission Line	EACOP	TIRP II (MGR)	
Community health, safety and security	х	х	x	
Indigenous people	x	-	Х	
Tangible and intangible cultural heritage	х	х	-	
Ecosystem services	x	Х	-	

Note: X = interaction between SGR and other project; X = significant impact.

Ecosystem services are covered in each of the subsections below as appropriate.

24.3.2 Physical environment

24.3.2.1 Air quality

Potential cumulative impacts are predicted between the construction and operation of Lots 3 & 4 and the following projects (see Table 24-3):

- transmission line
- EACOP
- upgrades to the existing MGR.

The baseline of the air quality in the AOI is provided in Sections 16.4 and 16.5. Concentrations of carbon monoxide, oxides of nitrogen and nitrogen dioxide, ozone, VOC and PM_{10} and $PM_{2.5}$ particulate matter were mostly within the relevant guideline and consistent with expectations for a rural location in Tanzania.

The limit of acceptable change is that the Tanzanian, East African and World Health Organization (WHO) air quality guidelines (as detailed in Section 16.3.4) are not exceeded from the combined effects of the Project and other developments.

Impacts to air quality from the Project during construction phase include fugitive dust from site activities (e.g. earthworks) and release of exhaust emissions from plant and vehicles on site and the local road network. During operations, reduced air quality may occur due to increased exhaust emissions from increased road traffic associated with stations and locomotives in marshalling yards. Another potential impact is fugitive dust affecting amenity, PM_{10} and $PM_{2.5}$ concentrations and increased risk to human health, due to loading of quarried materials to freight trains at quarries.

Fugitive dust and impacts from railway construction and operation will be greatest within 400 m and particulate matter impacts are unlikely to be significant at more than 1 km from the source. Along most of the SGR alignment, both the transmission line and the MGR alignment fall within 400 m of the SGR, as well as the point at which the EACOP pipeline and SGR intersect in Nzega District.

A worst-case scenario has been assumed that the construction activities of the projects are conducted concurrently, generating emissions to air. This could lead to potential direct cumulative impacts on the ambient air quality and indirect impacts on communities.



However, as the impacts associated with fugitive dust and exhaust emissions are considered localised and short term, and with the implementation of appropriate mitigation measures, a significant cumulative effect on local air quality is not likely.

TRC, TANESCO and EACOP are applying for funding from the international financial institutions, it is therefore assumed that they will follow good industry practices to minimise impacts on air quality. As far as possible, SGR construction phases should be coordinated with the transmission line to minimise the potential for a cumulative impact.

Impacts on local air quality during the operational phase are considered to be negligible, and therefore a significant cumulative impact on local air quality is not expected.

24.3.2.2 Climate and GHG emissions

Potential cumulative impacts are predicted between the construction and operation of the SGR project and the following projects (see Table 24-3):

- transmission line
- EACOP
- upgrades to the existing MGR.

The VC related to GHG emissions and climate change is Tanzania's total emissions in the context of its commitment under the Paris Agreement. Based on the latest update to Tanzania's nationally determined contributions (NDC), this is an economy-wide emissions reduction target range for 2030 of 30% relative to the business as usual (BAU) scenario.

GHG emissions are inherently cumulative, as all emissions have the same per-unit impact on the same ultimate receptor. The impact is climate change, or global warming, caused by the radiative forcing effects of GHG in the atmosphere, and the affected receptor is the global climate and all the ecosystems and biomes that depend on it.

The limit of acceptable change is that Tanzania's ability to meet its emission reduction target published as part of the Paris Agreement is not impacted.

A GHG inventory for the lifetime of the proposed SGR lots 3 & 4 project (assumed 60 years) has been completed; see Table 19-9 in Section 19.1.4. Total scope 1 and 2 emissions over the project life are estimated at 5,884,797 tCO₂e, and total scope 1, 2 and 3 emissions over the project life are estimated at 8,717,267 tCO₂e. During the first three years of construction, annual scope 1 and 2 construction-related emissions are classed as large, i.e. 100,000 – 1,000,000 tCO₂e annually (according to the magnitude criteria discussed in Section 19.1.4.2). For the fourth year it is anticipated that Lot 3 will be fully constructed and operational, and Lot 4 will be completed halfway through the year, and operational for the remaining half of the year. In this scenario combined scope 1 and 2 emissions are still classed as large (100,000 – 1,000,000 tCO₂e annually). Once construction is finished, annual scope 1 and 2 emissions from the operation of the proposed development are moderate (25,000 – 100,000 tCO₂e annually).

Estimated annual scope 1, 2 and 3 emissions are presented in Table 24-4 below.

	Construction Y1	Construction Y2	Construction Y3	Construction Y4 / operation	Operation Y1 and onwards
Total scope 1 & 2	203,101	203,101	203,101	119,235	86,877
Total scope 1, 2 & 3	605,597	605,597	605,597	261,981	111,850

Table 24-4: Annual GHG emissions for each phase (tCO2e)



Depending on the nature and remit of a project, scope 3 activities can contribute a significant proportion of overall emissions. In today's globalised society, many scope 3 emissions occur in nations other than where the activity or entity whose emissions are under consideration is located. Relevant and material scope 3 (i.e. other indirect) emissions have been assessed when determining the overall net emissions gain or loss. This is because the GHG savings of the Project in the form of displacing passenger travel and transport of freight by combustion vehicles constitutes a saving of indirect GHG emissions.

The annual scope 1, 2 and 3 emissions of 111,850 tCO2e, and annual potential GHG savings of 733,894 tCO2e result in net GHG emissions reductions of 622,044 tCO2e annually (Table 24-5). Therefore, the total construction emissions (2,006,272 tCO₂e) are offset after 3.2 years of project operation. These annual GHG savings contribute 4.0 - 4.7% of GHG reductions needed in the energy and transport sector, and 0.8 - 0.9% of GHG reductions needed across all sectors to meet Tanzania's NDC commitments.

Annual GHG emissions	Annual emissions (tCO ₂ e)
Annual GHG emissions (scope 1,2 &3) from operation of Project	111,850
Annual GHG emissions from equivalent transport via internal combustion vehicles	733,894
Annual GHG savings through operation of the Project	622,044

Table 24-5: Annual GHG savings from operation of the proposed development

The transmission line and EACOP, will cause emissions during all phases of development (construction, operation, and decommissioning). The MGR upgrade (TIRP II) will also lead to emissions during all phases of development, but similar to the SGR, may contribute to GHG reductions in the future by reducing individual passenger travel and freight transport in vehicles with combustion engines.

As the overall effect of GHG emissions is cumulative in nature (in that all emissions act on the same receptor – the global climate), these developments will have an additional negative effect on the global climate and are therefore considered to be significant.

However, the cumulative effect of this Project, alongside other similar projects (such as upgrading the MGR, TIRP II), would be significantly positive and contribute towards climate change mitigation and Tanzania's NDC commitments.

24.3.2.3 Noise

Potential cumulative impacts are predicted between the construction and operation of lots 3 & 4 and the following projects (see Table 24-3):

- transmission line
- EACOP
- upgrades to the existing MGR.

Background 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 trains on the existing MGR alignment.

Section 15.1 presents the predicted noise levels associated with construction as well as operations of the SGR using IFC and Tanzania standards criteria. The limit of acceptable change for this VC is determined by compliance with these criteria.



In the worst-case scenario where noise generating construction activities are conducted concurrently from SGR, MGR and the transmission line, and EACOP in the Nzega district, there could be cumulative impacts on communities.

All the construction activities will be transient therefore any overlap in construction schedules would be for a short period of time. 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.

Given the close distances between the Project and transmission line, and proximity to existing noise receptors in the AOI (e.g. settlements and roads along the SGR, transmission line and MGR alignments), cumulative impacts are expected. However, the duration of activities and transient nature of the projects will mean that these levels will be experienced for very short periods of time.

The noise control measures detailed in Section 15.3.1 will be implemented by the Project. As TRC, TANESCO and EACOP are applying for funding from the international financial institutions it is assumed that they are expected to follow good industry practice mitigation measures to minimise noise impacts.

Cumulative impacts are expected to not be significant.

During operations, the SGR alignment route is proposed parallel to that of the existing MGR route. The MGR and SGR will not operate at the same time and therefore cumulative rail noise impacts will not be relevant.

24.3.2.4 Surface water

Potential cumulative impacts are predicted between the construction and operation of lots 3 & 4 and the following projects (see Table 24-3):

- transmission line
- EACOP
- upgrades to the existing MGR.

The Project alignment crosses the Lake Tanganyika Basin and internal drainage basin (IDB). Most of the rivers in the corridor are seasonal rivers, draining to these two river basins. In the IDB, the Project crosses Bahi swamp and Lake Eyasi catchments. Apart from the seasonal rivers, the Project also crosses several wetlands and flood plains from Makutopora to Isaka. There are also several dams in the Project area at varied distances from the Project alignment. Surface water is an important and vulnerable resource in the study area and is a critical ecosystem service for local communities. Many communities use rivers and reservoirs that hold runoff from Lake Victoria for domestic purposes, and earthen dams filled with rainwater or damming seasonal streams and rivers are used to irrigate vegetable gardens and livestock (see Section 10.10.1.5). Water springs are also used for African traditional religious rituals and are considered a cultural ecosystem service (see Section 12.4.2).

The limit of acceptable change for surface water is there will be no impact to preconstruction channel morphology and stability, water quality and drainage patterns.

Cumulatively, construction of the SGR lots 3 & 4, the transmission line, the upgrade to the MGR and EACOP (particularly combined activity near watercourses north of the pipeline alignment near Isaka in Nzega district) have the potential to impact these catchment areas and effect downstream users for example, agriculture and domestic water supply.

Assuming a worst case that construction occurs concurrently, there is the potential for a short-term increase in sediment concentrations, reduced water quality and surface flooding from the projects, and longer term impacts to the morphology of channel beds


and riverbanks from erosion resulting from surface runoff at construction sites into watercourses leading to higher flow rates, and from excavation works.

Impacts to surface water quality and quantity may result in loss of ecosystem services for local communities residing in the area.

For the SGR, impacts will be managed based on the mitigation measures described in Section 18.4.

It is anticipated that the transmission line and third party projects will implement similar mitigation measures to manage impacts on water quality as they will be internationally funded. Consequently, it is predicted that the limit of acceptable change will be achieved, and the potential cumulative impact is considered to be not significant.

24.3.3 Biological environment

Potential cumulative impacts are predicted between the construction and operation of lots 3 & 4 and the following projects (see Table 24-3):

- EACOP
- transmission line
- upgrades to the existing MGR.

24.3.3.1 Legally protected, internationally or nationally recognised areas

Figure 10-1 in Section 10 presents the numerous protected areas in the AOI. The Project traverses several protected areas that include game reserves, GCAs, forest reserves and open areas. There are also three IBAs in the AOI, i.e., the Wemberre Steppe, the Ugalla River and the Moyowosi – Kigosi but are not located within the ROW.

The limit of acceptable change is that there will be no impacts to the integrity or ecological function of any protected areas from the combined effects of the Project and other developments.

Impacts from the Project during the construction phase include habitat loss, habitat fragmentation impacts on wildlife corridors, the potential for mortality and/or injury as a result of excavation works and vehicular collisions, and the spread of alien invasive species. During operations, fauna displacement and disruption of habitat connectivity (i.e. long term habitat fragmentation) are the main impacts identified.

The North Makere Forest Reserve is located where the SGR and EACOP cross in the northern part of lot 4. With the development of the SGR, EACOP and the transmission line there may be a combined loss of habitat and disturbance to the wildlife crossings in the area. EACOP and the SGR project should ensure coordinated liaison with the Tanzania Forest Services Agency (TFS) to ensure that impacts to the forest reserve are minimised.

The transmission line and SGR will traverse the same route and will therefore impact on the same designated areas at a similar time. The upgrade to the MGR is likely to be the smallest contributor to impacts. As the construction of the transmission line and associated infrastructure will be undertaken in coordination with TRC, coordinated stakeholder engagement can take place with TANESCO.

Given the scale of impact from the SGR development itself, it is not expected that cumulative impacts through interaction with other developments would result in significant escalation of any impacts to protected areas. The cumulative impact is therefore considered to be not significant.



24.3.3.2 Habitats, flora and fauna species of conservation importance

Section 10 describes the baseline of the habitats, flora and fauna species of conservation importance in the AOI. Modified habitat (principally farming and agricultural activities) comprises approximately 40% of land area within the CIA study area. Natural habitats such as the Miombo Woodlands and unique Itigi Thickets support assemblages of flora and fauna of largely native origin; they also include a number of IUCN vulnerable or endangered species providing a refuge for large wildlife. There is a notable area of critical habitat surrounding Manyoni and Itigi, (see Section 10.7) namely Itigi Thicket, as well as other high value conservation species such as the African Savannah Elephant (*Loxodonta africana*). Both the lot 3 and 4 alignments have existing wildlife crossings that are linked to feeding grounds and/or to existing wildlife corridors, in particular the Swagaswaga-Muhesi/Kigosi corridor around the Manyoni and Itigi Districts which is key for both aforementioned receptors.

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.

As described in Section 24.3.3.1, impacts from the Project during the construction phase include habitat loss, habitat fragmentation impacts on wildlife corridors, the potential for mortality and/or injury as a result of excavation works and vehicular collisions, and the spread of alien invasive species. During operations, fauna displacement and long term disruption to connectivity (i.e. fragmentation) are the main impacts identified.

The natural habitats are potential sources of fuelwood, and medicinal herbs and shrubs. Clearance for the ROW and camps is likely to result in loss of ecosystem services for local communities residing in the area. The SGR will also have a permanent impact on the habitats, flora, fauna and provisioning ecosystem services whereas the transmission line impacts will, on the whole, be largely temporary during the construction phase. The upgrade to the MGR is likely to be the smallest contributor to impacts. The SGR is therefore the main contributor to the cumulative impacts which are likely to be significant.

Yapi Merkezi have considered several design changes to avoid ground clearance and construction within areas containing Itigi Thicket and to avoid loss of the Miombo Woodlands by reducing the construction camp sizes. As per Section 10.11.3, a Biodiversity Action Plan will be developed to manage Project impacts on any identified Priority Biodiversity Values and to address residual impacts to CH qualifying species and landscapes. However, the cumulative impact could be considered to be significant.

TRC should also liaise with TANESCO regarding their design options to ensure safe crossing points are included for wildlife species, but also to consider the spread of invasive species and traffic management to avoid wildlife vehicular collisions.

With regards to habitat loss, the SGR should form a joint monitoring scheme with TANESCO to ensure that habitat loss and is kept to a minimum and restoration is implemented effectively and with the overall aim of achieving no-net loss for natural habitats, as well as net gains for critical habitat.

24.3.4 Socioeconomic environment

Potential cumulative impacts are predicted between the construction and operation of lots 3 & 4 and the following projects (see Table 24-3):

- EACOP in Nzega District
- transmission line
- upgrades to the existing MGR.

The baseline condition is provided in Section 11.



24.3.4.1 Economy

The preferred condition is for the standards of living of the impacted individuals and households of the affected communities in the AOI to be equal to, or better than, before construction.

Tanzania's economy is one of the fastest-growing in Africa and the world (AfDB et al. 2016). Tanzania has embarked upon its third Tanzania National Five Year Development Plan 2021/22 - 2025/26 plan to stimulate economic growth and transformation with particular emphasis on the completion of infrastructure projects, notably rural electrification, rural water programme and human capital development. Tanzania's economic growth is expected to average 6.2% between 2017 and 2026, underpinned by infrastructure project, SGR, together with other large-scale projects, will contribute to the economic growth of the country.

At the PAC level, beneficial cumulative impacts may be incurred from the construction and operation of SGR, the transmission line, EACOP (in Nzega District) and the upgrades to the MGR. Possible benefits include local employment and training, improved access to resources and opportunities for provision of goods and services. These may enhance economic development at the local level.

Construction activities associated with the SGR, transmission line and upgrading of the MGR will provide opportunities for some local enterprises to supply goods (e.g., equipment, materials, food) and services (e.g., transportation) to the projects. Providing goods and services to the projects would enable local businesses to boost revenue and profit margins during construction.

Microbusiness and microenterprises are common across the six districts and represent an important livelihood strategy, alongside small-scale agriculture. Microenterprises are particularly widespread in the urban district of Tabora Municipal, where retail businesses constitute 35% of GDP. Expansion of financial services has spurred the growth of SMEs in Tabora Municipal.

PAC members may benefit from increased opportunities to establish new enterprises, or expand existing enterprises, through provision of services to staff working on the projects. Kiosk and food vendors, motorcycle / bodaboda and bicycle riders may be most able to benefit.

Owing to the scale of the EACOP project, enterprises in Ngeza District may benefit from further opportunities, though SMEs may be unable to take advantage of opportunities due to their inability to meet EACOP procurement standards.

Where project procurement opportunities do materialise, the increased incomes of local workers may also lead to increased community spending, benefitting local enterprises, including women-led enterprises. This is a form of livelihood diversification that supports women's access and control of assets - i.e. the access and control of money - although it is noted that not all women will retain control their earnings.

Generally, income from provision of goods and services presents opportunities to improve living standards within the household, such as improving the capacity to pay school and healthcare fees.

Local communities have high expectations of employment with large projects. There is an increased risk of dissatisfaction over the scale and duration of employment opportunities, particularly in Ngeza District, where PAC members may have high expectations about obtaining employment with EACOP. Competition over the limited employment opportunities may lead to tension between PAC members and the projects, and could cause conflicts within communities (e.g., among individuals who obtain employment, and those who's applications are unsuccessful). Within the AOI, employment of nonlocals is widely considered unfair and unfavourable and would likely



lead to an increase in tensions and conflicts. Additionally, discrimination against nonlocals in employment opportunities may infringe upon the right to equal treatment and non-discrimination.

There may be a cumulative increased risk of inequitable access to employment opportunities. For example, gender or cultural norms may prevent certain PAC members from engaging in employment opportunities provided by the projects. This may further entrench gender and economic inequalities within communities.

The SGR project will develop a local recruitment plan as described in Section 11.3.9 and it is expected that the transmission line and EACOP will do the same to manage this impact.

The combined impacts of the projects during their construction phases is likely to lead to an expansion of local markets with increased demand for construction materials, sustenance products and other support services that can be sourced from local communities at a relatively low cost. This increase in demand for locally available products and services may trigger the commercialization of subsistence-oriented economies characterizing most of the project-affected communities (PACs). Inflation may have an adverse effect on the PACs, with poorer households particularly vulnerable to price increases; potentially impacting their right to an adequate standard of living. TRC and TANESCO should share monitoring of price changes along their combined route. TRC and EACOP should share monitoring of price changes in Nzega District.

The SGR and the associated transmission line are likely to be constructed concurrently, there may therefore be cumulative access restrictions on small business activities due to the movement of light and heavy construction vehicles causing delays or blockages on common roads. Road closures or restrictions may also interfere with business owners who use the road to purchase supplies from within or outside in the affected communities. Alternative routes (if available) may increase the cost and time needed to source supplies. TRC will liaise with TANESCO and EACOP in Nzega District, the police and authorities to identify and implement additional traffic management measures that limit disruption.

Retrenchment following the construction activities from SGR, the transmission line and improvements to the MGR, and the SGR and EACOP in the Nzega District, may result in economic decline in the AOI as most workers will be on temporary fixed-term contracts. If all the project workers are on fixed-term contracts there could be a cumulative impact on loss of employment, leading to a loss of income, economic decline and a rise in unemployment figures in the AOI. The comparative employment during operations phase will be significantly smaller. More generally, there is a risk of a 'boom and bust' phenomenon (the rapid expansion of the local economy followed by sudden contraction when the project's construction phases end).

As mentioned, to reduce their contribution to the cumulative impact, TRC will develop a local recruitment plan; this should incorporate the management of demobilisation which shall include risk mitigation associated with end of employment and planning to facilitate re-deployment. Due to lack of publicly available information, at the time of writing it is unknown whether the other third party projects have similar plans in place. However, the incremental impact from SGR and the third-party projects means that this is a potentially significant cumulative impact. It is therefore recommended that TRC, TANESCO and EACOP (in Nzega District only) collaborate and share information regarding worker skill sets which could see a transfer of workers between projects once temporary fixed-term contracts end. TRC should encourage other projects to be transparent about the likely temporary nature of construction workers' employment and to regularly remind workers of this fact.



24.3.4.2 Land and livelihoods

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.

Section 11.3.1 discusses the project impacts of resettlement due to land acquisition; this will be exacerbated by the presence of the SGR, the transmission line and its associated infrastructure and the EACOP project (in Nzega District). Potential cumulative impacts associated with physical and economic displacement (resettlement and land-based livelihoods) are predicted where the projects require significant land take. As agriculture is the major economic activity in the CIA study area, the permanent and temporary loss of land for farming may be compounded by the presence of multiple projects; this may lead to insufficient availability of productive land for PACs' land-based livelihoods. The MGR will have no impact.

The majority affected land along the ROW will be agricultural land, residential and forest reserves. Increased acquisition associated with the projects may result in permanent or temporary loss of structures, land and economic livelihood activities.

At the time of writing a RAP study is being undertaken to address all project-related land access, resettlement and livelihoods restoration impacts in detail. EACOP will be developing a RAP which will include the Nzega District. TRC and EACOP should closely liaise to ensure that there is no risk of double displacement. It is expected that the transmission line will require development of a RAP, although SGR will be the main contributor to this cumulative impact.

With the mitigation measure of coordinated resettlement planning between the two projects in place, the cumulative impact is considered to be not significant.

24.3.4.3 Infrastructure and services

The preferred condition is defined as return to, or near the original condition of, infrastructure and services before construction.

Beneficial cumulative impacts from SGR and upgrades to MGR include improved connectivity and access to markets and other opportunities for businesses and communities. This will enable greater exchange of goods and services and may lead to reduced journey times and travel costs.

The transportation of construction materials and other supplies to the project ROW and personnel to and from the construction camps will cause increased traffic on the assigned routes on public roads. Transport routes are likely to be affected by the transmission line during construction and work on the MGR upgrade, with the potential to increase the risk of congestion or accelerate deterioration of road conditions, bridges and communal infrastructure. Where there is potential for congestion on shared transport routes, the project will liaise with TANESCO, the police and authorities to identify and implement additional traffic management measures that limit disruption.

Construction activities from the projects may lead to increased pressure on regional waste management facilities and the resulting need to dispose of increased quantities of waste. As described in Section 11.3.3, there is a shortage of waste management facilities for both hazardous and non-hazardous waste in the CIA study area. Improper management of waste increases the risk of adverse health and environmental impacts within communities; this could also impact the right to health and the right to a clean environment and is potentially significant.

TRC should liaise with the district authorities to encourage the development and implementation of a district-wide waste management strategy to ensure all projects appropriately manage and dispose of construction and operational waste. Ownership of such a strategy is beyond TRC's control and remit, however TRC should consider



lobbying for district-led waste management measures as part of ongoing stakeholder engagement.

Project workforce and in-migration of employment seekers, entrepreneurs, petty traders and other economic opportunists may also lead to greater demand and pressure on existing social infrastructure and services. Unmanaged project-induced in-migration may overload the local area's assimilative capacity, notably, through increased pressure on local water supply networks and local sewerage systems, but also electricity services, education facilities, health facilities and security facilities (e.g., policing). The ability of infrastructure, services and utilities to meet the needs of higher levels of demand associated with a larger population is a key factor in determining the scale of potentially negative in migration impacts.

It is recommended that SGR, TANESCO and EACOP (in Nzega District) and the relevant district authorities share findings from the monitoring of socioeconomic changes in communities, including population size and arrival of economic migrants through regular meetings, and to share measures to reduce potential in-migration including (but not limited to) recruitment and procurement procedures and community engagement activities. The potential for in-migration should further be embedded in monitoring activities to ensure that changes to baseline conditions in communities in the AOI are identified.

24.3.4.4 Health, safety and security

The preferred condition is no increase disease, no overburdening of the health care system including the result of traffic accidents, 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.

Potential cumulative impacts are predicted where SGR, the transmission line and the EACOP (in Nzega District) may result in an influx of workers to the area causing the spread of communicable diseases. The communication of the workers from each of the projects with the communities may exacerbate the spread of communicable diseases (such as STIs), either from the workforce to the community or vice versa. High prevalence groups that pose the most concern include migrant and resident commercial sex workers, as well as long-haul truck drivers across all of the linear projects. This may lead to a cumulative burden on local health services.

During the SGR operations phase, and resulting from the upgrade to the MGR, more people may be encouraged to move close to the new stations (for example in search of economic opportunities) and this may overburden existing medical infrastructure.

The project will develop and implement a Communicable Diseases Management Plan. It is anticipated that the transmission line will have a similar requirement to develop some kind of community health management plan for the project's construction phase. For the impacts on the Nzega District, it is expected that EACOP will have a community health and safety plan in place prior to mobilising for construction.

As the construction of the transmission line and associated infrastructure will be undertaken in coordination with TRC, coordinated stakeholder engagement campaigns can take place with TANESCO.

In migration into PACs from people seeking economic opportunities associated with the projects may result in population growth. Cumulatively, the population growth will be higher than rates associated with only the SGR project. High levels of population growth may change community dynamics leading to an increase in social ills and violence and a decline in social cohesion within PACs. This could include tensions due to different cultural traditions and values between non-local workers and members of the PACs, leading to conflict.



The contribution by SGR to cumulative impacts is difficult to assess because future community dynamics are difficult to predict. However, SGR's contribution to the potential cumulative impact on community safety, security and welfare will be managed by the mitigation measures in Section 11.3.5 and as part of its stakeholder engagement planning. TRC should work closely with the local authorities and TANESCO and EACOP to identify and monitor any emerging tensions and conflict related to this impact.

With the project mitigation measures and the additional mitigation measure implemented, it is predicted that the limit of acceptable change will be achieved and hence the cumulative impact is not considered significant.

24.3.4.5 Road traffic accidents and other incidents

An increase in the volume of traffic on local road networks during the construction of the SGR and the other projects may lead to an increase in the risk of road traffic accidents. There is also an increased risk of accidents involving community members at work sites leading to injury and potential mortality. Inadequate control of access to work sites may result in the community gaining entry and sustaining injuries from interactions with construction equipment and materials or by slips, trips and falls.

The project will develop and implement traffic management plan and restrict access to work sites to manage their contribution to the cumulative impacts. It is expected that the other project will implement similar measures. access to construction camps will be restricted.

TRC will liaise with TANESCO and EACOP in Nzega District, the police and authorities to identify and implement additional traffic management measures that limit disruption and improve safety.

In the longer term, the operation of the SGR and upgrade to the MGR should decrease road traffic due to increased use of the railways. However, monitoring should continue throughout the life cycle of the project to identify and implement interventions should they be required.

24.3.5 Indigenous people

Potential cumulative impacts are predicted between the construction and operation of Lots 3 & 4 and the following projects (see Table 24-3):

- transmission line
- upgrades to the existing MGR.

Lot 3 of the project passes through village lands traditionally and customarily occupied, owned, and used by the Datoga (Barabaig and Taturu), Sandawe, and Maasai IP. No IP were identified for Lot 4, and therefore no cumulative impacts are expected with EACOP. The baseline condition is provided in Section 13.

The preferred condition is for the standards of living of indigenous people in the AOI to be equal to, or better than, before construction.

The impacts discussed above will also impact the IP communities and this section discusses the specific impacts on those communities.

Construction of SGR and the transmission line, plus to a lesser extent upgrades to the MGR may cumulatively improve employment opportunities for the IP communities in lot 3. The projects may also create opportunities for IPs to sell their livestock and other good to the local construction camps.

The combined temporary and permanent land acquisition required for the SGR and the transmission line may adversely impact the IPs ability to access land used for grazing, watering their livestock and collection of natural resources including firewood, building



material, wild foods and medicinal plants. However, as discussed in Section \Box , some of the medicinal plants are regarded as plentiful therefore this impact is not considered to be significant.

The two linear projects cross key grazing areas and access routes between winter and summer pastures. Access restrictions due to construction activities will affect the livestock routes and pastures used by IP and other livestock keepers. During the operations phase, these routes will be permanently impacted as the railway track will be fenced. Crossings have been negotiated with local communities, including indigenous communities.

The concurrent construction of SGR and the transmission line will increase the number of employment seekers, entrepreneurs and other economic opportunists into the project area. This influx may have a negative impact on the wellbeing of the indigenous communities and their traditional lifestyles, for example where new arrivals embody different cultural values. Unmanaged, this impact could be significant. It is therefore important that TRC, TANESCO and the district authorities work collaboratively to ensure that impacts on IP communities are minimised through combined stakeholder engagement and considered land use and design.

The cultural impacts on cultural heritage, for example the relocation of graves and access to sacred trees in discussed in Section 24.3.6.

24.3.6 Tangible and intangible cultural heritage

Potential cumulative impacts are predicted between the construction and operation of Lots 3 & 4 and the following projects (see Table 24-3):

- EACOP in Nzega District
- transmission line
- upgrades to the existing MGR.

The baseline condition is provided in Section 12.

24.3.6.1 Tangible cultural heritage

The preferred condition is the tangible cultural heritage (TCH) is preserved in situ. The limit of acceptable change, if the site or structure is to be impacted, is for it to be preserved for research purposes by appropriate professional excavation.

Stone Age artefacts, ceramics/pottery and other archaeological relics have been identified in the study area, and there is potential for cumulative impacts of damage, disturbance or disruption of access to known and unknown TCH.

The Project will need to implement a Cultural Heritage Management Plan including a detailed Chance Finds Procedure. The construction of the transmission line is unlikely to disturb potential cultural heritage, but the construction of the associated infrastructure might. SGR is considered to be the main contributor to the cumulative impact.

With the implementation of the Project Cultural Heritage Management Plan and chance finds procedure, it is predicted that the preferred condition will be achieved and hence the cumulative impact is considered to be not significant.

24.3.6.2 Intangible cultural heritage

The preferred condition for ICH is for 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 stakeholders, is that an alternative will be developed.

SGR, the transmission line and EACOP may have a potential cumulative impact on local communities with traditional belief systems, who consider certain sites, such as trees (e.g. *msabida* or *sabida*) as highly important for religious rituals. It is a concern of local



people that, although located away from the SGR alignment, ancestors at spiritual sites may be annoyed by construction disturbance. The combined impacts of construction activities on noise, for example, may be considered a significant cumulative impact.

Graves and graveyards are found along the Project alignment, access roads, stations, planned quarry and borrow pit sites, which are tangible cultural heritage with strong intangible elements. Land disturbance from construction of SGR, the transmission line and EACOP may result in cumulative impacts on TCH/ICH. Although it may be unlikely that there will be cumulative impacts on these TCH/ICH from the existing MGR as the alignment will stay the same during upgrades, there are sites of importance, such as graves of Chiefs and/or Sub-Chiefs in close proximity with MGR at Itigi Station. Potential upgrades in this location alongside transmission line and SGR works could have an impact, and further information on the exact location and ROW of the combined works would be needed to determine the level of significance.

The value of ICH to the project-affected communities is sensitive to change, particularly as a result of influx (PIIM) and displacement. As a result, when influx increases, and more people are attracted to the area by additional projects the traditional belief system and associated ICH may erode further.

Coordination is required between TRC, TANESCO and EACOP to undertake stakeholder engagement with local communities, Indigenous Peoples and local authorities to help manage cumulative impacts collaboratively. This may include providing prior notice of noisy activities in the vicinity of known ICH sites, coordinating the relocation of graves, understanding community requirements for rituals, for example.

With the implementation of the Project Cultural Heritage Management Plan, the Stakeholder Engagement Plan, grievance procedure and Resettlement Action Plan, it is predicted that the preferred condition will be achieved and hence the cumulative impact is considered to be not significant.

24.4 Management and Monitoring

The effective management of cumulative impacts requires collaboration of all parties that contribute to these cumulative impacts. 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. 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).

TRC 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.

24.4.1 Management of cumulative impacts

The cumulative impacts identified in this assessment are summarised in Table 24-6 which also lists actions for TRC to mitigate cumulative impacts either by management and/or monitoring, and collaborative mitigations where TRC will engage and liaise with other proponents (or the district 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 TRC's control and remit and should be driven and implemented by district authorities. However, the potential for this could be explored with the relevant stakeholders as part of ongoing stakeholder engagement.



TRC will use commercially practicable efforts to engage relevant government authorities, other developers and other relevant stakeholders, in the implementation of coordinated mitigation measures to manage the potential cumulative impacts. This will be undertaken in accordance with the Project Stakeholder Engagement Plan.

As the transmission line and the SGR will run parallel to each other, it is critical that TANESCO and TRC coordinate their efforts to manage the environmental and social cumulative impacts. In order to coordinate these efforts, it is proposed in the SEP (Appendix 3) that TRC and TANESCO establish a Joint Task Force (with support from their subcontractors). The Joint Task Force will be responsible for planning and coordinating stakeholder engagement and they will be responsible for the following:

- coordinating stakeholder engagement
- training staff deployed in the field with regard to international standards for stakeholder engagement and grievance management
- developing a shared grievance database
- establishing a shared stakeholder log and updating it regularly
- periodically updating the list of shareholders in areas
- coordinate and integrate efforts in terms of relocation and livelihood restoration
- agree on the content of reporting to external stakeholders.

This Joint Task Force can be used as the conduit to manage the cumulative impacts across the combined routes. For Nzega District, a similar Task Force could be considered with EACOP.

In addition, Section 3.3 states that TRC will develop and operationalise an Associated Facilities Management Plan to ensure the transmission line is constructed in line with the applicable standards.

The Project should also implement lessons learned from Phase I of TIRP MGR, and from the construction of lots 1 and 2 of the SGR to ensure efficient development of both the SGR and Phase II.



Table 24-6: Summary of CIA findings and management/mitigation measures

VC	Cumulative impact	Management / mitigation measures
Air quality	Construction activities of the projects conducted concurrently, generating emissions to air	As far as possible, SGR construction phases should be coordinated with those of the transmission line to minimise deterioration of localised air quality
Habitats, flora and fauna species of conservati on importanc e	Additional construction and operational traffic leading to the spread of invasive species and wildlife vehicular collisions	TRC should also liaise with TANESCO regarding their design options to ensure safe crossing points are included for wildlife species, and consider the avoidance of the spread of invasive species and traffic management to avoid wildlife vehicular collisions
	Cumulative temporary and permanent land access leading to habitat loss and fragmentation	SGR should form a joint monitoring scheme with TANESCO to ensure that habitat loss and is kept to a minimum and restoration is implemented effectively and with the overall aim of achieving no-net loss for natural habitats, as well as net gains for critical habitat
Economy	Increase in procurement from the combined projects leading to local inflation	TRC and TANESCO should share monitoring of price changes along their combined route. TRC and EACOP should share monitoring of price changes in Nzega District
	Retrenchment following construction activities from the projects may result in economic decline in the AOI	TRC, TANESCO and EACOP (in Nzega District only) should collaborate and share information regarding worker skill sets which could see a transfer of workers between projects once temporary fixed-term contracts end. TRC should encourage other projects to be transparent about the likely temporary nature of construction workers' employment and to regularly remind workers of this fact
Land and livelihoods	Cumulative land acquisition leading to double displacement of PACs	TRC and EACOP should closely liaise to ensure that there is no risk of double displacement
Infrastruct ure and services	Construction activities may lead to increased pressure on regional waste management facilities	TRC should liaise with the district authorities to encourage the development and implementation of a district-wide waste management strategy to ensure all projects appropriately manage and dispose of construction and operational waste
	Unmanaged project induced in migration may lead to disruptions to local community businesses with negative economic and social consequences	It is recommended that SGR, TANESCO and EACOP (in Nzega District) and the relevant district authorities share findings from the monitoring of socioeconomic changes in communities, including population size and arrival of economic migrants through regular meetings, and to share measures to reduce potential in-migration including (but not limited to) recruitment and procurement procedures and community engagement activities. The potential for in-migration should further be embedded in monitoring activities to ensure that changes to baseline conditions in communities in the AOI are identified
Health, safety and security	Unmanaged project induced in migration may lead to change community, leading to conflict	TRC should work closely with the local authorities and TANESCO and EACOP to identify and monitor any emerging tensions and conflict
	An increase in the volume of traffic on the local road network during the construction of railway and the other projects may lead to an increase in the risk of road traffic accidents (RTAs)	TRC will liaise with TANESCO and EACOP in Nzega District, the police and authorities to identify and implement additional traffic management measures that limit disruption



VC	Cumulative impact	Management / mitigation measures
Indigenous people	Unmanaged project induced in migration impacting Ips wellbeing and their traditional lifestyles, for example where new arrivals embody different cultural values	TRC, TANESCO and the district authorities should work collaboratively to ensure that impacts on IP communities are minimised through combined stakeholder engagement and considered land use and design
Intangible cultural heritage	Unmanaged project induced in migration leading to the erosion of traditional belief systems and associated ICH	Coordination is required between TRC, TANESCO and EACOP to undertake stakeholder engagement with local communities, IPs and local authorities. This may include providing prior notice of noisy activities in the vicinity of known ICH sites, coordinating the relocation of graves, understanding community requirements for rituals etc



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APPENDIX 1 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT TEAM



APPENDIX 2 ADDITONAL LEGISLATION

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APPENDIX 3 STAKEHOLDER ENGAGMENT PLAN



APPENDIX 4 BIODIVERSITY IMPACT ASSESSMENT ANNEXES



APPENDIX 5 NOISE AND VIBRATION IMPACT ASSESSMENT APPENDICES



APPENDIX 6 IMPACT ASSESSMENT METHODOLOGY

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APPENDIX 7 IMPACT ASSESSMENT APPENDICES

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APPENDIX 8 AIR QUALITY BASELINE REPORT



APPENDIX 9 HUMAN RIGHTS RISK ASSESSMENT

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APPENDIX 10 INDIGENOUS PEOPLES PLAN APPENDICES



Appendix 10.1: Stakeholder engagement materials used during the 2023 may site visit



Appendix 10.2: Minutes of meetings conducted in May 2023 (include attendance lists)



Appendix 10.3: PAC Profiles



Appendix 10.4: Map and minutes of meetings regarding the cultural heritage sites in Kitopeni and Itigi



Appendix 10.5: Crossing consultations



APPENDIX 11 AOI MAPS



Appendix 12 Hydrology and Hydrogeology Baseline and Impact Assessment