



**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)
STUDY FOR THE PROPOSED CONSTRUCTION OF THE NAIVASHA-
KISUMU STANDARD GAUGE RAILWAY (SGR), PHASE 2B AND
KISUMU PORT (INCLUDING THE 8KM BRANCH LINE).**



FINAL REPORT

FEBRUARY 2026

Consultant



Dar Al -Handasah Consultants

(Shair and Partners)

Sub Consultant



Ecoscience Engineering Limited

CERTIFICATION

Preparation of this Environmental and Social Impact Assessment (ESIA) report was commissioned by KRC in fulfilment of requirements of the Environment Management and Coordination Act, 1999(Amended 2015); Legal Notice No. 101; The Environmental (Impact Assessment and Audit) (Amendment) Regulations of 2019.

Proponent: KENYA RAILWAYS CORPORATION

Name of Contact Person:

Eng. Tobias Otieno

Designation:

General Manager - Engineering & Technical Services

Signature / Date / Official Stamp:

Tobias Otieno 05/03/2026



Submitted by:

Dar Al Handasah Consultants (Shair and Partners) in association with Ecoscience and Engineering Limited

NEMA Reg. No: 11492

Approved by: Philip Abuor (Lead Expert no. 1710)

Signature/Date/Official Stamp:

dar Dar Al-Handasah
Shair and Partners

ISSUE AND REVISION RECORD

Rev	Date	Originator	Reviewer	Approver	Description
01	August 2025	Caleb Mango	Philip Abuor	Philip	Final ESIA
02	October 2025	Kevin Kimani Naumy Kurui John Opiyo Eng. Daniel Karuiki Calvince Arum	Bob Odhiambo Calvince Arum Eng KM.	Abuor	Report

PROPONENT DETAILS

Kenya Railways Corporation (KRC)

P.O. Box 30121 – 00100
Workshop Road, Kenya Railways Headquarters,
Off Haile Selassie Ave, Nairobi
Kenya.

Dar Al- Handasah Consultants (Shair and Partners)

6th Floor, Sifa Towers,
Ring Road Kilimani
P.O. Box 76225-00508,
Nairobi, Kenya.

In Association with:

Ecoscience Engineering Limited

NEMA Reg No: 11492

11th Floor, Mitsumi Business Park,
Muthithi Road, Westlands
P.O. Box 55533- 00200
Nairobi – Kenya

Mobile: +254713566825

Telephone: +254(020)2000582

Email: info@ecoscience.co.ke

ACKNOWLEDGEMENT

The preparation of this report was made possible through the cooperation, guidance, and support of various institutions and individuals. We sincerely acknowledge the Kenya Railways Project team for their leadership, coordination, and continuous technical support throughout the assignment as well as the timely provision of project information and strategic guidance from the Kenya Railways Team contributed significantly to the effective execution of this study. Appreciation is further extended to all relevant stakeholders, government agencies, local administration authorities, community representatives, and project-affected persons who participated in the consultation process. Their valuable inputs greatly enriched the assessment. We wish to formally acknowledge the study team for their exceptional professionalism, dedication, and thoroughness. Their work ensured that this report aligns with all relevant national regulations as well as international best practice standards.

Table of Contents

CERTIFICATION	0
ABBREVIATIONS.....	29
CHAPTER 1.0 INTRODUCTION.....	27
1.1 Project Background	27
1.2 Project Need and Justification	28
1.3 Project Objectives.....	29
1.4 Purpose of ESIA	30
1.5 Project location/Route Alignment	31
1.5.1 Some of Traversed Features in the Route Alignment	34
1.6 Environmental and Social Consultants Team	34
1.7 Structure of the ESIA report	35
1.8 Roles and Responsibilities	36
CHAPTER 2.0 PROJECT DESCRIPTION AND ITS COMPONENTS	38
2.1 Introduction	38
2.2 Route Alignment.....	38
2.2.1 Overview of Salient features.....	46
2.3 Project Components	47
2.4 Stations and Yards	47
2.5 Main Technical Standards of Designed Railway Line.....	50
2.5.1 Track Gauge.....	52
2.5.2 Railway Track.....	52
2.6 Bridges	53
2.7 Tunnels.....	55
2.8 Road Crossings	55
2.8 Track Structure and Foundation	56
2.11 Water Supply and Treatment Infrastructure.....	57
2.11.1 Water Supply System.....	57
2.13 The Project Implementation Activities	60
2.14 Railway development phases	61
2.15 Project timelines.....	61
CHAPTER 3.0 ANALYSIS OF PROJECT ALTERNATIVES	63
3.1 Introduction	63
3.2 Analysis of alternatives	63
3.2.1 No Project Alternative	63
KE25036-0100D (2) R_03 ESIA Study for Phase 2B SGR	17

3.2.2 Alternative – Option of Main Passage Routes.....	63
3.2.3 Technology Alternatives	64
3.2.4 Locomotive Type.....	65
3.2.5 Alternative Construction Materials	65
3.2.6 Conclusion	66
 CHAPTER 4.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK	67
4.1 Introduction	67
4.2 National Policy Framework.....	67
4.2.1 National Environment Policy.....	67
4.2.2 Environment and Development (Sessional Paper No. 6 of 1999)	68
4.2.3 Forest Policy (2014).....	69
4.2.4 Wildlife Policy of 2011.....	69
4.2.5 National Environmental Policy, 2014.....	69
4.2.6 The Kenya National Biodiversity Strategy and Action Plan of 2000.....	70
4.2.7 Kenya Vision 2030	70
4.2.8 National Land Policy 2023.....	71
4.2.9 Physical Planning Policy.....	72
4.2.10 HIV/AIDS Policy of 2009	72
4.2.11 Kenya National Gender and development Policy of 2011.....	72
4.2.12 The Kenya National Climate Change Response Strategy of 2010.....	72
4.2.13 The Kenya Environmental Sanitation and Hygiene Policy of 2016-2030.....	73
4.3 National Environmental Legal and Regulatory Framework.....	74
4.3.1 Relevant National Environmental Legislations and Regulations.....	74
4.5 Development Partners Regulations on Environmental and Social Management.....	82
4.6 World Bank Group Environmental and Social Framework (ESF)	88
4.7 International Environmental Agreements Relevant to Kenya.....	92
4.7.1 International Labour Organization Fundamentals and Other Conventions.....	93
 CHAPTER 5.0 ESIA APPROACH AND METHODOLOGY	95
5.1 Introduction	95
5.2 Socio Economic Data Collection Methodology	95
5.2.1 Desktop Study Studies	95
5.2.2 Stakeholder Engagement and Public Participation.....	95
5.3 Biodiversity Data Collection Methodology.....	105
5.3.1 Biodiversity Assessments	105
5.3.2 Mammal Survey Methodology.....	106
5.3.4 Bird Survey Methodology	107
5.3.5 Herpetofauna Survey Methodology	107
5.3.5 Fish Surveys Methodology.....	108

5.3.6 Invertebrate Survey Methodology	108
5.4. Physical Environment Data Collection Methodology	109
5.4.1 Air Quality Assessment Methodology.....	109
5.4.2 Soil Quality Assessment Methodology	109
5.4.3 Water Quality Assessment Methodology.....	110
5.4.4 Noise and vibration assessment methodology.....	111
5.5 Impact Analysis and Evaluation Methodology	113
5.5.1 Sensitivity of a Receptor.....	113
5.5.2 Change Parameter.....	114
5.5.4 Mitigation and Enhancement Measures	115
5.6 ESIA Study Area / Area of Influence	116

CHAPTER 6.0 ENVIRONMENTAL AND SOCIAL BASELINE CONDITION OF THE PROJECT AREA 117

6.1 Introduction	117
6.2 Physical Environment.....	117
6.2.1 Hydrology	117
6.2.2 Baseline Air Quality	123
6.2.2.3 Nitrogen Dioxide Results	131
6.2.3 Noise Measurements	134
6.2.4 Soil Measurements	144
6.2.5 Water Quality Measurements	147
6.3 Biodiversity Baseline	154
6.3.2 Vegetation and Land Cover.....	154
6.3.3 Protected Areas and Key Biodiversity Features along the Route.....	156
6.3.4 Biodiversity Assessment Findings	158
6.3.5 Sensitivity Analysis	163
6.3.6 Critical Habitat Analysis.....	167
6.4 Baseline Social and Economic Conditions	170
6.4.1 Introduction	170
6.4.2 Narok County	170
6.4.3 Bomet County.....	177
6.4.4 Kericho County.....	184
6.4.4.4 Land Tenure and Use.....	189
6.4.4.5 Education.....	190
6.4.4.6 Energy Sources	190
6.4.4.7 Health.....	190
6.4.4.8 Water Sources	191
6.4.4.9 Transport and Communication Network	191
6.4.5 Nyamira County	193
6.4.6 Kisumu County.....	200

CHAPTER 7.0. CLIMATE CHANGE RISK AND VULNERABILITY ASSESSMENT	212
7.1 Background	212
7.2 Purpose of Climate Risk and Vulnerability assessment	212
7.3 Study Methodology	213
7.3.1 Shared Socioeconomic Pathways (SSPs) and Planning Horizons	214
7.4 Climatic Conditions	217
7.5 Climatic Projections	217
7.5.1 Heterogeneity of county Rainfall Trends	217
7.5.2 Spatial heterogeneity of Seasonal Rainfall	220
7.6 Climatic Change Impact on SGR Infrastructure	223
7.7 Climatic Hazards Assessment	224
7.8 Climatic Risk Assessment Matrix	230
7.9 Infrastructure Climate Vulnerabilities	233
7.10 Railway Infrastructure Heat Stress Vulnerability	233
7.11 Climate Change Adaptation plan	240
7.12 Greenhouse Gas (GHG) Emissions Climate Mitigation Strategy	242
7.12.1 The Construction Phase, The Initial Carbon Debt	242
7.12.2 The Operational Phase: Direct and Indirect Emissions	243
7.12.3 The Net Carbon Benefit: Avoided Emissions and Payback Analysis	244
7.12.4 Conclusions on GHG Mitigation	245
7.13 Conclusions	245
 CHAPTER 8.0 STAKEHOLDER AND COMMUNITY CONSULTATION	 247
8.1 Introduction	247
8.2 Objectives of Stakeholder Engagement	247
8.3 Stakeholder Consulted	247
8.4 Stakeholder Response Matrix	249
8.5 Analysis of Stakeholder questionnaire responses	284
8.5 Public Consultation Meetings	288
8.6 Validation Workshops	295
8.6.1 Introduction	295
8.6.2 Objective of a Validation Workshop	295
 CHAPTER 9.0 SIGNIFICANT ENVIRONMENTAL IMPACTS IDENTIFICATION, ANALYSIS AND EVALUATION	 298
9.1 Introduction	298

9.2 IMPACT IDENTIFICATION	298
9.3 Significance and Impact Analysis	320
9.3 Potential Impacts.....	333
9.3.1 Anticipated positive social and economic impacts during site preparation, construction, operation and decommissioning phases	333
9.3.2 Positive Environmental Impacts during site preparation, construction, operation and decommissioning phases	334
9.3.3 Negative Environmental Impacts During Site Preparation and Construction Phases	335
9.3.4 Predicted negative social and economic impacts during site preparation and construction phases.	347
9.3.5 Negative Environmental Impacts During Operation Phase.....	351
9.4 Cumulative Impacts Assessment (CIA).....	362
9.4.1 Objectives CIA.....	362
9.4.2 Key Projects/Activities for Cumulative Impact Assessment (CIA).....	362
9.4.3 Impacts Identification.....	363
9.4.4 Cumulative Impact Matrix	364
9.4.5 Cumulative Impact Mitigation and Monitoring Matrix	365
10.1 Overview	368
10.2 Purpose and Objectives of ESMP	368
10.3 Auditing of the ESMP.....	368
10.5 Chance Find procedures for Archaeological and Cultural Heritage	401
10.6 Responsibility and Accountability for ESMP	401
10.7 Training, Awareness and Capacity Building.....	402
 CHAPTER 11.0 ENVIRONMENTAL AND SOCIAL MONITORING PLAN.....	404
11.1 Internal Monitoring.....	404
11.2 External Monitoring and Evaluation	404
11.3 Impacts, Mitigation and Monitoring Matrix for Kisumu Port	417
 CHAPTER 12.0 CONCLUSIONS AND RECOMMENDATIONS.....	422
12.1 Conclusions	422
12.2 Recommendations	422
 REFERENCES.....	424

LIST OF TABLES

Table 1: ESIA Consultants for the project.....	34
Table 2: Main ESIA Report Structure	35
Table 3: Roles and Responsibilities	36
Table 4: Salient features along SGR Phase.....	46
Table 5: Stations along the proposed SGR line.....	49
Table 6: Technical standards of railway	50
Table 7: Technical standards for port area branch line.....	51
Table 8: Implications of technical standards to ESIA study.....	51
Table 9: Schedule Bridges	53
Table 10: Road Crossings	55
Table 11: Legal Frameworks and their relevance.....	78
Table 12: Relevant IFC performance standards	83
Table 13: Relevant ESS and their relevance to the project	89
Table 14: International agreements relevant to Kenya.....	92
Table 15: ILO standards and other conventions.....	93
Table 16: Stakeholders Mapping.....	98
Table 17: Stakeholder and public consultation methods	102
Table 18: Stakeholder Engagement plan	103
Table 19: Sampled points along the SGR Phase 2C corridor.....	105
Table 20: Parameters and method of analysis	110
Table 21: Criteria and scoring system for determining sensitivity of a receptor Category.....	113
Table 22: Change receptors.....	114
Table 23: Guidance to significance points	115
Table 24: Major Catchments	121
Table 25: Sampling Locations	125
Table 26: Respirable and Inhalable Particulate Matter Results	128

Table 27: Carbon dioxide results	130
Table 28: Nitrogen Dioxide results.....	131
Table 29: Total Volatile Organic Compounds Results	132
Table 30: Noise and Excessive Vibrations Pollution Regulations.....	135
Table 31: Noise and Ground Vibration Measurements Locations.....	136
Table 32: Noise measurement results	140
Table 33: Ground Vibration Measurement Results.....	142
Table 34: Soil sample collection sites and results	144
Table 35: Water sampling locations	147
Table 36: Quality Standards for Sources of Domestic Water	150
Table 37: Summarized results of different parameter.....	152
Table 38: Rivers Originating from Mau Forest Complex and their Drainage Basins	157
Table 39: Conservation status of different bird spp.....	161
Table 40: Sensitivity Analysis	164
Table 41: Critical habitat analysis.....	168
Table 42: Area and Administrative units in Narok Sub-counties.....	171
Table 43: Population Distribution per Sub County.....	172
Table 44: Administrative Sub Division of Narok County	177
Table 45: Population Density and Distribution by Sub County.....	179
Table 46: Population and Area of different Sub Counties.....	187
Table 47: Administrative Units.....	194
Table 48: Population projections (by sub-county and sex)	195
Table 49: Sub Counties and Sizes	201
Table 50: Population projections.....	202
Table 51: Livelihood distribution among the Sub Counties.....	203
Table 52: Number of Learning Institutions and Teachers in Kisumu County	205
Table 53: AR6 scenarios and project planning horizons	215

Table 54: Summary of data set used	215
Table 55: Unit Conversions for CMIP6 Variables	216
Table 56: Weather elements	217
Table 57: Temperature projections (2030, 2050 and 2070) for the five counties	222
Table 58: Rainfall Projections (2030, 2050 and 2070) for the five Counties.....	222
Table 59: Impact Matrix of extreme weather events on vulnerable assets	223
Table 60: Effects of climate change on the SGR	224
Table 61: Hazard indicators and thresholds	228
Table 62: Climate change risk assessment matrix.....	232
Table 63: Impacts, Risk and Mitigations	233
Table 64: Climate Change Adaptation plan	240
Table 65: Summary of Projected Operational GHG Emissions (Annual)	244
Table 66: Carbon Payback and Net Impact Timeline.....	244
Table 67: List of stakeholders consulted.....	248
Table 68: Stakeholder Response Matrix.....	249
Table 69: Analysis of Stakeholder questionnaire responses.....	285
Table 70: Meeting schedule	288
Table 71: Validation Workshop Meetings.....	295
Table 72: Scoping Matrix - Environmental aspects identification of the potential interactions between project actions and environmental aspects	299
Table 73: Scoping Matrix – Social aspects identification of the potential interactions between project actions and social aspects	300
Table 74: Impact identification.....	301
Table 75: Evaluation of Noise and vibration	320
Table 76: Evaluation of Air pollution – Gaseous emissions.....	320
Table 77: Evaluation of Air pollution – Dust Generation.....	321
Table 78: Evaluation of impact due to vegetation clearance.....	322
Table 79: Evaluation of Health and Safety of workers	322

Table 80: Evaluation of Community Health and Safety	323
Table 81: Evaluation of Solid and liquid waste generation	324
Table 82: Evaluation of Soil erosion.....	324
Table 83: Evaluation of Influx of Workers leading to increased HIV prevalence and moral decay	325
Table 84: Evaluation of Pollution from oil spills	325
Table 85: Evaluation of Slope Destabilization	326
Table 86: Evaluation of Impacts associated with depletion of Local natural resources (sand, ballast, murram and hardcore).....	327
Table 87: Evaluation of Traffic accidents	328
Table 88: Evaluation of Hydrology and water quality degradation	328
Table 89: Evaluation of Contribution to climate change.....	329
Table 90: Evaluation of wildlife and livestock accidents	330
Table 91: Evaluation of disruption of existing public utilities.....	330
Table 92: Evaluation of Disputes over employment.....	331
Table 93: Evaluation of loss of grazing land and livelihoods.....	331
Table 94: Evaluation of Habitat loss and fragmentation	332
Table 95: Projects/ Activities for cumulative impacts.....	363
Table 96: Impacts Identification.....	363
Table 97: Cumulative Impact Matrix.....	364
Table 98: Cumulative Impact Mitigation and Monitoring Matrix	365
Table 99: Actors and tasks in ESMP implementation.....	368
Table 100: Environmental Social Management Plan (ESMP)	370
Table 101: Step-by-Step Procedure for a Chance Find	401
Table 102: Responsibilities of various staff Implementing the Project ESMP	402
Table 103: Environmental Social Monitoring plan (ESMP) of the Proposed Project.....	405
Table 104: Environmental Social Monitoring plan (ESMP) of the Proposed Kisumu Port.....	418

LIST OF FIGURES

Figure 1: Meter Gauge / Proposed Phase 2B/Phase 2C Standard Gauge Rail network.....	32
Figure 2: Phase 2B - Route Alignment	33
Figure 3: River Sondu	34
Figure 4: Silted Riverbed on the Project Alignment.....	34
Figure 5: Concept layout plan SGR Phase 2B Alignment – Narok County	40
Figure 6: Concept layout plan SGR Phase 2B Alignment – Bomet County.....	42
Figure 7: Layout plan SGR Phase 2B Alignment – Kericho & Nyamira Counties.....	44
Figure 8: Project activities	62
Figure 9: Stakeholder analysis	97
Figure 9: Level 1 Grievance Process	104
Figure 10: Level 2 Grievance Process.....	104
Figure 11: Tomahawk cage.....	107
Figure 12: Pitfall Traps with drip fences.....	108
Figure 14: Air Pollutants Measurements at Obumba Passing Station	109
Figure 15: Air Pollutants Measurements at the proposed Masandare Passing Station.....	109
Figure 16: Soil sample collection	110
Figure 17: Sampling at Emurtoto/ Ndoroto Water Pan.....	111
Figure 18: Sampling at Engare River	111
Figure 19: A view of the Sound Level Calibrator used	112
Figure 20: A view of the Sound Level Meter used	112
Figure 21: Noise Measurements at proposed Sondu Station	112
Figure 22: Vibration measurement at the proposed Narok Station	113
Figure 23: Ground vibration monitoring equipment	113
Figure 24: A map showing the project area and the broader hydrological catchment area.....	118
Figure 25: Delineation of Catchment's outer boundary based on topography.....	119

Figure 26: Major catchments the proposed rail is traversing: From Right to left, Ewaso Ngiro River, Mara River, Sondu River, Nyando River, Kibos River, Kisian River, Yala River, Nzoia River, Sio River and lastly the Malaba River Catchment.	121
Figure 27: Mapped areas where air samples were collected.....	127
Figure 28: Location of Noise and vibration mapped areas.....	138
Figure 29: Mapped soil sampled areas	145
Figure 30: Water sampling locations on google map.....	149
Figure 31: Open grasslands within the project areas	155
Figure 32: Rice plantation in Ahero	156
Figure 33: Tea Plantation in Kericho	156
Figure 34: Some of the wetlands in the project area	156
Figure 35: Sisal plant.....	158
Figure 36: Water Lililes	158
Figure 37: Tilapia SPP.....	159
Figure 38: Conservation status of Fish.....	160
Figure 39: Some of the amphibians in the project area	160
Figure 40: <i>Agama lionotus</i> reptile SPP	161
Figure 41: Mammalia Order within the project corridor	162
Figure 42: Mammals conservation status.....	163
Figure 43: Plauns zebra, <i>Equus guagga</i> from Narok County.....	163
Figure 44: Livestock Grazing in the Fields	174
Figure 45: Administrative Units	177
Figure 46: Administrative Units	185
Figure 47: Tea farms within Nyamira County.....	196
Figure 48: Administrative units	200
Figure 49: Land use within Kisumu County	204
Figure 50: Percentage of HHs Accessing safe drinking water	207
Figure 51: Distribution of Households by Energy use	208

Figure 52: Percentage of HHs with Access to Electricity.....	209
Figure 53: Categorized flood risk levels showing areas with the highest projected increases in seasonal precipitation.....	225
Figure 54: Unified Rainfall erosivity index (R-Factor) for MAM and OND seasons across the Phase 2B project counties.....	227
Figure 55: Multi-Hazard Index (MHI) for MAM and OND seasons.	231
Figure 56: 2-Year Return Level (T2) – High-frequency, low-magnitude storm events.....	235
Figure 57: 5-Year Return Level (T5) – Operational threshold storm events.....	236
Figure 58: 10-Year Return Level (T10) – Minor drainage design storms.....	237
Figure 58: 20-Year Return Level (T20) – Intermediate Infrastructure stress-test.....	238
Figure 58: 25-Year Return Level (T50) – Major infrastructure Design Storm for bridges and viaducts	239
Figure 61: Participants per county by gender.....	290
Figure 62: Ongoing meetings during validation workshop.....	296

ABBREVIATIONS

°C	Degrees Celsius
AoI	Area of Influence
ACC	Area County Commissioner
AIDS	Acquired Immunodeficiency Syndrome
BETA	Bottom Up Economic Transformational Agenda
CBD	Convention of Biological Diversity
CBOs	Community Based Organizations
CIDP	County Integrated Development Plan
CDRI	Coalition for Disaster Resilient Infrastructure
CEC	County Environment Coordinator
CRA	Commission for revenue Allocation
DCC	Deputy County Commissioner
DD	Data Deficient
EHS	Environment Health and Safety
EMCA	Environmental Management and Coordination Act
EMP	Environment Management Plan
E&S	Environmental and Social
ESCA	Environmental and Social Compliance Audit
ESIA	Environmental and Social Impact Assessment
ESF	Environmental and Social Framework
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Safeguards
FGD	Focus Group Discussion
g	Grams

GBV	Gender Based Violence
GPS	Geographic Positioning System
GRC	Grievance Redress Committee
GVA	Gross Value Added
HIV	Human Immunodeficiency Virus
HSE	Health Safety and Environment
ICD	Internal Container Depot
IFC	International Finance Corporation
IIBP	International Industrial Best Practices
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
KESHP	Kenya Environmental Sanitation and Hygiene Policy
KNBSA	Kenya National Biodiversity Strategy and Action Plan
KRC	Kenya Railways Corporation
KWS	Kenya Wildlife Services
MEA	Multilateral Environmental Agreements
NCA	National Construction Authority
NEMA	National Environmental Management Authority
NEP	National Environmental Policy
NGO	Non-Governmental Organizations
NMK	National Museum of Kenya
NT	Near Threatened
NORM	Naturally Occurring Radioactive Materials
NTU	Nephelometric Turbidity Unit

ODF	Open Defecation Free
OHS	Occupational Health and Safety
OSHA	Occupational Safety and Health Act
PAPs	Project Affected Persons
PS	Performance Standards
PES	Payment for Environment Services
PM	Particulate Matter
PPM	Parts Per Million
PPE	Personal Protective Equipment
PS	Performance Standards
PPV	Peak Particle Velocity
RAP	Resettlement Action Plan
SEP	Stakeholder Engagement Plan
SHIFA	Social Health Insurance Act
SGR	Standard Gauge Railway
TDS	Total Dissolved Solids
TOR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
VECs	Valued Environmental and Social Components
µg/m ³	Micrograms per Cubic Meter
WBG	World Bank Guidelines
WRA	Water Resources Authority

CHAPTER 1.0 INTRODUCTION

1.1 Project Background

Kenya Railways Corporation (KRC) is a state corporation in Ministry of Roads and Transport. The corporation was established in 1978 under the Kenya Railways Corporation Act (Cap 397) of the laws of Kenya to take over the railways section in Kenya after the collapse of East Africa Community in 1977 which managed the East African Railways and Harbours Corporation. The functions as outlined in Cap 397 of the Kenya Railway Act include:

- Development, operation and maintenance of railway infrastructure in the country
- Ensure safety and security of railway transport
- Ensure funding and financing of the corporation activities
- Facilitate partnerships between the public and private sectors in development, operation and maintenance of railways.
- Ensure compliance with the relevant regional and international convention on transport that guide the economic and environmental sustainability of railway transport.
- Undertake research for the purpose of encouraging innovations in the railway sector
- Conduct technical capacity development at the Railway Training Institute (RTI)
- Ensure effective and efficient service delivery in railway operations

Management of rail assets including land, buildings, workshops, permanent way, signaling and telecommunication systems, rolling stock, vessels on Lake Victoria, and the Railway Museum—is central to achieving Kenya’s long-term transport and development goals. Kenya aspires to become a prosperous, industrializing middle-income country, and this vision depends heavily on the development of efficient, modern transport infrastructure and services.

The country has adopted a holistic transport corridor strategy aligned with national and regional development frameworks, including the United Nations 2030 Agenda for Sustainable Development, the African Union Agenda 2063, the East African Community Vision 2050, Kenya Vision 2030, and the Bottom-Up Economic Transformation Agenda (BETA). Section 3.4 of Kenya Vision 2030 emphasizes the creation of a well-connected nation through comprehensive road, rail, port, airport, water, sanitation, and telecommunications infrastructure.

The proposed Standard Gauge Railway (SGR) project involves the planning, design, construction, and operation of a modern, high-capacity railway to facilitate the efficient movement of passengers and freight across key economic zones. The alignment will traverse urban, peri-urban, agricultural, and environmentally sensitive areas. The project is expected to significantly enhance the regional rail network, upgrade the country’s rail standards, and ease pressure on the existing transport system.

In Kenya, Environmental and Social Impact Assessment (ESIA) is mandatory for major projects listed in the Second Schedule of the Environmental Management and Coordination Act (EMCA) 1999. The ESIA ensures that environmental and social impacts are addressed during project design, construction, operation, and decommissioning. In compliance with these requirements, and to avoid conflicts that may hinder national development, Kenya Railways Corporation (KRC) commissioned this ESIA to integrate the relevant environmental and social considerations into project planning.

KRC proposes to construct the Standard Gauge Railway (SGR) Phase 2B a 262.384km rail line from Naivasha to Kisumu, inclusive of 8.684 km branch line and Kisumu Port. This regional project aims to enhance connectivity from Mombasa to Malaba and onward to Kampala, with potential links to South Sudan, Rwanda, and the Democratic Republic of Congo. Rail transport is among the safest and most environmentally sustainable modes of transportation, contributing to reduced carbon emissions. The project is expected to stimulate socio-economic development both nationally and regionally.

The Naivasha–Kisumu SGR begins at the terminus of the Nairobi–Naivasha SGR and pass through Narok, Bomet, Sotik, Sondu, and Ahero before terminating in Kisumu. It traverses five counties: Narok, Bomet, Nyamira, Kericho and Kisumu. Key project components include tracks, sleepers, tunnels, bridges, stations, and locomotives. The Kisumu Port component will involve constructing two multi-purpose berths, associated facilities, and a work-boat berth to support safe docking operations.

In accordance with Kenya’s EIA procedures, this project requires submission of an ESIA report to the National Environment Management Authority (NEMA). Kenya Railways Corporation engaged Dar Al-Handasah Consultants (Shair and Partners), in association with Ecoscience & Engineering Limited (a NEMA-registered firm), to undertake the ESIA Study for this project. This document constitutes the ESIA Report for the proposed Standard Gauge Railway Project.

1.2 Project Need and Justification

Kenya’s rapid economic growth in recent years has outpaced the development of its transportation infrastructure, particularly the railway system. The existing metre-gauge railway, built in 1901, has limited capacity, low efficiency, and inadequate service levels, making it unable to meet the rising demand for passenger and freight transport. As a result, over 90% of transport volume has shifted to road networks, increasing congestion and pressure on the road system. These constraints now pose a significant bottleneck to national and regional economic development.

Although minor rehabilitation works have improved the metre-gauge railway, it still meets only a fraction of Kenya’s transport needs. In contrast, a standard gauge railway provides greater capacity, higher speeds, and improved passenger comfort. The SGR currently under development will connect to the existing Mombasa–Nairobi–Naivasha line, forming a key section of the East African Standard Gauge Railway network. Designed to China’s Class I railway standards, the new line marks an important step toward modernizing Kenya’s rail infrastructure and advancing the goals of Vision 2030.

The proposed Naivasha - Kisumu SGR serves as a major transport corridor for western Kenya, supporting natural resource development, industrial growth, and daily passenger travel. When completed, it will ease the constraints caused by the existing transport system, enhance regional connectivity, and unlock economic potential along the corridor. The project is therefore essential to sustaining Kenya’s rapid economic growth and supporting long-term regional development.

1.3 Project Objectives

The Standard Gauge Railway (SGR) is a flagship Vision 2030 project aimed at modernizing Kenya's transport sector by replacing the ageing meter-gauge system with a faster, more efficient, and reliable rail network. The SGR Phase 2C project will deliver multiple socio-economic, environmental, and infrastructural benefits throughout its pre-construction, construction, operation, and decommissioning phases.

Key objectives and benefits include:

- **Reduced Transport Costs:** Lower transportation costs across Narok, Bomet, Nyamira, Kericho and Kisumu Counties, and improved regional trade links with Uganda, Rwanda, Burundi, DRC, and South Sudan.
- **Environmental Benefits:** Reduced carbon emissions due to decreased reliance on road transport.
- **Industrial Growth:** Support for industrialization through efficient freight movement and the emergence of industries linked to railway operations.
- **Economic Growth:** Contribution to GDP growth during both construction and operational phases.
- **Strengthened Regional Logistics:** Enhanced role of the Port of Kisumu as a key transport and logistics hub for the East African region.
- **Preservation of Road Infrastructure:** Less strain on roads as freight shifts from trucks to rail.
- **Reduced Travel Time:** Faster and more reliable travel between Narok and Kisumu.
- **Improved Freight Security:** Enhanced safety and security of goods compared to road transport.
- **Industrial Park Development:** Promotion of industrial parks and Special Economic Zones (SEZs) along the corridor.
- **Job Creation:** Employment opportunities for both skilled and unskilled workers during construction and operation, with long-term benefits for regional railway capacity.
- **Growth of New Sectors:** Expansion of services such as hospitality, accommodation, food, and informal enterprises.
- **Increased Local Input Demand:** Boost in demand for locally produced materials including steel, cement, aggregates, electrical components, roofing materials, and glass.
- **Improved Road Safety:** Fewer heavy trucks on the Naivasha to Kisumu, reducing accidents and enhancing safety.
- **Regional Integration and Growth:** Strengthened economic ties and resource development within the East African region.

- Tourism Promotion: A safer and more affordable travel alternative to inland parks, reserves, and western Kenya, supporting tourism development.

1.4 Purpose of ESIA

Railway lines and ports are classified as high-risk projects under Kenya's EMCA 1999 (Amended 2015), Second Schedule, as updated by Legal Notice No. 31 of April 2019. Such projects require a full Environmental and Social Impact Assessment (ESIA) and preparation of a detailed Study Report.

This ESIA has been conducted in line with Section 58 of EMCA and the EIA/EA Regulations (2003), as well as relevant guidelines, IFC Performance Standards, and the World Bank Group EHS Guidelines (2007).

- The main purpose of the ESIA is to ensure a comprehensive assessment of the project's environmental and social risks and compliance with Kenyan laws and international best practice. Specifically, the ESIA aims to:
- Identify significant environmental and social impacts and propose appropriate mitigation measures.
- Verify compliance with national environmental regulations and industry standards.
- Establish baseline data to support monitoring and evaluation during the project lifecycle.
- Assess climate change risks and vulnerabilities affecting the project.
- Recommend cost-effective mitigation measures for anticipated impacts.
- Provide guidance to stakeholders on managing adverse social impacts.
- Develop a project-specific Environmental and Social Management Plan (ESMP).
- Produce an ESIA Study Report consistent with EMCA CAP 387, summarizing findings and recommendations.

1.5 Project location/Route Alignment

The proposed 262.384 km single-track, standard gauge railway, inclusive of 8.684 km branch line to the new Kisumu Port, represents one of Kenya's most significant transport infrastructure undertakings under the national Vision 2030 framework. The alignment traverses diverse and highly sensitive terrain, cutting across the Great Rift Valley escarpment, the Mau and Kericho highlands, and the extensive Kano floodplains before terminating at the Lake Victoria Basin. The counties to be traversed by the proposed alignment are Narok County, Bomet County Kericho County, Nyamira County and Kisumu County. **Figure 1** below show the Meter gauge/proposed SGR Phase 2B/2C rail network in Kenya.

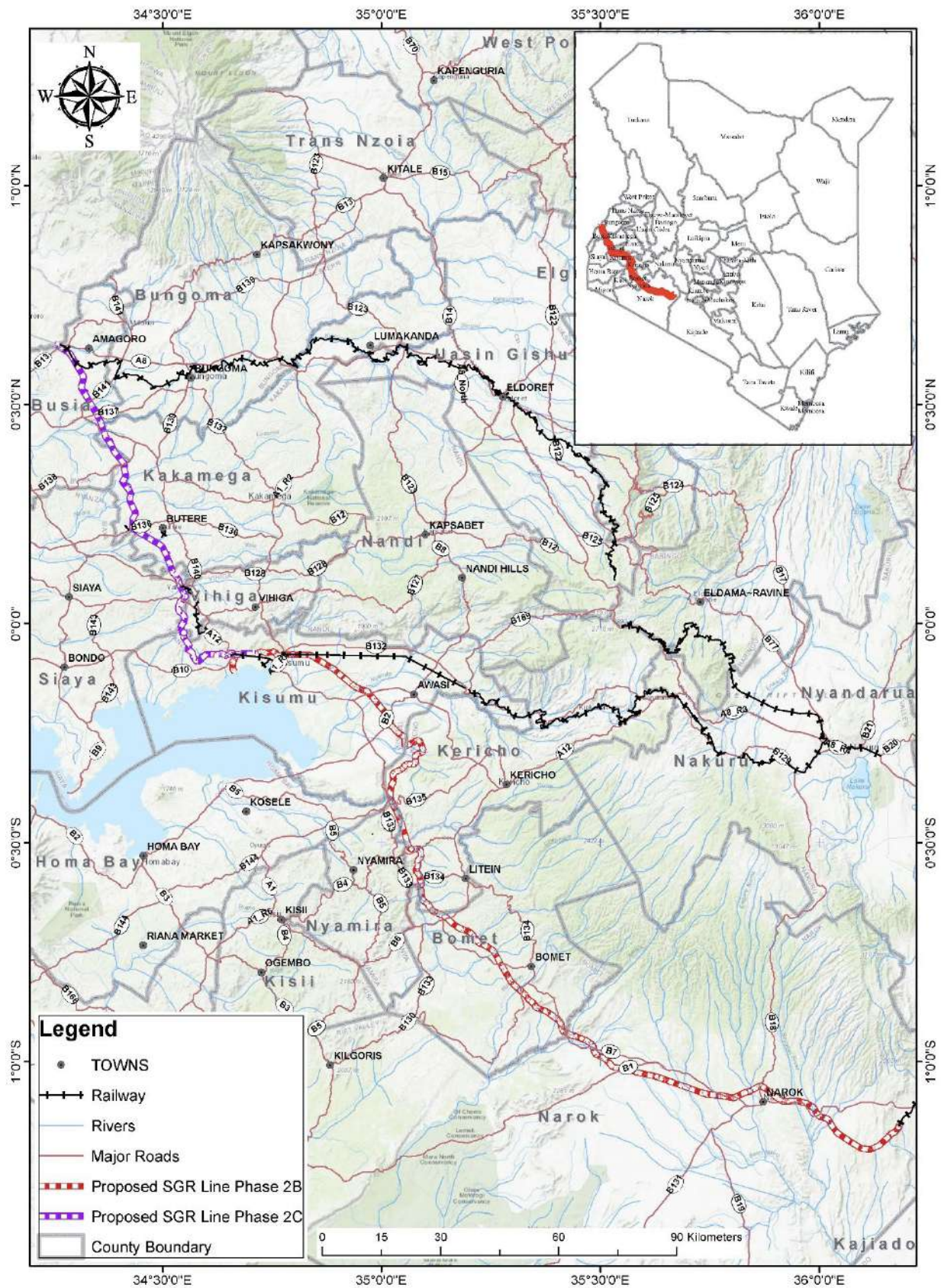


Figure 1: Proposed Phase 2B/Phase 2C Standard Gauge Rail network

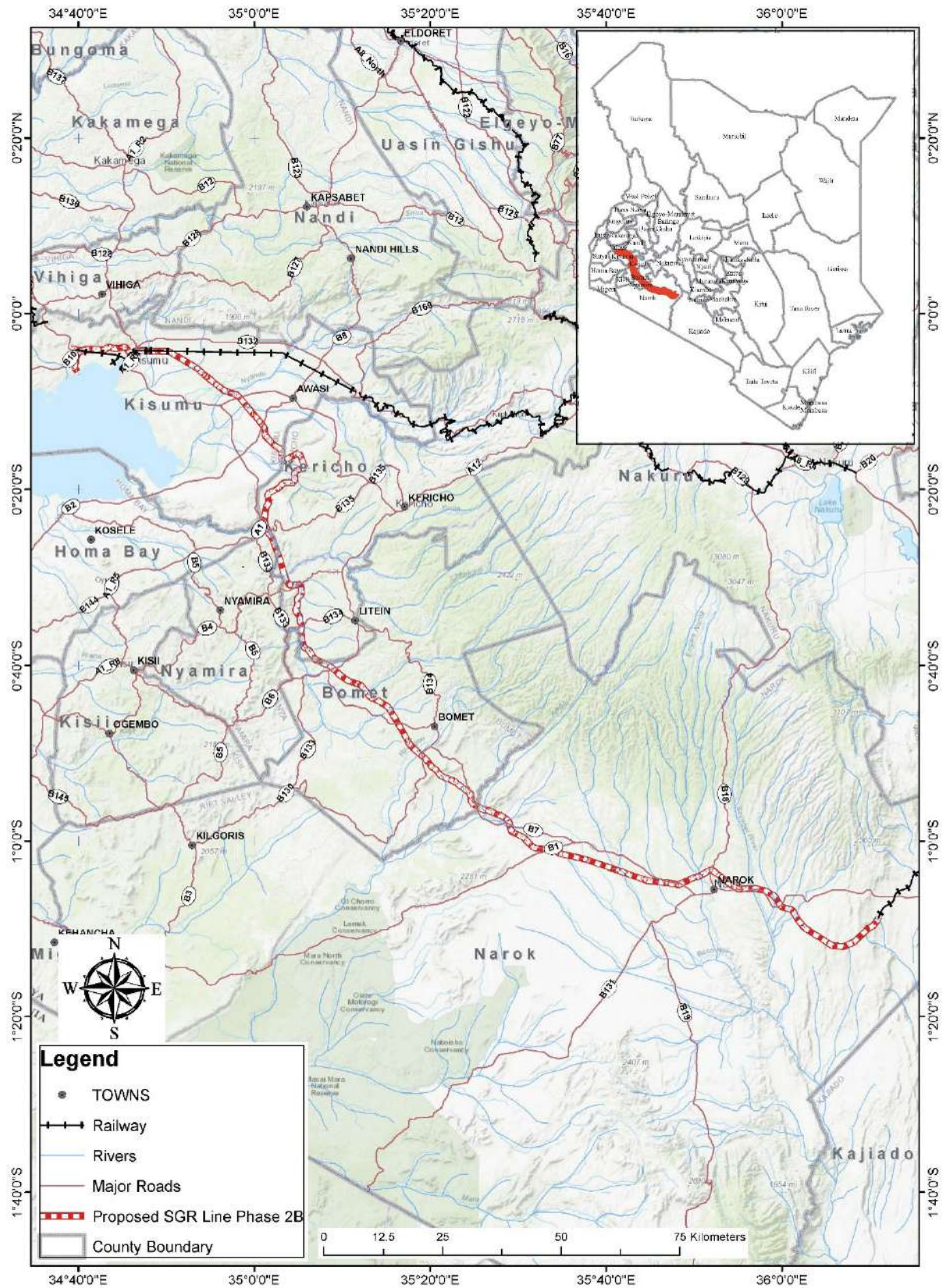


Figure 2: Phase 2B - Route Alignment

1.5.1 Some of Traversed Features in the Route Alignment

The Proposed Naivasha–Kisumu Standard Gauge Railway traverses the northwest of the Republic of Kenya. The line starts from the end point of the Nairobi–Naivasha Standard Gauge Railway. It passes through Narok, Bomet, Sotik, Sondu, Ahero, and ends at Kisumu. Figure 3 and Figure 4 below depicts some of the features along the route alignment.



Figure 3: River Sondu



Figure 4: Silted Riverbed on the Project Alignment

1.6 Environmental and Social Consultants Team

The key Dar Hadassah and Ecoscience & Engineering Limited consultants that conducted the ESIA Study are presented in **Table 1** below.

Table 1: ESIA Consultants for the project

Name	Role	Years' Experience	Tasks
Philip Abuor	Team Leader/ Lead Expert	18	Technical review and input to ESIA
Caleb Mango	Social Safeguard Expert	16	Public and stakeholder Engagement
Kevin Kimani	Environmentalism	11	Environmental impact Assessment
John Opiyo	Biodiversity Specialist	10	Ecology and Biodiversity
Frankline Rono	Climate Specialist	8	CRA/CV Assessments
Naumy J.Kurui	Health & Safety Expert	10	Preparation of OSH Plans
Eng. Daniel Kariuki	Railway Expert/ Hydrologist	>10	Project Description and Alternatives/Railway Safety/ Hydrological Study

Name	Role	Years' Experience	Tasks
Calvince Arum	Project Manager	10	Project Coordinator

1.7 Structure of the ESIA report

The structure of the ESIA study report is as laid in **Table 2** below.

Table 2: Main ESIA Report Structure

S/ No	Chapter	Contents
	Executive Summary	Presents summarized essential information contained in the report for decision-makers, stakeholders, and the public.
1	Introduction	Provides the description of the project background, location, purpose, objectives, NEMA reporting requirements, study methodology and the overall report structure
2	Project description	Presents the project design and implementation strategies
3	Analyses of Project alternatives	Gives an analysis of project alternatives including the no-project option.
4	Policy, Legal and Regulatory framework	Outlines the overview of relevant legislative regulatory and framework, international guidelines and conventions relevant to this project.
5	Methodology	Provides the framework and process for how impacts are identified, analyzed, and evaluated.
6	Baseline environmental and socioeconomic conditions	Provides description of the baseline environmental and social setting of proposed project and surrounding areas, e.g. climate, soils, geology, vegetation, fauna, land use, socio-economic profile and cultural heritage
7	Climate Change Risk Assessment and Vulnerability Assessment	Identifies Climate-related risks to the project and provides mitigation measures.

S/ No	Chapter	Contents
8	Public Participation and Stakeholder Engagement	Gives description of the objectives, methods used and summary of results of the public consultation activities undertaken during the project report stage.
9	Project Impacts, Analysis and Mitigation Measures	Provides description of the objectives, methods used and summary of results of the public consultation activities undertaken during the project report stage.
10	Environmental and social management plan	Presents the proposed Environmental and Social Management Plan (ESMP) and site-specific sub-plans
11	Environmental and Social Monitoring Plan	Provides the proposed Environmental and Social Monitoring Plan (ESMP)
12	Conclusions and Recommendations	Briefly presents the environmental and social acceptability of the project, considering the impacts and mitigation measures identified during the assessment process
13	References	Lists all the reference material used in the course of the study.

1.8 Roles and Responsibilities

To ensure effective implementation of the ESIA study, the roles and responsibilities of key stakeholders are defined in **Table 3** below.

Table 3: Roles and Responsibilities

Stakeholder	Role	Responsibilities
KRC	Project owner	• Ensure the ESIA study is successfully undertaken. • Ensure the final ESIA report is submitted to NEMA. • Pay the license fee and obtain a valid NEMA license.
ESIA Consultants	Undertake ESIA study	• Conduct environmental and social baseline studies.

Stakeholder	Role	Responsibilities
		• Conduct stakeholder and public participation. • Identify potential impacts and develop mitigation strategies • Prepare and submit ESIA report to KRC and NEMA for review and subsequent licensing.
NEMA	Licensing and regulatory services	• Review, approve/reject ESIA report. • Issuing ESIA licenses and improvement orders.
County Governments of Narok, Bomet, Kericho, Nyamira and Kisumu.	Local coordination and community liaison.	• Participate in ESIA report review and communicate feedback to NEMA • Support issuance of relevant permits. • Community mobilizations and facilitation of barazas and meetings.
Local Communities / Project-Affected Persons (PAPs)	Primary stakeholders	• Participate in public consultation meetings • Provide local knowledge and feedback. • Participate in ESIA report validation.

CHAPTER 2.0 PROJECT DESCRIPTION AND ITS COMPONENTS

2.1 Introduction

This chapter presents a detailed description of the proposed Standard Gauge Railway (SGR) Project and its principal components. It outlines the essential construction and operational requirements, including inputs and materials, expected outputs and waste streams, machinery and equipment need, workforce demands, project scheduling, investment considerations, and the anticipated lifespan of the railway infrastructure.

To facilitate a clear understanding of the project's structure and progression, the chapter is organized into thematic sections covering the pre-construction activities, the operational and maintenance framework, and the decommissioning phase. It further provides a comprehensive definition of the project and an overview of the route alignment across the five counties Narok, Bomet, Kericho, Nyamira and Kisumu through which the Naivasha–Kisumu SGR Phase 2C will traverse.

The subsequent sections elaborate on the alignment characteristics, key engineering structures, and the spatial distribution of stations and ancillary facilities, providing a foundation for appreciating the project's technical, environmental, and socio-economic dimensions.

2.2 Route Alignment

The proposed 262.384 km single-track, standard gauge railway, inclusive of 8.684 km branch line to the new Kisumu Port, represents one of Kenya's most significant transport infrastructure undertakings under the national Vision 2030 framework. The alignment traverses diverse and highly sensitive terrain, cutting across the Great Rift Valley escarpment, the Mau and Kericho highlands, and the extensive Kano floodplains before terminating at the Lake Victoria Basin. The counties to be traversed by the proposed alignment are Narok County, Bomet County Kericho County, Nyamira County and Kisumu County

The proposed railway line and its associated infrastructure will be implemented in the counties as displayed below.

Narok County

The Phase 2B alignment within Narok County traverses the following sub counties Narok East, Narok Central, Narok South and Narok Amalo. Within these sub counties the Railway alignment and the associated infrastructure includes:

- Track lay out of approximately 99.11Km railway line within Narok County from (Km120+100-Km219+210); The line starts at Murtoto at Km 120 + 100 in Narok East Sub- County and terminates at Mulot tat Km219+210
- Construction of 2 intermediate and 8 Passing Stations in Narok (Km162+400) and Mulot (Km215+600);
- Construction of 2 Tunnels at (Km 124+045) near Ntutumeti Dispensary and (Km133+660) Southwest of Ntutumeti market, respectively.
- Construction 12 Super Major Bridges and 7 major Bridges with the longest bridge of 1.36 km being at Km147+050.

- Narok Commercial Logistics Hub at Narok town (Km162+400.)
- Right of Way (ROW); General alignment (70m) and Station Areas (100-300m);

The general arrangement of the railway track and associated infrastructure is illustrated in **Figure 5** below.



Figure 5: Concept layout plan SGR Phase 2B Alignment – Narok County

Bomet County

The alignment within Bomet County traverses the following sub counties Bomet East, Bomet Central, Chepalungu and Sotik. Within these sub counties the Railway alignment and the associated infrastructure includes:

- Track layout of approximately 45.94Km railway line within Bomet County from Mulot town (Km219+210) through Kapkesosio, Sachangwan to Kaplong (Km265+150).
- 1 Intermediate Station at Bomet Km 236 +100 and 2 future Passing Stations.
- 8 Super Major Bridges and 6 Major Bridges with the longest being 1km bridge at Km237+985 crossing river Nyangores.
- Bomet Logistics and Commercial Hub at Kapkesosio Km 236+100.
- ROW: General alignment of 70m and Station Areas (200- 300m).

The general arrangement of the railway track and associated infrastructure is illustrated in below.

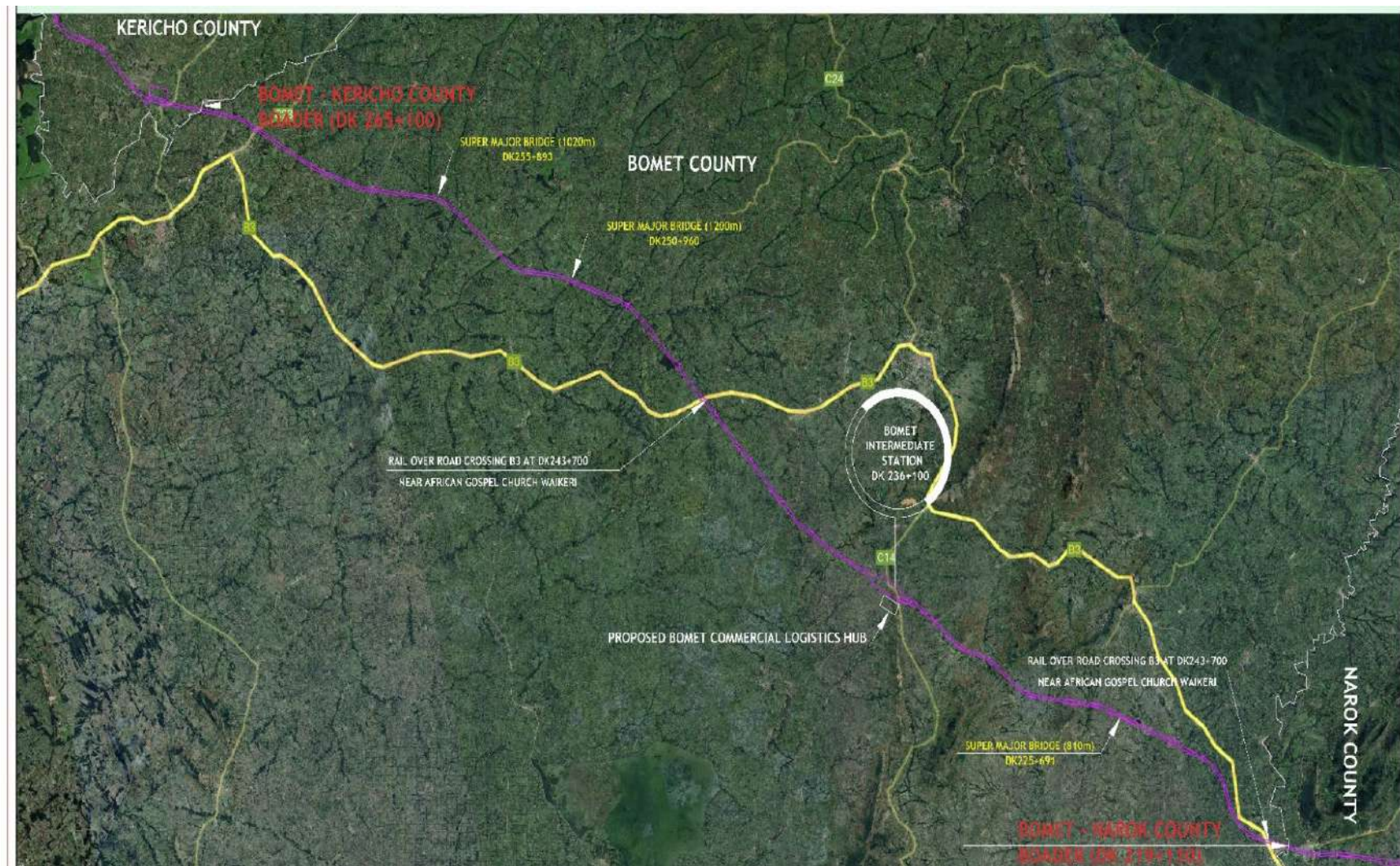


Figure 6: Concept layout plan SGR Phase 2B Alignment – Bomet County

Kericho & Nyamira Counties

The alignment within Kericho County traverses the following sub counties Bureti and Soin Sigowet. While in Nyamira County it passes through Nyamira North. Within these sub counties the Railway alignment and the associated infrastructure includes:

- Track lay out of approximately 53.85Km railway line within Kericho County at near Chebinyiny Center (Km265 + 150) to near Lelagio primary school (293 + 650), near Sondu town Km 297.682 – Km 298 +399, Form Sondu town Km 298 + 800 – near Kapsarok Km 324 + 150.
- Track lay out of approximately 5.15Km railway line within Nyamira County along river Sondu near Nyabwaroro primary school (Km293+650 – Km 298 + 800).
- 8 Stations comprising 1 intermediate station at Sondu, 3 passing stations Liteini, Ikonge west, 3 future passing stations and 1 future intermediate station near Bureti TTC.
- 44 Bridges (Major and Super Major Bridges);
- Logistics and Commercial Hub at Km 235+600.
- 6 Tunnels.
- ROW: General alignment of 70m and Station Areas (200- 300m).

The concept layout plan is as shown in Figure 6: Concept layout plan SGR Phase 2B Alignment – Nyamira and Kericho County below.

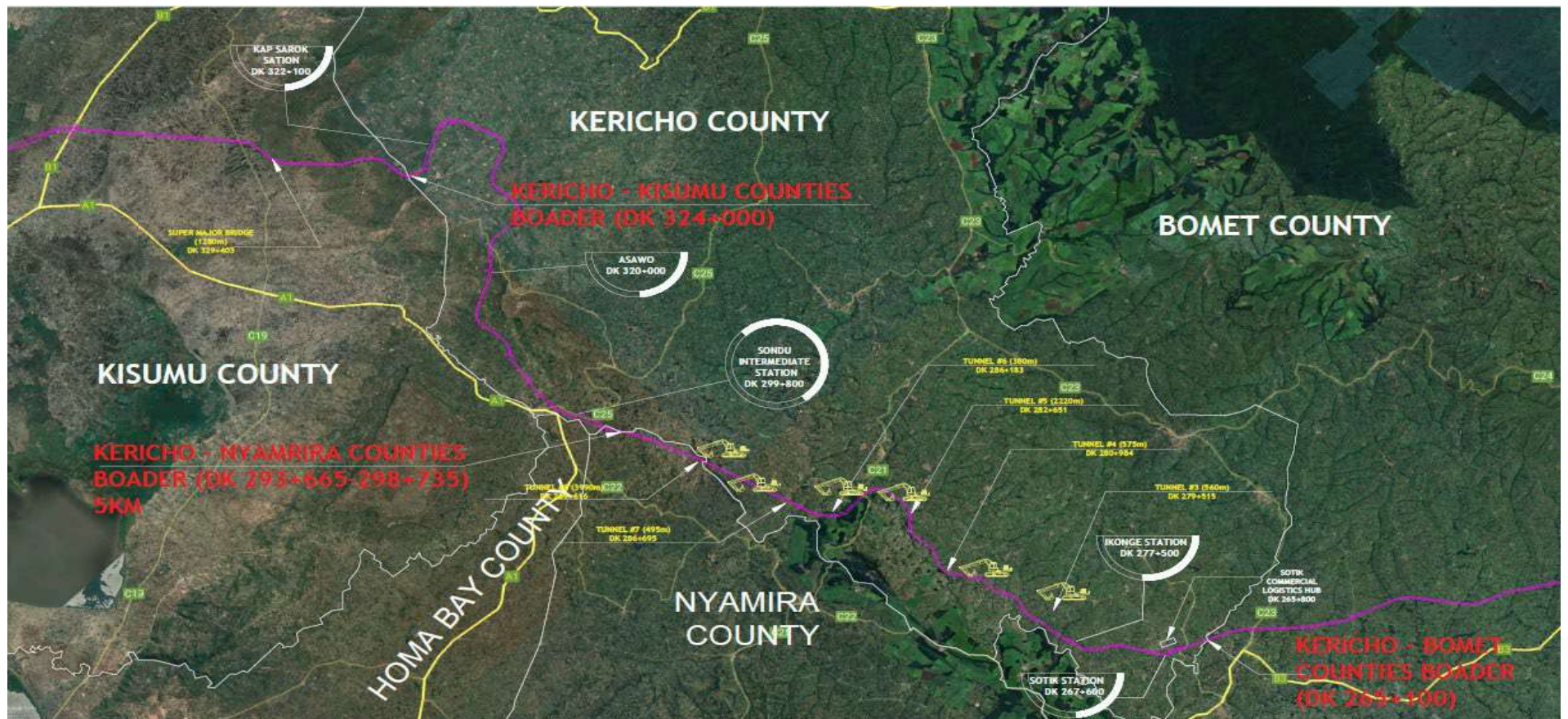


Figure 7: Layout plan SGR Phase 2B Alignment – Kericho & Nyamira Counties

Source: KRC

Kisumu County

The alignment within Kisumu County traverses the following sub counties Muhoroni, Nyando, Kisumu East, Kisumu Central and Kisumu West. Within these sub counties the Railway alignment and the associated infrastructure includes:

- Track layout of approximately 49.65Km railway line within Kisumu County from near Kapsarok (Km 324+150) to Korando B Otonglo (Km 373+800)
- 4 Stations including 1 Terminus Station Kibos at (Km 363 + 000); Port Station (GCK 8 + 200); Freight Station at Korando B Otonglo (Km 373 + 800) and 1 Intermediate Station.
- Logistics and Commercial Hub at Korando B Otonglo Km 374+100
- 6 Bridges (Major and Super Major Bridges); 2 Super Major Bridges and 4 Major Bridges.
- ROW: General alignment of 70m and Station Areas (200- 300m)

The concept layout plans is as shown in **Figure 8** below

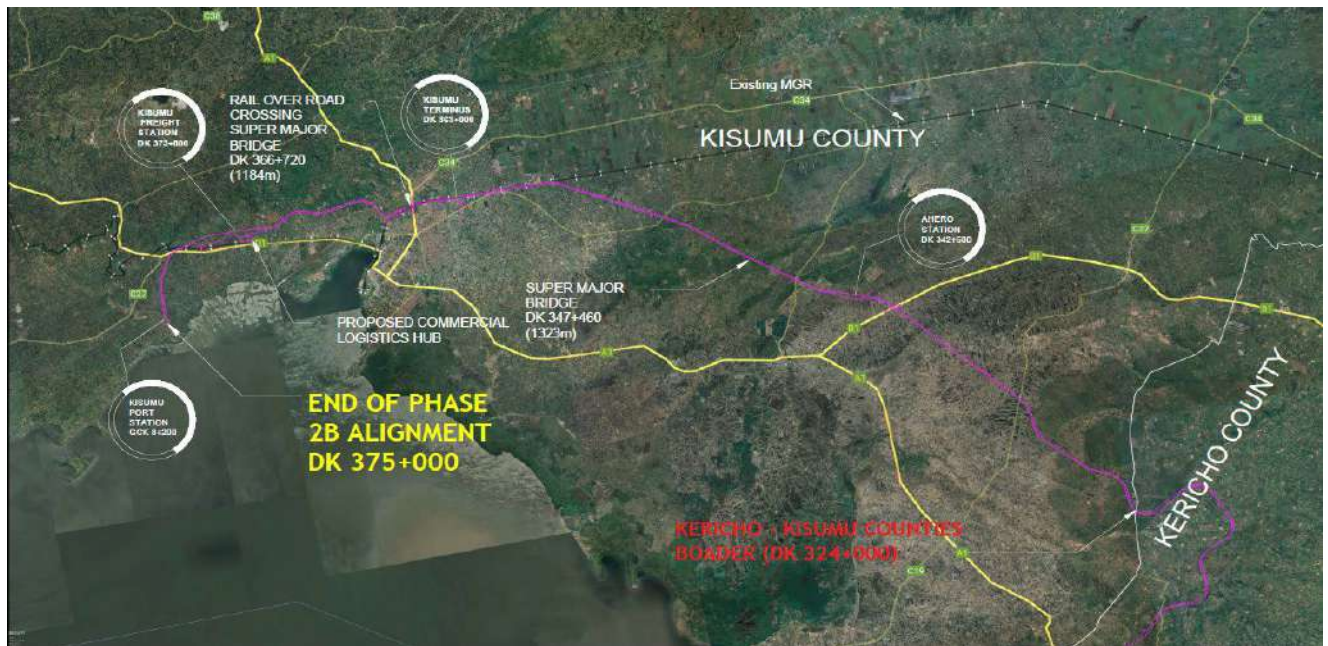


Figure 8: Layout plan SGR Phase 2B Alignment – Kisumu County

2.2.1 Overview of Salient features

The **Table 4** below highlights the salient features of each county within the Phase 2B project

Table 4: Salient features along SGR Phase

County	Salient Features
Narok	- Length (Km 120+100 – Km219+210) – 99.11Km, 2 intermediate stations (Narok Km162+400; Mulot Km215+600) 8 passing stations, 4 future passing stations, 2 Tunnels. ✓ Km124+045 (3840m) ✓ Km133+660 (220m) - Bridges – 12 Super Major and 7 Major (Longest bridge – 1.36Km at Km 147+050), - Commercial Logistics Hub (Km162+400). - General alignment 70m & Station Areas (100m – 300m)
Bomet	- Length (Km 219+210 – Km 265+150) – 45.94Km, 1 intermediate station (Km K236+100) 2 future passing stations, - Bridges – 8 Super Major and 6 Major (Longest bridge – 1.3Km at Km 237+985), - Commercial Logistics Hub (Km 236+100) - General alignment 70m & Station Areas (200m – 300m)
Nyamira	Length (Km 293+650- Km 298+800) (5.51Km),
Kericho	- Length Km265+150 – Km293+650), Km298+800 –324+100 (53.85Km), 1 intermediate station, 3 passing stations, 3 future passing stations, 6 Tunnels, 44 Bridges – Super Major and Major, - Logistics Hub (Km235+600) - General alignment 70m & Station Areas (200m – 300m)
Kisumu	- Length (Km324+150 – Km373+800) – 49.65Km, 1 intermediate station 1 Terminus station, 1 Port station, 1 Freight Station 6 Bridges – (Super Major and Major), - Logistics Hub (Km374+100) - General alignment 70m & Station Areas (100m – 300m)

2.3 Project Components

The key project components of the proposed SGR Phase 2B are listed below:

- Bridges.
- Tunnels.
- Railway Stations
- Internal Container Depots (ICDs)
- Logistic Hubs.
- Water supply /Treatment infrastructure.
- Rolling Stocks (Locomotives and Cars);
- Signaling and Communication & Power Supply System.

The footprint of these key project components is also referred to 'project area' within this ESIA. **Figures** above present the general route alignment map traversed by the proposed SGR Project. The concept plans for these key project components are summarized further below. Prior to construction, a detailed engineering design will be performed to confirm these plans.

2.4 Stations and Yards

The project involves the development of 25 stations along the railway alignment, functionally categorised to support both the operational requirements of the railway and the economic needs of the region. The siting and design of these stations form key development nodes and potential areas of environmental impact.

Station Categories:

Terminal Station (1 No.) - The main terminal station at Kisumu, serving as a major hub for passenger and freight operations, including locomotive servicing and marshalling yards.

Intermediate Stations (6 No.) - Located at strategic towns Narok, Mulot, Bomet, Sondu, Ahero, and Kibos—these stations will handle passenger traffic and local freight, providing essential economic interfaces for surrounding communities.

Passing Stations (18 No.) - Smaller technical stations designed to allow safe passing of trains travelling in opposite directions on the single-track line.

According to the station distribution plan, the full network of 25 stations comprises 1 terminal station, 6 intermediate stations, and 18 passing stations. The average distance between stations is 10.88 km, with the maximum spacing being 13.65 km (Ikonge North–Sondu) and the minimum 8.65 km (Ahero South–Ahero).

In the near term, 15 stations will be opened, with the remaining 10 to be phased in gradually. During this initial operational phase, the average station spacing is 18.65 km, ranging from 10.50 km (Sondu–Asawo) to 23.40 km (Ikonge–Sondu). In the long term, all 25 stations will be operational.

The Kisumu Port branch line will diverge from the Kisumu main station, extending 8.69 km to the New Kisumu Port, where a dedicated loading and unloading yard will be constructed.

Key Station Designs

Narok and Bomet Stations: These intermediate stations are designed as combined passenger and freight facilities. They will include passenger platforms, station buildings, and dedicated freight yards with loading/unloading tracks and warehousing. They are also the designated sites for proposed Commercial Logistics Hubs.

Kisumu Terminus Area: This is the most complex station zone, comprising a Terminus Station for passengers, a separate Freight Station, and the Port Station at the end of the branch line. This separation of functions is designed for operational efficiency but will require a significant land footprint and careful management of local traffic.

Table 5 below shows the stations and the status of stations along the proposed railway line

Table 5: Stations along the proposed SGR line

S/N	Station Name	Center Chainage	Distance between two stations (Km)	Type of station
1	Murtoto	Km120+750	9.15	Passing station
2	Noolpopong East	Km129+900	9.70	Passing station
3	Noolpopong	Km139+600	9.20	Passing station
4	Seyabei	Km148+800	13.6	Passing station
5	Narok	Km162+400	11.80	Intermediate station
6	Narok West	Km174+200	9.30	Passing station
7	Ololulunga	Km183+500	8.50	Passing station
8	Ololulunga West	Km192+000	10.80	Passing station
9	Ngorengore	Km202+800	12.80	Passing station
10	Mulot	Km215+600	8.90	Intermediate station
11	Mulot North	Km224+500	11.6	Passing station
12	Bomet	Km236+100	9.95	Intermediate station
13	Bomet West	Km246+050	11.55	Passing station
14	Sotik	Km257+600	9.90	Passing station
15	Sotik North	Km267+500	10.00	Passing station
16	Ikonge	Km277+500	9.35	Passing station
17	Ikonge North	Km286+850	12.95	Passing station
18	Sondu	Km299+800	10.00	Intermediate station
19	Asawo	Km309+800	12.30	Passing station
20	KapSarok	Km322+100	11.70	Passing station
21	Ahero South	Km333+800	8.70	Passing station
22	Ahero	Km342+500	10.55	Intermediate station
23	East Kolwa	Km353+050	9.70	Passing station
24	Kisumu Terminal Kibos	Km362+750	11.05	Terminus station
25	Kisumu West	Km373+800		Freight station

Source: Feasibility Study Report for Naivasha - Kisumu (SGR Phase 2B)

2.5 Main Technical Standards of Designed Railway Line

The technical standards for Phase 2B are consistent with those established for the rest of the SGR network to ensure complete operational interoperability. These standards are not merely guidelines but are fundamental design parameters that dictate the physical form and operational capacity of the railway. They represent the engineering of the project, and understanding their implications is critical to assessing the environmental and social impacts. **Table 6** below summarizes the technical standards of SGR project.

Table 6: Technical standards of railway

Item	Naivasha - Kisumu
Railway classification	China Railway Class I
Number of main tracks	Single-track
Design running speed	Passenger train: 120km/h; freight train: 80km/h
Minimum radius of curve	Generally, 1200m, 800m in difficult conditions; determined in combination with design speed for speed limiting terminal sections
Ruling grade	Double-locomotive: 12‰
Track type	Jointed track
Track Structure	Ballasted
Traction type	Diesel (with electrified conditions reserved)
Locomotive type	Passenger locomotive: DF11; freight locomotive: DF8B
Traction mass	4,000t
Effective length of reception tracks	880m; Reserve for 1,050 m
Block type	Automatic block between stations
Construction clearance	Basic structure clearance for double-deck container transport
Train Operation Control System	CTCS-0
Coupler type	Automatic Coupler

The table 7 below outlines the main technical standards for port area branch line

Table 7: Technical standards for port area branch line

Number of main tracks	Single-track
Design running speed	80km/h
Minimum radius of curve	Generally, 600m, 500m in difficult conditions
Ruling grade	12‰
Track type	Jointed track
Track Structure	Ballasted
Traction type	Diesel (with electrified conditions reserved)
Locomotive type	DF8B
Traction mass	2000t
Effective length of reception tracks	450m
Block type	Automatic block between stations
Construction clearance	Basic structure clearance for double-deck container transport
Train Operation Control System	CTCS-0
Coupler type	Automatic Coupler

Table 8 below summarizes the implications of technical standards on ESIA study.

Table 8: Implications of technical standards to ESIA study

Parameter	Specification	Implication for Physical Works and Environmental Interaction
Railway Class	China Railway Class I	This is the highest classification for a mixed-traffic railway, mandating a design philosophy centred on high safety margins, long-term durability, and operational resilience. For the ESIA, this means that the physical works will be substantial. The requirement for a smooth and stable track bed necessitates large-scale earthworks, high-quality, certified construction materials (ballast, concrete, steel), and robust, large-scale structural designs for all bridges and tunnels, leading to a significant construction footprint.
Design Speed	Passenger: 120 km/h; Freight: 80 km/h	The design speeds are a primary determinant of the track's geometry. To ensure safe and comfortable operation at 120 km/h, the horizontal alignment is restricted to large curve radii, and the vertical profile to gentle gradients. In the undulating terrain of Western Kenya, achieving this geometry requires extensive "cut-and-fill" operations to smooth the natural landscape, dictating the width of the land corridor and the scale of earthworks.
Traction Type	Diesel (with provision for future electrification)	The infrastructure must be designed to accommodate the dynamic loads, weight, and operational characteristics of heavy diesel locomotives. For the ESIA, this has direct

Parameter	Specification	Implication for Physical Works and Environmental Interaction
		implications for the operational phase, particularly in relation to noise (engine rumble) and atmospheric emissions (exhaust fumes), which will be primary considerations for communities near the alignment. The provision for future electrification also means that vertical clearances at bridges and tunnels are larger than would otherwise be required.
Ruling Gradient	12‰ (1.2% grade)	This is the maximum allowable longitudinal slope of the track and is the single most important factor driving the scale of earthworks. Adhering to this gentle gradient across the hilly and undulating terrain is the primary reason for the project's extensive deep cuttings and high embankments, as well as the need for numerous viaducts and tunnels to maintain a smooth vertical profile that locomotives can safely and efficiently climb.
Track Structure	Ballasted track with jointed rails	This traditional track structure requires the quarrying, crushing, and transport of vast quantities of high-quality stone (ballast) to form the track bed. Sourcing this material will have off-site impacts at quarry locations. Operationally, the joints between the rails produce a characteristic rhythmic "click-clack," which is a key component of the railway's noise signature and a primary source of potential noise disturbance.
Right-of-Way	70m (general); 100-300m (stations)	This legally defined corridor represents the area of permanent land acquisition and direct physical disturbance. All construction activities, permanent structures, drainage systems, and operational safety zones are contained within this footprint. For the ESIA, it is the primary boundary for assessing direct impacts on land use, biodiversity, and community severance.

2.5.1 Track Gauge

Track gauge is the distance between two rails of railway track. Rails are classified into broad gauge, standard gauge and narrow gauge. Railway with narrow gauge at 1m is called meter-gauge railway. The standard gauge was determined as 1,435mm (equal to 4 feet and 8½ inches) by the International Union of Railways in 1937. Considering the advantages of the standard rail railway and the universality of the world, it is proposed to use the standard gauge to construct a new railway to form the future railway network. This project is an extension of the Mombasa-Nairobi standard gauge railway. Therefore, standard rail gauge of 1435mm as Mombasa -Nairobi Railway will be used for the proposed line.

2.5.2 Railway Track

The main line of the Naivasha – Kisumu Railway is designed with heavy-duty, ballasted tracks and a jointed rail system. Currently, two types of track systems exist jointed tracks and continuous welded rail (CWR) and for the proposed SGR, the jointed track option has been selected. The line is constructed to the standard gauge of 1.435 m, which is wider and more stable than the existing metre-gauge railway. The railway is currently being developed as a single-track line.

2.6 Bridges

A total of 71 bridges are distributed along the project corridor. Due to the complex topography of the Rift Valley and the Mau Escarpment, Phase 2B requires substantial structural engineering interventions to maintain the ruling grade. The main line comprises 27 super major bridges and 50 major and medium bridges. Details are provided in **Table 9** below.

Table 9: Schedule Bridges

S/No	Name	Chainage	span		County
1	Ntulelei	123+494	5-32	40+64+40+4	Narok
2	Noolpopong	128+220	4-32		Narok
3	Noolpopong 2	131+150	12-32		Narok
4	Seyabi 1	143+421	40-32		Narok
5	Seyabi 2	145+176	15-32		Narok
6	Seyabi 3	147+050	39-32	40+64+40	Narok
7	Eoret Narasha 1	150+210	9-32		Narok
8	Eoret Narasha	152+800	40-32		Narok
9	Narok 1	156+544	19-32		Narok
10	Narok 2	160+410	28-32		Narok
11	Narok 3	164+265	15-32		Narok
12	Narok 4	166+681	37-32		Narok
13	Narok 5 B3	172+081	25-32	40+64+40	Narok
14	Oloulong	184+977	35-32		Narok
15	Oloulong 2	193+050	51-32		Narok
16	Ngorengere	210+430	8-32		Narok
17	Ngorengore B3	211+887	13-32	40+64+40	Narok
18	Mulot	214+252	30-32		Bomet
19	Amala B3	219+110	55-32	40+64+4	Bomet
20	Mulot 2	222+751	14-32		Bomet
21	Mulot North	225+691	25-32		Bomet
22	Mulot North 1	227+793	3-32		Bomet
23	Bomet 1	231+970	15-32		Bomet
24	Nyangores	237+985	41-32		Bomet
25	Bomet 1	243+810	6-32		Bomet
26	Bomet 2	243+810	16-32		Bomet
27	Bomet 3	248+794	15-32		Bomet
28	Bomet 4	250+960	38-32		Bomet
29	Sotik	253+280	12-32		Bomet
30	Sotik 1	255+893	62-32		Bomet
31	Sotik 2	259+630	19-32		Bomet
32	Sotik 3	261+417	16-32		Bomet
33	Lo	265+200		L1400	Kericho
34	Lo	268+785		L1070	Kericho

S/No	Name	Chainage	span		County
35	Lo	269+710		L160	Kericho
36	Litein	271+519	18-32		Kericho
37	Litein	272+423	5-32		Kericho
38	Longei	275+236	15-32		Kericho
39	Longei 1	275+842	3-32		Kericho
40	Longei 2	276+561	7-32		Kericho
41	Longei 3	277+243	11-32		Kericho
42	-	278+174	2-32		Kericho
43	Sondu 1	278+391	5-32		Kericho
44	Sondu 2	279+330	3-32		Kericho
45	Sondu 3	280+188	2-32		Kericho
46	Sondu 4	280+613	4-32		Kericho
47	Sondu 5	280+919	6-32		Kericho
48	Sondu 6	281+740	2-32		Kericho
49	Sondu 7	282+120	5-32		Kericho
50	Sondu 8	282+621	8-32		Kericho
51	Sondu 9	285+473	10-32		Kericho
52	Sondu 11	287+012	8-32		Kericho
53	Sondu 12	287+711	10-32		Kericho
54	Sondu 13	288+690	8-32		Kericho
55	Sondu 14	289+091	12-32		Kericho
56	Sondu 15	293+666	6-32		Kericho
57	Sondu 17	298+640	13-32		Kericho
58	Sondu 18	302+231	4-32		Kericho
59	Sondu 19	302+829	13-32		Kericho
60	Sondu 20	303+486	9-32		Kericho
61	Sondu 21	304+740	2-32		Kericho
62	Kaplelarteti 1	305+459	24-32		Kericho
63	Kaplelarteti 2	307+800	8-32		Kericho
64	Asawo 3	310+776	4-32		Kericho
65	Asawo 4	312+191	20-32		Kericho
66	Asawo 5	313+955	21-32		Kericho
67	Asawo 6	315+359	6-32		Kericho
68	Kapsarok	320+491	5-32		Kericho
69	Ahero South	329+403	40-32		Kisumu
70	-	337+825	3-32		Kisumu
71	-	345+204	1-32		Kisumu
72	-	347+460	40-32		Kisumu
73	Kibos	360+800	10-32		Kisumu
74	Kisumu	366+720	37-32		Kisumu

2.7 Tunnels

Phase 2B negotiates the steep ascent and descent of the Mau Escarpment, necessitating the use of tunnels to maintain Ruling gradient. The main line includes a total of 8 tunnels with a combined length of approximately 14.74 km, 2 in Narok County and 6 in Kericho with a General Burial Depth: 30-60m, with a maximum depth of 140m.

The tunnels are as follows.

- Tunnel No. 1 of 3840m long from km124+400 Narok County
- Tunnel No. 2 of 2220m long from km133+900 Narok County
- Tunnel No. 3 of 560m long from km279+820 Kericho County
- Tunnel No. 4 of 575m long from km 281+375 Kericho County
- Tunnel No. 5 of 2220m long from km284+120 Kericho County
- Tunnel No. 6 of 380m long from km287+900 Kericho County
- Tunnel No. 7 of 495m long from km288+250 Kericho County
- Tunnel No. 8 of 3990m long from km291+530 Kericho County

2.8 Road Crossings

The alignment interacts with several major national highways (A1, B1, B3). While major highways are Grade Separated, the current design includes several At Grade crossings on secondary roads which serve as critical rural access routes. Some of the crossings along the corridor are shown in the **Table 10** below.

Table 10: Road Crossings

Crossing Type	Location / Road Name	Chainage (Km)	Description
Grade Separated	B3 Highway (Narok - Mai Mahiu)	Km146+500	Railway Viaduct over Highway.
	B3 Highway (Narok - Bomet)	Km 172+081	Railway Viaduct over Highway
	B3 Highway (Ngorengore)	Km 211+700	Railway Viaduct over Highway
	Amala River & Road B3 Highway (Narok – Bomet) at Mulot	Km 219+110	Railway Viaduct over Highway 1,800m Viaduct.
	C21 Road (Ikonge -Chemosit) / Sondu River	Km 285+473	Viaduct connecting Tunnel 5 & 6.
	B1 Highway (Kericho - Kisumu)	Km 340+400	Road Overpass. / Railway Underpass
	A1 Highway (Kisumu - Kakamega)	Km 365+200	Road Overpass. / Railway Underpass.
	SGR over MGR	Km 366+720	1,184m Viaduct crossing existing rail.
At Grade (<i>Level Crossings</i>)	C57 Road	Km 165+375	Level crossing (
	C13 Road	Km 200+600	Level crossing
	C14 Road (Kapkesosio)	Km 236+100	Near Bomet Station.

Crossing Type	Location / Road Name	Chainage (Km)	Description
	B3 Highway (Sachangwan)	Km 244+700	Level crossing (Safety risk noted).
	C23 Road (Kaplóng)	Km 263+975	Level crossing.
	C25 Road (Sondú-Kapsoit)	Km 301+300	Level crossing
	Kibos Road	Km 361+800	Level crossing

Source: KML files

2.8 Track Structure and Foundation

The long-term stability and performance of the railway are dictated by the quality of its track structure. The design specifies a heavy-duty, ballasted system engineered to support a maximum axle load of 25 tonnes.

The structure consists of the following key components:

- **Subgrade (Foundation):** A robust 2.5-meter-thick subgrade bed forms the core foundation. It is constructed in two highly compacted layers using specified gravel, crushed stone, and sandy soils (Groups A, B, and C) to create a stable, load-bearing platform and prevent long-term settlement.
- **Ballasted Track Bed:** A 50 cm deep, double-layer Class I ballasted track-bed is laid on top of the subgrade. This crucial layer of crushed stone provides excellent drainage and allows for precise, ongoing adjustments to the track's alignment, which is essential for maintenance.
- **Sleepers and Fasteners:** The mainline will utilize New Type II prestressed concrete sleepers at a density of 1,760 sleepers per kilometer. These are vital for transferring forces from the rails to the ballast. They are secured with a Type II elastic fastening system, which maintains the precise 1,435 mm standard gauge and absorbs train-induced vibrations.
- **Rails:** The design specifies 60 kg/m standard steel rails, a profile appropriate for the heavy freight demands and 25-tonne axle loads.

2.9 Rolling Stock

The operation of the SGR Phase 2B requires a robust fleet of locomotives and wagons capable of handling both passenger and freight movement across the new corridor under varying gradients and climatic conditions.

Locomotive Types

Two primary locomotive classes will be used:

- **DF11 diesel locomotives** for high-speed passenger services, known for their reliability, comfortable acceleration, and compatibility with long-distance operations.
- **DF8B diesel locomotives** for freight transport, offering high tractive effort suitable for hauling heavy cargo, especially along steep gradients such as those present in portions of Narok and Bomet.

Rolling Stock Allocation

The initial operational plan recommends:

- **53 passenger vehicles**, including coaches, service cars, brake vans, and auxiliary wagons
- **956 freight vehicles**, including flat wagons, open wagons, covered wagons, tanker wagons, and specialized cargo units

This allocation ensures adequate line capacity for both regional and international freight integration, particularly for the Northern Corridor and port-linked cargo.

2.10 Maintenance Facilities

To keep the fleet in optimal operating condition, multiple maintenance levels will be implemented:

- The **Nairobi Terminus Maintenance Hub**, part of the existing Mombasa–Nairobi SGR infrastructure, will be expanded to undertake **major repairs, overhaul, and periodic heavy maintenance** for rolling stock operating on the extended line.
- A new **Kisumu Locomotive Turnaround Depot** will be constructed at Kisumu Station. This facility will handle:
 - Daily locomotive servicing
 - Routine inspections
 - Minor repairs
 - Fuelling and washing activities

This depot is strategically located at the western terminus of the line, ensuring quick turnaround for return trips and supporting lake-port intermodal operations.

2.11 Water Supply and Treatment Infrastructure

A comprehensive and reliable water supply system is an essential component of the proposed SGR Phase 2B, enabling seamless operation of stations, maintenance depots, staff facilities, and emergency services across the railway corridor. To meet these needs, the project incorporates a combination of municipal connections, newly developed groundwater sources, and supplementary water delivery arrangements designed to ensure adequate supply under diverse climatic and geological conditions.

2.11.1 Water Supply System

Three major water supply stations will be established at **Narok, Kibos, and Kisumu**, each serving as a primary distribution hub for the respective station clusters.

- **Narok Station** will primarily rely on **municipal tap water**, enabling the project to take advantage of the existing local water distribution infrastructure.
- **Kibos and Kisumu Stations**, including nearby operational points, will be supplied through the development of **new deep wells**. These boreholes are planned for locations such as Kibos, Kisumu, Mulot, Bomet, Sondu, and Ahero. Hydrogeological surveys during feasibility stages confirmed adequate groundwater yields in these areas, making groundwater abstraction the most sustainable long-term supply option.
- Smaller and more remote stations such as **Murtoto** will depend on **truck-delivered water**, particularly during the early phases of construction and operation. This arrangement ensures operational reliability even in areas where neither municipal networks nor reliable groundwater sources exist.

Collectively, this water supply strategy ensures redundancy, spatial coverage, and long-term sustainability across the full length of the corridor.

2.11.2 Treatment and Sanitation Infrastructure

Both domestic and industrial wastewater streams are addressed to protect the environment, avoid contamination of natural watercourses, and comply with national environmental regulations.

2.11.3 Domestic Sewage Treatment

All passenger stations, staff buildings, canteens, and administrative offices will generate domestic wastewater. This effluent will undergo multiple treatment stages:

1. **Primary containment in septic tanks**, which allow sedimentation and anaerobic digestion of organic solids.
2. **Oil separation tanks** installed at canteens and kitchen facilities, preventing fats, oils, and chemical residues from entering downstream systems.
3. **Secondary biochemical treatment**, where effluent is passed through biological filtration or constructed wetland systems for further purification.

The treated water will then be discharged **safely into natural depressions or engineered evaporation ponds**, minimizing the risk of contamination to surface and groundwater resources. These ponds are designed with impermeable linings and appropriate drainage to avoid seepage.

2.11.4 Production and Industrial Sewage

Specialized wastewater management is required at the **Kisumu Locomotive Depot**, which handles mechanical servicing, refuelling, and washing of locomotives and rolling stock. Wastewater from this depot contains oils, grease, suspended solids, and cleaning chemicals.

To ensure safe disposal, the depot will incorporate a dedicated **industrial wastewater treatment line**, consisting of:

- **Oil isolation and separation units**, which remove petroleum-based contaminants
- **Neutralization basins**, balancing pH levels to acceptable discharge standards
- **Air flotation units**, which remove fine suspended particles and emulsified oils

Only after these processes will the treated effluent be released into designated drainage facilities that comply with NEMA water quality regulations.

2.12 Signaling Communication, and Power Supply Systems

The reliability and safety of the SGR Phase 2B depend heavily on a modern integrated system incorporating advanced signalling, robust communication technologies, and stable power supply infrastructure.

2.12.1 Signalling System

The railway adopts an **automatic inter-station block signalling system**, providing safe separation between trains along block sections. At each station, signalling operations are governed by **computer-based interlocking (CBI)** systems, which automatically set routes, protect points, and prevent conflicting train movements.

The train control system conforms to **CTCS-0 (Chinese Train Control System – Level 0)** standards, ensuring:

- Compatibility with the existing Mombasa–Nairobi SGR line
- Reliable on-board signaling for train drivers
- Safe operational control in both normal and degraded modes

2.12.2 Communication System

A comprehensive communication network enhances operational coordination, safety, passenger service, and emergency response capabilities. Key components include:

- **Fiber-optic backbone networks (SDH/MSTP)** running along the entire track to support high-speed, interference-free data transmission
- **GSM-R (Global System for Mobile Communications – Railway)** mobile communication for secure, real-time train dispatching
- **Digital dispatching system**, centralized at the Nairobi Dispatch Center, ensuring unified national control
- **Video monitoring and CCTV** at stations, depots, tunnels, and key trackside points
- **Environmental and power monitoring systems** for real-time detection of faults

This network ensures seamless voice and data communication, which is essential for safe daily operations.

2.12.3 Power Supply System

Distribution System

The project incorporates a **33kV power supply system**, designed to provide reliable power for stations, depots, communication equipment, and operational systems. To distribute electrical power effectively along the corridor, **new outdoor substations** will be constructed at:

- Murtoto
- Narok
- Bomet
- Sondu
- Kisumu

These substations reduce transmission losses and enhance local reliability.

Backup Power and Reliability

Because signaling, communication, and safety systems must operate continuously, even during outages, all critical stations will be equipped with:

- Self-starting outdoor diesel generators
- Uninterruptible Power Supply (UPS) systems
- Battery banks

These systems ensure that essential equipment remains operational during power interruptions, safeguarding both passengers and freight operations.

Traction Power

While the line will initially operate on **diesel traction**, all infrastructure including bridges, tunnels, clearances, and trackside installations has been designed with **future electrification in mind**. This future-proofing approach accommodates Kenya's long-term railway modernization goals without requiring extensive reconstruction.

2.13 The Project Implementation Activities

For the purposes of this ESIA, the SGR project implementation activities can be split into three key phases as outlined below:

i. Construction Phase

- Site preparation & earthworks; clearing and grading land /site clearance
- Track laying & Infrastructure Development
- Drilling of wells, water and sanitation treatment systems
- Construction of burrow pits
- Temporary materials storage yard
- Establishment of campsites
- Construction of stations, sub stations and passing stations.
- Construction of bridges, viaducts and other related infrastructure.

ii Operations Phase

- Regular inspections and preventive maintenance
- Track repairs and system upgrades
- Materials and waste handling

iii Decommissioning Phase

- Dismantling and removal of equipment and temporary infrastructure
- Restoration of site vegetation
- Refiling of burrow pits
- Decommissioning of camp sites and yards

2.14 Railway development phases

Railway construction involves several key activities comprising of the following:

- **Planning and Feasibility Study** – Conducting feasibility studies, environmental and social impact assessments, and route selection;
- **Land Acquisition & Site Preparation** – Land acquisition & stakeholder consultations and relocating utilities;
- **Design & Engineering** – Detailed engineering designs for stations, tracks, bridges, and tunnels; selection of materials and construction methodologies; integration of signaling and communication systems;
- **Earthworks & Grading** – Excavation, embankment construction and soil stabilization and drainage system installation;
- **Track Laying & Infrastructure Development** – Installing sleepers, ballast, and rails to form the railway line; construction of bridges, tunnels, and stations; electrical and signaling system setup – implementing modern railway control systems for efficient train operations;
- **Stations & Depots Development** – Constructing passenger stations, freight terminals, and maintenance depots;
- **Testing & Commissioning** – Trial runs to assess track integrity and operational efficiency; Safety inspections and regulatory approvals;
- **Operations & Maintenance** – Regular inspections and preventive maintenance; Track repairs and system upgrades; Passenger and freight service optimization.

2.15 Project timelines

The anticipated construction period of 36 months. **Figure 8** below outlines the indicative overall the project schedule.

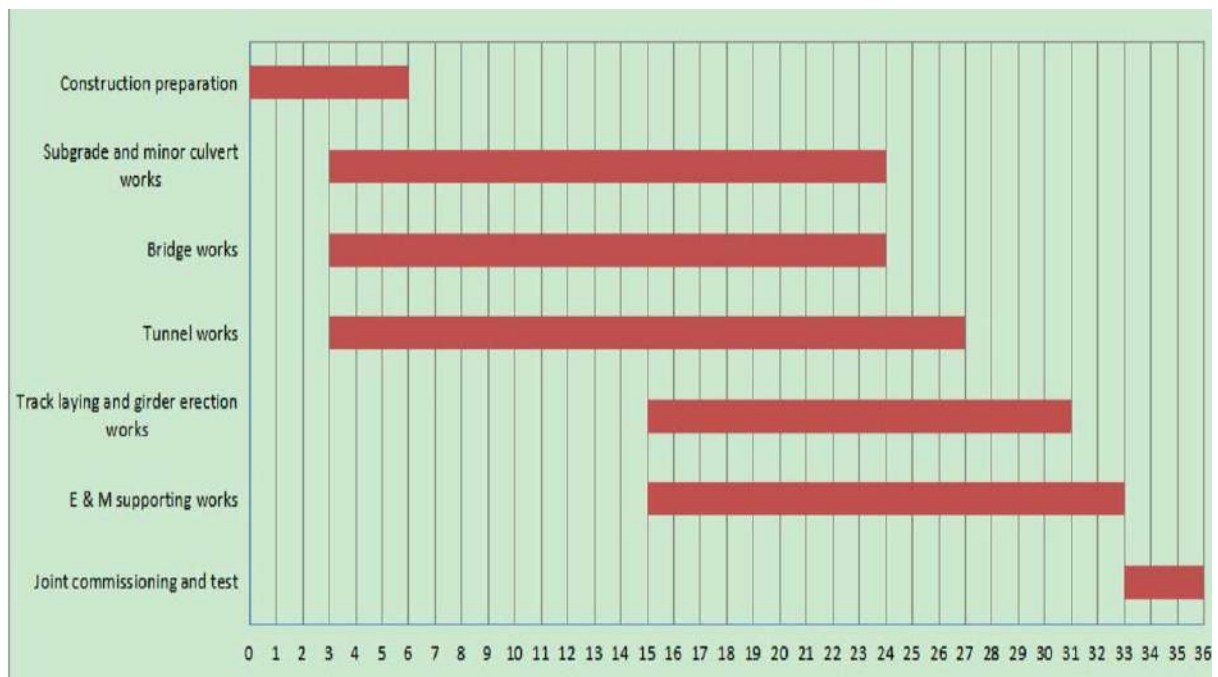


Figure 8: Project activities

Source: KRC

CHAPTER 3.0 ANALYSIS OF PROJECT ALTERNATIVES

3.1 Introduction

This chapter presents the assessment of alternatives considered for the proposed Standard Gauge Railway (SGR) Project, including the “No Project” option, route alternatives, technological options, and locomotive configurations. The analysis aims to identify the most environmentally, socially, and economically feasible alternative in line with Kenya’s development priorities and regional transport objectives.

3.2 Analysis of alternatives

3.2.1 No Project Alternative

Under the No Project scenario, the existing transport challenges road congestion, high accident rates, increased emissions, and rising logistics costs would persist or worsen. The alternative would also limit regional integration, economic growth, and job creation opportunities associated with the SGR. The scenario offers minimal long-term environmental or socio-economic benefits and would constrain

Kenya’s ability to meet national infrastructure and development goals.

Conclusion: The No Project alternative is not viable.

3.2.2 Alternative – Option of Main Passage Routes

Three broad route corridors were comparatively evaluated based on engineering feasibility, environmental and social considerations, cost implications, and alignment with national development strategies.

3.2.2.1 Nairobi - Nakuru - Eldoret - Malaba Option (Northern Route Option)

The Nairobi–Nakuru–Eldoret–Malaba route option, combined with a proposed Eldoret–Kisumu branch line, forms the Northern Corridor alternative. The mainline from Nairobi to Malaba is 505.2 km, with the Eldoret–Kisumu branch adding 133.2 km, resulting in a total length of 638.2 km—making it the longest and most costly of the assessed options. Although the route connects major economic centres such as Nakuru and Kisumu, it requires significantly higher construction and operational investment, follows the old metre-gauge corridor which does not align with Kenya’s current development strategy, and passes through geologically complex Rift Valley sections with dense fault lines. Overall, this option is longer, more expensive, and more technically challenging compared to the southern route.

3.2.2.2 Nairobi - Nakuru - Kisumu - Malaba Option (Middle Route Option)

The Nairobi–Naivasha–Nakuru–Nandi–Kericho–Kisumu–Malaba route option has a total length of 525.2 km. It passes through major economic hubs in northern Kenya, offering strong potential for passenger and freight transport. However, a significant section—approximately 233 km—lies within a high seismic hazard zone (Intensity VIII–IX), where ground instability poses risks such as structural damage, track distortion, and alignment failures, making this route less suitable from an engineering and safety perspective.

3.2.2.3 Option of Nairobi - Naivasha - Kisumu - Malaba (Southern Route Option)

The Nairobi – Ngong – Kiambu – Mai Mahiu – Suswa – Narok – Bomet – Sondu – Ahero – Kisumu Malaba route option covers 489.57 km. Although its operating costs are similar to the central route, comparison focuses on economic hubs, engineering geology, and investment requirements. The route has several advantages: it crosses only 133 km of high seismic intensity zones 80 km less than the middle route—encounters fewer fault-affected areas in the Rift Valley, is 31 km shorter, and requires approximately USD 772.7 million less investment. Its main limitation is that while it connects key towns such as Narok and Kisumu, its economic centres are slightly smaller in scale compared to those along the middle route.

3.2.2.4 Analysis of option of retaining/ refurbishing the existing railway line

An alternative to constructing a new Standard Gauge Railway (SGR) line is to maintain operations on the existing metre-gauge railway. However, the current system is highly inefficient and has driven an increase in heavy-truck movements along the Nairobi–Nakuru–Malaba corridor, resulting in elevated road maintenance costs, higher emissions, and persistent road-accident fatalities involving humans, livestock, and wildlife.

While this option presents some advantages including reduced environmental disturbance, quicker implementation, and limited displacement of communities or economic activities—it also has significant drawbacks. The ageing metre-gauge infrastructure cannot support modern high-speed or high-capacity railway operations, is technologically outdated and incompatible with SGR infrastructure, and would require ongoing and costly maintenance, making it unsustainable in the long term.

In comparing route alternatives, the southern alignment although bypassing major towns such as Nakuru and Eldoret offers more favorable topographic and engineering conditions than the middle route. Additionally, it provides an opportunity to stimulate economic growth in the southwestern region by opening a new development corridor. For these reasons, the southern route option (Nairobi–Naivasha–Kisumu–Malaba) is recommended as the preferred alignment.

3.2.3 Technology Alternatives

The Project evaluated several alternative technology and design options to ensure efficiency, safety, and cost-effectiveness. Key technical considerations included: number of main-line tracks, traction type (electric vs. internal combustion), locomotive type, traction tonnage, reception track length, blocking system, construction clearance, train operating system, and coupler type.

Main Line Configuration - The railway is designed as a Class I standard line, suitable for high-speed and heavy-freight operations. Based on projected traffic 4 passenger train pairs daily and 17.75 million tonnes of freight per year a single-track main line is sufficient to meet long-term transport demand.

Maximum Running Speed - Two design speeds were assessed: 120 km/h and 160 km/h. While

160 km/h offers higher passenger performance, it requires extensive engineering upgrades, especially in hilly terrain, significantly increasing project costs. Given the line's Grade I classification, mixed freight-passenger operations, and economic considerations, a design speed of 120 km/h is recommended.

Traction System Options

Two traction options were considered:

Electric Traction - Offers energy efficiency, lower emissions, reduced noise, and better acceleration. However, it requires high initial investment and substantial external power infrastructure.

Internal Combustion Traction:

- Lower upfront cost and minimal reliance on external infrastructure.
- Choosing this system reduces investment risk and financing pressure.

Electric traction would increase project costs by approximately USD 299.95 million (excluding transmission line costs). Considering Kenya's current power supply capacity, operational needs, investment constraints, and future flexibility, internal combustion traction is recommended, with the option for future electrification preserved. Electricity demand estimates for a potential electrified system were generated for planning purposes, including projected power consumption for 2030, 2035, and 2045.

3.2.4 Locomotive Type

Locomotive type and traction tonnage were assessed together, with altitude, gradients, and engine performance influencing hauling capacity. A 12‰ ruling gradient and 4,000-tonne traction tonnage were found adequate and economical for projected traffic. DF8B was selected as the preferred freight locomotive due to better speed and operational efficiency, while DF11 was chosen for passenger services for its superior performance and compatibility with the existing SGR fleet. An 880 m effective reception-track length (with provision for 1,050 m) was recommended to maintain system consistency and avoid costly upgrades. The line will apply Class I standards, including single-track design, diesel traction with provision for electrification, automatic inter-station block control, and clearance for future double-deck container operations.

3.2.5 Alternative Construction Materials

When selecting construction materials for the SGR, options were evaluated for cost, durability, environmental impact, and suitability to local conditions.

Sleepers: Concrete sleepers are preferred for their strength, durability, and stability, supporting heavy freight and passenger loads, and can be locally produced, creating jobs. Steel sleepers are lighter and cheaper initially but are prone to corrosion in Kenya's humid or saline environments, increasing long-term maintenance.

Track Type: Ballasted track is cost-effective, flexible, and uses locally available materials, but requires regular maintenance, especially in high-rainfall areas. Ballastless (slab) track offers superior stability, lower maintenance, and longer service life, making it suitable for steep gradients, tunnels, bridges, and heavy freight/high-speed corridors, though construction costs are higher.

Eco-Friendly Cement Alternatives: Blended cements using fly ash, slag, or natural pozzolana can reduce carbon emissions while maintaining strength. Emerging technologies like geopolymer concrete and recycled aggregates further reduce environmental impact and can be applied in non-critical structures, supporting green infrastructure and local technical capacity development.

3.2.6 Conclusion

Based on the comprehensive assessment of environmental, social, engineering, and economic parameters, the preferred project configuration consists of:

- Southern Route Alignment (Nairobi–Naivasha–Bomet–Kisumu–Malaba)
- Class 1 single-track standard gauge line
- Design speed of 120 km/h for passenger trains
- Diesel traction system (future-ready for electrification)
- DF8B freight locomotives and DF11 passenger locomotives
- Reception track length of 880 m

This configuration offers the most sustainable, cost-effective, and operationally efficient option, while minimizing adverse environmental and social impacts.

CHAPTER 4.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

4.1 Introduction

This chapter presents both the national and international legal framework for planning and environmental and social protection in Kenya, applicable to a railway construction project. In addition, reference has been made to relevant international standards, in this instance namely the International Finance Corporation's (IFC) Performance Standards (PS), associated PS Guidance Notes, and the World Bank Group Environmental Health and Safety (EHS) Guidelines (2007). Generally, where national legal standards are not as stringent as international requirements or vice versa, the Project will be required to defer to the most stringent requirement except in cases where national law or regulations have been explicitly identified as taking precedence for the Project.

4.2 National Policy Framework

4.2.1 National Environment Policy

The National Environment Policy (NEP) was officially adopted in 2013 to provide a comprehensive framework for environmental management in line with Sustainable Development Goals. Its main aim is to ensure a clean, healthy, and sustainable environment for all Kenyans, as guaranteed under Article 42 of the Constitution of Kenya (2010). The broad objectives of the national environmental policy in Kenya are:

- Provide a framework for an integrated approach to planning and sustainable management of Kenya's environment and natural resources.
- Strengthen the legal and institutional framework for good governance, effective coordination and management of the environment and natural resources.
- Ensure sustainable management of the environment and natural resources, such as unique terrestrial and aquatic ecosystems, for national economic growth and improved livelihoods.
- Promote and support research and capacity development as well as use of innovative environmental management tools such as incentives, disincentives, total economic valuation, indicators of sustainable development, Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs), Environmental Audits (EA) and Payment for Environmental Services (PES).
- Promote and enhance cooperation, collaboration, synergy, partnerships and participation in the protection, conservation, sustainable management of the environment and natural resources.
- Ensure inclusion of cross-cutting and emerging issues such as poverty reduction, gender, disability, HIV&AIDS and other diseases in the management of the environment and natural resources.
- Promote domestication, coordination and maximization of benefit from Strategic Multilateral Environmental Agreements (MEAs).

i) NEP Guiding principles

Implementation of NEP is guided by the following principles:

- a) **Environmental Right:** Every person in Kenya has a right to a clean and healthy environment and a duty to safeguard and enhance the environment.
- b) **Right to Development:** The right to development will be exercised taking into consideration sustainability, resource efficiency and economic, social and environmental needs.
- c) **Ecosystem Approach:** An integrated ecosystem approach to conserving environmental resources will be adopted and enhanced to ensure that all ecosystems are managed in an integrated manner while also providing a range of benefits to the citizenry.
- d) **Total Economic Value:** The benefits that ecosystems generate will be integrated into the national accounting system, programmes and projects.
- e) **Sustainable Resource Use:** Environmental resources will be utilized in a manner that does not compromise the quality and value of the resource or decrease the carrying capacity of supporting ecosystems.
- f) **Equity:** The management of the environment and natural resources will ensure equitable access to resources for present and future generations.
- g) **Public Participation:** A coordinated and participatory approach to environmental protection and management will be enhanced to ensure that the relevant government agencies, county governments, private sector, civil society and communities are involved in planning, implementation and decision-making processes.
- h) **Subsidiarity:** The management of the environment and natural resources will be through decentralization and devolution of authority and responsibilities to the lowest level possible.
- i) **Precautionary Principle:** Where there are credible threats of serious or irreversible damage to key environmental resources, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- j) **Polluter Pays Principle:** The polluter and users of environmental and natural resources shall bear the full environmental and social costs of their activities.
- k) **International Cooperation:** MEAs and regional instruments will be domesticated and implemented cooperatively for better environmental management of shared resources.
- l) **Good Governance:** Rule of law, effective institutions, transparency and accountability, respect for human rights and the meaningful participation of citizens will be integrated in environmental management.
- m) **Benefit sharing:** Where benefits will accrue from utilization of biodiversity, these will be shared in order to promote conservation and sustainable use of biodiversity.
- n) **Community Empowerment:** Communities will be involved in decision making and empowered in the implementation of such decisions.

To achieve the above policy objectives, it is a policy directive that appropriate reviews and evaluations of all forms of developmental project plans and operations are carried out to ensure compliance with the environmental policy and legal frameworks.

4.2.2 Environment and Development (Sessional Paper No. 6 of 1999)

Sessional Paper No. 6 of 1999 on Environment and Development was Kenya's first comprehensive policy framework aimed at integrating environmental management with development planning. It laid the foundation for the country's environmental governance system and influenced future

environmental legislation, including the Environmental Management and Coordination Act (EMCA), 1999(Amendment 2015).

The policy defined approaches that will be pursued by the Government in mainstreaming environment into development. The policy harmonized environmental and developmental objectives with the broad goal of achieving sustainable development. The policy paper also provided guidelines and strategies for government action regarding environment and development.

Relevance

This policy is relevant to the proposed project in view of the potential impacts on the environment and involvement of the public in project planning including ensuring long-term environmental sustainability alongside economic growth and balancing infrastructure needs with ecological preservation (e.g., wildlife corridors and fencing to prevent animal-train collisions).

4.2.3 Forest Policy (2014)

The Forest Policy of 2014 in Kenya provides the framework for sustainable forest management, conservation, and utilization of forest resources.

Its relevance to infrastructure projects like the Standard Gauge Railway (SGR) lies in ensuring that such developments do not degrade forest ecosystems, and that any necessary forest land use is sustainable, mitigated, and compensated.

Relevance

The proposed project may intersect forested areas, including riparian forests and wildlife corridors. The policy requires environmental assessments to minimize impacts on any indigenous forests, water catchment areas and protected forest reserves.

4.2.4 Wildlife Policy of 2011

The Kenya Wildlife Policy provides a framework for the conservation and management of wildlife resources in Kenya. It plays a crucial role in ensuring that projects are developed in a way that respects wildlife habitats, promotes ecological integrity, and balances development with biodiversity conservation.

Relevance

The Wildlife Policy mandates that development projects must avoid or minimize disruption of wildlife habitats and migration routes. The SGR design should include elevated sections and underpasses to allow safe wildlife movement, especially in their natural habitats, corridors, migratory routes and dispersal areas.

4.2.5 National Environmental Policy, 2014

This policy aims to guide sustainable environmental management and ensure that environmental considerations are mainstreamed into all development sectors and levels of government.

The National Environmental Policy is an outcome of the Sessional Paper No. 10 of 2014. The overall goal of the policy is better quality of life for present and future generations through sustainable management and use of the environment and natural resources. One of the objectives

of the policy is to promote and support research and capacity development as well as use of innovative environmental management tools such as Environmental Impact Assessments (EIAs) and Environmental Audits that is necessary to ensure environmental quality and resource productivity on long term basis.

The policy among other important objectives calls for promotion of domestication, coordination and maximization of benefits from Strategic Multilateral Environmental Agreements (MEAs). The policy further calls for integration of environmental concerns into development policies, plans and activities.

The National Environmental Policy proposes a broad range of measures and actions responding to key environmental issues and challenges. It seeks to provide the framework for an integrated approach to planning and sustainable management of natural resources in the country. It recognizes the various vulnerable ecosystems and proposes various policy measures not only to mainstream sound environmental management practices in all sectors of society throughout the country but also recommends strong institutional and governance measures to support the achievement of the desired objectives and goal.

Relevance

The policy requires that projects such as this one, which are likely to have significant environmental and social impacts should be undertaken with sound environmental management plan.

4.2.6 The Kenya National Biodiversity Strategy and Action Plan of 2000

The Kenya National Biodiversity Strategy and Action Plan (NBSAP) of 2000 was developed in line with the country's commitments under the Convention on Biological Diversity (CBD). Its purpose is to conserve biodiversity, promote its sustainable use, and ensure equitable sharing of benefits from genetic resources

The strategy is a national framework of action for ensuring that the present rate of biodiversity loss is reversed, and present levels of biological resources are maintained at sustainable levels for posterity. The general objectives of the strategy are to conserve Kenya's biodiversity; to sustainably use its components; to share the benefits arising fairly and equitably from the utilization of biological resources among the stakeholders; and to enhance technical and scientific cooperation nationally and internationally, including the exchange of information in support of biological conservation.

Relevance:

The proposed project may impact biodiversity through land use, habitat fragmentation, and ecosystem disturbance.

4.2.7 Kenya Vision 2030

The Vision 2030 is based on 3 key pillars; Economic Pillar, Social Pillar, and Political Pillar. The economic, social and political pillars of Kenya Vision 2030 are anchored on the following foundations: macroeconomic stability; continuity in governance reforms; enhanced equity and wealth creation opportunities for the poor; infrastructure; energy; science, technology and innovation, land reform; human resources development; security and public-sector reforms.

According to the vision, the country aims at enhancing and diversifying national power generation and supply by identifying new generation and supply sources through exploitation of geothermal power, coal, renewable energy sources, and connecting Kenya to energy-surplus countries in the region.

In terms of environment, one of the aims is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation for better support the economic pillar flagship projects.

Relevance

Vision 2030 is a long-term development blueprint aiming to transform Kenya into a middle-income, industrializing country that provides a high quality of life to all its citizens by 2030. The SGR is one of the flagship infrastructure projects under Vision 2030 which directly supports multiple pillars and objectives of the Vision.

4.2.8 National Land Policy 2023

The Land Policy in Kenya is guided by the environmental management principles which are aimed at restoring the environmental integrity through introduction of incentives and encouragement of use of technology and scientific methods for soil conservation, among others. The policy further requires fragile ecosystems to be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities. The policy also requires zoning of catchment areas to protect them from degradation and establishment of participatory mechanisms for sustainable management of fragile ecosystems. The policy also called for development of procedures for co-management and rehabilitation of forest resources while recognizing traditional management systems and sharing of benefits with contiguous communities and individuals. Lastly, all national parks, game reserves, islands, front row beaches and all areas hosting fragile biodiversity are declared as fragile ecosystems under the policy.

The policy recognizes that sustainable management of land based natural resources depends largely on the governance system that defines the relationships between people, and between people and resources. To achieve an integrated approach to management of land-based natural resources, all policies, regulations, and laws dealing with these resources need to be harmonized with the framework established by the Environmental Management and Coordination Act (EMCA), 1999

The policy also addresses land management on ecosystem protection (including wetlands). Measures for protection are required for fragile ecosystems. The policy also calls for the protection of watersheds, lakes, drainage basins and wetlands. The policy prohibits settlement and agricultural activities in water catchment areas and calls for identification, delineation and gazettement of all water courses and wetlands.

Relevance;

The proposed project shall intersect different aspects concerning land use, environmental conservation, and community rights ensuring adherence to the principles outlined in the policy including contributing positively to Kenya's socio-economic development while safeguarding the rights of affected communities and preserving the environment.

4.2.9 Physical Planning Policy

The Physical Planning Policy of Kenya provides a strategic framework for land use planning, infrastructure development, and spatial organization across urban and rural areas. It plays a critical role in guiding sustainable development, including the planning and implementation of projects. Its main objectives include promotion of **Sustainable** Land Use, coordination of Infrastructure Development, enhancement of Environmental Protection, guide urbanization and Settlement Patterns, Strengthen Institutional Frameworks and Facilitate Public Participation in Planning.

Relevance.

The policy is essential since it shall ensure the proposed project aligns with national and county land use plans, minimizes environmental and social impacts and supports long-term economic growth through planned urban and regional development.

4.2.10 HIV/AIDS Policy of 2009

The HIV and AIDS Policy of 2009 in Kenya provides a comprehensive framework for the prevention, treatment, care, and mitigation of HIV/AIDS. Although primarily a health-focused policy.

Relevance:

The proposed project shall involve a mobile and concentrated workforce, often working for extended periods. Workers may be at higher risk of engaging in risky behaviors due to isolation, limited recreation, or separation from families.

The proponent shall create HIV/AIDS awareness among staff, provide condoms in dispensers and discourage against any form of discrimination against any would be HIV/AIDS patient.

4.2.11 Kenya National Gender and development Policy of 2011

The Kenya National Gender and Development Policy (2011) aims to mainstream gender considerations into all sectors of development and ensure equality, equity, and empowerment for both women and men.

Relevance:

It ensures that projects promote inclusive development, protects the rights and safety of women and marginalized groups and integrate gender equality into all stages of project planning and execution. This contributes to Kenya's broader goals of social justice, equity, and sustainable development. The proponent shall ensure equal employment opportunities to both gender and discourage any form of discrimination based on gender.

4.2.12 The Kenya National Climate Change Response Strategy of 2010

The Kenya National Climate Change Response Strategy of 2010 was the first comprehensive policy document to guide the country's response to the challenges posed by climate change. It laid the groundwork for climate-resilient development, aiming to integrate climate considerations into all sectors, including transport infrastructure.

Relevance:

The policy will guide on how the proposed project mitigates and assesses climate risks e.g. flooding, heat stress, landslides, promotes resilience, emissions are reduced through sustainable transport and promote economic sustainability.

4.2.13 The Kenya Environmental Sanitation and Hygiene Policy of 2016-2030

The Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016-2030 provides broad guidelines to both state and non-state actors at all levels to work towards universal access to improved sanitation leading to improved quality of life for the people. Primarily, the KESHP policy aims to increase the proportion of the population with access to improved sanitation to 100 percent by 2030 and ensure a clean and healthy environment for all in Kenya. The development of KESHP 2016-2030 is a result of extensive policy review and participatory stakeholder consultations and validation meetings held throughout the country.

The policy sets Kenya on the trajectory of ensuring that all Kenyans have sustainable access to improved sanitation and a clean and healthy environment by 2030. The policy therefore sets the following targets:

- Achieve and sustain 100 percent Open Defecation Free (ODF) Kenya by 2030;
- Achieve and sustain 100 percent access to improved sanitation in rural and urban areas by 2030.

Policy Objectives

- To scale up rural and urban sanitation towards an ODF Kenya and universal access to improved sanitation by 2030;
- To assure a clean and healthy environment for all Kenyans through appropriate technology choices for waste management and pollution control;
- To foster strong private sector participation and investment in creating sanitation demand and increasing uptake of appropriate products and services.
- To establish an enabling legal and regulatory environment for sanitation at both national and county levels;
- To strengthen institutional and human resource capacity of the environmental sanitation sector for efficient and effective provision of sanitation and hygiene services;
- To establish an effective research and development framework for sanitation to improve appropriate technology choices and promote evidence-informed sector decision-making;
- To establish a functionally effective monitoring and evaluation framework for the sanitation sector to ensure maximum accountability in policy implementation at all levels.

Relevance;

The project will engage a number of workers, construction camps, and impacts on surrounding communities. The policy will ensure public health, environmental protection, and sustainable development. The proponent and the contractor will seek to comply with the provision of this policy to achieve 100% ODF at the project area during construction period.

4.3 National Environmental Legal and Regulatory Framework

The Republic of Kenya has numerous statutes that guide environmental management and conservation. Most of these statutes are sector specific and cover a wide range of issues including public health, soil conservation, protected areas conservation, endangered species, public participation, water rights, water quality, air quality, excessive noise control, vibration control, land use, among others.

4.3.1 Relevant National Environmental Legislations and Regulations

The proposed project is governed by a wide range of national environmental laws and regulations designed to ensure that projects are planned, executed, and operated in a manner that promotes sustainable development, protects the environment, and safeguards the rights and well-being of affected communities.

The following is a summary of the key environmental legislations and regulations applicable to the project:

- **The Constitution of Kenya 2010:** It onboards various issues that are related to environmental management. Article 42 of the Bill of Rights provides that ‘every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures.
- **The Environment Management and Co-ordination (EMCA), 1999(Revised 2015);** The legislation advocates for environmental protection during project implementation and restoration of impacted environment.
- **The Environment (Impact Assessment and Audit) Regulations, 2003;** Provides guidelines that have been established to govern the conduct of environmental assessments and environmental audits in Kenya. The legislation provides guidance on project impact categorization into low, medium and high risks and implementation of appropriate environmental and social impact assessments.
- **Environmental Management and Co-ordination (Water Quality) Regulations, 2024;** Observes that, every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether the water resource was polluted before the enactment of the Act.
- **Environmental Management and Co-ordination (Waste management) Regulations, 2024;** Defines rules for the management of waste in general and for the management of solid waste, industrial waste, hazardous waste, pesticides and toxic substances, biomedical waste and radioactive substances in particular.
- **Environmental Management and Co-ordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009;** Observes that, except as otherwise provided in the Regulations, no person shall make or cause to be made any loud, unreasonable, unnecessary, or unusual noise which annoys, disturbs, injures, or endangers the comfort, repose, health or safety of others and the environment,

- **Environmental Management and Co-ordination (Air Quality) Regulations, 2024;** Aimed at providing for prevention, control and abatement of air pollution to ensure clean and healthy ambient air.
- **Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources, and Benefit Sharing) Regulations, 2006.;** Aims at enhancing the preservation of biodiversity as well as safeguarding the endangered and rare species of plants and animals existing within a project area. Part II stipulates the prohibitions on the extraction and use of biological resources
- **The Occupational Safety and Health Act, No. 15 of 2007;** Provides for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes.
- **Work Injury Compensation Benefit Act 2007;** Provides for compensation for employees on work related injuries and diseases contracted in the course of employment and for connected purposes. The act includes compulsory insurance for employees. The act defines an employee as any worker on contract of service with employer will be relevant during construction.
- **The Energy Act 2019;** Consolidates the laws relating to energy, provides for National and County Government functions in relation to energy, provides for the establishment, powers and functions of the energy sector entities; promotion of renewable energy; exploration, recovery and commercial utilization of geothermal energy; regulation of midstream and downstream petroleum and coal activities; regulation, production, supply and use of electricity and other energy forms; and for connected purposes.
- **The Wildlife Conservation and Management Act No. 47 of 2013 (Revised 2014);** Provides for the protection, conservation, sustainable use and management of wildlife in Kenya. Section 19 elaborates on the functions of the County Wildlife Conservation and Compensation Committees that includes undertaking education, extension services and public awareness.
- **Forest Conservation and Management Act No. 34 of 2016;** Gives effect to Article 69 of the Constitution with regard to forest resources; to provide for the development and sustainable management, including conservation and rational utilization of all forest resources for the socioeconomic development of the country and for connected purposes. The Act applies to all forests on public, community and private lands.
- **National Land Commission Act, 2012;** Makes further provision as to the functions and powers of the National Land Commission, qualifications and procedures for appointments to the Commission; to give effect to the objects and principles of devolved government in land management and administration, and for connected purposes.
- **Land Act 2012(Revised 2019);** Gives effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land-based resources, and for connected purposes

- **Water Act No. 43 of 2016;** Provides for the regulation, management and development of water resources, water and sewerage service, and for other connected purposes. Further provides for the regulation, management and development of water resources and water and sewerage services in line with the Constitution.
- **The Physical Planning and Land Use Act 2019;** Provides for the preparation and implementation of physical development plans and for connected purposes. The Act provides for implementation of regulated development through preparation of physical development plans while considering potential environmental impacts.
- **Employment Act No 11 of 2007 (Amendment 2022);** Declares and defines the fundamental rights of employees, to provide basic conditions of employment of employees, to regulate employment of children and to provide for matters connected with the foregoing.
- **HIV and AIDS Prevention and Control Act No. 14 of 2006 Revised in 2012;** Provides for measures for the prevention, management and control of HIV and AIDS, to provide for the protection and promotion of public health and for the appropriate treatment, counselling, support and care of persons infected or at risk of HIV and AIDS infection
- **Public Health Act, Cap 242;** Regulates activities detrimental to human health. An environmental nuisance is one that causes danger, discomfort or annoyance to the local inhabitants or which is hazardous to human health. The Act prohibits activities (nuisances) that may be injurious to health.
- **The Climate Change Act, 2016;** Provides for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development.
- **National Gender and Equality Commission Act, 2011;** An Act of Parliament to establish the National Gender and Equality Commission as a successor to the Kenya National Human Rights and Equality Commission pursuant to Article 59(4) of the Constitution; to provide for the membership, powers and functions of the Commission, and for connected purposes.
- **The Valuers Act cap 532;** The Act Cap makes provisions for the relevant charges and conducts of valuers in relation to valuation of assets
- **County Government Act No. 17 of 2012 Revised 2017;** The Act is intended to provide powers, functions and responsibilities to deliver services to the Counties under the devolved government.
- **The Sexual Offences Act, 2006 and its amendment 2012;** Makes provision about sexual offences, their definition, prevention and the protection of all persons from harm from unlawful sexual acts, and for connected purposes.
- **The Environment and Land Court Act, 2012;** Plays a crucial role in providing legal and institutional framework for resolving disputes and enforcing environmental and land laws.

- **Traffic Act Cap 403;** Supports the safe and lawful transport and logistics operations which is also essential to the proposed project since it will involve transport of machinery and construction materials.
- **The Penal Code, Cap 63;** This is crucial to preventing and addressing any criminal offenses that may arise during project planning, construction, and operation. The Penal Code covers a wide range of offenses including corruption, property damage, public safety, and environmental harm.
- **The National Museums and Heritage Act (2006);** This is crucial in protecting cultural, historical, and archaeological heritage. The Act governs the conservation of sites and objects of historical or cultural significance and is enforced by the National Museums of Kenya (NMK)
- **National Construction Authority Act, 2011;** The Act provides that civil works such as construction of bridges, access roads and tunnels must be undertaken by NCA-registered contractors
- **Community Land Act, 2016;** The Act provides a legal framework governing how community land is managed, accessed, and utilized
- **The Labour Relations Act 2007;** The Act governs the rights, duties, and mechanisms for resolving disputes between employers and employees. It is a foundational law ensuring fair labor practices, collective bargaining, and industrial harmony.
- **Building Code;** The Building Code provides a set of regulations governing the design, construction, alteration, and maintenance of buildings across the country.
- **Social Health Insurance Act, No. 16 of 2023 (“SHIFA”);** The Constitution of Kenya in the Bill of Rights assures every person in Kenya to the highest standard of health which includes the right to health care services. Towards this end, the Government, through the Ministry of Health, embarked on the creation of a fund to ensure lower cost of health since many Kenyans will have access to affordable health care.
- **The Urban Areas and Cities Act, 2011;** The Act provides a legal framework for the classification, governance, and management of urban areas and cities and plays a key role in guiding how the project interacts with urban development, land use, and governance structures in cities and towns along its route.
- **Kenya Railways Corporation Act (Cap. 397);** This is the primary legislation governing the establishment and operations of the Kenya Railways Corporation (KRC) and provides a comprehensive legal framework for the management of railway services. The relevance of the cited legal frameworks are shown in **Table 11** below;

Table 11: Legal Frameworks and their relevance

Legal Framework	Relevant environmental obligations
Kenya Railways Corporation Act (Cap. 397), 1979	The overall mandate of the Corporation is to provide a coordinated and integrated system within Kenya for rail and inland waterways transport services and inland port facilities.
Standard Gauge Railway Protocol, 2014	Article 2 - Stipulates the overall objective of the SGR which is to jointly develop and operate a modern, fast, reliable, efficient and high capacity railway transport system as a seamless single railway operation among the Parties with the specific objectives of the SGR project.
Environmental Management and Coordination Act (EMCA) No. 8 of 1999.	Section 42 – Supporting the protection of rivers and wetlands Section 50 – Supporting the conservation of biological diversity Section 51 – Supporting the conservation of biological resources <i>in situ</i> Specific compliance obligations • Prohibiting and controlling the introduction of alien species into natural habitats • Controlling and prevention of environmental pollution • Carrying out ESIA for all proposed projects with a potential for adverse impacts • Carrying out environmental audit and monitoring of all activities that are likely to have significant effect on the environment • Ensuring compliance with all other relevant EMCA (1999) Regulations including the following: - Environmental Impact Assessment and Audit Regulations, 2003 ○ The Environmental management and coordination (Noise and Excessive vibration Pollution Control) Regulation, 2009 ○ Water Quality Regulations, 2006 (Legal Notice No. 121) ○ Waste Management Regulations, 2006 (Legal Notice No.121) ○ Air Quality, Regulations, 2024 ○ Controlled Substances Regulations, 2007 (Legal Notice No.73 of 2007) ○ Fossil Fuel Emission Control Regulations (2006) ○ Conservation of Biodiversity Regulations 2006 Wetlands, River Banks, Lake Shores and Sea Shore Management Regulation, 2009.

Legal Framework	Relevant environmental obligations
	The EMCA Section 68 and 69 also states that the proponent must submit an ESIA Report to be reviewed by NEMA. We intend to comply fully with the requirements of EMCA.
Wildlife Conservation and Management Act, 2013	33 (c): Supporting the establishment of wildlife Development Fund for development of conservation areas. 68:(4): Preventing development in a National Park without approved management plans. Section 30 of part VI: Prevention of adverse effects on the environment, including the seepage of toxic waste into streams, rivers, lakes and wetlands.
Way Leaves Act (Cap. 292)	The Act provides for certain undertakings to be constructed e.g. rail lines transmission lines, pipelines, canals, pathways etc., though, over or under any lands. Section 3: Allows the Government may carry any works through, over or under any land whatsoever provided it shall not interfere with any existing building or structures of an ongoing activity.
Physical Planning and Land Use Act, 2019	Section 29: Ensuring that developers to ensure proper execution and implementation of approved physical development plans Other legal obligations: - Ensuring that subsidiary area plans are recognized and integrated in the Regional Physical Development Plans - The local authority concerned shall require the developer to restore the land on which such development has taken place to its original condition within a period of not more than ninety days.
The Land Act, 2012	Part viii: Provides procedures for compulsory acquisition of interests in land. Section 111 (1): States that if land is acquired compulsorily under this Act, just compensation shall be paid promptly in full to all persons whose interests in the land have been determined. The Act also provides for settlement programmes.
Land Adjudication Act, 2010	Act applies to any area of Trust land where the County Council in whom the land is vested so requests; and the Minister considers it expedient that the rights and interests of persons in the land should be ascertained and registered.
Forest Conservation and Management Act, 2016	Highlights the integration of the community on the management, utilization and conservation of forests and its resources. It prohibits wanton destruction of the forests.

Legal Framework	Relevant environmental obligations
Water Act, 2016	Article 20. (1) Ensuring that state schemes shall take precedence over all other schemes for the use of water or the drainage of land Part IV: Addresses the issues of water supply and sewerage Other legal obligations • Promoting the conservation and proper use of water resources • Protection of any water resource, its source or catchment.
Public Health Act, Cap 242	Article 129: Supporting the protection of public water supplies. Article 117: Supporting the prevention or remedy danger to health from unsuitable activities including dust and noise.
Occupational Safety and Health Act, 2007.	This Act applies to all workplaces where any person is at work, whether temporarily or permanently. The purpose of this Act is to secure the safety, health and welfare of persons at work, and protect persons other than persons at work against risks to safety and health arising out of, or in connection with, the activities of persons at work
The Agriculture Act	The Agricultural Land-Use Rules under Cap 318 are clear on activities proscribed in riparian areas and it's essential that the proposed construction of transmission lines does not contradict requirements of this Act.
Antiquities and Monuments Act, 1983, Cap 215	The Act aims to preserve Kenya 's national heritage. Kenya is rich in its antiquities, monuments and cultural and natural sites which are spread all over the country. The National Museums of Kenya is the custodian of the country 's cultural heritage
Mining and Minerals Act, Cap 3016	The Mining and Minerals Act administered by the Department of Mines and Geology in the Ministry of Mining requires that the resulting open pits be rehabilitated appropriately, so that the natural environment is protected.
Explosives Act Cap 115	Section 7(1) - Stipulates that No person shall keep, store or be in possession of any unauthorized explosive in or on any premises except in an explosives factory or explosives magazine or unless the explosive is kept for private use, and not for sale or other disposal, and in accordance with rules or unless the explosive is kept for use in the construction of railway, road or other public work, in quantities not exceeding two thousand five hundred kilograms in weight and is stored in a temporary magazine approved by an inspector and under conditions specified in writing by an inspector. 7(2) - Stipulates that any person who contravenes the provisions of this section or any condition imposed or prescribed thereunder or mentioned therein shall be guilty of an offence and liable to a fine not exceeding three thousand shillings or in default of payment to imprisonment for a term not exceeding one year.

Legal Framework	Relevant environmental obligations
The Standards Act Cap 496	The Act is meant to promote the standardization of the specification of commodities, and to provide for the standardization of commodities and codes of practice; to establish a Kenya Bureau of Standards, to define its functions and provide for its management and control.
National Land Commission Act, 2012 (No. 5 of 2012)	Section 5: Mandates the Commission to: - <i>a)</i> Initiate investigations, on its own initiative. or on a complaint, into present or historical land injustices, and recommend appropriate redress; <i>b)</i> Encourage the application of traditional dispute resolution mechanisms in land conflicts; Assess tax on land and premiums on immovable property in any area designated by law.
The Kenya Civil Aviation Act, Cap 394	The Act mandates the KCAA to authorize and approve the usage of the flight for the purpose of ensuring the safety of flying aircraft over the proposed SGR project area.
Building Code 2024	The Act mandates the Municipalities or County Governments the powers to approve building plans.
Penal Code Cap 63	Section 191 - States that if any person or institution that voluntarily corrupts or foils water from public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence Section 192 – States that a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighbourhood or those passing along public way, commit an offence.
Public Participation Bill, 2024	provide conduct of public participation; to give effect to the constitutional principles of democracy and participation of the people under Articles 10(2), 69(1)(d), 118, 184(1)(c), 196, 201(a) and 232(1)(d) of the Constitution.
The Climate Change Act, 2016	The ACT provide for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development.
County Integrated Development Plans	County Integrated Development Plan (CIDP) is a plan that guides development within a county, integrating national and county government initiatives. SGR project transverse through the counties.

4.5 Development Partners Regulations on Environmental and Social Management

i) International Finance Corporation

The International Finance Corporation (IFC) part of the World Bank Group has a well-defined set of environmental and social regulations, standards, and procedures designed to ensure that the projects are environmentally sound, socially responsible, and sustainable.

Table 12 below outlines the various performance standards, their objectives, relevance and applicability to the proposed project.

Table 12: Relevant IFC performance standards

PS	Performance Standard	Objectives	Relevance to the proposed railway transport project	Remarks
PS1	Assessment and Management of Environmental and Social Risks and Impacts.	- To identify and evaluate projects environmental and social risks and impacts. - To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts - To promote improved environmental and social performance of clients through the effective use of management systems. - To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. - To promote and provide means for adequate engagement with Affected Communities throughout the project cycle.	Underscores the importance of managing environmental and social performance throughout the life of a project. It requires the proponent to conduct ESIA to establish and maintain an Environmental and Social Management System (ESMS), appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts. The concept of mitigation hierarchy is central to PS1, whereas it requires projects to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.	<i>Applicable</i> There are Environmental and Social risks that will arise during construction and operational phases of the project.
PS 2	Labour and Working Conditions	To promote the fair treatment, nondiscrimination, and equal opportunity of workers.	Recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of	<i>Applicable</i>

PS	Performance Standard	Objectives	Relevance to the proposed railway transport project	Remarks
		- To establish, maintain, and improve the worker-management relationship. - To promote compliance with national employment and labor laws. - To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. - To promote safe and healthy working conditions, and the health of workers. - To avoid the use of forced labor.	workers ensuring proper health and safety, e proper labor conditions, and addressing concerns related to work place environment.	The proposed project shall engage both skilled and unskilled workers to offer services in the project and their welfare will need to be taken care of.
PS 3	Resource Efficiency and Pollution Prevention	- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. - To promote more sustainable use of resources, including energy and water. - To reduce project-related GHG emissions.	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.	<i>Applicable</i> There are project activities like maintenance of vehicles and machines, dust and exhaust emissions that have the potential to cause pollution.

PS	Performance Standard	Objectives	Relevance to the proposed railway transport project	Remarks
PS 4	Community Health, Safety, and Security	- To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life. - To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles.	Recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. It calls for establishing procedures for local safety protocols, and emergency response plans for potential accidents.	<i>Applicable</i> Community members will be employed in the project. Project vehicles will also be transporting equipment, materials and waste outside the project area exposing community members to safety risks
PS 5	Land Acquisition and Involuntary resettlement	- To avoid and/or minimize displacement by exploring alternative project designs. - To avoid forced eviction. - To anticipate and/ or void/minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost⁴ and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. - To improve, or restore, the livelihoods and standards of living of displaced persons.	It recognizes that project related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use the land. Ensures that land acquisition processes are fair and transparent, and that communities are not involuntarily displaced due to the project operations.	<i>Applicable</i> PS5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.

PS	Performance Standard	Objectives	Relevance to the proposed railway transport project	Remarks
		To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure⁵at resettlement sites.		
PS 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	- To protect and conserve biodiversity. - To maintain the benefits from ecosystem services. - To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.	Recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainable management of living natural resources are fundamental to sustainable development. It further addresses impact on local biodiversity and ecosystems, especially in sensitive areas, and ensures sustainable management of natural resources (e.g., water bodies, local habitats).	<i>Applicable</i> PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.
PS 7	Indigenous Peoples	- To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. - To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.	Seeks to ensure project activities minimize negative impacts, foster respect for human rights, dignity, and culture of indigenous populations, and promote development benefits in culturally appropriate ways. Ensures that Indigenous Peoples' rights and cultures are respected during the project planning, implementation and decommissioning phases. Free, Prior, and Informed Consent (FPIC) is required for	<i>Applicable</i> The Maasai Community, who mainly live in Narok County are regarded as indigenous peoples.

PS	Performance Standard	Objectives	Relevance to the proposed railway transport project	Remarks
		- To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. - To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. - To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. - To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.	projects that affect indigenous territories or practices.	
PS 8	Cultural Heritage	- To protect cultural heritage from the adverse impacts of project activities and support its preservation. - To promote the equitable sharing of benefits from the use of cultural heritage	It recognizes the importance of cultural heritage for current and future generations. Ensures that any cultural or archaeological sites along the railway line are identified and preserved, respecting the cultural heritage of local communities during operations.	<i>Applicable</i> Before project commencement, survey to ascertain the presence of any archaeological or cultural sites to avoid disturbance will be conducted.

4.6 World Bank Group Environmental and Social Framework (ESF)

The Environmental and Social Framework (ESF) promotes green, resilient, and inclusive development by strengthening protections for people and the environment. It introduces enhanced measures in key areas such as labor, inclusion and non-discrimination, gender, climate change, biodiversity, community health and safety, and stakeholder engagement. The ESF adopts a risk-based and proportionate approach that allocates greater oversight and resources to complex projects and allows for adaptive risk management and continuous stakeholder engagement in response to changing project conditions. It also supports integrated environmental and social risk management.

The ESF emphasizes strengthening national environmental and social management systems and institutions, as well as building the capacity of implementing agencies. It promotes transparency and inclusive participation by requiring timely disclosure of information, meaningful and continuous stakeholder consultations throughout the project life cycle, and effective grievance mechanisms to ensure that concerns raised by project-affected communities are addressed promptly.

Within the ESF, the Environmental and Social Standards (ESS) guide the assessment and management of environmental and social risks for World Bank financed projects, ensuring that such projects are sustainable and responsibly implemented. **Table 13** below summarizes the triggered ESS and their relevance to the project.

Table 13: Relevant ESS and their relevance to the project

Standard	Purpose	Relevance to the project
ESS1 - Assessment and Management of Environmental and Social Risks and Impacts	Establishes the foundation for identifying, evaluating, and managing environmental and social risks. Requires Environmental and Social Impact Assessment (ESIA) and Environmental and Social management Plan (ESMP) to be put in place	The proponent has commissioned a full Environmental and Social Impact Assessment (ESIA) for the proposed project including construction, implementation and decommissioning phases.
ESS2 - Labor and Working Conditions	Protects workers' rights and ensures fair and safe labor practices, including for contractors and subcontractors.	The proposed project will engage both skilled and unskilled workers at different phases of the project. The proponent and contractor will promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions
ESS3 - Resource Efficiency and Pollution Prevention	Promotes sustainable use of resources (energy, water) and reduces pollution and GHG emissions.	The economic activities and urbanization which will result from the project often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. The proponent will put in measures to address resource efficiency, pollution prevention and management throughout the project life-cycle.

Standard	Purpose	Relevance to the project
ESS4 - Community Health and Safety	Addresses project impacts on community health, safety, and security (e.g. traffic, hazardous materials, emergency response)	The proponent shall ensure community safety (e.g., rail crossings, vibrations, noise) and put in place emergency response and security plans to reduce any negative impacts on project-affected communities.
ESS5 - Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Minimizes displacement, ensures fair compensation, and requires Resettlement Action Plans (RAPs)	The project will acquire land across different counties to lay the railway line. It's should be ensured that the land acquisition process and any resettlement is managed fairly well.
ESS6 - Biodiversity Conservation	Protects habitats, species, and promotes sustainable land use practices.	The project will traverse some sensitive ecosystems hence strong biodiversity management measures will be required. It will also recognize the need to consider the livelihood of project-affected parties, whose access to, or use of, biodiversity or living natural resources may be affected by a project.
ESS7 - Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Ensures respect for Indigenous Peoples' rights, culture, and Free, Prior, and Informed Consent (FPIC).	The project shall impact the Maasai community, which are regarded as Indigenous people; report shall not impact any indigenous people.
ESS8 - Cultural Heritage	Protects tangible and intangible cultural heritage and requires Chance-find procedures	Before project commencement, survey for any archaeological or cultural sites will be conducted to

Standard	Purpose	Relevance to the project
		avoid disturbance. An elaborate Chance find procedures will be included in the ESIA report.
ESS10: Stakeholder Engagement and Information Disclosure	Requires early and ongoing stakeholder engagement and an accessible grievance mechanism.	Strengthens stakeholder dialogue and transparency between the proponent, County Governments, Community and other stakeholders. Elaborate stakeholder management process shall be carried out during the ESIA process.

4.7 International Environmental Agreements Relevant to Kenya

Kenya is involved in numerous international environmental agreements to address global challenges covering diverse areas like climate change, biodiversity, ozone layer protection, and trade in endangered species amongst others. Some of the agreements are included in the **Table 14** below.

Table 14: International agreements relevant to Kenya

Theme	Convention objective	Summary
Biodiversity	International Plant Protection Convention -new revised text approved by Resolution 12/97 of the 29th Session of the FAO Conference in November 1997 – Declaration	To prevent the spread and introduction of pests of plants and plant products and to promote measures for their control.
	Convention on Biological Diversity	To ensure the conservation of biological diversity; the sustainable use of its components and the fair and equitable sharing of the benefits.
	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	To protect migratory species of wild animals and their habitat
	Convention on International Trade in Endangered Species of Wild Flora and Fauna	To ensure that international trade in specimens of wild animals and plants does not threaten their survival.
Climate change	Kyoto Protocol to the United Nations Framework Convention on Climate Change	To reduce or limit the emission of gases contributing to the "greenhouse effect" and causing climate change in the industrialized countries
	United Nations Framework Convention on Climate Change (UNFCCC)	To achieve stabilization of greenhouse gas concentrations
	The Paris climate change agreement-UNFCCC	Its goal is to limit global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels
Cultural Heritage	UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage	To ensure that effective and active measures are taken for the protection, conservation and presentation of the “cultural and natural heritage” on its territories.
	UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage	To safeguard and ensure respect for the world’s Intangible Cultural Heritage, including raising awareness of the importance of intangible heritage and encouraging international cooperation and assistance.
Democracy	Partnership agreement between the members of the African, Caribbean and	To promote and expedite economic growth

Theme	Convention objective	Summary
	Pacific Group of States of the one part, and the European Community and its Member States, of the other part, signed on 23 June 2000 - Protocols- Final Act - Declarations	with a view to contributing to peace and security and to promoting a stable and democratic political environment
Desertification	United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	To combat desertification and mitigate the effects of drought with a view to achieving sustainable development
Ozone Layer Depletion	Amendment to the Montreal Protocol on substances that deplete the ozone layer, adopted at the ninth meeting of the Parties	To ensure effective protection of the ozone layer by regulating trade in substances that deplete it.
Waste Management	Basel Convention on the control of trans boundary movements of hazardous wastes and their disposal	To lay down obligations with regard to ensuring that the trans-boundary movement of wastes is reduced to the minimum consistent with the environmentally sound and efficient management of such wastes

4.7.1 International Labour Organization Fundamentals and Other Conventions

Table 15 below indicates the standards aimed to promote rights at work, encourage decent employment opportunities, enhance social protection, and strengthen dialogue on work-related issues.

Table 15: ILO standards and other conventions

Theme	Convention	Summary	Application in Kenya
Women rights	International labour organization Convention No. 89 on Women's Rights and working conditions	These conventions set our basic principles and rights at work in regard to gender equity	The principles and rights set out in these conventions are generally adopted in the 2010 constitution and in Kenya's Employment Law – 2007, and the Industrial Relations Act, 2007, the Workers Injury benefit Act, 2007 and the Occupational Safety and Health Act, 2007
	ILO Discrimination (Employment and Occupation Convention 1958(No.111)		
	United Nations Convention on the Elimination of all Forms of Discrimination Against Women.		
	ILO Worst Forms of Child Labour Convention, 1999 (No. 182)		

Theme	Convention	Summary	Application in Kenya
	ILO Child Rights and Working Conditions Convention No. 90		
	ILO Forced Labour Convention, 1930 (no. 29)		
	ILO Abolition of Forced Labour Convention, 1957 (No. 105)		
Labour Rights	ILO Right to Organize and Collective Bargaining Convention, 1949 (No. 98)	These conventions set out basic principles and rights at work in regard to representation	
	ILO Freedom of Association and Protection of the Right to Organize Convention, 1948 (no. 87)		
Occupational Health and Safety	ILO Occupational Safety and Health Convention, 1981 (No. 155)	This convention sets out basic principles and rights at work in regard to workplace health and safety management	

CHAPTER 5.0 ESIA APPROACH AND METHODOLOGY

5.1 Introduction

This chapter outlines the stakeholder engagement (consultation, participation and disclosure) process and methodology used during data and information collection. The different methodologies were applied to collect and analyze data relevant to social-economic environment, physical environment and biodiversity. These methodologies are expounded in the foregoing sections,

5.2 Socio Economic Data Collection Methodology

5.2.1 Desktop Study Studies

Desktop study entailed an office-based exercise during which available existing information (such as available aerial imagery, mapping and published literature) was undertaken prior to undertaking field work, to describe the existing environment. Relevant literature and available project documents were reviewed to help in describing the biophysical and social settings of the project's area of influence. The documents reviewed included but not limited to the following:

- Feasibility Study Report-Naivasha–Kisumu Standard Gauge Railway Project in Kenya, June 2023.
- Relevant Acts of parliament,
- Kisumu County Integrated Development Plan 2023 - 2027
- Kericho County Intergrated Development Plan 2023 – 2027
- NyamiraCounty Intergrated Development Plan 2023 – 2027
- Bomet County Intergrated Development Plan 2023 – 2027
- Narok County Intergrated Development Plan 2023 – 2027
- Kenya Railways Strategic Plan 2023-2027
- KNBS Kenya Population and Housing Census Report-2019.
- The Railways Bill,2024
- World Bank Group Enivronmental,Health And Safety Guidelines (Ehs Guidelines)
- Convention on Biological Diversity website (<http://www.cbd.int/>)
- UNESCO database on World Heritage Sites (<http://whc.unesco.org/en/interactive-map/>)

5.2.2 Stakeholder Engagement and Public Participation

The core stakeholders of the project include Project Affected Persons (PAPs), local residents, motorists, businesses, and service providers along the SGR corridor individuals and groups who may either benefit from or be impacted by the development. The primary objective of stakeholder consultation is to ensure that their views and concerns are incorporated into the Environmental and Social Impact Assessment (ESIA), thereby supporting a transparent, inclusive, and robust evaluation process.

Stakeholders are categorized as either directly affected or indirectly involved, such as regulatory agencies, interest groups, and other institutions with a stake in the project's outcomes. Engagement activities commenced during the scoping phase and continued throughout the project lifecycle, in accordance with national legislation, IFC Performance Standards, and the World Bank Environmental and Social Framework.

Stakeholder engagement and consultations were undertaken in order to determine and capture all the key areas of potential environmental impact, namely: a) physical environment, b) biological environment, c) social-cultural environment, d) economic issues, e) political issues, f) institutional issues, g) international implications, and h) any other issues.

5.2.2.1 Stakeholder Identification

The following list outlines the parties to be consulted, they will likely be affected or have interest in the proposed railway corridor.

1. Government Institutions officials including, Kenya Pipeline Company (KPC), Kenya Civil Aviation Authority (KCAA), Kenya Power Company, Kenya Airports Authority (KAA), Kenya Wildlife Service (KWS), Kenya Ports Authority (KPA), Kenya Railway Corporation (KRC), Kenya Highways Authority (KENHA), Kenya Urban Roads Authority (KURA), Kenya Rural Roads Authority (KeRRA), Kenya Electricity Generating Company (KenGen), Kenya Electricity Transmission Company (KETRACO), Kenya Forest Service (KFS), Water Resource Authority (WRA), Ministry of Mining, Relevant ministries in the County governments of Kisumu, Kericho, Nyamira, Bomet and Narok such as Environment, Transport, National Transport Safety Authority (NTSA), National lands Commission (NLC), Academia, Youth among others.
2. Long Distance Truck Drivers Union.
3. Kenya Association of Transporters.
4. Kenya Association of Manufacturers (KAM).
5. Kenya Association of Tour Operators.
6. Kenya Chamber of Commerce.
7. Local community representatives (Local political and Community leaders).
8. Local community members along the proposed railway line.
9. Business operators – Hotel owners, shop owners, service stations, freight terminal owners, truck owners among others.
10. Truck drivers, turn boys, mechanics, puncture repairers.
11. Residents Associations along the proposed alignment
12. Conservation NGOs – Conservation alliance, Nature Kenya,
13. Local administration in the SGR route for the five counties – Kisumu, Kericho, Nyamira, Bomet and Narok.

5.2.2.2 Stakeholder Mapping and Analysis

Stakeholder mapping seeks to understand stakeholders' level of interest in the Project and influence in decision making as well as on other Project stakeholders, and will continue throughout the Project lifecycle. It is also important to note that stakeholder interests and level of influence is dynamic and changes over time; hence the need to periodically update the stakeholder map as well as the wider SEP. Mapping will also help identify stakeholders who may find it more difficult to participate in consultation activities and are affected by or interested in the proposed Project because of their marginalized or vulnerable status.

Stakeholder mapping considers:

- Who is affected by the Project and how;
- Who the formal and informal community leaders are and to what degree they are seen as representative;
- Whether the stakeholder supports, is neutral towards, or is opposed to the Project;
- Each stakeholder's interests and concerns in relation to the Project; and
- How different stakeholders can influence the Project and what risks or opportunities this presents.

According to each stakeholder's levels of interest or impact on the proposed Project, different levels of engagement intensity will be employed. Stakeholders will be mapped using the matrix presented below.

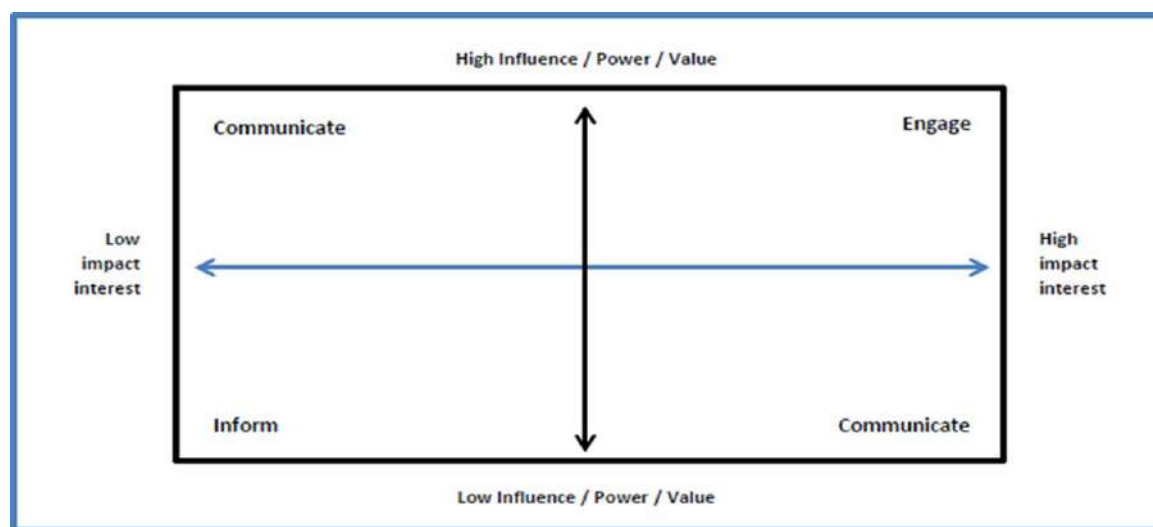


Figure 9: Stakeholder analysis

In addition to the stakeholder mapping analysis presented above, the dimensions of stakeholder interest and influence were also considered, as summarized in the table below. This analysis categorizes stakeholders based on their level of interest in, and influence over, the project. The identification process began with a brainstorming exercise to determine which stakeholders may be affected by the project and the extent of their influence. The expert team then classified the stakeholders into four distinct groups based on their respective levels of interest and influence:

- Low interest, low influence
- Low interest, high influence

- High interest, low influence
- High interest, high influence

The **Table 16** below presents the identified stakeholder groups, their roles, interests, and levels of influence.

Table 16: Stakeholders Mapping

Category	Stakeholder	Role	Interest	Influence	Strategy
National Government	Districts County Commissioners (DCC) Assistant County Commissioners (ACCs), Area Chiefs, Assistant Chiefs	• Smooth implementation of the Project • PAPs are informed about the project • PAPs are compensated • The project is done within the law	High	High	Engage
County Governments	Narok	• Providing information to the consultants in regards to the public land where the project is being undertaken. • Providing necessary information in respect to community, • Participate in validating the project outputs.	High	Medium	Communicate
	Bomet	• Providing information to the consultants in regards to the public land where the project is being undertaken. • Providing necessary information in respect to community, • Participate in validating the project outputs.	High	Medium	Communicate

Category	Stakeholder	Role	Interest	Influence	Strategy
	Nyamira	• Providing information to the consultants in regards to the public land where the project is being undertaken. • Providing necessary information in respect to community, • Participate in validating the project outputs.	High	Medium	Communicate
	Kericho	• Providing information to the consultants in regards to the public land where the project is being undertaken. • Providing necessary information in respect to community, • Participate in validating the project outputs.	High	Medium	Communicate
	Kisumu	• Providing information to the consultants in regards to the public land where the project is being undertaken. • Providing necessary information in respect to community, • Participate in validating the project outputs.	High	Medium	Communicate
Government Institutions	KRC	• Project Proponent (Project	High	High	Engage

Category	Stakeholder	Role	Interest	Influence	Strategy
		implementation (Timely and efficient implementation of the project)			
	NEMA	Environmental regulating agency	High	Medium	Communicate
	KFS	Providing information in regards to forestry	Low	Low	Inform
	KWS	Providing information in regards to wildlife	Moderate	Low	Inform
	KMFRI	Providing information in regards to marine and fisheries	Moderate	High	Engage
	Water Resources Authority (WRA)	Providing information in regards to water management and conservation.	Moderate	Medium	Communicate
	KPLC, KETRACO and other related Institutions	- Providing information in regards their existing infrastructures. - Relocation of their infrastructures where necessary for the project	Moderate	Low	Inform
Project Affected Persons (PAPs)	Individual Land Owners along the ROW	- Providing the required information for preparation of the Resettlement Action Plan. - Participate in decision making.	High	High	Engage
Transport	Bodaboda,	Information on	Moderate	Moderate	Inform

Category	Stakeholder	Role	Interest	Influence	Strategy
Operators	Lorries, Matatus, Trucks Operators	the expectation of the SGR project	Low		
Business Communities	Traders	Information on the expectation of the SGR project	Moderate	Moderate	Inform
Local Communities	Communities group and members	Involvement in public participation	Low	Low	Inform
Trade/Manufacturers Associations	KAM KNCCI	Information on the expectation of the SGR project	Low	Low	Inform
Others	- Religious groups representative - Community Based Organizations (CBO) - Non-Governmental Organizations (NGO) - Youth and Women groups - People with disability - Vulnerable groups	- Participate in providing local information. - Providing the required information for project execution and consideration.	Low	Low	Inform

5.2.2.3 Stakeholder and Public Consultation Methods

The consultation methods that will be used to engage the stakeholders in the specific projects will include:

- High-Level Introduction to County Leadership – already done during 3rd – 7th March 2025.
- One- to-one meetings with Key Informants
- Community/ Public Meetings

The **Table 17** below outlines the stakeholder and public consultations methods.

Table 17: Stakeholder and public consultation methods

Method of Consultation	Purpose	Justification	Target Audience
Public Meetings	• Share information about the project • Provide a forum for the community to raise issues and concerns about the proposed project • Allow issues to be verified and solutions formulated • Document stakeholders' comments and concerns for consideration during the subsequent studies • Provide response to the project related questions	• Allows wider consultation and discussion on issues and relevant topics • Increased ownership by the participants	Local communities, PAPs, National and County Government officers and others Stakeholders
Focus Group Discussions	• Provide information about the project to the key informants and stakeholders • To verify the information provided by the community • Gather data on specialized/thematic areas issues	• Allows wider consultation and discussion on issues and relevant topics • Increased ownership by the participants	• Women • Youths • Persons with Disabilities
One to One Interviews	• Provide information about the project to the key informants and stakeholders • To verify the information provided by the community • Gather data on specialized/thematic areas issues	• Allows for follow up on issues and gather detailed further information.	• Government Institutional Representatives, • County Government Representatives, • Academia, professions
Administration of Questionnaires	• Provide information about the project to the key informants and stakeholders • Gather data on specialized/thematic areas issues	• Allows wider consultation and collect relevant data	• Government Institutional Representatives, • County Government Representatives, • Academia, professions • Community Members

5.2.2.4 Stakeholder Engagement Plan

The **Table 18** below presents stakeholder plan outlining strategies to be used, timing and frequencies throughout project life cycle.

Table 18: Stakeholder Engagement plan

Stakeholder category	Specific needs/role	Means of communication	Timing
Ministry of Interior and Coordination of National Government	- Information dissemination and outreach - Facilitate public participation	Correspondence by phone/email, Meetings	During implementation – input into all project activities
County Governments (Kisumu, Kericho, Nyamira, Bomet and Narok)	- Information dissemination and outreach - Facilitate public participation	Correspondence through letters, Email, meetings	During implementation of the project Lifecycle
Government Institutions and Lead agencies	- Issuing of permit, guidelines - Provision of Technical support	Correspondence by phone/email, Roundtable discussions, website link.	Throughout the project life cycle
Project Affected Persons (PAPs)	Provision of Right of Way and to be Compensated	Meetings and Focus group discussions	- During compensation process, - Land acquisition
Business Communities	Partnership collaboration and	Meetings and Focus group meeting	Entire project cycle
Other Stakeholders	Partnership collaboration and	Meetings and Focus group meeting	Entire project cycle

NB: Kindly note that a detailed Stakeholder Engagement Plan is annexed to this report.

5.2.2.5 Grievance Redress Mechanism (GRM)

A user-friendly Grievance Redress Mechanism is in place to allow stakeholders to submit any concerns or complaints throughout the project lifecycle. The GRM aims to resolve issues promptly and openly, encouraging community participation in finding solutions.

Information on how to file and monitor grievances will be shared widely, and the process will be promoted during all community engagement activities. Local-language explanations and visual aids such as posters, leaflets, and flowcharts will be displayed in public institutions including chiefs' offices, schools, health facilities, markets, and places of worship.

Other modes of communication, including WhatsApp and text messaging, will also be used whenever a grievance arises whether from the community to the project team or internally between the contractor and employees. The grievances are in three levels as illustrated below;

Level 1 Grievances: Resolved at Field Level

These grievances relate to matters that can typically be addressed at the field level. The expected resolution period is 14 days; however, until the full procedure is fully implemented, claimants will be notified within 30 days. Addressing these grievances may involve engaging relevant stakeholders in the field, sharing necessary information, negotiating compensation with the affected parties, issuing an apology, or applying any other appropriate remedy within the abilities and resources of

the field staff and their local networks.

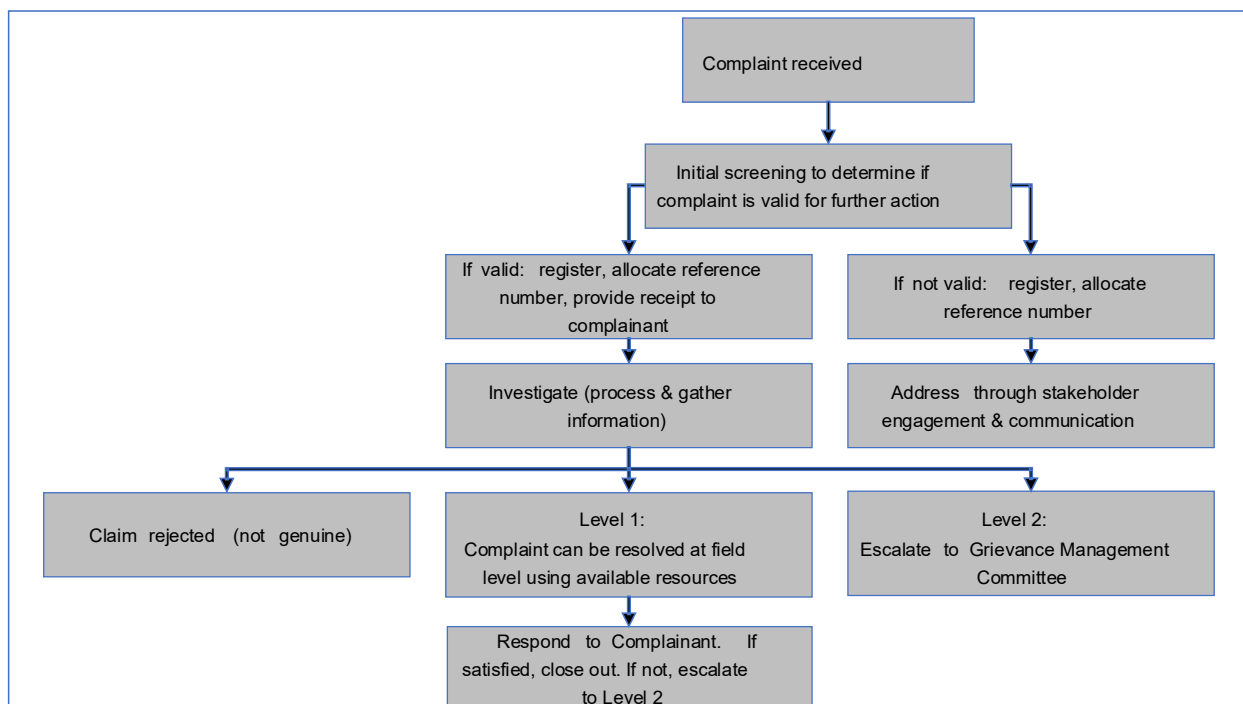


Figure 10: Level 1 Grievance Process

If all resources and options have been totally exhausted at field level and the claimant still appeals the resolutions proposed by KRC, the case needs to be escalated to level 2.

Level 2 Grievances: Resolved through a Grievance Management Committee

These are complex claims usually related to project aspects that could have adverse impacts on the claimant's livelihood, health and safety and cultural norms and traditions.

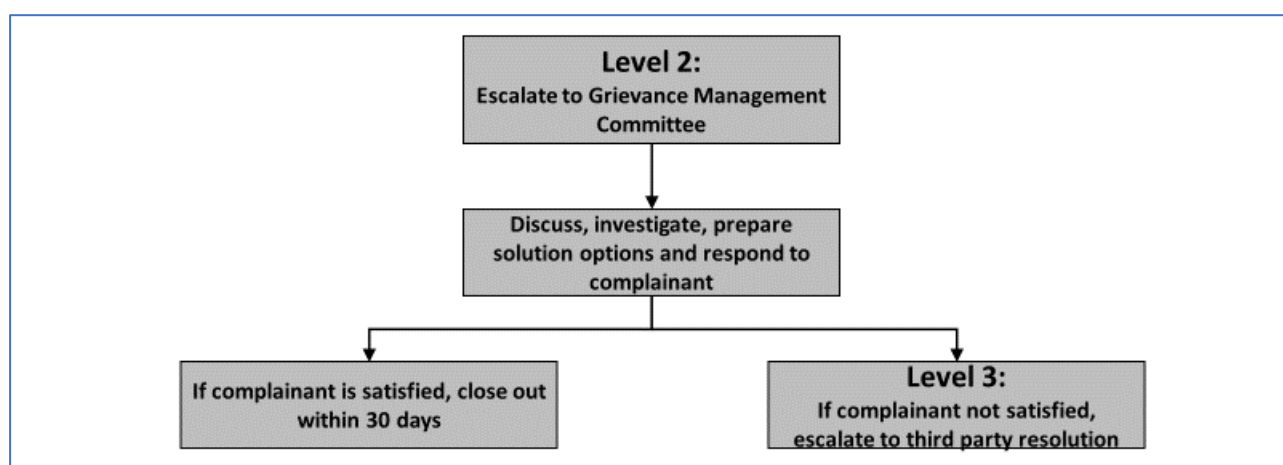


Figure 11: Level 2 Grievance Process

Level 3 Grievances: Referred to Third Party

A grievance that remains unresolved despite following all available avenues to resolve it through first and second levels grievance resolution will become a Level 3 Grievance. KRC will comply with all legal requirements and will follow up regularly to assess the status of all such outstanding

cases.

NB: Kindly note that a detailed Grievance Redress Mechanisms is annexed to this report.

5.3 Biodiversity Data Collection Methodology

The biodiversity data collection was done to assess the project's environmental footprint, identify potential ecological impacts on habitats and species, inform mitigation and conservation efforts, ensure compliance with environmental regulations, and predict long-term effects on biodiversity within the standard gauge railway corridor. The assessment focused on the distribution and status of flora and fauna, the sensitivity of habitats, and the presence of any species of conservation concern.

5.3.1 Biodiversity Assessments

The study adopted a purposive sampling design, targeting wetlands and their immediate surroundings. This approach was informed by observations that much of the area traversed by the railway has already been modified by human activities, including farming and human settlement. As a result, the only remaining natural habitats are flowing rivers and streams, since most marshes have been converted into sugarcane plantations. Wetlands and adjacent areas were therefore prioritized because they are relatively less disturbed and are more likely to serve as refuge habitats for remnants of the original biota.

A field survey was conducted from 1st to 18th July 2025 along the entire alignment. Sampling points were strategically selected in areas where the railway intersects wetlands and in locations designated for major infrastructure such as train stations, which are expected to experience higher levels of impact. The sampling locations are presented in **Table 19** below.

Table 19: Sampled points along the SGR Phase 2C corridor

Location	Latitude	Longitude	Altitude (m)
Albalbal Wetland	1° 3'36.69"S	35°52'18.54"E	
Chebaricha Stream	0°53'0.08"S	35°22'22.02"E	1866
Chororoita River	0°44'7.72"S	35°14'13.92"E	1836
Engare Ngoso River	1° 6'0.94"S	35°58'36.30"E	1840
Ewaso River	1° 3'36.06"S	35°51'3.28"E	
Jujulet River	0°18'24.99"S	35° 3'42.65"E	1271
Kaposirir Swamp	0°46'56.53"S	35°16'25.57"E	1882
Koetoni River	1° 4'40.26"S	35°46'16.59"E	1909
Maasai Mara Vocational River	1° 7'23.75"S	35°59'27.12"E	1776
Masandare Dam	1° 2'12.94"S	35°37'40.12"E	1932
Murototo/ Ndoroto Water Pan	1° 9'33.75"S	36°10'16.06"E	1799
Ndubai Water Pan	0°53'31.99"S	35°23'15.18"E	1854

Ngurumet River	0°57'53.92"S	35°28'54.00"E	1871
Nkor Korri Wetland	1° 0'53.80"S	35°33'48.78"E	1974
Nyando River	0° 9'8.34"S	34°55'48.70"E	1124
River Amalo (Mulot)	0°56'12.70"S	35°25'32.36"E	1791
River Muguruk	0° 6'9.07"S	34°39'29.89"E	1118
River Ngasiat	0°57'10.54"S	35°28'5.40"E	
River Nyangores	0°49'34.96"S	35°18'8.65"E	1869
River Sise	0°44'40.83"S	35°15'3.24"E	1836
Shiongi Stream	0°34'23.33"S	35° 5'19.51"E	1699
Siyabei River/ Oljororok Stream	1° 5'33.00"S	35°57'15.30"E	1818
Sondu River	0°24'22.84"S	35° 1'21.61"E	1490
Susait/ Lendaet River	0°45'0.34"S	35°15'19.79"E	1856
River Sondu	0° 4'16.72"S	34°48'55.50"E	
River Cherumbas	0°42'35.14"S	35°12'13.39"E	1818

The approach adopted for each taxonomic group during the biodiversity assessment is outlined below. For each taxa, specific survey methods and tools were applied to ensure accurate data collection and representation. By using methodologies specific to each taxa, the study ensured that the biodiversity along the Right of Way was comprehensively evaluated and that both common and conservation-sensitive species were adequately considered.

5.3.2 Mammal Survey Methodology

Different sampling methods were employed based on the size of the mammal targeted along the sampling points indicated in the **Table 19** above.

- Sherman traps; these were set to target small mammals like rats and mice. The traps were baited with peanut butter, oatmeal and *omona*.
- SM4: the SM4 were used to sample the small flying mammals, bats. These are active at night and their behavior of echolocation is what informs the method which records the sounds produced by the bats. These are then analyzed using a computer program which is able to identify the bats.
- Tomahawk traps: these were employed for the medium sized carnivores. The trap was baited with fish and placed in areas where the animals were likely to pass as shown in **Figure 11** below (in this case near a water pan).
- Camera traps: the camera trap was used to target all groups of mammals especially the large ones. These use motion-sensors and were allowed for one night at a given point.



Figure 12: Tomahawk cage

Source: Ecoscience Engineering Biodiversity Assessment report-May 2025

5.3.4 Bird Survey Methodology

Vantage point and spot surveys, as well as walked transects in each study area were used to mark the spot and identify birds within the study area. Binoculars were employed to increase visibility of distant birds. Identification was based on calls and physical observation.

5.3.5 Herpetofauna Survey Methodology

Different sampling methods were employed to complement each other and maximize chances of species observation.

- **Pitfall traps associated with drift fences (Corn, 1994)**

The drift fences as shown in **Figure 12** below were either laid in an X or cross formation to trap animals moving from all direction. Also laid in a strain line. The choice is influenced by the topography of the sampling site. The traps were laid at intervals of approximately 5km all along the transect/ wayleave



Figure 13: Pitfall Traps with drip fences

Source: Ecoscience Engineering Biodiversity Assessment report-May 2025

- **Time Limited Searches (Karns, 1986).**

This involved actively seeking the herps from their possible cover within a restricted time frame of one hour and recording the observation. The searches involved digging up soil, moving leaf litter, turning rocks, logs and inspecting tree barks for the animals.

- Acoustic surveys for the amphibians and is targeted at their calling behavior in wetlands especially at night as some species are able to call even during the day. This was nested within the Time Limited searches and was done from late evening into the early hours of the night as these are the hours when the amphibians and other crepuscular reptiles are active. Some species such as *Phrynobatrachus spp.* can call during the day as well and this method was used to locate them.
- Opportunistic encounters during other field activities and observations recorded and reported by other members of the team and the community. The identification was based on the description given and the expert knowledge of the possible species in the region.
- Interviews done with the locals provided more species. This was used to enrich the inventory but only took to account well described species and those that are within the distribution range based on the expert's knowledge

5.3.5 Fish Surveys Methodology

Fish data was obtained from unpublished report from recent studies in the study area which covered the river systems captured in the present study.

5.3.6 Invertebrate Survey Methodology

Different methods were employed as informed by the behavior of the targeted invertebrates. Pitfall traps were used for crawling species. These were dug to flush with the ground and filled halfway with water. Pantraps were used for flying butterflies seeking flowers, aerial nets for butterflies seeking rotting fruits and sweep nets for flying species.

5.4. Physical Environment Data Collection Methodology

5.4.1 Air Quality Assessment Methodology

Air quality monitoring was carried out using Aeroqual Monitor and sensors that meets Monitoring Certification Scheme (MCERTS) standards that are compliant with ISO/IEC 17000 series of conformity assessment standards. The methods are in line with the following standard methods;

- KS ISO 8672: Air quality - Determination of the number concentration of airborne inorganic fibres by phase contrast optical microscopy - Membrane filter method was for inhalable and respirable particulate matter;
- KS ISO 7996: Ambient air - Determination of the mass concentration of nitrogen oxides -- Chemiluminescence method for nitrogen oxide;
- KS ISO 4224: Ambient air - Determination of carbon monoxide non-dispersive infrared spectrometric method for carbon dioxide; and
- KS ISO 14965: Air quality - Determination of total non-methane organic compounds -- Cryogenic pre-concentration and direct flame ionization detection method for total volatile organic compounds.

The Aeroqual sensor heads used feature an active fan sampling, which ensures a representative sample is taken and therefore increases measurement accuracy. The sensor heads used (CO₂, NO₂, VOC and PM₁₀& PM_{2.5}) are duly calibrated with their calibration certificates annexed in the report. The monitors were elevated at a height of approximately 1.5m using a tripod stand as illustrated of **Figure 14 and 15** below. The monitor was set to log the pollutant data every minute. They were then placed in an area free of any obstruction during the monitoring period to allow free air circulation. Data was logged and download in the computer for analysis and interpretation.



Figure 14: Air Pollutants Measurements at Obumba Passing Station



Figure 15: Air Pollutants Measurements at the proposed Masandare Passing Station

Source: Ecoscience Engineering Air quality Assessment report-May 2025

5.4.2 Soil Quality Assessment Methodology

ISO 18400-104:2018 Soil quality — Sampling Part 104: Strategies was adopted in soil sampling.

Soil samples were obtained for between 15-30 cm above the surface as shown in **Figure 16** below.

Composite samples were obtained from each site in weighing approximately 500g. The soil samples were stored in air-tight plastic containers in readiness for transportation and analysis. The samples were stored in a cooler pack ensuring a temperature of below 4°C was maintained.



Figure 16: Soil sample collection

Analysis

The samples obtained were then transported to CSI International Limited, an ISO/ ICE 17025 Accredited Laboratory for analysis. Respective analysis methods for respective parameters are as detailed on the **Table 20** below.

Table 20: Parameters and method of analysis

Parameter	Method	Units
TPH	CSITP 033	mg/Kg
Oil and grease	CSITP 014	mg/Kg

5.4.3 Water Quality Assessment Methodology

ISO 5667-1:2023 Water quality — Sampling Part 1: Guidance on the design of sampling programmes and sampling techniques was adopted in water sampling from all the sources. **Figure 17 and 18** below shows some of the rivers where water samples were obtained.



Figure 17: Sampling at Emurtoto/ Ndoroto Water Pan



Figure 18: Sampling at Engare River

Source: Ecoscience Engineering Water quality Assessment report-May 2025

Water Analysis

The samples obtained were then transported to Crop Nutrition Laboratory Services, an ISO/ ICE 17025 Accredited Laboratory for analysis. Respective analysis methods/ standards for respective parameters are as detailed on the below.

- pH - ISO 10390;
- Turbidity - EPA 180.1;
- Total Suspended Solids - EPA 160.2;
- Total Dissolved Solids - EPA 160.1; and
- Oil and Grease- EPA 1664.

5.4.4 Noise and vibration assessment methodology

Noise measurement methodology

ISO 1996, Acoustics – Description and Measurement of Environmental Noise was applied in the noise assessment. Measurement was carried out with the use of a duly calibrated SVAN 971 Type 1 (Serial Number 82474) sound level meter. Monitoring locations were based on prevalent wind direction south west to north east and the two sensitive receptors located in the vicinity of the facility. Four sampling locations were, however selected with their geo-location identified using a Global Positioning System (GPS).

Field calibration checks was done before and after measurement using a duly calibrated sound level calibrator (Type SV36- Serial Number 112554). Sound level meter was positioned in unobstructed location and elevated with a tripod stand during measurement. This is as illustrated on **Figures 19 - 21** below.



Source: Ecoscience Engineering Noise and Vibration Assessment report-May 2025

Ground Vibration Methodology

ISO 4866: 2010 ‘Mechanical vibration and shock-Vibration of fixed structures - Guidelines for the measurement of vibrations and evaluation of their effects on structures’ was applied in monitoring. The Instantel Micromate; Serial Number UM152275 that is duly calibrated; a 4-channel unit, is designed to monitor and transmit event data with one triaxial geophone and one air overpressure microphone, was used for the vibration monitoring exercise. The vibration monitoring equipment had a frequency response is within the recommended range of between 1 Hz to 80 Hz for accurate readings.

Ground vibration was measured on a tri-axial arrangement of velocity transducers and air blast by means of air blast microphone. Set-up of the monitor include times when the unit is active, set trigger levels for ground vibration and air blast as well as general information about the location and client. Trigger levels are those levels that are pre-programmed in the system to start the recording if any event is greater than those set levels. Normally the system is to trigger on ground vibration and/or air blast. Set levels are such to minimize the possibility of false triggers due to noise/vibration generated in the vicinity of the monitor and ensure accurate and effective monitoring of any blast related event. The vibration measurement is as illustrated on **Figure 22 and 23** below.



Figure 22: Vibration measurement at the proposed Narok Station



Figure 23: Ground vibration monitoring equipment

5.5 Impact Analysis and Evaluation Methodology

This exercise is intended to give an analysis of possible impacts of the project. The analysis and evaluation of potential impacts associated with all the project phases has been undertaken the project based on site surveys, available secondary information, professional knowledge and judgment drawn from similar projects. The methodology applied in this ESIA to assess impacts is as follows:

- Each receptor is analyzed to understand how sensitive it is to a change in its external environment as indicated in **Table 20** below.
- Each potential change which will be caused by the project is analyzed to understand the extent to which it might impact the receptors in the project area.
- The two factors (sensitivity of a receptor and change parameter) are combined to estimate the significance of each impact to the receptors. The method used is described below.

5.5.1 Sensitivity of a Receptor

The sensitivity of each group of receptors has been estimated based on the understanding of their potential status, using the criteria and scoring system set out the **Table 21** below. It is important to note that the way in which sensitivity is assessed varies from receptor to receptor so the criteria is only used as a guide.

Table 21: Criteria and scoring system for determining sensitivity of a receptor Category

Criteria	Score	Description
Negligible	1	Receptor with good capacity to absorb proposed changes or good opportunities for mitigation.
Low	2	Receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Medium	3	Receptor with little capacity to absorb proposed changes or limited opportunities for mitigation.

Criteria	Score	Description
High	4	Receptor (human, physical or biological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.

5.2.2 Change Parameter

Each potential change describes various parameters of the change and considers how each change could affect each receptor applying a scoring system. To describe the change, we used the parameters set out in **Table 22** below.

Table 22: Change receptors

Parameter	Score	Description
Nature	Positive Negative (scoring system not applicable)	The nature of the change that is being considered may be positive, neutral or negative. For example, a gain in available habitat area for a key species would be classed as positive, whereas a habitat loss would be considered negative.
Magnitude	1 Negligible 2 Minor 3 Moderate 4 Major	The magnitude of change is a measure of the degree of change that will be incurred as a result of the proposed development. The categorization of magnitude is based on a set of criteria that is specific to the discipline area being considered. For example, in the case of surface water, the magnitude may be defined as the extent to which the water quality (for example, suspended solids) exceeds the adopted national criteria.
Duration	1-Short term(0-6months) 2-Medium term (7-18 months) 3-Longterm (19-36 months) 4 Permanent	The duration of change refers to the length of time over which an environmental impact may occur.
Scale	1 Local 2 Regional 3 National 4 International	The change may happen at a local, regional, national or international level
Probability	1 Low (Unlikely) 2 Medium (as likely as not) 3 High (likely) 4 Certain	How likely is it that the change will happen

5.5.3 Significance of Impact

Having assessed the sensitivity of a receptor and change parameters set out in **Table 20 and 21** above, an estimation of the significance of the change by combining the parameters of change

with the sensitivity of the receptor was conducted using the following formulae; **SP (Significance points) = (Magnitude + Duration + Scale + Probability) x Sensitivity**.

Based on the result of the calculation (the significance point), the relative significance of the impact is classified as set out in **Table 23** below.

Table 23: Guidance to significance points

Significance points	Significance	Description
Between 48- 64	Major	The degree of impact that the project may have upon the environment and/or the community(s) is unacceptably high. It is unlikely that an impact of this magnitude can be satisfactorily mitigated. If this impact cannot be avoided, the project is unlikely to be permitted for development.
Between 32-47	Moderate	The degree of impact that the project may have upon the environment and/or the community(s) is high. The project may be compromised if this impact cannot be avoided or mitigated (i.e. to reduce the significance of the impact).
Between 16-31	Minor	The degree of impact that the project may have upon the environment and/or the community(s) is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.
<16	Negligible	No noticeable impact on the environment and/or the community(s). No mitigation is required.

The methodology chosen for this ESIA aims to provide a reasoned determination of significance, which demonstrates how the impacts have been assessed whether significant effect will occur, indicating how the scores are applied to different parameters to easily understand the rationale for the assessment based on the magnitude of the change, duration, scale and probability.

5.5.4 Mitigation and Enhancement Measures

Mitigation measures are identified through the ESIA process in order to reduce the level of adverse impact upon a receptor. The following hierarchy of mitigation measures is applied:

- Avoid and reduce impacts through design (embedded mitigation)
- Abate impacts at source or at receptor
- Repair, restore or reinstate to address temporary construction impacts
- Compensation for loss or damage

In addition to the above, community engagement and disclosure activities have played a key role in managing the extent of impacts and consideration has also been given to the identification of enhancement measures. Enhancement measures are actions and processes that:

- Create new positive impacts or benefits

- Increase the reach or number of positive impacts or benefits
- Distribute positive impacts or benefits more equitably

5.6 ESIA Study Area / Area of Influence

The project Area of Influence (AOI) is the area over which the impacts of the project are likely to be felt including all its related facilities such as the construction of access roads, as well as any reasonably foreseen unplanned developments induced by the project or cumulative impacts.

The project AOI is comprised of areas of direct impacts and indirect impacts which will inform the impact assessment.

- Direct area of influence: considers the physical footprint of the project such as the construction sites, work staging area and area affected during project works
- Indirect area of influence: includes the area which may experience project related changes in combination with activities not under the direct control of the project.

The project direct AOI often varies depending on the specific environmental or social aspect considered based on the extent an impact may be affected and can be influenced on a spatial and temporal level.

The temporal influence of the project has been assessed by comparing the existing baseline conditions (social, biodiversity, hydrological and other) with the change expected over time as a result of the project activities as listed below phases:

- Site preparation/Construction phase
- Operation phase
- Decommissioning phase

CHAPTER 6.0 ENVIRONMENTAL AND SOCIAL BASELINE CONDITION OF THE PROJECT AREA

6.1 Introduction

This section provides the baseline state of the environment covering biophysical, social, and economic prior to commencement of the project. The section is significant in undertaking the project's impact prediction and analysis. The proposed project traversed through 5 counties namely Narok, Bomet, Kericho, Nyamira and Kisumu.

6.2 Physical Environment

Taking of baseline conditions and measurements is essential to provide an understand existing environmental and social dynamics, predict and manage project impacts, comply with local and international legislations, enables monitoring the effectiveness of mitigation measures. Under this section physical conditions relating to Hydrology, Water Quality, Air Quality, Soil Quality are discussed.

6.2.1 Hydrology

6.2.1.1 Drainage

The Phase 2B SGR project corridor traverses' diverse drainage environments spanning Narok, Bomet, Kericho, and Kisumu counties. These counties are underlain by a range of hydrological systems that collectively discharge into Lake Victoria and the Ewaso Ngiro Basin. The upper sections in Narok and Bomet counties are characterized by steep escarpments, high rainfall, and well-defined river catchments, while Kericho presents rolling highlands dominated by intensive agriculture and perennial streams. As the corridor approaches Kisumu County, it enters low-lying floodplains and lake-influenced drainage systems, including the Nyando, Kibos, and Kisian basins. This variation in topography, climate, and land use gives rise to a complex drainage pattern along the alignment, influencing runoff generation, sediment transport, and flood risks that must be accounted for in both environmental and engineering planning.

The drainage areas intersected by the alignment are illustrated in **Figure 24** which provides a spatial overview of the catchments traversed by the project.

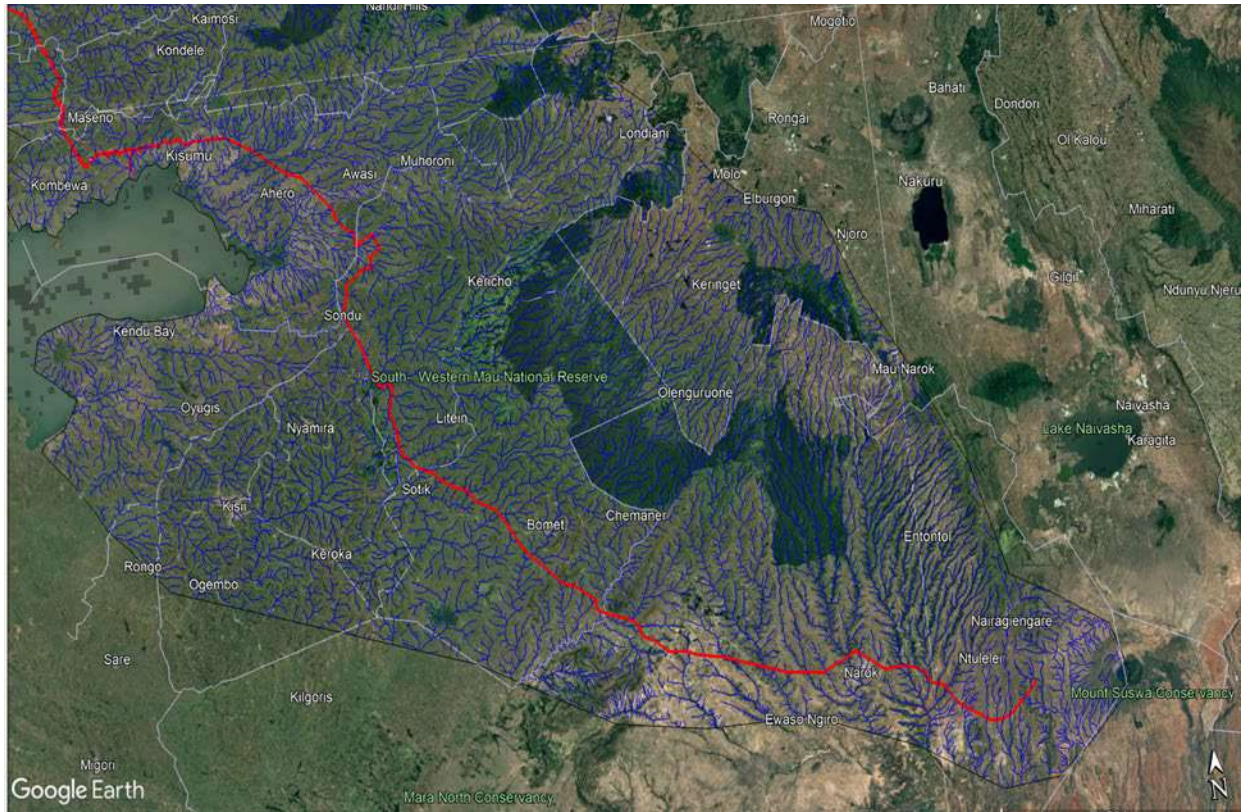


Figure 24: A map showing the project area and the broader hydrological catchment area

6.2.1.2 Topography/ Climate and Vegetation

Climate

The counties traversed by the Phase 2B SGR corridor experience varied climatic conditions influenced by altitude, topography, and proximity to the Rift Valley and Lake Victoria. Narok records moderate temperatures with mean annual rainfall ranging from about 500 mm in the lower plains to 1,800 mm in the highlands. Bomet experiences cooler conditions, with rainfall above 1,200 mm annually, supporting intensive farming. Kericho receives some of the highest rainfall in Kenya, typically between 1,800 mm and 2,200 mm per year, with cool, stable temperatures conducive to tea cultivation. Kisumu, within the Lake Victoria basin, has a tropical climate with 1,000–1,800 mm of rainfall annually, higher humidity, and warmer temperatures.

Topography

The corridor traverse's diverse terrain. Narok forms part of the Rift Valley system, with high escarpments, rolling grasslands, and low-lying plains. Bomet lies on a highland plateau dissected by rivers, creating undulating to steep landscapes. Kericho is defined by the elevated Mau escarpment, with rolling hills and valleys sloping westwards. In Kisumu, land descends into expansive low-lying plains and floodplains interspersed with scattered hills, characteristic of the Lake Victoria basin.

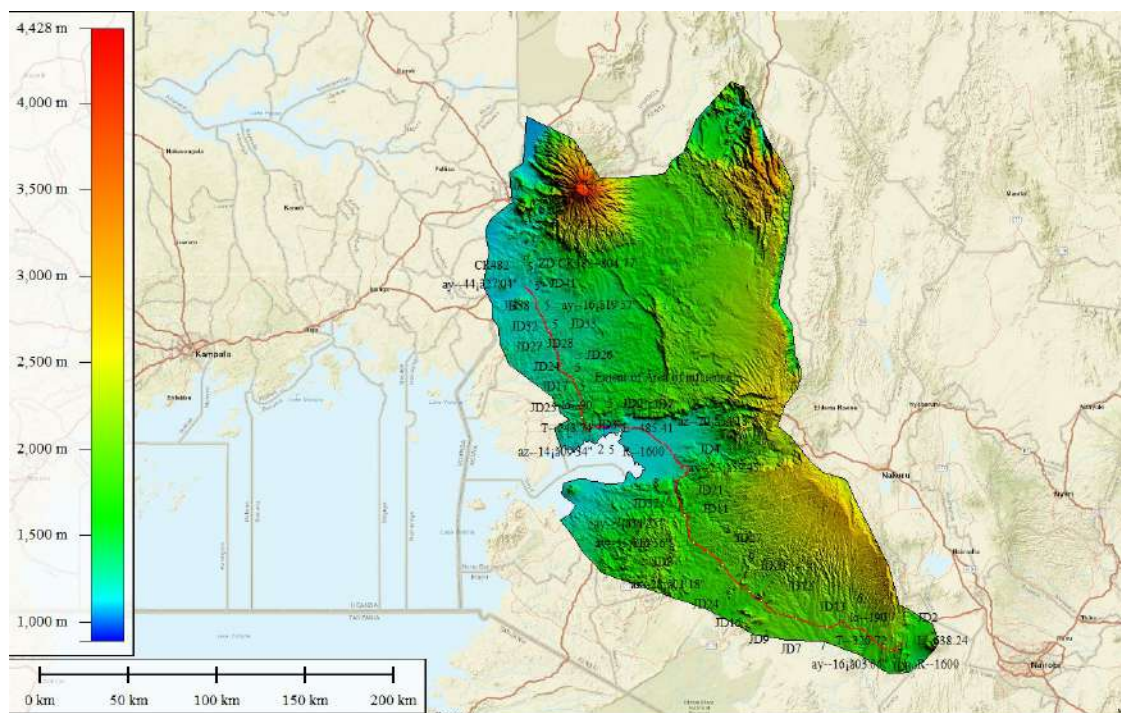


Figure 25: Delineation of Catchment's outer boundary based on topography.

Vegetation and Land use

Vegetation and land use patterns vary significantly across the alignment. Narok is dominated by savannah grasslands, acacia woodlands, and forest patches in higher elevations, with the Maasai Mara ecosystem supporting wildlife and pastoralism. Wheat, barley, and maize farming are expanding in its highlands. In Bomet, natural vegetation has largely been cleared for agriculture, with tea, maize, potatoes, and horticulture dominating alongside livestock keeping. Kericho is globally recognized for its extensive tea estates, complemented by subsistence and commercial maize, beans, and vegetables. The Mau Forest Complex, spanning into Kericho, remains an important ecological and hydrological resource. Kisumu's lowland environment is marked by papyrus swamps and wetlands along Lake Victoria, with sugarcane, maize, sorghum, cassava, and rice cultivation widespread in the floodplains. Woodland and grassland patches persist but are increasingly modified by settlement and farming.

6.2.1.3 Soils and Geology

Soils along the Narok–Bomet–Kericho–Kisumu corridor reflect underlying geology and topography, with drainage characteristics varying considerably. In Narok, upland soils derived from volcanic rocks are generally sandy loams and loamy soils, well-drained and suitable for cereals, while the lower plains are dominated by poorly drained black cotton soils (vertisols), which present construction challenges. Bomet's soils are mainly andosols and humic nitisols from volcanic ash and tuffs, deep and fertile with good drainage, supporting intensive farming. Kericho's soils are similarly volcanic in origin, dominated by humic nitisols and andosols, which are stable and well-drained, underpinning the extensive tea estates; however, shallow lithosols on steeper slopes are

erosion prone. Kisumu County features poorly drained vertisols in the lowlands, prone to swelling and shrinking, alongside alluvial soils in floodplains used for sugarcane and rice cultivation. Uplands and isolated hills carry ferralsols and sandy loams, which are moderately to well-drained and support mixed farming.

Surface and Subsurface Hydrology

The surface catchments influencing the railway alignment are primarily fed from the Mau Complex to the east, where high rainfall and steep terrain generate significant runoff. In contrast, the western sections of the corridor lie at lower elevations and contribute less directly to stormwater flows. Urban centers within the project area are expected to expand rapidly with improved connectivity from the SGR and regional roads. Increasing building density and commercial development will raise impervious surface cover, accelerating surface runoff and reducing natural infiltration. These changes, coupled with the transition from subsistence farming and light residential use to more intensive urban land use, underscore the need to account for heightened stormwater volumes in the hydrological assessment.

6.2.1.4 Catchments Characteristics

Catchment boundaries were delineated from contoured topographic maps generated using Google satellite imagery and DEM data. In flat terrain, where interpretation was less reliable, the boundaries were verified during field investigations. The catchment areas, shapes, and longest flow lengths were then established using AutoCAD, Global Mapper, and ArcGIS tools. These parameters are essential for hydrological design, as they directly influence runoff concentration, peak discharge estimation, and the sizing of drainage structures.

The Phase 2B railway corridor exhibits a predominantly uniform surface drainage pattern, largely controlled by the prevailing topography. Surface runoff flows mainly in a north-westerly direction, from the right-hand side (RHS) to the left-hand side (LHS) of the proposed rail alignment. The alignment traverses two major hydrological systems: the Ewaso Ngiro River Catchment and the Lake Victoria Basin. The latter comprises five principal rivers, (Mara, Sondu-Miriu, Nyando, Kibos, and Kisian), all of which drain into Lake Victoria. In addition to these major basins, the proposed railway intercepts several smaller sub-catchments that act as tributaries feeding into these larger river systems. These sub-catchments play a critical role in influencing local runoff, sediment transfer, and flood dynamics along the corridor, underscoring the need for careful hydrological considerations in the design and planning of the railway infrastructure.

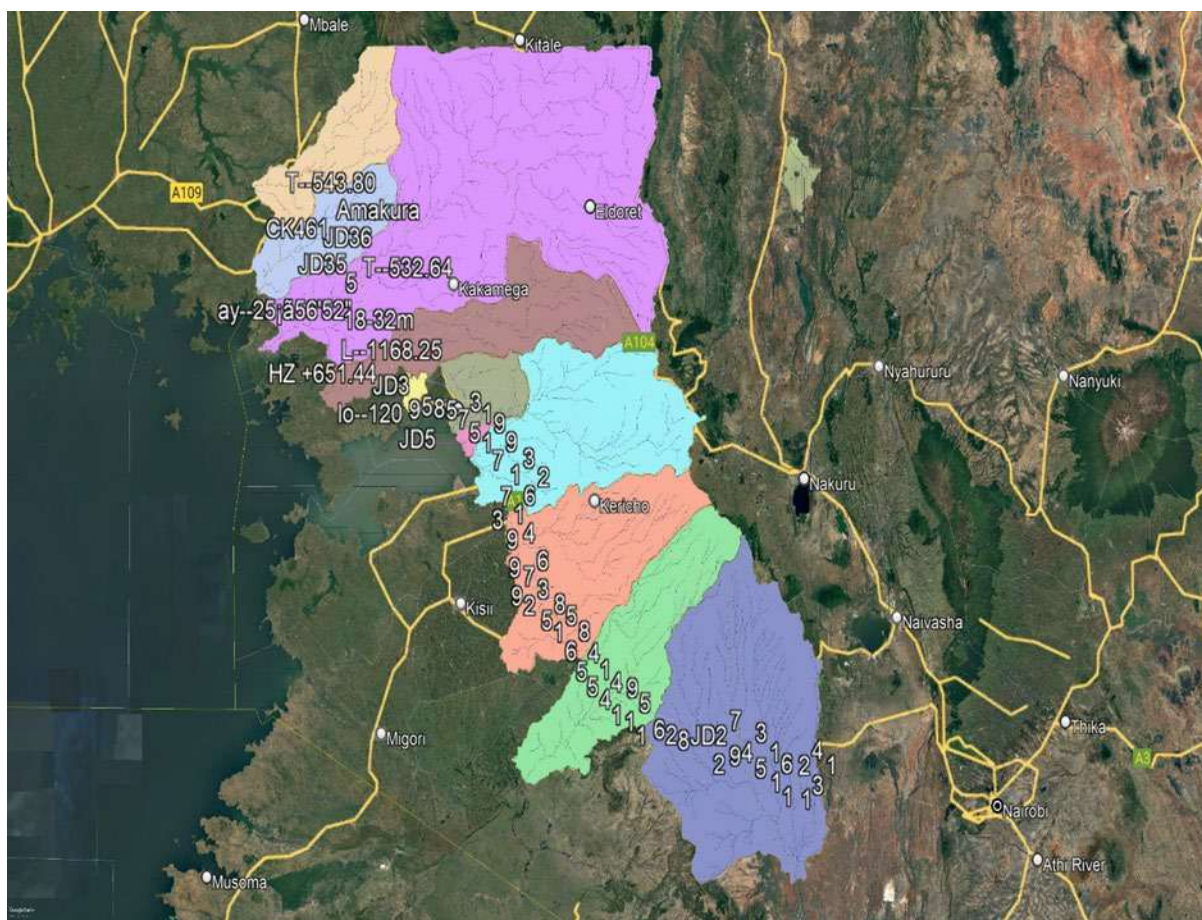


Figure 26: Major catchments the proposed rail is traversing: From Right to left, Ewaso Ngiro River, Mara River, Sondu River, Nyando River, Kibos River, Kisian River, Yala River, Nzoia River, Sio River and lastly the Malaba River Catchment.

Table 24 below outlines the hydrological characteristics of the entire catchments along the SGR Phase 2B corridor.

Table 24: Major Catchments

Catchment / Topic	Key Characteristics	Hydrology	Ecology & Socio-Economic Importance	Key Issues / Pressures
Ewaso Ngiro River Catchment	• Headwaters: Aberdare Range & Mt. Kenya western slopes • Flows through Laikipia → Samburu	• Perennial upstream; highly seasonal downstream	• Supports montane forests, acacia–commiphora bushlands, riverine ecosystems	• Heavy upstream abstraction causing conflicts • Headwater degradation → soil erosion & erratic flows • Frequent/prolonged

Catchment / Topic	Key Characteristics	Hydrology	Ecology & Socio-Economic Importance	Key Issues / Pressures
	→ Isiolo → Garissa → Lorian Swamp Highly diverse topography from montane forests to ASAL plains	- Influenced by bimodal rainfall - Flows often vanish into sandy beds in dry periods	- Lifeline for Samburu, Buffalo Springs & Shaba reserves (Grevy's zebra, reticulated giraffe, gerenuk) - Irrigation for large-scale horticulture upstream - Critical for pastoralism & tourism economy downstream	droughts increasing ecological & livelihood stress
Mara River Catchment	- Origin: Mau Forest - Transboundary (Kenya–Tanzania) - Flows through Narok into Serengeti → Lake Victoria - Upper: steep escarpments; lower: savanna grasslands	- Perennial but increasingly erratic - Seasonal floods & high sediment loads	- Supports Maasai Mara–Serengeti ecosystem & wildebeest migration - Tourism, pastoralism & wheat farming	- Mau Forest degradation (logging, settlement, charcoal burning) - Sedimentation & pollution from farms and lodges
Sondu-Miriu River Catchment	3,470 km² - Origin: Mau Escarpment → Bomet, Kericho, Kisumu → Winam Gulf - Steep profile with gorges & waterfalls	- Perennial; powered by high rainfall in Kericho highlands - Hosts Sondu-Miriu & Sang'oro hydropower	- Major hydropower corridor - Supports tea estates, smallholder farming, fishing communities	- Agrochemical runoff - Severe erosion on steep slopes - Altered flows from hydropower affecting downstream ecosystems

Catchment / Topic	Key Characteristics	Hydrology	Ecology & Socio-Economic Importance	Key Issues / Pressures
Nyando River Catchment	• 3,550 km² • Origin: Tinderet Forest → Nandi Escarpment → Kano Plains → Lake Victoria • Mix of steep highlands & low floodplains	• Highly seasonal • Severe, recurrent flooding (Ahero Floodplain) • Very high sediment loads	• Supports sugarcane, rice, maize, and livestock in Kano Plains	• Upland deforestation • Heavy erosion → sedimentation of Winam Gulf • Flood displacement & crop losses
Kibos River Catchment	• Smaller system in Kisumu County • Origin: Nandi Hills → Kibos industrial hub → Lake Victoria	• Perennial but heavily modified by abstraction, effluents & urbanization	• Supports sugarcane cultivation & Kisumu industries (incl. Kibos Sugar)	• Severe pollution (industrial effluent, sewage, agricultural runoff) • Eutrophication & habitat loss • Flood–pollution interactions in Kano Plains
Kisian River Catchment	• Small peri-urban catchment west of Kisumu • Gently sloping terrain → lakeshore	• Rainfall-driven flow; influenced by urban runoff	• Supports horticulture supplying Kisumu • Key sand harvesting area for construction	• Unregulated sand harvesting → channel instability • Pollution from waste dumping & wastewater • Urban expansion pressures

Source-Hydrological Report

6.2.2 Baseline Air Quality

Baseline air quality assessment was undertaken in accordance with Environmental Management and Co-ordination (Air Quality) Regulations, 2024. Air quality measurements were undertaken between 1st and 8th August 2025. (See Annex 1 – Air Quality Report)

The objectives of baseline air quality measurements include;

- Establish Baseline Air Quality Levels: Document existing concentrations of key air pollutants (e.g., PM_{2.5}, PM₁₀, NO₂, SO₂, CO, and O₃) in the project area prior to the proposed development.

- **Support Environmental and Social Impact Assessment (EIA):** Provide scientifically credible data to evaluate how the project may influence local and regional air quality.
- **Identify Sensitive Receptors:** Determine the presence and proximity of communities, schools, hospitals, and ecological zones that may be affected by changes in air quality.
- **Inform Mitigation Measures:** Guide the development of targeted air pollution control and mitigation strategies during construction and operation phases.
- **Ensure Compliance with Regulations:** Ensure that the project adheres to national and international air quality standards and guidelines including EMCA (Air Quality) Regulations, 2024.
- **Enable Long-Term Monitoring:** Establish a reference point for future air quality monitoring to track changes and verify the effectiveness of implemented mitigation measures.

Table 25 below shows the different areas where the air samples were collected from.

Table 25: Sampling Locations

Id	Location Description	Coordinates		Pollutants Monitored	Altitude
		Longitude	Latitude		
SP 1	Narok Railway Station	1° 4'8.71"S	35°53'10.21"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1945
SP 2	Ewaso Passing Station	1° 3'43.47"S	35°42'27.65"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1924
SP 3	Olgilai Village Passing Station	1° 2'10.53"S	35°38'11.06"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1999
SP 4	Masandare Passing Station	1° 2'10.45"S	35°38'9.56"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1935
SP 5	Olo Birik (Narok West)	1° 0'48.84"S	35°32'29.45"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1985
SP 6	Chemager (Mulot station)	0°56'49.78"S	35°27'21.44"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1874
SP 7	Kiplabotwa Passing Station	0°54'0.20"S	35°23'50.63"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1866
SP 8	Bomet Railway Station (Kipsegon)	0°50'14.57"S	35°18'59.08"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1904
SP 9	Kagawet Primary School	0°47'22.76"S	35°16'41.52"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1910
SP 10	Wareki Passing Station	0°45'53.02"S	35°15'55.68"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1882
SP 11	Kamoronga Passing Station	0°41'55.53"S	35°11'14.16"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1888
SP 12	Chepininy Commercial Hub	0°39'16.99"S	35° 7'12.24"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1812
SP 13	Siritiet Station	0°34'22.74"S	35° 5'10.00"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1715
SP 14	Ngoina Plantation	0°30'57.19"S	35° 4'6.35"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1642
SP 15	Sondu Railway Station	0°24'21.46"S	35° 1'27.04"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1533
SP 16	Chemokit Passing Station	0°19'34.50"S	35° 3'3.71"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1423
SP 17	Kapsorok Industrial Park	0°16'18.40"S	35° 4'5.42"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1296
SP 18	Waradho Village Station	0°12'16.26"S	35° 0'36.68"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1162
SP 19	Awasi Station (Konim)	0° 9'4.12"S	34°57'31.78"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1154
SP 20	Obumba Passing Station/Obuma Primary & Secondary School	0° 5'42.09"S	34°52'42.29"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1141
SP 21	Kibos	0° 4'14.91"S	34°48'55.26"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1153

Id	Location Description	Coordinates		Pollutants Monitored	Altitude
		Longitude	Latitude		
SP 22	Kusule (Kisumu Terminus)	0° 4'15.70"S	34°47'41.50"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1154
SP 23	Korando ICD 2	0° 4'7.48"S	34°41'12.65"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1166
SP 24	Korando ICD 1	0° 4'15.35"S	34°41'55.71"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1159
SP 25	Usare Primary & Secondary School	0° 6'7.29"S	34°39'51.33"E	PM ₁₀ and PM _{2.5} , NO ₂ , TVOC & CO ₂	1127

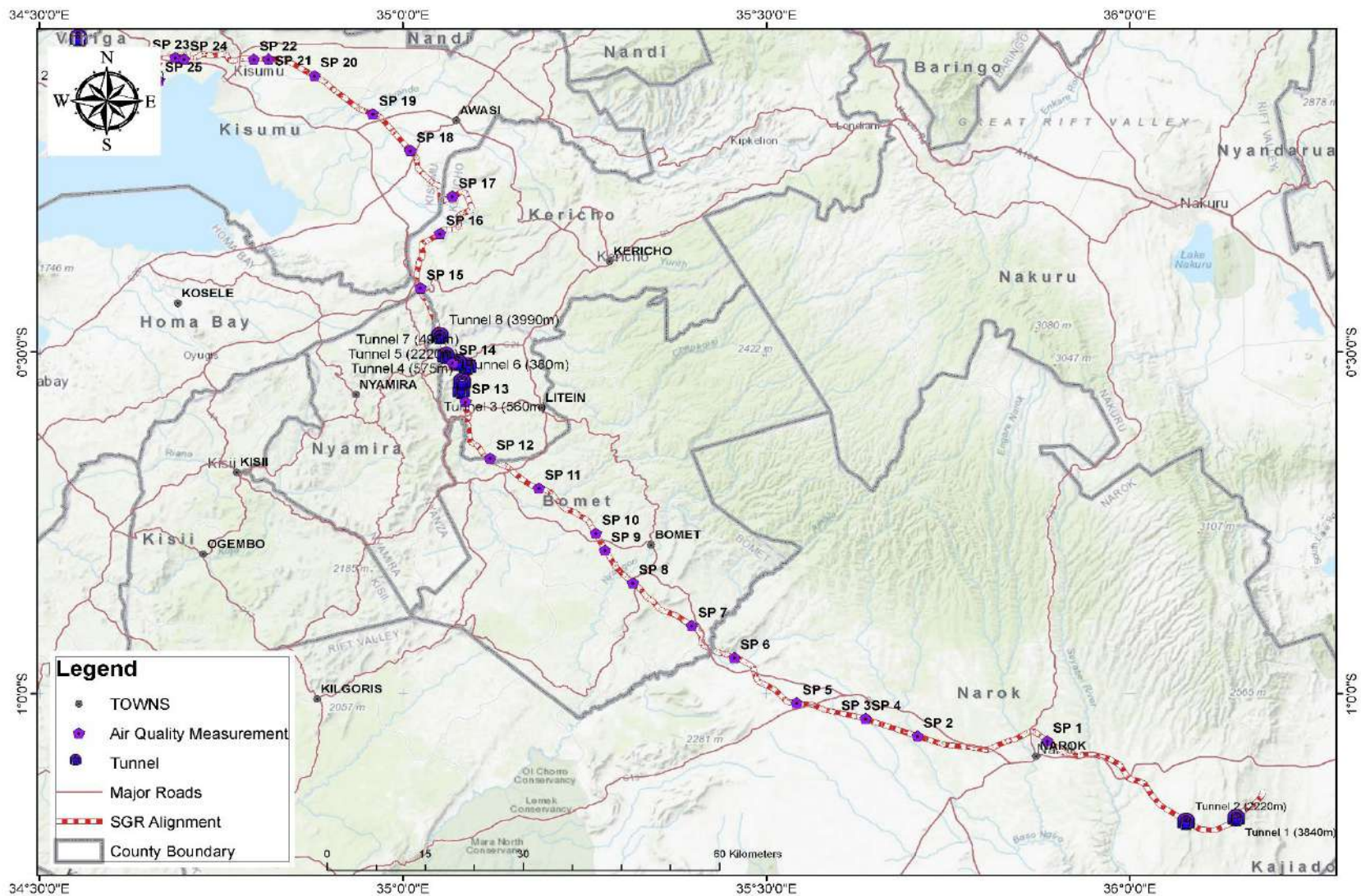


Figure 27: Mapped areas where air samples were collected

6.2.2.1 Inhalable and Respirable Particulate Matter Results

Inhalable particulate matter (PM₁₀) from all assessed areas ranged between 15.0-92.5 µg/m³ with Proposed Kamoronga Passing Station and Proposed Korando ICD 1 having the lowest and highest concentrations respectively. Similarly, respirable particulate matter (PM_{2.5}) concentration ranged between 5.6-35.3µg/m³ with Proposed Narok Railway Station and Proposed Korando ICD 1 having the lowest and highest concentrations respectively. A summary of the results is presented on **Table 26** below.

Logger results for some areas are also as presented on the figures below. From the results, it is evident that all sampling locations had their inhalable and respirable particulate matter results within EMC, 2014 Tolerance Limit.

Table 26: Respirable and Inhalable Particulate Matter Results

ID	Location	PM ₁₀ Results (µg/m ³)	PM ₁₀ Tolerance Limit (µg/m ³)	PM _{2.5} Results (µg/m ³)	PM _{2.5} Tolerance Limit (µg/m ³)
SP 1	Narok Railway Station	19.1	100.0	5.6	75.0
SP 2	Ewaso Passing Station	22.2		5.7	
SP 3	Olgilai Village Passing Station	22.8		6.9	
SP 4	Masandare Passing Station	31.3		11.0	
SP 5	Olo Birik (Narok West)	30.0		7.9	
SP 6	Chemager (Mulot station)	22.4		7.8	
SP 7	Kiplabotwa Passing Station	25.5		8.7	
SP 8	Bomet Railway Station (Kipsegon)	24.4		9.7	
SP 9	Kagawet Primary School	25.2		9.5	
SP 10	Wareki Passing Station	22.6		9.7	
SP 11	Kamoronga Passing Station	15.0		7.0	

ID	Location	PM ₁₀ Results (µg/m ³)	PM ₁₀ Tolerance Limit (µg/m ³)	PM _{2.5} Results (µg/m ³)	PM _{2.5} Tolerance Limit (µg/m ³)
SP 12	Chepininy Commercial Hub	21.7		9.7	
SP 13	Siritiet Station	26.4		13.4	
SP 14	Ngoina Plantation	19.6		8.2	
SP 15	Sondu Railway Station	22.0		9.0	
SP 16	Chemokit Passing Station	20.0		8.0	
SP 17	Kapsorok Industrial Park	21.5		8.2	
SP 18	Waradho Village Station	27.0		12.0	
SP 19	Awasi Station (Konim)	21.2		7.9	
SP 20	Obumba Passing Station	40.4		18.8	
SP 21	Kibos	39.0		18.0	
SP 22	Kusule (Kisumu Terminus)	56.0		34.0	
SP 23	Korando ICD 2	40.7		19.9	
SP 24	Korando ICD 1	92.5		35.3	
SP 25	Usare Primary & Secondary School	51.5		26.6	

6.2.2.2 Carbon dioxide

From the monitoring, carbon dioxide concentration ranged between **330.6 - 417.7 mg/m³** with the Proposed Olo Birik (Narok West) and the Usare Primary and Secondary School having the lowest and highest concentrations respectively. A summary of the results is as presented in **Table 27** below. Logger results for some locations assessed are as shown in figures below. From the results, it is evident that carbon dioxide concentrations were above EMC Tolerance Limit. This is however characteristic of most areas in the country especially along highways.

Table 27: Carbon dioxide results

ID	Location	Carbon Dioxide Results (mg/m ³)	Carbon Dioxide Tolerance Limit (mg/m ³)
SP 1	Narok Railway Station	338.0	4.0
SP 2	Ewaso Passing Station	344.3	
SP 3	Olgilai Village Passing Station	337.5	
SP 4	Masandare Passing Station	340.6	
SP 5	Olo Birik (Narok West)	330.6	
SP 6	Chemager (Mulot station)	341.8	
SP 7	Kiplabotwa Passing Station	349.7	
SP 8	Bomet Railway Station (Kipsegon)	337.5	
SP 9	Kagawet Primary School	341.9	
SP 10	Wareki Passing Station	350.4	
SP 11	Kamoronga Passing Station	370.0	
SP 12	Chepinyiny Commercial Hub	348.4	
SP 13	Siritiet Station	355.8	
SP 14	Ngoina Plantation Passing Station	383.8	
SP 15	Sondu Railway Station	401.9	
SP 16	Chemokit Passing Station	380.0	
SP 17	Kapsorok Industrial Park	372.5	
SP 18	Waradho Village Station	405.0	
SP 19	Awasi Station (Konim)	376.5	
SP 20	Obumba Passing Station	366.7	
SP 21	Kibos	375.0	
SP 22	Kusule (Kisumu Terminus)	401.0	
SP 23	Korando ICD 2	392.2	

ID	Location	Carbon Dioxide Results (mg/m ³)	Carbon Dioxide Tolerance Limit (mg/m ³)
SP 24	Korando ICD 1	402.7	
SP 25	Usare Primary & Secondary School	417.7	

6.2.2.3 Nitrogen Dioxide Results

Nitrogen dioxide results from the assessed areas ranged between **0.0-55.0 µg/m³**. proposed Ewaso, Masandare, Obumba Passing Station, Kapsorok Industrial Park and Korando ICD 2 averaged the least nitrogen dioxide (0.0 µg/m³) while the proposed Kamoronga Passing Station averaged the highest (**55.0 µg/m³**). The results are as presented on **Table 28** below with logger results of some locations assessed also presented in the figures below. It is evident from the results that nitrogen dioxide concentrations in all locations assessed were within EMC, 2024 Tolerance Limit.

Table 28: Nitrogen Dioxide results

Location	Nitrogen Dioxide Results (µg/m ³)	Nitrogen Dioxide Tolerance Limit (µg/m ³)
Narok Railway Station	48.0	410.00
Ewaso Passing Station	0.0	
Olgilai Village Passing Station	24.0	
Masandare Passing Station	0.0	
Olo Birik (Narok West)	3.0	
Chemager (Mulot station)	42.0	
Kiplabotwa Passing Station	14.1	
Bomet Railway Station (Kipsegon)	33.2	
Kagawet Primary School	14.7	
Wareki Passing Station	0.4	
Kamoronga Passing Station	55.0	
Chepinyiny Commercial Hub	37.0	
Siritiet Station	2.0	
Ngoina Plantation Passing Station	1.3	

Location	Nitrogen Dioxide Results ($\mu\text{g}/\text{m}^3$)	Nitrogen Dioxide Tolerance Limit ($\mu\text{g}/\text{m}^3$)
Sondu Railway Station	8.5	
Chemokit Passing Station	2.1	
Kapsorok Industrial Park	0.0	
Waradho Village Station	2.0	
Awasi Station (Konim)	0.4	
Obumba Passing Station	0.0	
Kibos	0.0	
Kusule (Kisumu Terminus)	3.0	
Korando ICD 2	0.0	
Korando ICD 1	37.8	
Usare Primary & Secondary School	7.6	

6.2.2.4 Total Volatile Organic Compounds Results

Total volatile organic compounds in the assessed areas ranged between **217.1-365.0 $\mu\text{g}/\text{m}^3$** with the Proposed Ngoina Estate Plantation Passing Station and the Usare Primary and Secondary School having the highest and lowest concentrations respectively. A summary of the results is as presented on **Table 29** below with logger results for some locations assessed also presented below. It is evident from the results that Total Volatile Organic Compound concentrations in all locations assessed were within EMC, 2024 Tolerance Limit of 600 $\mu\text{g}/\text{m}^3$.

Table 29: Total Volatile Organic Compounds Results

Location	TVOC Results ($\mu\text{g}/\text{m}^3$)	TVOC Tolerance Limit ($\mu\text{g}/\text{m}^3$)
Narok Railway Station	280.0	600.00
Ewaso Passing Station	320.0	
Olgilai Village Passing Station	310.0	
Masandare Passing Station	270.0	
Olo Birik (Narok West)	270.0	
Chemager (Mulot station)	289.4	

Location	TVOC Results ($\mu\text{g}/\text{m}^3$)	TVOC Tolerance Limit ($\mu\text{g}/\text{m}^3$)
Kiplabotwa Passing Station	218.6	
Bomet Railway Station (Kipsegon)	289.3	
Kagawet Primary School	280.0	
Wareki Passing Station	252.5	
Kamoronga Passing Station	330.0	
Chepinyiny Commercial Hub	290.0	
Siritiet Station	291.5	
Ngoina Plantation Passing Station	365.0	
Sondu Railway Station	330.6	
Chemokit Passing Station	280.0	
Kapsorok Industrial Park	265.0	
Waradho Village Station	270.0	
Awasi Station (Konim)	264.4	
Obumba Passing Station	226.7	
Kibos	230.0	
Kusule (Kisumu Terminus)	260.0	
Korando ICD 2	270.0	
Korando ICD 1	269.2	
Usare Primary & Secondary School	217.1	

6.2.2.5 Discussions

Twenty-five sampling locations were identified whereby measurement was carried out to assess for nitrogen dioxide, Inhalable Particulate Matter (PM_{10}), Respirable Particulate Matter ($\text{PM}_{2.5}$), total volatile organic compounds and carbon dioxide concentration in air. Based on the monitoring, below is a summary;

- Inhalable particulate matter (PM_{10}) ranged between 15.0-92.5 $\mu\text{g}/\text{m}^3$;
- Respirable particulate matter ($\text{PM}_{2.5}$) concentration ranged between 5.6-35.3 $\mu\text{g}/\text{m}^3$;
- Carbon dioxide concentration ranged between 330.6-417.7 mg/m^3 ;

- Nitrogen dioxide results ranged between 0.0-55.0 $\mu\text{g}/\text{m}^3$; and
- Total volatile organic compounds concentration ranged between 217.1-365.0 $\mu\text{g}/\text{m}^3$.

It is, therefore, evident from the results that inhalable and respirable particulate matter, total volatile organic compounds and nitrogen dioxide concentration from all sampling locations were within Environmental Management and Coordination (Air Quality) Regulations, 2024 tolerance limits. Carbon dioxide concentrations in all the locations were above EMC, 2024 Tolerance Limit. This is however characteristic of most areas, especially along roads.

The proposed project will involve excavation activities, concrete works, and the use of various machinery. Consequently, it is anticipated that pollutant levels may increase if adequate control measures are not implemented throughout all phases of the project. To mitigate these impacts, the following measures are recommended:

- Implement dust suppression measures, particularly during dry seasons, in all earth-moving operations.
- Ensure vehicles transporting dry soil materials are properly covered.
- Regularly sprinkle water on earth roads used as transit routes during dry seasons.
- Conduct all material batching operations in designated areas.
- Ensure timely servicing and maintenance of all machinery used in the project.
- Provide continuous training to all workers on air pollution control measures.
- Ensure timely servicing and maintenance of all locomotives used in the project.
- Undertake annual ambient air quality monitoring in compliance with the Environmental Management and Coordination (Air Quality) Regulations, 2024.

6.2.3 Noise Measurements

Baseline ambient noise and ground vibration assessment was undertaken between 1st to 8th August 2025 in accordance with Environmental Management and Coordination (EMC) (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61. The Noise assessment report is annexed.

The objectives of noise and vibration measurements include:

- Assess current environmental conditions: Document existing ambient noise and vibration levels to understand the pre-project acoustic and vibrational environment.
- Support Environmental and Social Impact Assessment (ESIA): Provide essential data for evaluating the potential impacts of construction and operational phases on nearby communities and sensitive receptors.
- Inform mitigation strategies: Aid in the development of effective noise and vibration mitigation measures by identifying high-risk zones and sensitive areas.

- Ensure regulatory compliance: Ensure adherence to national and international environmental standards and guidelines regarding noise and vibration including EMCA (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 and international guidelines
- Enable future monitoring and comparison: Establish a baseline for future monitoring, allowing for the assessment of actual project impacts during and after construction by comparison with baseline data.

Permissible noise limits as provided by the First Schedule of EMC (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 are as presented in **Table 30** below.

Table 30: Noise and Excessive Vibrations Pollution Regulations

Zone		Sound Level Limits dB(A)		Noise Rating Level (NR)	
		Day	Night	Day	Night
A.	Silent Zone	40	35	30	25
B.	Places of worship	40	35	30	25
C.	Residential: Indoor	45	35	35	25
	Residential: Outdoor	50	35	40	25
D.	Mixed residential (with some commercial and places of entertainment)	55	35	50	25
E.	Commercial	60	35	55	25

EMCA (Noise and Excessive Vibration Pollution (Control) Regulations, 2009 (Legal Notice No. 61) further is aimed at ensuring vibration levels from a facility does not exceed stipulated limits. Regulations 4 stipulates that exceed vibration levels does not exceed 0.5 cm/second (cm/s) or 5.000 mm/s beyond any source property boundary or 30 metres from any moving source.

6.2.3.1 Site Location and Sampling Locations

The proposed SGR project is situated within Narok, Bomet, Kericho, Nyamira and Kisumu counties. The proposed project alignment main land uses include agricultural, residential and commercial. Among key areas of interest proposed in the project include the proposed, railway stations, passing stations and industrial parks/commercial hubs. These were the key areas of interest for this assessment whereby measurements were carried.

Table 31 and **Figure 28** below presents a summary of all sampling locations.

Table 31: Noise and Ground Vibration Measurements Locations

Id	Location Description	Coordinates		Monitored Parameters	Altitude
		Longitude	Latitude		
SP 1	Narok Railway Station	1° 4'8.71"S	35°53'10.21"E	Noise & Ground Vibration	1945
SP 2	Duka Moja/Nairasirasa Passing Station	1° 4'47.15"S	35°47'21.90"E	Noise & Ground Vibration	1960
SP 3	Olgilai Village Passing Station	1° 2'10.53"S	35°38'11.06"E	Noise & Ground Vibration	1999
SP 4	Masandare Passing Station	1° 2'10.45"S	35°38'9.56"E	Noise & Ground Vibration	1935
SP 5	Olo Birik (Narok West)	1° 0'48.84"S	35°32'29.45"E	Noise & Ground Vibration	1985
SP 6	Chemager (Mulot station)	0°56'49.78"S	35°27'21.44"E	Noise & Ground Vibration	1874
SP 7	Kiplabotwa Passing Station	0°54'0.20"S	35°23'50.63"E	Noise & Ground Vibration	1866
SP 8	Bomet Railway Station (Kipsegon)	0°50'14.57"S	35°18'59.08"E	Noise & Ground Vibration	1904
SP 9	Kagawet Primary School	0°47'22.76"S	35°16'41.52"E	Noise & Ground Vibration	1910
SP 10	Wareki Passing Station	0°45'53.02"S	35°15'55.68"E	Noise & Ground Vibration	1882
SP 11	Kamoronga Passing Station	0°41'55.53"S	35°11'14.16"E	Noise & Ground Vibration	1888
SP 12	Chepinyiny Commercial Hub	0°39'16.99"S	35° 7'12.24"E	Noise & Ground Vibration	1812
SP 13	Siritiet Station	0°34'22.74"S	35° 5'10.00"E	Noise & Ground Vibration	1715
SP 14	Ngoina Plantation	0°30'57.19"S	35° 4'6.35"E	Noise & Ground Vibration	1642
SP 15	Sondu Railway Station	0°24'21.46"S	35° 1'27.04"E	Noise & Ground Vibration	1533
SP 16	Chemokit Passing Station	0°19'34.50"S	35° 3'3.71"E	Noise & Ground Vibration	1423
SP 17	Kapsorok Industrial Park	0°16'18.40"S	35° 4'5.42"E	Noise & Ground Vibration	1296
SP 18	Waradho Village Station	0°12'16.26"S	35° 0'36.68"E	Noise & Ground Vibration	1162
SP 19	Awasi Station (Konim)	0° 9'4.12"S	34°57'31.78"E	Noise & Ground Vibration	1154
SP 20	Obumba Passing Station/Obuma Primary & Secondary School	0° 5'42.09"S	34°52'42.29"E	Noise & Ground Vibration	1141
SP 21	Kibos	0° 4'14.91"S	34°48'55.26"E	Noise & Ground Vibration	1153

Id	Location Description	Coordinates		Monitored Parameters	Altitude
		Longitude	Latitude		
SP 22	Kusule (Kisumu Terminus)	0° 4'15.70"S	34°47'41.50"E	Noise & Ground Vibration	1154
SP 23	Korando ICD 2	0° 4'7.48"S	34°41'12.65"E	Noise & Ground Vibration	1166
SP 24	Korando ICD 1	0° 4'15.35"S	34°41'55.71"E	Noise & Ground Vibration	1159
SP 25	Usare Primary & Secondary School	0° 6'7.29"S	34°39'51.33"E	Noise & Ground Vibration	1127

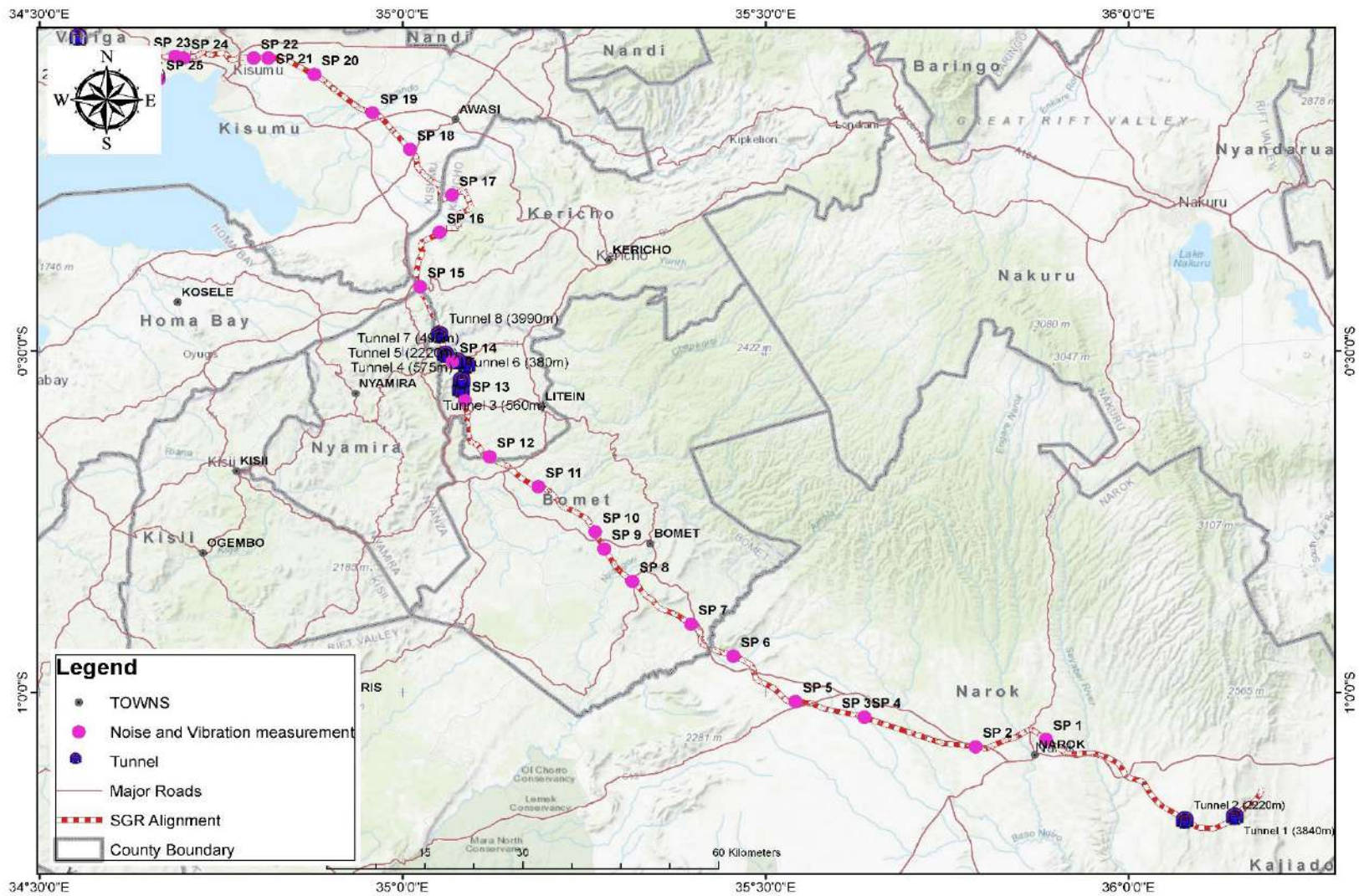


Figure 28: Location of Noise and vibration mapped areas

6.2.3.2 Baseline Noise Measurement Results

The measurement results are expressed as follows:

- L_{eq} : Value of A-weighted sound pressure level of a continuous steady sound that, within a specified interval, has the same mean square sound pressure as a sound under consideration whose level varies with time.
- L_{10} : Value is the level just exceeded for 10% of the time.
- L_{50} : Value is the level just exceeded for 50% of the time.
- L_{90} : Value is the level just exceeded for 90% of the time (Background noise).

Baseline environmental noise equivalent noise results from all the sampling locations ranged between 41.7-55.5 dB(A) with Ngoina Plantation and Kamoronga Passing Station having the lowest and highest noise levels respectively. Similarly, background noise (L_{90}) levels result from all the measurement locations ranged between 30.5-47.4 dB(A) with the Proposed Olo Birik (Narok West) Passing Station and Kibos area having the lowest and highest noise levels respectively. A summary of the noise measurement results is provided on **Table 32** below.

From the results shown in the table below, it is evident that most sampling locations had their noise levels within EMC, WHO and IFC recommended limits. However, the proposed Ewaso Passing Station, Proposed Masandare Passing Station, Kagawet Primary School, Proposed Kamoronga Passing Station, Proposed Sondu Railway Station, Obumba Passing Station/ Obumba Primary & Secondary School, Kibos, Kasule (Kisumu Terminus), Korado ICD 1 and Usare Primary & Secondary School had their noise levels above the EMC limit. High noise levels in these were intermitted and can be attributed to traffic mainly to traffic movement as most of the areas along allocated along roads. However, background noise levels in all the areas assessed were within EMC Limit

Table 32: Noise measurement results

Location	L _{eq} (dBA)	EMC Limit (dBA)	L ₁₀ (dB)	L ₅₀ (dB)	L ₉₀ (dB)
Narok Railway Station	48.7	50.0	44.2	36.6	31.2
Duka Moja/Nairasirasa Passing Station	51.5		52.9	45.7	38.5
Olgilai Village Passing Station	48.7		50.9	46.0	41.7
Masandare Passing Station	50.2		49.0	41.8	36.4
Olo Birik (Narok West) Passing Station	45.7		42.7	35.1	30.5
Chemager (Mulot Station)	43.9		43.8	38.6	35.4
Kiplabotwa Passing Station	42.9		45.1	37.4	33.8
Bomet Railway Station (Kipsegon)	48.7		46.7	40.6	37.3
Kagawet Primary School	50.2		52.1	43.8	38.2
Wareki Passing Station	48.3		48.1	43.6	40.7
Kamoronga Passing Station	55.5		54.4	42.5	37.7
Chepinyiny Commercial Hub	49.8		51.8	43.2	38.4
Siritiet Station	49.4		50.8	42.5	38.3
Ngoina Plantation	41.7		41.9	36.7	34.2
Sondu Railway Station	51.5		51.2	44.3	40.5
Chemokit Passing Station	43.6		44.1	37.2	31.2
Kapsorok Industrial Park	47.4		49.1	38.2	33.7
Waradho Village Station	42.1		45.9	37.5	32.9

Location	L _{eq} (dBA)	EMC Limit (dBA)	L ₁₀ (dB)	L ₅₀ (dB)	L ₉₀ (dB)
Awasi Station (Konim)	48.7		44.4	36.9	31.4
Obumba Passing Station/ Obumba Primary & Secondary School	51.6		47.2	38.9	35.8
Kibos	54.3		57.4	51.2	47.4
Kasule (Kisumu Terminus)	50.7		51.2	42.7	39.8
Proposed Korando ICD 1	51.1		47.7	39.7	36.1
Proposed Korando ICD 2	47.4		50.3	44.2	40.5
Usare Primary & Secondary School	50.1		51.2	44.6	41.0
Key:		Above EMC Limit			
		Within EMC Limit			

6.2.3.3 Ground Vibration Measurement Results

Based on the assessment, ground vibration; Peak Particle Velocity (PPV) results from all sampling locations ranged between 0.065-1.040mm/s as shown on **Table 33** below. Proposed Sondu Railway Station and Chepinyiny Commercial Hub had the lowest and highest vibration levels respectively. All the locations assessed had their peak particle velocity results within EMC Limit of 5.000mm/s.

Table 33: Ground Vibration Measurement Results

Location Description	PPV Results (mm/s)	Threshold Limit (in mm/s)
Narok Railway Station	0.612	5.000
Ewaso Passing Station	0.654	
Olgilai Village Passing Station	0.828	
Masandare Passing Station	0.591	
Olo Birik (Narok West)	0.236	
Chemager (Mulot station)	0.694	
Kiplabotwa Passing Station	0.733	
Bomet Railway Station (Kipsegon)	0.765	
Kagawet Primary School	0.804	
Wareki Passing Station	0.158	
Kamoronga Passing Station	0.378	
Chepinyiny Commercial Hub	1.040	
Siritiet Station	0.512	
Ngoina Plantation	0.481	
Sondu Railway Station	0.065	
Chemokit Passing Station	0.497	
Kapsorok Industrial Park	0.504	
Waradho Village Station	0.449	
Awasi Station (Konim)	0.631	

Location Description	PPV Results (mm/s)	Threshold Limit (in mm/s)
Obumba Passing Station/Obuma Primary & Secondary School	0.701	
Kibos	0.922	
Kusule (Kisumu Terminus)	0.843	
Proposed Korando ICD 1	0.473	
Proposed Korando ICD 2	0.583	
Usare Primary & Secondary)	0.158	

6.2.3.4 Discussion of the Results

Sixteen sampling locations were identified whereby baseline noise and ground vibration measurements were undertaken.

Based on the measurements, baseline environmental noise equivalent noise results from all the sampling locations ranged between 41.7-55.5 dB(A). Background noise (L_{90}) levels result from all the measurement locations, on the other hand, ranged between 30.5-47.4 dB(A). the proposed Duka Moja/Nairasirasa Passing Station, Proposed Masandare Passing Station, Kagawet Primary School, Proposed Kamoronga Passing Station, Proposed Sondu Railway Station, Obumba Passing Station/Obumba Primary & Secondary School, Kibos, Kasule (Kisumu Terminus), Korado ICD 1 and Usare Primary & Secondary School had their noise levels above the EMC limit. However, background noise levels from all the areas assessed were within EMC Limit.

Additionally, ground vibration; Peak Particle Velocity (PPV) results from measurement locations ranged between 0.065-1.040mm/s. Proposed Sondu Railway Station and Chepinyiny Commercial Hub had the lowest and highest vibration levels respectively. All the locations assessed had their peak particle velocity results within EMC Limit of 5.000mm/s.

The proposed project is anticipated to contribute to an increase in environmental noise and ground vibrations levels. This is due to various operations relating to machineries operations, earth moving operations and locomotive movement during the operation phases of the project. However, the increase can be minimal or may have minimal effects if appropriate measures are put in place. Such measures which are recommended include ensuring that:

- machinery in use in the project are timely serviced;
- locomotives used during the operation phase of the project are timely serviced.
- high noise and high vibration activities are avoided within residential and institutional areas;

- adequate notices are provided on activities that might result to high noise and vibration generation;
- prior assessment is undertaken in areas where high vibration operations e.g. blasting are planned;
- continuous environmental noise and vibration assessment is undertaken throughout the proposed project lifespan.

6.2.4 Soil Measurements

Soil sampling was undertaken between 1st to 18th July, 2025. The soil analysis report is annexed to this Report. The objective of the assessment was to establish baseline soil quality in the proposed project for the purpose of future monitoring during project implementation. Parameters analyzed were limited to Polycyclic Aromatic Hydrocarbons (PAHs) and Oil & Grease. The samples were taken to CSI International Limited, an ISO/ ICE 17025 Accredited Laboratory for analysis for Total Petroleum Hydrocarbons (TPH) and Oil and Grease.

The soil samples were collected from eleven (11) sampling areas as shown in **Table 34** and **Figure 29** below.

Table 34: Soil sample collection sites and results

Id	Location	Coordinates		Altitude (m)
		Latitude	Longitude	
SP 1	Narok Railway Station	1° 4'8.71"S	35°53'10.21"E	1945
SP 2	Chemager (Mulot station)	0°56'49.78"S	35°27'21.44"E	1874
SP 3	Bomet Railway Station (Kipsegon)	0°50'14.57"S	35°18'59.08"E	1904
SP 4	Chepinyiny Commercial Hub	0°39'16.99"S	35° 7'12.24"E	1812
SP 5	Siritiet Station	0°34'22.74"S	35° 5'10.00"E	1715
SP 6	Sondu Railway Station	0°24'21.46"S	35° 1'27.04"E	1533
SP 7	Kapsorok Industrial Park	0°16'18.40"S	35° 4'5.42"E	1296
SP 8	Awasi Station (Konim)	0° 9'4.12"S	34°57'31.78"E	1154
SP 9	Kibos	0° 4'14.91"S	34°48'55.26"E	1153
SP 10	Kusule (Kisumu Terminus)	0° 4'15.70"S	34°47'41.50"E	1154
SP 11	Korando ICD 2	0° 4'7.48"S	34°41'12.65"E	1166

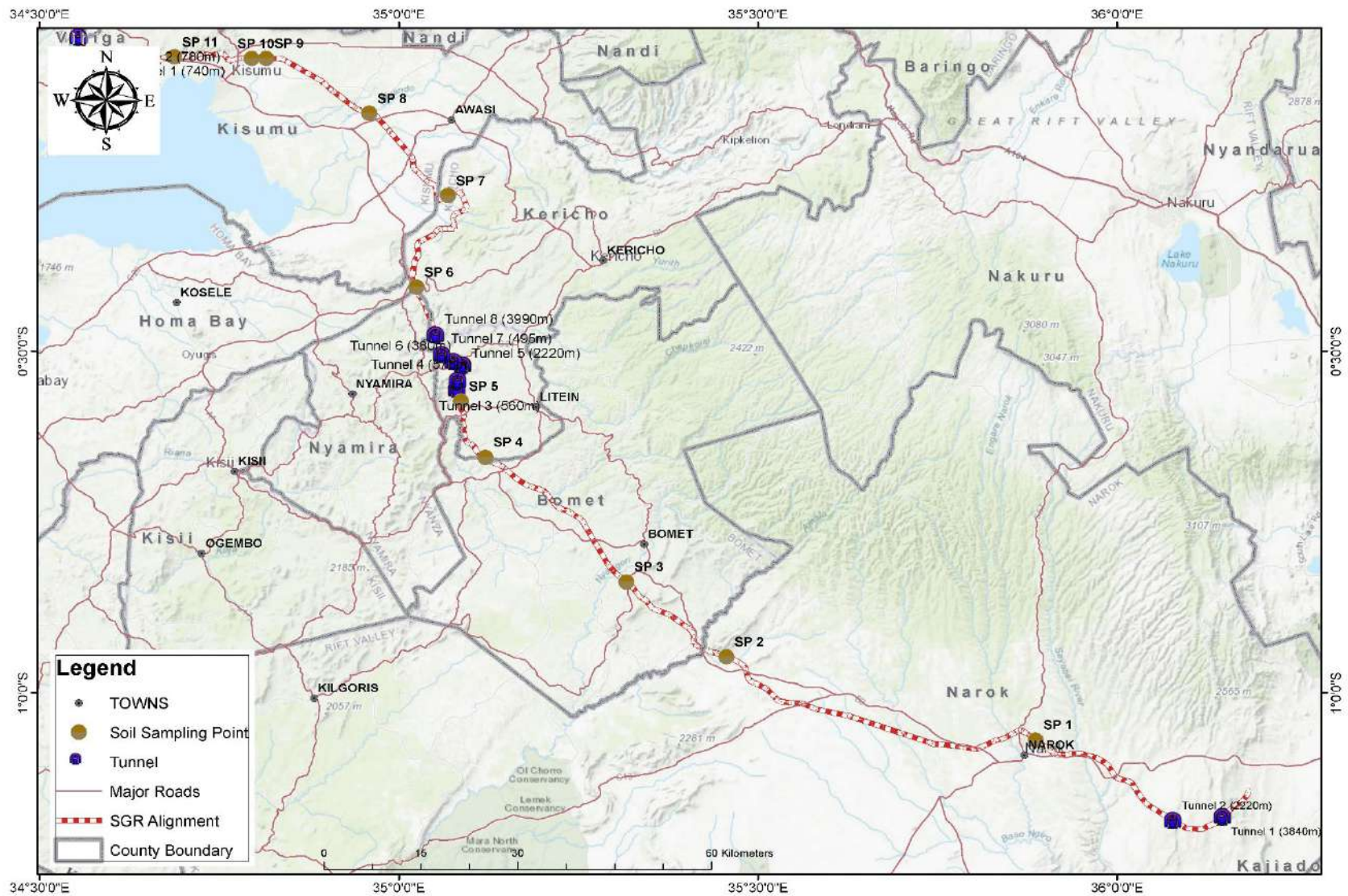


Figure 29: Mapped soil sampled areas

6.2.4.1 Soil Assessment Results

The samples collected from the Proposed Narok Railway Station, Chemager (Mulot station), Bomet Railway Station (Kipsegon), Chepinyiny Commercial Hub, Siritiet Station, Sondu Railway Station, Kapsorok Industrial Park, Awasi Station (Konim), Kibos, Kisumu (Kusule Terminus) and Korando ICD 2. The samples were taken to CSI International Limited, an ISO/ ICE 17025 Accredited Laboratory for analysis for Total Petroleum Hydrocarbons (TPH) and Oil and Grease.

From the laboratory analysis;

- Oil and Grease results ranged between 0.007-0.0099mg/Kg with Siritiet Station;
- TPH C5-C12 (gasoline) concentration in the soil ranged between 0.0009-0.0021mg/Kg;
- TPH C12-C28 (diesel) concentration ranged between 0.0005-0.0016mg/Kg; and
- TPH C28-C44 (oils) results ranged between 0.0004-0.0014mg/Kg.

From the laboratory analysis results, it is evident that all results were within Colorado Division of Oil and Public Safety threshold limit of 500 mg/Kg. The proposed development is anticipated to lead to an increase in concentration of the analysed parameters in the soil if measures are not put in place. Such activities will entail oil or fuel spillage either through accidental spillages, malfunctioning machineries, vehicles or locomotives or poor management of used oils.

6.2.4.2 Discussions

The proposed development is anticipated to lead to an increase in concentration of the analysed parameters in the soil if measures are not put in place. Such activities will entail oil or fuel spillage either through accidental spillages, malfunctioning machineries, vehicles or locomotives or poor management of used oils. In view of this a number of mitigation measures are proposed in minimizing this and include;

- All spillages to be immediately collected in avoidance of water pollution;
- All machineries and locomotives to be timely serviced in minimizing oil spillages;
- Machineries cleaning to be undertaken in designated areas;
- Machineries servicing to be carried out within designated areas.;
- The proponent to ensure periodic soil analysis.

6.2.5 Water Quality Measurements

Water sampling was undertaken between 1st to 18th July 2025 from (20) water points including rivers, springs and boreholes/ wells as shown in the **Table 35** below.

The objectives of water quality measurements include;

- Establish Existing Water Quality Status: Determine the chemical, physical, and biological characteristics of surface and groundwater resources.
- Establish baseline values for ongoing water quality monitoring during construction and operation project phases and enable future comparison to detect changes and evaluate the effectiveness of mitigation actions.

The parameters analyzed included pH, Total Dissolved Solids (TDS), Turbidity, Total Suspended Solids (TSS) and Oil and Grease.

Table 35: Water sampling locations

ID	Location	Latitude	Longitude
SP 1	Albalbal Wetland	1° 3'36.69"S	35°52'18.54"E
SP 2	Chebaricha Stream	0°53'0.08"S	35°22'22.02"E
SP 3	Chororoita River	0°44'7.72"S	35°14'13.92"E
SP 4	Engare Ngoso River	1° 6'0.94"S	35°58'36.30"E
SP 5	Ewaso River	1° 3'36.06"S	35°51'3.28"E
SP 6	Jujulet River	0°18'24.99"S	35° 3'42.65"E
SP 7	Kaposirir Swamp	0°46'56.53"S	35°16'25.57"E
SP 8	Koetoni River	1° 4'40.26"S	35°46'16.59"E
SP 9	Maasai Mara Vocational River	1° 7'23.75"S	35°59'27.12"E
SP 10	Masandare Dam	1° 2'12.94"S	35°37'40.12"E
SP 11	Murototo/ Ndoroto Water Pan	1° 9'33.75"S	36°10'16.06"E
SP 12	Ndubai Water Pan	0°53'31.99"S	35°23'15.18"E
SP 13	Ngurumet River	0°57'53.92"S	35°28'54.00"E
SP 14	Nkor Korri Wetland	1° 0'53.80"S	35°33'48.78"E

ID	Location	Latitude	Longitude
SP 15	Nyando River	0° 9'8.34"S	34°55'48.70"E
SP 16	River Amalo (Mulot)	0°56'12.70"S	35°25'32.36"E
SP 17	River Muguruk	0° 6'9.07"S	34°39'29.89"E
SP 18	River Ngasiat	0°57'10.54"S	35°28'5.40"E
SP 19	River Nyangores	0°49'34.96"S	35°18'8.65"E
SP 20	River Sise	0°44'40.83"S	35°15'3.24"E
SP 21	Shiongi Stream	0°34'23.33"S	35° 5'19.51"E
SP 22	Siyabei River/ Oljororok Stream	1° 5'33.00"S	35°57'15.30"E
SP 23	Sondu River	0°24'22.84"S	35° 1'21.61"E
SP 24	Susait/ Lendaet River	0°45'0.34"S	35°15'19.79"E
SP 25	River Sondu	0° 4'16.72"S	34°48'55.50"E
SP 26	River Cherumbas	0°42'35.14"S	35°12'13.39"E

Source: Ecoscience Engineering Limited Baseline water quality report-June 2025

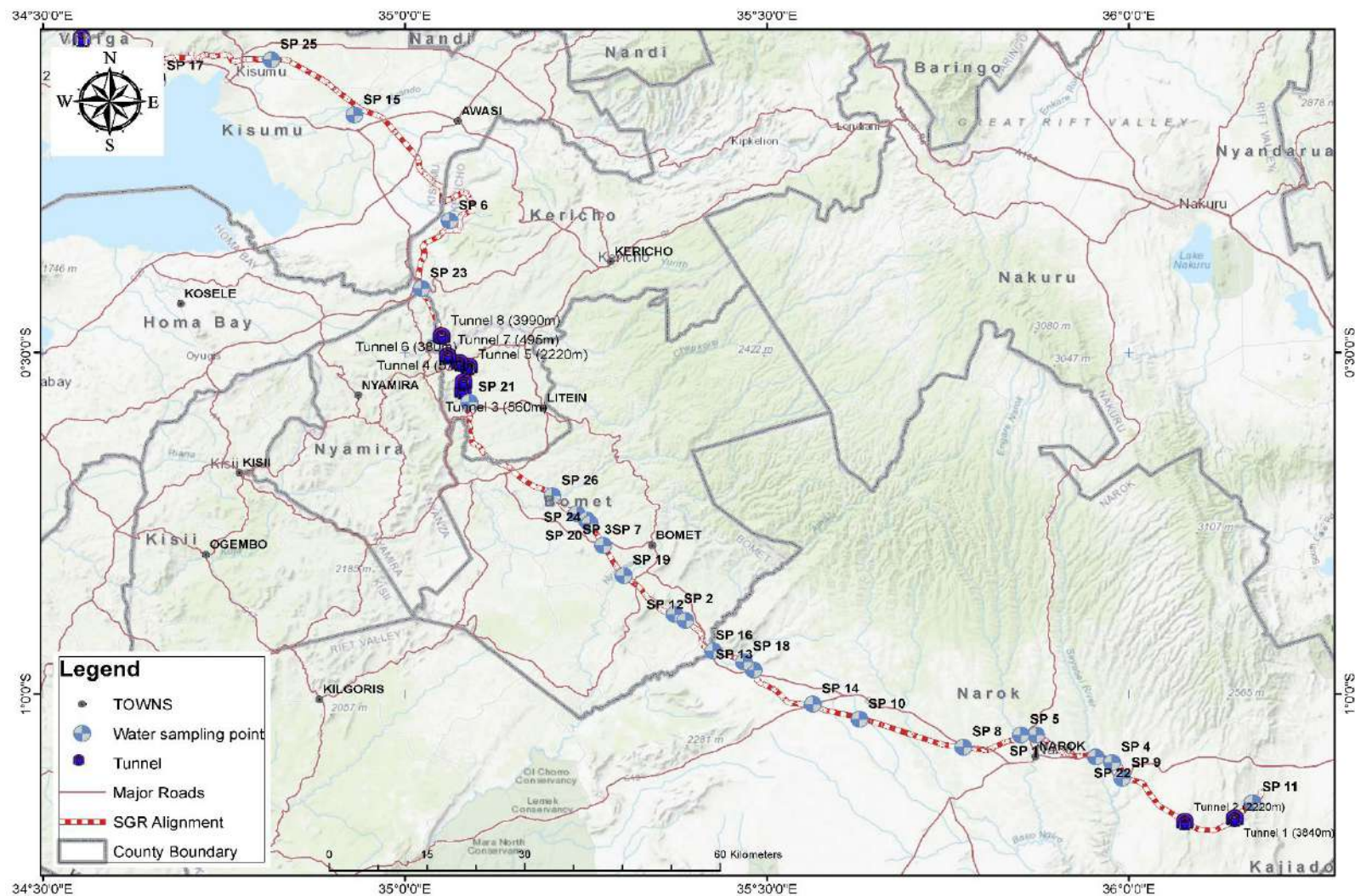


Figure 30: Water sampling locations on google map

Source: Ecoscience Engineering Limited Baseline water quality report-June 2025

Table 36 below is an excerpt the First Schedule of the Water Quality Regulations, 2006.

Table 36: Quality Standards for Sources of Domestic Water

Parameter	Guide Value (max allowable)
pH	6.5 – 8.5
Suspended solids	30 (mg/L)
Nitrate-NO ₃	10 (mg/L)
Ammonia –NH ₃	0.5 (mg/L)
Nitrite –NO ₂	3 (mg/L)
Total Dissolved Solids	1200 (mg/L)
Scientific name (<i>E. coli</i>)	Nil/100 ml
Fluoride	1.5 (mg/L)
Phenols	Nil (mg/L)
Arsenic	0.01 (mg/L)
Cadmium	0.01 (mg/L)
Lead	0.05 (mg/L)
Selenium	0.01 (mg/L)
Copper	0.05 (mg/L)
Zinc	1.5 (mg/L)
Alkyl benzyl sulphonates	0.5 (mg/L)
Permanganate value (PV)	1.0 (mg/L)

Source: Environmental Management and Coordination Act, (Water Quality Regulations), 2006

6.2.5.1 Summary of results

Twenty-six water samples were collected from the proposed project area from various surface water bodies. The samples obtained were then analyzed at Crop Nutrition Laboratory Services, an ISO/ ICE 17025 Accredited Laboratory for analysis of pH, Total Dissolved Solids (TDS), Turbidity, Total Suspended Solids (TSS) and Oil and Grease as shown in **Table 37** below.

From the analysis, below is a summary of the results:

- pH results ranged between 7.15- 8.96. Three water samples; Engare Ngosor River, Albalbal Wetland and Narok Vocational Training their results above Regulatory Limit.

- Total Dissolved Solids (TDS) results ranged between 28.0-1180.0 ppm. Only one water sample from Albalbal Wetland had TDS results above the Regulatory Limit
- Turbidity results ranged between 25.3 - 671.0 NTU. All the water samples had their results above the Regulatory Limit.
- Total Suspended Solids (TSS) results ranged between 18.0-220.0 ppm. Only three water samples; from Susati/Lendaet River, River Sise and Ndubai Swamp had their TSS results within Regulatory Limit.
- Oil and Grease results ranged between 0.004-0.02 ppm. All the water samples from sampled sources had their Oil and Grease results within Regulatory Limit.

High turbidity and Total Suspended Solids (TSS) from the water samples can mainly be attributed to the fact that samples were collected during a rainy season whereby soil erosion is high affecting most surface water sources.

The proposed development is anticipated to lead to an increase in concentration of the analyzed parameters if measures are not put in place. This will mainly entail activities within the rivers; particularly bridges construction leading to increased soil erosion and pollution of the water. In view of this a number of mitigation measures are proposed in minimizing this and include;

- Soil and loose material stock piling to be avoided along rivers;
- Concrete mixing operations to be avoided in close proximity to rivers;
- All spillages to be immediately collected in avoidance of water pollution;
- All machineries and locomotives to be timely serviced in minimizing oil spillages;
- Machineries cleaning to be prohibited along all rivers;
- Machineries servicing to be carried out within designated areas.;
- The proponent to ensure periodic water analysis.

Table 37: Summarized results of different parameter

Location	pH	Limit	TDS (ppm)	Limit	TUB (NTU)	Limit	TSS (ppm)	Limit	OG (mg/l)	Limit
River Muguruk	8.13	6.50-8.50	99.0	< 1000	66.3	<5.00	30.0	<25.0	0.012	<0.05
Albalbal Wetland	8.60		1180.0		63.6		60.0		0.008	
Chebaricha Stream	7.69		214.0		97.5		71.0		0.008	
Engare Ngosor River	8.59		410.0		116.0		100.0		0.008	
Jujulet Stream	7.76		42.0		65.4		32.0		0.008	
Kaposirir Swamp	7.15		107.0		94.5		161.0		0.008	
Narok Vocational Training	8.96		458.0		64.7		30.0		0.008	
Masandare Dam	8.15		257.0		671.0		220.0		-	
Murototo/Ndoroto Water Pan	7.38		165.0		38.8		34.0		0.012	
Ndubai Swamp	7.71		78.0		27.3		24.0		0.012	
Nkor Korri Wetland	7.58		139.0		263.0		192.0		0.008	
River Amalo	7.51		57.0		88.1		80.0		0.012	
River Cherumbas	7.25		28.0		36.9		51.0		0.008	
River Chororoita	7.35		58.0		25.3		25.0		0.020	
River Ewaso	8.17		247.0		64.4		33.0		0.008	
River Kibos	7.44		59.0		65.4		51.0		0.016	
River Koetoni	7.67		118.0		143.0		116.0		0.012	

Location	pH	Limit	TDS (ppm)	Limit	TUB (NTU)	Limit	TSS (ppm)	Limit	OG (mg/l)	Limit
River Ngasiat	8.28		492.0		55.9		49.0		0.012	
River Ngurumet	8.28		840.0		76.9		78.0		0.012	
River Nyando	7.87		130.0		287.0		196.0		0.012	
River Nyangores	7.37		30.0		61.3		41.0		0.008	
River Shiongi	7.40		46.0		41.4		32.0		0.004	
River Sise	7.38		48.0		34.9		20.0		0.012	
River Sondu	7.51		36.0		41.9		50.0		0.008	
Siyabei River/OlJOROROK Stream	8.16		192.0		87.1		52.0		0.012	
Susati/Lendaet River	7.47		71.0		51.5		18.0		0.008	
Key:		Denotes Above or Below Limit								
		Denotes Within Limit								
	TDS	Denotes Total Dissolved Solids								
	TUB	Denotes Turbidity								
	TSS	Denotes Total Suspended Solids								
	OG	Denotes Oil and Grease								
	-	Denotes No Data								

Source: Ecoscience Engineering Limited Baseline water quality report-June 2025

6.2.5.2 Discussions

High turbidity and Total Suspended Solids (TSS) from the water samples can mainly be attributed to the fact that samples were collected during a rainy season whereby soil erosion is high affecting most surface water sources.

The proposed development is anticipated to lead to an increase in concentration of the analysed parameters if measures are not put in place. This will mainly entail activities within the rivers; particularly bridges construction leading to increased soil erosion and pollution of the water. In view of this a number of mitigation measures are proposed in minimizing this and include;

- Soil and loose material stock piling to be avoided along rivers;
- Concrete mixing operations to be avoided in close proximity to rivers;
- All spillages to be immediately collected in avoidance of water pollution;
- All machineries and locomotives to be timely serviced in minimizing oil spillages;
- Machineries cleaning to be prohibited along all rivers;
- Machineries servicing to be carried out within designated areas.;
- The proponent to ensure periodic water analysis.

6.3 Biodiversity Baseline

6.3.1 Introduction

Satellite imagery and field reconnaissance indicate that much of the area along the proposed railway has been heavily modified by human settlements and agriculture. Traditional bushland is now scarce, with wetlands converted to sugarcane fields or used for livestock grazing, leading to significant changes in local biodiversity. Lotic wetlands and streams, despite being disturbed, remain important refuges for displaced species and serve as the most reliable sites for biodiversity sampling.

6.3.2 Vegetation and Land Cover

Vegetation along the alignment is highly variable, reflecting diversity in topographic, climatic features and land-use practices. Broad categorizations include:

Montane and Upper Montane Forests (Mau Complex, Kericho Highlands)

This is dominated by plant species like *Juniperus procera*, *Podocarpus latifolius*, *Hagenia abyssinica*, *Olea capensis*, and bamboo (*Yushania alpina*). This area is an important refugia for biodiversity like amphibians, forest birds, and small mammals. However, it is increasingly fragmented due to encroachment, agriculture, and logging as local anthropogenic threat while climate change.

Grasslands and Savannahs (Narok Plains, parts of Bomet)

These are dominated by the grasses as shown in **Figure 31** below (*Themeda triandra*, *Pennisetum clandestinum*, and scattered Acacia species (*Acacia xanthophloea*, *Vachellia seyal*). Several wetlands including swamps, rivers and streams are found within these grasslands. The grasslands and wetlands together make it an ideal habitat for grassland and wetland species of biota including amphibians, avifauna, and are also used for grazing livestock.



Agricultural Landscapes (Narok, Kericho, Nyamira, Bomet)

There are extensive maize and tea plantations in Narok County, tea and maize plantations characterize Kericho and Bomet Counties while sugarcane plantations are key features in Kisumu and lower parts of Kericho Counties as shown in **Figure 32 and 33** below. These plantations are interspersed with smallholder farms with maize and forests.



Wetlands and Riparian Vegetation (Narok, Kisumu and Lake Victoria Basin)

The wetlands found in the project area are both lotic and lentic as shown in **Figure 34** below. The lotic ones include rivers like Siyabei, Nyando, Mulot, Sondu Miriu and Kibos while lentic ones include Lake Victoria, Swamps and water pans. These host a myriad of biodiversity including fish, invertebrates, avifauna, and plants like *Cyperus papyrus*, *Vossia cuspidata*, and *Phragmites mauritianus*. These areas are crucial breeding grounds for fish and roosting sites for waterbirds and also serve the local communities in terms of fishing, water and raw materials for craftsmanship.

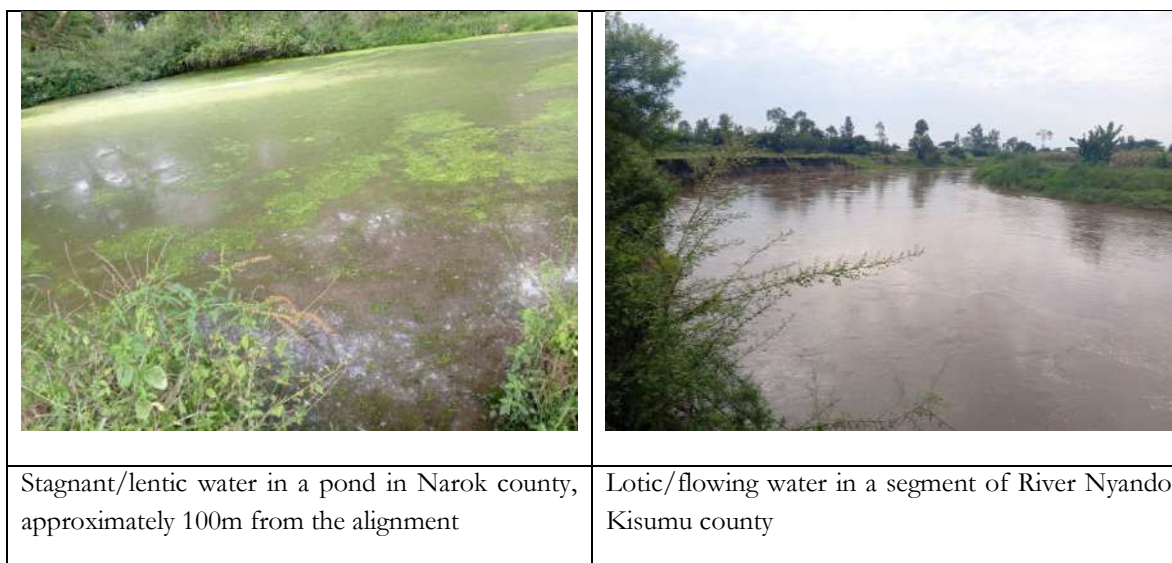


Figure 34: Some of the wetlands in the project area

6.3.3 Protected Areas and Key Biodiversity Features along the Route

Although the SGR alignment does not traverse gazetted national parks or reserves directly, it falls within the ecological influence of several protected and conservation-worthy areas. These areas are vital for biodiversity conservation, water regulation, and sustaining livelihoods. Their proximity

KE25036-0100D (2) R_03 ESIA Study for Phase 2B SGR

means that potential indirect impacts, such as habitat fragmentation, pollution, and increased access, need careful assessment.

Mau Forest Complex (Narok, Bomet, Kericho, Nyamira Counties)

The Mau Forest Complex are gazetted forest reserves which also serves as water tower of national importance. The complex is considered the largest closed-canopy montane forest in East Africa. Some of the rivers which originate from are shown in **Table 38** below.

Table 38: Rivers Originating from Mau Forest Complex and their Drainage Basins

Drainage Basin	Major Rivers from Mau	Receiving Water Body
Lake Victoria Basin	Sondu Miriu, Nyando, Mara, Kuja (Gucha), Migori	Lake Victoria and the Nile Basin
Lake Turkana Basin	Kerio, Turkwel, Nzoia tributaries	Lake Turkana
Rift Valley Lakes	Njoro, Makalia, Nderit, Naishi, Maraiget, Malewa, Gilgil	Lake Nakuru, Lake Naivasha, Lake Baringo
Southwards	Ewaso Ng'iro (South)	Flows through Maasai Mara and Serengeti

The forest is also a home to montane and bamboo forests critical for endemic flora and fauna in addition to being key for climate regulation and hydrological stability in the region. As a habitat, the forest supports a wide variety of forest birds, mammals and amphibians.

Mara River Basin and Maasai Mara Ecosystem (Narok County)

This is part of the Greater Mara Ecosystem, linked to Maasai Mara National Reserve. These play important ecological roles including serving as significant migratory corridor for wildlife including elephants, zebras and gnus. The ecosystem also supports large carnivores like lion, leopard, spotted hyena).

Kericho Highlands and Tea Belt Forest Fragments (Kericho, Bomet Counties)

This is a mixture of gazetted forests, community-managed patches, and private woodlots across the alignment. These forest fragments retain indigenous vegetation while the tea plantations host remnant biodiversity corridors.

Lake Victoria Basin Wetlands (Kisumu County)

The Lake Victoria basin is recognized as an Important Bird and Biodiversity Areas (IBAs), with a wetland like Yala Swamp recognized as a Ramsar site. The basin is important for flood control, water purification, and fish breeding grounds. It also supports subsistence fishing, papyrus

harvesting, and cultural practices. Some of the endemic bird species in the basin include the papyrus-dependent birds (Papyrus Gonolek, Papyrus Yellow Warbler, Papyrus Canary).

Biodiversity

6.3.4 Biodiversity Assessment Findings

Flora

A total of 314 species were recorded across the 5 counties. These included desert adapted species like sisal (**Figure 35**: Sisal plant) to aquatic species like the water lily (**Figure 36**: Water Lililes) showing the bracketed diversity of plants in the proposed corridor. However only 2 species, *Prunus Africana* and *Jacaranda mimosifolia* are Vulnerable, 1 *Polyscius kikuyuensis* is Near Threatened while *Morus nigra* is Data Deficient.

	
Figure 35: Sisal plant	Figure 36: Water Lililes
Sisal, <i>Agave sisalana</i> from the study area	Water lily, <i>Nymphaea</i> spp. from a small pond in Kericho

Invertebrates

The study revealed 198 species in 18 orders dominated by Hymenoptera and 74 families. Only 8% of the species have been evaluated by the IUCN and all are in the Least Concern category.

Fish

The study revealed a total of 60 fish species in 8 orders and 16 families (see Figure 37: Tilapia SPP). 1 species, *Xenoclarus eupogon* is Critically Endangered (CR), another 1 *Enteromius loveridgii* is Vulnerable (VU), 1 *Zaireichthys rotundiceps* is Data Deficient (DD), while 2 (*Oreochromis esculentus* and *Oreochromis variabilis*) are in the Near Threatened (NT) category. 36 species are Least Concern while 19 are yet to be evaluated as shown below.



Figure 37: Tilapia SPP

Tilapia spp from a wetland less than 50m from the railroad alignment in Ndubai, Bomet County

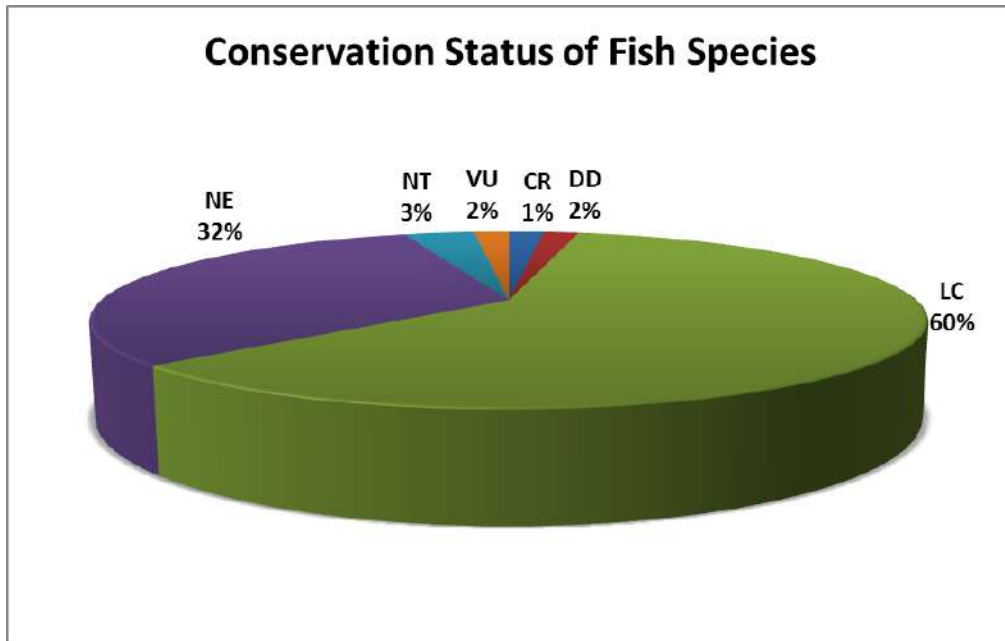


Figure 38: Conservation status of Fish

Amphibians

The study revealed 20 amphibian species in 8 families in the study area. Some are shown in **Figure 39** below. In terms of conservation status, 17 are in the Least Concern category, 2 are yet to be evaluated while 1 Maasai sand frog (*Tomopterns monticolor*) is in Data Deficient category. None of the species is endemic.

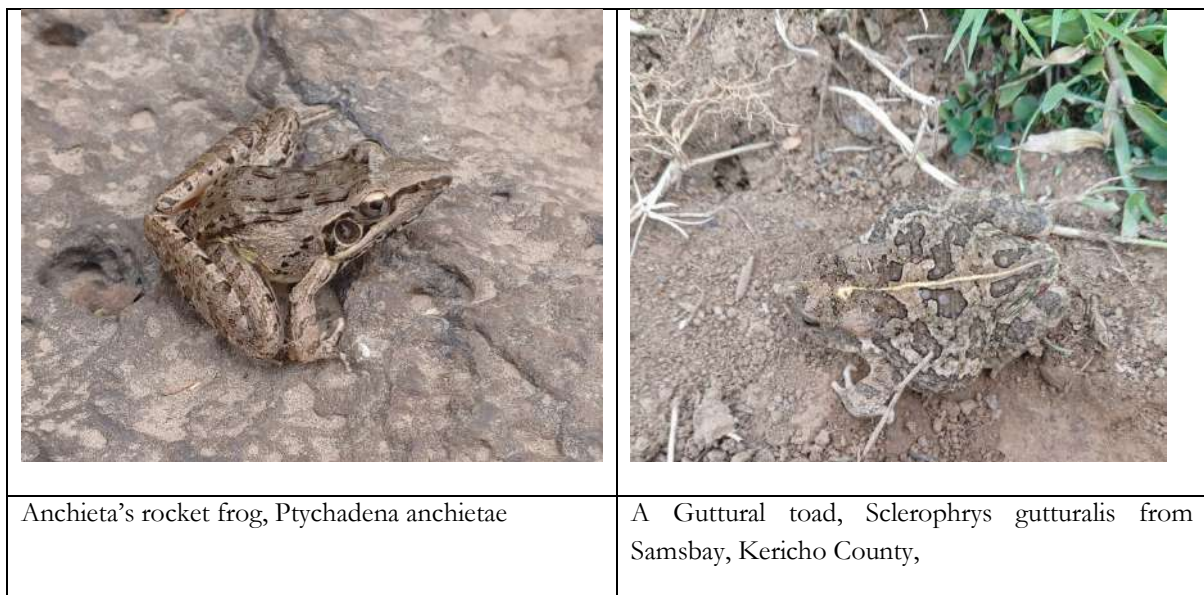


Figure 39: Some of the amphibians in the project area

Reptiles

A total of 43 reptile species in 16 families are recorded for the study area (See Figure 40: *Agama lionotus* reptile SPP below). 33 of these are in the Least Concern category, 5 are not evaluated while 2 are in the Near Threatened category. These are the Alpine meadow skink (*Trachylepis irregularis*) and the Central African rock python (*Python sebae*). No endemic species was recorded.



Birds

A total of 8 species were found to have potential CH triggers including 7 migrants and. However, only one species, Grey Crowned Crane (*Balearica regulorum*) EN was found to be of conservation concern as shown in **Table 39** below.

Table 39: Conservation status of different bird spp

Species Name	Common Name	IUCN Status	Migration
<i>Coturnix coturnix</i> (nominate race coturnix NRRZ)	Common Quail)	LC	pm
<i>Cuculus solitarius</i>	Red-chested Cuckoo	LC	am
<i>Balearica regulorum</i>	Grey Crowned Crane	EN	
<i>Ardea cinerea</i>	Grey Heron	LC	am, pm
<i>Bubulcus ibis</i>	(Western) Cattle Egret	LC	am
<i>Coracias caudatus</i>	Lilac-breasted Roller	LC	am
<i>Halcyon leucocephala</i>	Grey-headed Kingfisher	LC	am

Species Name	Common Name	IUCN Status	Migration
<i>Ispidina picta</i>	African Pygmy Kingfisher	LC	am

Mammals

The mammal assemblage from the study area is composed of 36 species in 21 families and 9 Orders. The bats on the Order Chiroptera are the dominant group with 31% of the species followed by members of the orders Carnivora and Artiodactyla at 25% and 17% respectively as shown in **Figure 41** below.

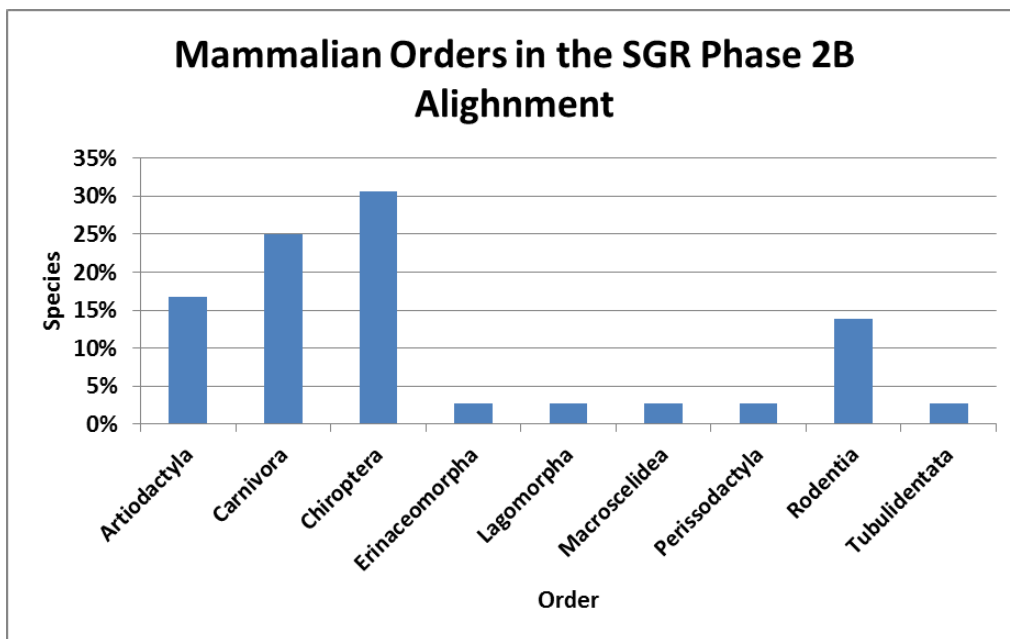


Figure 41: Mammalia Order within the project corridor

In terms of conservation status and Mitigatory behavior, 81% of the species are in the Least Concern Category, 11% are Data deficient while 8% are Vulnerable as shown **Figure 41** below. Three migrant species are the bats African long-fingered bat (*Miniopterus africanus*), Least long-fingered bat (*Miniopterus minor*) and the African straw-colored bat (*Eidolon helvum*)

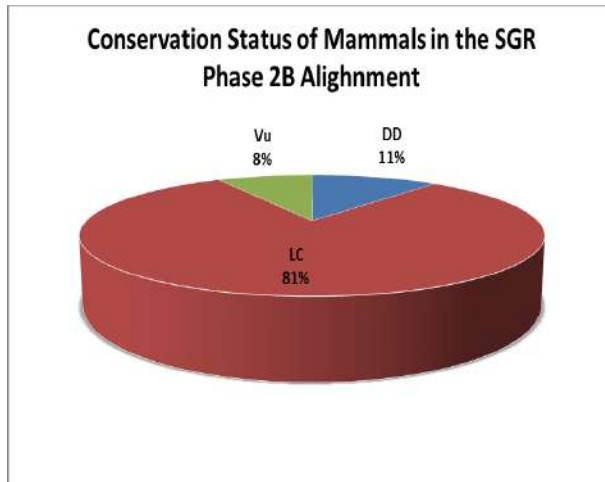


Figure 42: Mammals conservation status



Figure 43: Plauns zebra, *Equus guagga* from Narok County

6.3.5 Sensitivity Analysis

A total of 10 species (*Xenoclaras eupogon* and *Balearica regulorum*, *Enteromius loveridgii*, *Pipistrellus aero*, *Eidolon helvum* *Otomops harrisoni*, *Panthera pardus*, *Polyscias kukuyuensis*, *Prunus africana* and *Tachyoryctes splendens naivashae*) emerged as high sensitivity owing to their global conservation status and ecological/economic importance. 3 species are of medium sensitivity, requiring careful management. Majority of the species are of low sensitivity, posing limited conservation concern. This analysis provides the basis for identifying potential Critical Habitat and for prioritizing mitigation measures as shown in **Table 40** below.

Table 40: Sensitivity Analysis

Taxa	Species	Common name	IUCN	Endemism	Occurrence	Sensitivity	Justification / Carry forward?
Plant	<i>Prunus africana</i>	African cherry	VU	No	Confirmed	High	VU, high harvest pressure; local stands important. CARRY FORWARD (Potential CH)
Plant	<i>Polyscias kukuyuensis</i>	Parasol tree	NT	Endemic	Single individual \~1 km from alignment	High	Endemic (NT); single individual outside ROW → Potential CH (Criterion 2) but unlikely to be CH unless more populations are found; CARRY FORWARD (for targeted survey & precautionary protection)
Fish	<i>Xenoclaras eupogon</i>	Lake Victoria deep-water catfish	CR	No	Confirmed	Very High	CR, deep-water specialist — highly vulnerable to port works. CARRY FORWARD (CH candidate)
Fish	<i>Enteromius loveridgii</i>	—	VU	No	Confirmed	High	Vulnerable stream species — sensitive to siltation and flow changes. CARRY FORWARD (Potential CH)
Amphibian	<i>Tomopterna monticola</i>	Maasai sand frog	DD	No	Confirmed	Medium	DD; uses seasonal wetlands — monitor; do not carry unless further evidence.
Reptile	<i>Trachylepis irregularis</i>	Alpine meadow skink	NT	Regional	Likely	Medium	Regional endemism, NT; occurrence in Mau forest utilizing the moorlands

Taxa	Species	Common name	IUCN	Endemism	Occurrence	Sensitivity	Justification / Carry forward?
Reptile	Python sebae	Central African Rock python	NT	No	Confirmed	Medium	NT, large-bodied species, persecuted, threatened population is not in the country
Mammal	Panthera pardus	Leopard	VU	No	Confirmed	High	Wide-ranging, needs connectivity — CARRY FORWARD (where corridors intersect).
Chiroptera	Otomops harrisoni	Harrison's large-eared mastiff bat	VU	No	Confirmed	High	Roost specialist; disturbance sensitive. CARRY FORWARD (CH potential).
Chiroptera	Pipistrellus aero	Mount Gargues pipistrelle	DD	Endemic	Confirmed	Very High	Endemic; restricted range. CARRY FORWARD (CH candidate).
Mammal	Tachyoryctes splendens naivashae	NE African mole-rat (subsp.)	LC	Endemic subspecies	Confirmed	High	Localized fossorial colonies; vulnerable to earthworks. CARRY FORWARD
Mammal (Bat)	Eidolon helvum	African Straw-coloured Fruit Bat	VU	No	Migratory / regional presence	High	Congregatory/migratory species; roosts can be critical. CARRY FORWARD (survey roosts).

Taxa	Species	Common name	IUC N	Endemism	Occurrence	Sensitivity	Justification / Carry forward?
Bird	Balearica regulorum	Grey-crowned Crane	EN	No	Migrant / seasonal	Very High	Endangered, uses wetlands & wet grasslands — CARRY FORWARD (CH potential & priority receptor).
Plants & others	Various LC/NT species (e.g., Jacaranda mimosifolia, Morus nigra)	—	LC/NT/DD		Confirmed	Medium / Low	Baseline list — retain in Annex; do not carry forward unless trigger appears.

6.3.6 Critical Habitat Analysis

This section presents the Critical Habitat (CH) analysis across all taxa (plants, fish, amphibians, reptiles, and mammals) recorded during baseline surveys. The analysis follows the IFC Performance Standard 6 (PS6) criteria for Critical Habitat determination, considering the presence of globally threatened species, restricted-range endemics, congregatory or migratory species, and ecosystems of high importance.

The evaluation combines IUCN Red List status, distribution, endemism, and ecological role of each species to determine whether the project area may qualify as Critical Habitat for biodiversity conservation. Species are assessed against CH criteria, assigned a status (Yes, Potential, No), and justified accordingly as shown in the **Table 41** below.

Table 41: Critical habitat analysis

Taxa	Species	Common name	IUCN	CH Criterion(s)	CH Status	Rationale
Plant	Polyscias kukuyuensis	Parasol tree	NT (endemic)	C2	Potential CH	Endemic restricted-range species — CH only if alignment affects significant/essential population (unlikely if single individual 1 km away). Targeted vegetation survey recommended.
Plant	Prunus africana	African cherry	VU	C1/C2	Potential CH	Significant local concentrations or mature stands could be CH; needs mapping of local stands.
Fish	Xenoclarus eupogon	Lake Victoria deep-water catfish	CR	C1	Confirmed CH	Critically Endangered, habitat-specific to deep lake zones — loss irreversible; treat as Critical Habitat.
Fish	Enteromius loveridgii	—	VU	C1	Potential CH	Vulnerable stream fish; rivers supporting spawning aggregations may qualify.
Bird	Balearica regulorum	Grey-crowned Crane	EN	C1; C4	Potential CH	Endangered species using wetlands and congregating in wet grassland mosaics; breeding/roost sites could meet CH conditions.
Mammal (bat)	Eidolon helvum	African Straw-coloured Fruit Bat	VU	C4	Potential CH	Large migratory roosts are regionally significant; if roosts intersect project, CH tests apply.

Taxa	Species	Common name	IUCN	CH Criterion(s)	CH Status	Rationale
Mammal-bat	Pipistrellus aereus	Mount Gargues pipistrelle	DD (endemic)	C2; C4	Potential CH	Endemic with restricted distribution; possible congregatory roosts — targeted roost surveys required.
Mammal	Panthera pardus	Leopard	VU	C1 (if local pop important); C3	Potential CH	CH only if area supports a significant breeding population or critical corridors — requires landscape-level data.

6.4 Baseline Social and Economic Conditions

6.4.1 Introduction

This socio-economic baseline outlines the prevailing social and economic conditions within the project area. It examines key socio-economic dimensions, including administrative structures, demographic characteristics, economic activities, health and education services, land use and land tenure systems, among others.

Purpose of a Socio-Economic Baseline

- To understand who lives in the project area, their livelihoods, wellbeing, and vulnerabilities.
- To provide evidence for predicting social impacts, designing mitigation measures, and informing stakeholder engagement.
- To provide a baseline on which project socio-economic impacts can be evaluated and monitored.

Project Impacts on Livelihoods

A total of 5,981 PAPs/households and 104 institutions were registered during the census. Some PAPs own more than one parcel of land. Of the total PAPs, approximately 5,638 are landowners, 145 are roadside vendors, 181 operate affected business premises, and 17 are individuals leasing farmland.

Within the project corridor, several cultural and heritage resources were identified, including 2,506 graves and 51 cultural sites such as circumcision sites, traditional marriage sites, community shrines, and cemeteries that will be affected by the project.

Both private and public land parcels will be impacted, and the activities or services within these parcels will be disrupted. Field data collection indicates that approximately 601 homes will be fully displaced, in addition to various businesses and farmlands. The project will also directly affect over 100 institutions, including schools, health facilities, churches, and others.

In this regard, all PAPs and affected institutions will be appropriately compensated for their losses and provided with the necessary support to re-establish their lives, livelihoods, and essential services.

6.4.2 Narok County

6.4.2.1 Overview

Narok County is one of Kenya's 47 devolved counties, located in the former Rift Valley Province. It covers a vast geographical area and hosts diverse communities, landscapes, and economic activities. Administratively, the county is divided into sub-counties, divisions, locations, and sub-locations, which support governance, resource allocation, and service delivery.

6.4.2.2 Administrative Units

Administratively, Narok County had six sub-counties at the start of the devolution era. In 2019, two additional sub-counties Transmara South and Narok Central were created. The original sub-counties were Transmara West, Transmara East, Narok North, Narok South, Narok West, and Narok East. **Table 42** below shows the administrative structure of Narok County.

Table 42: Area and Administrative units in Narok Sub-counties

Sub-County	Area (sq. km)	No. Divisions	No. Locations	No. Sub-Locations
Narok East	2123.45	4	12	29
Narok North	920.3	2	11	27
Narok Central	1239.1	2	7	14
Narok South	5452.79	4	20	39
Narok West	5452.79	3	17	35
Transmara East	311	2	6	13
Transmara West	2301	3	18	40
Transmara South	224	5	17	32
Total	18,024.43	25	108	229

Source: Narok County Development Profile 2023-27

The SGR Phase 2B project traverses the sub-counties of Narok East, Narok Central, Narok South, and Narok Amalo.

6.4.2.3 Demographic Profile

The population of Narok County as at 2023 was 1,284,204, comprising 634,154 males and 650,050 females, reflecting an increase from the 2019 census figure of 1,263,331. The county represents about 2.4% of Kenya's total population and is distributed across 241,125 households with an average household size of 4.9. With a land area of 17,920.7 km², the overall population density is approximately 63 persons per km², up from 47 persons per km² in 2019.

Population density varies significantly across sub-counties, influenced by factors such as climate, availability of social amenities, and topography. Emurrua Dikirr has the highest density at 390 persons per km², while Narok West has the lowest at 34 persons per km². Understanding population size, density, and distribution is essential for effective development planning, as these indicators determine service delivery needs and the spatial allocation of resources. **Table 43** below indicate population distribution and projection per Sub County in Narok County.

Table 43: Population Distribution per Sub County

County	2019			2022			2025			2027		
	Area (Km2)	Population	Density	Area (Km2)	Population	Density	Area (Km2)	Population	Density	Area (Km2)	Population	Density
Narok	17,932	1,157,873	65	17,932	1,248,708	70	17,932	1,355,194	76	17,932	1,431,545	80
Narok East	2,042	115,323	56	2,042	124,370	61	2,042	134,976	66	2,042	142,580	70
Narok North	2,159	251,862	117	2,159	271,621	126	2,159	294,783	137	2,159	311,391	144
Narok South	4,577	238,472	52	4,577	257,180	56	4,577	279,112	61	4,577	294,837	64
Narok West	5,563	195,287	35	5,563	210,607	38	5,563	228,567	41	5,563	241,445	43
Transmara East	310	111,183	359	310	119,905	387	310	130,130	420	310	137,462	443
Transmara West	2,546	245,714	97	2,546	264,990	104	2,546	287,588	113	2,546	303,790	119
Mau Forest	734	32	0	734	35	0	734	37	0	734	40	0

Source: Narok County Integrated Development Plan, 2023-2027

Narok's population has a pyramid age structure, with numbers declining across higher age groups. This youthful profile has significant implications for the county's socio-economic development. The annual population growth rate is 3.13%, higher than the national average of 2.7%, and the population is projected to rise from 1.16 million in 2019 to 1.43 million by 2027, an increase of 273,672 people.

Indigenous People and Vulnerable Groups

Narok County is one of the three pre- dominantly Maasai inhabited counties in Kenya. However, it is increasingly becoming a cosmopolitan county with Maasai and Kalenjin being the larger ethnic groups. The County is also home to marginalized communities such as the Ogiek and Oromo ethnic groups. The primary indigenous group in the SGR traversed counties of Narok East, South, Central, and West is the Maasai people, a Nilotic ethnic group who are historically pastoralists.

The vulnerable groups identified across its sub-counties, including Narok East, South, Central, and West, generally encompass women, youth, persons with disabilities (PLWD), the elderly, and individuals experiencing poverty.

6.4.2.4 Economic Profile

According to the 2015/16 KNBS data, 69% of households in Narok County derive their livelihoods from agriculture, while sectors such as wholesale and retail trade (7%), education (6%), and construction (6%) account for smaller proportions. The county's economy is therefore strongly agriculture-driven, complemented by pastoralism, tourism, and trade. Tourism—anchored by the Maasai Mara ecosystem—remains a major economic pillar. However, livelihoods are highly vulnerable to climate change, with increasing occurrences of erratic rainfall, droughts, and flash floods, prompting communities to adopt strategies such as water harvesting and the cultivation of drought-tolerant crops.

Within the SGR project area, the key economic pillars include:

- **Agriculture:** This is the dominant economic activity, particularly in Narok East, Narok Central, Narok South, and Amalo sub-counties. Livestock keeping mainly cattle, sheep, and goats—is a major livelihood source, supported by vibrant markets for meat, milk, hides, and related products. While indigenous breeds remain prevalent, there is an increasing uptake of exotic breeds, alongside growth in commercial poultry farming and widespread beekeeping.
- **Employment:** Findings from HURUmap Kenya indicate that, as of the 2019 census, approximately 26.5% of women and 29% of men in Narok County are employed. Most employment is concentrated in agriculture, pastoralism, tourism, and trade, which collectively form the backbone of the local economy.



Figure 44: Livestock Grazing in the Fields

6.4.2.5 Land Tenure and Use

The SGR project area in Narok County is characterized by a rapidly evolving land tenure and land use system, transitioning from traditional group ranches to increased individual land ownership. This shift has encouraged agricultural intensification and a gradual move from predominantly pastoral livelihoods to mixed farming. Key land uses in the area include pastoralism, subsistence and commercial agriculture, agro-pastoralism, and tourism linked to the Maasai Mara ecosystem. The ongoing transition toward individual titles continues to shape land use patterns, productivity, and investment, prompting efforts to strengthen tenure security through policy and land administration reforms.

Land in the SGR-affected sub-counties Narok East, Narok Central, Narok South, and Amalo is held under community (customary), public, and private tenure systems. Group ranches remain an important form of communal ownership, but rising population pressure and a desire for formalized rights have accelerated the subdivision of communal land into individually owned plots.

Despite constitutional guarantees of equal land and inheritance rights, women in the project area continue to face significant barriers to land ownership due to persistent customary norms that restrict their rights to land accessed through male relatives. Limited legal awareness and conflicting cultural practices widen the gap between legal provisions and actual practice. Ongoing initiatives such as land adjudication processes and women's empowerment programs aim to improve women's access to land, but major cultural and institutional challenges remain.

Land use across the SGR project area is dominated by livestock keeping, crop farming (including wheat and maize), and tourism, supported by extensive grasslands, forest areas, and proximity to the Maasai Mara. However, land use is changing, with increasing conversion of forested areas into farmland and settlements.

In addition, the area hosts several informal land users, including smallholder farmers, nomadic pastoralists, and residents of informal settlements. These groups rely on customary access arrangements for their livelihoods, even though their rights often fall outside formal legal frameworks.

6.4.2.6 Education

Some of the learning Institutions within the project area include Maasai Mara Technical and Vocational College, Kosen Sylvester, Empopongi Primary School, Narok Teachers Training College, Hekima International School, Chestor school, Koitamugul Primary School, Kuto Primary School, Laluk Primary School, Chemagel Primary School, Ollmirani High School and Kilusu Primary School.

6.4.2.7 Health

Narok County's health sector includes public health facilities such as Level 4 hospitals, health centers, and dispensaries, alongside private clinics. Key health services provided are preventative, promotive, and curative care, while common health issues include respiratory diseases, malaria, and diarrheal diseases. Public Facilities within the County include Level 4 Hospitals, health centers and dispensaries.

The health provision system also included Community Health Units which are staffed by trained volunteers who deliver primary healthcare and sanitation services at the community level. Health centre within a radius of 1.5kms from the SGR wayleave corridor are ACK Nturumeti Dispensary, Siyapei AIC Dispensary, Lopiding Hospital, Mulot Health centre and Mulot Believers church.

6.4.2.8 Water

The main Water provider within the SGR project area in Narok County is Narok Water and Sewerage Services (NARWASSCO), which provides water supply and sanitation services, aiming for stable and sustainable provision for residents. NARWASSCO operates water treatment units and manages water distribution, but its current supply coverage is approximately 34%. The county's infrastructure includes three conventional treatment units and around 7,000 water connections.

6.4.2.9 Transport and Communication Network

Narok County has a growing transportation and communication infrastructure, with roads linking major administrative centres and key production zones, although some rural areas still experience accessibility challenges. Communication services continue to improve through government and private-sector initiatives, especially under the Universal Service Fund (USF), which is expanding mobile and internet connectivity to underserved locations through the installation of network masts and fiber-optic cables.

- **Roads:** The county's road network supports movement between administrative hubs and agricultural areas, facilitating the transport of commodities such as barley, wheat, maize, beef, and milk. Within the SGR Phase 2B project area, the Amalo Road provides an important connection to surrounding regions.
- **Communication Network:** The USF is progressively extending mobile network coverage to additional sub-locations through phased connectivity programs.
- **Internet Access:** Broadband expansion is ongoing, with fiber-optic infrastructure and related digital services being rolled out to improve access, including for public institutions such as libraries and schools.
- **Digital Inclusion:** Overall efforts aim to ensure that all rural areas in Narok County have reliable voice and data connectivity.

6.4.2.10 Energy

The main energy sources in the SGR Phase 2B project corridor include electricity and traditional biomass like firewood and charcoal. Contributing factors are a high reliance on biomass for cooking and heating due to limited electricity access, significant deforestation, and government-led initiatives to improve energy access through electricity grid expansion, mini-grids, and renewable energy technologies such as solar and biogas.

6.4.2.11 Tourism and Recreation Activities

Tourism in Narok County is anchored by the world-renowned Maasai Mara National Reserve, famous for its abundant wildlife, the annual Great Wildebeest Migration, and the rich cultural heritage of the Maasai community. The reserve forms part of the larger Serengeti–Maasai Mara Ecosystem, which includes protected areas, wildlife conservancies, and open rangelands that offer diverse tourism experiences. Tourism is a major economic pillar for the county, generating substantial employment and contributing significantly to local development.

The county's natural landscape provides extensive recreational opportunities. Beyond the Maasai Mara, attractions include Mount Suswa for hiking and nature exploration, as well as the Loita Plains and forests, which support camping, birdwatching, and eco-tourism. Additional tourism activities include agritourism, linked to the county's wheat and barley farming zones, and cultural tourism, centered on the traditions and lifestyle of the Maasai people.

Narok County is also rich in cultural heritage and archaeological resources. It hosts significant Neolithic sites such as Narosura and Salasun, associated with the Savanna Pastoral Neolithic (SPN) period. The county is a major centre for Maasai cultural preservation, supported by institutions such as the Maa Museum operated by the National Museums of Kenya. Its geological landscape dominated by Neogene volcanic formations and Rift Valley sediments further enhances understanding of human history and paleoenvironmental conditions in the region.

Overall, the combination of globally significant wildlife, vibrant Maasai culture, diverse natural attractions, and important archaeological sites makes tourism a central and dynamic component of Narok County's economy and identity.

6.4.2.12 Project Area of Influence

The SGR Phase two project wayleave corridor is within a radius of 1.5kms from the following places Mwisho wa Reli, Emurtoto-Kotikash, ACK Nturumeti Dispensary, Maasai Mara Technical and Vocational College, AIC Siayaibei Children's Home, Siyapei AIC Dispensary, K.A.G Oloroito church, Oloipito Jesus Healing Sanctuary, Kosen Sylvester, Empopongi Primary School, Narok Teachers Training College, Lopiding Hospital, FPFK Oldonyo church, Ekisiom church, Hekima International School, Chestor school, RIC Kuria Kenya, Koitamugul Primary School, Kuto Primary School, Kilanda Deliverence church, Laluk Primary School, Chemagel Primary School, Ollmirani High School, Kilusu Primary School, Mulot Health centre and Mulot Believers church.

6.4.3 Bomet County

6.4.3.1 Administrative Units

Bomet County is divided into five (5) Sub-Counties, 25 wards, 77 locations, 190 sub-locations and 1,275 villages as shown in **Table 44** and **Figure 45** below. The locations and sub-locations are administrative units of the national government. The Bomet County Government Coordination Act, 2014 (Amendment 2019) established Sub-County, Ward, Sub Ward and Villages as shown.

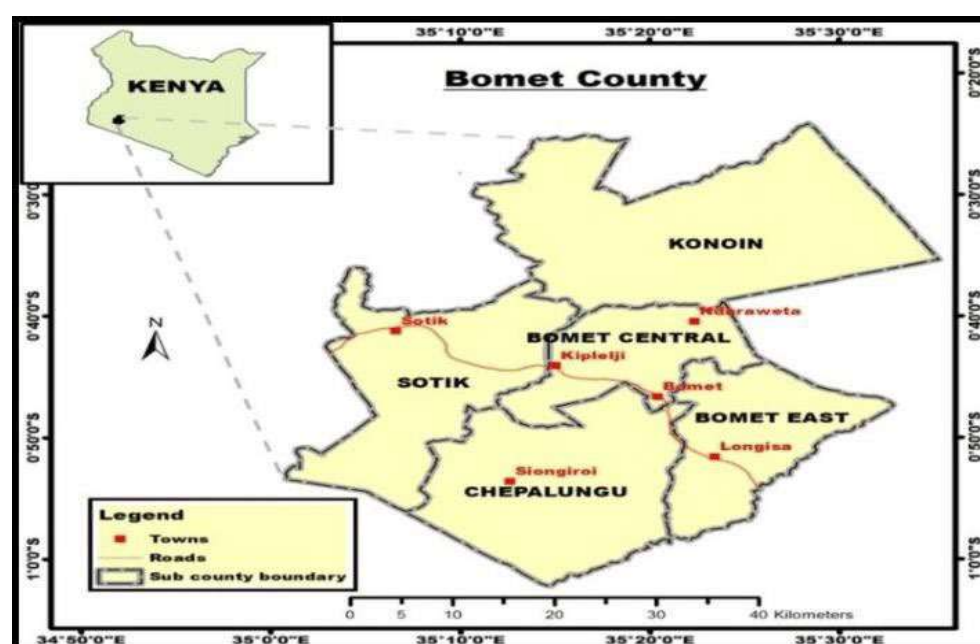


Figure 45: Administrative Units

Table 44: Administrative Sub Division of Narok County

Sub-County	Land Area in Km ²	Names of Wards	No. of Locations	No. of Sub-Locations
Bomet Central	305	Silibwet, Singorwet, Ndoraweta, Chesoen and Mutarakwa	8	24

Sub-County	Land Area in Km ²	Names of Wards	No. of Locations	No. of Sub-Locations
Bomet East	286.1	Longisa, Kembu, Chemaner, Merigi and Kiprerer	10	26
Chepalungu	460.5	Sigor, Kongasis, Chebunyo, Nyongores and Siongiroi	13	39
Sotik	544.3	Ndanai/Abosi, Kipsonoi, Kapletundo, Chemagel and Manaret/Rongena	19	51
Konoin	392.5	Kimulot, Mogogosiek, Boito, Embomos and Chepchabas	27	50
Total	1988.4		77	190

Source: Bomet County Integrated Development Plan, 2023-2027

Sotik sub-County is the largest in land area covering 544.3 Km², followed by Chepalungu (460.5 Km²), Konoin (392.5Km²) and Bomet Central (305 Km²). Bomet East is the smallest with an area of 286.1 Km². Some sections of the expansive Mau Forest fall within Bomet County and it covers an area of 542.3 Km².

6.4.3.2 Demographic Profile

Bomet County recorded a population of 875,689 in the 2019 Census (49.6% male and 50.4% female). Its demographic structure mirrors national patterns but with localized variations. The population was projected at 927,020 in 2022 and is expected to reach 965,243 in 2025 and 987,694 by the end of the planning period. This rapid population increase places considerable pressure on existing infrastructure and the provision of basic services.

Rural urban migration from the SGR Phase 2B project areas Bomet East, Chepalungu, Central, and Sotik is driven by limited rural economic opportunities, as well as the search for improved education, healthcare, and overall socio-economic stability.

According to the 2019 Census, Bomet town has the highest population (11,765), followed by Sotik (4,194), Mulot (3,149), and Chebilat (2,838). Chebilat lies along the main highway to Kisii and spans two counties. However, due to the small sample sizes, population projections for these centres cannot be reliably developed for the plan period. Proper urban planning remains essential to ensure adequate amenities for the growing population.

Table 45: Population Density and Distribution by Sub County

Sub County		2019		2022		2025		2027	
	Land area Km2	Pop	Density	Pop	Density	Pop	Density	Pop	Density
Bomet East	305	144,275	473	152,732	501	159,030	521	162,729	534
Chepalungu	461	164,837	358	174,499	379	181,694	394	185,920	403
Konoin	393	163,507	417	173,092	440	180,228	459	184,420	469
Sotik	544	227,855	419	241,211	443	251,157	462	256,999	472
Bomet Central	286	175,215	613	185,486	649	193,134	675	197,626	691
Total	1988.4	875,689	440	927,020	466	965,243	485	987,694	497

Source: Bomet County Integrated Development Plan, 2023-2027

Local Communities and Vulnerable Groups

Bomet County is predominantly inhabited by the Kipsigis, a sub-tribe of the Kalenjin people, who are the majority ethnic group in the county. The primary language spoken is Kipsigis, which is part of the Kalenjin dialect cluster. Vulnerable groups include those experiencing poverty due to the county's high poverty rate of 46.5%, which affects communities such as the Kipsigis, the predominantly Kipsigis population in Bomet County, women, and the youth. Other vulnerable groups are likely to be the elderly and persons with disabilities.

6.4.3.3 Economic Profile

Bomet County's economy is dominated by agriculture, particularly the production of tea, dairy, and horticultural crops like maize and Irish potatoes for subsistence and sale. Livelihoods are largely tied to farming, with residents relying on agriculture for their income and food security. While efforts are underway to improve infrastructure and social services, challenges like high poverty rates (46.5% in 2019) and limited electricity access persist, underscoring the need for further development to diversify the economy and improve livelihoods.

The economies of the Sub Counties traversed by the SGR project of Bomet East, Bomet Central, Chepalungu, and Sotik are primarily agricultural, with tea being a significant cash crop and tea factories serving as key employers. Other agricultural activities and Micro, Small, and Medium-sized Enterprises (MSMEs) also contribute to employment and livelihoods, with county plans focused on fostering socio-economic development and improving quality of life through strategic investments, infrastructure development, and promotion of sustainable practices. Other agricultural products

include bananas and pineapples, and the county has tea processing factories that serve the farming communities.

6.4.3.4 Land Tenure and Use

In the sub-counties of Bomet East, Central, Chepalungu, and Sotik, which are traversed by the proposed SGR project, the predominant land tenure systems include freehold, leasehold, and communal/customary ownership. Most agricultural land is held under freehold tenure, granting landowners absolute ownership. Other parcels are held under leasehold arrangements, while communal land is jointly owned by ethnic or cultural groups.

Land use within the SGR project area is largely driven by agriculture, with extensive cultivation of tea, maize, beans, potatoes, and various vegetables. Bomet County's long-term economic vision is to develop into a balanced, agro-based economy by 2031, supported by land-use planning focused on sustainable agriculture, rural and urban development, industry, infrastructure, ecotourism, and environmental management. Key land uses include:

Agriculture is the primary economic activity in Bomet County, comprising both subsistence and commercial production. Major practices include:

- **Tea Cultivation:** Primarily concentrated in the eastern parts of the county near the Mau Forest.
- **Food Crops:** Maize, beans, Irish potatoes, millet, cabbages, onions, bananas, and pineapples are grown for household consumption and for sale in local and regional markets.

Informal land use is dominated by subsistence and commercial agriculture. Residents cultivate maize, beans, potatoes, tea, bananas, pineapples, and vegetables. Local markets such as those in Mulot play an important role in the sale of these produce. The county's spatial plan seeks to formalize and regulate such land uses to support sustainable development and improved infrastructure.

The dominant informal land use remains agriculture, including:

- **Subsistence Farming:** Households grow maize, beans, Irish potatoes, millet, cabbages, and onions primarily for their own consumption.
- **Commercial Farming:** Tea, maize, beans, and potatoes are sold in local markets and supplied to external markets, including Nairobi and neighboring counties.
- **Fruit and Vegetable Cultivation:** Bananas, pineapples, and assorted vegetables are produced for both consumption and sale.

In the SGR project area Bomet East, Central, Chepalungu, and Sotik women experience considerable challenges in accessing land and inheritance rights. Despite constitutional guarantees of gender equality, entrenched Kipsigis customary laws prioritize male ownership, reinforcing patriarchal norms. These limitations are compounded by cultural beliefs, limited awareness of legal rights, economic constraints, and the high cost and complexity of navigating the formal legal system.

6.4.3.5 Education

In the 2020–2021 fiscal year, Bomet County recorded an Early Childhood Development and Education (ECDE) teacher pupil ratio of 1:58 in public ECDE centres and 1:27 in private centres.

For primary education, pupil–teacher ratios vary significantly across the county. Some schools have ratios ranging between 60–80 pupils per teacher, while others exceed 100 pupils per teacher, indicating uneven distribution of teaching staff and pressure on learning resources.

Schools within the SGR Phase 2B project area include:

Mulot Girl's High School, Kiplabotwa Secondary School, Ndubai Primary School, Siwot Primary School, Kesedut Primary School, Kerundut Secondary School, Bomet School, Kapkesosio Primary School, Kipsegon Primary School, Kimenderit Primary School, Kaplele Primary School, Kimatisio Primary School, Tiriyita Primary School, Kimatisio Secondary School, Kagwet Primary School, Davstar Academy, Nyagaa, Sachangwan Primary School, Tarakwa Secondary School, Tarakwa Primary School, Ivyana Academy, Heshima Junior Academy, Kimawit Primary School, Liz Education Centre, Kimolwet Junior Academy, Tamongo Primary School, and Kamirai Secondary School.

6.4.3.6 Health

Bomet County's health services are organized into a network of facilities, ranging from community health units to county referral hospitals, providing a continuum of care from basic primary services to specialized treatment. Key facility types include:

- Community Health Units: Comprising trained volunteers who deliver primary healthcare, sanitation, and health education at the community level.
- Dispensaries: Offer basic medical care, often with limited services.
- Health Centers: Provide a broader range of services than dispensaries and serve larger community populations.
- Sub-County Hospitals: Offer essential medical services at the sub-county level, with more advanced care than health centers.
- County Referral Hospitals: The highest tier of public healthcare in the county, providing specialized care and managing referrals from lower-level facilities. Longisa County Referral Hospital is an example.
- Private Clinics and Nursing Homes: Supplement public healthcare by offering alternative medical services.

Health facilities within a 1.5 km radius of the SGR project corridor include Kaplele Dispensary, Kimawit-Uswet Dispensary, and Cheptur Health Services.

Prevalent Diseases and Health Challenges

In Bomet East, Central, Chepalungu, and Sotik sub-counties, common health issues include:

- Aflatoxin contamination: Health risks from contaminated staple foods.

- East Coast Fever: Tick-borne livestock disease affecting livelihoods.
- Cardiovascular diseases (CVDs): Increasing incidence linked to limited access to healthcare.
- Environmental and other factors: High infant mortality rates and occurrences of esophageal cancer among young people have also been reported.

The county's health system aims to address these challenges through accessible healthcare, preventive interventions, and improved service delivery across both public and private facilities.

6.4.3.7 Water

Water supply in the Bomet East, Chepalungu, Bomet Central, and Sotik areas of Bomet County, Kenya, is being addressed by the Bomet Water Supply and Sanitation Project, a \$1.4 billion initiative funded by the African Development Bank (AfDB) and implemented by the Lake Victoria South Water Works Development Agency (LVSWWDA). This project aims to significantly expand clean water access and improve sanitation for approximately 216,850 people who have faced water scarcity.

Access to safe water within the Sub Counties traversed by the proposed project include water contamination from agricultural runoff containing pesticides and fertilizers also poses a major risk, alongside untreated wastewater from the Kapkoros Tea factory, increasing the prevalence of water-related diseases like cholera. Inadequate sanitation, such as improper latrine disposal and lack of sewage systems, further exacerbates these problems, leading to the contamination of shallow wells and increased health risks for residents.

6.4.3.8 Transport and Communication Network

The transport scenario in the sub-counties traversed by the proposed SGR project involves significant reliance on rural roads, with a general lack of tarmac, particularly in Bomet East. While these Sub Counties are a hub for agriculture, especially tea cultivation, the existing transport infrastructure, a mix of tarmac and many rural roads, struggles to support the needs of rural and urban development. Key challenges include connectivity, insufficient road networks, and the need for better infrastructure to facilitate economic activities and development initiatives within these constituencies.

Communication services in the SGR Project Sub Counties of Bomet East, Central, Chepalungu, and Sotik are generally available, with a focus on standard telecommunication providers and internet access, though specific network coverage can vary. These areas operate within the larger framework of Bomet County's ongoing development, which includes efforts to improve infrastructure and services. Safaricom, Airtel and Telkom Kenya services are available in the project area.

6.4.3.9 Energy

In the sub-counties of Bomet East, Central, Chepalungu, and Sotik, the primary sources of energy are traditional fuels such as firewood and charcoal, although efforts are underway to promote renewable energy, particularly solar power, through Bomet County's climate change action plans.

Electricity from the national grid is also used where accessible, while rural households largely depend on biomass for cooking and heating.

The heavy reliance on woodfuel is influenced by factors such as household income, accessibility of fuel, and availability of alternatives. Cost-effectiveness and convenience make woodfuel the dominant energy choice, particularly among lower-income and less-educated households, despite increasing awareness of sustainable energy options.

The extensive use of woodfuel has environmental and social impacts, including deforestation, soil erosion, loss of soil fertility, and air and water pollution. It also places a disproportionate burden on women, who spend significant time collecting fuel, and poses public health risks through respiratory problems. Biodiversity is also threatened, with Chepalungu experiencing notable tree cover loss.

6.4.3.10 Recreation and Tourism

Bomet County offers outdoor recreation through its caves and waterfalls located in Konoin, Bomet Central, Bomet East, and Chepalungu sub-counties, along the Itare, Nyongores, Amalo, and Chepkulo rivers. While the county is primarily recognized for its strong agricultural base—notably in tea, horticulture, and dairy farming—efforts are underway to develop and promote its natural tourism attractions.

The county's cultural heritage is closely linked to the Kalenjin people, particularly the Kipsigis sub-tribe, known for traditional farming practices, unique language, and ancestor veneration. Cultural preservation is supported by institutions such as the Kaplelach Cultural Centre, which showcases the history and traditions of the Kipsigis community.

6.4.3.11 Cross Cutting Issues

Bomet County is actively working to enhance the status of women, vulnerable groups, and human rights by implementing policies that promote gender equality, supporting children's homes, and providing resources for persons with disabilities. Despite these efforts, several challenges persist, limiting the full realization of equality and inclusion:

Challenges:

- **Gender Inequality:** Deeply entrenched patriarchal norms and cultural biases continue to restrict women's participation in governance and leadership, even with constitutional protections in place.
- **Land Rights:** Women, particularly in Bomet East, face significant barriers to accessing and controlling land due to limited awareness of legal rights and prevailing societal constraints.
- **Gender-Based Violence (GBV):** GBV remains a major concern, with gaps in awareness, access, and quality of prevention and response services.
- **Financial Barriers:** Economic constraints limit women's ability to participate in elections and leadership roles, affecting both candidacy and retention in leadership positions.

Addressing these issues requires continued policy enforcement, community sensitization, legal empowerment, and targeted interventions to ensure inclusive and equitable development across the county.

6.4.3.12 Proposed Project Area

The SGR Phase 2B project will traverse Bomet East, Chepalungu, Bomet Central, and Sotik sub-counties. The proposed wayleave corridor lies within a 1.5 km radius of several key landmarks, including:

- Towns and Commercial Centers: Mulot Sunset Town, Kiplenjin Shopping Centre
- Educational Institutions: Mulot Girl's High School, Kiplabotwa Secondary School, Ndubai Primary School, Siwot Primary School, Kesedut Primary School, Kerundut Secondary School, Bomet School, Kapkesosio Primary School, Kipsegon Primary School, Kimenderit Primary School, Kaplele Primary School, Kimatisio Primary School, Tiriyita Primary School, Kimatisio Secondary School, Kagwet Primary School, Davstar Academy, Nyagaa, Sachangwan Primary School, Tarakwa Secondary School, Tarakwa Primary School, Ivyana Academy, Heshima Junior Academy, Kimawit Primary School, Liz Education Centre, Kimolwet Junior Academy, Tamongo Primary School, Kamirai Secondary School.
- Religious Institutions: Korara AGC, Kiplabotwa Deliverance Church, Sach Angwan AGC Church, African Gospel Church – Waikeri, Kiletien Church of God – Seventh Day, Africa Inland Church – Chebango, AIC Cheseon, Kapkesembe Kingdom Assembly, Kambira Deliverance Church, Deliverance Church Kaplong.
- Health Facilities: Kaplele Dispensary, Tarakwa Health Centre, Kimawit-Uswet Dispensary, Cheptur Health Services.
- Infrastructure and Natural Features: River Mara crossing, KETRACO Bomet Substation, Chororoita Dam (within the wayleave corridor).

This corridor passes near numerous key social, educational, religious, and infrastructure landmarks, highlighting the need for careful planning and mitigation during project implementation.

6.4.4 Kericho County

6.4.4.1 Administrative Units

Kericho County, located in the Rift Valley region of Kenya, covers an area of approximately 2,454 km² and had a population of over 900,000 according to the 2019 Census. The county is administratively divided into six sub-counties: Bureti, Kipkelion West, Kipkelion East, Ainamoi, Belgut, and Sigowet-Soin. These sub-counties serve as the main administrative units for coordinating government functions, development initiatives, and service delivery. Each sub-county is further subdivided into wards, which are electoral units represented by Members of County Assembly (MCAs) and also function as local administrative zones for planning and provision of services. Within these wards, there are smaller locations and sub-locations, which in turn are divided into villages, representing the grassroots level of administration where community-based development activities are implemented.

The county is divided into 6 sub-counties, which are further sub-divided into 85 locations and 209 sub-locations as indicated in **Figure 46** below. There are also a total of 333 villages.



According to the 2019 Kenya Population and Housing Census by KNBS, Kericho County had a population of 901,777, comprising 450,071 males, 451,008 females, and 28 intersex persons, representing 49.91% male and 50.01% female. This was an increase of 143,438 people (16.46%) from the 2009 Census. Among sub-counties, Bureti had the highest population (199,470), while Kipkelion West had the lowest (122,380). The county's population growth rate of 1.2% is below

the national rate of 2.2%. Projections indicate the population will reach 949,953 in 2022, 1,000,704 in 2025, and 1,036,035 in 2027. The increasing population places pressure on the county's limited resources, underscoring the need for strategic planning and prioritization to ensure efficient service delivery.

Kericho County has seven urban centers, as classified under the Urban Areas and Cities Act. Kericho town is the largest, with a population of 53,804 in 2019, projected to grow to 61,810 by 2027. Kapkatet town is the smallest, with 1,310 people in 2019, expected to reach 2,854 by the end of the planning period.

The growth of urban centers is driven by rural-to-urban migration, as people seek employment, better education, business opportunities, and access to social amenities available in urban areas.

Table 46: Population and Area of different Sub Counties

Sub-County	No. of Locations	No. of sub- locations	Area (Km ²)	Population as at 2019	Population density as at 2019	HHS at 2019	Average HH at 2019
Ainamoi	11	24	240.6	170,625	709	44,246	3.8
Belgut	12	27	264.3	145,075	549	35,012	4.1
Soin/ Sigowet	13	38	466.2	126,500	271	27,195	4.6
Kipkelion West	16	35	349.9	122,380	350	24,688	5
Kipkelion East	14	32	399.5	137,580	344	31,778	4.3
Bureti	19	53	320.6	199,470	622	43,117	4.6
Mau Forest	-	-	201.2	-	-	-	-
Tinderet Forest	-	-	193.7	-	-	-	-
Total	85	209	2436.1	901,777	370	206,036	4.4

Source: Kericho County Integrated Development Plan, 2023-2027

Vulnerable groups

Vulnerable groups in Bureti and Soin/Sigowet sub counties include the elderly, people with disabilities, at-risk youth and children, HIV/AIDS-affected individuals, and potentially ethnic minorities, alongside women and internally displaced persons. Specific vulnerabilities in Kericho County may also be linked to its large tea plantation economy, which can create unique challenges for workers and their families, and its environment. Vulnerable groups that exist in Bureti and Soin/Sigowet include:

- **The Elderly:** The elderly has challenges related to health, poverty, and social isolation, making them a vulnerable group.
- **People with Disabilities:** Individuals with mental and physical disabilities may require significant support and resources, putting them at risk of marginalization.
- **Children and Youth:** At-risk children and youth, including those orphaned, abandoned, or exploited, are often vulnerable.
- **People Affected by HIV/AIDS:** Households and individuals affected by HIV/AIDS may experience social and economic hardship.
- **Ethnic Minorities:** Although Bureti and Soin/Sigowet is largely Kipsigis, the presence of other ethnic groups could create vulnerabilities in certain contexts.
- **Women:** Women are a vulnerable group facing discrimination or other disadvantages such as land ownership and inheritance.
- **Tea Plantation Workers:** The large tea industry in Bureti and Soin Sigowet may create specific challenges for workers and their families, potentially including poor living conditions, low wages, or precarious employment, though these are not explicitly mentioned in the search results.

6.4.4.3 Economic Profile

Kericho County's economy is predominantly agriculture-based, with tea farming as the primary driver of employment and livelihoods. The county's fertile soils and cool climate make it ideal for tea cultivation, with large international companies such as Unilever Kenya, James Finlay, and Williamson Tea serving as major employers. Tea production not only supports local livelihoods but also contributes significantly to Kenya's national economy. Other cash crops, including coffee and sugarcane, also contribute to the county's economic output.

Tea Farming

Tea farming is the cornerstone of Kericho's economy, generating substantial economic activity through employment in cultivation, processing, packaging, logistics, and trade. The presence of major tea companies creates both direct and indirect job opportunities, benefiting local communities.

Poultry and Livestock Farming

In Bureti and Soin/Sigowet, poultry and livestock farming are key economic activities. Programs to improve farming practices include farmer training, community-based chicken distribution, and

initiatives to enhance dairy farming and milk collection, boosting incomes and market access for pastoralist communities.

Livelihood Sources

Large tea estates and agricultural companies provide stable employment, while additional livelihoods include trading, livestock keeping, and craft industries. In Bureti, residents rely on trade, livestock, and crafts, whereas Soin/Sigowet focuses on livestock management and dairy production.

Formal and Informal Employment

The county's economy features a mix of formal and informal employment. The formal sector, dominated by large-scale tea and coffee farming, offers skilled, stable, and long-term jobs, particularly in agribusiness, management, and technical roles. The informal sector including small businesses, trade, and services employs many residents, particularly youth and women, providing opportunities for entrepreneurship but often involving precarious work with limited support. Examples include women pineapple vendors and small-scale traders. Both sectors together form the backbone of Kericho's economic landscape, supporting livelihoods and local development.

6.4.4.4 Land Tenure and Use

Land tenure in Kericho County, particularly in Bureti and Soin/Sigowet sub-counties traversed by the SGR Phase 2B project, is shaped by a mix of formal laws and informal customs. Historical land settlement schemes and the establishment of large-scale tea estates have heavily influenced current land distribution. Most land is privately owned, either as individual freehold or leasehold, though communal ownership through families or clans remains common. Formal tenure is recognized under Kenyan law, while customary tenure governs access, use, and inheritance within local communities. Ongoing land adjudication processes sometimes give rise to disputes.

Land Use

Land use in the project area is predominantly agricultural, with tea cultivation as the dominant activity, complemented by other crops such as sugarcane. Supporting land uses include residential settlements, infrastructure, and areas designated for forests and natural reserves, which provide essential environmental services like water catchment and biodiversity protection.

Informal Land Users

Informal land users occupy areas without formal land rights or planning, such as Swahili Village, where residents live in settlements characterized by limited infrastructure and unregistered land tenure.

Women's Access to Land and Inheritance Rights

Despite constitutional protections and the Law of Succession Act, women in Bureti and Soin/Sigowet face significant barriers to land ownership and inheritance due to patriarchal cultural practices. Challenges include limited legal awareness, difficulty proving customary marriage, and unregistered land, leaving women vulnerable to disinheritance upon divorce or widowhood. Efforts

to enhance awareness and formalize land rights are critical to improving women's access and security over land.

6.4.4.5 Education

Kericho County has a public and private education sector for ECD centers, primary schools, and secondary schools, along with public youth polytechnics. Schools like Kabianga School and Kipsigis Girls are notable institutions in the county.

- Institutional breakdown includes;
- ECD Centres: There are 565 public and 489 private ECD (Early Childhood Development) centers.
- Primary Schools: The county hosts 526 public and 277 private primary schools.
- Secondary Schools: A total of 214 public and 15 private secondary schools are present.
- Youth Polytechnics: Six public youth polytechnics are located in the county.

The following are learning institutions with a radius of 1.5kms from the SGR wayleave corridor: Bureti Technical Training Institute, Kericho National Polytechnic, Kapsinendet Primary, Kaminjeiwa Primary, Tegat Comprehensive School, Arokyet Primary, Arokyet Girls Secondary, Kibaraa Elite Academy, Siongoi Primary, Cheptagum Primary School, Chesamisiet Primary School and Cheptuiyet High School.

6.4.4.6 Energy Sources

In Bureti and Soin/Sigowet, the energy mix is largely renewable, with geothermal and hydroelectric power being the primary sources. Other sources, including biomass, solar, and potential wind energy, also contribute to meeting local energy needs. Household energy use is influenced by socioeconomic factors such as income, which affects the ability to afford modern energy sources, and the accessibility of local energy options like solar panels or hydroelectric power from rivers. Household size and location rural versus peri-urban further shape energy requirements for cooking, lighting, and other daily needs. Additionally, the region's energy demand is heightened by tea production, which requires both thermal and electrical energy. National energy policies and international support for renewable energy also play a key role in shaping the energy landscape in these sub-counties.

6.4.4.7 Health

Kericho County's health sector includes the Kericho County Referral Hospital as a primary public facility, along with various health centers and dispensaries providing primary and community-level care. Services span from community outreach and preventive care to secondary care, following the Kenyan Essential Package for Health (KEPH). The system integrates public, private, and faith-based providers across multiple tiers of care.

Key Components of Kericho's Health Services

- County Referral Hospital: This is the main public hospital in the county, providing secondary-level care.

- Health Centers and Dispensaries: These facilities offer primary and basic health services at the community level, falling under the KEPH tiers for community health and primary care.
- Public, Private, and Faith-Based Facilities:
- Kericho's health system includes government-run facilities, private medical centers and clinics, and faith-based organizations offering healthcare services.

Doctor to patient ratio in Kericho county is 1:11,000 against national statistics of 1/16,000 and WHO 1:1000.

Medical facility within a radius of 1.5kms from the SGR project wayleave corridor is Cheptuiyet Dispensary.

Prevalent Diseases in the Project Area and their Causes

In the SGR project region of Bureti and Soin/Sigowet, diarrhea, typhoid fever, HIV-1 infection, and thyroid diseases are prevalent. Diarrhea and typhoid are often caused by contaminated water, food, and poor sanitation, especially in areas with open defecation and open water sources. HIV-1 prevalence is high, particularly among women, with risk factors including age, marital history, and sexually transmitted infection history. Increased cases of thyroid disease are also noted, with financial costs and access to follow-up care being significant challenges.

6.4.4.8 Water Sources

Bureti and Soin/Sigowet water supply relies significantly on surface and groundwater but is currently undergoing major upgrades through projects like the Bureti Water Expansion and the Litein-Itare Water and Sewerage Project to improve access and reliability. The Kericho Water and Sanitation Company Limited (KEWASCO), a wholly county-owned entity, manages the water distribution and sanitation services.

6.4.4.9 Transport and Communication Network

The Bureti and Soin/Sigowet transport scenario is characterized by a significant reliance on boda-bodas (motorcycle taxis) for local and youth-focused movement. Inter-city travel is dominated by buses and other public transport service providers.

6.4.4.10 Tourism and Recreation

Kericho County's tourism is anchored on its scenic tea plantations, natural landscapes, and rich cultural heritage. Visitors can enjoy tea tasting tours in the renowned plantations, explore the Mau Forest with its biodiversity and hiking trails, and visit natural attractions such as Boito and Chereres Waterfalls and the Chagaik Arboretum.

Tourism activities in the county include:

- Cultural Tourism: Experience Kipsigis traditions through dances, local markets, and handicraft shopping.
- Community-Based Tourism: Participate in homestays and cultural performances for immersive local experiences.

- **Adventure & Nature:** Engage in hiking, mountain biking, and wildlife spotting in protected areas.

Additional attractions include:

- **Kericho Tea Plantations:** Explore the estates that define the county's economy and landscape.
- **Masai Curio:** Discover local art, cultural artifacts, and crafts.
- **Cheru Cultural Tours:** Participate in guided tours to learn about local culture.
- **Chai Square:** A public space celebrating the region's iconic tea heritage.

Overall, Kericho offers a blend of nature, adventure, and cultural experiences, making it a unique destination for both recreation and learning.

6.4.4.11 Cultural Heritage and Archaeology

Kericho County's cultural heritage is rooted in the traditions of the Kipsigis community, a sub-tribe of the Kalenjin, with sites like Tulwap Kipsigis Hill holding cultural significance. While not extensively documented, archaeological interest could involve cave systems like Van Wicker's Lost Cave, which provides insight into early settlement and European influence. Other heritage aspects include numerous churches, and the unique cultural identity stemming from a blend of indigenous and immigrant communities, such as the Kikuyu, Luo, and Indian populations. Some cultural heritage and interest include;

- **Kipsigis Culture:** The predominant inhabitants are the Kipsigis, the county's primary ethnic group. Their rich traditions are central to the county's cultural identity.
- **Tulwap Kipsigis Hill:** This is a notable cultural attraction that holds deep spiritual and historical significance for the Kipsigis community.
- **Van Wicker's Lost Cave:** This cave, once the property of a Dutch national named Major Douglas van Wicker, offers a unique archaeological insight. The cave features man-made chambers and was initially intended as a private project, but its abandonment left it as an interesting historical site.
- **Indigenous Forests:** The county is home to several indigenous forests, which can also serve as sites of cultural or ecological significance.

6.4.4.12 Project Area

The SGR Phase 2B project passes through Bureti and Soin/Sigowet sub-counties, which are predominantly inhabited by the Kipsigis, a sub-tribe of the larger Kalenjin ethnic group.

Key landmarks within a 1.5 km radius of the SGR wayleave corridor include:

- **Educational Institutions:** Bureti Technical Training Institute, Kericho National Polytechnic, Kapsinendet Primary, Kaminjeiwa Primary, Tegat Comprehensive School, Arokyet Primary, Arokyet Girls Secondary, Kibaraa Elite Academy, Siongoi Primary, Cheptagum Primary School, Chesamisiet Primary School, Cheptuiyet High School.

- Religious Institutions: Tiritamoita SDA Church, Kaldit Liberty Gospel Church, Tononkoi Liberty Gospel Church (inside the corridor), AIC Cheptagum, Kapsiara AGC Church.
- Health Facility: Cheptuiyet Dispensary.

These landmarks highlight the social, educational, and cultural infrastructure located close to the SGR corridor, which may be impacted during project implementation.

6.4.5 Nyamira County

6.4.5.1 Administrative Units

Nyamira County is administratively divided into five sub-counties: Nyamira South, Nyamira North, Borabu, Manga, and Masaba North. The county further comprises 16 divisions, 49 locations, 113 sub-locations, and 1,862 villages. Borabu is the largest sub-county with an area of 246.9 km², followed by Nyamira North at 215.7 km², while Manga is the smallest at 111.5 km².

Politically, the county functions as an electoral unit led by an elected Governor and Deputy Governor, supported by six Members of the National Assembly. Four of these represent the county's constituencies:

- West Mugirango: aligns with Nyamira South sub-county
- Kitutu Masaba: covers Manga and Masaba North sub-counties
- North Mugirango: aligns with Nyamira North sub-county, except Kiabonyoru division, which falls under Borabu constituency
- Borabu: covers the entire Borabu sub-county

The remaining two elected members represent Nyamira County at the Senate and as the women representative in the National Assembly. The county also has 20 County Assembly wards, each represented by a Member of the County Assembly.

The proposed SGR Phase 2B corridor passes only through Nyamira North Sub-County. Key landmarks within a 1.5 km radius of the corridor that may interact with the project include: River Sondu crossing, Nyabwaroro Primary School, Gisage Secondary School, Gitebe Technical Training Institute, Garthill Educational Centre, Magwaga Health Centre, and Morembe Primary School.

Table 47: Administrative Units

Sub-county	Land Area (km ²)	No. of Divisions	No. of locations.	No. of sub-locations.	No of Villages
Nyamira South	181.5	2	8	19	458
Nyamira North.	215.7	4	10	26	488
Borabu.	246.9	4	9	18	196
Manga.	111.5	3	10	24	359
Masaba North.	141.7	3	12	26	361
TOTAL.	897.3	16	49	113	1,862

Source: Nyamira County Integrated Development Plan, 2023-2027

6.4.5.2 Demographic Profile

According to the 2019 Population and Housing Census, Nyamira County has an inter-census population growth rate of 1.2% per year, below the national rate of 2.2%. The county population was estimated at 653,515 in 2022 (317,109 males and 336,407 females), expected to rise to 665,477 in 2025 and 672,337 by 2027, with women slightly outnumbering men across most age cohorts. The productive population (20–49 years) is female-dominated, underscoring the need for gender mainstreaming in economic and employment opportunities. Higher female numbers among those aged 70+ indicate the importance of interventions addressing male vulnerability and mortality at advanced ages.

Urbanization is increasing due to rural-urban migration and population growth. Urban populations are projected to grow from 202,853 in 2022 to 215,321 by 2027, driving demand for improved infrastructure and services such as roads, housing, sewerage, waste management, health, and education. Keroka town, along the Kisii-Sotik highway, experiences high settlement due to business opportunities.

Nyamira Municipality, established under the Urban Areas and Cities Act (2011, amended 2019), spans parts of Borabu, Nyamira North, and Nyamira South sub-counties. Covering 155 km² with a population density of 947 persons/km², its population is projected to increase from 161,240 in 2022 to 171,150 in 2027, with an average household size of 38.

The county is predominantly inhabited by the Abagusii (Gusii) community, with Ekegusii as the main language. Minority groups include the Luo in the north and Kipsigis in the east, while Swahili and English are commonly used for official and inter-ethnic communication.

Table 48: Population projections (by sub-county and sex)

Sub County	2019			2022			2025			2027		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Borabu	36,736	36,431	73,167	40,045	38,949	78,959	40,538	39,882	80,404	40,827	40,411	81,233
Manga	44,868	49,339	94,209	48,909	52,750	101,667	49,512	54,013	103,528	49,864	54,730	104,595
Masaba North	52,884	58,974	111,860	57,647	63,051	120,715	58,357	64,561	122,925	58,773	65,417	124,192
Nyamira North	80,314	86,947	167,267	87,548	92,957	180,508	88,626	95,183	183,812	89,257	96,447	185,707
Nyamira South	76,105	82,965	159,073	82,960	88,700	171,666	83,981	90,824	174,808	84,580	92,030	176,610
TOTAL	290,907	314,656	605,576	317,109	336,407	653,515	321,014	344,463	665,477	323,301	349,035	672,337

Source: Nyamira County Integrated Development Plan, 2023-2027

6.4.5.3 Economic Profile

Nyamira County's economy is heavily dependent on agriculture, which provides the primary source of livelihood and employment for the majority of its population, despite persistent poverty challenges. The services sector is the second-largest contributor, followed by industry, while the county's agricultural productivity remains vulnerable to climate change. Approximately 90% of the population relies on agriculture directly or indirectly, which accounts for about 80% of employment opportunities.

In the SGR project area of Nyamira North Sub-County, both formal and informal employment are largely driven by the informal sector, particularly agriculture and tea farming, which sustains the local economy and provides widespread employment. The formal sector is less dominant due to limited wage employment opportunities. Many youths engage in informal businesses, contributing to a labor-intensive sector that also serves as a platform for skills development through apprenticeships and on-the-job training. **Figure 47** below shows the Tea Plantation.



Figure 47: Tea farms within Nyamira County

6.4.5.4 Land Tenure and Use

Land Tenure

Nyamira North Sub-County's land tenure is primarily characterized by its reliance on customary land inheritance practices, despite the government's efforts to amend laws, establish land courts, and promote Alternative Dispute Resolution (ADR) to address issues like inheritance conflicts and gender inequality in property rights. Land ownership in Kenya, and thus likely in Nyamira North, falls under the formal systems of freehold and leasehold, but these are often intertwined with or superseded by customary practices, particularly in the context of inheritance.

Land Use

Nyamira North Sub-County land uses are primarily agricultural. Given Nyamira County's economy is 90% dependent on agriculture, the dominant land use in Nyamira North, like the rest of the county, is for agricultural activities. Other land uses may include settlements, infrastructure, and potentially conservation areas, though agriculture is the most significant economic and land-use driver in the region.

Nyamira North sub-county, features significant poultry and livestock farming, particularly dairy and cattle, which are threatened by extreme rainfall. The region also has a high poultry production, with "kienyeji" chicken farming being a growing, profitable venture for farmers. Efforts are underway to enhance food security through climate-smart agriculture and improved farming practices.

6.4.5.5 Education

Nyamira County provides education from ECDE to university, with 661 ECD centres, 510 primary schools, 247 secondary schools, 3 public university campuses and 15 Youth Polytechnics.

The following learning institutions which are within 1.5kms radius from the wayleave corridor which are likely to interact with the project are Nyabwaroro Primary School, Gisage Secondary, Gitebe Technical Training Institute, Garthill Educational Centre and Morembe Primary.

6.4.5.6 Energy Sources

In the proposed SGR project region of Nyamira North sub-county, the primary sources of energy are solar, biomass (wood fuel, charcoal), and kerosene for lighting, with electricity from the national grid for some homes and businesses. Key contributing factors include the county's reliance on solar due to its renewable nature, the extensive use of biomass driven by agricultural activities and the need for domestic energy, and the impact of poverty and energy infrastructure on the availability and affordability of electricity.

6.4.5.7 Water Supply

The community gets water from local streams, springs and wells. Independent water supply through the Nyamira Water and Sanitation Company (NYAWASCO) was launched on 1st July 2025, after splitting from the Gusii Water and Sanitation Company (GWASCO). This initiative aims to provide adequate, reliable, and affordable water and sanitation services to improve the health of its residents and support economic development, following the Kisii and Nyamira Water Supply and Sanitation Systems Expansion Project.

According to the International Federation of Red Cross (IFRC), Nyamira North Sub-County, water-related diseases are a significant concern, with common conditions including diarrhea, typhoid, cholera, and other waterborne illnesses resulting from contaminated water sources. These diseases, often caused by pathogenic bacteria and viruses from animal or human faecal waste, manifest as symptoms like abdominal pain, vomiting, and diarrhea. Improving water and sanitation, protecting water sources, and implementing hygiene education programs are crucial for risk reduction in the area.

6.4.5.8 Health

Nyamira County provides a range of public health services through the County Government of Nyamira's Department of Health Services, which manages various facilities including the Nyamira County Referral Hospital and numerous health centers and dispensaries across the county. Services offered include specialized treatments like dialysis and orthopaedics at the referral hospital, as well as primary healthcare and medical insurance programs for vulnerable families. Some key health facilities include;

- ✓ **Nyamira County Referral Hospital (NCRH):** Located in Nyamira town, this government-run hospital provides comprehensive outpatient and inpatient services, including specialized treatments such as dialysis, orthopaedic surgery, and other major surgeries, which previously required referrals outside the county.
- ✓ **Health Centers and Dispensaries:** Nyamira County has a network of lower-level facilities, including health centers and dispensaries, such as Riechieri Health Centre, St Joseph's Nyansiongo Health Centre, and Tinga Health Centre, which offer primary and specialized medical care.

Inadequate staffing leading to overstretched medical staff. The doctor: population ratio is 1:11,906 against the Kenyan ratio of 1 doctor per 10,000 people. This indicates overstretched medical personnel. The inadequacy in staffing leads to low motivation hence low productivity. Poor accessibility of some health facilities located in the rural areas due to impassable roads during the rainy season.

Magwaga Health Centre is within 1.5km from the wayleave corridor and is likely to interact with the SGR project.

Prevalent Diseases and their Causes within the SGR Project Area

Nyamira County experiences a range of diseases, including non-communicable diseases like prostatism and cardiovascular diseases, linked to lifestyle changes and urbanization, and communicable diseases such as typhoid fever, often stemming from poor hygiene. Drug and substance abuse are also prevalent, particularly among males. The presence of contaminants in medicinal plants, potentially due to fertilizer and pesticide use, also presents a health concern.

6.4.5.9 Transportation and Communication Network

Nyamira County has a transportation network of approximately 1,132 km of classified roads and 435 km of rural access roads, with a significant portion being earth or gravel roads, serving its agricultural potential. For communication, the county is connected by various mobile network providers and is working to improve its infrastructure to stimulate the economy and enhance rural access

Roads: Nyamira County has a network that includes classified roads (e.g., tarmacked, graveled, and earth roads) and rural access roads.

6.4.5.10 Recreation and Tourism

Nyamira County offers diverse recreational opportunities through its natural landscapes, including hills, valleys, and swampy wetlands, providing scenic areas for exploration and nature-based activities. The county's cultural heritage is predominantly shaped by the Gusii community, known for traditional crafts such as basket weaving, pottery, and blacksmithing, as well as vibrant cultural dances and music. The region, part of the Lake Victoria Basin, is rich in history and holds potential for archaeological discoveries related to early human settlements.

The county is primarily inhabited by the Abagusii, with minority groups including Luo in the north and Kipsigis in the east. Tourism in Nyamira emphasizes Abagusii culture and traditional practices, with organizations like the Otenyo Cultural Group in Keroka promoting cultural tourism through dance performances, language courses, and traditional cuisine. Notable natural attractions include hilly terrains, valley bottoms, and wetlands, offering both scenic beauty and opportunities for eco-tourism.

6.4.5.11 Cross Cutting Issues

In Nyamira County, promoting and protecting the rights of vulnerable groups—including women, girls, persons with disabilities, the elderly, and other marginalized populations—is a key development priority. The county addresses these issues through strategies such as promoting gender equality, increasing access to justice, mobilizing communities, and building capacity among local stakeholders. These efforts aim to reduce discrimination, ensure equitable access to public services, and empower vulnerable populations to participate fully in social, economic, and political life.

Key Focus Areas and Challenges

- **Gender Inequality and Gender-Based Violence (GBV):** Women and girls in Nyamira face systemic barriers to empowerment, including limited participation in leadership, unequal access to resources, and high rates of domestic and sexual violence. County initiatives focus on improving access to services, legal protection, and empowerment programs to enhance safety, independence, and decision-making capacity.
- **Vulnerable Populations:** Other marginalized groups, such as persons with disabilities, the elderly, and the poor, encounter social, economic, and structural exclusion. Challenges include poverty, limited mobility, and inadequate representation in decision-making processes, which hinder their access to essential resources and opportunities.
- **Access to Justice and Public Services:** Vulnerable groups often struggle to access justice, healthcare, education, and social support services. Barriers include lack of awareness of rights, high costs, cultural practices, and limited infrastructure. Improving service delivery and raising legal and social awareness are critical for inclusion.
- **Poverty and Livelihoods:** Women and marginalized groups are disproportionately affected by poverty, often relying on natural resources and informal livelihoods. This dependence increases vulnerability to economic shocks, climate change, and social marginalization. Cross-cutting interventions, such as skills development, financial inclusion, and equitable access to land and markets, are essential to enhance resilience and promote sustainable livelihoods.

Table 49: Sub Counties and Sizes

Sub-County	No. of Divisions	No. of Locations	No. of sub- locations	Area (Km ²)
Kisumu East	1	5	12	141.6
Kisumu Central	1	3	9	36.8
Kisumu West	3	6	20	209.0
Seme	1	6	28	267.7
Muhoroni	2	10	35	657.5
Nyando	2	14	36	446.1
Nyakach	4	23	35	326.7

Source: Kisumu County Integrated Development Plan, 2023-2027

6.4.6.2 Demographic Profile

In 2019, Kisumu County had a population of 1,155,574, comprising 560,942 males, 594,609 females, and 23 intersex persons. The population is projected to grow to 1,290,016 in 2025 and 1,329,805 in 2027 (Kisumu CIDP 2022–2027). This rapid population growth underscores the need for increased investment in social infrastructure and utilities, including schools, healthcare facilities, water, sanitation, and other essential services.

Population density, which reflects the concentration of people in a given area, is an important indicator of resource utilization. Kisumu County has an overall density of 554 persons per km², with the most densely populated sub-counties being Kisumu Central (4,737), Kisumu East (1,560), Kisumu West (827), Nyakach (460), Seme (454), Nyando (362), and Muhoroni (234). This pattern is expected to continue, with general increases in density across all sub-counties throughout the implementation period, reflecting overall population growth.

Population distribution in Nyando, Muhoroni, Kisumu East, Kisumu Central, and Kisumu West sub-counties is influenced by factors such as access to water sources (e.g., proximity to the River Nyando), land use patterns, socio-economic opportunities including employment, and environmental hazards such as flooding. These factors concentrate populations in resource-rich, stable areas like urban centers and along major waterways, while other areas remain sparsely populated or experience fluctuating settlement patterns. **Table 50** below shows demographic profile of Kisumu County.

Table 50: Population projections

Sub- county	Census (2019)				2022 (Projection)			Projection (2025)			Projection (2027)		
	M	F	Inter-sex	T	M	F	T	M	F	T	M	F	T
Kisumu Central	84,155	89,985	5	174,145	91,726	93,267	184,993	96,031	98,354	194,386	98,796	101,587	200,402
Kisumu East	108,304	112,689	4	220,997	118,047	116,799	234,846	123,588	123,170	246,758	127,146	127,219	254,318
Kisumu West	85,697	87,121	3	172,821	93,406	90,299	183,705	97,791	95,224	193,015	100,606	98,354	198,878
Nyando	77,121	84,380	7	161,508	84,059	87,458	171,517	88,005	92,228	180,233	90,538	95,260	185,859
Nyakach	71,237	79,082	1	150,320	77,645	81,967	159,612	81,290	86,437	167,727	83,630	89,278	172,984
Muhoroni	76,770	77,345	1	154,116	83,676	80,166	163,842	87,604	84,539	172,143	90,126	87,318	177,353
Seme	57,658	64,007	2	121,667	62,845	66,342	129,187	65,795	69,960	135,755	67,689	72,260	140,011

Source: Kisumu CIDP, 2023-2027

Vulnerable groups

This section represents the population profile of Persons with Disability in Kisumu County and attempts to provide a breakdown of the demographic features and their social economic implications for the county in terms of resource mobilization and allocation.

The plan relied on the data provided by the National Census on the population of Persons with Disabilities (PWDs) According to 2019 Census, 2.2% (0.9million people) of the total population of Kenyans represent PWDs. From the National census conducted Kisumu County had a total of 39,868 Persons with Disabilities in which Males were 16,311 and Females 23,557 spread across the seven sub counties.

Majority of the Population presenting with disability were of the Visual domain (17606) and this was evident across all the age groups, followed by physical/mobility (16,196), Hearing (7291), other cognition (7922), Self-care (4288) and Speech (3409). The age group that is mostly affected by disability is the 55+ due to the onset of old age.

6.4.6.3 Economic Profile

Kisumu County serves as the main commercial and transport hub for western Kenya and the broader East African region. Its economy is diverse, with major activities including subsistence farming, livestock keeping, fishing, rice and sugarcane farming, and small-scale trading as shown in **Table 50** below. The county's economic base is largely composed of micro, small, and medium enterprises (SMEs).

Industrial activities also play a significant role in Kisumu's economic growth. The county hosts three state-owned sugar mills Chemelil, Muhoroni, and Miwani and one privately-owned mill, Kibos. Additionally, Kisumu is home to Kenya Breweries, which supports local sorghum farmers, and Equator Bottlers, responsible for processing, bottling, and distributing Coca-Cola products throughout the western region. Other industries include ballast manufacturing, paint production, and steel and cement factories, contributing to employment and industrial development in the county.

Table 51: Livelihood distribution among the Sub Counties

Sub County	Farming	Crop production	Livestock production	Aquaculture	Fishing	Irrigation
Kisumu East	16,348	13,516	10,354	119	235	875
Kisumu central	4,157	2,541	2,769	47	289	451
Kisumu West	23,207	21,018	15,276	99	1,009	538
Seme	24,014	22,896	16,524	91	1,634	459
Muhoroni	26,368	25,070	16,932	141	384	2,284

Sub County	Farming	Crop production	Livestock production	Aquaculture	Fishing	Irrigation
Nyando	26,570	24,012	18,947	162	1,613	4,150
Nyakach	26,453	24,338	18,482	124	920	935

Source: KNBS Kenya Population and Housing Census, 2019.

6.4.6.4 Land Tenure and Use

Land Tenure

In Kisumu County, land tenure systems are mainly public, and individual tenure, with leaseholds and freeholds also prevalent in the peri-urban fringe. Urbanization and population growth put pressure on land, leading to challenges in land use planning and security of tenure. Kisumu County is classified into public land owned by the County Government, while communal land is traditionally held by local communities. Individual tenure, including leaseholds and freeholds, is also common, particularly in urban areas and peri-urban fringes.

Land Use

Kisumu County's land uses include a variety of agricultural practices, urban development, and areas designated for specific purposes like urban renewal and infrastructure as indicated in **Table 49** below. The county also has areas with forest cover, shrubs, herbaceous vegetation, wetlands, and bare/sparse vegetation.

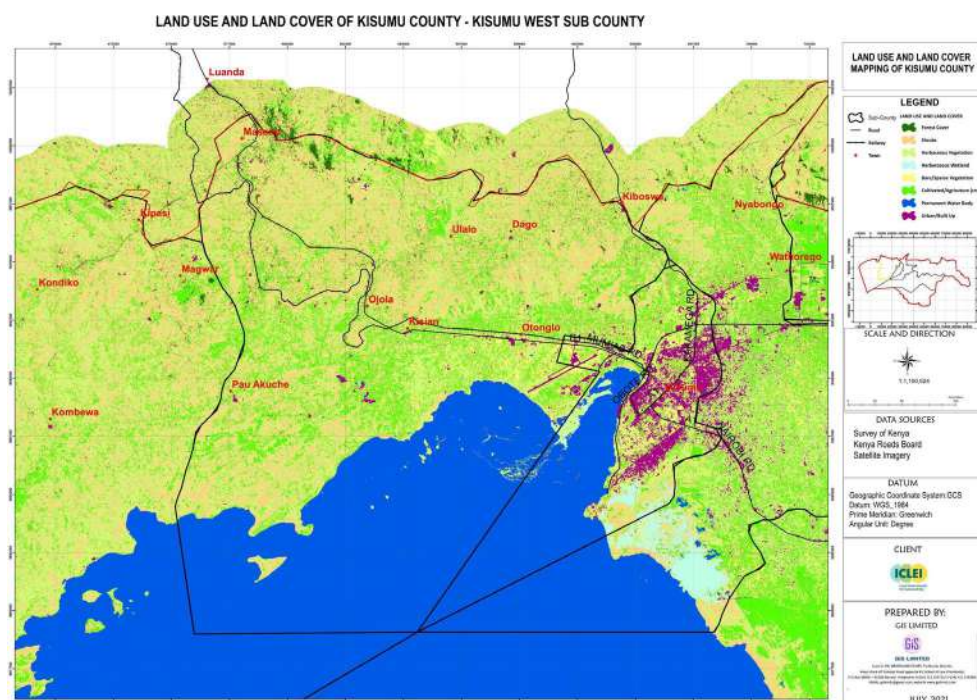


Figure 49: Land use within Kisumu County

Source: Land use/Land cover in Kisumu County (2022)/<https://www/Kisumu.go.ke>

Land use within project corridor is primarily driven by agricultural activities, with significant sugarcane and rice farming in Muhoroni and Nyando and diverse land uses including urban development, residential areas, and smaller-scale agriculture in the Kisumu City-centered constituencies of Kisumu East, Kisumu Central, and Kisumu West. These areas are characterized by interactions between human activities and the natural potential of the land, leading to a mix of land use dynamics.

In Kisumu County, informal land use is characterized by rapid urbanization, migration, inadequate housing, and limited infrastructure, alongside issues like land grabbing, subdivisions, and encroachment on public land, which create conflicts and insecurity. Land ownership is predominantly male-dominated, with women's ownership extremely low (as little as 5.99% in Nyando), reflecting historical and customary biases. Emerging reforms, including family-centered approaches and joint ownership, aim to address these gender disparities and promote more equitable land access.

6.4.6.5 Education

Kisumu's education infrastructure is focused on providing foundational education, vocational training, and supporting social services. The county government aims to improve access to quality education, including early childhood development (ECD) and vocational training. Significant investments are being made in ECD centers, including construction and capacity building for teachers.

A total of 77.7% of the population has completed either primary or secondary education. According to 2019 KNPHS, Kisumu County has 504, 312 school going population at different levels distributed as shown in **Table 52** below.

Table 52: Number of Learning Institutions and Teachers in Kisumu County

Number of schools	Public	Private
ECD centres	657	550
Primary schools	615	206
Secondary schools	226	26
No. of teachers	Public	Private
ECD centres	1688	1627
Primary schools	6174	1554
Secondary schools	2895	288
Pupils Teacher Ratio	Public	Private
ECD centres	29	18

Primary schools	41	21
Secondary schools	31	11

Source: CRA County Data Sheet, 2023

6.4.6.6 Health

According to an assessment conducted by labflow.com in Kisumu County has a total of 353 health facilities of different levels spread across the 7 sub-counties. Out of these, 5.4% are faith-based facilities (19) while 41.6% owned by the Ministry of Health (147). This leaves 7.9% under NGO's (28) and 45% listed as private facilities (159).

Some of the key health facilities within Kisumu County offering specialist services e.g. Diagnostic Imaging, Surgical Services, Maternity Services, Tuberculosis Treatment, dental care and youth-Friendly Services amongst others include friendly health services include:

- Kisumu County Referral Hospital (KMHR): A major public hospital with services like youth-friendly services, X-ray, vaccination, ultrasound, tuberculosis treatment, surgical outpatient clinics, and specialized X-ray.
- Kisumu Specialists Hospital (KSH): A 50-bed hospital with emergency services, diagnostic imaging (including MRI, CT scan, X-ray), and a range of clinical care specialties.
- Avenue Healthcare Kisumu Hospital: A hospital with a range of services, including general medical and surgical wards, maternity, pediatric, burns and isolation units, dialysis, private rooms, ICU, operating theaters, outpatient services, pharmacy, laboratory, and CT scan/X-ray.
- The Aga Khan Hospital, Kisumu: Provides a range of medical services, including general medicine and surgery, women's health, and other specialized areas.
- Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH): A national teaching and referral hospital with various specialized services.

Medical Facilities Within 1.5kms Radius from the Wayleave corridor include Katolo-Manyatta Dispensary, Melrose Arc Hospital, Obumba Dispensary, Star Hospital Kisumu Annex and St. Jairus Hospital.

6.4.6.7 Water Sources

The main water sources in Kisumu are L. Victoria, shallow wells, unprotected springs, boreholes and roof catchment systems and bottled water. During the dry season, some of the water sources run dry forcing people to take longer time to fetch water. Women and children specially spend more time in search of water than men and boys. Kisumu Water and Sanitation Company (KIWASCO) provides water and sanitation services in Kisumu town and its environs County, according to KIWASCO's website. KIWASCO operates two water treatment plants, Dunga (44,000 m³), which produces 40% of Kisumu's water through pumping and Kajulu (36,000 m³), with a total capacity of 80,000 m³ and produces 60% of Kisumu's water via gravity.

The contractor will be required to obtain water abstraction permit from Water Resources Authority to draw water for construction and other uses from surface water bodies. In the event that contractor may need to drill boreholes, necessary permits shall be obtained in compliance with the WRA requirements.

Access to Safe Drinking Water

According to Commission for Revenue Allocation (CRA) County Data Sheet, 2023, only 5.9% Household in Muhoroni, 8.8% in Nyandon and 46% in Kisumu central Sub Counties have access to safe drinking water as shown in **Figure 50** below.

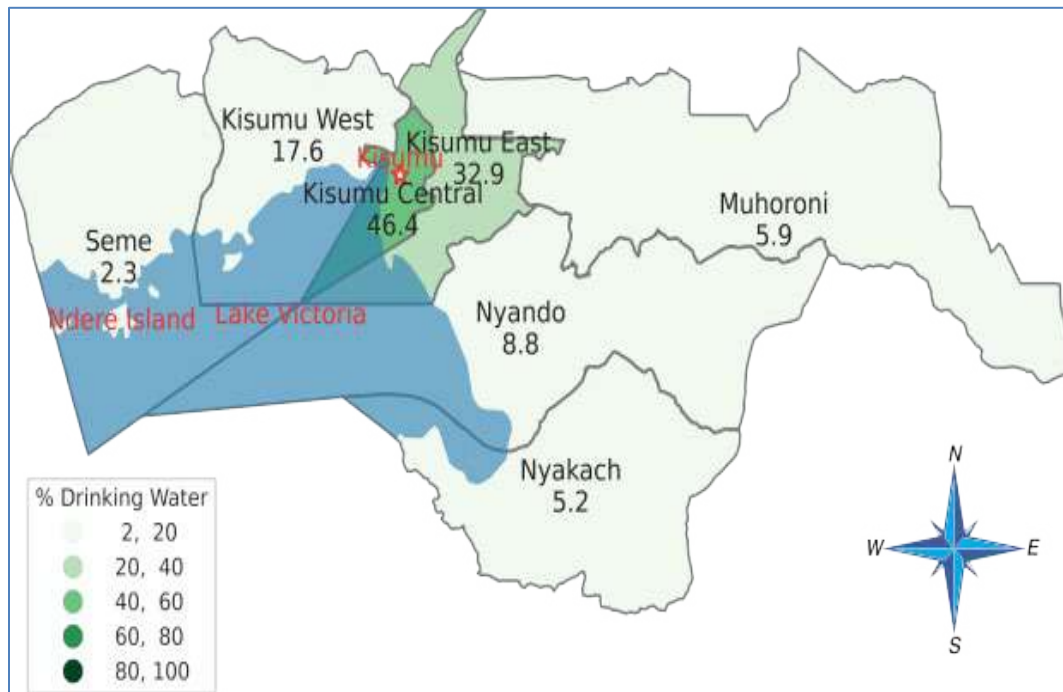


Figure 50: Percentage of HHs Accessing safe drinking water

Source: CRA Kisumu County Data Sheet, 2023

6.4.6.8 Energy

Kisumu County's energy consumption for household needs primarily revolves around paraffin gas, Biogas, firewood, charcoal and solar mainly for cooking and lighting.

Urban–rural disparities are significant since most household in town centres use LPG gas as compared to firewood in rural areas. **Figure 51** below shows that majority of households in Nyando use firewood (89.2%) and charcoal (13%) while in Kisumu West, majority of households use firewood (55.1%), Charcoal (20.9) and LPG gas (16.1)

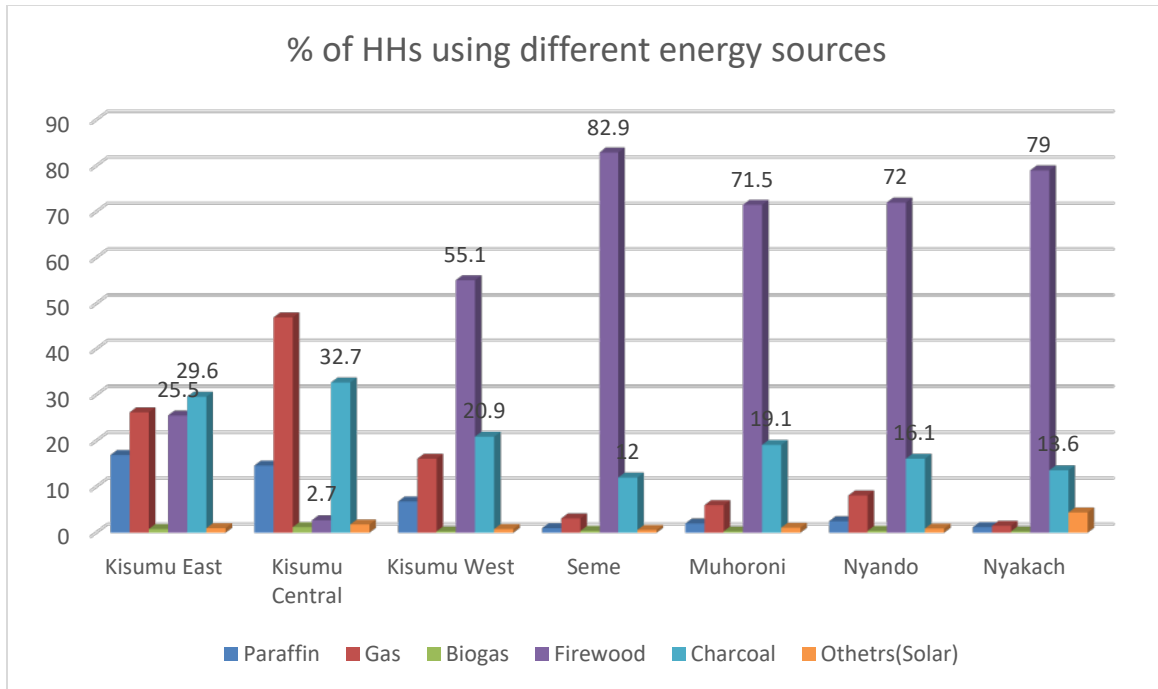


Figure 51: Distribution of Households by Energy use

Source: Source: Kenya Population and Housing Census, 2019

Access to Electricity

Household electricity connection within Kisumu County stands at 52.8%. The county hosts three major energy sources including Hydro: Sondu Mirui (60 MW), Sango'ro (21 MW), Thermal: Muhoroni GT1 (28 MW), Muhoroni GT2 (28 MW) and Biomass from sugar factories (own consumption), 21 MW. Electivity connectivity in Muhoroni sub County stand at 28.3%, Nyando at 33.8%, Kisumu Central at 91.3%while Kisumu East at 75.8% as shown **Figure 52** below.

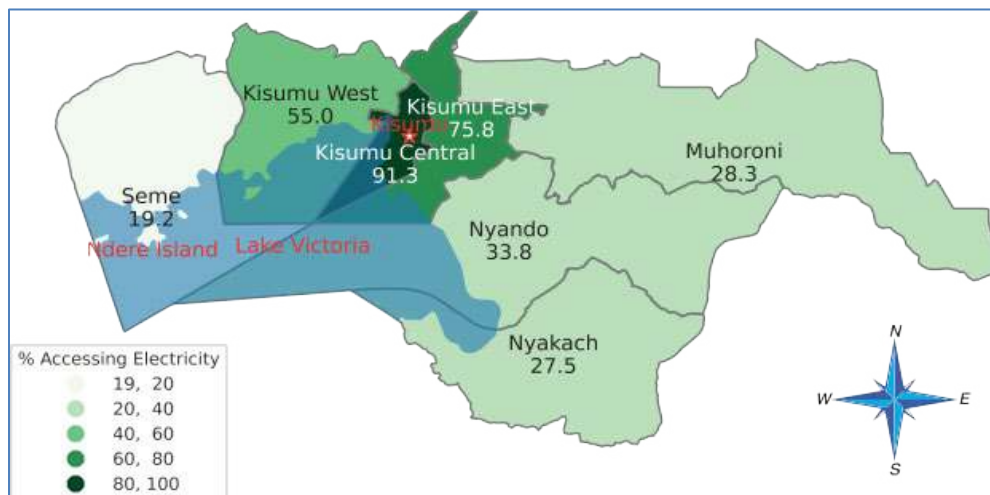


Figure 52: Percentage of HHs with Access to Electricity

6.4.6.9 Transport Network

The transportation scenario in Nyando, Muhoroni, Kisumu East, Kisumu Central, and Kisumu West is evolving with a focus on sustainable mobility, but continues to face challenges in public transport, infrastructure, and connectivity.

Kisumu Central, being the city center, likely has the most developed public transport system, including matatus and taxis. In contrast, other sub-counties like Nyando, Muhoroni, Kisumu East, and Kisumu West may have limited formal public transport, relying more on informal options like boda-bodas (motorcycle taxis) and private vehicles.

Some of the challenges affecting transport sector include congestion, accessibility, cost and reliability. Other transportation facilities include:

- **Air Transport:** Kisumu International Airport offers daily flights to other parts of the country.
- **Railway:** A railway line connects Nairobi and Kisumu, offering a scenic journey through the Kenyan landscape.
- **Ferry Service:** Traditional steam and diesel-powered ferries operate on Lake Victoria, connecting Kisumu with other ports in Uganda and Tanzania.

6.4.6.10 Recreation and Tourism

Kisumu offers a variety of recreational activities and attractions. These include exploring the Kisumu Impala Sanctuary, enjoying the vibrant Dunga Beach and wetlands, visiting the Kisumu Museum, and experiencing the unique rock formation of Kit Mikayi). Visitors can also enjoy boat trips on Lake Victoria, explore the West End Shopping Mall, and discover local markets like Kibuye and Oile. Below are some of the recreational sites within the county

Nature and Wildlife

- **Kisumu Impala Sanctuary:** This sanctuary is home to impalas, the rare Sitatunga antelope, and various other animals, including lions, leopards, and giraffes. Visitors can enjoy nature walks, bird watching, and boat rides.
- **Dunga Beach and Wetlands:** A unique ecological area with rich biodiversity, including over 800 bird species. Activities include bird watching, kayaking, and boat rides.
- **Ndere Island National Park:** Located on an island in Lake Victoria, offering opportunities for wildlife viewing and scenic views.
- **Hippo Point:** A popular spot near Dunga, offering views of Lake Victoria and the chance to see hippos.
- **Kit Mikayi:** A large rock formation with cultural and historical significance, offering scenic views and a place for picnics and other activities

These nature and wildlife sites are more than 10kms from SGR wayleave corridor.

Historical Sites

Kisumu County has a number of cultural and historical sites namely;

- **Kisumu Museum:** Features displays of local artifacts and cultural exhibits.
- **Kibuye Market and Oile Market:** Bustling local markets where visitors can experience the local culture and find a variety of goods.

Other Recreational Activities:

- **Boat Trips on Lake Victoria:** Enjoy scenic views of the lake and the city from a boat or canoe.
- **Bike ventures:** Offers bicycle tours and rentals for exploring the city and surrounding areas.
- **Sports:** Kisumu also has sporting venues like Oile Park, Jamhuri Park, and Jaramogi Oginga Sports Ground, which provide opportunities for active recreation.

Cultural Practices and Expressions

- **Ramogi and Dodo Dances:** Kisumu is known for its unique and vibrant cultural dance performances.
- **Oral Traditions:** Oral traditions are an important part of the cultural heritage of the region, and efforts are underway to document and preserve them.
- **Religious Diversity:** The city's diverse religious landscape, including Christian churches, Sikh temples, Muslim mosques, and Hindu temples, reflects the varied cultural backgrounds of its inhabitants.

These cultural sites and practices attract tourists hence a justification for the SGR project i.e ease of transport for tourists.

6.4.6.11 Area of Influence

The Area of Influence is governed through a dual leadership structure. Regular administration is divided between the County and National Governments. The County government structure includes Village Administrators, Ward Administrators, and the Governor, while the National government system includes Chiefs, Assistant County Commissioners (ACCs), District Commissioners (DCCs), and the County Commissioner. Political representation is provided by Members of County Assemblies (MCAs), Members of Parliament (MPs), and Senators at the national level.

Traditional leadership, represented by elders, is not officially recognized like elected officials but continues to play an important role in dispute resolution, community mobilization, and the preservation of cultural heritage.

The following locations are approximately within 1.5 km of the SGR wayleave corridor: Olasi Church, Olasi Primary School, Olasi Dispensary, Katolo-Manyatta Dispensary, Yogo Primary, Siany SDA Katito District, Waradho Primary School, Melrose Arc Hospital, Nyakongo Primary, Kochieng Health Centre, KE25036-0100D (2) R_03 ESIA Study for Phase 2B SGR

Okiro Primary, Kokuoyo Primary, Ahero Resource Centre, St. Camulus Ogwedhi Mixed, Konim Secondary School, Konim Primary, Onjiko Kobongo Primary School, Kigoche Primary, Kigoche Vocational Training Centre, Marega Primary School, Mitando Primary, Bacho Primary, Ombeyi Chief's Camp, Yao Catholic Centre, Obino Primary School, Dr. Aloo Gumbi Secondary School, Kang'o Primary, Achuodho Primary School, Obumba Dispensary, Prof. Ayiecho Olweny Obumba School, Chiga Market, Chiga Primary, St. John's Masawa Primary, St. Elizabeth Hospital Chiga, Bridge International Chiga, Kings Garden, Kibos East SDA Church, OLPS Kalusi Water Kiosk, Dodo Farm, Nyamonge Primary School, Kibos River Crossing, Kibos School for the Blind, Kenya Water Institute (KEWI) Campus, Tido Primary School, Star Hospital Kisumu Annex, Disciple of Mercy Kisumu, Jomo Kenyatta Stadium Kisumu, Kakamega-Kisumu Road Crossing, Victory SDA Church, KCA University Land Kanyakwar Kisumu, Kasarani Church of Christ, St. John Chrisostom Kudho Secondary School, Uzima University Main Campus, Central Nyanza Conference, Holo ACK, Kanyamedha Primary, Jowi Gardens, Kanyamony Primary School, Jan's Academy, St. Jairus Hospital, Okore Ogonda Secondary School, AIC Church, Kodiaga Prison Primary School, Kodiaga Main Prison, and Ogongo Primary School.

CHAPTER 7.0. CLIMATE CHANGE RISK AND VULNERABILITY ASSESSMENT

7.1 Background

The Narok–Kisumu SGR Phase 2B corridor traverses Narok, Bomet, Kericho, Nyamira, and Kisumu Counties—regions that are highly climate-sensitive and characterized by high rainfall variability, rising temperatures, recurrent flooding, and localized droughts. These climatic conditions pose both direct and indirect risks to rail infrastructure, rolling stock, maintenance operations, workers, and surrounding communities.

The corridor is increasingly exposed to climate hazards including extreme heat and cold, droughts, intense rainfall, flooding, landslides, and dust storms. Such hazards can adversely affect infrastructure stability, drainage systems, bridges, occupational health and safety, and local livelihoods.

This ESMP section on climate change risk and vulnerability draws on historical climate data and CMIP6 projections under SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios, bias-corrected using CHIRPS, CHIRTS, and ERA5 datasets. The assessment evaluates both current and future climate risks along the corridor to inform climate-resilient planning, construction, operations, and emergency preparedness. This approach aims to ensure that the SGR delivers sustained socio-economic benefits while safeguarding communities, agriculture, and ecosystems from the impacts of climate change.

Given the non-linear nature impacts of the SGR Phase 2B project, we augmented the regional summary with pixel-level spatial modeling (0.05° resolution) to identify localized *hazard hotspots* along the track. By integrating high-resolution historical baselines with future projections, in this study we identify specific segments of the corridor where topography, soil erosivity, and intensifying return-period rainfall events converge. This spatially explicit approach ensures that climate-resilience measures are targeted at the exact kilometer-markers most vulnerable to track washouts, slope failures, and hydraulic overtopping, thereby safeguarding the project's long-term structural integrity and operational continuity.

The assessment below summarizes the key climate hazards, exposure pathways, sensitivity factors, and the overall vulnerability of the project corridor.

7.2 Purpose of Climate Risk and Vulnerability assessment

The objectives of climate risk and vulnerability assessment for the proposed Narok - Kisumu SGR Phase 2B project are as under listed:

- To assess potential climate-induced impacts on structural integrity, operational continuity, safety, and maintenance needs of the SGR Project.
- To analyze the key climate-related hazards such as extreme rainfall, flooding, drought, temperature increases, storms, and erosion likely to affect the Narok - Kisumu SGR Phase 2B

section during construction and operation.

- To examine how susceptible the SGR infrastructure, operations, workers, and adjacent communities are to climate stresses, considering design standards, site conditions, and socio-economic factors.
- To determine which project components (tracks, bridges, culverts, embankments, work camps) and which surrounding communities are located in climate-sensitive or hazard-prone areas.
- To guide the integration of climate-resilient design measures such as improved drainage, slope stabilization, flood-proofing, and material selection into project plans and technical specifications.
- To minimize climate-related risks to nearby settlements, floodplains, wetlands, agricultural land, and ecosystems that may be affected by SGR development.
- To ensure that the SGR remains safe, functional, and reliable under future climate scenarios, reducing potential disruptions and increasing asset longevity.

7.3 Study Methodology

The climate impact assessment for the proposed railway project in Kenya used internationally recognized methods combining CMIP5 global climate models and CORDEX-Africa regional models, supported by historical data from KMD, CHIRPS (rainfall), and CHIRTS (temperature). The analysis examined key climate variables temperature, rainfall, and extreme precipitation alongside secondary risks such as flooding, soil moisture changes, and erosion. Model outputs were bias-corrected and ensemble statistics applied to manage uncertainty.

Climate results were aggregated at county and corridor levels to align directly with the railway route. Projections were integrated with engineering design standards to identify vulnerabilities in structures such as bridges, culverts, and embankments. Threshold analysis helped highlight areas requiring climate adaptation.

High-resolution satellite datasets provided a strong historical baseline, while future climate projections were generated from two GCMs (CESM1-CAM5 and MPI-ESM-MR) under RCP2.6, RCP4.5, and RCP8.5 scenarios. Monthly trends for temperature and rainfall were computed after bias correction to ensure consistency with observed conditions. Multi-model means were used to produce more reliable ensemble projections. The followings methods were used;

1. Resampling/ Regridding

Climate datasets from CHIRPS, CHIRTS, ERA5, and CMIP6 were processed to ensure consistency for project analysis. Coarser-resolution datasets (ERA5 and CMIP6) were regridded to match the high-resolution CHIRPS/CHIRTS grid (~5 km), using conservative methods for precipitation and bilinear interpolation for temperature and related variables. All data were standardized to daily values, ensuring

spatially and temporally aligned climate information for accurate assessment of climate impacts and project planning.

2. Bias correction

To ensure that the climate projections used in this study are realistic and relevant for local decision-making, we applied a bias-correction process. Because climate models can over- or underestimate rainfall, temperature, and other variables, we compared model outputs with trusted historical datasets (CHIRPS, CHIRTS, and ERA5) and used quantile mapping, a statistical method, to align the projections with observed patterns. This adjusts the full range of values, including averages and extremes, so projections better reflect the climate experienced on the ground.

3. Trend and Variability Analysis

After resampling and bias correction, the climate datasets were analyzed to identify trends and variability over the project corridor. Historical and projected time series were evaluated to detect long-term changes in temperature, precipitation, and other key variables, as well as interannual and seasonal variability.

4. Geospatial modeling and extreme value analysis

After the trend analysis, the corrected climate datasets were used to drive models to support the engineering and environmental safeguards of the SGR, three advanced spatial modules were developed:

1. **Extreme Precipitation Modelling:** Utilizing Extreme Value Theory (EVT), the Annual Maximum 3-day rainfall (AM3D) was extracted and fitted to a Gumbel Distribution. This facilitated the calculation of return levels for 2, 5, 10, 20, and 50-year return periods (IT), providing the hydrological 'stress-test' data required for culvert and bridge sizing.
2. **Rainfall-Induced Flood Risk Index (RFRI):** A fractional change analysis was performed to categorize the corridor into flood risk classes (Low to Very High) based on the percentage shift in seasonal precipitation from the historical baseline across all SSP scenarios.
3. **Soil Erosivity (R-Factor) Modelling:** To predict slope stability risks, the study modelled the R-Factor using the rainfall as leading indicator ($R=0.5 \times PR=0.5 \times P$), slope, soil and temperature. This identifies the kinetic power of projected rainfall to trigger landslides and embankment washouts.

7.3.1 Shared Socioeconomic Pathways (SSPs) and Planning Horizons

We used daily CMIP6 outputs for historical, SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios (1983–2099) to assess climate risks. CMIP6, from IPCC AR6 (2021), builds on and supersedes CMIP5 (AR5), which used RCPs to project warming (Siabi et al., 2023). Unlike CMIP5, CMIP6 couples' socio-economic pathways (SSPs) with forcing scenarios, enabling analysis of emissions, land use, and

adaptation storylines from sustainability (SSP1-2.6) to high-emission development (SSP5-8.5). The IPCC recommends AR6 CMIP6 scenarios as the basis for climate impact assessments. The 1983–2099 period ensures overlap with CHIRTS data, allowing consistent bias correction and high-resolution historical-to-future climate analysis.

The assessment relies on daily CMIP6 outputs (1983–2100) under three Shared Socioeconomic Pathways (SSPs):

Table 53: AR6 scenarios and project planning horizons

Scenario	Description	Planning Horizon Alignment
Historical	Baseline (1983–2014)	Construction phase and Immediate Operations
SSP1-2.6	Sustainability / Low emissions	Long-term operations (2070s)
SSP2-4.5	Middle-of-the-road	Mid-century maintenance (2050s)
SSP5-8.5	High-emission development	Early operations / construction impacts (2030s)

We used MPI-ESM1-2-LR and CanESM5 from the CMIP6 ensemble to project future climate over Kenya. MPI-ESM1-2-LR performs well in reproducing East African temperature and rainfall patterns, while CanESM5 adds structural diversity to capture uncertainties in climate projections (Hirons et al., 2021; Gleckler et al., 2025). Together, these models provide a balanced representation of plausible future climate conditions for regional impact assessment.

Overall, the approach delivers robust, county-specific climate projections that support risk-informed planning for railway infrastructure and broader sectors such as agriculture, water resources, and disaster management. **Table 54** below outlines summary of data set.

Table 54: Summary of data set used

Dataset	Source	Years	Spatial resolution	Temporal resolution	Variables	Use
CHIRPS	Climate Hazards Center	1981–2014	0.05° (~5 km)	Hourly	Precipitation used for downscaling	Bias correcting CMIP6 precipitation
CHIRTS	Climate Hazards Center	1983–2014	0.05° (~5 km)	Daily	Minimum & maximum temperatures	Downscaling and bias correcting CMIP6
ERA5	ECMWF - Climate Data Store	1983–2014	0.25° (~28 km)	Daily	Temperature; dew point temperature, maximum temperature, u wind, v wind, relative humidity	Bias correcting corresponding CMIP6 variables
CMIP6	ECMWF - Climate Data Store	1983–2100	~25 km	Daily	Mean temperature, minimum temperature, maximum temperature,	Baseline and future scenarios

Dataset	Source	Years	Spatial resolution	Temporal resolution	Variables	Use
					precipitation, specific humidity, pressure	

Unit conversions

Table 55: Unit Conversions for CMIP6 Variables

Variable	Original Units	New Units	Formula / Conversion
tas (Near-surface air temperature)	K	°C	°C = K – 273.15
tasmax (Daily maximum near-surface air temperature)	K	°C	°C = K – 273.15
tasmin (Daily minimum near-surface air temperature)	K	°C	°C = K – 273.15
pr (Precipitation)	kg m ⁻² s ⁻¹	mm/day	mm/day = (kg m ⁻² s ⁻¹) × 86400
huss (Near-surface specific humidity)	Dimensionless	kg/kg	No conversion needed
psl (Surface air pressure / Sea level pressure)	Pa	Pa	No conversion needed

Computation of Climate Indices Relevant to the SGR Project and Surrounding Areas

To support risk assessment and adaptation planning, a suite of climate indices was calculated from the processed datasets.

Assumptions and uncertainties

- Bias-corrected CMIP6 outputs accurately represent local climate conditions.
- Thresholds for heat/cold stress follow FAO (2018), Thornton et al. (2021), and Steadman (1979).
- Uncertainty arises from multi-model spread, scenario variability, and bias-correction/regridding methods.
- Confidence levels (IPCC AR6 guidance): High for temperature trends, Medium for extreme precipitation, Low–Medium for combined hazards (heat + dust, cold + rainfall).

References (for data sources)

- Funk, C., Peterson, P., Shukla, S., et al. (2019). *A high-resolution 1983–2016 Tmax climate data record based on infrared temperatures and stations by the Climate Hazard Center*. Journal of Climate, 32(17), 5639–5658. <https://doi.org/10.1175/JCLI-D-18-0698.1>
- Copernicus Climate Change Service (2018). *CMIP5 monthly data on single levels*. CDS. DOI: 10.24381/cds.9d44a987 (Accessed on 27-Nov-2025)

7.4 Climatic Conditions

Table 56 below present the summary of weather elements for the five counties traversed by the SGR Phase 2B project.

Table 56: Weather elements

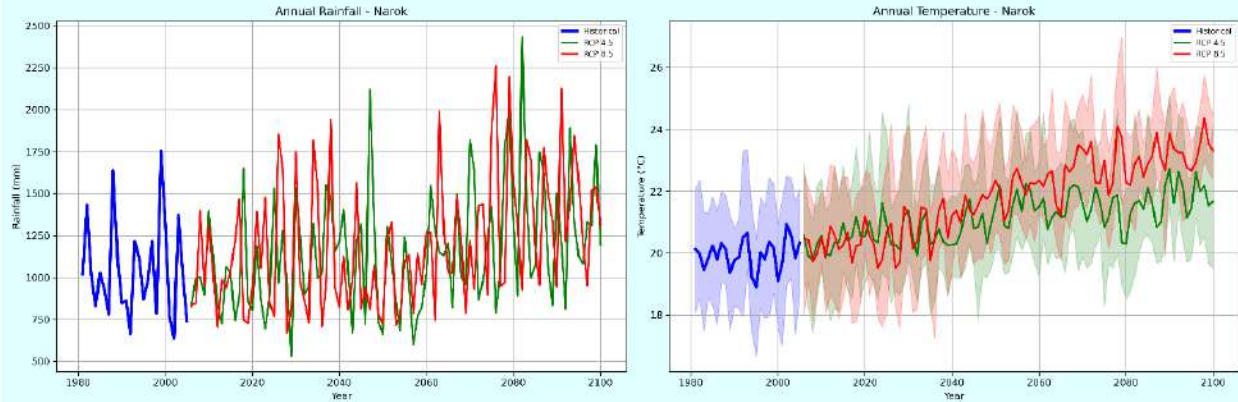
Weather Element	Narok	Bomet	Nyamira	Kericho	Kisumu
Climate Type	Highland & Semi-arid lowlands	Cool highlands	Wet highlands	Moist highlands (tea zone)	Tropical lowlands (Lake Victoria basin)
Annual Rainfall (mm)	500–1800	1200–1800	1400–2000	1800–2200	1000–1800
Rainfall Pattern	Bimodal (MAM, OND)	Bimodal (MAM–J, S–D)	Bimodal, rainfall nearly year-round	Bimodal with year-round showers	Bimodal; lake-induced convection
Temperature Range (°C)	10–30	12–26	14–28	10–24	20–34
Relative Humidity (%)	40–70 (lower in lowlands)	60–80	70–90	75–95	60–95 (high near lake)
Wind Characteristics	Moderate; stronger in plains	Light–moderate	Light winds	Light–moderate	Breezy near lake, occasional storms
Sunshine Hours/day	6–9	5–7	4–6	4–6	6–8
Seasonal Hazards	Droughts, flash floods	Flooding, erosion, landslides	Intense rainfall, landslides	Storms, erosion on slopes	Floods, thunderstorms, heatwaves
Evapotranspiration	Moderate–high	Low–moderate	Moderate	Moderate	High due to heat and humidity
Typical Weather Drivers	Altitude + ENSO	Mau Forest influence	Humidity + topography	Highlands rainfall dynamics	Lake–land breeze interactions

7.5 Climatic Projections

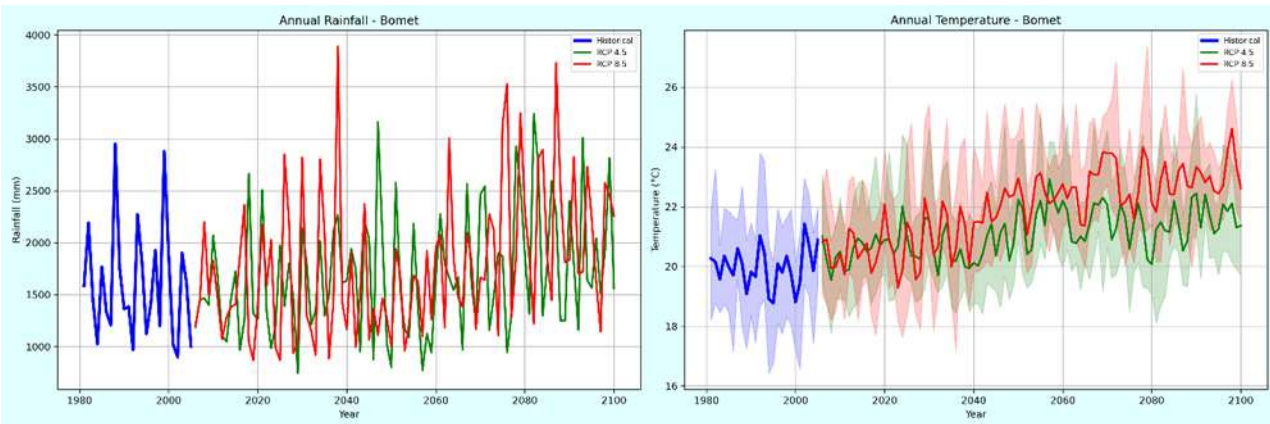
7.5.1 Heterogeneity of county Rainfall Trends

This section presents the projected climatic conditions for the five counties traversed by the SGR Phase 2B corridor. We first present county summaries and then show pixel based seasonal totals over the project area counties in section 7.5.2.

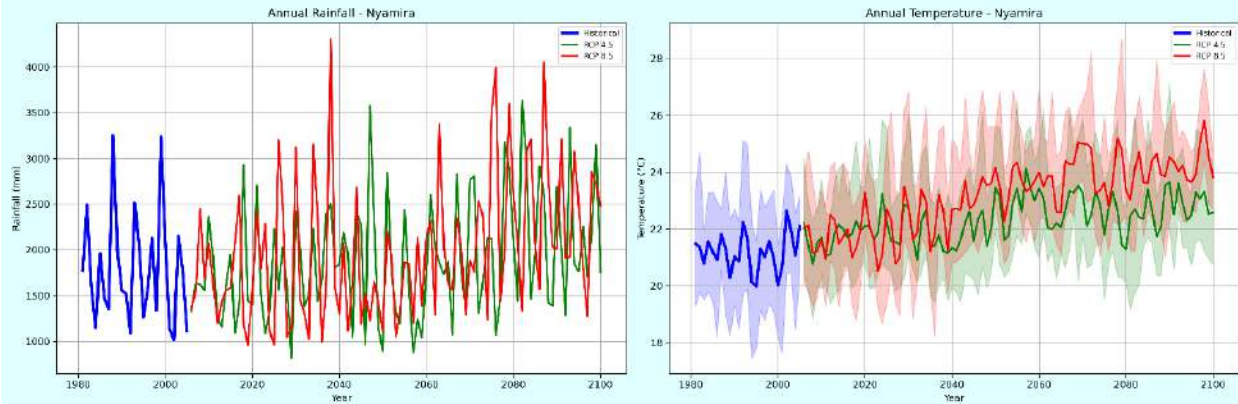
1. **Narok:** Narok, the historically driest county, shows moderate early-century increases (~157 mm, RCP4.5 2030s), minor mid-century decreases (-95 mm, RCP8.5 2050s), and late-century gains of ~383 mm (RCP8.5 2070s). Even with smaller absolute values, the relative changes may influence seasonal runoff along the railway corridor. *The figure below shows annual rainfall and temperature for Narok County.*



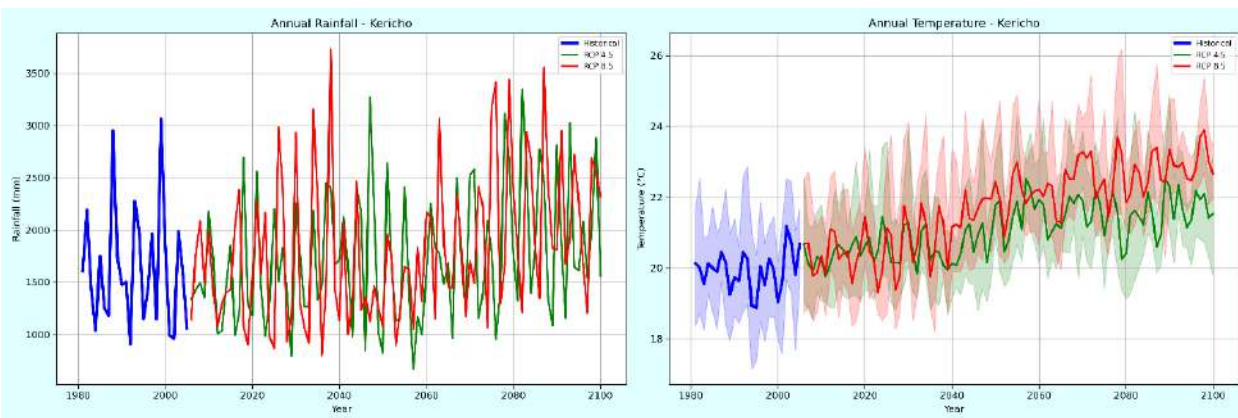
2. **Bomet:** Compared to its historical mean of 1597.91 mm/year, Bomet shows a slight increase of ~149 mm under RCP4.5 in the 2030s, a mid-century dip of -125 mm under RCP8.5, and a substantial late-century increase of ~688 mm under RCP8.5. This indicates that while early changes are moderate, late-century rainfall could significantly increase flood risk along the railway. *The figure below shows annual rainfall and temperature for Bomet County.*



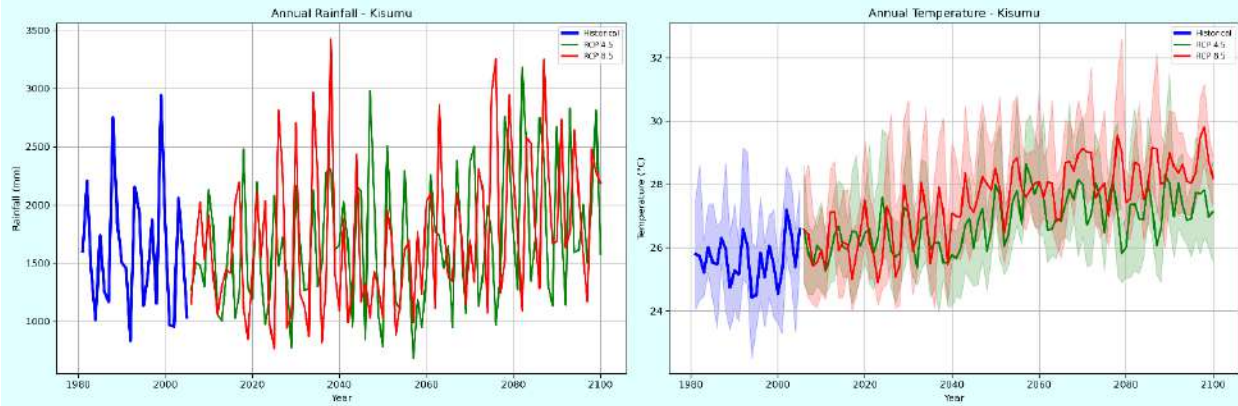
3. **Nyamira:** Nyamira's rainfall rises by ~170 mm in the early century, dips slightly mid-century (-146 mm), and sees the largest late-century surge (~758 mm, RCP8.5 2070s). This substantial increase implies heightened flood and landslide risks, necessitating robust water management infrastructure. *The figure below shows annual rainfall and temperature for Nyamira County.*



4. **Kericho:** Kericho's rainfall rises by ~201 mm in the RCP4.5 2030s, dips to -167 mm in RCP8.5 2050s, and surges by ~640 mm by the 2070s. Such fluctuations emphasize the need for combined flood and slope stabilization strategies for railway design. *The figure below shows annual rainfall and temperature for Kericho County.*

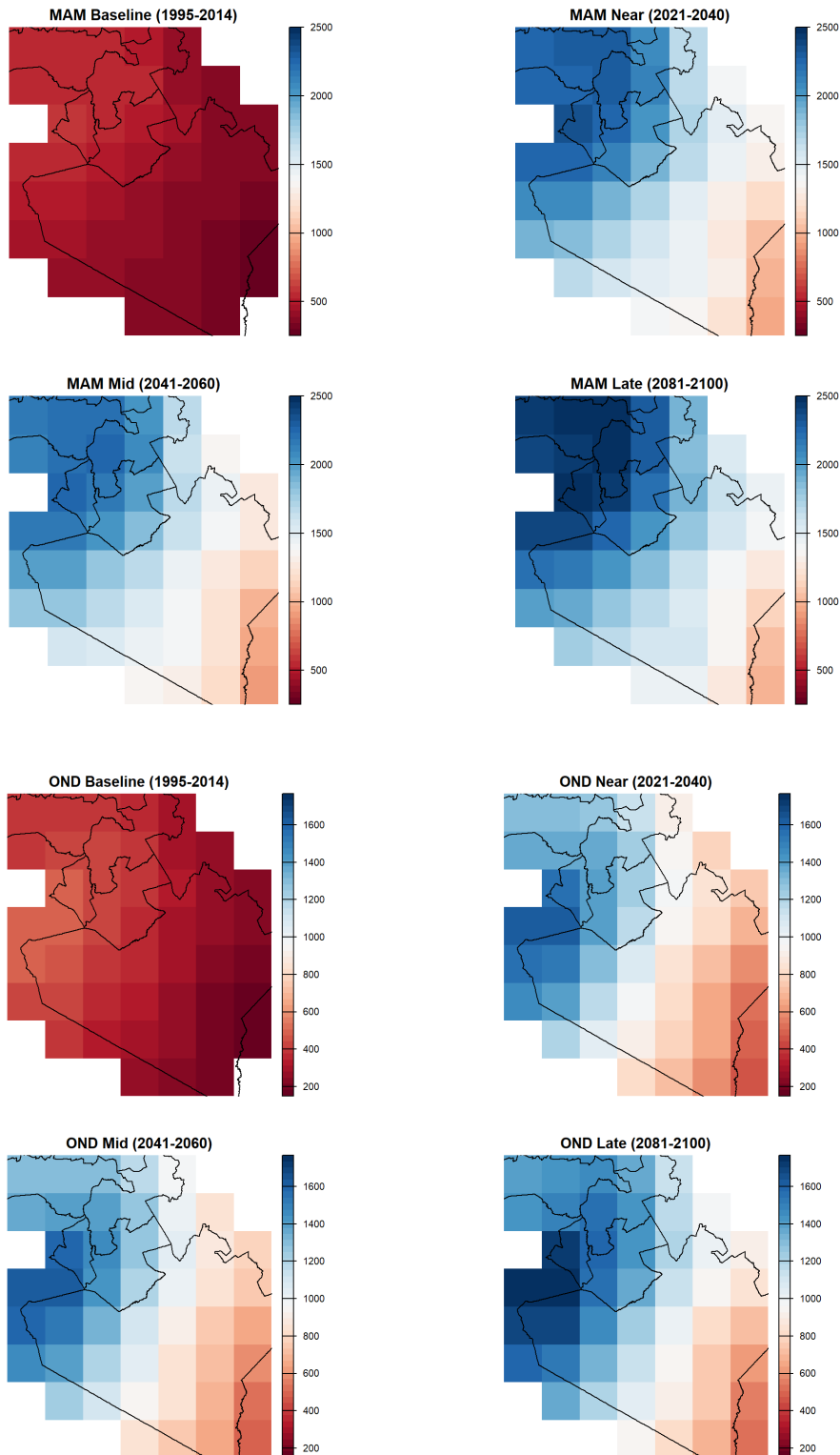


5. **Kisumu:** Rainfall in Kisumu increases by ~155 mm in the early century (RCP4.5 2030s), dips by -162 mm mid-century under RCP8.5, and ends with a late-century increase of ~543 mm (RCP8.5 2070s). This variability points to potential periods of water scarcity followed by heavy rainfall, impacting embankments and drainage systems. *The figure below shows annual rainfall and temperature for Kisumu County.*



7.5.2 Spatial heterogeneity of Seasonal Rainfall

The spatial distribution of rainfall (Figure below) reveals significant intra-county variability that annual averages often obscure. In the Kericho highlands and the Kisumu basin, the GFDL-ESM4 model projects a marked intensification of the MAM 'Long Rains.' However, the OND 'Short Rains' show the most dramatic shift under the SSP5-8.5 scenario, suggesting a transition toward a more volatile bimodal system. The county spatial maps clearly demonstrate that the SGR sections traversing the Nyando floodplains will face significantly higher seasonal volumes (upto 2,500mm/yr), which will increase peak discharge and groundwater saturation, potentially impacting the subgrade integrity during the operational phase while the southern plains of the map covering Narok county will receive lower average rainfall of about 500mm/yr during the historical period and increasing to 1000-1200mm/r in the near mid and late century scenarios.



Figures above shows the precipitation Historical (baseline) and projections (2030, 2040 and 2060 and 2100) for the five counties traversed by SGR Phase 2B project.

After presenting the precipitation results, we summarize the projected temperature data. These projections follow the RCP pathways and will be integrated with other leading indicators to support the computation of climate-related risks.

Table 57 below shows the temperature projections (2030, 2050 and 2070) for the five counties traversed by SGR Phase 2B project.

Table 57: Temperature projections (2030, 2050 and 2070) for the five counties

County	Baseline mean annual (approx.) °C	RCP4.5			RCP8.5		
		RCP4.5 2030 (median, range)	RCP4.5 2050 (median, range)	RCP4.5 2070 (median, range)	RCP8.5 2030 (median, range)	RCP8.5 2050 (median, range)	RCP8.5 2070 (median, range)
Narok (highlands + lowlands)	14–22	+1.1°C (0.6 → 1.6)	+1.5°C (0.9 → 2.1)	+1.9°C (1.0 → 2.8)	+1.2°C (0.7 → 1.9)	+2.0°C (1.2 → 3.0)	+3.0°C (1.8 → 4.5)
Bomet (wet highlands)	14–20	+1.0°C (0.6 → 1.6)	+1.4°C (0.9 → 2.0)	+1.8°C (1.0 → 2.6)	+1.1°C (0.6 → 1.8)	+1.9°C (1.1 → 2.8)	+2.8°C (1.6 → 4.2)
Nyamira (western highlands)	15–21	+1.1°C (0.6 → 1.7)	+1.5°C (0.9 → 2.1)	+1.9°C (1.1 → 2.7)	+1.2°C (0.7 → 2.0)	+2.0°C (1.2 → 3.1)	+3.1°C (1.9 → 4.7)
Kericho (tea highlands)	13–20	+1.0°C (0.5 → 1.5)	+1.4°C (0.8 → 2.0)	+1.8°C (1.0 → 2.6)	+1.1°C (0.6 → 1.8)	+1.9°C (1.1 → 2.9)	+2.9°C (1.7 → 4.3)
Kisumu (Lake Victoria basin)	20–26	+1.2°C (0.7 → 1.8)	+1.7°C (1.0 → 2.4)	+2.1°C (1.2 → 3.0)	+1.3°C (0.8 → 2.1)	+2.3°C (1.3 → 3.4)	+3.6°C (2.1 → 5.0)

Table 58 below shows the rainfall projections (2030, 2050 and 2070) for the five counties traversed by SGR Phase 2B project.

Table 58: Rainfall Projections (2030, 2050 and 2070) for the five Counties

County	Baseline annual (typical) mm	RCP4.5			RCP8.5		
		2030	2050	2070	2030	2050	2070
Narok (highlands + lowlands)	500–1800	–2% to +6%	–3% to +8%	–6% to +12%	–2% to +7%	–5% to +12%	–10% to +20%
Bomet (wet highlands)	1200–1800	–1% to +6%	0% to +8%	–3% to +10%	–1% to +7%	–2% to +12%	–8% to +18%
Nyamira (western highlands)	1400–2000	0% to +7%	0% to +9%	–2% to +12%	0% to +8%	–1% to +13%	–6% to +20%

Kericho (moist tea highlands)	1800–2200	–1% to +6%	0% to +8%	–3% to +10%	–1% to +8%	–4% to +12%	–8% to +18%
Kisumu (Lake Victoria basin)	1000–1800	–3% to +8%	–2% to +10%	–6% to +15%	–3% to +9%	–6% to +15%	–12% to +25%

Across the western counties, early-century projections (2030s) under RCP4.5 show modest increases in rainfall relative to historical values, with Bomet (+149 mm), Kericho (+201 mm), Kisumu (+155 mm), Narok (+157 mm), Nyamira (+170 mm).

Mid-century (2050s) projections under RCP8.5 indicate moderate decreases in most counties, including Bomet (-126 mm), Kericho (-167 mm), Kisumu (-162 mm), Narok (-95 mm), Nyamira (-146 mm). These fluctuations suggest that the mid-century period may experience temporary drier conditions, potentially impacting water availability for construction and operation activities along the railway corridor.

By the late century (2070s), most counties are projected to experience substantial rainfall increases under RCP8.5, with Bomet (+688 mm), Kericho (+640 mm), Kisumu (+543 mm), Narok (+383 mm), Nyamira (+758 mm).

These pronounced increases highlight a significant risk of flooding, soil erosion, and slope instability, particularly in Nyamira and Kericho. The variability in rainfall, combined with these projected surges, emphasizes the need for robust drainage, embankment stabilization, and flood management measures in the railway's design to ensure resilience against future climatic extremes.

7.6 Climatic Change Impact on SGR Infrastructure

Railway infrastructure including tracks, bridges, catenary systems, and embankments is highly sensitive to extreme weather events such as high/low temperatures and heavy precipitation. These conditions can disrupt operations, damage infrastructure, and reduce the lifespan of assets. Understanding weather patterns during planning, design, operation, and maintenance is essential to ensure safety and reliability.

Depending on the severity of weather events, impacts may require increased inspections, reduced train speeds, and proactive climate risk assessments. If not addressed, failures can lead to operational disruptions, economic losses, higher emissions from alternative transport, and in severe cases, derailments or threats to human life. **Table 59** below outlines the incidence of weather elements on various infrastructure.

Table 59: Impact Matrix of extreme weather events on vulnerable assets

Vulnerable infrastructure	Bridges/ Viaducts	Tunnels	Drainage systems	Railway tracks	Culverts	Slip slopes
Temperature	X	X		X		
Rainfall	X	X	X	X	X	X
Wind	X					

Table 60 below outlines the effects of climatic change elements identified above on SGR
KE25036-0100D (2) R_03 ESIA Study for Phase 2B SGR

infrastructures.

Table 60: Effects of climate change on the SGR

Climate change effect category	Risk ranking	Vulnerable asset
Rainfall (including high amount falls, variations to mean rainfall, groundwater content, and soil moisture)	High	Track movement Line closure Reduced operating speeds
Extreme high temperature (including air and ground temperature)	High	Track buckling Line closure Reduced operating speeds
Flooding (including river and surface flooding)	High	Track washout Line closure Reduced operating speeds
Inland erosion and instability	High	Disruptions from blockages Decrease in track condition
High winds	High	Rolling stock stability Modest risk of railway equipment and destruction Decreased operating speeds
Lightning	High	Risk to line workers Outages of power Destruction to infrastructure

7.7 Climatic Hazards Assessment

All climate hazard indicators for the SGR corridor are derived from bias-corrected CMIP6 outputs (tas, tasmax, tasmin, pr, huss, psl), with additional stresses computed using proxies such as soil water stress (NDWS) and THI (from tasmax and RH). Cold stress affects workers, livestock, and crops (tea, maize, wheat, sugarcane) in highland zones, while livestock thresholds follow Thornton et al. (2021) and human heat stress thresholds follow Steadman (1979) and Stull (2011). Flood and waterlogging hazards are derived from precipitation combined with simple soil moisture proxies, and aquaculture/fish cold stress uses tas as a proxy for water temperature. All indicators are ESMP-relevant, guiding worker and passenger safety, livestock and crop adaptation, and the resilience of railway infrastructure, embankments, bridges, drainage, and construction sites. Thresholds in the table below were locally adjusted to observed SGR corridor conditions (min 11–18°C, max 25–30°C) to ensure realistic worker, crop, livestock, and passenger hazard assessment for planning and interventions.

To provide scientific backup for the hazard criteria, this assessment utilizes spatially explicit modeling to identify the geographic concentration of the most critical physical threats: Rainfall-Induced Flooding and Rainfall Erosivity (R-Factor).

1. Geospatial Validation of Flood and Waterlogging Hazards - The precipitation-related hazards defined in the thresholds below are spatially validated through the Flood Risk Class modeling.

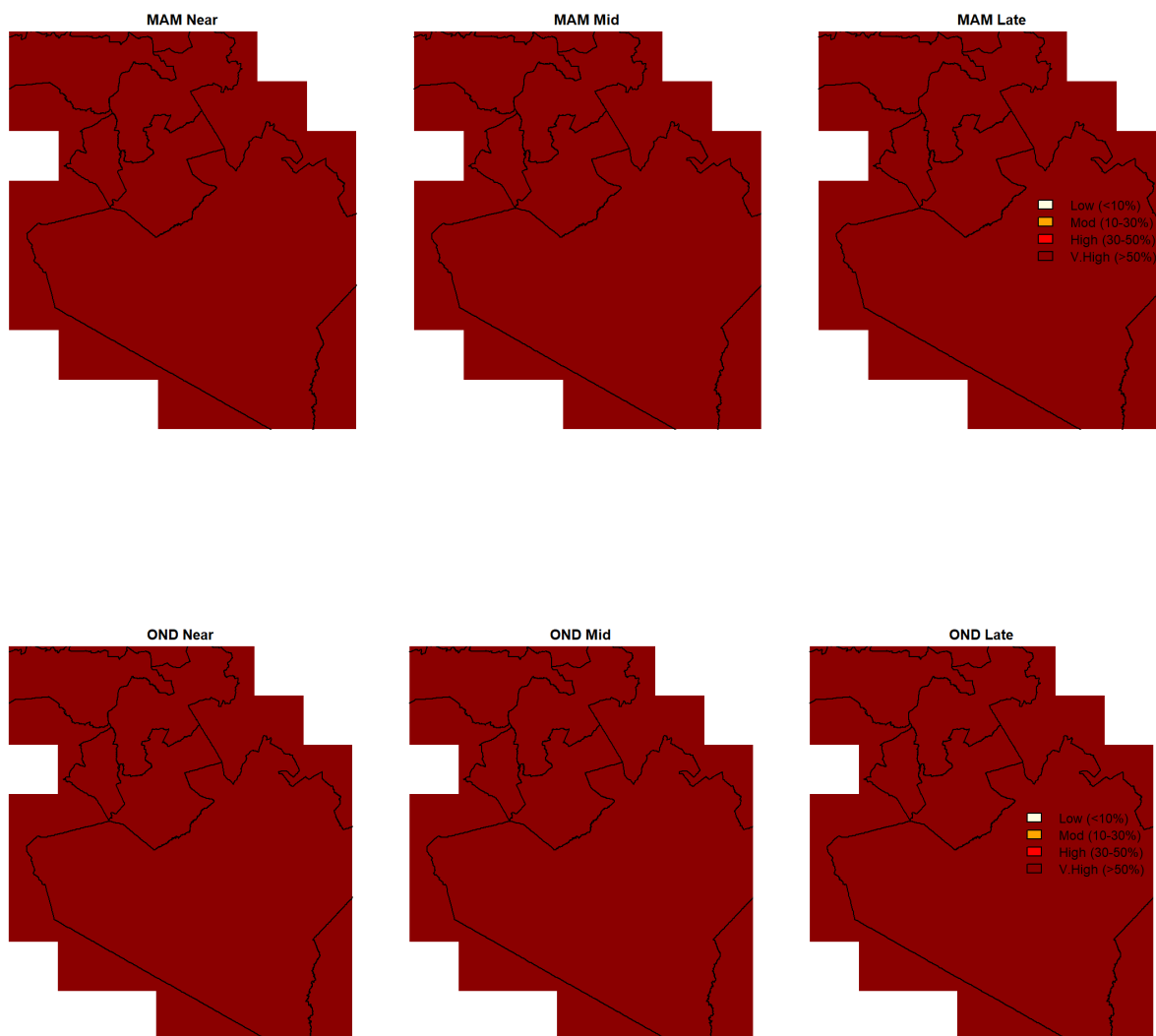


Figure 53: Categorized flood risk levels showing areas with the highest projected increases in seasonal precipitation

The spatial analysis shows that the most vulnerable areas, shown in dark red, are concentrated spread across the entire project area. In these specific locations, seasonal rainfall is projected to increase by more than 30 percent. This provides the direct evidence for the Heavy rain and flood indicators used in the hazard table 60.

1. Spatial Analysis of Soil Erosivity and Landslide Risk

The risks related to landslides and slope stability along the Phase 2B corridor are validated by our Rainfall Erosivity (R-Factor) modeling. This index quantifies the potential for projected rainfall to destabilize the land along the SGR route. To ensure a clear comparison between the different planning

horizons and seasons, both the MAM and OND maps are plotted on a unified scale from 0.00 to 0.015.

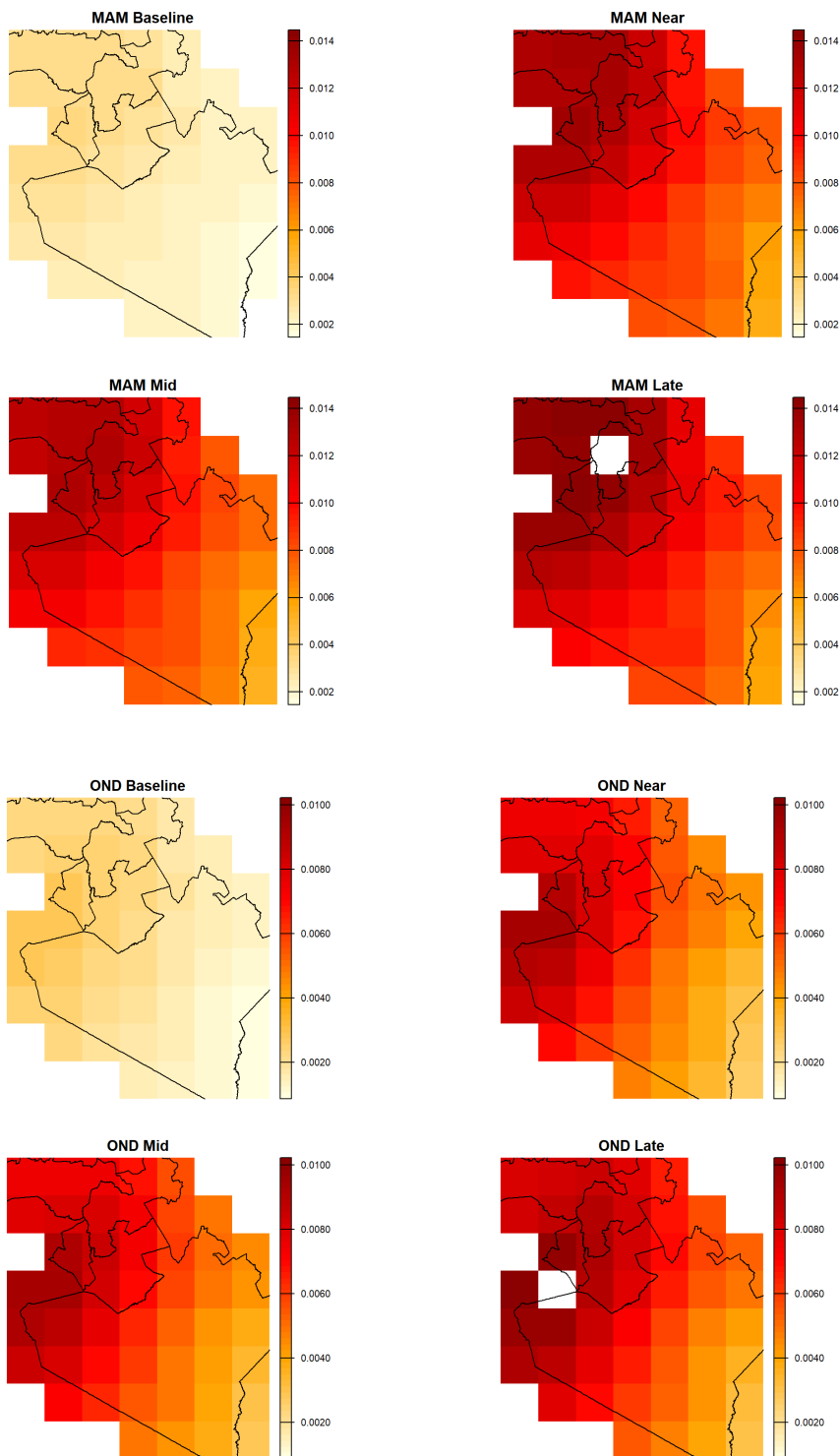


Figure 54: Unified Rainfall erosivity index (R-Factor) for MAM and OND seasons across the Phase 2B project counties

The spatial data reveals that the R-factor across the five counties remains within a low-to-moderate range, with values peaking between **0.002 and 0.014**.

These relatively low values are a direct reflection of the regional pedology. The corridor is dominated by well-aggregated volcanic soils in the highlands and clay-rich soils in the Kisumu basin, both of which possess strong structural stability and natural resistance to surface wear. However, the distribution of this erosive power is closely tied to the specific topography of the route:

The MAM maps exhibit a noticeable amber intensification, with values ranging from 0.010 to 0.014 in the high-altitude zones. These hotspots are most prominent in the areas south of Kericho, across northern Bomet, and along the northern border of Kisumu county. While the volcanic soils here are naturally stable, the steep topographic gradients of the Mau Escarpment and the Nyamira hills mean that even moderate erosivity levels can become problematic. When these values coincide with the projected 30 percent increase in intense 3-day rainfall events, the kinetic energy of the runoff can overcome soil aggregation. This poses a direct risk of localized gullying and failure of the railway embankments.

In contrast, the areas in southern Narok exhibit significantly lower R-factor values, ranging from 0.002 to 0.006. On the maps, these are shown in pale yellow, indicating that the rainfall has less kinetic power to move soil. The MAM Baseline period represents the lowest risk across the entire study. In these flatter lowlands and the Kisumu shoreline, the heavy clay soils are less prone to high-velocity erosion due to the gentle slopes.

2. Engineering and ESMP Implications

The analysis indicates that the OND season generally shows slightly lower erosive values than the MAM season, though the spatial patterns remain similar. The projected increase in 3-day rainfall extremes poses a dual risk. In the highlands, the risk is physical erosion, while in the flatter plains of Narok and Kisumu, the risk is waterlogging.

The structural stability of SGR embankments in the lowlands will depend more on drainage capacity than on slope reinforcement. However, in the identified hotspots of Kericho and Bomet, the ESMP justifies the requirement for aggressive bio-engineering, such as bamboo terracing and geotextile reinforcement, particularly on 'cut-and-fill' sections. These targeted interventions will ensure that the natural stability of the volcanic soils is not compromised by the increasing intensity of future storm events. Other important hazards and indicators relevant to the corridor are summarized in **Table 61**.

Table 61: Hazard indicators and thresholds

Hazard / Stress	Indicator	CM IP6 Variables	Formula / Computation	Original Thresholds / Categories (Source)	Local Adjustment / Justification	Relevance for SGR Corridor / ESMP
Cold stress (workers)	Cold stress days (field/rail)	tasmin	Count days tasmin < threshold	Moderate: 5–10°C, Severe: <5°C, Extreme: <0°C (FAO, 2018)	Adjusted to Mild: 13°C, Moderate: 11°C, Severe: 9°C, Extreme: 7°C to reflect local min temps (11–18°C) in highland and midland counties	Worker safety on rail/construction / farm sites; protective gear, rotation planning
Heat stress (workers)	Heat stress days (field/rail)	tas, huss	Count days tas > threshold or HI > threshold	Moderate: 35–38°C, Severe: 38–41°C, Extreme: >41°C (Steadman, 1979; Stull, 2011)	Adjusted to Mild: 28°C, Moderate: 30°C, Severe: 32°C, Extreme: 34°C to reflect observed max temps 25–30°C	Worker safety; heat alerts, rotation, hydration, PPE
Cold stress (crops)	Cold stress – crop risk	tasmin	Count days tasmin < species threshold	Maize <10°C, Wheat <5°C, Tea <8°C, Sugarcane <12°C, Bananas <15°C (FAO, 2018)	Adjusted per crop and local temps: Maize Mild:14, Mod:12, Sev:10, Ext:8; Tea Mild:14, Mod:12, Sev:10, Ext:8; Sugarcane Mild:17, Mod:15, Sev:13, Ext:10; Bananas Mild:17, Mod:15, Sev:13, Ext:10	Crop growth delay, frost-sensitive crop protection, irrigation adjustments
Crop extreme heat	Flowering/fruiting heat stress	tasmax	Count days tasmax > species flowering threshold	Maize/Wheat/Tea Severe>35°C (Sacks et al., 2010)	Adjusted to Mild:30, Moderate:32, Severe:34, Extreme:36°C to match local peak temps 25–30°C	Yield reduction, planting/harvesting adjustments, labor planning
Cold stress (livestock)	THI cold / minimum temp	tasmin	Count days below species thresholds	Cattle <2°C severe; Sheep/Goats <2°C severe; Poultry <5°C severe; Bees <10°C moderate (FAO, 2018; Thornton et al., 2021)	Adjusted for local temps: Cattle Mild:10, Mod:9, Sev:8, Ext:6; Sheep/Goats Mild:9, Mod:8, Sev:7, Ext:6; Poultry Mild:12, Mod:10, Sev:9, Ext:7; Bees Mild:12, Mod:10, Sev:8, Ext:6	Livestock sheltering, feed adjustments, mortality risk, veterinary interventions
Heat stress (livestock)	THI heat / max temp	tas, huss	Count days THI > species thresholds	Cattle: 94, Goats: 94, Sheep: 93, Pigs: 92, Poultry: 92 (Thornton et al., 2021)	Same as original; thresholds already meaningful for local climate	Shelter, water supply, veterinary planning, grazing schedule adjustment

Hazard / Stress	Indicator	CM IP6 Variables	Formula / Computation	Original Thresholds / Categories (Source)	Local Adjustment / Justification	Relevance for SGR Corridor / ESMP
Cold stress (aquaculture/fish)	Water temperature proxy	tas	Count days water temp < species thresholds	Lake fish <18°C moderate, <15°C severe; Pond <16°C moderate, <13°C severe (FAO, 2018)	No change; thresholds already appropriate for Kenyan lakes and ponds	Fish growth, pond management, aquaculture survival, harvest timing
Heat stress (fish)	Water temperature proxy	tas	Count days water temp > species thresholds	Lake fish >28°C, Pond >30°C (FAO, 2018)	No change; reflects local maximum water temperatures	Fish growth, survival, pond/aquaculture management
Dust / Air quality stress	Dust risk days	tas, pr, NDWS	Count days NDWS >15 AND pr <1mm	Low <5, Moderate 5–10, High 10–20, Extreme >20 (Morton, 2017)	No change; thresholds reasonable for SGR corridor	Worker health (rail/field), passenger exposure, livestock respiratory risk, crop deposition
Wind-exacerbated dust	Dust-Wind risk	psl, tas, pr	Days with low pr + high wind (estimated from daily pressure gradients)	Moderate / High / Extreme (Morton, 2017)	No change	Construction site mitigation, vegetation buffers, PPE for workers, dust exposure control along railway corridor
Flood / Landslide risk	Heavy rain/flood events	pr, slope, soil	Count days pr>50mm /day; combine with slope & soil data	Moderate: 5–10 days/year, Severe: >10 days/year (Roco et al., 2017)	No change; rainfall thresholds appropriate	Embankment stability, bridge safety, drainage design, flood emergency preparedness
Occupational multi-stress	Multi-stress days (heat/cold/drought/dust)	tasm ax, tasm in, pr, NDWS, RH	Count days exceeding extreme thresholds for multiple hazards	Extreme per literature (Steadman, 1979; Stull, 2011; Thornton et al., 2021; FAO, 2018; Morton, 2017)	Adjusted cold/heat thresholds applied locally (see above)	Labor rotation, rest breaks, PPE, emergency health response
Crop/livestock	Heat +	tasm ax,	Count days NTx35>20	Severe: >20 days (Sacks et al., 2010;	Thresholds maintained; local climatology supports this	Crop yield reduction,

Hazard / Stress	Indicator	CM IP6 Variables	Formula / Computation	Original Thresholds / Categories (Source)	Local Adjustment / Justification	Relevance for SGR Corridor / ESMP
compound stress	Drought	pr, NDWS	AND NDWS>20	ENVIREM R Package)		livestock mortality, irrigation/feeding adjustments
Occupational heat/dust stress (rail/construction)	HI + Dust days	tasm ax, tasm in, pr, huss	Count days HI>41 OR Dust risk >10 days/year	Severe / Extreme (Steadman, 1979; Morton, 2017)	Adjust HI threshold using local climatology: Extreme rarely >34°C	Worker safety, health alerts, ESMP planning, PPE requirements
Human thermal stress – passengers	Heat Index / Wet-bulb temp	tas, huss	Compute HI and Tw as above	Same categories as heat stress humans (Steadman, 1979; Stull, 2011)	Apply locally adjusted HI/thresholds	Passenger comfort, station design, shelter, scheduling impacts
Seasonal risk indicators	Dry spells, NDWS seasonal count	pr, tas, soil proxy	Seasonal sum of dry days and NDWS	High risk: NDWS>20 days, consecutive dry days>15 (ENVIREM R Package; CHIRPS/CHIRTS)	No change	Planning for water supply, irrigation, ESMP mitigation for crop/livestock/farm workers
Dust-Heat compound stress	Heat + Dust	tasm ax, tasm in, pr, huss	Count days exceeding thresholds for HI and dust	Severe / Extreme (Steadman, 1979; Morton, 2017)	Use locally adjusted HI/heat thresholds + dust thresholds	Worker safety, ESMP planning, PPE, scheduling adjustments

7.8 Climatic Risk Assessment Matrix

The potential impacts emanating from the climate-related hazards along the SGR Phase 2B corridor are synthesized through a multi-dimensional risk analysis. This section transitions from individual hazard modelling to an integrated spatial risk profile.

To provide a definitive prioritization of climate risks, this assessment developed a unified Multi-Hazard Index (MHI). This index is a geospatial integration of four leading project-risk drivers: projected temperature shifts, seasonal rainfall intensification, topographic slope, and the soil erosivity index. The MHI is represented on a standardized scale from 0.00 to 1.00, where 0.00

(displayed in white/pale yellow) indicates a stable climate profile, and 1.00 (displayed in deep red/crimson) indicates a state of extreme multi-dimensional vulnerability. This *thermal* color-coding allows for the immediate identification of segments where multiple hazards, such as high rainfall on steep, erosive slopes, converge to create potential compounding risks.

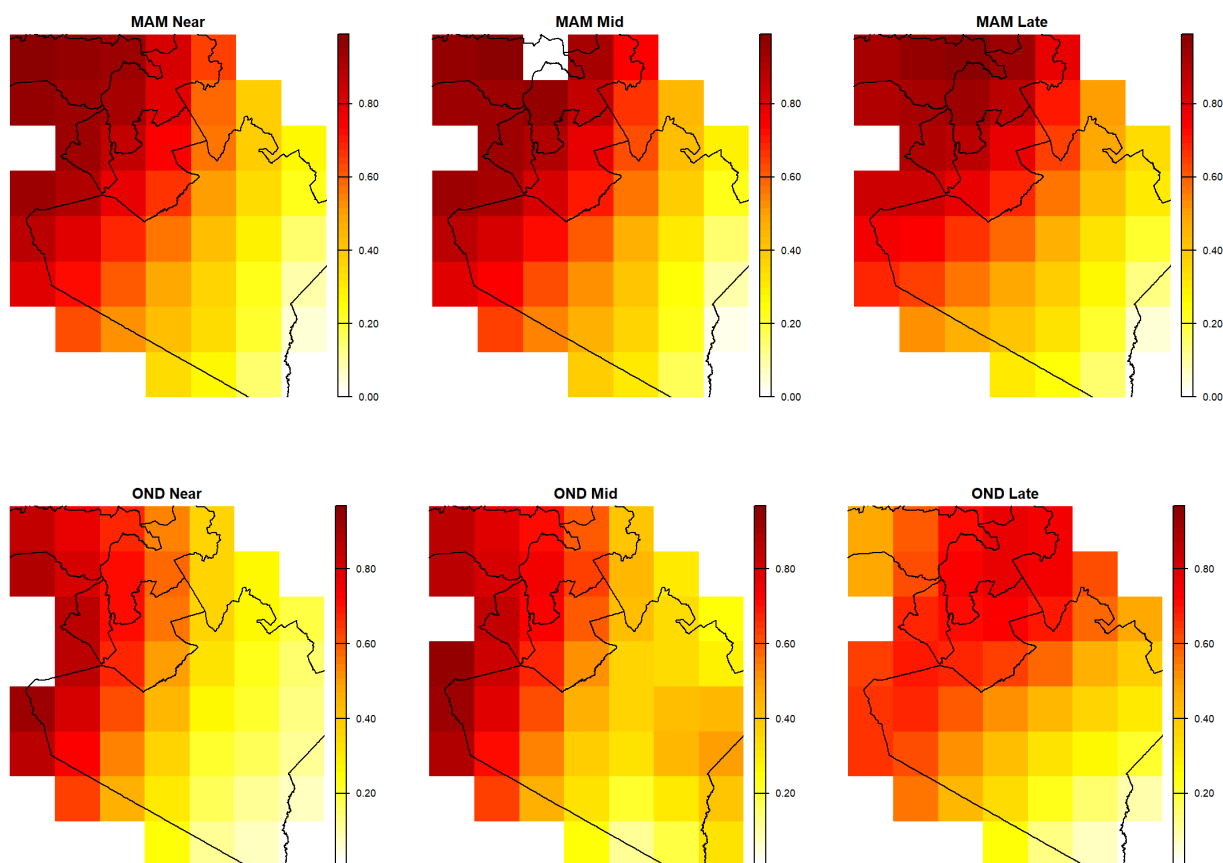


Figure 55: Multi-Hazard Index (MHI) for MAM and OND seasons.

The index (0–1 scale) identifies priority intervention zones where climatic, topographic, and erosional drivers converge.

The MHI maps (**Figure 55**) reveal that risk is highly concentrated. The 'Hot' zones ($MHI > 0.70$) are predominantly located in the Kericho-Bomet escarpments and the Nyamira highlands. In these red-coded areas, the convergence of steep terrain and high projected rainfall creates a dual-threat of slope failure and drainage overload. Conversely, the Kisumu lowlands exhibit elevated risk driven by extreme temperature and flood accumulation. This spatial synthesis provides the quantitative basis for the Risk Assessment Matrix presented in **Table 62**. The Overall Risk levels in the table are derived directly from these MHI hotspots, ensuring that the ESMP prioritizes resources toward the specific kilometre-markers where infrastructure exposure is highest.

Table 62: Climate change risk assessment matrix

Climate Hazard	Exposure to SGR Assets	Sensitivity of SGR Components	Overall Risk	Most Affected Counties
Extreme Rainfall & Flooding	High (bridges, culverts, embankments)	High	High–Very High	Kisumu, Narok, Nyamira
Flash Floods / Stormwater Surges	High	High	Very High	Narok, Kisumu
Drought / Prolonged Dry Spells	Moderate	Low	Low–Moderate	Narok, Bomet
Heat Stress / High Temperatures	Moderate	Moderate	Moderate	Kisumu, Narok
Landslides & Slope Failures	High for cut sections & hilly terrain	High	High	Kericho, Nyamira, Bomet
Soil Erosion & Gully Formation	High in embankment zones	High	High	Narok, Bomet
Lightning & Electrical Storms	Moderate–High	Moderate	Moderate	Kisumu
Windstorms / Strong Winds	Moderate	Low–Moderate	Low–Moderate	Rift valley escarpments
Increased Pests/Vegetation Overgrowth (maintenance risk)	Moderate	Low	Low–Moderate	All counties

7.9 Infrastructure Climate Vulnerabilities

Extreme precipitation undermines railway infrastructure through flooding, erosion, and slope instability, leading to operational shutdowns, safety hazards, and costly repairs. With climate change amplifying these events, resilience planning such as improved drainage, slope stabilization, and predictive monitoring is becoming essential for railway systems worldwide. **Table 63** below outlines impacts, risks and mitigation/ adaptation measures.

Table 63: Impacts, Risk and Mitigations

Impact	Risk/Consequence	Mitigation/Adaptation
Flooding of tracks & stations	Service interruptions, electrical failures, passenger safety hazards	Elevate track beds, install flood-resistant electrical systems, improve drainage capacity
Erosion & washouts	Track instability, derailment risk, costly repairs	Reinforce ballast/subgrade, use geotextiles, regular inspection after heavy rainfall
Bridge & culvert overload	Structural collapse or blockage, long-term service disruption	Upgrade culverts/bridges for higher flow capacity, implement debris screens, proactive maintenance
Landslides & debris flows	Track blockage, derailments, passenger injury	Slope stabilization, vegetation management, early-warning monitoring systems
Signal & power system damage	Communication failures, unsafe train operations	Waterproof enclosures, redundant power supplies, real-time monitoring
Reduced operational speeds	Delays, economic losses, cascading supply chain disruption	Adaptive scheduling, predictive weather monitoring, contingency routing
Rising maintenance costs	Increased O&M budgets, insurance claims, regulatory scrutiny	Long-term resilience planning, climate-proof design standards, risk-sharing mechanisms

7.10 Railway Infrastructure Heat Stress Vulnerability

Extreme temperatures both heat and cold can warp tracks, degrade materials, disrupt operations, and pose serious safety risks across railway systems. These impacts are intensifying with climate change and require proactive adaptation.

Railway systems are highly sensitive to ambient temperature extremes due to the thermal properties of steel, concrete, and electrical components. With climate change increasing the frequency and intensity of heatwaves and cold spells, railway infrastructure faces heightened exposure to thermal stress, material degradation, and operational disruptions. This section outlines the physical,

operational, and safety-related impacts of extreme temperature events, along with mitigation strategies relevant to infrastructure planning and climate resilience.

1. Track Buckling (Sun Kinks) - Steel rails expand under high temperatures. Without adequate expansion joints or stress management, this thermal expansion leads to lateral deformation known as “sun kinks,” which pose derailment risks. Buckling is most prevalent in continuously welded rail (CWR) systems and is exacerbated by poor ballast conditions or inadequate anchoring.

2. Electrical and Signaling Failures - Overheating of trackside electrical systems, including signal relays, transformers, and power cabling, can result in system outages. Thermal stress may degrade insulation and reduce the reliability of control systems, compromising operational safety.

3. Speed Restrictions and Service Delays - To mitigate derailment risks during heatwaves, operators often impose speed restrictions. These reduce dynamic loads on heat-stressed tracks but result in cascading delays across the network, affecting both passenger and freight services.

4. Passenger Comfort and HVAC Stress - Rolling stock HVAC systems may be undersized for extreme heat conditions, leading to passenger discomfort and potential health risks. Thermal loading on carriages also increases energy demand and maintenance frequency.

5. Return Period Intensification and Hydraulic Design Sensitivity- Rolling A critical hydrological risk to the SGR Phase 2B infrastructure is the projected intensification of 'Design Storms.' Railway drainage systems, including culverts, side drains, and bridge freeboards, are traditionally engineered based on historical return periods. However, climate change is altering the magnitude and frequency of these events.

As illustrated in the following series of Return Level maps (Figures below), the 3-day annual maximum rainfall (AM3D) is projected to increase across all planning horizons. This shift implies that the "Safety Factor" built into historical designs may be eroded by the intensifying hydrological cycle. For an asset like the SGR, designed for a century-long operational life, future-proofing against these shifts is essential to prevent **hydraulic overtopping**, where extreme runoff exceeds drainage capacity, leading to ballast scouring, embankment washouts, or catastrophic derailments.

The following maps present the projected rainfall intensities for T2, T5, T10, T20, and T50 return periods, comparing MAM and OND seasons to show the evolution of extreme storm potential across the corridor.

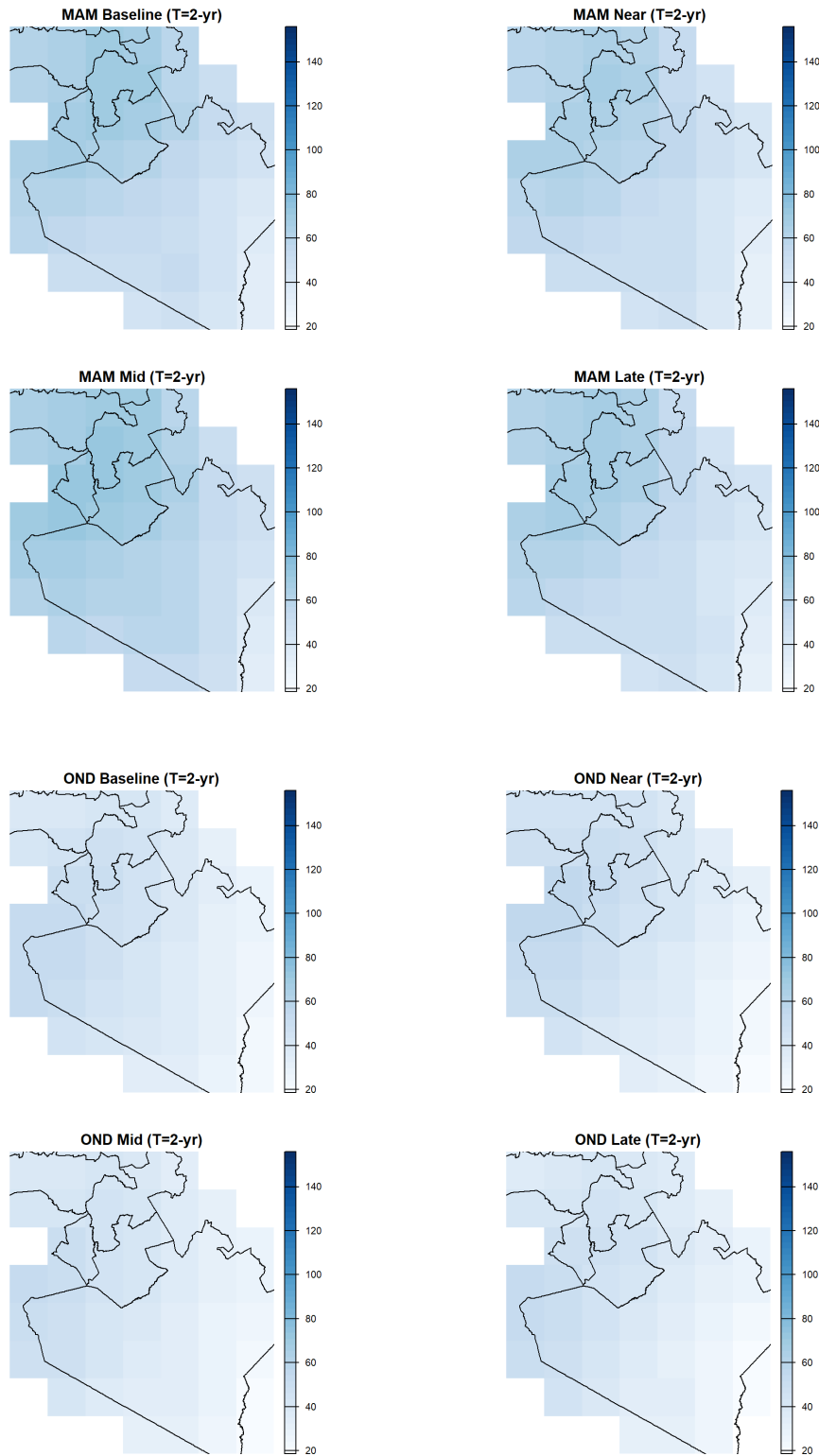


Figure 56: 2-Year Return Level (T2) – High-frequency, low-magnitude storm events

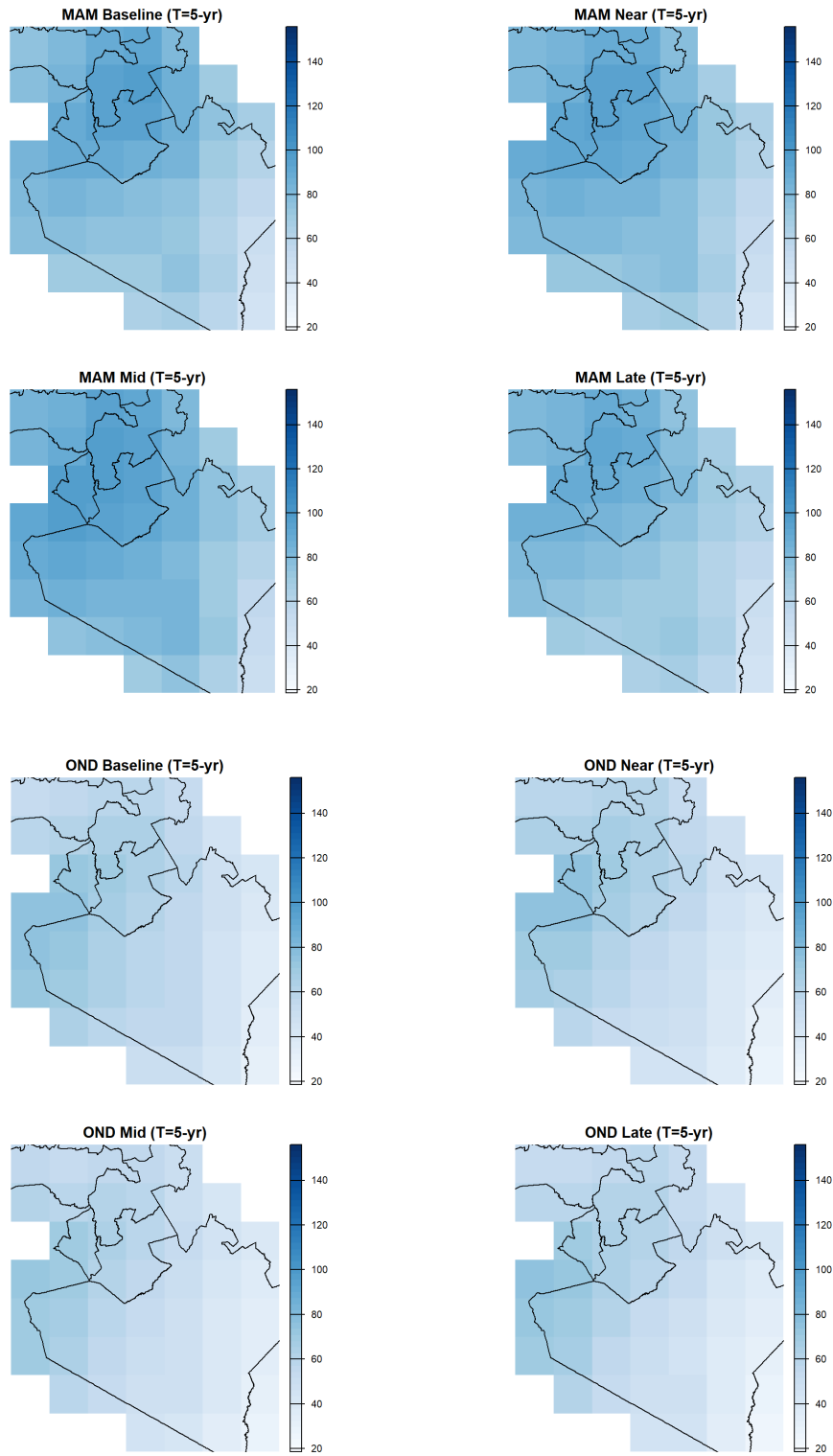


Figure 57: 5-Year Return Level (T5) – Operational threshold storm events

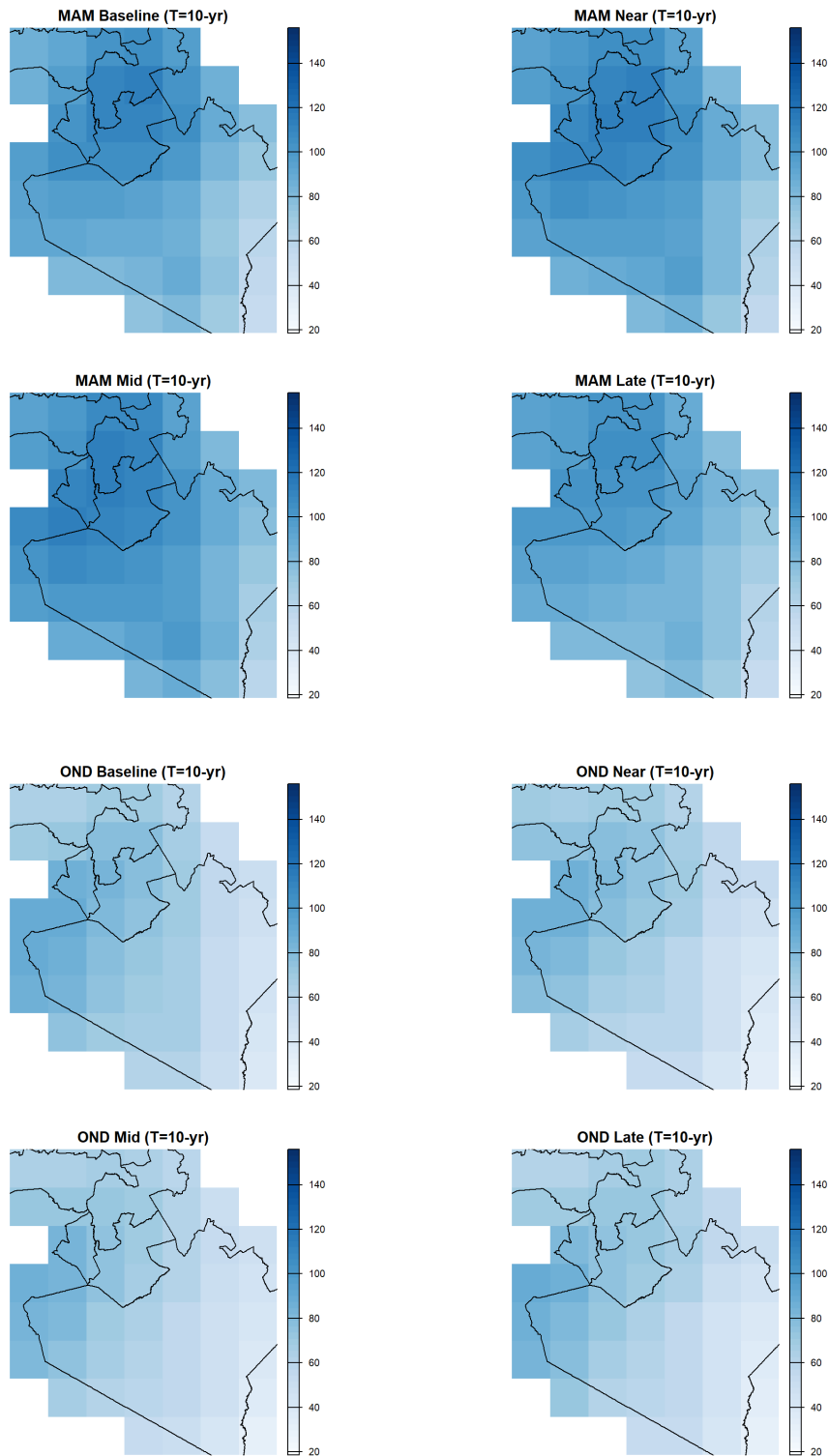


Figure 58: 10-Year Return Level (T10) – Minor drainage design storms

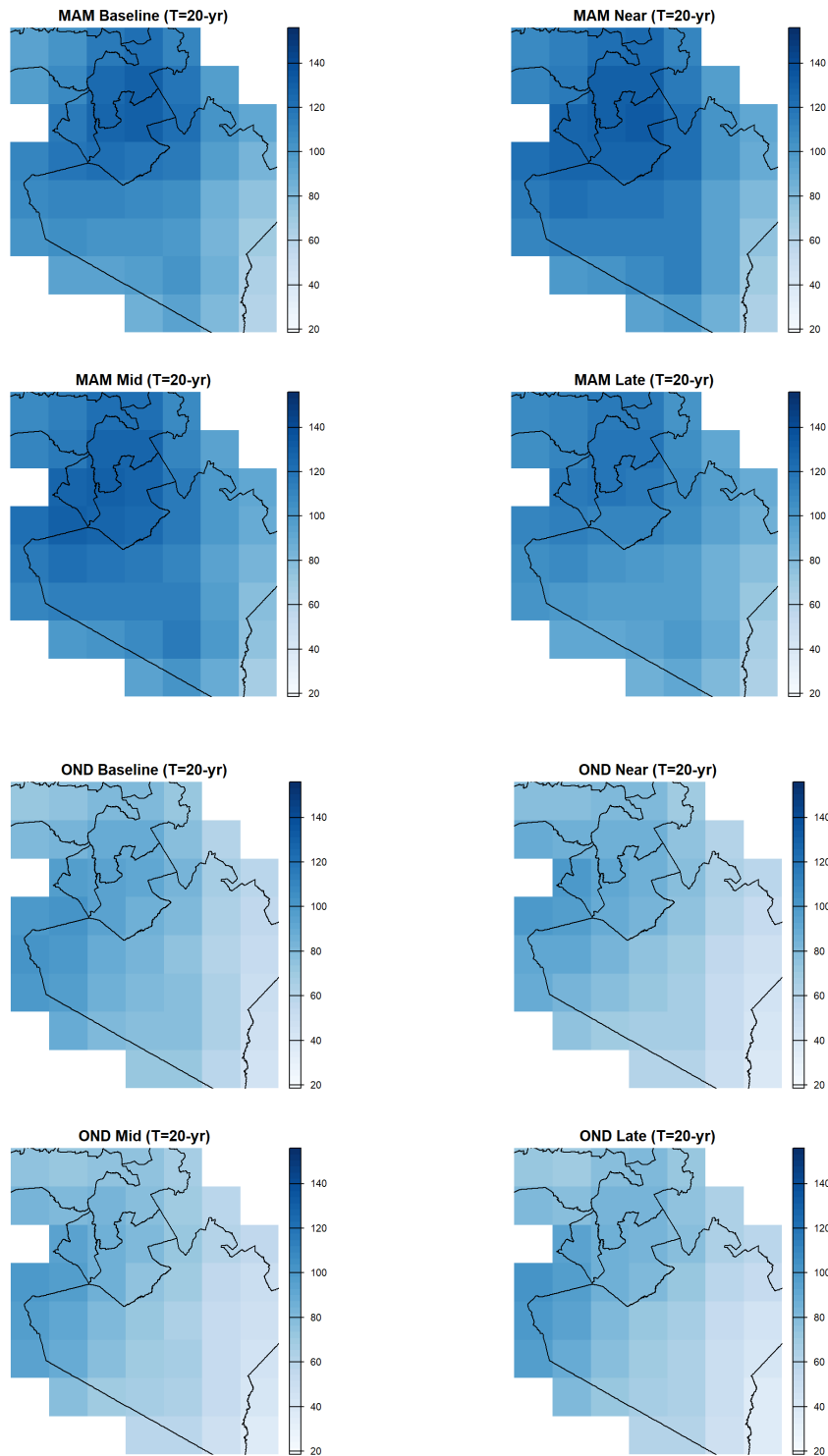


Figure 59: 20-Year Return Level (T20) – Intermediate Infrastructure stress-test

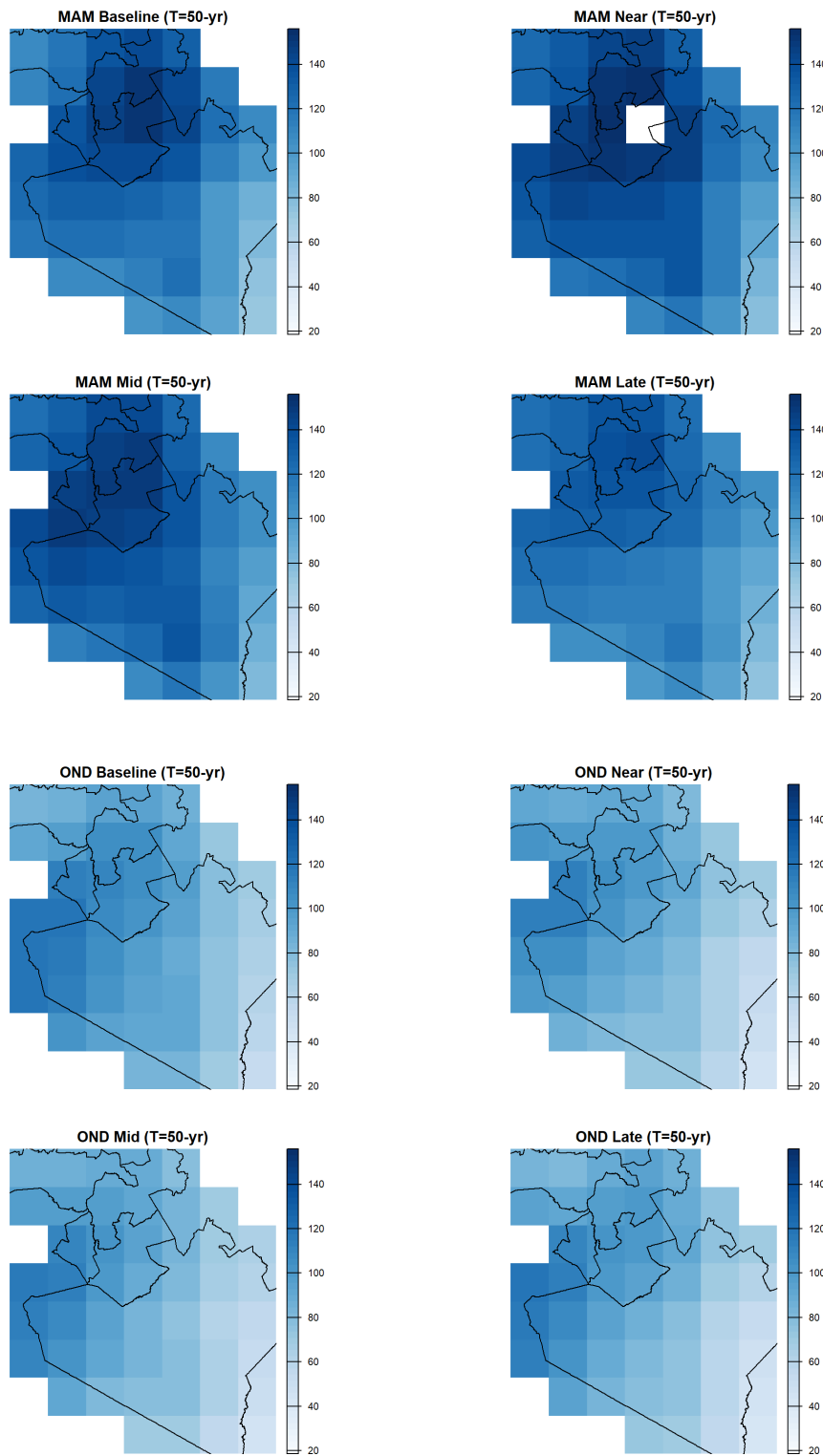


Figure 60: 25-Year Return Level (T50) – Major infrastructure Design Storm for bridges and viaducts

The spatial sequence of return levels reveals a significant *Return Period Compression*. This phenomenon occurs when a storm intensity that was historically considered a rare **50-year event (T50)** begins to occur with the frequency of a **10 or 20-year event**.

Key Engineering Implications

1. **Hydraulic Overload in Kisumu and Nyamira:** The maps demonstrate that the *T50* levels (3-day totals) in the Western lowlands and highlands are projected to exceed historical benchmarks by approximately 30%. This intensification suggests that the *Standard Design* for culverts in these segments may face a high probability of overtopping during the mid-to-late century.
2. **Increased Scouring at Bridge Abutments:** The surge in the *T20* and *T50* intensities, particularly during the OND season, will lead to higher peak flow velocities in ephemeral streams. This increases the risk of "scouring" at bridge piers and abutments, requiring deeper foundations or reinforced rip-rap protection.
3. **Operational Maintenance Costs:** The intensification of high-frequency storms (*T2* and *T5*) indicates that "minor" flooding and siltation of side drains will occur more often. This will likely lead to higher OpEx (Operating Expenditure) costs for the Kenya Railways Corporation (KRC) due to the need for more frequent drainage clearance and ballast tamping.

The spatial modeling of these return levels provides a definitive Hydrological Stress-Test for the Phase 2B corridor. To ensure long-term resilience, the project's technical specifications must adopt a 'Climate-Plus' design philosophy, where drainage capacities are calculated based on these projected future return levels rather than solely on historical KMD records.

7.11 Climate Change Adaptation plan

Table 64 below outlines the climate change adaption plan for the SGR Phase 2B project.

Table 64: Climate Change Adaptation plan

Climate Risk	Adaptation Measures	Resilience Outcome	Responsibility	Monitoring Indicators
Extreme Rainfall & Flooding	- For sizing of culverts 1 in 100 years designed will be adopted - Flood-resistant bridges - Embankment reinforcement	Rail infrastructure withstands heavy rains and floods	Contractor / KRC	- Drainage flow check - Inspection after rainfall
Soil Erosion & Landslides	- Bioengineering (grass and bamboo) - Terracing and geotextiles on	Reduced erosion and slope stability	Contractor	- Slope stability monitoring - Sediment load measurements

Climate Risk	Adaptation Measures	Resilience Outcome	Responsibility	Monitoring Indicators
	slopes Sediment traps and silt fences			
Water Scarcity & Drought	- Rainwater harvesting at camps - Boreholes with permits - Water-efficient construction (e.g., batching plants)	Stable water supply with reduced conflict	Contractor	- Water abstraction volume - Borehole output logs
High Temperatures & Heatwaves	- Heat-resistant rail steel - Expansion joints monitored - Worker heat stress protocols (shaded rest areas, hydration)	Reduced thermal stress on tracks & workers	Contractor / KRC	- Worker H&S logs - Rail temperature records
Storms, Wind Gusts & Lightning	- Lightning arrestors on tall structures - Anchoring cranes and scaffolding - Weather alert systems at construction sites	Lower risk of equipment failure & accidents	Contractor	- Lightning protection tests - Incident reports
High Humidity & Corrosion	- Anti-corrosion coatings - Regular maintenance & inspections - Use of stainless steel where necessary	Prolonged lifespan of steel structures	Contractor / KRC	Corrosion inspection logs
Floodplain & Wetland Sensitivity	- Elevated rail sections near wetlands (use of Viaducts) - Controlled construction access in Nyando Wetland - Wetland buffer zones	Reduced ecological and structural vulnerability	KRC / Contractor	Wetland monitoring reports
Public Health Risks (Malaria, Waterborne Diseases)	- Camp drainage improvements - Mosquito nets & fumigation	Healthy workforce and reduced downtime	Contractor	- Clinic records - Malaria incidence trends

Climate Risk	Adaptation Measures	Resilience Outcome	Responsibility	Monitoring Indicators
	On-site medical facilities			

7.12 Greenhouse Gas (GHG) Emissions Climate Mitigation Strategy

The Standard Gauge Railway (SGR) Phase 2B project, extending 262 kilometers from Naivasha to Kisumu, is a fundamental pillar of Kenya's low-carbon transport policy. While the project is essential for regional connectivity, its lifecycle involves significant carbon exchanges. This section evaluates the Greenhouse Gas (GHG) implications of the project by quantifying the initial Carbon Debt created during construction and the long-term Net Carbon Benefit achieved through operational efficiency and modal shift.

7.12.1 The Construction Phase, The Initial Carbon Debt

The construction phase represents the most carbon-intensive period of the project's early lifecycle. This debt is calculated as the sum of emissions from material production, land clearing, and heavy machinery logistics.

1. Embodied Carbon in Construction Materials

Embodied carbon refers to the CO_2e generated during the extraction, processing, and manufacturing of materials. For SGR Phase 2B, cement and steel are the primary contributors. The total embodied carbon (EC) is calculated using the following formula:

$$EC = \sum (Q_m \times L \times C_f)$$

Where:

- Q_m = Quantity of material per kilometer
- L = Total length of the corridor (262 km)
- C_f = Carbon conversion factor (tonnes of CO_2e per tonne of material)

A. Cement Consumption

Based on technical benchmarks from SGR Phase 1 (Mombasa to Nairobi), the project utilizes 318 tonnes of cement per kilometer.

- Total Quantity:** $262 \text{ km} \times 318 \text{ t/km} = 83,316 \text{ tonnes}$
- Conversion Factor:** $0.912 \text{ t}^2 \text{CO}_2e/\text{t}$ (Source: Inventory of Carbon and Energy - ICE Database)
- Total Cement CO_2e :** $83,316 \times 0.912 = 75,984 \text{ tonnes}$

B. Steel Consumption

Reinforcement steel and rail tracks are estimated at 70 tonnes per kilometer for a heavy-haul SGR specification.

- **Total Quantity:** $262 \text{ km} \times 70 \text{ t/km} = 18,340 \text{ tonnes}$
- **Conversion Factor:** $1.85 \text{ t}^2 \text{CO}_2 \text{e/t}$ (Source: World Steel Association average for global rail steel)
- **Total Steel CO₂e:** $18,340 \times 1.85 = 33,929 \text{ tonnes}$

The combined embodied carbon for primary materials is approximately 109,913 tonnes of CO₂e.

2. Land Use Change and Sequestration Loss

The clearance of the 262 km right-of-way results in a localized loss of biomass. The carbon impact is calculated based on the lost sequestration potential (*SP*):

$$SP = \text{Area} \times \text{ACSR}$$

Where *ACSR* is the Annual Carbon Sequestration Rate. For the high-rainfall zones in Kericho and Bomet, this results in an immediate carbon release and a permanent loss of a natural carbon sink. This loss necessitates the reforestation programs outlined in the mitigation plan to move the project toward a net-zero land-use balance.

3. Construction Logistics and Machinery

Heavy-duty diesel machinery used for earthworks and tunneling contributes to Scope 1 emissions. The total logistics footprint (*E_{log}*) is estimated based on fuel consumption:

$$E_{log} = \text{Total Fuel (L)} \times 2.68 (\text{kgCO}_2/\text{L})$$

The coefficient of 2.68 is the standard IPCC factor for mobile diesel combustion.

7.12.2 The Operational Phase: Direct and Indirect Emissions

Once operational, the SGR Phase 2B transitions to a more stable emissions profile, defined by service frequency and traction technology.

1. Direct Locomotive Emissions (Scope 1)

The direct emissions from diesel-electric locomotives (*E_{ops}*) are calculated as follows:

$$E_{ops} = \text{Trips} \times \text{Distance} \times \text{Fuel Economy} \times \text{Emission Factor}$$

Using a service level of 2,920 annual trips and a fuel economy of 4.0 L/km, the project generates substantial operational emissions. However, these are significantly lower than the road-transport equivalent per tonne of cargo.

2. Station Operations and Auxiliary Power (Scope 2)

Indirect emissions arise from the consumption of grid electricity. Kenya's national grid is an international leader in renewable energy, with approximately 90 percent of power coming from geothermal, hydro, and wind sources. Consequently, the Scope 2 emission factor for SGR Phase 2B is estimated at only 0.40 kgCO₂/kWh., making station operations remarkably low-carbon.

3. Efficiency Gains through Operational Design

The SGR design reduces carbon intensity through two primary mechanisms. First, optimized gradients minimize the fuel energy required for uphill hauls. Second, regenerative braking systems in modern locomotives capture kinetic energy during the descent from the highlands into the Kisumu basin, further reducing net energy demand.

7.12.3 The Net Carbon Benefit: Avoided Emissions and Payback Analysis

The climate justification for SGR Phase 2B is the Modal Shift, where high-efficiency rail replaces high-emission road transport.

Table 65: Summary of Projected Operational GHG Emissions (Annual)

Parameter	Diesel Traction (Current)	Electric Traction (Potential)
Fuel or Energy per one-way trip	1,048.0 Litres	1,310.0 kWh
CO ₂ per one-way trip	2,808.6 kg	131.0 kg
CO ₂ per train-kilometer	10.72 kg	0.50 kg
Annual CO ₂ (2,920 trips)	8,201.2 tonnes	382.5 tonnes
Annual CO _{2e} (Total Operational)	8,693.3 tonnes	405.5 tonnes

To calculate the Carbon Payback Period, we compare the total construction debt against the Avoided Road Emissions. Standard heavy-duty trucks emit approximately 1.1 kg of CO₂ per kilometre. Replacing a fleet of trucks with a single SGR train results in an annual avoided emission of approximately 38,252 tonnes of CO_{2e}.

Table 66: Carbon Payback and Net Impact Timeline

Phase / Year	Cumulative Project Emissions (tCO _{2e})	Annual Avoided Road Emissions (tCO _{2e})	Net Project Carbon Impact
Construction (Year 0)	109,913 (Debt)	0	-109,913 (Debt)
Operation Year 1	118,606	38,252	-80,354
Operation Year 2	127,299	76,504	-50,795
Operation Year 3	135,992	114,756	-21,236
Operation Year 4	144,685	153,008	+8,323 (Net Zero Reached)

Phase / Year	Cumulative Project Emissions (<i>tCO₂e</i>)	Annual Avoided Road Emissions (<i>tCO₂e</i>)	Net Project Carbon Impact
Operation Year 10	196,843	382,520	+185,677 (Net Positive)

The project is projected to reach the *Carbon Break-Even* point in **3.7 years of operation**.

7.12.4 Conclusions on GHG Mitigation

The analysis confirms that the SGR Phase 2B will reach carbon neutrality within its first four years of service. Beyond this point, the project becomes a major net-positive contributor to Kenya's climate goals. To accelerate these benefits, the ESMP recommends that the Kenya Railways Corporation prioritize electrification readiness and implement a corridor-wide reforestation program to offset the sequestration loss in Narok, Bomet, and Kericho Counties. Adopting these measures will ensure the railway serves as a model for sustainable, low-carbon infrastructure in East Africa.

7.13 Conclusions

The railway infrastructure along the Narok–Kisumu SGR Phase 2B corridor, including tracks, bridges, culverts, embankments, signaling systems, and power components, is highly sensitive to extreme weather conditions. As established in this assessment, rising temperatures, intense rainfall, and flooding pose direct threats that can cause track deformation, ballast washouts, and operational delays. However, this study significantly advances the baseline understanding by demonstrating that these risks are not uniform; spatially explicit modeling using the GFDL-ESM4 model reveals that hydrological and geomorphological hazards are concentrated in specific geographic "hotspots."

The integration of the Multi-Hazard Index (MHI) and Rainfall Erosivity (R-Factor) modeling has successfully identified the Kericho-Bomet escarpments and the Kisumu lowlands as the most climate-critical segments of the corridor. In these zones, the convergence of steep topography and high erosivity (peaking at indices of 0.014) creates a high probability of slope failure and drainage siltation. Furthermore, the analysis of Return Periods (T2 to T50) confirms a projected intensification of *Design Storms*. The shift in the 50-year return levels (T50) suggests that extreme events will exceed historical benchmarks, increasing the risk of hydraulic overtopping if drainage systems are sized only on stationary historical data.

To maintain safety and service reliability, climate factors must be integrated into every stage of the planning, design, operation, and maintenance of the SGR. This includes enhanced inspections during extreme weather and proactive climate-risk assessments, as well as the implementation of targeted bio-engineering and future-proofed drainage sizing in the identified high-risk zones.

Ultimately, the failure to implement these climate-responsive measures could result in significant social and economic consequences, including travel disruptions, increased transportation emissions, and infrastructure damage. By adopting the *Climate-Plus* design philosophy supported by the spatial hazard profiles and return-period models provided in this report, the Kenya Railways Corporation (KRC) can mitigate the threat of accidents and derailments, ensuring that the SGR remains a resilient and reliable asset for the 21st century.

CHAPTER 8.0 STAKEHOLDER AND COMMUNITY CONSULTATION

8.1 Introduction

This chapter presents the approach, process, and outcomes of the Stakeholder and Community Consultation conducted as part of the ESIA process. Stakeholder engagement is a critical component of the ESIA process, ensuring that the views, concerns, and knowledge of affected and interested parties are considered in project planning and decision-making.

Public participation is an essential and legislative requirement for environmental authorization. The Firm of Experts undertook the public stakeholder consultation (PSC) with regard to the proposed project. The public consultation was undertaken between 1st and 22nd July 2025 to obtain information from interested and affected parties (stakeholders), solicit their views and consult on sensitive issues by completing a set of questionnaires. The output is incorporated in the development of mitigation measures.

8.2 Objectives of Stakeholder Engagement

Stakeholder engagement for the proposed project was undertaken to:

- a) Inform key stakeholders of the proposed project and create public awareness on environmental and social risks associated with the project.
- b) Identify opportunities and risks from and to the project: By anticipating a project's potential problems, consultations can help reduce the risk profile (delays, legal disputes, and negative publicity), lead to cost savings, and enhance the social benefits to local communities.
- c) Explicitly address stakeholders' comments and concerns, in the project's decision-making process.
- d) Achieve a transparent decision-making process with greater input from stakeholders and their support of the decisions that are taken.
- e) To enhance the project to support the aspirations and needs of the local communities, including the vulnerable marginalized groups (VMGs) living within the project area.
- f) To build local capacities and foster ownership, which are crucial elements of project sustainability.

The consultation process enabled the establishment of a communication channel between the Public and the ESIA Consultants, KRC and the Government (through the Local Administration), and ensured that concerns of the stakeholders were known to the decision-making bodies at an early phase of project development.

8.3 Stakeholder Consulted

Table 67 below summarize the stakeholder consulted that will be affected or have an interest in the proposed Narok – Kisumu SGR Project and are therefore expected to have an influence on its implementation in one way or another.

Table 67: List of stakeholders consulted

Category	Stakeholders Consulted
National Government	County Commissioner Narok, Bomet, Kericho, Nyamira and Kisumu
	DCC, s for each Sub County traversed by the SGR
	ACC, s for each division traversed
	Chiefs for each location
County Governments	County governments of Narok, Bomet, Kericho, Nyamira and Kisumu Sub Counties administrators
Government Institutions	KRC
	NEMA at the County levels
	KFS at the county levels
	KWS at the county levels
	KMFRI Kisumu Office
	Water Resources Authority (WRA) at regional levels
	KPLC, KETRACO and other related Institutions at Regional levels
Project Affected Persons (PAPs)	All
Transport Operators	Representatives
Business Communities	Representatives
Local Communities	Communities group and members
Trade/ Manufacturers Associations	KAM KNCCI
Others	• Religious groups representative, • Community Based • Organizations (CBO) • Non-Governmental Organizations (NGO) • Youth and Women groups • People with disability • Vulnerable groups

8.4 Stakeholder Response Matrix

Table 68 below summarizes the stakeholder outcomes during consultation.

Table 68: Stakeholder Response Matrix

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
1	Awori Audrey Joyce, Business Woman	• Possible displacement of many communities from their ancestral lands. • KRC should do proper and fair compensation for the locals. • KRC should consider fair compensation with favorable and convenient time limits to alleviate long fights between the locals and the government (compensation might take 4-5 years). • The project will lead to environmental pollution- Noise, dust.	• Increase in the value of land. • Opening of the area to potential business opportunities.	• Environmental degradation. • Displacement of human population. • Little faith from the locals in the land commission to offer fair and proper compensation.	• Proper and fair compensation of the locals to be done on time.
2	Tony, Entrepreneur	• KRC should engage the youth and community members when sourcing for labor. • Methods for labor sourcing should be free, fair, and transparent. • KRC, through the project should engage in	• Creation of employment	• Displacement of human population.	• Compensation for land acquired.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
		CSR to help communities.			
3	Enos Obado, Self Employed, Resident.		Increased business and connectivity.	- Displacement of human population. - Noise pollution. - Access. - Cracks on nearby houses. - Felling of trees.	- KRC to promote and sponsor tree growing. - Compensation. - Provide reasonable access. - Use less noisy equipment.
4	Esther Onunga, Medic/ MOH, Nurse.	KRC should consider job opportunities to the locals especially during project implementation.	- Improve socio-economic status hence eradicating poverty. - Employment creation. - Promote education through building of new schools. - Increase security.	- Displacement of people. - Loss of community networks (moving from your kin). - Destruction of property. - Social tension and conflict among family members. - Early pregnancies due to circulation of money. - Destruction of public facilities and infrastructure. - Misuse of compensation money.	- KRC should compensate the affected persons promptly. - KRC should offer disturbance allowance. - KRC should consider livelihood restoration. - KRC should find reconciliation measures among family members.
5	Evellyne Jasmin Sunday, Business Woman.		Job creation during the construction and operations of the SGR.	- Environmental pollution - dust and water pollution, - Vibration from the railway.	

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
6	Philip Anayo, Businessman, Managing Director	KRC should consider early payment to the land owners.	- Job creation - Development along the proposed project areas. - Land value appreciation. - Reduced transportation cost.	Noise pollution and dust.	Restrict working hours to latest 6:00pm.
7	George O. Juma, Public Health	KRC should continue improving on the community livelihood and wellbeing.	- Quick means of transport. - Tourism. - Attract investors.	- Displacement of people from ancestral land. - Interference with normal routine livelihoods. - Emergence of zoonotic infections.	- KRC should offer compensation. - Anti-rabies campaigns. - Training on alternative sources of livelihood.
8	Dorothy A. Onong'wo CGK/Social Services, Director Social Services.	KRC should involve all the stakeholders in all the stages of the project.	- Social welfare improvement. - Improved transport network. - Employment creation.	- Social Impacts. - Environmental Impacts.	- Sensitization of the public. - RC should involve the public/ community at all levels. - KRC should have a working TOR between the contractors and the clients.
9	Lavina A. Oduor, Social Services, Social Worker.	- KRC should consider 5% of allocation for PWDs. - During construction, disability infrastructure, accessibility, and	- Creation of job. - Ease transportation. - Boost trade.	- Conflict of interest among families during compensation. - Lack of title deeds in some areas.	- KRC should consider family engagement. - KRC should engage key departments like chief's office, land, and housing departments.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
		inclusivity should be considered. KRC should consider involving sign language interpreters in most of the work.			
10	Achieng Geogina, Agriculture, Agricultural Officer		- Reduced solid waste pollution. - Reduced tire risks by tracks. - Less emission of CO2 gases in the air. - Reduced greenhouse emission effect.	- Pollution of rivers. - Deforestation. - Soil erosion. - Destruction of wildlife migratory areas. - Noise pollution and vibration through machines. - Oil spillage in the soil leading to death of micro and macro-organisms. - Destruction of crops.	- Compensation for tress in partnership with Kenya Forest Services. - Crop compensation to be done through the department of agriculture. - During construction, pits should be filled with soil to avoid mosquito breeding sites when filled with water - Construction to be done at daytime to minimize noise pollution.
11	Florence A. Obara Village Elder.	KRC should facilitate the process of compensation to end the active tension building in the community.	- Potential of attracting investors. - Enhanced security by Kenya police and the Kenya Railways police. - Business opportunities within East and Central Africa.	- Displacement of families. - Compulsory land acquisition- loss of ancestral land. - Description of income. - Social tension within families. - Social disorder- early pregnancies and school	- Compulsory acquisition with compensation within the current market values. - Value properties such as residential and commercial at current market value i.e proximity to social amenities.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
				dropout among the young population.	• 15% disturbance allowance.
12	Peter Asiero CGK, SCA.	• KRC should consider several strategic community meetings and provide psycho—social and economic support through various community groups (CSOs)	• Economic benefits as business will boost. • Spring up of urban centers will bring up markets.	• Human displacement and that of buried loved ones will have psychological impacts.	• KRC should organize sensitization meetings especially on cultural dynamics associated with the local belief systems.
13	George Opiyoh SCSPO	• Sensitize the community.	•	• Livelihoods will be displaced.	
14	John Ongween	• KRC and the study team should give the best feedback on behalf of the community(ies).	• Create job opportunities.	•	•
15	Susana Ouma Village Elder.	• The project will help in reducing some diseases. • It will reduce road accidents. • Markets will be improved hence attracting investors. • As compared to road transport, the SGR will accommodate more passengers. • Improve tourism.	• Ease of travel. • Short time during the usage of SGR. • Improvement of factories and businesses. • Creation of job opportunities.	• Disruption of source of income. • Cultural erosion. • Conflict within families in sharing the compensation money.	• KRC should compensate trees according to current market value. • Land should also be compensated based on current market value.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
16	Jeffrey Bonyo, CGK-DAILF SAO.	KRC is doing a great job.	Ease of transporting products and people.		
17	Joyce Opondo, Group Corp. Affairs.		- Ease of transportation of goods and people. - Reduction of traffic. - Reduction of road accidents. - Sustainable road infrastructure due to reduction of heavy transport vehicles. - Possibility of export and import of goods. - Attraction of investors. - SEZs will benefit from transport of goods and imports of machinery and raw materials. - Kenya will have an advantage on international trade. - Cheaper travel in EAC	- Reduction of agricultural land. - Displacement and separation of families. - Uncertainty of future considering loss of land and migration of families. - High demand for alternative land due to displacement of families from ancestral land.	Cost benefit analysis of agriculture and soil use.
18	Goffins Okoth Ngeso		- Increase trade. - Raise revenue collection.	- Disruption of local business. - Displacement of people.	KRC should organize early

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Farmer		• Help reduce road maintenance cost.	• Loss of communal land. • Increase in crime rates.	• payment/compensation for the affected people. • KRC should offer disturbance allowance. • Security officers to be deployed in the area.
19	Brian Otieno, Veterinary.	• More sensitization should be done for locals to understand the purpose of SGR. • KRC should allow time for locals to process their land documents for compensation.	• Ease of transport. • Potential CSR especially in Kano with the flooding. • Roads may be built.	• Displacement of people from ancestral homes. • Demolition of structures.	•
20	Odhiambo Opande Lawrence Farmer	• KRC should put more stations along the railway line. • KRC should help the community process their documents faster since the process is slow.	• Improvement of the economy. • Increase in employment. • Increase in trade. • Increase in towns within the railway line. • Increase in income.		
21	Kelvin Okedo Odhiambo Youth Leader	• KRC should consider CSR initiatives like building schools, roads, and hospitals.	• Easy transportation of agricultural goods. • Increase transport connectivity.	• People will be forced to abandon their farms. • Displacement of homesteads.	• Proper compensation to affected families. • Provide alternative land. • Engage the community directly.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
22	Loice Ochieng, Business Woman.	•	- Improved business opportunities. - Easy and fast transportation of goods, services, and people.	- Displacement of families. - Compensation done may not be enough. - Disorganizing people who had already settled. - Noise and air pollution.	- Settling people in land that is equal to what they already had. - Adequate compensation for inconveniences.
23	David Odhiambo Oluoch Accountant/Banker CPAs	Affected parties should be fully compensated before project initiation.	- Timely transport means. - Development of impacted places. - SGR is faster than MGR.	- Displacement of people. - Change of land ownership to KRC. - Donated lands not yet transferred will lose benefits. E.g. churches, Hospitals, schools	- Proper and timely compensation to be done. - Chief to support without conditions/exaggerated changes with land for acquisition of title deeds.
24	Judith Nowa Casual Worker.	KRC should consider implementing the project quickly since the price of materials increases daily.	- Improve tourism opportunities. - Attract investors. - Increase property value.	•	•
25	Lucy	KRC should offer quick and well compensation to the affected people.	- Job opportunities to the community. - Ease means of transporting goods and people.	•	•
26	Paul Omondi Oyugi,	A request for underpass for affected people with vast parcels of land to enable them access to	- It will create job opportunities. - Improve tourism and attract investors.	Tamper with livelihood restoration for affected people.	Affected members to be compensated before relocation.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Local Administration. Village/Community opinion leader/Elder.	their other parcels that the SGR will divide into two.	• Reduce pressure on roads. • Reduce STDs for long distant drivers.	• Dust emissions during construction.	
27	Alice Shabola Business Lady	• Currently have a better understanding of the SGR from the public consultation meetings.	• Job creation. • Ease of transportation. • Increase business opportunities.	• Relocation will be expensive and have psychological impacts.	•
28	James Ochieng Ageyo, Rtd. Public Servant, Trainer Consultant	• KRC should encourage faster and adequate compensation.	• Improved businesses. • Reduced transportation costs and improved efficiency. • Faster communication.	• Possibility of inadequate compensation or long delays as the Mombasa phase.	• Education of members and public participation.
29	Pius Oriane Farmer.	•	• Employment opportunities. • Easy transportation of goods. • Increase property value. • Encourage farmers to grow many crops.	•	• Allow free movement. • Creation of employment.
30	Anne Okado,	• Continuous education to the community on health issues and how to	• Create job opportunities.	• Vibrations and noise pollution. • Loss of livelihoods.	• Machine silencers to reduce noise.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Public Health Officer	manage compensation money. • KRC should take care of the graves that are existing within the land and offer psychological counselling. • KRC should erect signage, billboards and barriers. • Any food vendors must be medically examined to be allowed to supply workers with food.	• Ease of transporting people and goods. • May open social partnerships. • Improve revenue collection.	• Dust and smoke emissions. • Population influx and money circulation leading to prostitution. • Environmental Pollution through human waste and other waste which may lead to outbreak of diseases.	• Controlling or reducing the dust and smoke emissions. • Continuous sensitization/education of the public on life skills. • Have signage and billboards. • Compensation of those whose livelihoods will be affected. • Construction of sanitary facilities for workers along the railway line.
31	James Aura Aput, Water Department, Muhoroni Sub-County. Sub-County Officer.	• KRC should consider long-term sustainability of the project. • Promotion of research policies and development in areas related to SGR and technology, operation, and management.	• Economic growth within the region. • Improved infrastructure. • Faster and efficient transportation of goods and people. • Creation of employment.	• Displacement of communities. • Social disruption. • Environmental damage within the area.	• Risk identification and assessments. • Preventive measure i.e. creating noise barriers. • Contingency planning i.e. create plan on natural disasters. • Risk transfers- taking insurance for accidents.
32	Ngeno Sammy Chepchilat,	• KRC to consider paying for perennial crops since some such as mangoes and avocados are already doing well.	• Employment to the locals. • Increased business opportunities like shops, hotels etc. • Ease access to markets.	•	•

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Agriculture and Irrigation, Sub-county Crops Officer- Muhoroni		• Attract investors. • Boost tourism.		
33	Collins Akong'o, Secretary Onjiko.	• Hope for the best.	• Upgrading livelihoods.	• Disruption of schools. • Lack of water for farmers. • Lack of medical.	• Building schools. • Construction of health centers. • Construction of roads.
34	Samuel G.O. Olal. Farmer.	• KRC should consider and identify the vulnerable who are not financially stable to process their land title deeds to be paid by KRC after assessment.	• Create employment. • Increase business opportunities. • Compensation for land owners. • Faster means of transport. • Enhance trade.	• Non-payment by KRC to affected individuals who could not have all the required documents due to time and financial capacity.	•
35	Paul Olang Akeyo Kenya Disables Info Advisory Centre. Founder-Director.	• KRC should hasten the process to avoid anxiety. • KRC should consider vulnerable populations with special focus to PWDs.	• Employment creation. • Business opportunities.	• Livelihood disruption through displacement and migration of families. • Education disruption through closing of schools or transfer.	• Early preparation and prompt settlement and compensation. • Seamless transfer of learners/ timely construction of learning institutions.
36	Teddy Odarjo Public Health	• KRC should involve county government departments during construction.	• Job creation. • Increase in business.	• Displacement of people. • Relocation of schools affecting students.	• Compensation of land, houses and businesses.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	SCPHO-Nyando		• Increase in value of land. • Increase of investors in the region. • Better means of transport within the region.	• Pollution. • Cultural erosion. • Relocation of health facilities affecting patients and their treatment.	• Relocate schools to better places through the Ministry of Education. • Control Pollution. • Health education on cultural issues. • Relocate health facilities through the health ministry and county government.
37	Andrew O. Odhiambo Agriculture, Principal Agriculture Officer.		• Job creation for locals. • Sources of livelihoods. • More investors attracted.	• Air pollution due to construction and emission. • Destruction of forests/tree cover. • Soil degradation. • Reduced food supply since some agricultural land will be affected.	• Re-afforestation. • Control land degradation. • Rehabilitate degraded soil.
38	Addah Adhiambo Ndiege	• KRC should consider training for youth and young adults about self-discipline. • KRC should create awareness on negative effects of the project. • KRC should clearly address issues that affected families may not well understand.	• Creation of employment. • Faster means of transport. • Business opportunity. • Reduce pressure on roads. • Promote Tourism.	• Displacement and delocalization of people. • Destruction of property. • Disruption of sources of income. • Social tension on how to share compensation.	• Proper and prior compensation to displaced members. • Affected members to be given appropriate time to find other places to stay.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
39	Dennis O. Sikukuu Civil Servant. CRS	KRC should talk to the land office in Nyando Sub-County to reconstruct green cards for beneficiaries since many people submitted their documents a long time ago and reconstruction has not yet been done.	- Employment opportunities. - Development of areas. - Enhance and provide cheap transport.	- Immoralities. - Land disputes. - Displacement of people. - Family disputes.	- Educate people on how to conduct self-discipline and control. - Use local chief and assistant chief to settle land disputes. - Compensation of displaced people.
40	Beneventure Ombura Teacher		- Easy travel. - An opener to many economic activities. - Employment to young people.	- Displacement of people. - Nose pollution from the train. - Cultural erosion.	- The community should be intact and not dispersed. - The train should limit noise. - Enhance cultural practices.
41	John Otieno Oguya VCL Sales and Marketing Executive	KRC to ensure that those affected are well compensated and everything is put in place.	- Improve physical appearance of the land after the project. - Improve livelihoods. - Compensation of those whose lands are affected by the project.	- Displacement of people from their ancestral land. - Environmental pollution-noise. - Loss of land. - Interference of roads and schools.	- Compensation of people involved. - Concentrate on creating access roads and under-passes. - Build new and modern schools and have temporary classes for schools.
42	Peter O. Miruka Farmer		Building schools and Markets		

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
43	Elkanah Obande	Prior arrangement to be done before 2027 election time.	- Create job opportunity. - Improve transport accessibility. - Improve living standards.		- Payment mode to be done for the destruction of property. - Payment in advance to avoid late relocation.
44	Bernard Nyaonga Omwamba. Stakeholder.	Compensation should be commensurate and paid in one phase.	- Promotion of socioeconomic development of the region and the entire country. - Economic empowerment of individuals.	- Displacement of people. - Destruction of houses. - Change of environment. - Increased distance from family members.	- Compensation. - Construction payment expenses.
45	Simeon Morcasi Rtd Manager	KRC should have the representatives of the affected areas to collect views of other affected members before implementation.	- Employment opportunities for the local communities. - Economy of the locals will improve due to improved purchasing power.	- Relocation of homesteads. - Separation of family members. - Disturbances of areas. - Introduction of new behaviors that are not in line with the community.	- Education of affected members to be prepared psychologically. - Agree on how to move graveyards before construction.
46	Ronald Ocharo Osoro Farmer	Have a good understanding regarding the SGR Phase B.	- Job creation - Market growing - Good transport.	- Land relocation. - Plant disturbance - School relocation - House relocation.	
47	Onsongo Fredrick	The project should be supportive to each individual and be positive to the society.	- Creating job opportunity. - Promoting markets	- Market disruption. - Dangers to the environment. - Collapse of towns.	Address environmental impacts of the project.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	South Nyanza Water Company, Coordinator.		Promoting the transport sector.	Increased debts.	Restore, replace and empower to control debts.
48	Edwine Oluoch Okaka Farmer		- Business Opportunity. - Good transportation.		
49	Jane Chepkemoi, Kapkisiara, Farmer	- Congratulated the project and felt was brought in time. - KRC was to link the Kenyan economic zones to other countries economic networks - KRC should practice Environmental impact monitoring - Supports project since there will be resettlement for those affected by project	- Creates job opportunities - Easy/Cheap transport cost - Minimization of accidents - Reduction of travel time and costs - Enables water resource management	- Environmental pollution - Contribute to climate change - Air/ Water pollution - Garbage disposal	- Creates public awareness through local administration - Engage the locals to understand their concerns and develop measures - Put in measures to reduce noise
50	Department of Social Development, Soin-Sigowet Sub-County;	- KRC will provide alternative means of transport - KRC will attract more investors thus creation of employment to the community members	- Creation of employment - Reduction of road accidents caused by trucks	- Displacement of people, schools and other institutions along the proposed rail line passage. - Some families will find difficult to access the remaining portion of the	- Expedite compensation to affected people & institutions. - Build under pass/over pass to enable access of schools, land etc.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Social Development Officer	There should be easiest means of communication between members and KRC concerned personnel.		land or institutions like schools, hospitals and churches.	
51	Evans Kiplangat NG-CDF Sigowet/ Soin	KRC should work hand in hand with all stakeholders for easier and smooth running of project.	- Faster transportation of goods thus promote business - Creation of employment during construction. - Reduce transportation costs - Decongestion of traffic on roads	- Displacement of people - Demolition of structures such as schools, churches etc. - Conflicts may arise between KRC and affected people over compensation amount.	- KRC to engage National Land Commission in making land rates - KRC to work hand in hand with interior to provide security.
52	Daisy C. Bor Immigration & Citizen Services Deputy County Registrar of Persons	- KRC should ensure involvement of all stakeholders in the implantation process. - The project has more positive impacts compared to negative impacts and ultimately will benefit the community.	- Employment creation to the locals - Availability of faster means of transport as compared to road transport - Promote agricultural agribusiness	- Displacement of household - Crop up of social vices-prostitution - Cultural changes - Destruction of essential institutions e.g. Hospital, schools and churches	- Encourage the locals not to adopt other cultural behaviors - Compensation to be done within the shortest time possible and be made simple
53	Stephen Kimoi Principal P. Health Officer	KRC to ensure the contractor commits a mandatory percentage of money for health risk awareness.	- Ease of transport (safe transport) hence reduced accidents - Reduced CO2 emissions	- Rise in malaria due to stagnant water arising from excavations - Increased transmission of STIs and HIV/AIDS.	- Facilitation of Health education awareness - Prompt drainage of stagnant water to prevent mosquitos breeding

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
			- Improved business and income to the community hence quality life - Prompt delivery of health commodities		
54	Prof. Moses K Rotich Lecturer	- KRC should create job sensitization hub to teach and give knowledge to potential business persons and marketers - KRC will attract investors by provision of business areas with security.	- Economic /business improvement - Creating job opportunities - Faster mode of transport to major cities	- Noise on ground - Displacement of persons/facilities/public utilities - Destruction of trees already on farms - Blockage of access road.	- Build schools, health facilities, roads affected or destroyed - Compensate affected persons and their properties. - Creates access and safer crossings
55	Dr. Wiily Chepkuro Community member/University Lecturer	KRC should consider constructing SGR terminus & Hub at Kapsorok due to industrial park & many industrial complexes in Soliat and Soin wards	- Significant reduction on cost of transport - Crop of new economic opportunities - Creation of job opportunities	- Non-payment or delayed compensation especially those with succession challenges - Wide inter-terminus or inter-hub distance	- Ensure 100% compensation, promptly] - Consider alternative/validated documentation besides land title deeds. - Construct more terminus and hubs
56	Josephat Kipkoech Businessman	- KRC to ensure affected people are educated on banking for safety - The affected people be prioritized for faster compensation	- Creation of employment to people - Improve infrastructure	- Displacement of people - Open business will be closed - Increase in social immorality	- Compensation be done in time to the affected people. - Sensitization of people

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
		- Government should protect the affected people from middle men during compensation - Affected people be considered first for job opportunities. - KRC should conduct sensitization and financial literacy education to the community.	- Improve living standards of people - Development of urban centers	Family conflict during sharing of funds.	
57	Benjamin Koech Chairperson PWD	- The project was highly welcomed in the community - The project was to change people lives in terms of social economic and environmentally	- Creation of job. - The mode of transportation will be cheaper - It will improve the value of land around SGR.	- Displacement of people. - Agricultural activities to be affected.	- Compensation of displaced and their farms - Resettling the affected persons
58	Teacher/Extension	- The affected people be paid with appropriate prices - KRC to pay compensation in time - KRC to consider our cultural practices- Kalenjin practices	- It improves movement of products from rural to urban areas - It improves trade of local products by ensuring they access urban markets		
59	Moses Koech Farmer	SGR will decongest vehicles on the roads	It is the quickest means of transport and communication	Land will be possessed by government, where land acreage is reduced	

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
			It will improve economic status and growth of centers along the line	and degradation is experienced. - Those with small pieces of land will be impacted negatively - Small pieces of land are created among the residence affected - Sound pollution as a result of train locomotion.	
60	Jonathan k. Soi Commissioner Bomet Public Service Board	- Local residents to be given priority in job opportunities during recruitment - Public utilities affected be compensated	- Creation of employment - Business opportunities - Efficient / faster mobility of goods, services and passengers		
61	Gillian Chepkemoi DCC Office CO II	- KRC to do as per the people words and not to take long in order to maintain - To ensure everyone is paid accordingly	- Improve business among people - Improve transportation - Reduce accidents - Reduce cost of living - Create job opportunities	- Displacement of people. - Noise pollution - Environmental pollution	- To resettle the affected people - To improve machines used during construction of SGR
62	Duncan K. Ngeno	There is need to compensate the affected families on time	- Efficient and effective transport - The business in the area will flourish		

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Deputy Director Ministry of Labour and Social Protection		• People will be economically empowered		
63	Richard Terer Teacher	• Workers to be sourced within the SGR Posses • Construction materials sourced within • The affected landowners be given first priority in matters concern SGR So that they can benefit • People without land ownership documents be assisted financially to obtain such.	• Better life standard • Good infrastructure • Opening up remote areas for better business • Better education standard	• Relocation of humanity • Diseases and traumatization • Some amenities will be existed	• Proper legal structure be put in place in good time
64	Stella Langat	• The national land commission should undertake deliberate valuation for specific areas because not all land is valued in the same rate • Land in freehold and from municipality should be valued separately	• Access to cheap mode of transport • Increase of economic activities within the affected region • Creation of employment • It will reduce accidents and congestion on our roads	• Relocation of families from family land • Disruption of access roads to rivers • Disruption of existing development, farms and other economic activities	• Urgent compensation of families with their economic activities • Establishment of grievance redress mechanism committee for prompt response to emerging challenges
65	Nimrod c. k. Rono	• Kindly connect the Bitumen Road infrastructure of the local	• Fluid transport corridor		

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Local Leadership Aspirant	area to facilitate ease of access to the railway stations	• A boost in economic synergy projects • Ornamental infrastructure development • Indirectly benefit in industrial development		
66	Cyprian Rono Farmer		• Creates employment • Improves transport means(faster)		
67	Kiprono Weldon	• Conduct regular public participation in order to ensure views &needs of the local are captured correctly • Consider compensating the affected households well.	• Improve infrastructure like roads within area • Creates employment to the local residents • Connect rural areas to external markets for their farm products		
68	Rono Geoffrey Farmer	• To further educate the affected people on positive and negative impacts	• It leads to the country's economic growth and improves the livelihood of our people along the line at large • Business will mushroom along the SGR line • It will promote agriculture along the catchment area.	HIV and other communicable diseases will be realized along the line	Public sensitization and awareness on HIV diseases

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
69	Winny C Rotich Survey Department Land Surveyor	Go to the main ground and meet with the locals	- Faster means of transport, eases of road congestions and ports congestion. - Creation of new business opportunities by enhancing trade and improving large scale farming & productions. - Reduced accidents and attraction of new investors	- Displacement due to the compulsory acquisition - Causes disruptions of livelihood, family conflicts on the distribution mode - Increases in HIV infections & family separation due to compensation money - Distraction of Roads, water supplies & powerlines - Misuse of compensation money.	- Educate the affected people on how to use compensation money and negative effects of misusing the money - Sensitizing them on long-term solutions
70	Beatrice c. Ngetich Teacher	Assess the psychological impacts of SGR, if possible, mitigate or compensate	- Access to different places with low costs and short time - Source of employment to many - Emergence of business centers	- Displacement from ancestral land - Extended family separation	- Good compensation from SGR to enable family to resettle again in other places - Improving the existing road network
71	Mr Tonui Weldon Ministry of Interior ASS.Chief Kimenderit	- Should help some families speed up succession process of their land for easier compensation - Should consider youths for employment opportunities at all levels	- Job creation opportunities - Likelihood for business setup along the railway - It will improve and ease business in the area as transportation will be much easier.	- Displacement of persons - Machines sound - Disputes and disagreement - Social life change - Possibility of rapid spread of HIV/AIDS	- Displaced persons should be fully compensated before the project starts and psychological counselling done - The public should be advised early to avoid any disagreement as far

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
					as compensation is concern The public should be informed on the irresponsible sexual behaviors (set up sensitization meetings)
72	Langat Gilbert Chepalungu Constituency Office Personel Assistant	- KRC should engage the stakeholders well to get to understand the cultural, economic and political background of the area for efficient implementation of the project. - Though the project has some demerits, its positive impacts supersede the negative	- Employment opportunities to the locals - Enhances business opportunities due to the existence of reliable and affordable transport means - It helps in intercommunity relations	- The displaced individuals will not easily find a place for resettlement - Economic impacts due to disturbance of some permanent investment - The compensation rates may not satisfy the expectation of the affected individuals - Environmental effects shall be felt due to destruction of both natural and manmade vegetation - Cultural effects might occur as the rail might pass through the community cultural sites and cemeteries	- Proper compensation and disturbance allowances to be considered especially by the NLC and property valuers - Counselling to be done to the affected individuals
73	Lelei Philemon Chepalungu	The government to assisting facilitating in the process of succession of property that are	SGR will improve the economic status of the region	Compulsory displacement to unknown destination	Provision of alternative land by government to displaced persons possible

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Farmer	currently pending in the court of laws, majority of the affected persons have not gotten title of ownership due to long process in courts	- Locals will secure skilled and unskilled jobs - Efficient transport of goods and services	Fear of un-fair compensation especially NLC. the rate of price of land differs from one village to another	Fair negotiation of land prices between land owners affected by project with national NLC from one place to another
74	Anonymous	Persons affected should be paid properly- Compensation adequately because it is their life	- It will improve economic livelihood of people living around - First means of transport and reduce traffic on roads	- It might increase HIV - Disturbed the life style of people before settling in on new areas.	Ensure counselling before resettling of the affected persons.
75	Wesley Kemboi TSC Education SCHRO	- The team to do serious feasibility study on the negative impacts - The positive impacts are more than negative impacts	- Trade and people doing business will improve - Faster way of travelling from one station to another	Building will be demolished, crops, schools, hospitals and traders will be affected	The mitigation measures will be to compensate the affected families
76	Hillary Koech Ministry of public works Work officer	Requested information on how the affected will be compensated, valuation progress and employment litigation.	Employment opportunities	Destruction of properties and element of cultural erosion.	Compensation of properties.
77	Sub-county Agricultural Officer	- Do more sensitization on compensation measures - Allow farming of annual crops on wayleave	- Cheaper means of transport - Faster means of transport compared to vehicles	- Destruction of crops mostly tea - Soil erosion	- Valuation & compensation to farmers - Contractor to put measures to reduce soil erosion

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
			- Enhances movement of bulky goods - Ease access of movements of farm inputs like fertilizers of Agro inputs		
78	David Chepkwony, Teacher	- Support the mainline but the station at Kipsegon is not supported should be relocated. - Kipsegon is source of water for several villages hence will affect most villagers to access to clean water.	It will enhance transport system.	The water table at Kipsegon serves several villages with clean water and its therefore their responsibility to protect and conserve the spring.	KRC should consider to allocate the station to another place.
79	Isaack Rotich, Farmer.	- Compensation to be done to the affected people - Consider alternative land provision for the displaced - Consider the well-established socio-economic facilities	Improve development in the society		
80	Bensy Chepkemoi Education Director	- To identify real owners of the land - Avoid brokers - Give appropriate information to the owners in advance	- Promote tourism both local and international - Promote economic to the local people/country - Easy travelling - Job creation	- Displacement of people - People will remain landless - People wouldn't get enough land equivalent - Expensive to purchase another land.	- The government should provide enough land for people elsewhere - The government should consider good value for the land.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
		Give accurate valuation of parcel in advance	Raise the standard of living around them.		
81	Rob K. Rowald, Social Services, C.D.O	- Public engagement and public participation take place - Gender sensitivity training should be conducted - Support self-help groups and local communities such as FBOs	- Availability of services to locals - Growth of businesses - Improvement of other infrastructures - Employment opportunities	- Displacement of people to new places - Transfer of schools/hospitals to other areas - Movement of locals to areas with higher crime rates	- Local opinions should be considered especially in land acquisition - Social economic mitigation plans should be established - Training locals on crime alerts and responses.
82	Ngetich Samson, TSC, Teacher	- Information to be passed onto PAPs at specified times - Project related alerts to be announced to locals via SMS	- Increased trade for farmers - Increased value of land - Increased interaction with other towns	- Change of lifestyle due to displacement - Overall change in town lay-out	- Appropriate compensation for affected locals - Maintenance of established infrastructure - Public sensitization to be thoroughly done
83	Kiprotich Boniface Ngeno, Driver/Mechanic, B.C.E Class	Recommends the study team have a good relationship with locals and their culture	- Creation of jobs - Improved ease of transport	- Increased noise pollution - Possible reduction in jobs due to reduction on driver-focused opportunities	Primarily focusing on displacement of people living near the proposed construction site
84	Langat K. Jonah, TSC, Teacher	The study team keep sensitizing people on pros and cons of the project to locals	- Ease of transportation of goods and services - Opens up the interior part of East Africa - Growth of industry	Displacement of people from their original homeland	Proper compensation to PAPs.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
85	Lilian Resian Shieni, Teacher,	• Tenders be awarded to local communities • Locals to take priority in employment for the project • Maintain environmental standards	• Employment of locals • Increased attraction of local and foreign investment • Increased value of local land • Awarding of tenders	• Displacement of residents from their homes • Loss of land causing a loss of income • Land division reducing food output • Noise pollution during construction and operation phases.	• Compensation of displaced people • Minimizing noise from construction
86	Joseph Tiyo, Farmer	• Prior assessment of land to avoid disputes and allow for fair compensation	• Ease of transport • Employment increase • Improves the local economy	• Re-location of people to un-favorable land.	• Adequate compensation to enable favored relocation.
87	Michael Muna, Sub-county Chairman of Peace	• Participation should occur at every stage of the project. • Frequent consultation with locals	• Increase of business opportunities • Transportation of farm products	• Demolition of constructed homes • Limited availability of land for displaced locals	• Make land accessible for purchase by locals at fair rates • Establishment of proposed resettlement regions
88	Ezra Lesinyan Sikamoi, Social Development, Senior Social Development Officer	• Sensitization is highly necessary for locals to be aware of the projects and all its effects	• Job creation and economic growth • Enhanced accessibility to services • Improve transport • Social development	• Displacements • Social inequalities • Disruption of livelihoods	• Provide fair compensation • Consult with locals • Collaboration with all parties through stakeholder engagement • Community sensitization

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
89	Owino Jared Okumu, Interior, Assistant County Commissioner	Inclusivity of PAPs in project development to avoid collapse of towns	- Employment increases - Ease of transport will increase	Pastoralism will be affected due to the project	Extension of underpasses at a regular interval of ~3km.
90	Parmon Siampei, Narok County Government, Sub- county Administrator		- Fast means of transport for goods and people - Employment - Cultural exchange and increased social interaction - Improves tourism	- Transmission of diseases - Family displacement - Collapse of businesses - Habitat manipulation	- Sensitization to the public about STDs - Carry out EIAs - Service of all machinery on time - Provision of masks among PPEs - Increased re-forestation
91	Kiplangat K. Cheruiyot, MOH. Public Health, PHO	For Kenya Railways to work hand in hand with MOH to ensure smooth project coordination.	- Job creation to the locals - Minimize air pollution and car congestion on the road - Reduction of transport costs	- Displacement of public from their land - Increased presence of health hazards such as dust. - Noise pollution	- Compensation to displaced persons - Provision of PPEs both to construction workers and potentially affected locals
92	Ambrose Nchoko, Administration, Resident	- Awareness of community needs and recommendations and prioritization of these demands - Creation of project awareness	- Creation of employment - Promotion of globalization	- Displacement of persons - Increased rate of STI transmissions - Pollution of the environment	- Compensation of displaced individuals - Public sensitization on the effects of HIV/AIDS - Conduct public participation - Use of water to control dust dispersion

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
93	Benedict K. Churichin, SCPC-NPS, SCPC	- The project team to avoid disputes with local communities - Timely compensation of the community - Voiced support for the proposed project	- Employment - Creation of market - Introduction of market and road network - Increased business opportunities - Increased value of lands	- Increase in crime - Increase in STI cases - Disruption of existing road network - Increased prostitution	- Establishment of a police post(s) along the route - Sensitization and supply of condoms - Counselling and conflict resolution strategies to be adopted - Introduction of overpasses/underpasses
94	Rose Bore, Public Health, Public Health Officer	- Sensitization of local community to project benefits - Ensuring safety precautions are followed - Proper waste disposal.	- Improved economic status of the region - Increase in employment opportunities	- Noise pollution - Destruction of vegetation - Increase soil erosion - Unprotected sexual practices and increase in sexual harassment.	- Provision of ear plugs and conducting work primarily during daytime - Compensation for destroyed vegetation - GBV training and promotion of safe sexual practices.
95	Betty Sang, Ministry of Labour and Social Protection, Social Development Officer	- Allocation of appropriate time slots and sensitization on awareness on the project - Establishment of grievance handling mechanisms	- Improved transport costs - Improved socio-economic standards in the area - Improved livelihoods	- Conflict between families. - Displacement of families.	- Sensitize members of the public in advance for those who will be affected and compensated. - Consultation on compensation will be made and utilization of that money.
96	Japhet Kirui,	Ensure project benefits locals by guaranteeing employment to local youths	Reduced pollution by road trucks	- Sound pollution - Air and water pollution	Carry out construction during the day to reduce night sound pollution

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Social and EIA Expert Bureti		• Reduced time spent on the roads • Employment opportunities • Improved livelihoods and business opportunities	• Cultural erosion by foreigners • HIV/AIDS spread	• Sensitization on HIV/AIDS.
97	Sigei Augustine, Plumbing Instructor	• After compensating the land owners, they should be given time settle elsewhere before construction starts	• Improves economic activities along the SR lines -towns will emerge • It makes transports efficiency and saves time	• Creates noise pollution in the nearby people • It will lead to lack of employment to some individuals like drivers who normally transport goods from one station to another • Displacing people who live near the SGR line	
98	Munke Agnes, N.C.G, Deputy Sub-county administrator	• Take care of wild animal corridors	• Increased food production • Increase in financial opportunities for locals • Improved security in the region • Increased mobility of people/products	• Financial irresponsibility and family conflicts from land acquisition • Destruction of the environment • Noise & air pollution	• Guidance and counselling to PAPs • Re-afforestation on affected areas • Dust mitigation using water • Consistent and timely communication to locals regarding project activities
99	Thomson Siriba Mekubo,	• Continuous collaboration for the span of the project	• Opens up the area for business	• Congestion of towns • Increased traffic jams • Potential redesign of Narok town	• Construction of by-passes and feeder roads • Restructuring the urban planning of Narok town

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
	Teachers' Service Commission, CSE for SCD-TSC			- Relocation of schools - Shortage of amenities for both locals and temp. workers	Government collaboration with the community for items such as school relocation
100	Stanley Konata, Narok County Govt, Municipal Manager	Limiting disruption of locals by considering environmental, economic and social aspects	- Improved business opportunities - Faster movement of goods and services	- Crowding on the road - Displacement of people - Inaccessibility due to the railway.	
101	Jane Chebet, Agriculture, Sub-county Agricultural Officer	Ensuring community development through supporting projects such as well and water-pan digging	- Cheap transport for farmers - Increased interaction with different communities	Loss of farmland, potentially leading to food shortage	- Diversifying skills of farmers through training - Increasing food production capacity per area of land.
102	Malack Olang Kennedy, Public Health, PHO		- Increased economic output - Improved transportation in the region	Spread of communicable diseases like HIV/STIs	- Set-up mobile HIV test units - Conduction of routine public health screenings and education.
103	Joseph Moitah Oltinaiyo, Narok County Government, Administrative Officer	- Proper waste management plan - Compensation of trees destroyed during the construction process	- Increased employment opportunities - Open market for goods and services - Enhanced transport	- Displacement of people - Social tension in/during compensation process	- Compensation to be conducted in advance - Community sensitization on project impacts e.g. workshops

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
104	Lovians Ochieng, DOSH Narok County		• Creation of employment opportunities	• Increased risks to health/safety from pollutant exposure	• Proper health and safety training protocol • Conduction of medical assessments
105	Barack Ndire, Directorate of Social Development, County Coordinator	• Advising PAPs well on sexual behavior and wise investment of compensation money	• Increased mobility of goods and people • Increased business opportunities • Reduced congestion due to lorries	• Sexual exploitation of women • Impact to established businesses • Impact on infrastructure from project related activities	• Adequate compensation on those displaced • Policy on sexual exploitation and monitoring perpetrators • Establishment of an area and infrastructure for relocation of PAPs
106	Francis Kangangi, Public Health & Sanitation, Public Health Officer	• Involvement and understanding of local culture by project team • Community sensitization is key • Consider opinion leaders and gatekeepers during community entry	• Ease of transport leading to lower prices • Employment opportunities • Attraction of new investors • Reduction of HIV/AIDS incidences	• Increase in pollution of water sources, dust and noise exacerbation • Lower food production leading to malnutrition	• Mitigate dust pollution by regular water sprinkling • Noise management e.g. use of silencers on machines • Provision of water treatment chemicals • Supplementing the local food supply
107	Kenya Forest Service (KFS), Deputy County Forest Conservator	• KFS should be involved in technical project implementation • Minimize excavation as much as possible • Identification and documentation of		• Loss of some extinct tree species • Increased soil erosion • Deforestation • Loss of biodiversity	• Tree species should be identified and documented • Animal habitats should be documented • Minimize excavation

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
		invasive species along the route			Implementation of tree planting projects
108	Ibrahim Bokeye, Interior, ACC - Suswa	All cross paths/under passages be considered	- Employment creation opportunities - Reduced traffic on the road - Reduced the amount of time of travel - Improve security	- Displacement of people - Spread of diseases, e.g. HIV - Disruption of sources of income - Elements of Cultural erosion	- Purchase of alternative land by owner - Regular testing of HIV - Avoid learning new culture
109	Tesot Paul, Interior, HRO	Study team should be educational, direct and friendly to locals	- Faster transport - Creation/expansion of markets for farm and animal products. - Compensation money will benefit PAPs.	- Land theft during project land acquisition. - Pollution of air and noise	Timely and considerate compensation for land acquired.
110	David Kabagi, Agriculture, SCELDO	- Construction of water pans to harvest water run-off - Proper disposal of waste water, e.g., retention ditches	- Employment to locals - More agricultural activities - Ease of marketing of farm produce.	- Displacement of locals - Destruction of farm land	- Resettlement of people - Compensation for crops destroyed
111	Geoffrey Kirui, K.W.S, Forest Officer	- Ensuring that the local culture is preserved and protected. - Protection of the environment is paramount	- Increased entrepreneurial and employment opportunities - Increased movement of goods	- Displacement of locals - Destruction of water sources - Infiltration of cultures and norms - Interruption of normal operation of public facilities	- Relocation of people in the vicinity of their old establishments - Increased monitoring by forestry and water services - Restoration of the affected institutions.

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
112	Moses Kipkoech, Businessman	Study team should be understandable and be open to conversation	- Increased employment - Development of infrastructure - Increase in population	- Displacement of people. - Lack of title deeds in the area	Give PAPs reasonable timelines for relocations and compensations
113	Abraham Koech, Interior, Chief Chesoen Location	Frequent visitation and meetings should be held by the study team(s).	- Creation of employment - Perishable goods will be able to reach the market - Increased interaction with people.	- Displacement of people - Increased disturbances due to noise and quakes - Rise of unwanted pregnancies	- Ensuring resettlement of displaced people - Training on home construction to locals - Awareness training on money management
114	Joel Sitienei, TSC, Teacher	- Preservation of local culture is necessary - Protect farmers and water catchment areas - Proper valuing of property	- Increased employment - Growth of urban areas - Increased quality of life for locals - Improvement of local infrastructure		
115	Kiplangat Rotich, Teacher	- Stakeholders should employ residents of the affected area - Expansion of rail should include increase in stations - Reconstruction of affected roads and bridges	- Increased employment - Market development - Ease of transportation	- Displacement of residents. - Loss of developed assets - Separation of family - Land disputes - Increased crime rate	- Relocation and compensation should take top priority - Payments to be done before displacement

INDEX	STAKEHOLDER	COMMENTS GIVEN	POSITIVE IMPACTS	NEGATIVE IMPACTS	MITIGATION MEASURES
116	Anonymous	Lighting in tunnels should be improved for security reasons	- Growth of employment and entrepreneurial activities - Increase in rental houses - Increased food supply - Promotion of tourism	No serious negative impact	
117	Anonymous	Study team should create awareness of the importance of the project to locals.	- Increased employment opportunities - Compensation of land will assist locals financially.	- Increased transmission of STIs - Cultural erosion - Land disputes and growth of squatters	- Compensation to be done responsibly - Sensitization of locals to diseases such as HIV/AIDS - Teaching the community on importance and preservation of local culture.
118	Jameson Mututwu, Village Administrator	Appreciation is extended towards the study team due to their work in raising awareness to the project	- Creates employment - Benefits to locals if given tenders - Economic growth - Ease of accessibility	- Dust pollution - Soil erosion due to poor drainage in the area - Water and air pollution - Displacement of locals - Increased STIs in the area - Blasting risks damaging local infrastructure	- Use of water to alleviate dust dispersion - Proper drainage infrastructure to be established - Being mindful to limit pollution - Timely compensation for damages incurred

8.5 Analysis of Stakeholder questionnaire responses

The stakeholder consultations demonstrate broad awareness of, and general support for, the proposed SGR project, with most participants acknowledging its substantial socio-economic benefits. However, the consultations also underscore significant environmental, social, and livelihood-related concerns that will require careful and proactive management.

Across the 118 stakeholders consulted representing government agencies, community leaders, farmers, businesspersons, civil servants, and special interest groups there is a strong consensus that the SGR project is a transformative development initiative. Stakeholders widely recognize its potential to stimulate regional economic growth, enhance connectivity, and improve access to markets and social services. Nevertheless, stakeholder support is largely conditional on the provision of fair and timely compensation, transparent and continuous communication, and the effective mitigation of adverse impacts. Presented below is a tabulated thematic analysis that synthesizes stakeholder inputs.

Table 69: Analysis of Stakeholder questionnaire responses

Theme	Key Stakeholder Issues Raised	Perceived Positive Impacts	Perceived Negative Impacts	Required Mitigation & Management Measures
Land Acquisition, Displacement & Compensation	• Fairness and timeliness of compensation • Loss of ancestral land • Succession issues and lack of title deeds • Land brokers and fraudulent claims • Residual uneconomical land parcels	• Increased land value • Formal land valuation processes	• Physical and economic displacement • Family separation and conflicts • Displacement of schools, markets, utilities • Landlessness	• Fair, prompt, and transparent compensation • Compensation prior to displacement • Legal and succession support • RAP implementation and GRM • Disturbance allowance and market-based valuation
Livelihoods & Economic Impacts	• Loss of farmland and grazing land • Disruption of small businesses • Job losses in transport and farming sectors	• Job creation (skilled & unskilled) • Growth of trade and markets • Improved market access	• Reduced food production • Loss of income sources • Poverty risks post-displacement	• Local employment prioritization • Livelihood restoration programs • Skills training and enterprise support • Support for residual land use
Environmental Impacts & Biodiversity	• Deforestation and habitat loss • Noise, dust, and vibration • Wildlife displacement • Water and soil pollution	• Opportunity for afforestation • Improved environmental planning	• Biodiversity loss • Soil erosion and land degradation • Water contamination • Climate stress	• ESMP implementation • Afforestation and habitat restoration • Wildlife corridors • Dust, noise, and emissions control
Water Resources & Drainage	• Protection of rivers, springs, boreholes	• Improved drainage infrastructure	• Disruption of water supply	• Collaboration with WRUAs and Water Authorities

Theme	Key Stakeholder Issues Raised	Perceived Positive Impacts	Perceived Negative Impacts	Required Mitigation & Management Measures
	• Flood risks in low-lying areas		• Pollution of surface and groundwater • Flooding	• Protection and rehabilitation of water sources • Alternative water supply provision
Social Risks & Community Well-being	• HIV/AIDS and STI transmission • Gender-based violence • Crime and insecurity • Psychological stress	• Improved living standards • Urban growth	• Community disintegration • Health risks • GBV and social conflict	• HIV/AIDS and GBV prevention programs • Worker codes of conduct • Community health outreach • Psychosocial support
Community Access, Safety & Mobility	• Restricted access to farms and amenities • Need for underpasses and crossings	• Safer and faster transport • Reduced road accidents	• Accidents involving people and livestock • Community severance	• Adequate underpasses and crossings • Traffic and safety management plans • Fencing and signage
Cultural Heritage & Social Infrastructure	• Disturbance of graves and cultural sites • Displacement of schools and churches	• Improved regional integration	• Loss of cultural heritage • Disruption of education and social services	• Chance-find procedures • Rerouting where feasible • Relocation and reconstruction of facilities
Stakeholder Engagement & Communication	• Need for continuous consultation • Inclusion of PWDs and vulnerable groups • Clear grievance mechanisms	• Improved trust and project ownership	• Misinformation • Conflict and resistance	• Continuous public participation • Inclusive communication (local languages, sign language) • Functional GRM

Theme	Key Stakeholder Issues Raised	Perceived Positive Impacts	Perceived Negative Impacts	Required Mitigation & Management Measures
Governance & Institutional Coordination	• Compliance with laws and regulations • Inter-agency coordination	• Improved service delivery	• Delays and disputes	• Strong institutional coordination • Transparent disclosure • Regular monitoring and reporting
Corporate Social Responsibility (CSR)	• Demand for community projects (schools, water, health)	• Improved community welfare	• Unrealistic expectations	• Clearly defined and targeted CSR programs aligned with community priorities

8.5 Public Consultation Meetings

The ESIA Public Consultation Meetings were held between 1st and 22nd July 2025 at various locations as shown in Figures below. The meetings were carried out in a language that was appropriate to the different audience i.e. English, Swahili and Luo. While the local project affected people, meeting was organized at location level with support of the respective DCCs. The public consultation meetings provided a wide platform for all the relevant stakeholders to raise their concerns, highlight the project related environmental, social, economic, cultural and risk impacts and issues of significant. The total of 2,363 persons attended the consultative meeting, among them 1,835(78%) were males and 528(22%) were females. Issues and concerns articulated during the stakeholder meetings. **Table 70** below indicates meeting schedule.

Table 70: Meeting schedule

Date	County	Sub – County	Venue	Attendance	Gender	
					Male	Female
01/07/2025	Narok	Narok East	NTULELE CHIEF's OFFICE	63	53	10
02/07/2025		Narok Central	COUNTY COMMISSIONER OFFICE-CONFERENCE HALL	153	118	35
03/07/2025		Narok South	OLOLULUNGA-NAROK SOUTH SUB-COUNTY DCC OFFICE	107	96	11
04/07/2025		Narok Amalo	NAROK AMALO SUB-COUNTY - SOGOO (ILMOTIOK DISPENSARY)	158	139	19
07/07/2025	Bomet	Bomet East	KIPLABOTWA HEALTH CENTRE BOMET EAST SUB-COUNTY	168	122	46
08/07/2025		Chepalungu	DCC OFFICE - CHEPALUNGU SUB-COUNTY	70	51	19
09/07/2025		Bomet Central	BOMET CENTRAL SUB-COUNTY KIPLELJI SUB-LOCATION.	109	78	31
		Sotik	PCM-SOTIK DCC OFFICE	129	97	32

Date	County	Sub – County	Venue	Attendance	Gender	
					Male	Female
10/07/2025			MUTARAKWA ACC’s OFFICE CHEBOLE	96	78	18
11/07/2025	Kericho	Bureti	BURET SUB COUNTY CHEPLANGET CHIEF’S OFFICE	198	163	35
			BURET SUBCOUNTY KAPKISIARA CHIEF’s OFFICE	153	125	28
14/7/2025		Sigowet Soin	SONDU PRIMARY SCHOOL	204	150	54
15/7/2025	Nyamira	Nyamira North	NYAMIRA NOTH SUB-COUNTY, ESANIGE GROUND	156	130	26
16/7/2025	Kisumu	Nyando	WAWIDHI A/WAWIDHI B (OKIRO)	197	139	58
18/7/2025		Muhoroni	KASESE MARKET [OBUMBA] MUHORONO	99	65	34
		Kisumu East	CHIGA SUB-LOCATION (KISUMU EAST)	73	60	13
21/07/2025		Kisumu Central	KONDELE LOCATION KWANYAKWAR KISUMU CENTRAL	63	44	19
22/7/2025		Kisumu West	EAST KISUMU LOCATION KOGONY SUB-LOCATION KOGONY SOCIAL HALL	167	127	40
Total				2363	1835	528

Public participation meetings attracted 2363 participants across the 5 counties traversed by the proposed Narok Kisumu SGR line. Of the participants 1835 were male while 528 were female.

Figure 61 below provides a comparative analysis of participants by county and gender.

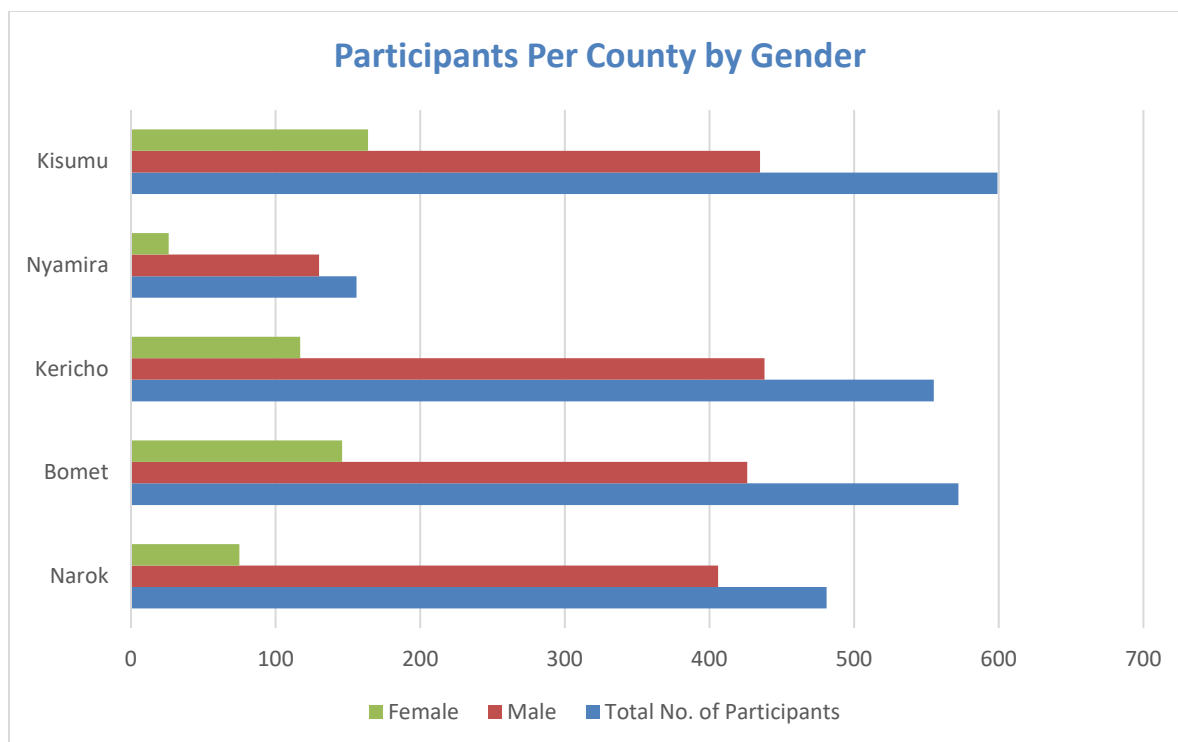


Figure 61: Participants per county by gender

The figures below show the images during the public participation forums held in Narok County.



At Ntulele Chief's Office, Narok East



At Ololunga – Narok South DCC's Office



At Narok East DCC's Office



At Sogoo – Narok Amalo

The figures below show the images during the public participation forums held in Bomet County.



At DCC's Office, Chepalungu



At Kalabotwa Health Centre, Bomet East



At Kiplelji Sub Location, Bomet Central



At Mutarakwa ACC's Office Chebole, Sotik

The figures below show the images during the public participation forums held in Kericho County.



At Kapkisiara Chief's Office, Bureti



At Sondu Primary School, Sigowet Soin

The figures below show the images during the public participation forums held in Nyamira County.



At Esanige Ground, Nyamira North



The figures below show the images during the public participation forums held in Kisumu County.



At Wawidhi A/ Wawidhi B (Okiro), Nyando



At Chiga Sub Location, Kisumu East



At Kanyakwar, Kondele Location – Kisumu Central



At Kogony Social Hall, Kisumu East

The public engagement meetings revealed that most stakeholders were already informed about the proposed project. During these sessions, the consultant and the proponent provided detailed briefings to the community and relevant stakeholders on the planned Standard Gauge Railway line from Narok to Kisumu. Questions and concerns raised by participants were also responded to their satisfaction.

Stakeholders had varied perspectives to the project, with residents expressing both support and apprehension due to the potential positive and negative impacts. Stakeholders and local communities openly shared their views, opinions, and suggestions based on their interests and the circumstances influencing their livelihoods and institutions.

The meetings created an opportunity for those who would be directly affected to voice their concerns. These contributions played a key role in identifying issues that guided the ESIA process. It was noted that some project-affected persons expressed a sense of entitlement, believing that the proposed

project passes through their parcels of land. All environmental issues raised are to be addressed through the mitigation measures outlined in the subsequent chapter of this report. Other project-related concerns were also clarified and resolved during the meetings with support from the proponent's representatives, who provided further explanations where necessary.

8.6 Validation Workshops

8.6.1 Introduction

The draft ESIA report and its findings were subjected to a validation workshop attended by regulators, lead agencies, national and county government officials, representatives of affected communities, and technical experts, in line with NEMA guidelines and international best practices.

The purpose of the validation workshop was to ensure that the findings of the Environmental and Social Impact Assessment (ESIA) accurately reflected the realities, views, and concerns of stakeholders consulted during the fieldwork.

8.6.2 Objective of a Validation Workshop

The objectives are:

- Present the ESIA findings including identified impacts, baseline conditions, and proposed mitigation and management measures.
- Receive stakeholder feedback to verify the accuracy and completeness of the information documented during the ESIA process.
- Ensure stakeholder ownership of the results by providing a platform for meaningful participation and dialogue.
- Confirm that community concerns were correctly captured and reflected in the ESIA report.
- Enhance transparency and accountability by involving stakeholders in reviewing and validating project impacts and proposed actions.

Notice letters were issued seven days prior to the workshops to the respective County Commissioners (CCs), Deputy County Commissioners (DCCs), County Government offices, and relevant government agencies as per the NEMA guidelines.

Table 71 below presents the meetings of the validation workshops for the Narok Kisumu SGR Phase 2B.

Table 71: Validation Workshop Meetings

County	Narok County	Bomet County	Nyamira County	Kericho County	Kisumu County
Date	10 th November, 2025	11 th November, 2025	12 th November, 2025	13 th November, 2025	14 th November, 2025
Venue	Esiram Hotel	Chang Sierra Springs	The Guardian Hotel	Sunshine Hotel	Pinecone Hotel

The output during the validation workshop have been incorporated in this final report.

The figures below illustrate the ongoing validation workshop sessions.



Figure 62: Ongoing meetings during validation workshop

The validation workshop confirmed that the findings of the draft ESIA report reflected the

environmental and social baseline conditions, as well as the key issues raised during earlier consultations.

Participants including regulators, government representatives, technical experts, and representatives of the affected community members verified that their concerns had been correctly captured and highlighted any additional issues that needed inclusion.

The proposed mitigation and enhancement measures were reviewed, with stakeholders offering further recommendations to strengthen the Environmental and Social Management Plan (ESMP).

The workshop provided an opportunity to clarify outstanding questions related to project design, anticipated impacts, and institutional responsibilities.

Any gaps identified in the ESIA process were noted, and follow-up actions were agreed upon. Overall, the workshop facilitated consensus-building on the ESIA findings, with stakeholders acknowledging the inclusiveness and transparency of the consultation process. A record of participants, key contributions, and deliberations was documented to meet NEMA requirements.

The outcome of the deliberation from the validation workshops, attendance sheets are annexed in this report.

CHAPTER 9.0 SIGNIFICANT ENVIRONMENTAL IMPACTS IDENTIFICATION, ANALYSIS AND EVALUATION

9.1 Introduction

This chapter presents the systematic identification, evaluation, and analysis of potential environmental and social impacts associated with the proposed project the objective is to determine the likely positive and negative effects of project activities across all phases and to assess their significance in order to inform decision-making and the design of appropriate mitigation measures.

9.2 IMPACT IDENTIFICATION

This forms the foundation upon which mitigation, management, and monitoring plans are built. It helps in identifying potential environmental and social impacts (positive and negative) helps decision-makers assess the feasibility, acceptability, and sustainability of the proposed project.

Impact identification was conducted through project screening and scoping, baseline data collection, stakeholder engagement,) GIS and Spatial analysis, Use of impact identification tools e.g. checklists and expert judgements from past similar projects.

During the site preparation and clearance phase of the proposed project, several negative environmental and social impacts may arise if the right mitigation measures are not put in place. This phase typically involves vegetation clearing, land leveling, excavation, and relocation activities — all of which can disrupt ecosystems and communities.

During the construction phase, several negative environmental and social impacts may occur if proper mitigation measures are not implemented. This phase involves intensive activities such as earthworks, bridge and tunnel construction, material transport and infrastructure installation.

The operation phase of a Standard Gauge Railway (SGR) project brings significant long-term benefits like efficient transportation and economic growth. However, it can also lead to negative environmental, social, and economic impacts if not properly managed. These impacts typically arise from train operations, maintenance activities, and associated infrastructure use.

The decommissioning phase may involve dismantling railway infrastructure and restoring the site to its original or another agreed-upon state. This phase may have significant negative environmental and social impacts if not properly managed including waste generation, soil disturbance and erosion, air and noise pollution amongst others. **Table 72 and 73** below provides the scoping matrix for environmental and social aspects respectively.

Table 72: Scoping Matrix - Environmental aspects identification of the potential interactions between project actions and environmental aspects

	Project Activities	Soil quality	Topsoil	Soil erosion	Surface water	Surface water flow patterns	Sediments	Groundwater	Hydrogeological flow patterns	Air quality	Noise and	Landscape	Flora	Fauna	Habitats	Ecosystem Services	Protected and Designated sites	Cultural Heritage
1	<i>Clearance of existing land, vegetation and buildings</i>	X	X	X	X		X			X	X	X	X	X	X	X	X	X
2	<i>Temporary sites used for construction works (material storage and equipment maintenance camps, concrete batching plants, crushing plants) and housing of construction workers)</i>	X	X		X			X		X	X	X	X	X	X	X	X	X
3	<i>Above ground construction, earthworks, cut and fill or excavations, building of linear structures and stations</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	<i>Underground works including mining / tunneling</i>							X	X	X	X	X			X	X	X	X
5	<i>Haulage roads</i>	X	X	X						X	X	X	X	X	X	X	X	X
6	<i>Construction traffic and machinery movement</i>	X	X	X			X			X	X	X	X	X	X	X	X	
7	<i>Inert waste landfills</i>	X	X	X	X		X			X	X	X	X	X	X	X	X	
8	<i>Borrow pits</i>	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
9	<i>Impoundment, realignment or other changes to the hydrology of watercourses or aquifers</i>	X	X	X	X	X	X	X	X				X	X	X	X		X
10	<i>Rivers/Stream crossings (building the bridges)</i>	X	X	X	X	X	X						X	X	X	X		
11	<i>Usage, storage, transport, handling or production of hazardous substances</i>	X	X	X	X	X	X	X		X		X	X	X	X	X	X	

12	<i>Trains passing</i>				X			X		X	X		X	X	X	X	X	X
13	<i>Presence of permanent way, bridges, tunnels and stations</i>			X		X	X	X	X	X	X	X	X	X	X	X	X	X
14	<i>Passengers/loads in/out the trains and at stations</i>				X					X	X							X
15	<i>Maintenance of railway track</i>	X	X		X			X		X	X		X	X	X			
16	<i>Overhead power lines</i>												X	X	X	X	X	X

Table 73: Scoping Matrix – Social aspects identification of the potential interactions between project actions and social aspects

<i>Project Activities</i>		Land and Property	Community Health and safety	Community tensions	Access & Severance	Disruption of utilities	Economy	Employment	Education and Training	Vulnerable groups	Workforce	Related impacts	Communities “Quality of Life”
Construction phase	1 <i>Above ground construction, earthworks, cut and fill or excavations, and building of linear structures and stations</i>	X	X	X	X	X	X	X	X	X	X	X	X
	2 <i>Temporary sites used for construction works (material storage and equipment maintenance camps, concrete batching plants, crushing plants) and housing of construction workers, placement of borrow pits and landfill</i>	X		X	X	X	X	X	X		X		
	3 <i>Haulage roads</i>	X	X		X								X
	4 <i>Construction traffic and machinery movement</i>		X	X	X						X		X
	5 <i>Manipulation with hazardous materials during construction and transport of raw materials and finished materials</i>		X								X		
Operational phases	1 <i>Presence of permanent way, bridges, tunnels and stations, passenger and freight traffic</i>	X	X		X		X	X	X	X	X	X	X
	2 <i>Passengers/loads in/out the trains and at stations</i>		X								X		

3	<i>Maintenance of railway track</i>										X	
4	<i>Trains passing</i>		X								X	X
5	<i>Overhead power lines</i>		X			X					X	

Summarized impacts are indicated in **Table 74** below.

Table 74: Impact identification

PHASE 1: SITE PREPARATION/CONSTRUCTION	
Impact category	Impacts
Air Quality -Dust	- Activities such as site clearance, vegetation removal, and earthworks contribute significantly to the release of dust particles into the atmosphere. - The use of heavy machinery to excavate soil and rock, level the ground, and construct embankments exposes large surfaces of bare earth, making them highly susceptible to wind erosion mainly in arid and semi-arid regions such as Narok or during dry seasons. - The movement of trucks and construction vehicles along unpaved access roads also agitates fine particles, resulting in localized clouds of airborne dust that may travel considerable distances depending on wind direction and speed. - Handling and transportation of bulk construction materials such as ballast, cement, sand, and gravel further exacerbate dust emissions. Stockpiles of loose materials kept on-site without proper covering can become additional sources of wind-blown dust. - Vegetation along the construction route may be coated with layers of dust, reducing their photosynthetic capacity, clogging stomata, and stunting growth. - Dust deposition may disrupt the feeding and breeding patterns of small mammals, birds, and insects, while also compromising the quality of nearby aquatic habitats through sedimentation and reduced water clarity.

Air Quality-Gaseous Emissions)	• CO₂, NO_x, SO₂, CO gases are primarily emitted from fossil fuel combustion in vehicles, generators, and machinery. Ambient concentrations contribute significantly to climate change, harmful to respiratory health and contribute to ground-level ozone and acid rain formation. • Volatile Organic Compounds (VOCs) may be released from fuel handling, paints, solvents, and adhesives used in construction. VOCs react with NO_x under sunlight to form ozone, contributing to smog. • Fine airborne particles including PM₁₀ and PM_{2.5} are closely associated with combustion emissions and are included in air quality assessments due to their respiratory and cardiovascular impacts • In regions adjacent to forests, wetlands, or Lake Victoria's shorelines, gaseous pollutants can interfere with plant respiration, reduce visibility (due to smog), and affect sensitive fauna • Sources of gaseous emissions include heavy-duty diesel-powered construction machinery, On-site power generation and open burning of waste. • Odours from VOCs, smoke from waste burning, or generator fumes can cause discomfort and lead to community grievances, especially in densely populated zones like Kisumu suburbs or market centers along the corridor.
Impacts on Soil	• Vegetation clearance, topsoil removal, grading, and earthworks. In hilly and high rainfall areas such as Bomet and Kericho, the risk of erosion is particularly high due to the combination of steep slopes and heavy precipitation. It also exposes soil to wind erosion and gradual degradation of land productivity. • Topsoil is typically removed or disturbed during excavation for foundations, drainage structures, and access roads. In agriculturally productive counties like Nyamira and Kericho disrupting fertile topsoil reduces soil quality and impacts food security and local livelihoods. • Soil compaction from use and movement of heavy machinery reduces pore space, impedes root penetration, and decreases infiltration rates, leading to increased surface runoff and a heightened risk of erosion and localized flooding.

	• The use and storage of petroleum products, lubricants, bitumen, cement, and construction chemicals can result in accidental spills or leaks that pollute soils. • The introduction of borrow pits and quarry sites to source materials for construction (e.g., murram, gravel, and ballast) also results in direct soil disturbance.
Impacts on Slope Instability and Associated Risks	• Excavation activities along sloped landscapes have the potential to destabilize slopes, increasing the likelihood of soil erosion, landslides, and slope failures. • Improper excavation or poorly engineered cut slopes can compromise the structural integrity of surrounding landforms, posing safety hazards to both the infrastructure and nearby communities. • In The threat of landslides is particularly significant in areas with high rainfall, clay-rich soils, and fractured metamorphic rock common across the highland sections due to creation of fractured rock formations create inherent zones of weakness that can be triggered by vibration, excavation, or excessive loading.
Vegetative Cover & Habitat Disruption Impacts	• Land clearing has the potential of permanent loss of native grasses, shrubs, and scattered acacia woodlands that play a critical role in maintaining ground cover. preventing desertification and provision of grazing land for livestock and wildlife. • These dryland ecosystems are slow to regenerate once disturbed, and loss of vegetation cover can exacerbate soil erosion, reduce soil moisture retention, and disrupt traditional grazing systems relied upon by pastoral communities. • Uprooting of trees, shrubs, herbs, and ground cover in areas as Narok and Suswa, where medicinal herbs, ferns, indigenous acacia woodlands and grasslands dominate, this can lead to a reduction in native plant diversity and the irreversible loss of endemic species that may not exist outside their localized habitats. • Agricultural highlands in Nyamira and Kericho dominated by smallholder farms growing tea, maize, bananas, vegetables, and other crops. Construction may result in the uprooting of productive vegetation, disruption of hedgerows, and destruction of agroforestry systems.

	• Natural habitat disruption and fragmentation leading to diminishing biodiversity and ecosystem services, disruption of wildlife movement, breeding, migration, seed dispersal, and pollination pathways. • Dust deposition on adjacent vegetation leading to blocking sunlight, reducing photosynthetic efficiency, and impairing plant respiration. • Increased risk of invasive species colonization, especially along disturbed and compacted soils of the right-of-way. Species such as <i>Lantana camara</i>, <i>Parthenium hysterophorus</i>, and <i>Opuntia stricta</i>, may rapidly establish themselves in these disturbed habitats, outcompeting native flora and further altering the ecological balance. • Removal of vegetation particularly woody biomass will result in a corresponding reduction in terrestrial carbon sequestration capacity, contributing to a net increase in atmospheric CO₂ levels.
Solid Waste	• In areas close to settlements along the route, particularly around Bomet, Sotik, and Kisumu, improperly managed construction debris can negatively affect the local landscape, degrade visual aesthetics, and introduce hazards to residents and livestock. • In areas like Nyamira, Bomet Parts of Kisumu and Narok, which are agricultural, indiscriminate dumping of excavated soil, spoil and debris could displace productive land and harm soil fertility. • Improper disposal of construction waste into rivers or low-lying areas may result in the obstruction of water channels, causing altered hydrology, localized flooding, smothering of vegetation and habitat destruction. • Hazardous solid waste e.g. spent oil filters, chemical drums, paint containers, solvent residues, used batteries, and welding materials could contaminate soil, water resources, and ecosystems, presenting health risks to the workforce and nearby communities.
Liquid waste	• Liquid waste from concrete batching plants, typically established at strategic locations along the corridor, generate alkaline wastewater high in cement particulates and chemical admixtures.

	• If discharged untreated, such wastewater can significantly increase the alkalinity and turbidity of nearby rivers, streams, groundwater aquifers and sensitive aquatic ecosystems along the Mara River and tributaries flowing into Lake Victoria, could be negatively affected by changes in water quality, potentially harming aquatic biodiversity. • Ground water and soil contamination from washing of equipment, vehicles, and machinery, accidental oil spills, fueling, and maintenance. • Storm water runoff from areas stripped of vegetation in areas characterized by frequent heavy rainfall, exposed construction surfaces could generate substantial sediment-laden runoff, leading to increased turbidity and siltation of waterways. • Domestic liquid waste from workers' accommodation camps and temporary construction facilities (kitchens, showers, and toilet), poses potential public health risks.
Noise & Vibrations	• Prolonged exposure to noise can cause a range of health and social effects on nearby populations including sleep disturbances, leading to fatigue, stress, and reduced productivity. • Blasting produces intense impulsive noise and sudden acoustic shockwaves which negatively affects children and elderly populations who are vulnerable to impacts from blasting. • Communication interference, which affects educational institutions, health centers, and places of worship located near the railway path. • Impacts of wildlife and livestock-Behavioral changes, interfere with mating calls and other reproductive behaviors, fleeing from their habitats, abandonment of nests, alteration of feeding and breeding behaviors due to repeated disturbances. • Other impacts include elevated heart rates, changes in hormone levels and weakened immune responses, which can impact overall health and fitness, disrupting the natural predator-prey relationships.
Increased Water Demands	• If not carefully planned, this increased water demand can exert pressure on local water sources including springs, rivers, shallow aquifers, and piped municipal supplies leading to resource stress, social conflict, and ecological degradation.

	• Lowering of water tables and drying of shallow wells, reduced stream and spring flows especially during dry seasons • Improper siting of storage tanks, refilling points, or wash-down zones can lead to spills, siltation, or runoff that contaminates water sources, particularly unprotected springs and surface water used for domestic consumption. • In towns like Bomet and Kisumu, tapping into municipal water systems to meet construction needs can cause reduced water pressure, affecting hospitals, schools, and residential areas, especially during peak hours
Water Quality Impacts	• Soil erosion and sedimentation in areas with hilly terrain and moderate rainfall e.g. Narok, Bomet, and Kericho counties. • Loosened sediments are likely to be washed into nearby rivers and streams such as the Kipsonoi River in Bomet or the Nyando River and Lake Victoria itself in Kisumu. This increases turbidity, disrupts aquatic habitats, and leads to sedimentation in drainage channels and wetlands. • Construction of the railway and the port station within the Kisumu port area which is close to the lake has a high likelihood to cumulatively impact the lake's water quality and wetland degradation resulting from sedimentation and erosion during the construction phase. • Use and storage of construction-related chemicals and materials including cement, bitumen, oils, fuels, and lubricants used in machinery pose a serious threat if spilled or improperly disposed of. • Accidental discharge into water bodies such as the Sondu River or smaller wetlands and springs in Bomet and Nyamira can result in elevated pH levels, toxic residues, and bioaccumulation risks for aquatic organisms. • Inadequate liquid waste handling at temporary worker camps and storage yards poses a risk of microbiological contamination of nearby surface water sources, including community water pans, springs, and shallow wells commonly used in Bomet and Nyamira as well as Lake Victoria itself.

	• Construction near these wetland areas can lead to partial or complete alteration of hydrological regimes, affecting wetland-dependent biodiversity and the natural filtration services these ecosystems provide. The final sections of the railway approaching Kisumu are particularly sensitive, as they lie within the Lake Victoria catchment. • Interruption of Recharge Zones and Springs- Construction works that compact the soil or remove vegetation impair this infiltration process, thereby reducing groundwater recharge rates.
Aesthetic Impacts	• Blasting and excavation may result in visible cuts into natural slopes, the removal of vegetation, and exposure of raw rock and soil surfaces. These disturbed landforms often appear as large, irregular scars on otherwise green and continuous hills capes, disrupting the visual harmony of the area. • The placement of spoil heaps, machinery, access roads, and laydown areas further adds to the temporary but significant aesthetic degradation. • Parts of Narok, Kericho, and Kisumu are located within or adjacent to well-known scenic and ecotourism zones, such as the Mau Forest complex, tea plantations, and Lake Victoria's shoreline which attract tourists. • The presence of construction machinery, dust, open blasting pits, and exposed cuttings during construction may significantly affect the visual character of tourist attraction zones e.g. Mau Forest complex, tea plantations, and Lake Victoria's reducing their appeal for nature-based tourism and photography. • Blasting, earthworks, and hauling of materials generate large volumes of fugitive dust, which can reduce air clarity and create a hazy appearance over the construction corridor.
Interference with Public Utilities and Access Infrastructure	• To enable safe and efficient construction, many utilities e.g. domestic water pipelines, sewerage networks, electricity transmission and distribution lines, and fiber optic communication will need to be relocated during the pre-construction phase which may cause short-term disruptions to service delivery, impacting households and institutions along the corridor.

Project influx/induced in-migration	Due to availability of both skilled and casual work opportunities, a number of jobseekers will be attracted to the area looking for employment opportunities. This will result in a temporary increase in population in the project areas. This increase is also not expected to result in increased pressure on local services or markets for local goods and services although it could contribute to perceptions that local people are not sufficiently benefiting from employment opportunities and create conflict between the local community and non-local workers.
Land acquisition and economic displacement	- Physical displacement is expected for residential structures have been identified to be closer to the proposed railway infrastructure. The project is expected to result in loss of land and access to land for landowners and livestock farmers along the railway line. The proponent commissioned a Resettlement Action Plan which outlines how affected individuals and communities will be identified, consulted, compensated, relocated, and supported to restore or improve their livelihoods and living standards. In total, the following categories of potentially economically displaced Project Affected Person (PAPs) have been identified: - Legal landowners and legal tenants - Informal land landowners and informal land users - Ecosystem services users (restricted access to farming lands, grazing areas, disruption of wildlife habitat,)
Health, safety and security risks to workers	The key OHS risks for the site establishment phase, include: - Exposure to physical hazards from use of heavy equipment - Trip and fall hazards - Exposure to dust, noise and vibrations - Falling objects

	• Exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery • Environmental hazards adverse weather conditions, such as working in extreme heat, heavy rainfall • Psychological hazards including high-stress work environments or fatigue • Risks specific to the project location include exposure to extreme heat and hazards associated with working on or near roads. • Workers involved in vegetation clearance are at greater risk of snake bites.
Health, safety and security risks to the local community	• The project creates potential risks of incidences, accidents and transmission of disease to the community members. These risks and associated hazards require management measures. • During site establishment, if not mitigated the following activities could cause disturbance or impact the health safety and security of land users, neighboring villages and local community members: • Truck and vehicle movements will increase existing traffic volumes. • Nuisance impacts from increased noise, vibration and dust related to site clearance activities. • Potential diseases and infections passed from workers to local community, in particular HIV/AIDS and other sexually transmitted infections as a result of the influx of labour force population from other areas.
Movement of vehicles and mobilization of the materials and other associated equipment	• Injury and killing of species through project activities e.g vehicle movement can cause degradation of terrestrial habitats. There is also potential for injury/ death of terrestrial fauna due to collisions with vehicles.

	• Incidents and accidents caused by vehicles transporting equipment to and from the site. • Emissions from vehicles and pollution from operational vehicles
PHASE 2: OPERATION	
Air Quality Impacts	• The cumulative emissions from diesel locomotives e.g. NO_x, particulate matter, CO, CO₂, SO₂ and VOCs (if electrification is not used), support vehicles, freight handling activities, and increased human activity can degrade ambient air quality, particularly in urban and peri-urban nodes such as Narok, Bomet, Ahero, and Kisumu. • Emissions from Auxiliary Equipment including diesel generators, forklifts, cranes, and other cargo-handling machinery within logistics hubs will also contribute to local air pollution, especially black carbon and fine particulates. • Vehicular Emissions from Last-Mile Connectivity due to improved accessibility brought by railway stations and cargo terminals will likely spur a rise in vehicular traffic—matatus, buses, taxis, trucks around nodes like Narok, Sotik, Ahero, and Kisumu. • Dust from movement of trains along unpaved service roads and maintenance yards during dry seasons may cause dust resuspension, especially if proper ground covering or vegetation is not established. • Air conditioning (AC) units in trains, passenger station lobbies, offices, and logistics hub facilities can pose air quality and climate-related concerns, especially due to the use of refrigerant gases which produce Hydrofluorocarbons (HFCs)—are potent greenhouse gases.
Water Quality Impacts and Liquid Waste	• Passenger stations at Narok, Bomet, Sondu, Ahero, and Kisumu terminus will generate significant amounts of greywater (from sinks, cleaning, showers) and black water (from toilets). If these effluents are not properly treated before discharge, they could pollute both surface and ground water sources, • Pollution can also lead to eutrophication in slow-moving water bodies near Ahero and Kisumu, resulting in algal blooms and fish kills.

	• Heavy vehicle movements at cargo handling, fuel storage, and maintenance activities can generate runoff contaminated with oil, grease, and hydrocarbons from vehicle and machinery operations. These substances can be washed by rain into nearby water sources. • Cleaning agents and detergents used in facility maintenance can pollute underground and surface water. • Surface Runoff from Paved Infrastructure e.g. parking areas, access roads, and cargo yards, increases impervious surface cover during rains can pollute water sources. • Discharge warmer water, which can affect aquatic life by altering the thermal balance of receiving ecosystems. • Accidental oil spillage at the Port and Kisumu Terminal and waste water from rail tank cleaning can directly flow into Lake Victoria, causing acute pollution events that may damage fisheries, affect potable water quality, and compromise biodiversity within the lake. • Leaky underground fuel tanks, chemical storage, or poorly designed wastewater soak pits at remote stations (e.g., in Narok or Nyamira) could introduce contaminants into groundwater supplies—posing health risks to communities reliant on boreholes or springs.
Surface and Groundwater Hydrology Impacts	• The presence of the railway embankments, culverts, bridges, and platforms may continue to alter natural drainage patterns, particularly in areas with natural drainage channels, wetlands, and floodplains such as the Kano plains, Ahero, and Nyando Basin. • Another effect can lead to water pooling or backflow upstream of culverts and embankments due to insufficient drainage capacity, leading to localized flooding or waterlogging, especially in rainy seasons. • Impervious surfaces such as paved station areas, access roads, cargo yards, and rail lines significantly reduce the natural infiltration of rainwater into the soil especially critical in high-recharge areas such as Narok, Bomet, Kericho, and Nyamira, where local communities depend on shallow wells and springs for their water supply.

	• Operation of the railway through marshes, floodplains, and seasonal wetlands—particularly in Sondu, Ahero, and the Kano Plains poses the risk of floodplain encroachment and drainage disruption. • The establishment of embankments, platforms, and access roads may lead to the filling or compaction of wetland soils, reducing their ability to store floodwaters. • Operation of the railway across or near springs and first-order streams risks compromising natural flows through embankments or poorly designed drainage structures cutting off or isolating spring outlets, leading to the drying of critical water sources. • Surface water interception and redirection could also result in reduced baseflows in adjacent streams, particularly during the dry season, while sediment delivery regimes may be disrupted, ultimately degrading downstream water quality. • The modification of feeder rivers such as the Nyando, Sondu, and Kibos may alter their seasonal hydrographs, influencing the timing and magnitude of inflows into Lake Victoria. • Increased sediment loading and nutrient accumulation may contribute to lake level fluctuations and eutrophication, with consequences that extend beyond national boundaries.
Increased Water Demand	• Increase in demand may place significant pressure on the existing water supply systems and utility services resulting to seasonal water shortages or implementation of water rationing measures, thereby affecting residents' access to water. • Where boreholes are relied upon excessively to meet this new demand, there is a real risk of groundwater depletion jeopardizing long-term aquifer sustainability and the resilience of local water sources.
Solid Waste	• Railcars equipped with amenities such as onboard catering services, restrooms, and dedicated seating areas are expected to generate diverse waste streams during daily operations. Additionally, general passenger activity will lead to the accumulation of plastic, paper, and mixed waste throughout the railcars.

	• Tracksider littering could tarnish the visual appeal of the surrounding landscape and attract scavenging wildlife. • The presence of non-biodegradable materials like plastics poses a particular threat, as they may obstruct culverts and drainage channels, exacerbating flood risks during rainy seasons. • Decomposing organic waste in improperly contained conditions could emit unpleasant odors and encourage infestations of vermin such as rodents and flies. • Routine cleaning operations will add further waste, including disposable items such as, paper towels, and discarded packaging from cleaning agents. • During rainfall events, improperly contained waste may be washed into storm water systems, contributing to the pollution of nearby rivers, wetlands, and potentially even Lake Victoria in downstream areas like Kisumu.
Increased Energy Demands	• The heightened demand for electricity has the potential to strain local electricity distribution networks, particularly in semi-rural regions such as Sotik and Narok, where the grid infrastructure may not be adequately developed or maintained. • Meeting industrial-level electricity for logistics and freight hubs needs could necessitate significant upgrades to the existing energy infrastructure. Local expansions involving transformers and new power lines may be required, which can alter land-use patterns and potentially impact accessibility for nearby communities. • As an indirect impact, the establishment of stations and logistics centers may stimulate nearby urban growth, increasing local energy demand for housing, commerce, and other services.
Ecological Fragmentation	• The continuous rail line planned from Naivasha to Kisumu introduces a substantial physical barrier that disrupts the natural movement of wildlife and livestock, as their migratory routes and daily foraging patterns often span wide territorial ranges that are now segmented by railway infrastructure. • Fragmentation can isolate breeding populations, limiting genetic exchange and potentially leading to long-term declines through genetic bottlenecks.

	• The railway also poses a direct threat to animal life through train collisions during hours of reduced visibility especially early morning or nighttime presenting elevated risks to nocturnal mammals and ground-dwelling species. • Underpasses shared by humans, livestock, and wildlife heighten the risk of direct conflict through startled animals lashing out defensively, resulting in injuries or fatalities. • Carnivorous species may exploit shared spaces for hunting, leading to livestock predation. In response, local communities may resort to retaliatory measures that include wildlife persecution, poisoning, or erecting informal barriers, further exacerbating the fragmentation of wildlife habitats. • Breach of fences in areas where underpasses are poorly sited, too few in number, or frequently disturbed. These behaviors can damage fencing and increase operational maintenance costs and also heighten train-animal collisions.
Noise	• Underpasses, being enclosed or semi-enclosed, reflect and amplify train noise, creating temporary but intense bursts that can be startling to people or animals using them. • Human Impacts from noise can range from sleep disruption, stress, headaches, and loss of concentration may occur in residential areas near stations, hubs, or track segments with high train frequency. • Vulnerable groups such as children, the elderly, and hospital patients are especially sensitive to chronic exposure. Noise from passing trains and station activities may disrupt schools, religious centers, or health facilities located within 500 meters of the railway. • Wildlife using or living near underpasses or habitats adjacent to the railway corridor may experience startle responses, altered movement patterns, and avoidance behavior. Continuous exposure can also lead to displacement from feeding or breeding areas, especially for species in Narok, Kericho, and Nyamira counties.

	• Cumulative Impacts can manifest especially in urban centers like Narok and Kisumu. Cumulative noise from trains, road traffic, and port activities are likely to contribute to urban soundscape degradation.
Vibration Impacts	• The consequences of vibrations from train movement on railway tracks range from structural damage to nearby buildings especially vulnerable ones to discomfort or sleep disruption among residents due to low-frequency disturbances. Sensitive facilities like hospitals or labs may also be affected due to the interference with precision instruments.
Impacts of Light Pollution	• Nocturnal animals and birds may experience disorientation, altered foraging and mating behavior, and avoidance of lit areas. • Species in marshes, wetlands, and riparian corridors (e.g., Sondu, Nyando, and Kipsonoi rivers are particularly sensitive to nighttime illumination and may gradually abandon traditional habitats. • Migratory birds in the Lake Victoria basin may become confused by intense or poorly directed lighting at night, increasing the risk of collisions or disorientation. • Communities living near stations or logistics hubs may suffer from sleep disruption, eye strain, and reduced melatonin production due to exposure to light at night. • Skyglow the halo effect caused by excessive upward light can degrade visibility of stars and diminish the natural nightscape, affecting tourism, cultural practices, and aesthetics, especially in scenic areas like Kericho highlands and Narok plains. • Bright floodlights and mast lights can create visual discomfort especially for road users near hubs, footpaths near underpasses, or rail workers on night shifts.
Aesthetic and Visual Impacts	• The sight of passing trains, elevated tracks, cut-and-fill embankments, and artificial structures may degrade the natural visual appeal of these landscapes. For instance, in Narok and Bomet, known for pastoral and open rangeland scenery, the presence of trains, fences, and overhead infrastructure may fragment panoramic views and disturb the sense of visual openness.

	• In Kericho and Nyamira, where the landscape includes lush, rolling tea plantations and river valleys, the railway's above-ground structures and tunnels may create stark contrasts with the natural topography. • The railway stations and logistic hubs will introduce varied architectural styles, modern lighting systems, signage and industrial elements that may visually dominate traditional low-rise settlements. • At night, especially in rapidly urbanizing zones like Ahero and Kisumu, the combination of digital signage, floodlights and illuminated advertisements could generate visual clutter affecting the skyline and introduce light pollution and potentially altering nighttime ambiance. • At the terminus and adjacent port at the lakeshore, the integration of cargo-handling cranes, warehousing facilities, and train movements may diminish the visual appeal of Lake Victoria's waterfront.
Hazardous Material	• Hazardous materials include petroleum-based products such as diesel fuel, lubricants, and transformer oil. Others include industrial paints, adhesives, chemicals solvents, battery units, electronic waste, acids, bases, and specialized cleaning agents which pose significant risks to human health, aquatic life and environment. • Such materials, when spilled or improperly stored, can infiltrate drainage systems, leading to downstream contamination of water bodies. • They also raise safety concerns, including the possibility of fires and adverse health effects for maintenance personnel exposed to fumes or chemical residues • They can lead to soil, surface and underground water pollution when they are not handled and disposed off in environmentally safe way.
PHASE 3: DECOMISSIONING	
Soil Disturbance and Erosion	• Decommissioning activities, such as the removal of tracks, ballast, sleepers, station structures, and logistics facilities, often involve heavy machinery, excavation, and earthworks disturb the

	soil profile, especially in areas with cut-and-fill sections along slopes in the Rift Valley and highland areas of Bomet and Kericho. • With ground cover removed, there is increased vulnerability to soil erosion, gully formation, and sediment runoff, particularly during the rainy seasons. • Disturbance during removal can spread or leach metals e.g. copper, zinc, lead, cadmium collected from operation and maintenance activities over the years.
Vegetation Loss and Habitat Disruption	• The decommissioning process may involve clearing residual vegetation that had regrown along the railway alignment or around station peripheries. • Additionally, lands rehabilitated post-construction may be re-disturbed, affecting secondary habitats for flora and fauna. • Wildlife corridors that had adjusted to the presence of the railway may be disrupted again as machinery, noise, and human activity return. • In biodiversity-rich areas like parts of Kericho and Nyamira with forest and wetland ecosystems, even temporary disturbances can cause displacement of fauna and loss of vegetation.
Impacts on local community	• Dismantling activities may release dust and particulate matter from heavy machinery affecting nearby residents and wildlife. • Noise and vibration from the decommissioning activities. • Potential diseases and infections passed from workers to local community, in particular HIV/AIDS and other sexually transmitted infections as a result of decommissioning labour force population
Impact on workers	The key OHS risks for the site decommissioning phase, include: • Exposure to physical hazards from use of heavy equipment

	• Trip and fall hazards • Exposure to dust, noise, vibrations and falling objects. • Exposure to electrical hazards from the use of tools and machinery • Environmental hazards adverse weather conditions, such as working in extreme heat, heavy rainfall • Psychological hazards including high-stress work environments or fatigue • Risks specific to the project location include exposure to extreme heat and hazards associated with working on or near roads. Workers involved in vegetation clearance are at greater risk of snake bites
Water Quality	• There is potential for pollution of surface watercourses from fuel or chemical spillages (if poorly managed) and spoil materials generated during decommissioning, particularly if heavy rainfall occurs.
Soils and geology	• Soil disturbance and erosion from removal of rail tracks, embankments, and foundations. • Increased risk of soil erosion, especially on slopes or loose soils. • Heavy machinery used in dismantling and transportation can compact soil, reducing Infiltration, drainage and soil aeration when designated routes are not followed.
Land acquisition and economic displacement	• Further impacts on land acquisition and economic displacement are not expected during decommissioning phase. - Once the project has been decommissioned it is expected that most land will be rehabilitated and returned to the existing land uses. The land required for the upgraded roads and new access roads will not be rehabilitated and so the land loss will be permanent.

Damage to Cultural Heritage/known and unknown archaeological sites	- There is a possibility that during the decommissioning activities hitherto undiscovered artefacts or sites may be discovered although the likelihood of this is low given that no new areas of land take is expected.

9.3 Significance and Impact Analysis

Significance and impact analysis matrix have been used purposely to evaluate the importance and severity of predicted impacts on the environment and local communities. The matrix combines likelihood of occurrence and magnitude incase the impact. It also ensures that predicted negative impacts are evaluated objectively, forming the basis for effective mitigation planning, stakeholder engagement, and environmental management throughout the project lifecycle. The following tables below indicate the significance of the evaluated impacts;

i. Noise and vibration

Table 75: Evaluation of Noise and vibration

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	2(Minor)	2(minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	2(Regional)	1(Local)	1(Local)
Probability	4(Certain)	3(Likely)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	36(Moderate)	30(minor)	21(Minor)
Implication	The degree of impact that the project may have upon the Community is high. The project may be compromised if this impact cannot be avoided or mitigated.	The degree of impact that the project may have upon the community during operation and decommissioning is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project	
Discussion	Noise and vibrations levels is expected to increase mainly due to blasting during site preparation. Baseline environmental noise equivalent noise results from all the sampling locations ranged between 44.4-60.0 dB(A) which is within EMC, WHO and IFC recommended limits. Ground vibration levels ranged between 0.011 and 0.49mm/s which is within EMC Limit of 5.000mm/s.		

ii. Air pollution- Gaseous emissions

Table 76: Evaluation of Air pollution – Gaseous emissions

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	3 (Moderate)	2 (Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)

PHASE	Site Preparation/Construction	Operation	Decommissioning
Scale	1(Local)	1(Local)	1(local)
Probability	3(Likely)	2(Medium (as likely as not)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	30(Minor)	30(Minor)	21(Minor)
Implication	The degree of impact that the project may have upon the environment and community during the 3 phases is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.		
Discussion	Emissions during the construction and operation phases may be relatively higher as compared to decommissioning phase due to extensive machinery and materials usage. By adopting modern emission controls and use of clean energy sources, the project will be able to sufficiently mitigate the impacts.		

iii. Air pollution- Dust generation

Table 77: Evaluation of Air pollution – Dust Generation

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	1(Negligible)	3(Moderate)
Duration	3(Long term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(Local)
Probability	4(Certain)	1(Low)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	36(Moderate)	21(Minor)	18(Minor)
Implication	The degree of impact that the project may have upon the environment and community is high. The project may be compromised if this impact cannot be avoided or mitigated	The degree of impact that the project may have upon the environment and community during operation and decommissioning is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.	
Discussion	This will be relatively high during site preparation/construction phase generated through vegetation clearing, earthworks disturbing the soil surface and making fine particles airborne. Access roads used by trucks and equipment may also raise large amounts of dust.		

iv. Impact due to vegetation clearance

Table 78: Evaluation of impact due to vegetation clearance

	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	2(Minor)	2(Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	2(Regional)	1(Local)	1(Local)
Probability	4(Certain)	2 Medium (as likely as not)	2(Medium (as likely as not)
Sensitivity	3(High)	2(Low)	2(Low)
Significant points	39(Moderate)	18(minor)	14(negligible)
Implication	The degree of impact that the project may have upon the environment is high. The project may be compromised if this impact cannot be avoided or mitigated.	The degree of impact is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project	No noticeable impact on the environment and community. Little or no mitigation is required
Discussion	Site preparation/construction phase has a relative impact on vegetation due to expected extensive land clearing for rail corridors and embankments, station infrastructure, construction camps, burrow pits and access road.		

v. Health and safety of workers

Table 79: Evaluation of Health and Safety of workers

	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	4(Major)	4(Major)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(Local)
Probability	3(High)	3(High)	3(High)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant	33(Moderate)	36(Moderate)	30(Minor)
Implication	The degree of impact that the project may have upon the workers during construction and operation phases is high. The project may be compromised if this impact cannot be avoided or mitigated.	The degree of impact that the project may have upon the workers is relatively low. Opportunities to avoid or mitigate the impact should	

	Site Preparation/Construction	Operation	Decommissioning
			be considered; however, this should not compromise the viability of the project.
Discussion	The project may expose workers to significant occupational risks. Relatively high impacts is expected to be experienced in construction and operation phases due to exposure to sharp tools, snake/insect bites, falls into trenches, dust inhalation, accidents during routine operation and maintenance activities, noise pollution from heavy machinery and heat stress due to prolonged outdoor exposure amongst others.		

vi. Community health and safety

Table 80: Evaluation of Community Health and Safety

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	3(Moderate)	3(Moderate)
Duration	3(Long-term)	4(Permanent)	3(Medium term)
Scale	1(Local)	1(Local)	1(Local)
Probability	3(High)	3(High)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	33(Moderate)	33(Moderate)	27(Minor)
Implication	The degree of impact that the project may have upon the community during construction and operation is high. The project may be compromised if this impact cannot be avoided or mitigated.		The degree of impact that the project may have upon the community is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project
Discussion	The project can significantly affect the health and safety of surrounding communities through exposure to physical, environmental, and social risks throughout construction and operation. Identifying and addressing these risks is essential to ensuring sustainable and inclusive development.		

vii. Solid and liquid waste generation

Table 81: Evaluation of Solid and liquid waste generation

PHASE	Site Preparation/construction	Operation phase	Decommissioning
Magnitude	4(Major)	4(Major)	4(Major)
Duration	2(Medium term)	2(Medium term)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	4(Certain)	4(Certain)	4(Certain)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	33(Moderate)	33(Moderate)	33(Moderate)
Implication	The degree of impact that the project may have upon the environment and community during the three project phases is high. The project may be compromised if this impact cannot be avoided or mitigated effectively.		
Discussion	Significant quantities of solid waste are expected to be generated throughout the project, primarily from soil excavation activities, leftover construction materials, and associated packaging waste. Additionally, municipal and domestic waste produced at labor camps and train stations presents a substantial risk of contributing to land pollution if not properly managed. Improper disposal or uncontrolled dumping of these waste streams can lead to the leaching of contaminants into the soil, subsequently posing risks to both surface and groundwater quality through infiltration and runoff pathways.		

viii. Soil erosion

Table 82: Evaluation of Soil erosion

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	1(Negligible)	2(Minor)
Duration	3(Long term)	0	2(Medium term)
Scale	1(Local)	0	1(Local)
Probability	3(High)	0	2(Likely)
Sensitivity	3(Medium)	0	3(Medium)
Significant points	30(Medium)	0	21(negligible)
Implication	The degree of impact that the project may have upon the environment is relatively low. Opportunities to avoid or mitigate the impact	No noticeable impact.	The degree of impact that the project may have upon the environment is relatively low. Opportunities to avoid or mitigate the impact

	should be considered; however, this should not compromise the viability of the project.		should be considered; however, this should not compromise the viability of the project.
Discussion	Excavation and construction activities may loosen soil particles, increasing their vulnerability to erosion. This may be significant when the topsoil is left exposed without protective vegetation or ground cover, allowing natural erosion agents like wind and water to actively displace the soil.		

ix. Influx of workers leading to increased HIV/Aids prevalence and moral decay

Table 83: Evaluation of Influx of Workers leading to increased HIV prevalence and moral decay

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	3(Moderate)	3(Moderate)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	2(Local)	1(Local)	1(Local)
Probability	3(Likely)	3(Likely)	3(Likely)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	36(Moderate)	33(Moderate)	27(Minor)
Implication	The degree of impact that the project during construction and operation phases may have upon the community during construction and operation phases is high. The project may be compromised if this impact cannot be avoided or mitigated		The degree of impact that the project may have upon the community is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project
Discussion	Influx of workers during the three phases in search of job and business opportunities has the potential of creating social vices like spread of communicable diseases and promotion of crime incidents. Communicable or infectious diseases that may be of major concern include HIV/AIDS and other sexually transmitted infections.		

x. Pollution from oil spills

Table 84: Evaluation of Pollution from oil spills

PHASE	Site Preparation/Construction	Operation phase	Decommissioning
Magnitude	3(Moderate)	3(Moderate)	3(Moderate)

PHASE	Site Preparation/Construction	Operation phase	Decommissioning
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	2(Regional)	2(Regional)	2(Regional)
Probability	3 (Likely)	2(Likely)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	33(Moderate)	33(Moderate)	27(Moderate)
Implication	The degree of impact that the project may have upon the environment during construction and operation phases is high. The project may be compromised if this impact cannot be avoided or mitigated.		The degree of impact that the project may have upon the environment during decommissioning phase is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project
Discussion	Significant oil spillage may occur during site preparation /construction due to leaks from petroleum products, as well as the routine dripping and leaking of oil, grease, and solvents from machinery and vehicles transporting materials to the site. Additionally, oil spills may occur when conducting routine operation and maintenance of coaches.		

xi. Slope Destabilization

Table 85: Evaluation of Slope Destabilization

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	3(Moderate)	3(Moderate)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(Local)
Probability	3(Likely)	2(Medium (as likely as not)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	2(Low)
Significant points	33(negligible)	30(minor)	16(negligible)
Implication	The degree of impact that the project may have upon the environment is high. The project may be		The degree of impact that the project may have upon the environment during operation and decommissioning phases is relatively low. Opportunities to avoid or mitigate the impact should

PHASE	Site Preparation/Construction	Operation	Decommissioning
	compromised if this impact cannot be avoided or mitigated (i.e. to reduce the significance of the impact	be considered; however, this should not compromise the viability of the project	
Discussion	Excavation activities along landscapes and hillsides during the construction of the rail track have the potential to destabilize slopes, increasing the risk of erosion and slope failures. Vibration during operation phase may also lead to destabilization. Mitigation measures have been suggested in		

xii. Impacts associated with depletion of local natural resources-sand, ballast, murram, hardcore

Table 86: Evaluation of Impacts associated with depletion of Local natural resources (sand, ballast, murram and hardcore)

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	1(Negligible))	1(Negligible)
Duration	3(Long-term)	0	0
Scale	1(Regional)	0	0
Probability	4(Certain))	0	0
Sensitivity	3(Medium)	0	0
Significant points	36(negligible)		0
Implication	The degree of impact that the project may have upon the environment and community is high. The project may be compromised if this impact cannot be avoided or mitigated.	No noticeable impact on the environment and community during operation and decommissioning phases. No mitigation is required	
Discussion	The construction of the railway line will necessitate substantial quantities of raw materials, particularly aggregates and lateritic soil (murram), which are essential for forming embankments, subgrades, and ballast layers. These materials are likely to be sourced from off-site borrow pits and quarry locations identified and operated by the contractor.		

xiii. Traffic accidents

Table 87: Evaluation of Traffic accidents

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	3(Moderate)	2(Minor)
Duration	3(Long term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	2Medium (as likely as not)	2(Medium (as likely as not)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	27(Minor)	27(Minor)	21(Minor)
Implication	The degree of impact that the project may have upon the community during construction, operation and decommissioning is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.		
Discussion	Traffic accidents may occur during the 3 phases, mainly caused by over speeding of vehicles, use of undesignated routes, absence of road traffic marshals amongst others causes.		

xiv. Hydrology and water quality degradation

Table 88: Evaluation of Hydrology and water quality degradation

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3 (Moderate)	2(Minor)	2(Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	2(Regional)	2(Regional)	2(Regional)
Probability	3(Likely)	2 Medium (as likely as not)	2 Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	33(Moderate)	30(Minor)	24(Minor)
Implication	The degree of impact that the project may have upon the environment is high. The project may be compromised if this impact	The degree of impact that the project may have upon the dam is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.	

	cannot be avoided or mitigated.	
Discussion	Excavation activities have the potential to impact groundwater quality. Disturbance of contaminated soils or previously polluted groundwater along the excavation path can mobilize pollutants, leading to their migration into adjacent aquifers. Additionally, accidental spills of hazardous substances such as fuels, lubricants, or chemical additives during construction within excavated areas pose a significant risk of leaching into the subsurface environment, further compromising groundwater integrity. Water quality results were as follow • PH results ranged between 6.09-7.91 against a limit of 6.5-8.5 • Total Dissolved Solids results ranged between 40.0-187.0 ppm against a limit of 1200 (mg/L) • Total Suspended Solids (TSS) results ranged between 1.00-658 ppm against a limit of 30 (mg/L)	

xv. Contribution to climate change

Table 89: Evaluation of Contribution to climate change

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	2(Minor)	2(Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	3(Likely)	3(Likely)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	30(Moderate)	30(Minor)	21(Minor)
Implication	The degree of impact that the project may have upon the environment during the three phases is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.		
Discussion	Vegetation clearance may result in a corresponding reduction in terrestrial carbon sequestration capacity, contributing to a net increase in atmospheric CO ₂ levels. This loss of carbon sink function represents a minor but relevant factor in the context of cumulative greenhouse gas (GHG) emissions. Construction-phase activities may contribute directly to atmospheric carbon through the combustion of fossil fuels in heavy machinery, transport coaches, vehicles, and generators. These operations emit CO ₂ and NO _x and particulate matter, which collectively exacerbate climate change and local air quality degradation.		

xvi. Wildlife and Livestock accidents

Table 90: Evaluation of wildlife and livestock accidents

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	2(Minor)	2(Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	3(Likely)	2(Medium (as likely as not)	2(Medium (as likely as not)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	27(Moderate)	27(Minor)	21(Minor)
Implication	The degree of impact that the project may have upon the environment and/or the community(s) during the three phases is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.		
Discussion	Wildlife and wildlife injury and mortality may occur resulting from collisions as animals attempt to cross the tracks and falls in burrow pits. The installation of fencing along the railway corridor and barriers around burrow pits is a critical safety measure aimed at minimizing these incidents by restricting animal access to the track area.		

xvii. Disruption of existing public utilities

Table 91: Evaluation of disruption of existing public utilities

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	1(Negligible)	2(Minor)
Duration	3(Long-term)	0	2(Medium term)
Scale	1(Local)	0	1(local)
Probability	3(Likely)	0	2(Medium (as likely as not)
Sensitivity	3(Medium)	0	3(Medium)
Significant points	33(Moderate)	0	21(Minor)
Implication	The degree of impact that the project may have upon the environment and/or the community(s) is high. The project may be compromised if this impact cannot be avoided or	No impact	The degree of impact that the project may have upon the environment and/or the community(s) is relatively low. Opportunities to avoid or mitigate the impact should be considered;

	mitigated.		however, this should not compromise the viability of the project.
Discussion	Existing community service utilities located within the designated railway corridor—including domestic water supply lines, sewerage systems, electrical transmission and distribution networks, and optical fiber communication cables—will require relocation as part of the project’s easement and right-of-way acquisition process. However, during the relocation phase, end-users and customers connected to the affected utility networks may experience service outages.		

xviii. Disputes over employment

Table 92: Evaluation of Disputes over employment

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	3(Moderate)	3(Moderate)	3(Moderate)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	3(Likely)	3(Likely)	3(Likely)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	30(Moderate)	30(Moderate)	30(Moderate)
Implication	The degree of impact that the project may have upon the community during the three phases is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.		
Discussion	Recruitment of unskilled workers from local communities can result in conflicts due lack of proper stakeholder engagement. Protection of vulnerable and marginalized groups such as youth and women within the project’s labour force may also require especial measures		

xix. Loss of grazing land and livelihoods

Table 93: Evaluation of loss of grazing land and livelihoods

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	2(Minor)	2(Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	4(Certain)	2(Medium (as likely as not)	2(Medium (as likely as not)

Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	36(Moderate)	30(Minor)	21(Minor)
Implication	The degree of impact that the project may have upon the Community and their livestock are high. The project may be compromised if this impact cannot be avoided or mitigated.	The degree of impact that the project may have upon the community and their livestock is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.	
Discussion	Potential disruption to traditional grazing lands and patterns as a result of the proposed infrastructure development may affect livestock, which is a key livelihood source for some households.		

xx. Habitat loss and fragmentation

Table 94: Evaluation of Habitat loss and fragmentation

PHASE	Site Preparation/Construction	Operation	Decommissioning
Magnitude	4(Major)	3(Moderate)	2(Minor)
Duration	3(Long-term)	4(Permanent)	2(Medium term)
Scale	1(Local)	1(Local)	1(local)
Probability	4(Certain)	4(Certain)	3(Likely)
Sensitivity	3(Medium)	3(Medium)	3(Medium)
Significant points	36(Moderate)	33(Moderate)	24(Moderate)
Implication	The degree of impact that the project may have upon the wildlife and other small animals is high. The project may be compromised if this impact cannot be avoided or mitigated.		The degree of impact that the project may have upon the wildlife and other small animals is relatively low. Opportunities to avoid or mitigate the impact should be considered; however, this should not compromise the viability of the project.
Discussion	The proposed project will lead to habitat destruction and fragmented wildlife dispersal areas, impacting wildlife movements and breeding patterns.		

9.3 Potential Impacts

9.3.1 Anticipated positive social and economic impacts during site preparation, construction, operation and decommissioning phases

- **Employment Opportunities**

The proposed project during different phases will create different job opportunities, both casual, skilled and unskilled. Employment opportunities are of benefit both economically and socially. Several workers including casual laborer's, masons, carpenters, joiners, electricians, and plumbers are expected to work along the railway alignment site during the construction phase. Apart from casual labour, semi-skilled, unskilled labour and formal employees are also expected to obtain gainful employment during the period of construction. Generally, employment during the site preparation, construction and operation phases will lead to multidimensional development in the area and improve several people's living standards.

- **Economic Growth**

Through the use of locally available materials during the construction phase e.g. cement, steel metals and others; the project will contribute towards growth of the country's economy by contributing to the gross domestic product. The consumption of these materials, oil, fuel and others will attract taxes including VAT which will be payable to both national and county governments hence increasing government revenue while the cost of these raw materials will be payable directly to the producers.

- **Reduced Transport Cost of Goods**

The transport costs of passengers and goods like petroleum products, building materials, cereals and food stuffs, minerals, e.t.c. are expected to reduce and this will greatly improve regional trade by making the country's goods and services competitive.

- **Reduced Road Congestion and Improved Safety**

Significant reduction of volumes of cargo and passengers from roads to rail shall be realized, reducing wear and tear on highways. It will further lead to a decrease in the number of road accidents and fatalities caused by heavy trucks and buses.

- **Increased local incomes**

The local community may get extra income from the sale of construction materials from their farms and also renting spaces for company sites, borrow pits, dumping sites, lease of ground for yards and temporary passage to pick materials.

It will also spur economic activity along the transport corridor by attracting investments in logistics hubs, dry ports, and industrial parks and increase market access for agricultural and other produce.

- **Improved Community and road Infrastructure**

Implementation of the proposed project will require a road network to facilitate ferrying of materials and equipment to the construction sites. A favorable road network will be developed to allow for easy movement of machinery and construction materials. The proponent will rehabilitate existing roads and create new access roads which in the long run will be used by the residents. Additionally, the proposed project will improve existing community facilities including schools and healthcare facilities as part of corporate social responsibility initiatives or government partnerships.

- **Promotion of education skill and knowledge transfer**

By hiring labor for the project, workers will gain a range of skills related to railway construction, maintenance, and environmental and social governance (ESG). This is considered a significant positive impact, as it equips individuals with experience that can be applied to similar projects in the future.

9.3.2 Positive Environmental Impacts during site preparation, construction, operation and decommissioning phases

- **Reduction in greenhouse gases**

Rail transport produces significantly lower greenhouse gas emissions per ton-km compared to trucks. This reduces air and noise pollution in urban centers caused by heavy commercial vehicles and helps in achieving Kenya's commitments under climate change frameworks such as the Paris Agreement and its Nationally Determined Contributions (NDCs).

- **Improved Land Use Efficiency**

Proposed railway line uses less land area per unit of transport capacity compared to roads, especially for bulk cargo transport. Concentrating freight movement on railways helps preserve land for agriculture, forestry, conservation and other users.

- **Reduced noise pollution**

Modern train transport produces less cumulative noise compared to the combined impact of many individual vehicles on highways. Modern rail infrastructure includes **noise control measures**, especially near residential and sensitive areas.

- **Reduced Pressure on Natural Resources**

More efficient railway transport leads to lower fuel consumption per ton of cargo. This minimizes pressure on non-renewable fossil fuels and supports energy-efficient logistics.

- **Reclamation of Disturbed land**

Borrow pits and unproductive land can be used as disposal areas for the topsoil excavated during construction activities. The developer is responsible for restoring any sites that are disturbed during the construction process. Because rehabilitation and watershed protection efforts will extend beyond the immediate project area, the developer must also provide seedlings to state agencies and local communities to support these initiatives.

- **Reduced Carbon Emissions**

The proposed project is expected to reduce greenhouse gas emissions currently associated with the heavy vehicular traffic along the Nairobi – Nakuru – Kisumu Road. Compared to road transport, rail transport produces significantly lower emissions. Therefore, the development of a reliable and efficient rail network is likely to attract more passengers, resulting in decreased traffic volumes on the Road. Consequently, this reduction in vehicle usage will lead to lower emission levels and a smaller carbon footprint.

- **Reduced littering along the Highway**

A decrease in vehicular traffic particularly private and commercial road transport within and around protected areas is expected to result in a corresponding reduction in anthropogenic solid waste deposition. This includes commonly discarded items such as used vehicle tyres, single-use food

packaging, cigarette filters, and other non-biodegradable materials. Such forms of litter not only degrade the aesthetic and ecological integrity of conservation zones but also pose direct threats to wildlife through ingestion or entanglement.

Furthermore, leveraging mass transit systems, particularly railway networks, presents a more scalable and controlled platform for environmental education and awareness campaigns. Unlike the dispersed and often informal nature of road-based transit, trains offer centralized points of engagement (e.g., stations, compartments) and extended travel durations, allowing for targeted dissemination of conservation messaging. Educational content related to proper waste disposal and ecosystem preservation can be integrated into on-board announcements, digital displays, brochures, and interactive media. This approach enables broader outreach across demographic groups, enhancing public participation in minimizing environmental degradation in protected areas

- **Landscaping and improvement of aesthetic value**

Alongside the proposed construction activities, the developer will implement landscaping measures not only within the railway corridor but also in areas designated for station offices and staff residences. These efforts aim to improve the visual appeal of the surroundings, particularly in locations that are currently degraded or lack proper vegetation. By introducing greenery, organizing open spaces, and possibly incorporating decorative elements, the landscaping will contribute to environmental restoration and enhance the overall aesthetic value of the project area. In the long term, this can also foster a more pleasant and welcoming environment for both staff and the public.

9.3.3 Negative Environmental Impacts During Site Preparation and Construction Phases

- **Clearance of Vegetation**

The construction process will necessitate the removal of portions of existing tree cover found both on farms and in urban areas at the project sites. Some of the trees to be affected include include Tea plantations, *Eucalyptus species*, *Delonix regia*, *Grivellia robusta*, *Pinus spp*, *Cupressus lustanica*, *Bischofia javonica*, *Casuarina equisetifolia* and *Jacaranda mimosifolia*. Indigenous trees are few and dot the area with species such as *Spathodea campanulata*, *Albizia spp*, *Ficus natalensis*, *Ficus luscchnathiana*, *Makhamia lutea*, *Zanthoxylum gilleti*, *Melia azedarach*, *Azadirachta indica* *Croton macrostachyus* and *Croton megalocarpus*, *Cordia africana* and *Acacia polycantha*. Some of the fruit trees along the alignment include; *Mangifera indica*, *Persea americana*, *Artocarpus heterophyllus*, *Syzygium cumini*, *Aleurites moluccana* and *Carica papaya*. This deforestation will lead to environmental changes, including altered temperature patterns, shifts in light exposure, changes in soil moisture and nutrient content, and modifications to the natural landscape. The loss of vegetation in urban areas and residential zones will leave communities more vulnerable to harsh winds, which can cause increased soil erosion and environmental degradation. Additionally, the removal of trees will result in the loss of valuable resources such as cash crops, natural shade, windbreaks, animal fodder, fruits, timber, medicinal plants, and firewood resources that many local households depend on for both economic and daily living needs.

Mitigation

1. Establishment of woodlots on affected farms to help restore tree cover, support local

ecosystems, and ensure continued access to these essential natural resources.

2. Clearing Minimization: Limit clearing to the smallest area necessary for the project to reduce habitat loss and soil exposure.
3. Buffer Zones: Establish protective buffers around sensitive habitats, water bodies, and remnant vegetation to maintain ecological connectivity.
4. Compensatory Planting: Implement tree planting programs to replace cleared trees, using native and fast-growing species to restore ecosystem functions.
5. Agroforestry Practices: On farms, integrate trees with crops to maintain biodiversity, improve soil health, and provide economic benefits.

- **Disturbance of indigenous forests**

Declining forest cover, driven by land degradation and rapid climate change, has led to immediate impacts such as the extinction and migration of native vegetation, plants, and animal species, along with the spread of invasive species like striga weed, *cuscuta dodder*, *Psidium guajava*, and *Lantana camara*. The project will involve clearing sections of forested areas, resulting in the permanent loss of indigenous vegetation. It is worth noting that the project will not traverse any major forests. These forests play a crucial role as catchment zones for streams and springs, so their removal could negatively impact water quality and reduce water flow. The disturbance caused by construction activities will alter the forest's structure, species composition, and overall biodiversity. If such disturbances occur frequently or over short periods, there is a risk that the forest ecosystem could shift to an alternative, less desirable state, which would harm the plants and animals that depend on it.

Mitigation

1. Minimization of forest clearance during the construction phase to preserve the ecological integrity and sustainability of these vital habitats.
2. Micro-siting: Align project elements (e.g. access roads, utility corridors) along disturbed or degraded areas rather than intact forest patches to minimize fragmentation.
3. Ecological Buffer Zones: Establish and maintain buffer zones around high-value conservation areas, riparian zones, and wetlands.
4. Fauna Translocation and Rescue Plans: Safely relocate fauna from the project area in coordination with wildlife authorities, especially for species with limited mobility or breeding grounds.
5. Reforestation and Assisted Natural Regeneration (ANR): Restore disturbed areas using native species that match the original forest composition. Employ ANR techniques where natural seed banks exist.
6. Participatory Forest Management (PFM): Involve local communities in forest protection, replanting, and monitoring initiatives to enhance stewardship.
7. Alternative Livelihood Programs: Provide support for non-forest-based income activities (e.g., beekeeping, agroforestry, eco-tourism) to reduce pressure on forest resources.

- **Impact of oil Spillage**

There is a notable risk of oil spillages during construction from leaking machinery, vehicles, and improper handling of petroleum products. These spills can contaminate soil especially in East Seme,

where the porous Kavirondian basement rock increases vulnerability and may pollute nearby rivers and wildlife habitats if they reach water bodies.

To prevent environmental degradation, the contractor must enforce strict spill prevention and management measures, including equipment maintenance, safe storage of hazardous substances, and rapid spill response protocols.

Mitigation

1. Spill Prevention, Control, and Countermeasure (SPCC) Plan: Develop a site-specific SPCC plan that outlines procedures for handling, storage, and spill response.
2. Risk Assessment: Identify high-risk areas (fueling stations, equipment storage zones, vehicle maintenance areas) and assess potential spill scenarios.
3. Secondary Containment Systems: Store oil and fuel in tanks or containers with bunds or drip trays capable of holding 110% of the container's volume.
4. Impermeable Surfaces: Conduct fuel transfer and storage activities on concrete or other impermeable surfaces to prevent infiltration into the soil.
5. Routine Inspection: Regularly inspect construction machinery for leaks in hydraulic systems, fuel tanks, and lubrication lines.
6. Preventive Maintenance: Ensure that all construction equipment is well-maintained to prevent accidental leaks.
7. Spill Kits: Provide and strategically locate oil spill response kits (absorbents, pads, booms, PPE) on-site and in vehicles.
8. Training: Train workers on proper fuel handling and spill response procedures, including use of spill kits and emergency reporting protocols.
9. Sediment and Oil Traps: Use grit chambers, silt fences, and retention ponds to control runoff and filter out pollutants
10. Designated Waste Oil Tanks: Collect used oil, grease, and contaminated materials in clearly labeled, sealed containers.
11. Licensed Disposal: Dispose of used oil and oily waste through licensed hazardous waste handlers

- **Impacts associated with sourcing of construction materials from the locality**

The construction of the railway line will necessitate substantial quantities of raw materials, particularly aggregates and lateritic soil (murrum), which are essential for forming embankments, subgrades, and ballast layers. These materials are likely to be sourced from off-site borrow pits and quarry locations identified and operated by the contractor. While essential for construction, quarrying and borrow pit excavation activities can have considerable environmental and socio-economic impacts if not properly managed.

Key environmental impacts include:

1. Loss of Vegetation and Topsoil: Vegetation clearance and the stripping of topsoil disturb local ecosystems, reduce biodiversity, and degrade soil quality, making the land less suitable for future agricultural or ecological use.

2. **Visual Intrusion and Landscape Alteration:** Unrehabilitated quarries and borrow pits can become permanent eyesores, negatively affecting the visual aesthetics of the surrounding landscape.
3. **Air and Noise Pollution:** Operations involving blasting, crushing, and hauling of materials generate significant dust (particulate matter), as well as high noise and vibration levels, which can adversely affect both workers and nearby communities.
4. **Hydrological and Public Health Impacts:** Abandoned and unrehabilitated pits can collect rainwater, leading to the formation of stagnant water bodies that serve as breeding grounds for disease vectors such as mosquitoes, posing serious public health risks (e.g., malaria, dengue). Additionally, if such water is used by local populations, there is a risk of contamination and waterborne diseases.
5. **Safety Hazards:** Steep, unsecured pit walls pose fall and drowning risks, particularly for children, livestock, and other vulnerable populations. Without fencing or signage, these sites can become hazardous zones.

Mitigation

1. Development and implementation of rehabilitation plans including backfilling, contouring, topsoil replacement, and re-vegetation of borrow sites.
2. Adoption of dust suppression techniques (e.g., water spraying, windbreaks) and noise control measures (e.g., sound barriers, regulated blasting times).
3. Installation of drainage controls to prevent water stagnation, and sites should be securely fenced with warning signage.
4. Monitoring and enforcement by regulatory agencies e.g. NEMA must be strengthened to ensure contractors comply with restoration obligations post-excavation.

- **Blasting and rock excavation**

Blasting is a controlled use of explosives to fracture and dislodge rock material, primarily employed during the excavation of bedrock or in quarrying operations to facilitate material extraction. While blasting is an effective technique for breaking hard rock, it is associated with several potential environmental and safety impacts, particularly in areas in proximity to active blasting zones.

Key environmental and occupational health and safety concerns include:

1. **Air Quality Degradation:** Blasting activities generate significant quantities of dust and fine particulate matter (PM₁₀ and PM_{2.5}), which can be suspended in the atmosphere and transported over considerable distances. These particulates pose respiratory health risks to workers and nearby communities and may degrade local air quality.
2. **Noise Pollution and Ground Vibrations:** The detonation of explosives produces high-intensity impulsive noise and ground vibrations. These can lead to human discomfort, disturbance of wildlife, and structural damage to nearby buildings especially those not engineered to withstand such vibrations.
3. **Fly rock and Debris Projection:** Improperly controlled blasting can result in fly rock the ejection of rock fragments at high velocities—which poses serious safety hazards to workers, nearby residents, livestock, and infrastructure. This risk is exacerbated in densely populated or

poorly demarcated blasting zones.

4. **Safety Hazards to Workers:** Workers face direct risks from premature detonations, misfires, and fly rock. Strict adherence to occupational health and safety protocols—including the use of Personal Protective Equipment (PPE), blast zone clearance procedures, and proper training—is essential.
5. **Water and Soil Contamination:** If explosive materials, oils, or other chemical residues are spilled or improperly handled, they may leach into the soil and surface water, causing contamination. Additionally, the disruption of natural ground surfaces can accelerate sedimentation in nearby water bodies, impacting aquatic ecosystems.
6. **Localized Impact Zone:** The negative effects of blasting especially noise, dust, and fly rock are typically concentrated in areas surrounding the quarry or blasting site. However, depending on geological conditions and blast intensity, these impacts can extend beyond anticipated buffer zones.

Mitigation and Control Measures:

1. Blasting should be carried out in accordance with a site-specific Blast Management Plan (BMP), which includes pre-blast surveys, vibration and air overpressure monitoring, and risk assessments.
2. Use of modern blasting techniques, such as electronic detonators and controlled delay sequences, can reduce vibration and fly rock.
3. Establishment of blast exclusion zones with proper signage and fencing to restrict access during detonation.
4. Real-time monitoring of vibration and air overpressure levels.
5. Dust suppression strategies, such as water spraying and wind barriers, should be implemented before and after blasting.

In summary, while blasting is essential for efficient rock excavation, its associated risks demand rigorous planning, engineering controls, and regulatory compliance to ensure environmental protection and the safety of both workers and surrounding communities.

- **Waste from excavated materials and obsolete equipment**

Some excavation tools and equipment used during the project will become worn out or obsolete hence there will be need for them to be discarded. Similarly, certain soil and rock materials excavated from the site may be unsuitable for reuse once the excavation is complete. Furthermore, site excavations must meet established standard specifications, meaning that some materials will inevitably be rejected and classified as waste requiring proper disposal. If not managed correctly, the improper disposal of these materials could cause negative environmental impacts, such as soil contamination or disruption of local ecosystems. Therefore, it is essential that all waste materials whether tools, equipment, or excavated soil and rocks are carefully collected, transported, and either recycled or disposed of in designated, environmentally approved locations. Additionally, efforts should be made to explore alternative uses for these materials to transform potential waste into valuable resources, contributing to economic benefits and reducing environmental harm.

Mitigation:

1. Material Segregation: Separate excavated materials into reusable (e.g., topsoil, gravel) and non-reusable/spoiled materials (e.g., contaminated or mixed debris).
2. Backfilling and Embankment Construction: Use inert excavated materials for backfilling, slope stabilization, or forming embankments where geotechnically suitable.
3. Construction Use: Crushed rock and clean fill can be reused in subgrade or roadbed layers
4. Designated Disposal Sites: Transport non-reusable materials to approved dumping sites.
5. Fluids Draining: Drain fuel, lubricants, coolant, and hydraulic fluids from decommissioned equipment prior to disposal.
6. Scrap Recovery: Salvage metals, rubber parts, and electronics for recycling through licensed waste handlers.

- **Impacts of Soil Erosion**

Construction and excavation loosen the soil, increasing erosion risks especially where topsoil is left exposed or where open quarries are created. Runoff from these disturbed areas can carry large amounts of sediment downstream, disrupting local hydrology, degrading water quality, and introducing contaminants into rivers and reservoirs. Effective erosion control measures, including soil stabilization, runoff management, and timely site rehabilitation, are essential to prevent these impacts.

Mitigation:

1. Soil and Terrain Survey: Conduct geotechnical and hydrological assessments to identify erosion-prone zones (e.g., steep slopes, loose soils).
2. Erosion Risk Mapping: Develop erosion susceptibility maps to inform alignment design, cut-and-fill balances, and drainage planning.
3. Construction Phasing: Schedule earthworks during dry seasons where possible to minimize rainfall-induced erosion
4. Minimal Clearance: Clear only the areas necessary for construction to preserve natural ground cover and reduce exposure.
5. Topsoil Stripping and Storage: Remove and store topsoil separately for reuse in site restoration and landscaping.
6. Rapid Revegetation: Replant native grasses, shrubs, or fast-growing groundcover species as soon as construction is complete in each section.
7. Retaining Structures: Construct gabions, rock bunds, or retaining walls on high embankments and cut slopes.
8. Proper Drainage Design: Construct lined channels, culverts, cross-drains, and side drains to manage surface runoff efficiently.
9. Check Dams and Sediment Traps: Install temporary sediment traps or check dams to capture soil before it enters watercourses.
10. Stormwater Detention Basins: Create holding ponds to allow sediment to settle before water is released downstream.
11. Compaction of Fills: Compact loose fill and embankments to reduce susceptibility to erosion

by water and wind.

12. Minimize Disturbance: Confine heavy equipment movement to designated paths to avoid unnecessary soil compaction and disturbance.

- **Slope Destabilization**

Excavation activities along landscapes and hillsides during the construction of the rail track have the potential to destabilize slopes, increasing the risk of erosion and slope failures. The destabilizing impact is particularly significant in hilly areas where the railway line crosses steep terrain. Historical evidence shows that landslides in such regions often result from a combination of steep slopes, heavy rainfall, and soil conditions especially where high clay content leads to increased water absorption, and where fractured metamorphic rocks create zones of weakness in the ground. Therefore, careful geotechnical assessment and slope stabilization measures are critical during construction to ensure the safety and stability of the railway infrastructure as well as the surrounding environment

Mitigation

1. Cut and Fill Balancing: Minimize the number of cut-and-fill earthworks by optimizing rail alignment and grading plans.
2. Reinforced Earth Structures: Use mechanically stabilized earth (MSE), geogrids, and retaining walls to support cut slopes and embankments.
3. Slope Reinforcement: Employ soil nails, rock bolts, or micropiles to provide deep anchoring in unstable slopes.
4. Drainage Control: Install subsurface and surface drainage (e.g., French drains, interceptor ditches, and weep holes in retaining walls) to prevent water accumulation that weakens soil.

- **Impacts of generated exhaust emissions**

Construction machinery, equipment, and vehicles powered by diesel and petrol will generate exhaust emissions including NO_x, CO, PM, and VOCs leading to increased atmospheric pollution during the construction phase. Transport vehicles for workers and materials will further add to these emissions, potentially causing localized declines in air quality and posing environmental and health risks. Baseline data show that current air quality along the alignment is good, with locations such as the proposed Sondu Station recording the lowest CO₂ levels.

Mitigation

1. Retrofitting: Retrofit older machinery with emission control technologies such as Diesel Particulate Filters (DPFs) and oxidation catalysts.
2. Electric or Hybrid Alternatives: Use electric, hybrid, or compressed natural gas (CNG)-powered equipment where feasible, particularly in enclosed or urban areas.
3. Use of Clean Fuels: Utilize ultra-low sulfur diesel to reduce sulfur dioxide and particulate emissions.
4. Fuel Storage Practices: Store fuels in sealed, labeled tanks to prevent evaporation losses and reduce fugitive emissions
5. Preventive Maintenance: Implement a strict maintenance schedule to ensure that engines operate at optimal efficiency and with minimal emissions.

6. **Idle Reduction:** Enforce anti-idling policies for machinery and vehicles (e.g., limit idling to 3–5 minutes) to reduce unnecessary fuel combustion.
7. **Load Optimization:** Avoid engine overloading by matching the size and capacity of machinery to the task, ensuring efficient operation.
8. **Phased Construction:** Implement phased construction to limit the number of machines operating simultaneously and reduce peak emissions.
9. **Material Sourcing:** Source materials (e.g., ballast, sand, steel) locally to reduce long-distance transport and associated emissions.
10. **Traffic Management:** Use efficient routing and scheduling for material delivery to avoid congestion and repeated trips.
11. **Air Quality Monitoring:** Establish ambient air monitoring stations near sensitive areas to track PM₁₀, PM_{2.5}, and NO_x levels during construction.
12. **Emission Tracking:** Keep records of equipment types, fuel use, and hours operated to estimate and report construction-phase emissions.

- **Contribution to climate change**

The railway project will require limited vegetation clearing, which, although minimal, reduces local carbon sequestration capacity and contributes slightly to cumulative GHG emissions. Construction activities will further add to atmospheric carbon through fossil fuel use in machinery, vehicles, and generators, releasing CO₂, NO_x, and particulate matter. These emissions collectively contribute to climate change and localized air quality impacts.

Technical Recommendations and Mitigation Measures

1. Minimize vegetation clearance by optimizing the construction corridor and integrating natural landscape features into the design where possible.
2. Implement carbon offset measures, such as reforestation or afforestation programs in nearby areas to compensate for lost carbon sinks.
3. Ensure all construction equipment meets emission standards (Euro Stage V should be a good reference), and promote the use of low-emission fuels or electric-powered machinery where feasible.
4. Develop integrated waste management plans in collaboration with local authorities, emphasizing waste minimization, segregation, recycling, and safe disposal practices.
5. Incorporate climate resilience and low-carbon strategies into regional development planning to ensure that induced growth does not exacerbate environmental degradation.

- **Air quality impacts due to dust generation**

Cumulative impact of Inhalable particulate matter (PM₁₀) and respirable particulate matter (PM_{2.5}) are likely to be experienced at the Nzoia/ Musonga Station Location 2. Air pollution during the site preparation and construction phase will primarily result from fugitive dust emissions generated by various site activities. These activities include site clearance, demolition, excavation, loading, and the transportation of construction materials and excavated earth. Dust emissions are expected to originate not only from the main construction areas but also from diversion roads and blasting sites associated

with the project. The predominant air pollutant anticipated is Suspended Particulate Matter (SPM), which encompasses a range of airborne particles capable of penetrating respiratory systems and contributing to adverse health effects. The generation of SPM is directly linked to earthmoving operations and material handling processes, which disturb soil surfaces and liberate fine particulate matter into the atmosphere. Effective dust control measures, such as water spraying, use of dust suppressants, covering of transported materials, and maintaining vegetation buffers, are critical to minimizing airborne particulate concentrations and mitigating impacts on air quality and public health.

Mitigation

1. **Progressive Land Clearing:** Clear only the areas required for immediate work to reduce the amount of exposed, dust-prone soil.
2. **Moisture Conditioning:** Apply water to loose soil prior to and during earthworks (excavation, grading, backfilling) to suppress dust at the source.
3. **Water Spraying:** Regularly spray water or non-toxic dust suppressants (e.g., calcium chloride or magnesium chloride solutions) on access and haul roads, especially during dry or windy conditions.
4. **Speed Limits:** Enforce low speed limits (e.g., <20 km/h) for construction vehicles on unpaved surfaces to minimize dust uplift.
5. **Paved Access Routes:** Where feasible, pave or gravel main site access roads to reduce dust from vehicle movement.
6. **Dust-Controlled Loading/Unloading:** Minimize drop heights when loading or unloading fine materials like sand or ballast, and use enclosed conveyors or hoppers when available.
7. **Covered Storage:** Store loose construction materials such as cement, sand, and aggregates in enclosed or covered facilities.
8. **Transport Covering:** Use tarpaulins or fitted covers on trucks transporting dusty materials.
9. **Wet Methods:** Apply water spray during demolition, concrete cutting, and rock drilling to suppress dust at the point of generation.
10. **Dust Extraction Systems:** Equip drilling and grinding equipment with vacuum or extraction systems to capture fine particles.
11. **Dust Monitoring Stations:** Install PM₁₀ and PM_{2.5} monitors at sensitive locations (e.g., residential areas, schools, hospitals) to track ambient dust levels.

- **Impacts on hydrology and water quality**

Disturbance of contaminated soils or previously polluted groundwater during excavation can mobilize pollutants and allow them to migrate into adjacent aquifers. Linear excavations such as trenches for pipelines or rail foundations can create preferential pathways that facilitate both lateral and vertical movement of contaminants into previously unaffected groundwater zones. Additionally, accidental spills of hazardous substances, including fuels, lubricants, and chemical additives, within excavated areas pose a significant risk of leaching into the subsurface and further degrading groundwater quality. To mitigate these risks, it is essential to conduct thorough site assessments before excavation, implement effective containment measures to prevent spills, and maintain continuous groundwater

monitoring to detect early signs of contamination migration.

Mitigation

1. Silt Fences and Sediment Barriers: Install geotextile silt fences or sediment traps around exposed soils, stockpiles, and drainage paths to intercept suspended solids.
2. Sedimentation Ponds/Basins: Construct temporary settling basins to capture and treat stormwater runoff from construction areas before discharge into natural water bodies
3. Stormwater Diversion Channels: Build lined or vegetated swales and diversion ditches to redirect clean runoff away from construction zones.
4. Check Dams and Contour Trenches: Install check dams along drainage channels on slopes to reduce flow velocity and trap sediments.
5. Grading and Drainage Planning: Design site grading to control surface runoff direction and volume to avoid erosion and water body contamination.
6. Designated Refueling and Maintenance Areas: Locate fuel and maintenance areas at least 50 m away from watercourses and provide impervious, bunded surfaces with oil-water separators.
7. Secondary Containment: Store fuels, lubricants, and chemicals in leak-proof containers within secondary containment systems.
8. Spill Response Plan: Maintain spill kits on-site and train personnel in emergency spill response. Implement a Spill Prevention and Control Plan (SPCC).
9. Worker Sanitation Facilities: Provide portable toilets or biodigester toilets for workers, located away from water bodies and serviced regularly.
10. Construction Wastewater Treatment: Treat wastewater from concrete batching, equipment washing, or drilling using sediment traps or pH neutralization before discharge.
11. No Direct Discharge: Prohibit direct discharge of untreated wastewater or sewage into rivers, lakes, wetlands, or groundwater.
12. Material Storage on Impervious Surfaces: Store construction materials (e.g. cement, lime, paint) on impervious surfaces under cover to prevent contact with rainwater.
13. Stockpile Management: Cover soil and spoil stockpiles with tarpaulin and place them away from drainage paths and watercourses.
14. Riparian Buffer Zones: Maintain buffer zones (e.g., 30 meters) along rivers and streams to act as natural filters.
15. Wetland Avoidance: Avoid construction in or near wetlands; where unavoidable, apply wetland restoration and compensation measures.
16. Water Quality Monitoring: Regularly test parameters such as turbidity, pH, oil & grease, BOD/COD, nitrates, and coliforms in nearby surface and groundwater.

- **Flooding and water logging risks**

The construction phase may face flooding challenges due to surface runoff influenced by local topography, outfall configurations, and inadequate drainage infrastructure. If not well managed, these conditions can affect construction quality, cause delays, and compromise the long-term stability and performance of the railway. Proper design and installation of drainage channels and outfall systems are therefore critical during both design and construction.

Key drainage-related risks include:

- Localized flooding caused by temporary blockages or disruptions to natural drainage, especially in spoil disposal areas where debris or excavated material may obstruct water flow.
- Soil erosion resulting from unmanaged runoff, which can destabilize soils and increase sedimentation in nearby water bodies.
- Stormwater concentration into roadside drains, cross-culverts, and downstream outfalls, leading to siltation and potential structural damage, thereby heightening downstream flood risks.

Mitigation

1. Development of a comprehensive stormwater management plan that incorporates proper grading, installation of appropriately sized and aligned drainage infrastructure, regular maintenance of drainage pathways during construction, and erosion control measures such as sediment traps, silt fences, and vegetative buffers.
2. Integrate hydrological modeling in the design phase will optimize drainage capacity and ensure resilience against varying rainfall events, thereby safeguarding both construction progress and the long-term functionality of the railway system.

- **Solid Waste Generation**

Significant quantities of solid waste are expected to be generated throughout the project, primarily from soil excavation activities, leftover construction materials, and associated packaging waste. Additionally, municipal and domestic waste produced at labor camps presents a substantial risk of contributing to land pollution if not properly managed. Improper disposal or uncontrolled dumping of these waste streams can lead to the leaching of contaminants into the soil, subsequently posing risks to both surface and groundwater quality through infiltration and runoff pathways.

Mitigation

1. Implement an integrated waste management plan that includes waste segregation, collection, and disposal in accordance with NEMA guidelines.
2. Implementing measures including designated landfill sites, recycling of construction debris, and effective sanitation systems at labor camps should be enforced to prevent pollution and safeguard surrounding ecosystems.
3. Provision of sanitation facilities to workers to prevent open defecation.
4. Prioritize options of waste reduction, reuse and recycling, particularly papers, polythene bags and plastic wrappers and containers and other materials that can possibly be recycled.
5. Sensitize site workers and frequent visitors (especially those operating food catering services) to the work sites on proper waste management practices.
6. Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of waste generated over time.
7. Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or homeowners.

8. Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site.
9. Waste collection bins to be provided at designated points on site and contract a NEMA Licensed waste handlers to be contracted to transport and dispose the solid waste from site

- **Noise and vibrations impacts**

Construction activities such as operating heavy machinery, blasting, and quarrying will generate high noise levels that may affect nearby communities, especially where traffic or equipment is diverted closer to homes, schools, or businesses. Vibrations from heavy equipment, excavation, and blasting also pose a risk to surrounding structures, potentially causing ground-borne vibrations that may lead to cracking, destabilization, or other damage, particularly in older or vulnerable buildings.

Mitigation

1. Implement engineering controls such as vibration dampening and noise barriers, and establish monitoring programs. Moreover, communication with affected communities and stakeholders should be maintained throughout the construction period to manage expectations and address concerns related to noise and vibration exposure.
2. Construction Scheduling: Plan high-noise activities during daytime hours (e.g. 08:00–17:00) to minimize impact on nearby communities
3. Modern Equipment: Use new or well-maintained machinery designed with noise-reducing features (e.g. mufflers, silencers, acoustic enclosures).
4. Electric or Hydraulic Equipment: Use electric or hydraulic-powered tools instead of pneumatic tools to reduce noise and vibration
5. Temporary Acoustic Barriers: Erect movable noise barriers (e.g. acoustic curtains, sound-insulating panels) around high-noise equipment like generators and compressors.
6. Enclosures for Fixed Equipment: Install acoustic enclosures for stationary noise sources such as concrete mixers, batching plants, and power units.
7. Earth Berms or Gabions: Use constructed embankments or gabion walls along site perimeters to attenuate sound propagation.
8. Limit Simultaneous Operations: Avoid operating multiple high-noise machines simultaneously near sensitive areas.
9. Relocation of Noisy Equipment: Position equipment and haul roads away from populated areas whenever possible.
10. Vehicle Movement Control: Implement traffic management plans to reduce vehicle idling and control speeds on site to reduce noise and vibration from transport.
11. Vibration Dampening Systems: Use vibration isolation pads, trench barriers, or matting under machinery to reduce transmission.
12. Controlled Blasting: If blasting is necessary, use controlled methods (e.g., pre-split or cushion blasting) and time it to avoid peak community activity.
13. Noise and Vibration Monitoring Stations: Install real-time monitoring devices at key sensitive locations to measure dB(A) levels and vibration (PPV – Peak Particle Velocity).

14. Spoil soil emanating from excavations will be reused for landscaping followed by revegetation of the landscaped areas.
15. Implementing procurement measures that ensure ordering the correct amount of materials when needed to reduce chances of unused materials being abandoned at the site.

9.3.4 Predicted negative social and economic impacts during site preparation and construction phases.

- **Loss of grazing land**

Livestock rearing constitutes a key livelihood activity within the project area, providing both subsistence and economic benefits to local communities. During stakeholder engagement sessions, including public consultation meetings, the communities expressed concerns regarding the potential disruption to traditional grazing patterns as a result of the proposed infrastructure development.

Specifically, the construction and eventual operation of the railway corridor may:

1. Restrict access to established grazing routes and communal pasturelands due to the erection of physical barriers such as fencing, embankments, or culverts.
2. Reduce available grazing land through land acquisition and site occupation for railway infrastructure (e.g., tracks, access roads).
3. Limit livestock mobility, which is critical in dryland areas where herders rely on seasonal movement to access water and forage resources.
4. Exacerbate resource pressure on remaining communal lands, leading to overgrazing, land degradation, and reduced pasture productivity.
5. Increase the risk of livestock accidents or fatalities due to proximity to active construction zones or operational rail lines.

Mitigation

1. Designing livestock underpasses or overpasses at strategic locations to facilitate safe crossing and maintain grazing continuity.
2. Incorporating community grazing access corridors in the railway layout to minimize disruption to migratory routes.
3. Establishing participatory rangeland management plans with local stakeholders to ensure sustainable pasture use during and after construction.
4. Implementing fencing safety protocols and clear signage to reduce the likelihood of livestock-train collisions.
5. Engaging with livestock keepers throughout the project lifecycle—from planning to implementation and post-construction—is critical to minimizing adverse socio-economic impacts and maintaining community support for the project.

- **Disruption of existing public utilities**

Construction of the railway will require relocating existing utilities within the corridor, including water supply lines, sewer systems, power networks, and fiber-optic cables. This relocation is essential to protect infrastructure and allow uninterrupted construction access, but it may cause short-term service disruptions for connected users. Sequencing these works before major construction will help minimize delays and overlapping impacts.

Some utilities, particularly sewer systems, may not be relocated due to technical constraints linked to topography and gravity-based flow, requiring protective measures during construction. The railway design also includes several level crossings and underpasses, which may disrupt local traffic during both construction and operation. Effective traffic management, stakeholder engagement, and engineered detours will be necessary to maintain access and ensure public safety.

Mitigation

1. Coordination with utility service providers and local authorities to map existing underground and overhead infrastructure accurately to avoid service interruptions, and adhere to safety and regulatory standards during relocation activities.
 2. Integrating comprehensive surveys and utility mapping, coupled with robust monitoring frameworks into the project management plans to manage risks associated with utility relocations and traffic disruptions.
 3. Engage utility agencies early in the planning phase to identify vulnerable infrastructure and agree on protocols for relocation or protection.
 4. Where relocation is unavoidable, prepare detailed relocation plans approved by utility providers and schedule works during off-peak hours or planned outages.
 5. Install protective barriers, sleeves, or encasements around utilities that are close to excavation or piling activities.
 6. Clearly mark utility corridors on the ground and in site drawings to prevent accidental damage by construction crews.
 7. Set up a system to receive, document, and resolve complaints regarding service disruptions quickly.
- **Influx of Workers to the proposed project areas leading to increased HIV/Aids prevalence and moral decay.**

Influx of workers during site preparation, construction and operation phases in search of job and business opportunities has the potential of creating social vices like spread of communicable diseases and promotion of crime incidents. Communicable or infectious diseases that will be of major concern include HIV/AIDS and other sexually transmitted infections. Crime incidents likely to be encountered will comprise of, fraud, burglary, theft and vandalism of property. The location of the project greatly affects both the amount and type of crime that occurs. Increase in crime cases when working in or around cities urban and peri urban centres, and the nature of crime tends to vary in different regions.

Mitigation measures;

1. Prioritize recruitment of local workers for unskilled labour through job fairs, community hiring

- agreements and consider partnerships with local vocational training centers for skilled labour.
- 2. Restrict site access to only essential staff, especially during high-impact activities.
- 3. Develop shared strategies for mitigation (e.g., zoning and curfews)
- 4. Require incoming workers to follow a code of behavior that respects local cultures and laws.
- 5. Incorporate STD/HIV/AIDS awareness and prevention programmes into the training Programme for all project workers

- **Impacts on Slope Instability**

Excavation in sloped and hilly terrain presents major geotechnical risks for the railway project, including soil erosion, landslides, and slope failure—especially in steep sections requiring tunneling, blasting, or deep cuttings. These risks are heightened in areas with fragile geology, such as clay-rich soils and fractured metamorphic rocks, which lose strength when saturated or disturbed by construction vibrations. Historical patterns in similar terrains show that landslides often result from the combined effects of steep gradients, unstable geological formations, and inadequate drainage.

Mitigation

1. Conduct detailed geotechnical and hydrological investigations to identify vulnerable zones.
2. Design stable cut slopes and install retaining structures where needed.
3. Reinforce weak formations using soil nailing and rock bolting.
4. Apply controlled blasting techniques to minimize vibrations.
5. Construct proper drainage systems, including culverts, sub-surface drains, and catchwater ditches, to manage runoff and reduce water infiltration.
6. Use bioengineering methods such as vegetation cover, grassing, and terracing to stabilize slopes and reduce erosion.
7. Implement continuous monitoring with slope sensors, visual inspections, and early warning systems to detect movement or stress build-up.
8. Ensure timely interventions to protect railway infrastructure, nearby communities, and ecosystems from landslide hazards.

- **Interruptions of the existing railway operations**

During the construction phase, there is potential for operational interference with the existing meter gauge railway line, particularly at crossing points, shared yards, and depots. Such disruptions may arise from the necessity to relocate utilities and services, the temporary occupation of rail infrastructure for construction purposes, and the implementation of traffic diversions to accommodate work activities. These interruptions could adversely affect the regular functioning and efficiency of the meter gauge railway operations, potentially leading to delays and reduced service reliability.

Mitigation

1. Engage in extensive stakeholder consultations involving railway operators, service providers, and other affected parties
2. Conduct comprehensive planning and scheduling of construction activities to coordinate works in a manner that minimizes operational disruptions.
3. Employing phased construction approaches, optimizing work windows, and establishing clear communication channels will help ensure that business operations on the existing meter gauge

line are maintained as effectively as possible throughout the project lifecycle.

- **Wildlife and Livestock accidents due to breached fence**

Collisions between animals and trains along the existing railway corridor have caused wildlife and livestock fatalities. Fencing is a key measure to restrict animal access, though larger animals and occasionally humans may attempt to breach it. Effective mitigation includes durable, high-tensile or electrified fencing and earth embankments. Wildlife underpasses or culverts at strategic points allow safe animal crossings, maintaining habitat connectivity. These measures collectively reduce animal-train collisions, protect wildlife and livestock, enhance operational safety, and minimize economic losses from accidents.

Mitigations

1. Conduct wildlife movement and behavior studies to identify high-crossing zones and optimize the placement of underpasses.
2. Utilize fencing materials that balance strength, flexibility, and visibility to reduce damage by animals and humans.
3. Design underpasses with appropriate dimensions, lighting, and natural substrate to encourage regular animal use.
4. Implement regular fence inspection and maintenance schedules to promptly repair breaches and maintain barrier effectiveness.
5. Engage local communities and stakeholders in awareness programs to minimize human interference with fencing infrastructure.

- **Disputes over employment**

Recruitment of labour from the local communities can result in conflicts. These would result in need for proper stakeholder engagement in line with the requirements of the standards on labour and working conditions for smooth operation of activities that rely on local labour. Protection of vulnerable and marginalized groups such as youth and women within the project's labour force may also require especial measures.

Mitigation Measures

1. The proponent shall develop a grievance management system to manage grievances arising from the local labour force.
2. The proponent shall develop a Stakeholder Engagement and Community Development Plans.
3. The proponent shall develop local labour recruitment plans, including disclosure of opportunities and partnership building with local support agencies / institutions.

- **Loss of livelihood**

Land will be required for construction of the new railway project. This will require acquisition of public, community and private lands, and will involve social issues such as resettlement of quite a number of families. The project is likely to affect various households, business enterprises among others. Moreover, there is possibility of adverse effects on the quality of life of affected community members. There will be loss of land and crops as well as houses and other properties such as businesses, churches, institutions among others. The land will be acquired and the properties

destroyed to pave way for construction of the railway line and the respective stations. The identified line route will lead to physical displacement of people, loss of shelter, assets, income sources and livelihood, and restriction of access to economic resources

Mitigation measures

1. Conduct detailed socio-economic baseline surveys to understand the livelihoods at risk.
2. Develop a Livelihood Restoration Plan (LRP) alongside the Resettlement Action Plan (RAP).
3. Ensure the LRP includes short-term compensation and long-term recovery support.
4. Promote income diversification e.g. bee keeping to the affected communities.
5. Offer support for transitioning to new livelihoods through: Skills training, micro-financing and job placement in the project or related services
6. Prioritize affected persons for construction and support employment opportunities in the SGR project.

9.3.5 Negative Environmental Impacts During Operation Phase

- **Loss of vegetation during wayleave maintenance**

Effective and routine vegetation management along railway corridors (track alignments and associated wayleaves) is essential to ensure the safe and efficient operation of train services, as well as to facilitate proper maintenance of railway infrastructure.

Unchecked growth of vegetation, including trees, shrubs, and grasses, poses multiple operational hazards. Overgrown trees may obstruct visibility of trackside signaling equipment, encroach on overhead electrification lines, or even collapse onto the track during adverse weather conditions, causing service disruptions or derailments. Dense undergrowth can also impede access to emergency egress zones or maintenance pathways, potentially compromising the safety of personnel during routine operations or emergencies.

Vegetation Management Techniques

Vegetation control within the rail corridor should employ an integrated management strategy that includes the following methods:

1. **Mechanical Methods**

These involve the use of equipment such as rotary mowers, brush cutters, and flail mowers to control grass and shrub growth. Mechanical cutting is effective for large areas but may require frequent application due to regrowth.

2. **Manual Methods**

Manual techniques such as hand pruning and selective cutting are suitable for sensitive areas or where precision is needed, for example near infrastructure or ecologically sensitive zones.

3. **Chemical Methods (Herbicide Application)**

The use of approved herbicides can provide long-term control of invasive or fast-growing species. However, chemical use must be carefully managed to minimize off-target impacts, soil contamination, and exposure risks to non-target species, including humans.

Ecological Considerations and Potential Impacts

Vegetation maintenance must be balanced to meet both operational requirements and environmental

sustainability. Excessive or indiscriminate clearing can disrupt local ecosystems by continually removing successional species, reducing biodiversity, and exposing the area to colonization by invasive or opportunistic plant species including *Solanum mauritanium*, *Parthenium hysterophorus*, *Psidium guajava*, *Lantana camara* and *Cuscuta* spp.

Long-term ecological consequences may include:

1. Loss of native habitat for pollinators, birds, and small mammals;
2. Soil destabilization and increased erosion, especially on embankments;
3. Reduction in carbon sequestration potential due to removal of plant biomass.

Best Practices and Mitigation Measures

1. **Vegetation Management Planning:** Develop a site-specific Vegetation Management Plan (VMP) that incorporates biodiversity conservation objectives, prioritizes native species, and outlines treatment thresholds.
2. **Buffer Zones:** Establish vegetative buffer zones using low-growing, native plant species that do not interfere with infrastructure but support ecological functions.
3. **Integrated Pest Management (IPM):** Use herbicides as a last resort, incorporating monitoring and mechanical/manual methods first to minimize chemical dependency.
4. **Monitoring and Adaptive Management:** Regular ecological assessments should be conducted to track the effectiveness of vegetation control measures and adapt strategies to evolving site conditions.

• Liquid Waste Generation

The operation of sanitation facilities at train stations will inevitably result in the generation of liquid waste, primarily consisting of greywater and blackwater from toilets, handwashing stations, and other hygiene-related infrastructure. Effective management of this wastewater is critical to maintaining public health standards and ensuring environmental protection.

In instances where train stations are not connected to a centralized or conventional municipal sewerage network, on-site wastewater treatment solutions must be employed. A common approach involves the construction of septic tank systems in conjunction with soak away pits (also known as infiltration or percolation pits).

Mitigation measures

1. Construction of septic tanks in areas not served by sewer lines. The septic tank serves as a primary treatment unit where solids settle, and anaerobic digestion reduces the organic load of the wastewater. The effluent, while partially treated, is then discharged to a soak away pit—a subsurface structure designed to allow gradual infiltration of liquid into the surrounding soil. The soil acts as a secondary filtration medium, facilitating further biodegradation and pathogen removal through natural processes.
2. Proper design, sizing, and maintenance of liquid waste management systems to ensure their effectiveness and to prevent contamination of groundwater resources. Factors such as soil

permeability, water table levels, projected usage volumes must be considered in the engineering of these facilities. In areas with high water tables or impermeable soils, alternative technologies such as constructed wetlands or bio-digesters may be more appropriate.

3. Periodic monitoring and desludging schedules should be established as part of a comprehensive wastewater management plan.

- **Oil Spillage**

Petroleum hydrocarbon contamination is a significant environmental risk associated with the operation and maintenance of railway infrastructure, particularly during activities such as lubricant changes, cleaning, and mechanical repairs of rolling stock. Uncontrolled oil spillages are frequently observed in maintenance yards due to operational practices, equipment wear, and poor containment measures. In addition to acute spill events, chronic pollution can occur through persistent leaks and drips of lubricants, hydraulic fluids, solvents, and grease from locomotives and auxiliary machinery.

Railway yards, particularly fueling and servicing zones, are high-risk areas for such contamination. Spilled oil and related substances have the potential to infiltrate the surrounding soil matrix, leading to long-term degradation of soil quality and posing serious risks to terrestrial and aquatic ecosystems. Moreover, surface runoff, especially during rainfall events, can mobilize these pollutants, enabling their transport to adjacent agricultural lands and ecologically sensitive areas such as wildlife conservation zones. This runoff may also contain residues from incidental spills that are not effectively managed by containment infrastructure.

Stormwater falling on exposed maintenance areas, fuel storage zones, and washing bays can become contaminated with hydrocarbons. If not properly managed, this stormwater can act as a conduit for non-point source pollution

Mitigation Measures

1. **Primary Containment:** All maintenance and fueling activities should be conducted on impermeable, bunded surfaces equipped with oil-water separators to prevent direct infiltration and runoff.
2. **Secondary Containment Systems:** Drip trays, catchment basins, and covered storage should be employed to collect incidental leaks and spills, particularly in high-risk areas.
3. **Spill Interception and Treatment:** A grit chamber system should be installed to facilitate the settling of suspended solids and initial separation of hydrocarbons from wash water and stormwater runoff. These chambers should be regularly monitored and cleaned to maintain operational efficiency.
4. **Oil Recovery and Disposal:** Recovered oil and oily residues should be handled as hazardous waste. Appropriate disposal methods include:
 - Auctioning the waste oil to licensed recyclers or re-refiners.
 - High-temperature incineration in approved facilities, which ensures complete combustion of organic compounds and prevents groundwater contamination.
5. **Monitoring and Environmental Safeguards:** Regular environmental audits, soil and water quality assessments, and hydrocarbon concentration monitoring should be conducted, particularly in drainage pathways leading from the rail yard.

6. Emergency Response Planning: Personnel should be trained in spill response protocols, and spill kits must be readily accessible at all maintenance and fueling stations.

- **Pollution on Vegetation**

The operation of diesel-powered locomotives is expected to generate exhaust emissions comprising various air pollutants, including particulate matter (PM), nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), and unburned hydrocarbons (HC). These emissions contribute to both local air quality degradation and broader atmospheric environmental concerns.

Impacts on Vegetation and Ecosystems:

1. Deposition of Particulate Matter and Soot - When particulate-laden exhaust settles on plant foliage, it creates a physical barrier that obstructs light absorption and gas exchange through stomata, thereby disrupting the process of photosynthesis. This reduction in photosynthetic efficiency can lead to stunted growth, reduced crop yields, and overall decline in plant health, particularly in areas adjacent to the rail corridor.
2. Formation of Acid Rain - Nitrogen oxides (NO_x) and sulfur dioxide (SO₂) emitted from locomotive exhaust can undergo atmospheric chemical transformations, forming nitric and sulfuric acids. These acids are deposited on terrestrial and aquatic ecosystems through precipitation—a phenomenon known as acid rain. Acid rain leads to soil acidification, nutrient leaching, and direct damage to leaf surfaces, which collectively impair vegetation growth and biodiversity.

Mitigation Measures

To reduce the environmental footprint of locomotive operations, the project will implement a comprehensive emissions reduction strategy, including:

1. Adoption of low-emission or hybrid locomotives, and where feasible, electrification of rail lines, will significantly reduce combustion-related pollutants.
2. Routine inspection and maintenance of engines will ensure optimal combustion efficiency, thereby minimizing the release of incomplete combustion products such as soot and carbon monoxide.
3. Utilizing ultra-low sulfur diesel (ULSD) will directly reduce sulfur dioxide emissions, thereby decreasing the risk of acid rain formation.
4. Implementation of after-treatment systems such as diesel oxidation catalysts (DOCs), particulate filters, and selective catalytic reduction (SCR) units can substantially reduce NO_x and PM emissions from diesel engines.
5. Establishment of green buffers along the railway corridor can serve as biofilters for airborne pollutants, while also providing aesthetic and ecological benefits.
6. Continuous ambient air quality monitoring stations will be installed near sensitive ecological zones to track pollutant levels and assess the effectiveness of mitigation measures.

- **Air Emissions**

Diesel-powered locomotives are significant sources of air pollution, emitting nitrogen oxides (NO_x), particulate matter (PM), and carbon dioxide (CO₂), which impact public health and contribute to climate change. Rail yard operations can also generate fugitive dust from handling granular materials

and release volatile organic compounds (VOCs) and other hazardous pollutants from fuels, lubricants, and chemicals. These emissions can degrade air quality, reduce visibility, contribute to smog and ozone formation, and pose risks to nearby communities and ecosystems.

Mitigations

1. Employing advanced engine technologies with diesel particulate filters (DPFs), and selective catalytic reduction (SCR) systems to reduce NO_x and PM emissions.
2. Application of water sprays, chemical suppressants, and use of covered conveyors or enclosed handling facilities to reduce particulate matter during material transport and transfer operations.
3. Implementing leak detection and repair (LDAR) programs, utilizing vapor recovery systems during fuel storage and transfer, and maintaining sealed containment areas to limit VOC releases.
4. Continuous ambient air quality monitoring near sensitive receptors and rail yard boundaries should be conducted to inform adaptive management.

• Solid Waste Generation

Solid waste from passenger trains and terminals varies with passenger numbers and services offered. Key non-hazardous wastes include food residues, packaging, paper products, and single-use items. Rail infrastructure maintenance generates additional waste streams, including scrap steel, wooden sleepers, and construction debris, as well as hazardous wastes from lubricants, solvents, and other chemicals used in equipment maintenance. Overall, waste generation is primarily linked to locomotive and rolling stock maintenance, with track upkeep contributing to a lesser extent.

1. Solid residues from mechanical cleaning processes of railcars (e.g., accumulated dirt and debris);
2. Paint chips and abrasive blasting media such as sandblast grit used during surface preparation;
3. Residual and waste paint materials;
4. Spent solvents and solvent sludges resulting from painting and cleaning operations;
5. Sludge generated from wastewater treatment systems related to cleaning activities;
6. Waste oils, hydraulic fluids, and other petroleum-based lubricants;
7. Petroleum-contaminated solids such as used oil filters and absorbent materials saturated with spills;
8. Spent engine coolants and antifreeze solutions;
9. Metal shavings, scrap components, and worn mechanical parts;
10. Depleted locomotive and signaling batteries containing heavy metals and acids;
11. Spent brake shoes containing metallic components and potential hazardous residues.

At passenger stations, refuse primarily includes general garbage, rubbish, and floor sweepings. Efficient and sanitary collection and disposal of this waste are critical for vector control, minimizing odor and pest infestations, improving the aesthetic environment, and preventing pollution. Modernization efforts aim to digitize most station transactions and communications, thereby reducing reliance on paper-based materials and consequently lowering the proportion of paper waste generated during operations.

To maintain sanitary conditions, appropriately designed waste containers and collection bins will be strategically installed across all railway facilities. These receptacles will facilitate segregation where possible and support regular waste collection schedules to prevent accumulation and overflow.

Environmental Considerations:

The potential for increased littering, particularly within environmentally sensitive or protected areas adjacent to rail corridors, poses a risk to the visual amenity and ecological integrity of these zones. Littering by passengers and rail-line users can introduce non-biodegradable pollutants and wildlife hazards, thereby degrading habitat quality and the protected area's aesthetic value.

Recommendations for Waste Management

1. Implementation of a comprehensive Waste Management Plan (WMP) encompassing waste minimization, segregation, and recycling strategies;
2. Training of staff and public awareness campaigns to reduce littering and promote responsible waste disposal;
3. Regular monitoring and cleanup operations within and around rail facilities and protected areas;
4. Provision of adequate infrastructure for waste containment and environmentally sound disposal or recycling of hazardous materials;
5. Engagement with licensed waste handlers for safe disposal of hazardous wastes such as oils, solvents, and batteries in compliance with local regulations and international best practices.

• **Hazardous Materials**

Maintenance operations on locomotives and rolling stock frequently involve the use of hazardous materials, including chemical agents such as solvents, coolants, acids, and alkalis. These substances are essential for tasks such as degreasing, cooling system management, cleaning, and corrosion control. However, improper handling, storage, or disposal of these hazardous chemicals poses significant risks to worker safety, public health, and the environment, including soil and water contamination.

Risk Mitigation and Management Measures

1. Establish and enforce standard operating procedures (SOPs) for the safe storage, handling, and disposal of solvents, coolants, acids, and alkalis to minimize exposure risks and environmental release.
2. Identification and Inventory of Legacy Hazardous Substances: Conduct thorough inspections and material audits to identify equipment containing PCBs and asbestos. Maintain an updated inventory to support risk assessment and management planning.
3. Specialized Removal and Disposal Procedures: Engage licensed hazardous waste contractors for the safe removal, transport, and disposal of PCBs and asbestos-containing materials.
4. Personal Protective Equipment (PPE) and Training: Ensure maintenance personnel are equipped with appropriate PPE, such as respirators and protective clothing, and are trained in handling hazardous substances and emergency response protocols.

- **Noise and Vibration**

Railway operations are associated with multiple sources of noise pollution, which can have significant impacts on human health, wildlife, and the general acoustic environment, particularly in densely populated or environmentally sensitive areas. The primary contributors to railway-related noise emissions include:

1. **Rolling Noise:** This is the predominant noise source during train operation and is generated by the interaction between the steel wheels and the rail track. Rolling noise results from surface roughness, wheel and rail irregularities, and vibrations induced in the rail structure. It becomes more pronounced at higher speeds and varies depending on the condition of the track and wheel surfaces, track stiffness, and maintenance practices.
2. **Braking Noise:** During deceleration, especially with mechanical (friction-based) braking systems, additional high-frequency noise is produced. This is typically more pronounced in freight trains and older rolling stock, where braking involves significant contact forces between brake shoes and wheels or discs.
3. **Aerodynamic Noise:** Aerodynamic noise becomes significant at higher operating speeds and is generated by the displacement of air as the train moves. This includes turbulence created around the nose of the train, pantographs, and undercarriage, as well as pressure fluctuations that can lead to transient noise events (e.g., when trains enter tunnels).
4. **Traction and Mechanical Noise:** Noise from the propulsion system, particularly in diesel-electric locomotives, includes emissions from internal combustion engines, turbochargers, and associated mechanical systems. In electric trains, traction noise originates from electric motors, gearboxes, and auxiliary systems such as compressors and inverters. Cooling fans and ventilation units also contribute significantly to overall noise levels, especially at low speeds or when idling.

Mitigation Measures

- **Track and Wheel Maintenance:** Regular grinding of rails and re-profiling of wheels to maintain smooth contact surfaces and reduce vibrational noise.
- **Use of Noise Barriers:** Installation of physical barriers such as acoustic walls, earth berms, or vegetation screens along sections of track adjacent to noise-sensitive receptors (e.g., residential areas, schools, hospitals).
- **Low-Noise Rail and Wheel Technologies:** Adoption of damped wheel designs, resilient rail fasteners, and rail web dampers can effectively reduce noise at the source.
- **Aerodynamic Design Optimization:** Streamlining train profiles, optimizing pantograph geometry, and enclosing undercarriage components can significantly reduce aerodynamic noise for high-speed trains.
- **Quiet Braking Systems:** Transition to disc brakes or composite brake blocks which generate less noise than traditional cast-iron blocks.
- **Engine Enclosures and Acoustic Insulation:** Incorporating soundproofing materials around engines and mechanical compartments, as well as using vibration isolation mounts.
- **Operational Controls:** Imposing speed restrictions in urban and noise-sensitive areas, and

scheduling train operations to avoid nighttime disturbances.

The movement of trains along railway tracks results in the generation of ground-borne vibrations. These vibrations originate primarily from dynamic interactions between the train wheels and the rail, particularly during high-speed travel, at track joints, switches, or in areas with structural discontinuities or poor subgrade conditions.

While these vibrations are typically perceptible to humans, their magnitude is generally localized and tends to attenuate rapidly with distance from the source. In most cases, significant ground vibration levels are confined to areas immediately adjacent to the railway corridor, typically within 30 to 100 meters, depending on soil type, train speed, axle load, and track condition.

The primary mechanisms contributing to railway-induced vibration include:

- Quasi-static loads due to the weight of the train moving over the track;
- Dynamic loads from wheel-rail irregularities (e.g., out-of-round wheels, rail joints, or track defects);
- Impact loads at rail discontinuities or crossings.

Potential Impacts of Ground Vibration

- Structural vibrations: Repeated exposure may affect the integrity of nearby buildings, particularly older or poorly constructed structures.
- Human comfort: Vibrations can cause annoyance or sleep disturbances for residents near the railway, even at low frequencies.
- Sensitive equipment interference: Facilities with vibration-sensitive instruments (e.g., hospitals, laboratories) may be affected.

Mitigation Measures

1. Track Maintenance and Upgrades:
 - Ensuring smooth rail surfaces through regular grinding and alignment reduces dynamic impacts.
 - Use of continuously welded rail (CWR) instead of jointed track minimizes impact vibrations.
2. Track Design Solutions:
 - Ballast mats, under-sleeper pads, or floating slab track systems can absorb and dissipate vibration energy before it transmits to the ground.
 - Resilient track fasteners reduce the stiffness of the rail-to-tie connection and mitigate high-frequency vibration.
3. Operational Adjustments:
 - Speed limits in vibration-sensitive zones can significantly reduce both the amplitude and frequency of vibration.
 - Scheduling freight or heavy trains during daytime hours may help reduce nighttime disturbance.
4. Buffer Zones and Land Use Planning:
 - Maintaining appropriate setback distances between the railway and residential or sensitive land uses can prevent significant impacts.
5. Monitoring and Baseline Studies:

- Conducting pre-construction and operational vibration monitoring helps establish baseline levels and assess the effectiveness of mitigation measures.

- **Climate change**

The area along the proposed railway is heavily modified by human activities, with original bushland largely cleared for agriculture and settlements, making climate change impacts likely cumulative. The railway project links to climate change through:

1. Direct GHG emissions: Diesel trains, backup generators, and maintenance equipment will emit CO₂ and other greenhouse gases, increasing the project's carbon footprint.
2. Indirect emissions from induced development: Economic growth and urbanization along the corridor may increase organic waste (producing CH₄), wastewater emissions (CH₄ and N₂O), and land-use changes that reduce carbon sinks.
3. Climate feedback and vulnerability: The project area may face heightened climate risks, including temperature extremes, altered rainfall, and extreme weather events, which could affect railway operations and infrastructure integrity.

Mitigation and Climate-Resilient Recommendations:

- Adoption of low-emission locomotives, including electrified rail systems or hybrid alternatives to diesel engines.
- Energy-efficient station infrastructure, powered by renewable energy sources (e.g., solar PV systems).
- Implementation of solid and liquid waste management systems, including biogas digesters, composting units, and wastewater treatment plants to reduce methane and nutrient emissions.
- Afforestation or reforestation programs to offset unavoidable emissions and enhance carbon sequestration.
- Integration of climate risk assessments into infrastructure design to ensure climate-resilient development and reduce vulnerability to climate variability.

- **Water Ponding**

Poor drainage and the construction of railway embankments in low-lying or flood-prone areas can disrupt natural water flow, causing water to accumulate upstream. This ponding effect may lead to localized flooding, submerge land, damage ecosystems, and affect nearby communities. If embankments are not properly engineered to handle hydraulic pressure, water saturation can cause soil erosion, scouring, or structural failure, potentially destabilizing slopes and the track bed, posing safety risks and increasing maintenance needs.

Mitigation

- Hydrological Impact Assessment:
 - ✓ Conduct detailed hydrological and hydraulic modeling of the project area to identify all-natural drainage pathways, seasonal water flows, and potential flood zones.
- Drainage and Water Conveyance Infrastructure:
 - ✓ Integrate appropriately sized and strategically placed culverts, box drains, or small bridges along the embankment to allow unimpeded flow of water.

- ✓ Ensure these drainage structures are designed to handle peak flows based on historical flood data and climate change projections.
- Embankment Design Reinforcement:
- ✓ Use erosion-resistant materials such as riprap or geotextiles on embankment slopes to prevent soil loss due to water action.
- ✓ Consider vegetative stabilization techniques to improve slope integrity and absorb runoff.
- Regular Inspection and Maintenance:
- ✓ Implement a maintenance schedule to inspect drainage structures for blockages or sedimentation and monitor embankment stability, especially during and after heavy rainfall events.
- Environmental Flow Management:
- ✓ Ensure that natural flow regimes are maintained to protect downstream ecosystems and avoid waterlogging upstream agricultural or residential areas.

9.3.6 Negative environmental impacts during decommissioning phase

- **Solid Waste Generation**

Demolition of buildings and infrastructure will generate large volumes of solid waste, including concrete, metals, timber, glass, paints, adhesives, and sealants. While largely inert, these materials can release hazardous substances over time, leading to soil and water contamination. Leaching of chemicals and ions such as chloride, sodium, sulfate, and ammonia can degrade groundwater quality, affecting human health, agriculture, and local ecosystems.

Mitigation measures.

1. **Waste Characterization and Hazard Assessment:** Prior to demolition, a thorough waste audit and hazardous materials survey should be conducted to identify potential sources of contaminants and ensure proper segregation of hazardous and non-hazardous materials.
2. **Leachate Management:** Effective containment and management strategies for demolition waste stockpiles should be implemented to minimize leachate generation. This may include the use of impermeable liners, runoff diversion systems, and controlled drainage infrastructure.
3. **Groundwater Protection Measures:** Buffer zones around water bodies and groundwater extraction points should be established to prevent contamination. Regular groundwater monitoring programs should be instituted to detect early signs of pollution.
4. **Material Recycling and Reuse:** Emphasizing the recycling and repurposing of inert materials such as concrete and metals can reduce the volume of waste requiring disposal and mitigate environmental impacts.

- **Dust pollution**

Demolition activities are anticipated to produce substantial volumes of airborne particulate matter (dust), which can have significant occupational health and environmental implications. The generation of dust during demolition results primarily from the mechanical disruption of building materials such as concrete, drywall, wood, and other construction debris.

Exposure to elevated dust concentrations poses respiratory health risks to demolition workers, including the potential development of conditions such as silicosis, chronic obstructive pulmonary

disease (COPD), and other respiratory irritations or allergies. Additionally, nearby residents and sensitive receptors, including schools, hospitals, and community centers, may experience reduced air quality, leading to nuisance complaints and potential exacerbation of pre-existing health conditions such as asthma.

Mitigation and Management Measures:

- Dust Suppression Techniques:
 - ✓ Application of water sprays or misting systems at active demolition sites to suppress dust generation.
 - ✓ Use of dust extraction or vacuum systems where feasible.
- Personal Protective Equipment (PPE):
 - ✓ Provision of appropriate respiratory protective equipment (e.g., N95 masks) to workers.
 - ✓ Implementation of occupational health protocols including training and health surveillance.
- Site Management Practices:
 - ✓ Scheduling demolition during favorable meteorological conditions to minimize dust dispersion (e.g., avoiding high winds).
 - ✓ Installation of physical barriers such as screens or fencing to contain dust within the demolition zone.
- Air Quality Monitoring:
 - ✓ Deployment of particulate matter (PM10 and PM2.5) monitoring stations around the demolition site to assess dust levels.
- Community Engagement:
 - ✓ Informing and coordinating with neighboring residents and businesses regarding demolition schedules and mitigation efforts to manage expectations and minimize disruption.
- **Noise and Vibration**

Demolition activities will generate high noise levels and ground-borne vibrations, degrading the acoustic environment on-site and in surrounding areas. Elevated noise can disturb residents, businesses, schools, and healthcare facilities, potentially causing hearing impairment, stress, and sleep disturbances. Vibrations from equipment and impact operations may affect nearby structures, create discomfort, and interfere with sensitive equipment in adjacent facilities.

Mitigation and Control Measures

- Noise Control Strategies:
 - ✓ Utilize modern, well-maintained demolition equipment equipped with noise reduction features such as mufflers and silencers.
 - ✓ Implement time restrictions to limit demolition activities to daytime hours, minimizing disturbance during early mornings, evenings, and nighttime.
 - ✓ Employ physical noise barriers or acoustic screens around the demolition site to reduce sound propagation.
- Vibration Monitoring and Management:
 - ✓ Conduct pre-demolition structural assessments of nearby buildings to identify vulnerabilities.

- ✓ Install vibration monitoring devices during demolition to ensure levels remain within acceptable limits.
- ✓ Adjust demolition techniques or equipment usage if vibration thresholds are exceeded.
- Community Communication:
 - ✓ Inform local communities and stakeholders in advance about demolition schedules and expected noise levels.
 - ✓ Establish a grievance mechanism to address concerns promptly.
- **Visual intrusion arising from lighting at night**

Lighting at night from bulbs installed at railway stations, tunnels and bridges can cause visual intrusion, disrupting the natural landscape and affecting the aesthetic value of the area. It can disturb local communities, wildlife, and sensitive ecosystems by altering natural light patterns, potentially leading to disorientation in nocturnal animals and sleep disturbances for nearby residents.

Mitigation measures

1. Use downward-facing, shielded lighting to minimize light spill and glare.
2. Install motion-sensor or timer-controlled lights to limit usage to when necessary.
3. Choose low-intensity, warm-colored lights to reduce visual impact.
4. Position lights strategically to minimize exposure to nearby communities and natural habitats.
5. Conduct regular assessments to ensure lighting remains appropriate and causes minimal disturbance.

9.4 Cumulative Impacts Assessment (CIA)

The project is likely to have cumulative impacts when considered together with other existing, ongoing, or planned developments along the Kisumu Malaba corridor. These impacts may be additive, synergistic, or incremental over time.

9.4.1 Objectives CIA

The objectives of CIA include;

- To assess the combined effects of the project alongside other developments.
- To identify Valued Environmental and Social Components (VECs) that could be significantly affected.
- To recommend mitigation and management measures for sustainable development.

9.4.2 Key Projects/Activities for Cumulative Impact Assessment (CIA)

Along the Narok - Kisumu corridor, the SGR project interacts with several other developments that may create cumulative effects: **Table 94** highlight such projects.

Table 95: Projects/ Activities for cumulative impacts

Activities	Examples
Existing Infrastructure	• Road networks (A1, B1 and associated bypasses), managed by either KeNHA, KURA and KeRRA • KPA - Kisumu Port Operations • KPLC, KETRACO powerlines • Tea factories within Kericho, Bomet and Nyamira Counties
Planned or Ongoing Projects	• Urban expansion in Narok, Bomet, Sotik, Sondu and Kisumu • Inland container depots or freight logistics hubs • Utilities: electricity transmission lines, water projects, fibre optic lines • Industrial zones and agro-processing facilities
Environmental Baseline Conditions	• Wetlands (e.g., Lake Victoria catchment areas, River Nyando) • Forested or agricultural landscapes • Densely settled areas with existing transportation pressures

9.4.3 Impacts Identification

Cumulative impacts are heightened in the **Table 96** below.

Table 96: Impacts Identification

Category	Cumulative Impact	Description of Potential Cumulative Impact
Environmental	Habitat Loss & Fragmentation	Combined land-take from SGR, roads, power lines, and urban expansion may reduce wildlife movement corridors and affect wetlands, riparian areas, and agricultural biodiversity.
	Increased Soil Erosion & Sedimentation	Concurrent construction activities (SGR, road upgrades, urban development) can accelerate erosion and increase sediment loads in rivers flowing into Lake Victoria.
	Water Resource Pressure	Water demand from construction camps, agriculture, and municipal supply may cumulatively stress rivers, springs, and groundwater sources.
	Noise & Vibration Levels	SGR operations combined with road traffic, industry, and urban noise may increase overall noise affecting communities along the corridor.
	Air Quality Deterioration	Dust and emissions from construction machinery, vehicles, and industries may jointly degrade air quality, especially in Narok, Bomet, Kisumu.
	Cumulative Waste	Waste from multiple infrastructure projects may exceed

Category	Cumulative Impact	Description of Potential Cumulative Impact
	Generation	county waste management capacity, leading to illegal dumping or pollution.
Social	Land Acquisition Pressure	Sequential land demands from roads, utilities, and SGR may increase displacement risks in densely populated villages.
	Influx of Workers	Worker influx from multiple projects may strain housing, water supply, sanitation, and social amenities, potentially causing conflicts.
	Community Health & Safety Risks	Increased traffic from SGR, trucks, boda bodas, and urban growth may raise accident risks and contribute to health/safety concerns.
	Pressure on Public Services	An expanding project-related population may overwhelm schools, health centres, and county administrative services.
	Cross-Border Impacts (Malaba)	Freight congestion and customs operations combined with SGR/road activities may cause delays, pollution, and social/economic pressure on border communities.
Economic	Synergistic Economic Growth	Interaction of SGR operations, logistics hubs, and agriculture value chains may stimulate broader regional trade and investment.
	Impacts on Small Businesses	Rising land prices and competition for commercial spaces due to multiple projects may displace small-scale traders and farmers.
	Employment Effects	Overlapping project activities may create job opportunities but also expose workers to cumulative risks such as safety hazards or labour disputes.

9.4.4 Cumulative Impact Matrix

Cumulative impacts are classified as **additive**, **synergistic**, or **incremental**. Additive impacts occur when the identified projects, independently combine, resulting in a total effect equal to the sum of individual impacts. Synergistic impacts arise when project interactions amplify the overall effect beyond a simple sum. Incremental impacts are small, gradual changes that, over time, contribute to long-term cumulative effects.

Table 97 below depicts the identified cumulative impacts, SGR and other projects contributions, type of cumulative impacts and the overall significance of each receptor/ impact area.

Table 97: Cumulative Impact Matrix

Receptor / Impact Area	SGR Contribution	Other Projects	Type of Cumulative	Cumulative Significance
Land Use & Land Acquisition	M	H	Additive	High
Habitat Loss & Fragmentation (Wetlands, riparian areas, agricultural landscape)	M	M–H	Synergistic	High
Soil Erosion & Sedimentation (rivers draining to Lake Victoria)	M	M	Additive	Medium–High

Receptor / Impact Area	SGR Contribution	Other Projects	Type of Cumulative	Cumulative Significance
Water Resource Stress (surface & groundwater)	L–M	M–H	Incremental	Medium–High
Surface Water Quality (runoff, sediment loads)	M	M	Additive	Medium–High
Air Quality (dust, emissions)	M	H	Additive	High in urban centers
Noise & Vibration (settlements along corridor)	M	M	Additive	Medium–High
Waste Generation (solid waste from construction, camps, towns)	M	H	Additive	High
Biodiversity (flora & fauna)	M	M	Synergistic	High
Climate Change Contribution (GHG emissions)	L–M	M	Additive	Medium
Traffic Safety Risks (SGR + roads + port + border freight)	M	H	Synergistic	High
Community Health & Safety (disease exposure, accidents, dust, noise)	M	H	Synergistic	High
Worker Influx & Social Pressure	M	M	Incremental	Medium–High
Pressure on Public Services (schools, health centres, housing)	M	H	Incremental	High
Livelihood Disruption (farmers, traders, artisanal activities)	M	M	Additive	Medium–High
Economic Opportunities (trade, logistics, jobs)	H	H	Synergistic (positive)	High Positive
Cross-Border Impacts (Malaba congestion, freight handling)	M	H	Synergistic	High
Cultural Heritage Sites & Community Areas	L–M	M	Incremental	Medium

9.4.5 Cumulative Impact Mitigation and Monitoring Matrix

Table 98 below depicts the identified cumulative impacts, mitigation, Monitoring indicator, frequency and responsibility

Table 98: Cumulative Impact Mitigation and Monitoring Matrix

Cumulative Impact	Mitigation Measures	Monitoring Indicators	Frequency	Responsibility
Habitat Loss & Fragmentation	• Maintain ecological buffer zones and riparian reserves. • Avoid sensitive wetlands and forests through design refinement. • Rehabilitate disturbed areas and implement	• Number of hectares restored. • Compliance with buffer zone requirements. • Species diversity in restored areas.	Periodic	Contractor, Supervising Engineer, County Environment Depts., KWS

Cumulative Impact	Mitigation Measures	Monitoring Indicators	Frequency	Responsibility
	biodiversity offsets. Coordinate with county environment offices on land-use planning.			
Soil Erosion & Sedimentation	- Joint erosion-control plans with road/utility contractors. - Install silt traps, gabions, and contouring structures. - Phase construction to avoid rainy seasons.	- Suspended solids in rivers. - Condition of sediment traps. - Stabilization of embankments.	Frequent	Contractor, Supervising Engineer, WRMA, County Depts.
Water Resource Pressure	- Regulate water abstraction with WRMA permits. - Promote water-saving technologies at camps. - Coordinate abstraction schedules with nearby projects.	- Abstraction volumes vs. permit. - Water levels in rivers/boreholes.	Periodic	Contractor, WRMA, County Water Dept.
Surface Water Quality Degradation	- Implement wastewater management plans. - Use retention ponds for runoff. - Integrate waste controls with nearby industries and projects.	- pH, turbidity, BOD/COD indicators. - Visible pollution incidents.	Frequent	Contractor, NEMA, WRMA
Air Quality Deterioration (Dust, Emissions)	- Wetting of haul roads. - Limit vehicle speeds. - Maintain machinery. - Coordinate haulage routes with KeNHA/KURA.	- Dust levels (PM10/PM2.5). - Complaints recorded.	Frequent	Contractor, Supervising Engineer, County Public Health
Noise & Vibration	- Restrict construction to daytime. - Install noise barriers in urban areas. - Coordinate blasting/rail operations with other projects.	- dB(A) levels near settlements. - Complaints logged.	Frequent	Contractor, Supervising Engineer
Cumulative Waste	Develop integrated waste management plans	Waste volumes generated.	Frequent	Contractor, County

Cumulative Impact	Mitigation Measures	Monitoring Indicators	Frequency	Responsibility
Generation	- with counties. • Use licensed waste collectors. • Reuse/recycle materials where possible.	• Disposal manifests.		Governments, NEMA
Biodiversity Loss	• Implement reforestation/afforestation programs. • Avoid key wildlife crossing points. • Collaborate with KWS on conservation corridors.	• Number of trees planted/surviving. • Wildlife sightings/roadkill incidents.	Periodic	Contractor, KWS, County Environment Dept.

CHAPTER 10.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

10.1 Overview

Environmental and Social Management Plan (ESMP) for development projects provides a logical framework within which identified negative environmental impacts can be mitigated and monitored. In addition, the ESMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. ESMP is a vital output of an ESIA as it provides a checklist for project monitoring and evaluation.

10.2 Purpose and Objectives of ESMP

The purpose of ESMP is to ensure that the environmental and social impacts identified during the ESIA process are effectively managed, mitigated, or enhanced throughout the project lifecycle.

It specifically;

- Outlines specific measures to prevent or reduce possible negative impacts on the environment.
- Ensures the project adheres to Kenyan and international environmental law
- Assigns responsibilities, timelines, and resources for environmental and social risk management.
- Sets out how environmental and social impacts will be tracked, measured, and reported.

10.3 Auditing of the ESMP

Auditing the ESMP critical in ensuring the environmental and social commitments made during project planning and licensing are actually being implemented, and that they are effective in managing impacts throughout the project's lifecycle.

ESMP audit is crucial in;

- Verifying compliance with the ESMP and regulatory conditions as indicated in the NEMA license).
- Assessing effectiveness of mitigation measures, identify any gaps, non-compliance, or new risks.
- Recommending corrective and preventive actions.

10.4 Responsibilities of the ESMP

ESMP assigns clear responsibilities to various actors to ensure effective implementation, monitoring, and compliance with environmental and social safeguards as shown in the **Table 99** below.

Table 99: Actors and tasks in ESMP implementation

Actor	Responsibility
KRC	• Overall accountability for ESMP implementation. • Allocation of budget and resources for mitigation measures. • Ensuring all project phases (design, construction, operation) follow the ESMP. • Submitting compliance reports to NEMA and other regulators.

Actor	Responsibility
Environmental and Social (E&S) Officer /Manager	• Coordinating daily implementation of the ESMP. • Monitoring environmental indicators (dust, noise, waste) and social aspects (grievances, local engagement). • Conducting site inspections, train staff on environmental and safety practices. • Preparing ESMP compliance reports and recommend corrective action
Community Liaison Officer / Social Specialist	• Leading stakeholder engagement and public communication. • Operating the Grievance Redress Mechanism (GRM). • Monitoring and report on any community issues, land access, and cultural concerns.
National Environment Management Authority (NEMA)	• Approving the ESIA/ESMP. • Conducting environmental audits and inspections. • Enforcing compliance with environmental laws and license conditions.
County Governments of Kisumu, Vihiga, Kakamega, Siaya and Busia	• Reviewing and supporting land use approvals, local compliance, and permitting. • Participating in community consultations and conflict resolution where necessary.
Independent Environmental Auditor (if engaged)	• Conducting annual Environmental audits guided by the ESMP. • Providing objective evaluation of the environmental performance of the project and give recommendations.

ESMP outlined in **Table 100** below considers mitigation measures for impacts during site preparation, construction, operation and decommissioning phases of the project respectively.

Table 100: Environmental Social Management Plan (ESMP)

Phase 1: Site preparation and Construction					
Expected Negative Impacts	Recommended Mitigation Measures	Goal	Responsibility for implementation	Time Frame	Cost (KShs)
Loss of land	Documentation of the land acquisition/transfer agreements for the identified pieces of Land.	To ensure that the rightful owners are identified.	Proponent	Before acquisition of the identified land	To be determined from the RAP documents
	Any new land requirements for the project as well as arising grievances shall be handled in line with the Resettlement Action Plan (RAP).	To ensure grievances are identified and adequately addressed.	Proponent	Land take process to be completed before project construction commences.	
Vegetation Clearance/ Clearance of urban and farm trees	- Equipment and tools brought in for reuse from other project sites should be screened and cleaned of alien / invasive propagules to avoid introduction in the project area - Borrow sites should be inspected for invasive and colonizer propagules - Restrict vegetation clearing to demarcated project site boundaries. - Establishment of woodlots on affected farms to help restore tree cover. - Limiting clearing to the smallest area necessary for the project to reduce habitat loss and soil exposure. - Establishment of protective buffers around sensitive habitats.	To minimize ecological disruption and biodiversity loss.	Proponent & Contractor	Continuous	400,000

Phase 1: Site preparation and Construction					
	• Implement tree planting programs to replace cleared trees. • Work with farmers to promote agro forestry initiatives.				
Disturbance of indigenous forests	• Minimize the extent of forest clearance. • Align project elements (e.g. access roads, utility corridors) along disturbed or degraded areas. • Establish and maintain buffer zones around high-value conservation areas, riparian zones, and wetlands. • Safely relocate fauna from the project area in coordination with wildlife authorities, especially for species with limited mobility or breeding grounds. • Restore disturbed areas using native species that match the original forest composition. • Involve local communities in forest protection, replanting, and monitoring initiatives. • Provide support for non-forest-based income activities (e.g., beekeeping, agroforestry, eco-tourism) to reduce pressure on forest resources.	To minimize ecological disruption and biodiversity loss	Proponent & Contractor	Continuous	500,000
Loss of pasture for livestock and wildlife	• Avoid key grazing areas and wildlife habitats during route planning. • Incorporate wildlife corridors and livestock crossings (underpasses and overpasses) to ensure safe and uninterrupted movement to	Reduce negative impacts on rangeland ecosystems, local livelihoods while ensuring the sustainability of the project.	Proponent and contractor	Continuous	1,000,000

Phase 1: Site preparation and Construction					
	pasture areas. • Ensure transparent and timely disclosure of all relevant project information, particularly concerning activities that may affect local communities' rights, land use, and livelihoods. • Support development of fodder banks and irrigated pasture fields for livestock keepers. • Provide advance notice to local farmers, allowing sufficient time for the harvesting of grass. • Compensation where grasslands are unavoidably destroyed due to project activities.				
Oil Spillage	• Develop a site-specific SPCC plan. • Identify high-risk areas and assess potential spill scenarios. • Store oil and fuel in tanks or containers with bunds or drip trays capable. • Conduct fuel transfer and storage activities on concrete or other impermeable surfaces to prevent infiltration into the soil. • Regularly inspect construction machinery for leaks in hydraulic systems, fuel tanks, and lubrication lines. • Ensure that all construction equipment is well-	To protect soil, water resources, human health, and ecosystems.	Proponent and contractor	Continuous	300,000

Phase 1: Site preparation and Construction					
	maintained to prevent accidental leaks. • Provide and strategically locate oil spill response kits on-site and in vehicles. • Train workers on proper fuel handling and spill response procedures. • Use grit chambers, silt fences, and retention ponds to control runoff and filter out pollutants • Collect used oil, grease, and contaminated materials in clearly labeled, sealed containers. • Dispose of used oil and oily waste through licensed hazardous waste handlers				
Environmental degradation of areas where construction materials are sourced.	• Development and implementation of site rehabilitation plans. • Installation of controls to prevent water stagnation, and sites should be securely fenced with warning signage. • Strengthening monitoring and enforcement to ensure contractors comply with restoration obligations post-excavation.	Prevent long-term environmental degradation and supporting post-project land use.	Contractor and NEMA	Continuous	2,000,000
Blasting and rock excavation	• Blasting should be carried out in accordance with a site-specific Blast Management Plan (BMP). • Use of modern blasting techniques to reduce	To minimize the environmental, structural, and social impacts ensuring safety, protecting	Contractor	Continuous	500,000

Phase 1: Site preparation and Construction					
	vibration and flyrock. - Establishment of blast exclusion zones with proper signage and fencing to restrict access during detonation. - Real-time monitoring of vibration and air overpressure levels. - Implementing dust suppression strategies, such as water spraying and wind barriers, should be implemented before and after blasting.	ecosystems, and reducing disturbances to nearby communities.			
Poor disposal of excavated materials and equipment	- Separate excavated materials into reusable and non-reusable/spoiled materials. - Use inert excavated materials for backfilling, slope stabilization, or forming embankments. - Use crushed rock and clean fill in subgrade or roadbed layers. - Transport non-reusable materials to approved dumping sites. - Drain fuel, lubricants, coolant, and hydraulic fluids from decommissioned equipment prior to disposal. - Salvage metals, rubber parts, and electronics for recycling through licensed waste handlers.	To ensure the environmentally responsible and safe disposal, reuse, or management of excavated materials and decommissioned equipment, thereby minimizing environmental degradation, visual pollution, and public health risks.	Contractor	Continuous	800,000
Soil Erosion	- Conduct geotechnical and hydrological assessments to identify erosion-prone zones. - Develop erosion susceptibility maps to inform alignment design, cut-and-fill balances, and	To prevent, control, and minimize soil erosion, thereby protecting land productivity, water quality,	Contractor	Continuous	400,000

Phase 1: Site preparation and Construction					
	drainage planning. • Schedule earthworks during dry seasons to minimize rainfall-induced erosion. • Clear only the areas necessary for construction to preserve natural ground cover and reduce exposure. • Remove and store topsoil separately for reuse in site restoration and landscaping. • Replant native grasses, shrubs, or fast-growing groundcover species as soon as construction is complete in each section. • Construct gabions, rock bunds, or retaining walls on high embankments and cut slopes. • Construct lined channels, culverts, cross-drains, and side drains to manage surface runoff efficiently. • Install temporary sediment traps or check dams to capture soil before it enters watercourses. • Create holding ponds to allow sediment to settle before water is released downstream. • Compact loose fill and embankments to reduce susceptibility to erosion by water and wind. • Confine heavy equipment movement to designated paths to avoid unnecessary soil compaction and disturbance.	and surrounding ecosystems.			

Phase 1: Site preparation and Construction					
Slope Destabilization	- Minimize the number of cut-and-fill earthworks by optimizing rail alignment and grading plans. - Use mechanically stabilized earth (MSE), geogrids, and retaining walls to support cut slopes and embankments. - Employ soil nails, rock bolts, or micropiles to provide deep anchoring in unstable slopes. - Install subsurface and surface drainage (e.g., French drains, interceptor ditches, and weep holes in retaining walls) to prevent water accumulation that weakens soil.	To prevent and manage slope destabilization in order to ensure structural safety, protect the environment, and minimize risks to human life and property.	Contractor	Continuous	500,000
Generation of exhaust emissions	- Retrofit older machinery with emission control technologies such as diesel particulate filters (DPFs) and oxidation catalysts. - Use electric, hybrid, or Compressed Natural Gas (CNG)-powered equipment where feasible, particularly in enclosed or urban areas. - Utilize ultra-low sulfur diesel to reduce sulfur dioxide and particulate emissions. - Store fuels in sealed, labeled tanks to prevent evaporation losses and reduce fugitive emissions - Implement a strict maintenance schedule to ensure that engines operate at optimal efficiency and with minimal emissions. - Enforce anti-idling policies for machinery and vehicles (e.g., limit idling to 3–5 minutes) to	To minimize the generation and impact of exhaust emissions from machinery, vehicles, and equipment in order to protect air quality, human health, and the environment.	Contractor	Continuous	450,000

Phase 1: Site preparation and Construction					
	reduce unnecessary fuel combustion. • Avoid engine overloading by matching the size and capacity of machinery to the task, ensuring efficient operation. • Implement phased construction to limit the number of machines operating simultaneously and reduce peak emissions. • Source materials (e.g., ballast, sand, steel) locally to reduce long-distance transport and associated emissions. • Use efficient routing and scheduling for material delivery to avoid congestion and repeated trips. • Establish ambient air monitoring stations near sensitive areas to track PM₁₀, PM_{2.5}, and NO_x levels during construction. • Keep records of equipment types, fuel use, and hours operated to estimate and report construction-phase emissions				
Climate change	• Minimize vegetation clearance by optimizing the construction corridor and integrating natural landscape features into the design where possible. • Implement carbon offset measures, such as reforestation or afforestation programs. • Ensure all construction equipment meets emission standards and promote the use of low-emission fuels or electric-powered	To reduce the contribution of the project to climate change and enhance its resilience to climate-related impacts by minimizing greenhouse gas (GHG) emissions, promoting sustainable practices, and integrating climate adaptation strategies.	Contractor	Continuous	550,000

Phase 1: Site preparation and Construction					
	machinery where feasible. • Develop integrated waste management plans in collaboration with local authorities. • Incorporate climate resilience and low-carbon strategies into regional development planning to ensure that induced growth does not exacerbate environmental degradation				
Dust Emission	• Clear only the areas required for immediate work to reduce the amount of exposed, dust-prone soil. • Apply water to loose soil prior to and during earthworks (excavation, grading, backfilling) to suppress dust at the source. • Regularly spray water or non-toxic dust suppressants on access and haul roads, especially during dry or windy conditions. • Enforce low speed limits (e.g., <20 km/h) for construction vehicles on unpaved surfaces to minimize dust uplift. • Where feasible, pave or gravel main site access roads to reduce dust from vehicle movement. • Minimize drop heights when loading or unloading fine materials like sand or ballast, and use enclosed conveyors or hoppers when available. • Store loose construction materials such as cement, sand, and aggregates in enclosed or covered facilities.	To protect human health, reduce environmental degradation, and ensure regulatory compliance.	Proponent and Contractor	Continuous	400,000

Phase 1: Site preparation and Construction					
	• Use tarpaulins or fitted covers on trucks transporting dusty materials. • Apply water spray during demolition, concrete cutting, and rock drilling to suppress dust at the point of generation. • Equip drilling and grinding equipment with vacuum or extraction systems to capture fine particles. • Install PM₁₀ and PM_{2.5} monitors at sensitive locations (e.g., residential areas, schools, hospitals) to track ambient dust levels.				
Hydrology and water quality degradation	• Install geotextile silt fences or sediment traps around exposed soils, stockpiles, and drainage paths to intercept suspended solids. • Construct temporary settling basins to capture and treat stormwater runoff from construction areas before discharge into natural water bodies • Build lined and diversion ditches to redirect clean runoff away from construction zones. • Install check dams along drainage channels on slopes to reduce flow velocity and trap sediments. • Design site grading to control surface runoff direction and volume to avoid erosion and water body contamination. • Locate fuel and maintenance areas at least 50 m away from watercourses and provide impervious, bunded surfaces with oil-water	To preserve natural hydrological systems and prevent the degradation of surface and groundwater quality during and after the implementation of the project, ensuring the sustainability of water resources for ecosystems and communities.	Proponent	Continuous	400,000

Phase 1: Site preparation and Construction					
	separators. • Store fuels, lubricants, and chemicals in leak-proof containers within secondary containment systems. • Maintain spill kits on-site and train personnel in emergency spill response. • Provide portable sanitation facilities for workers, located away from water bodies and serviced regularly. • Treat wastewater from concrete batching, equipment washing, or drilling using sediment traps or pH neutralization before discharge. • Prohibit direct discharge of untreated wastewater or sewage into rivers, lakes, wetlands, or groundwater. • Store construction materials on impervious surfaces under cover to prevent contact with rainwater. • Cover soil and spoil stockpiles with tarpaulin and place them away from drainage paths and watercourses. • Maintain buffer zones (e.g., 30 meters) along rivers and streams to act as natural filters. • Avoid construction in or near wetlands; where unavoidable, apply wetland restoration and compensation measures. • Regularly test parameters such as turbidity, pH, oil & grease, BOD/COD, nitrates, and coliforms in nearby surface and groundwater.				

Phase 1: Site preparation and Construction					
Storm water drainage management	• Develop a comprehensive stormwater management plan that incorporates proper grading. • Install appropriately sized and aligned drainage infrastructure. • Regular maintenance of drainage pathways during construction, and erosion control measures. • Integrate hydrological modeling in the design phase.	To manage stormwater effectively during and after the construction phases in order to prevent flooding, erosion, waterlogging, and pollution, thereby protecting infrastructure, ecosystems, and community health.	Contractor	Continuous	300,000
Solid Waste Generation	• Prioritize options of waste reduction, reuse and recycling. • Soil emanating from excavations will be reused for landscaping followed by revegetation of the landscaped areas. • Food waste can be disposed in a composite pit as it can degrade and enrich the soil. • No burning of waste onsite • Contract a NEMA certified waste collection firm to collect solid waste for disposal	To minimize the amount of waste produced, ensure safe handling, storage, disposal, and prevent health hazards	Proponent and Contractor	Continuous	300,000
Noise and vibrations	• Plan high-noise activities during daytime hours (e.g. 08:00–17:00) to minimize impact on nearby communities • Use new or well-maintained machinery designed with noise-reducing features (e.g. mufflers, silencers, acoustic enclosures). • Use electric or hydraulic-powered tools instead of pneumatic tools to reduce noise and vibration	To manage and reduce noise and vibration impacts, safeguard public health, ensure a safe working environment and maintain regulatory compliance.	Proponent and Contractor	Continuous	530,000

Phase 1: Site preparation and Construction					
	• Erect movable noise barriers (e.g. acoustic curtains, sound-insulating panels) around high-noise equipment like generators and compressors. • Install acoustic enclosures for stationary noise sources such as concrete mixers, batching plants, and power units. • Avoid operating multiple high-noise machines simultaneously near sensitive areas. • Position equipment and haul roads away from populated areas whenever possible. • Implement traffic management plans to reduce vehicle idling and control speeds on site to reduce noise and vibration from transport. • Use vibration isolation pads, trench barriers, or matting under machinery to reduce transmission. • If blasting is necessary, use controlled methods (e.g., pre-split or cushion blasting) and time it to avoid peak community activity. • Install real-time monitoring devices at key sensitive locations to measure dB(A) levels and vibration (PPV – Peak Particle Velocity).				
Loss of Grazing Land	• Designing livestock underpasses or overpasses at strategic locations to facilitate safe crossing and maintain grazing continuity. • Incorporating community grazing access corridors in the railway layout to minimize	To minimize the adverse impacts of the on grazing land by preserving access to rangelands, restoring disturbed areas, and supporting the livelihoods of affected livestock-keeping	Proponent and Contractor	Continuous	300,000

Phase 1: Site preparation and Construction					
	disruption to migratory routes. - Establishing participatory rangeland management plans with local stakeholders to ensure sustainable pasture use during and after construction. - Implementing fencing safety protocols and clear signage to reduce the likelihood of livestock-train collisions.	communities			
Disruption of Public Utilities	- Coordinate with utility service providers and local authorities to map existing underground and overhead infrastructure accurately, - Avoid service interruptions, and adhere to safety and regulatory standards during relocation activities. - Integrated comprehensive surveys and utility mapping, coupled with robust monitoring frameworks. - Engage utility agencies early in the planning phase to identify vulnerable infrastructure and agree on protocols for relocation or protection. - Prepare detailed relocation plans approved by utility providers and schedule works during off-peak hours or planned outages. - Install protective barriers, sleeves, or	To prevent, minimize, and promptly address disruptions to public utilities (such as water supply, electricity, telecommunications, and sewerage systems), ensuring continued access to essential services for communities and businesses.	Proponent and Contractor	Continuous	600,000

Phase 1: Site preparation and Construction					
	encasements around utilities that are close to excavation or piling activities. - Clearly mark utility corridors on the ground and in site drawings to prevent accidental damage by construction crews. - Set up a system to receive, document, and resolve complaints regarding service disruptions quickly.				
Poor site management and control leading to accidents and incidences	- Nominate persons with defined responsibility for EHS - Through relevant training, ensure everyone on site is aware of their responsibilities and liabilities with respect to the environment. - Through site induction, make staff and visitors aware of Project environmental issues and environmental standards. - Display warning signs at key work sites prominently. - Avail environmental policy at the site - Provide adequate security at the site to protect primary work sites against vandalism, theft and breakage.	To ensure the operations are safe, environmentally responsible, efficient, and compliant with regulatory standards.	Proponent	Continuous	200,000
Road Accidents	- Any abnormal loads for the project must be transported in line with the traffic rules, including public notification and use of escort cars. - Sensitize project staff on risks of over speeding while on site	To safeguard lives and ensure safe transport operations.	Proponent and Contractor	Continuous	100,000

Phase 1: Site preparation and Construction					
	Erect warning signs for approaching drivers at the points of entry to the project site				
Disputes over employment	- Develop a grievance management system to manage grievances arising from the local labour force - Develop local labour recruitment plans, including disclosure of opportunities and partnership building with local support agencies / institutions.	To prevent conflicts, foster community trust, and ensure compliance with labor laws.	Proponent	One -Off	300,000
Phase 2: Operations Phase					
Expected Negative Impacts	Recommended Mitigation Measures	Goal	Responsibility for implementation	Time Frame	Cost (KShs)
Liquid Waste Generation	- Construction of septic tanks in areas not served by sewer lines to serve as a primary treatment unit. - Proper design, sizing, and maintenance of liquid waste management systems to ensure their effectiveness and to prevent contamination of groundwater resources. - Periodic monitoring and desludging schedules should be established as part of a comprehensive wastewater management plan. - Regularly inspecting drainage systems, separators, and treatment facilities.	To ensure safe, compliant, and environmentally sustainable handling, treatment, and disposal of all liquid waste generated.	Proponent	Continuous	1,000,000

Phase 1: Site preparation and Construction					
Oil Spillage	• All maintenance and fueling activities should be conducted on impermeable, bunded surfaces equipped with oil-water separators to prevent direct infiltration and runoff. • Drip trays, catchment basins, and covered storage should be employed to collect incidental leaks and spills, particularly in high-risk areas. • A grit chamber/pretreatment system should be installed to facilitate the settling of suspended solids and initial separation of hydrocarbons from wash water and stormwater runoff. These chambers should be regularly monitored and cleaned to maintain operational efficiency. • Recovered oil and oily residues should be handled as hazardous waste and appropriate disposal methods used including selling the waste oil to licensed recyclers or re-refiners. • Install high-temperature incineration in approved facilities, which ensures complete combustion of organic compounds and prevents groundwater contamination • Conduct regular environmental audits, soil and water quality assessments, and hydrocarbon concentration monitoring, particularly in	To prevent, control, and effectively respond to oil spills in order to protect soil, water resources, ecosystems, and public health.	Proponent	Continuous	900,000

Phase 1: Site preparation and Construction					
	drainage pathways leading from the rail yard. Personnel should be trained in spill response protocols, and spill kits must be readily accessible at all maintenance and fueling stations.				
Pollution of Vegetation	- Adopt low-emission or hybrid locomotives to significantly reduce combustion-related pollutants. - Routine inspection and maintenance of engines to ensure optimal combustion efficiency. - Utilize Ultra-Low Sulfur Diesel (ULSD) to directly reduce sulfur dioxide emissions, thereby decreasing the risk of acid rain formation. - Implementation of after-treatment systems such as diesel oxidation catalysts (DOCs), particulate filters, and selective catalytic reduction (SCR) units to substantially reduce NO_x and PM emissions from diesel engines. - Establishment of green buffers along the railway corridor to serve as biofilters for airborne pollutants, while also providing aesthetic and ecological benefits. - Conduct continuous ambient air quality monitoring near sensitive ecological zones to	To prevent and minimize the degradation, contamination, or destruction of vegetation, ensuring the preservation of biodiversity, ecosystem functions, and community resources.	Proponent	Continuous	800,000

Phase 1: Site preparation and Construction					
	track pollutant levels and assess the effectiveness of mitigation measures.				
Loss of vegetation during wayleave maintenance	- Develop a site-specific Vegetation Management Plan (VMP) that incorporates biodiversity conservation objectives, prioritizes native species, and outlines treatment thresholds. - Establish vegetative buffer zones using low-growing, native plant species that do not interfere with infrastructure but support ecological functions. - Regular ecological assessments should be conducted to track the effectiveness of vegetation control measures and adapt strategies to evolving site conditions.	To minimize the loss of vegetation during the maintenance of wayleaves (railway corridors), while promoting ecological integrity, preventing land degradation, and supporting sustainable land use.	Proponent	Continuous	800,000
Air Emissions	- Employ advanced engine technologies with Diesel Particulate Filters (DPFs), and selective catalytic reduction (SCR) systems to reduce NO_x and PM emissions. - Application of water sprays, chemical suppressants, and use of covered conveyors or enclosed handling facilities to reduce particulate matter during material transport and transfer operations. - Implementing leak detection and repair (LDAR) programs, utilizing vapor recovery systems during fuel storage and transfer, and	To reduce and manage air emissions generated in order to protect air quality, safeguard public health, and contribute to climate change mitigation efforts.	Proponent	Continuous	800,000

Phase 1: Site preparation and Construction					
	maintaining sealed containment areas to limit VOC releases. ○ Continuous ambient air quality monitoring near sensitive receptors and rail yard boundaries should be conducted to inform adaptive management				
Solid Waste Generation	● Implement a comprehensive Waste Management Plan (WMP) encompassing waste minimization, segregation, and recycling strategies; ● Training of staff and public awareness campaigns to reduce littering and promote responsible waste disposal; ● Regular monitoring and cleanup operations within and around rail facilities and protected areas; ● Provision of adequate infrastructure for waste containment and environmentally sound disposal or recycling of hazardous materials; ● Engagement with licensed waste handlers for safe disposal of hazardous wastes such as oils, solvents, and batteries in compliance with local regulations and international best practices.	To ensure the effective management, reduction, and safe disposal of solid waste generated, in order to protect public health, the environment, and maintain cleanliness along the railway corridor and facilities.	Proponent	Continuous	700,000

Phase 1: Site preparation and Construction					
Hazardous Materials	- Establish and enforce standard operating procedures (SOPs) for the safe storage, handling, and disposal of solvents, coolants, acids, and alkalis to minimize exposure risks and environmental release. - Conduct thorough inspections and material audits to identify equipment containing PCBs and asbestos. Maintain an updated inventory to support risk assessment and management planning. - Engage licensed hazardous waste contractors for the safe removal, transport, and disposal of PCBs - Ensure maintenance personnel are equipped with appropriate PPE and are trained in handling hazardous substances and emergency response protocols	To ensure the safe handling, storage, transportation, and disposal of hazardous waste generated in order to protect human health, the environment, and comply with regulatory requirements.	Proponent	Continuous	1,000,000
Wildlife and Livestock accidents due to breached fence	- Conduct wildlife movement and behavior studies to identify high-crossing zones and optimize the placement of underpasses. - Utilize fencing materials that balance strength, flexibility, and visibility to reduce damage by animals and humans. - Design underpasses with appropriate dimensions, lighting, and natural substrate to encourage regular animal use.	To prevent and minimize accidents involving wildlife and livestock along the SGR corridor caused by breaches or failures in fencing, thereby protecting animal life, enhancing railway safety, and supporting coexistence with surrounding communities and ecosystems.	Proponent	Continuous	900,000

Phase 1: Site preparation and Construction					
	- Implement regular fence inspection and maintenance schedules to promptly repair breaches and maintain barrier effectiveness. - Engage local communities and stakeholders in awareness programs to minimize human interference with fencing infrastructure.				
Noise and Vibration	- Ensure smooth rail surfaces through regular grinding and alignment to reduce dynamic impacts. - Use of continuously welded rail (CWR) instead of jointed track minimizes impact vibrations. - Use ballast mats, under-sleeper pads, or floating slab track systems to absorb and dissipate vibration energy before it transmits to the ground. - Use resilient track fasteners reduce the stiffness of the rail-to-tie connection and mitigate high-frequency vibration. - Set speed limits in vibration-sensitive zones to significantly reduce both the amplitude and frequency of vibration. - Schedule freight or heavy trains during daytime hours to help reduce nighttime disturbance.	To minimize the impact of noise and vibration generated on nearby communities, wildlife, and infrastructure, ensuring environmental compliance, public comfort, and structural integrity.	Proponent	Continuous	900,000

Phase 1: Site preparation and Construction					
	• Maintain appropriate setback distances between the railway and residential or sensitive land uses to prevent significant impacts. • Conduct noise and vibration monitoring to establish baseline levels and assess the effectiveness of mitigation measures as per EMCA (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009. • Workers performing in noisy working environment shall be provided with suitable ear protectors based on the expected noise levels • Undertake pre-employment and periodic audiometric testing for staff exposed to occupational noise risks to monitor the sharpness and acuity of an employee's hearing over time. This will be in line with OSHA (Medical Examination) Rules, 2005; • Servicing of stand by generators and other equipment to ensure they are maintained at optimal working conditions to minimize the noise that will be generated.				

Phase 1: Site preparation and Construction					
Climate change	• Adoption of low-emission locomotives, including electrified rail systems or hybrid alternatives to diesel engines. • Energy-efficient station infrastructure, powered by renewable energy sources (e.g., solar PV systems). • Implementation of solid and liquid waste management systems, including biogas digesters, composting units, and wastewater treatment plants to reduce methane and nutrient emissions. • Afforestation or reforestation programs to offset unavoidable emissions and enhance carbon sequestration. • Integration of climate risk assessments into infrastructure design to ensure climate-resilient development and reduce vulnerability to climate variability.	To reduce greenhouse gas emissions and enhance climate resilience, contributing to national and global efforts to combat climate change while ensuring the sustainability of railway services.	Proponent	Continuous	700,000

Phase 1: Site preparation and Construction					
Impacts on water quantity	• Ensure that water is used efficiently at the railway stations by sensitizing staff to use water efficiently and avoid irresponsible water wastage. • Install water-conserving automatic taps and toilets • Any water leaks through damaged pipes and faulty taps shall be fixed promptly. • Employ water recycling and re-use, explore rain water harvesting at railway stations.	To ensure efficient use, management, and protection of water resources, reducing wastage and preserving water availability for ecosystems, communities, and future use.	Proponent	Continuous	700,000
Flooding/water ponding	• Conduct detailed hydrological and hydraulic modeling to identify all-natural drainage pathways, seasonal water flows, and potential flood zones. • Integrate appropriately sized and strategically placed culverts, box drains, or small bridges along the embankment to allow unimpeded flow of water. • Ensure drainage structures are designed to handle peak flows based on historical flood data and climate change projections. • Use erosion-resistant materials such as riprap or geotextiles on embankment slopes to prevent soil loss due to water action. • Consider vegetative stabilization techniques to improve slope integrity and absorb runoff.	To prevent and reduce the risk of flooding in order to protect infrastructure, ensure passenger and worker safety, and safeguard surrounding communities and ecosystems.	Proponent	Continuous	800,000

Phase 1: Site preparation and Construction					
	- Implement a maintenance schedule to inspect drainage structures for blockages or sedimentation and monitor embankment stability, especially during and after heavy rainfall. - Ensure that natural flow regimes are maintained to protect downstream ecosystems and avoid waterlogging upstream agricultural or residential areas.				
Ground and surface water contamination	- Install septic tanks or sewage treatment systems at stations and staff facilities. - Ensure treated effluent meets NEMA discharge standards before release into the environment. - Regularly maintain wastewater systems to prevent overflows and leakages. - Construct stormwater drains that direct runoff away from sensitive areas. - Monitor surface and groundwater quality near stations and yards for signs of contamination (e.g., oil, heavy metals, pH, nitrates). - Refueling and maintenance of wagons, vehicles and equipment in designated bunded areas. - Use of drip trays, bunded storage, and spill kits on site, to minimize the potential for releases and spills of oils and other liquids. - Use of silt traps and other measures to control	To protect surface and underground water resources from pollutants that may be introduced during railway operations.	Proponent	Continuous	500,000

Phase 1: Site preparation and Construction					
	silt laden run off from sites, especially during the rainy season.				
Visual Impacts from Night time Lighting	- Night lighting should be shielded or designed to prevent any adverse impacts of offsite glare. - Use low-pressure sodium lights/lighting - Minimize light trespass and over illumination by limiting lighting to only those areas necessary - Use light activation mechanism (or assign as a responsibility to project staff) to ensure that lights are on only when needed - Use shrouds, low brightness fixtures with optical controls and other methods of shielding to control direct and stray lighting effects.	To reduce visual impact while maintaining safety and compliance.	Proponent and Contractor	Continuous	300,000
Energy Consumption	- Use energy-efficient lighting (e.g., LED) in stations, offices, and maintenance yards. - Install motion sensors and automatic timers for lighting and air conditioning in low-traffic areas. - Equip buildings with insulation and passive design features to reduce heating and cooling needs. - Regularly maintain locomotives and equipment to ensure fuel and energy efficiency. - Install solar panels at stations, signal systems, and maintenance yards for lighting and low-load applications.	To make project operations more efficient, cost-effective, and environmentally sustainable.	Proponent	Continuous	2,000,000

Phase 1: Site preparation and Construction					
	Introduce or upgrade to electric or hybrid locomotives, where infrastructure allows.				
Occupational Health & Safety of workers and visitors	- Ensure compliance with all standards and legally required health and safety regulations as per OSHA, 2007 revised in 2010. - Attach a full-time qualified safety and Health Officer - Provision of a standard First Aid kit and serviced Fire extinguishers at the railway stations at all times and train first aiders - Establish Occupational Health and Safety Committee - Undertake fire drills and statutory safety inspections and audits. - Develop specific emergency response plan and procedures - Proper servicing of the generators and other mechanical equipment - Maintain an accident register and carry out accident and incidents investigations and implement corrective actions, - Installation and maintenance of warning signage and emergency contacts at appropriate locations depending on the hazards.	To protect the health, safety, and well-being of workers, prevent accidents and injuries.	Proponent	Continuous	1,500,000
Phase 3: Decommissioning					
Expected Negative Impacts	Recommended Mitigation Measures	Goal	Responsibility	Time Frame	Cost (KShs)

Phase 1: Site preparation and Construction					
Solid Waste Generation	• Conduct a waste audit and hazardous material survey prior to demolition to identify potential sources and ensure proper waste segregation. • Implement an effective containment and management strategies for demolition waste stockpiles to minimize leachate generation. • Establish buffer zones around any water bodies and groundwater extraction points to close to the site to prevent contamination. • Emphasize the recycling and repurposing of inert materials such as concrete and metals to reduce the volume of waste requiring disposal and mitigate environmental impacts.	To minimize the generation and environmental impact of solid waste by promoting safe removal, reuse, recycling, and responsible disposal of materials.	Proponent Contractor	During decommissioning	1,200,000
Air Pollution from dust generation	• Apply dust suppression techniques e.g., application of water sprays at active demolition sites. • Use of Personal Protective Equipment. • Site Management Practices e.g. scheduling demolition during favorable conditions to minimize dust dispersion (e.g., avoiding high winds). • Installation of physical barriers such as screens or fencing to contain dust within the demolition zone.	To minimize the release of harmful airborne pollutants.	Contractor	During decommissioning	600,000

Phase 1: Site preparation and Construction					
	• Deployment of particulate matter (PM10 and PM2.5) monitoring stations around the demolition site to assess dust levels. • Informing and coordinating with neighboring residents and businesses regarding demolition schedules and mitigation efforts to manage expectations and minimize disruption. • Comply with the provisions of Environmental Management and Coordination (Air Quality) Regulations, 2024				
Oil Spills	• Prepare plans and procedures for proper storage and handling of any waste oil. • Comply with the provisions of EMCA (Waste Management) Regulations, 2024	To prevent environmental contamination from oil spills.	Contractor	During decommissioning	200,000
Noise Pollution	○ Comply with the provisions of EMCA (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 regarding noise limits. ○ Utilize modern, well-maintained demolition equipment equipped with noise reduction features such as mufflers and silencers. ○ Implement time restrictions to limit demolition activities to daytime hours, minimizing disturbance during early mornings, evenings, and nighttime. ○ Conduct pre-demolition structural assessments of any nearby buildings to identify	To reduce noise disturbances and uphold legal compliance.	Contractor	During decommissioning	500,000

Phase 1: Site preparation and Construction					
	vulnerabilities. ○ Inform local communities and stakeholders in advance about demolition schedules and expected noise levels. ○ Establish a grievance mechanism to address concerns promptly.				
Site degradation	○ Implement an appropriate landscaping and re-vegetation programme to restore the site to its original status. Consider use of indigenous plant species in re-vegetation.	To prevent and minimize environmental degradation through sustainable land restoration, pollution control, and landscape rehabilitation, ensuring the land is safe, stable, and suitable for future use.	Proponent and Contractor	One -Off	700,000

10.5 Chance Find procedures for Archaeological and Cultural Heritage

Chance Find Procedures (CFP) are essential protocols designed to protect archaeological and cultural heritage that may be unexpectedly discovered during different activities within the railway project corridor, mainly during excavation.

The main purpose is to establish a systematic procedure for handling unexpected discoveries of cultural heritage, including artifacts, fossils, human remains, or structures, during site preparation, construction or decommissioning activities.

Chance find may include any previously unknown:

- Human remains or burial sites
- Stone tools, pottery, or ceramics
- Fossils or bones
- Structures (e.g., foundations, walls, wells)
- Sacred or ceremonial objects

Responsibility and Training

- The Contractor is responsible for enforcing the CFP through training of site workers on:
 - What constitutes a chance find
 - Steps to take if one is discovered
 - Reporting lines and documentation

Table 101 below indicates procedures to be undertaken in case of a chance find during project activities.

Table 101: Step-by-Step Procedure for a Chance Find

Step	Action
Stop Work Immediately	All activities must cease in the immediate area of the find. Secure the area to prevent further disturbance.
Notify Supervisor	The discoverer must inform their immediate supervisor and the Environmental/Social Officer.
Record the Find	Document the location using GPS, take photographs, and describe the find (type, size, condition).
Report to Authorities	The Site Manager must notify the relevant national heritage authority within 24–48 hours.
Protect the Site	Establish a buffer zone (e.g., 10–30 m radius) with visible markers or fencing and prevent unauthorized access.
Assessment by Experts	Authorities or appointed archaeologists will inspect and assess the find.
Decision and Clearance	Based on the assessment:

10.6 Responsibility and Accountability for ESMP

The Environmental and Social Management Plan (ESMP) contains the schedule for implementing the mitigation measures for impacts identified for the proposed project. It includes the identified environmental and social parameters, indicators, monitoring frequency, assigns monitoring responsibility and associated costs.

The Proponent will utilize the existing arrangements in the implementation of the ESMP during planning and design, construction, operation and decommissioning phases. The Proponent is accountable for ensuring that resources are made available to effectively implement the ESMP and necessary environmental management measures arising from the proposed project. The contractor will oversee and take responsibility of the day to day running of the project while the EHS Manager will oversee the detail of implementation of the ESMP for the project phases. Environmental monitoring will be undertaken by the EHS specialists and independent audits of environmental performance will be conducted from time to time by independent NEMA approved environmental experts. **Table 102** below provides details on the functions of each staff member.

Table 102: Responsibilities of various staff Implementing the Project ESMP

Position	Responsibility
Proponent	- Overall, in charge of the project. - Schedule preparation and resource forecasting for both technical non-technical activities relating to the project.
Environmental Specialists	- Conducting environmental monitoring, preparation of environmental monitoring reports and any permit applications (if any) - Running of day-to-day requirements for EMP implementation - Supervising monitoring and review of EMP implementation by contractors.
Health and Safety Expert	- Monitor and promote HSE work practices within all the operational sites - Monitor HSE process and equipment availability and safe operations. - Safety and Environmental awareness creation to all workers within the project.
Community Liaison Officer	- Implementing community engagement strategies and overseeing all community liaison related matters - Management of emerging community matters - Liaison with the appropriate company personnel to ensure that community grievances are tracked, reported and responded to accordingly as necessary
Contractor	- Undertake development of project activities in accordance with contract signed with the Proponent - Ensure strict adherence to the project ESMP requirements, - HSE policies/procedures and other legal requirements in regard to the project

10.7 Training, Awareness and Capacity Building

The Proponent will ensure that project supervisors, managers, general staff, contractors and

community surrounding the project are inducted on health, safety, environmental and emergency response procedures. The Proponent will use written (EHS code of conduct/newsletter/posters/toolbox talks/ brochures) and verbal (as part of routine briefings) communication methods to raise awareness on a range of health, safety and environmental issues. This will be done in both Kiswahili and English languages (as appropriate) to ensure that all members of the workforce are made aware of the aspects of the ESMP.

The training components shall include but not limited to:

- Operational legislative frameworks detailing all applicable laws, regulations, standards and technical guidelines in work aspects that will affect environmental compliance
- Policies and procedures to be followed by the proponent and contractors applicable to the project
- ESMP as the tool and key document for project environmental compliance and associated documents including EHS and ERP among others
- Environmental monitoring and surveillance for ESMP implementation
- Documentation, record keeping and reporting procedures for ESMP related aspects
- Awareness creation methods, information packaging and communication procedures for ESMP purposes
- Complaints handling and good relationship nurturing with other stakeholders' local communities
- The economic and social cultural contexts and behavior of local communities in the within the project area.

CHAPTER 11.0 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

Environmental and social monitoring is key in any project implementation for it ensures that project activities comply and adhere to environmental laws/standards provisions. Environmental and social monitoring also ensures that mitigation measures are implemented and that they are effective. New and developing issues of concern are also addressed during the Environmental and social monitoring. The activities and indicators that have been recommended for monitoring are presented in the **Table 97** below.

The environmental monitoring program will operate during all the project phases and will include visual observations, selection of environmental parameters, sampling and regular testing of environmental parameters.

It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures proposed in the EMP. The parameters of the proposed railway project identified for monitoring include; vegetation, water quality, air quality, solid waste generation, occupational health and safety risks, wildlife/livestock/human accidents, AIDS/HIV incidence, Soil erosion, resettlement and livelihood and environmental risks/ hazards.

11.1 Internal Monitoring

It is the responsibility of the proponent to conduct regular internal monitoring of the project to verify the results of the Contractor and to audit direct implementation of environmental mitigation measures contained in the ESMMP and construction contract clauses for the Project.

The proponent also has direct responsibility to implement and monitor land acquisition and compensation issues arising from project. The monitoring should be a systematic evaluation of the activities of the operation in relation to the specified criteria of the conditions of approval.

The objective of internal monitoring and audit will be:

- To find out any significant environmental hazards and their existing control systems in place.
- Meeting the legal requirements as stipulated in EMCA and international standards.
- To come up with corrective actions to identified non-conformities to ensure adherence to the Environmental Management Plan

11.2 External Monitoring and Evaluation

NEMA has the overall responsibility for issuing approval for the Project and ensuring that their environmental guidelines are followed during Project implementation. Its role therefore is to review environmental monitoring and environmental compliance documentation submitted by the implementing authorities and they would not normally be directly involved in monitoring the Project unless some specific major environmental issue arose.

Table 103: Environmental Social Monitoring plan (ESMP) of the Proposed Project

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
Land acquisition	Land take for railway line construction.	Land size taken	Compensation documents	Inventory of PAPs	Quarterly	KRC
Livestock accidents	Habitat fragmentation, broken fences, proximity to feeding and watering areas	Number of animals knocked down by the trains, type of animals knocked, locations where they are knocked	Frequency/number of accidents reported.	Reports and complains raised.	Continuous during the project cycle	KRC
Soil Erosion	Vegetation clearance, delayed rehabilitation,	Soils eroded, Turbidity in storm water, sources and causes, e.t.c	Evidenced eroded areas	Reports and observed eroded areas	Continuous	KRC
Vegetation Disturbance Visual intrusion; Insecurity and Illegal Harvesting of Wild Products	Vegetation clearance, excessive harvesting of sand and other resources	% cover Vegetation cover and wildlife habitat.	No. of Trees felled; Areas of land cleared; Identified invasive species Number of seedlings replanted.	Inventory of vegetation baseline	Weekly	KRC
Noise and Vibration Impacts	Heavy construction machinery, blasting, delivery vehicles, trains wagons	dB and m/s	Noise levels monitoring data & Complaints log	Noise level measuring	Continuous	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
Air pollution	Different machinery, backup generators, open burning,	TSP, NOx, SO2, CO, Dust particles, particulate matter, e.t.c	Daily water uses for dust sprinkling; Safety induction records. Air Quality records Records on issuance and use of PPEs	Measure concentrations of particulate matter, TSP, NOx, SO ₂ and CO ₂	Continuous	KRC
Generation of Waste	Wrappings, excavated soil, cement bags,	Spoils, domestic refuse, scrap metal	Disposal sites	Site inspections / observations	Quarterly	KRC
Increased Demand for Water	Construction, cleaning of premises, dust suppression,	Rate of consumption	Consumption records Complains from other water users	Inspection of meter readings Observation of water levels	Continuous	KRC
Occupational and Public Health and Safety Impacts	Accidents from general works, site clearance, train accidents, oil spillage, hazardous waste handling	Job safety analysis	JSA Report by a qualified OSH Advisor		Once contractor takes possession of the site	KRC
		Health and safety action plan	Community sensitization and participation in Community health	Consultations of sample of the Project area communities	Quarterly	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
			and safety			
			Health and Safety Personnel	One on One Interview with the H&S Personnel	Once contractor takes possession of the sites	KRC
		Emergency Preparedness and Response Plan (EPRP)	EPRP as approved by the RE	Inspection of records	After conduct of a JSA	KRC
			Community awareness posters/ warnings Participation of response activities by the community	Community sensitization in their participation in community health and safety	Quarterly	KRC
		Registration of the workplace	Work place registration permit	Inspection of records	After conduct of a JSA	KRC
		Accidents and incidents	Number of accidents and incidents register	Inspection of incident reports	Quarterly	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
			Community complaints related to road accidents and incidents	Consultations of sample of the project area communities	Quarterly	KRC /DOSHS
		Safety training for workers	Training plans, Training Reports, Attendance list	Inspection of records	Quarterly	KRC
			Feedback Reports on Training from staff Attendance sheets	Inspection of records	Quarterly	KRC
			Staff awareness on health and safety issues Staff use of appropriate PPE Reduced accidents and incidents on site	Observation and interviews with a sample group of staff	Quarterly	KRC
		Awareness posters on identified risks and responses in case of emergency	Physical posters	Observation	Quarterly	KRC /DOSHS

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
			Physical posters for the community	Observation	Quarterly	KRC/DOSHS
		Emergency drills	Records of drills	Inspection of record.	Quarterly	KRC /DOSHS
		Safety and health committee for a contractor with more than 20 staff on site	Safety and Health Committee Minutes of meetings	One on One Interview with the committee	Quarterly	KRC
		OSHA required Reports to DOSHS	Copies of Reports submitted to DOSHS	Inspection of record	Quarterly	KRC /DOSHS
				Community Baraza with sample community	Quarterly	KRC
		Handling, storage and use of hazardous materials	Presence of Material Safety Data Sheet (MSDS)	Inspection of Material Safety Data sheets	Quarterly	Health and safety Officer

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
				Incidence reports resulting from improper handling of hazardous materials.		
HIV/AIDs and STIs program	In-migration of labour from other areas, moral decay,	Education and sensitization of workers on HIV/AIDs Management Program.	Training plans, Training Reports	Inspection records	Quarterly	KRC
			Feedback Reports on Training from staff Attendance sheets.	Inspection of records	Quarterly	KRC
			Formation of counselling Peer group	Interviews with staff	Semi-Annually	KRC
				Records of Training of trainers for peer counsellors	Quarterly	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
			Physical posters on appropriate locations within the worksite.	Observations	Monthly	KRC
			Staff awareness on HIV/AIDS and STI Causative agents, prevention, diagnosis and management.	Knowledge, Attitudes and Practices (KAP) Survey of a stratified sample group of staff, prior to Commencement Of the sensitization program and periodically every six months	Semi-Annually	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
Enhancement of project benefits-employment	Different employment opportunities	Equitable distribution of employment opportunities	Community complaints	Inspection of grievance logs	Monthly	KRC
			Gender mainstreaming strategies within the HR recruitment policies.	Inspection of Relevant HR policy procedures and records.	Once contractor takes possession of the site and every quarter after that	KRC
			Gender balance among project staff to a minimum proportion of 2/3 of men or women	Number of employees segregated by age and gender	Monthly	KRC
		Compliance with labor laws and labor standards	Availability of Human Resource Policy that includes a recruitment strategy (including a local staff recruitment strategy), non-discrimination	Inspection of records	Once contractor takes possession of the site	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
			procedures and practices as well as a retrenchment policy.			
			Availability of employment record	Inspection of employment records	Monthly	KRC
	Grievances resulting from community including noise, soil erosion, lack of equity in employment opportunities,	Mechanism for managing staff grievances	Establishment grievance mechanism Of staff redress	Inspection of records established under the grievance redress mechanism	Once contractor takes possession of the site and every quarter	KRC
			Policy and practice by the contractor that does not prohibit staff from joining workers associations.	Inspection relevant policy procedures records of HR	Once contractor takes possession of the site and every quarter after that	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
	Child labour and exploitation	Child protection	Compliance with child protection requirements by Kenyan law and ILO standards.	Inspection relevant policy procedures records of HR	Once contractor takes possession of the site and every quarter after that	KRC
Vandalism	Retaliation over land, jobs, or exclusion, Unregulated demand for stolen metal parts,	Destruction of railway associated infrastructure	Losses incurred	Inspection of railway infrastructure	Monthly	KRC
Stakeholder engagement during monitoring and evaluation of the implementation and efficacy of project environmental and social management plans and mitigation		Awareness on the project ESMPs and management plan that affect the various stakeholder	Increased ownership of project's ESMPs and management plans	Interviews with sample groups of stakeholders	Quarterly	KRC
		Stakeholder participation in decisions that affect them	Maintenance of social license	Interviews with sample groups of stakeholders	Quarterly	KRC
		Record of as felt	Records of as felt	Inspection of	Quarterly	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
		benefits or negative impacts to improve the ESMP and Management Plan	benefits or negative impacts Revision and updates of ESMP and management plans based on recommendations from stakeholder engagements	records		
Natural Resource use Conflicts		Maintenance of Project social license	Complaints by the communities	Inspection of community feedback records. Grievance logs	Quarterly	KRC
				Consultations of sample of the project area communities	Quarterly	KRC
Ground water Quality	Oil spillage, vegetation clearance,	pH, Salinity (EC), Nitrates Phosphorous, Pesticide residues	WRA Guidelines	Inspection of hydrological reports; Consultations with WRA for area data	6 months	KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
Surface water quality – intakes and receiving waters	Soil erosion, surface run off,	pH, Salinity (EC), Nitrates, Phosphorous, Pesticide residues, Coliforms BOD and COD	EMCA and WRA Guidelines	Water analysis of collected water samples	Yearly	KRC
Disputes over employment	Inequity in hiring, lack of transparent recruitment processes, poor grievance management mechanisms	A formal recruitment process to be adhered to Clearly explain to all job-seekers the terms and conditions of their respective employment contract.	Recruitment policy Copies of signed contracts for each employee filed	Inspection of records	Monthly	KRC
Interference with cultural sites	Inadequate cultural heritage surveys, lack of community consultation and disclosure and lack of cultural awareness among workers	Destruction of features or areas of cultural interest.	Registered cases	Inspection of records	Quarterly	Contractor/ KRC
Grievance Management	Land acquisition and compensation issues, lack of community engagement and lack	Resolve of grievances	Review of complaints logbook and the response and	Inspection of records	Entire duration of works	Contractor/ KRC

Monitoring Scope	Source of the impact	Parameter	Indicators	Activity	Frequency	Responsibility
	of consultation and broken promises		handling of the complaints.			
		Meetings held with the stakeholders	Reports shared with the community	Inspection of records	Quarterly	KRC
Excessive water usage	Leaky plumbing systems, Train washing and maintenance, lack of water meters or control systems	Water meter readings Reduced water level in the dams	Complaints by other water users. Reduction of water quantity for project activities	Feedback from other water users. Grievance logs	Entire duration of works	KRC
Excessive energy usage	Poor servicing of equipment, poor lighting systems, idle vehicles and equipment	Total energy used over time.	Energy efficiency reports	Review of energy reports	Entire duration of works	KRC

11.3 Impacts, Mitigation and Monitoring Matrix for Kisumu Port

Table 104 below presents a summary of key environmental and social impacts associated with the construction, operation, and cumulative effects of the proposed Port–SGR project at Lake Victoria, Kisumu. It outlines the nature of each impact, the receptors likely to be affected, the pre-mitigation significance, and the specific mitigation and monitoring measures proposed to manage these risks.

The table further assigns clear institutional responsibilities for implementation and indicates the expected residual impact significance after mitigation, providing a practical framework for environmental and social management throughout the project lifecycle.

Table 104: Environmental Social Monitoring plan (ESMP) of the Proposed Kisumu Port

Project Phase	Impact / Issue	Affected Receptors	Impact Significance (Pre-Mitigation)	Mitigation Measures	Monitoring Indicators	Responsibility	Residual Impact Significance
Construction	Loss of near-shore aquatic habitats	Fish breeding and nursery grounds, benthic fauna	Major	• Minimize footprint within littoral zone • Avoid works during peak fish breeding seasons • Restore disturbed areas using native wetland vegetation	• Area of habitat disturbed/restored • Evidence of fish breeding activity	Contractor	Moderate
	Increased turbidity and sedimentation	Water quality, fish eggs, benthic organisms	Major	• Install silt curtains and sediment traps • Phase dredging activities • Stabilize exposed soils immediately	• Turbidity (NTU) • Total Suspended Solids (TSS)	Contractor; Environmental Consultant	Moderate
	Pollution from fuels, oils, and cement	Aquatic life, lake water quality	Moderate–Major	• Bunded fuel storage areas • Spill prevention and response plans	• Number of spill incidents • Visual oil sheen presence	Contractor Site Health & Safety Officer	Low–Moderate

Project Phase	Impact / Issue	Affected Receptors	Impact Significance (Pre-Mitigation)	Mitigation Measures	Monitoring Indicators	Responsibility	Residual Impact Significance
				• Designated equipment maintenance zones			
	Disturbance to wetlands and papyrus zones	Wetlands, birds, shoreline stability	Moderate	• Demarcate no-go wetland areas • Restore disturbed papyrus zones • Maintain riparian buffer	• Wetland area conserved/restored • Compliance with buffer limits	Contractor	Low–Moderate
Operation	Chronic water pollution	Water quality, sediments, fisheries	Major	• Install oil-water separators • Controlled drainage systems • Routine water and sediment quality monitoring	• Oil & grease levels • Nutrient concentrations	Environmental Manager	Moderate
	Accidental fuel / hazardous material spills	Aquatic ecosystem, fisheries, public health	Major	• Emergency spill response plan • Staff training and drills	• Spill response time • Number of spill drills conducted	H&S Manager	Moderate

Project Phase	Impact / Issue	Affected Receptors	Impact Significance (Pre-Mitigation)	Mitigation Measures	Monitoring Indicators	Responsibility	Residual Impact Significance
				• Spill containment equipment			
	Alteration of shoreline processes	Shoreline stability, wetlands	Moderate	• Hydrodynamic modelling at design stage • Soft shoreline protection • Periodic shoreline inspections	• Evidence of erosion/accretion • Shoreline change mapping	Environmental Consultant	Low–Moderate
	Noise, vibration, and light disturbance	Fish behaviour, birds, wetlands	Moderate	• Equipment maintenance • Directional, low-glare lighting • Buffer zones near wetlands	• Noise levels (dB) • Light spill observations	Operations Manager	Low
	Impacts on fisheries and livelihoods	Small-scale fishers, BMUs	Major	• Maintain fishing access corridors • Engage BMUs regularly	• Fish catch trends • Number of BMU engagements	Community Liaison Officer	Moderate

Project Phase	Impact / Issue	Affected Receptors	Impact Significance (Pre-Mitigation)	Mitigation Measures	Monitoring Indicators	Responsibility	Residual Impact Significance
				• Support fisheries monitoring			
Cumulative	Cumulative ecological stress on Kisumu Port	Entire lake ecosystem	Major	• Coordination with Lake Basin Development Authority, KEMFRI and Kisumu County Government • Basin-level monitoring • Strengthened pollution control	• Long-term water quality trends • Ecological status indicators	LBDA / County Government of Kisumu	Moderate

The Port SGR project presents significant environmental and social risks during construction, operation, and cumulatively, particularly to near-shore aquatic habitats, wetlands, water quality, fisheries, and local livelihoods within the ecologically Lake Victoria zone. Construction impacts such as habitat loss, increased turbidity, and pollution from fuels and oils are initially assessed as major but can be reduced to moderate or low-moderate levels through footprint minimization, seasonal scheduling, silt controls, and spill prevention measures. During operation, longer-term risks including chronic pollution, accidental spills, shoreline modification, and noise or light disturbance, especially affecting fisheries and Beach Management Units, can similarly be mitigated through routine monitoring, emergency preparedness, and sustained stakeholder engagement. Overall, it demonstrates that a precautionary and adaptive management approach can reduce impacts to acceptable levels in line with Kenyan regulatory requirements and international good practice.

CHAPTER 12.0 CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

The ESIA study has identified both positive and adverse environmental and social impacts of the proposed SGR project. While the project offers significant benefits such as improved transportation infrastructure, economic growth, and regional integration it also presents environmental and social challenges that must be proactively managed.

If the recommended mitigation measures are effectively implemented, monitored, and enforced, the anticipated adverse impacts can be minimized to acceptable levels, and the project can proceed sustainably. The project will also go a long way in improving the country's energy needs and demands towards attainment of Vision 2030 and the Big 4 Agenda. The SGR project is therefore considered environmentally and socially viable, subject to the full adoption of the ESMP and adherence to regulatory frameworks.

12.2 Recommendations

Recommendations are made based on the assessment of cumulative and potential impacts of the proposed project and are summarized as:

12.2.1 Environmental Management

- Implement a robust Environmental and Social Management Plan (ESMP) with clear responsibilities, timelines, and budget allocations for mitigation and monitoring.
- Establish site-specific environmental management units at all key project locations to oversee compliance and provide technical support.
- Ensure timely acquisition of all necessary environmental licenses and permits from the National Environment Management Authority (NEMA) and relevant county governments.

12.2.2 Pollution Control

- Adopt best available technologies for controlling air emissions, wastewater discharge, and solid waste disposal, in line with NEMA guidelines.
- Prevent soil and water contamination by using lined and bunded storage areas for hazardous materials and maintaining proper spill response systems.
- Implement noise and vibration mitigation measures, particularly in residential and other sensitive zones.

12.2.3 Biodiversity and Land Use

- Minimize disturbance to vegetation and any wildlife habitats through careful route planning, restricted access, and habitat restoration.

- Construct animal underpasses and fencing to prevent wildlife and livestock-train collisions and maintain ecosystem connectivity.

12.3.4 Community and Social Aspects

- Engage communities continuously through participatory forums, grievance redress mechanisms, and benefit-sharing initiatives.
- Provide fair and transparent compensation for land acquisition, and ensure livelihood restoration for affected persons, as per the Resettlement Action Plan (RAP).
- Implement occupational health and safety programs for all workers and promote gender inclusion in employment opportunities.

12.3.5 Monitoring and Reporting

- Establish a monitoring framework with measurable indicators for air quality, noise, water quality, biodiversity, and social performance.
- Conduct independent environmental audits annually and share findings with relevant stakeholders, including the public.

REFERENCES

- Ondere, Lusambili, Matanga, & Kemei, “Thenexus between Land Tenure System& Household Livelihoods,” JJEOSHS, 2024, 7(2), pp.1-15.
- Antti Silvast, 2017. Infrastructure, risk, and resilience Bawantha Rathnayaka et al: Identifying and prioritizing climate change adaptation measures in the context of electricity, transportation and water infrastructure: A case study. International Journal of Disaster Risk Reduction. 2023.
- Bhasker Tripathi (2023). Climate Change Damage to Infrastructure Poses Huge Financial Risks
- Fabella, V.M.; Szymczak, S. Resilience of Railway Transport to Four Types of Natural Hazards: An Analysis of Daily Train Volumes. Infrastructures 2021, 6, 174. <https://doi.org/10.3390/infrastructures6120174>
- Gaoju Yang Xianhai Huang Jiahui Huang Chen Hangyu Chen Hangyu. 2020 Assessment of the effects of infrastructure investment under the Belt and Road Initiative. China Economic Review, 60(7):101418
- Garmabaki et al, 2022. Climate Change Impact Assessment on Railway Maintenance. 32nd European Safety and Reliability Conference
- Global Infrastructure Hub, 2024. Sustainable infrastructure for the climate transition
- Greenham, Ferranti, Quinn, 2020. The Impact of High Temperatures and Extreme Heat on Delays on the London Underground Rail Network.
- <https://blogs.afdb.org/climate-change-in-africa/building-climate-resilient-infrastructure-in-africa-challenges-and#:~:text=By%20Dr%20Al%20Hamndou%20Dorsouma%E2%83%B0%E2%83%B0%E2%83%B0,climate%2Drelated%20events%20have%20struck.>
- <https://theconversation.com/kenya-floods-as-the-costs-add-up-pressure-mounts-on-a-country-in-economic-crisis-229636#:~:text=Infrastructure%20destroyed&text=Nairobi%20satellite%20commuter%20train%20services,effects%20were%20felt%20for%20years.>
- https://www.mfa.gov.cn/eng/wjb/zzjg_663340/fzs_663828/xwlb_663830/202406/t20240606_11392799.html
- https://www.mfa.gov.cn/eng/wjb/zzjg_663340/fzs_663828/xwlb_663830/202406/t20240606_11392799.html
- IEA (2019), Africa Energy Outlook 2019, IEA, Paris <https://www.iea.org/reports/africa-energy-outlook-2019>, Licence: CC BY 4.0
- IPCC (2024). Sixth Assessment Report
- Jaroszweski, D., Hooper, E., Chapman, L. (2014). The impact of climate change on urban transport
- Lars-Göran Mattsson and Erik Jenelius. 2015. Vulnerability and resilience of transport systems – A discussion of recent research, Transportation Research Part A: Policy and Practice, Volume 81

- Lars-Göran Mattsson and Erik Jenelius. 2015. Vulnerability and resilience of transport systems – A discussion of recent research, Transportation Research Part A: Policy and Practice, Volume 81
- Nyumba TO, Sang CC, Olago DO, Marchant R, Waruingi L, Githiora Y, et al. (2021). Assessing the ecological impacts of transportation infrastructure development: A reconnaissance study of the Standard Gauge Railway in Kenya. PLoS ONE 16(1): e0246248. <https://doi.org/10.1371/journal.pone.0246248>
- Government of Kenya (2024), Environmental Management and Coordination (Air Quality) Regulations, 2024
- Government of Kenya. (2007). Factories and Other Places of Work (Hazardous Substances) Rules. Nairobi: Government Printers.
- International Finance Corporation. (2025, January 30). Environmental, Health, and Safety Guidelines. Retrieved from Disclosures Insights & Reports News: <https://www.ifc.org/en/insights-reports/2000/general-environmental-health-and-safety-guidelines>
- Occupational Safety and Health Administration, U.S. Department of Labor. (n.d.). Effects of Hydrogen Sulfide H₂S. Washington, D.C: Effects of Hydrogen Sulfide H₂S.
- United States Environmental Protection Agency. (2025, January 30). Criteria Air Pollutants. Retrieved from United States Environmental Protection Agency Website: <https://www.epa.gov/criteria-air-pollutants/naaqs-table>
- British Standards Institution. (1993). BS 7385-2: 1993 - Evaluation and Measurement for Vibration in Buildings – Guide to Damage Levels from Ground-borne Vibration. BSI.
- Government of Kenya. (1999). Environmental Management and Coordination Act (EMCA), 1999. Government Printers
- Government of Kenya. (2009). Environmental Management and Coordination (Noise and Excessive Vibration Pollution (Control) Regulations, 2009 (Legal Notice No. 61). Government Printers.
- International Organization for Standardization. (2010). ISO 4866: 2010- Mechanical vibration and shock-Vibration of fixed structures - Guidelines for the measurement of vibrations and evaluation of their effects on structures. ISO.
- Government of Kenya. (2006). *Environmental Management and Coordination (Water Quality) Regulations*. Nairobi: Government Publishers .
- International Organization for Standardization . (2023). *ISO 5667-1:2023 Water quality — Sampling Part 1: Guidance on the design of sampling programmes and sampling techniques* . Geneva : ISO.
- Canadian Council of Ministers of the Environment. (n.d.). *Canadian Environmental Quality Guidelines (CEQGs)*. Retrieved January 25, 2025, from Canadian Council of Ministers of the

Environment Website: <https://ccme.ca/en/current-activities/canadian-environmental-quality-guidelines>

- Intergovernmental Panel on Climate Change (IPCC). (2023). Climate Change 2023: Synthesis Report. Cambridge University Press.
- World Bank Climate Change Knowledge Portal. (2024). Kenya Climate Data and Projections. Available at: <https://climateknowledgeportal.worldbank.org/country/kenya>
- Kenya Meteorological Department. (2024). Climate Data and Analysis for Kenya. Nairobi: Kenya Meteorological Department.
- Government of Kenya. (2023). National Climate Change Action Plan (NCCAP) 2023-2027. Ministry of Environment and Forestry.
- Government of Kenya. (2023). Climate Change Act (Amendment) 2023. Kenya Gazette Supplement.
- Kenya Railways Corporation. (2024). Standard Gauge Railway Phase 2B Project Documents. Nairobi: Kenya Railways Corporation.
- Kisumu County Government. (2020). Climate Change Vulnerability Assessment Report. Kisumu: County Government of Kisumu.
- United Nations Framework Convention on Climate Change (UNFCCC). (2020). Kenya's Updated Nationally Determined Contribution (NDC).
- International Finance Corporation (IFC). (2024). Performance Standards on Environmental and Social Sustainability.
- World Bank. (2021). Climate Change Action Plan 2021-2025. Washington, DC: World Bank Group.
- Ellis, A. J. (1975). Heavy metal contamination from geothermal sources. *Environmental Health Perspectives*, 12, 147–150. <https://doi.org/10.1289/ehp.75121>
- Government of Tanzania. (2007). *Environmental Management (Soil Quality Standards) Regulations*. Dar es Salaam: Government Printers.
- International Organization for Standardization. (2018). *ISO 18400-104:2018 Soil quality — Sampling Part 104*. Geneva: ISO.
- Republic of Latvia. (2005). *Regulations Regarding Quality Standards for Soil and Ground*. Riga: Ministry for Regional Development and Local Government.

LIST OF ANNEXES

1. Baseline Air Quality Report
2. Baseline Noise and Vibration Report
3. Baseline Soil Quality Report
4. Baseline Water Quality Report
5. Biodiversity Report
6. SEP Report
7. GRM Report
8. Evidence of Stakeholder & Public Consultation.
 - 8.1. Signed Public Consultation Records (Notices for Invitation, Minutes of Meeting, and Attendance Sheets)
 - 8.2. Validation Workshop Records (Notices for Invitation, Attendance Sheets and Records of Meeting)
 - 8.3. Key Informant Questionnaires
 - 8.4. Community Based Organization Memoranda