



GHANA RAILWAY MASTER PLAN 2020 2035



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TITLE	Consultancy Service for the REVIEW OF RAILWAY MASTER PLAN (2013) OF GHANA
CLIENT	Ghana Railway Development Authority - GRDA Ministry of Railways Development - MoRD
CONTRACT N.	GRDA/TE/MP/002
DOCUMENT	FINAL REPORT
CODE	379 00 MP R FN 0
REVISION	0
DATE	February 2020

0	February 2020	MG	FM	LM	* FIRST ISSUE *
REV.	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION

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TABLE OF CONTENTS

LIST OF TABLES.....	8
LIST OF FIGURES	11
LIST OF ACRONYMS AND ABBREVIATIONS	13
1. PREFACE	21
2. EXECUTIVE SUMMARY	23
2.1 INVESTMENT PLAN FOR THE NEW RAILWAY SYSTEM.....	23
2.2 RESULTS OF THE TRAFFIC DEMAND FORECASTING	24
2.3 MAIN TECHNICAL CHARACTERISTICS.....	24
2.4 ECONOMIC ANALYSIS.....	24
2.5 ENVIRONMENTAL AND SOCIAL ASSESSMENT	26
2.6 RAILWAY MARKET RESEARCH: OUTCOMES FROM A SURVEY	26
2.7 FINANCIAL ANALYSIS	28
2.8 SOURCES OF FUNDING FOR THE MP IMPLEMENTATION	29
2.9 THE EVOLUTION OF PPP ARRANGEMENTS IN THE RAILWAY SECTOR	29
3. INVESTMENT PLAN FOR THE NEW RAILWAY SYSTEM.....	30
3.1 DESCRIPTION OF PHASES.....	30
3.2 RESULTS OF THE TRAFFIC DEMAND FORECASTING	34
3.3 OVERALL IMPLEMENTATION PLAN.....	43
3.4 PRESENT RAILWAY SYSTEM.....	45
3.4.1 Infrastructure	45
3.4.2 Technical installations.....	49
3.4.3 Rolling Stock	51
3.4.4 Ancillary Facilities	56
3.4.5 Area Management System.....	58
3.4.6 Relevant facts in the Railway Sector	59
3.5 INFRASTRUCTURE FEATURES AND MAIN TECHNICAL ASSUMPTIONS	63
3.5.1 Main features of the new railway lines	63
3.5.2 Main Design Criteria for Civil Infrastructure.....	64
3.5.3 Technological Infrastructure.....	77
3.6 ROLLING STOCK AND OPERATIONAL MODEL	84
3.6.1 Typical Train Size And Transport Capacity	84
3.6.2 Freight train.....	85
3.6.3 Passengers Trains.....	86
3.6.4 Locomotives.....	88
3.6.5 Procurement of Rolling stock	88
3.6.6 Rolling Stock Maintenance Organization and Facilities.....	90
3.6.7 Line capacity	90

3.6.8 Maintenance Depots and Workshops	90
4. ECONOMIC ANALYSIS	96
4.1 GENERAL APPROACH AND METHODOLOGY	96
4.2 SPECIFIC APPROACH AND METHODOLOGY	98
4.2.1 Traffic Forecasts incremental scenarios.....	99
4.3 ASSUMPTIONS AND PARAMETERS FOR THE ANALYSIS:	101
4.3.1 Social Discount Rate	101
4.3.2 Economic Conversion Factors.....	104
4.3.3 Residual Value	107
4.4 INPUTS FOR COST BENEFITS ANALYSIS.....	108
4.4.1 Railway Operating Costs	108
4.4.2 Vehicle Operating Costs	111
4.4.3 Infrastructure Investment Costs.....	116
4.4.4 Rolling Stock Investment Costs.....	118
4.5 BENEFITS OF THE PROJECT - DIRECT BENEFITS.....	120
4.5.1 Savings in Transportation Costs.....	120
4.5.2 Savings in Road Maintenance.....	125
4.5.3 Savings in Road Accident Casualties	127
4.5.4 Savings in Passengers' Journey Time	134
4.5.5 Saving from Greenhouse Gases Reduction	136
4.5.6 Additional Socio-Economic Benefits	139
4.6 ECONOMIC ANALYSIS - RESULTS.....	147
4.6.1 MAIN OUTCOMES.....	147
4.6.2 SENSITIVITY ANALYSIS	156
4.7 RELEVANT ASPECTS FOR DEFINITION OF RAILWAY FARES.....	157
4.7.1 Usual tariff schemes for railway market	157
4.7.2 Rail tariffs used in some African countries	158
4.7.3 Opportunities for a more competitive railway.....	161
4.7.4 Suggestions about general transport policies.....	163
5. ENVIRONMENTAL AND SOCIAL ASSESSMENT	166
5.1.1 Approach and Methodology	166
5.1.2 Updating the ESMF	166
5.1.3 Stakeholder Involvement	167
5.1.4 Potential Environmental and Social Impacts	168
5.1.5 Environmental and Social Safeguards and Mitigation Principles	169
5.1.6 ESMF Implementation and Management.....	169
6. RAILWAY MARKET RESEARCH: OUTCOMES FROM A SURVEY.....	172
6.1.1 Methodology	172
6.1.2 Results.....	173
7. FINANCIAL ANALYSIS.....	178

7.1	GENERAL CONSIDERATIONS	178
7.2	FINANCIAL APPROACH AND METHODOLOGY	179
7.3	ASSUMPTIONS ON TARIFFS	180
7.4	USE OF THE INFRASTRUCTURE (DEPRECIATION)	182
7.5	OPERATING AND MAINTENANCE (O&M) COSTS	182
7.6	FINANCIAL INVESTMENTS AND REQUIREMENTS	183
7.7	MAIN OUTCOMES OF THE FINANCIAL ANALYSIS	186
7.8	SENSITIVITY ANALYSIS.....	192
8.	SOURCES OF FUNDING FOR THE MP IMPLEMENTATION.....	193
8.1	NATIONAL FUNDING.....	193
8.2	INTERNATIONAL FINANCING.....	196
8.3	CHINA AND AFRICA.....	200
8.3.1	<i>The Belt and Road Initiative: opportunities for infrastructure development</i>	203
9.	THE EVOLUTION OF PPP ARRANGEMENTS IN THE RAILWAY SECTOR.....	205
9.1	PPP MODELS AND OPTIONS.....	205
9.2	RAILWAY CONCESSIONS IN AFRICA	212
9.2.1	<i>Cameroon: Camrail</i>	215
9.2.2	<i>Zambia: RSZ</i>	217
9.2.3	<i>Morocco: ONCF</i>	218
9.3	RAILWAY CONCESSIONS WORLDWIDE.....	220
9.3.1	<i>Europe</i>	220
9.3.2	<i>France (South East Atlantic HSR)</i>	220
9.3.3	<i>Netherland: (HSL Zuid)</i>	221
9.3.4	<i>Portugal - Spain: HSR Lisbon - Madrid</i>	223
9.3.5	<i>India</i>	223
9.3.6	<i>China</i>	224
9.4	RECOMMENDATIONS	225
	BIBLIOGRAPHY	229
	ANNEXES	237
	ANNEX 1: ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK.....	237
	ANNEX 2. RAILWAY MARKET SURVEY	388
	ANNEX 3. MAIN PPP RAILWAY PROJECTS IN AFRICA.....	438
	ANNEX 4. PREVIOUS PROPOSAL FOR THE RAILWAY DEVELOPMENT IN GHANA (DRAFT FINAL REPORT - REF: 379-00-MP-R-DF-1 DATED JULY 2019): EXECUTIVE SUMMARY.....	449

LIST OF TABLES

Table 2-1. Proposed New Rail Network.....	23
Table 2-2. Economic performance indicators.....	26
Table 2-3. Financial performance indicators	29
Table 3-1. Proposed phases for the expansion of the National Railway Network.....	33
Table 3-2. Freight Traffic - Summary of all Phases	37
Table 3-3. Passenger Traffic- Resume of all Phases	38
Table 3-4. Alignment and Load Characteristics of Existing Railway Network.....	46
Table 3-5. Summary of Track Structure Characteristics on Existing Railway Network	46
Table 3-6. Turnout Characteristics on the GRCL Network.....	47
Table 3-7. Important Bridges on the GRCL Network	48
Table 3-8. The Distribution of Bridges on GRCL Network.....	48
Table 3-9. GRDA Buildings.....	49
Table 3-10. Type of Diesel Electric Locomotive	52
Table 3-11. Fleet of Wagons.....	52
Table 3-12. Fleet of Coaches.....	53
Table 3-13. Equipment and Vehicles.....	54
Table 3-14. Required Rolling Stock for each Phase	89
Table 3-15. Main levels of Maintenance Operations.....	91
Table 4-1. Analysis for CBA indicators - Consultant's elaboration	98
Table 4-2. Passenger and Freight Railway Traffic Increments of each Phase	100
Table 4-3. Recent US\$ Sovereign Debt Issuance by GoG	103
Table 4-4. Cost Breakdown Structure of a typical Railway Project. - Consultant's elaboration	105
Table 4-5. Conversion Factors used for Economic Analysis	106
Table 4-6. ROC assumed for the analysis.	108
Table 4-7. ROC components for Freight Train	109
Table 4-8. ROC components for Passenger Train	110
Table 4-9. Vehicle Fleet Characteristics, Ghana Railway Master Plan 2013.....	112
Table 4-10. Vehicles Utilisation, Ghana Railway Master Plan 2013	112
Table 4-11. Road Characteristics by Surface Type	113
Table 4-12. Road Condition Classes Roughness (IRI)	113
Table 4-13. Average VOC (\$/veh-km)	114
Table 4-14. Average speed (Km/h)	114
Table 4-15. Vehicle Operating Costs for CBA.....	114
Table 4-16. Average occupation of each category of vehicles	115
Table 4-17. VOC assumed for the Analysis.	115
Table 4-18. Economic Investment Plan for Infrastructure.	118

Table 4-19. Economic Investment Plan for Rolling Stock	119
Table 4-20. Savings in Transportation Costs (US\$) for Phase 1 (A+B)	121
Table 4-21. Savings in Transportation Costs for Phase 1C	122
Table 4-22. Savings in Transportation Costs for Phase 2.....	123
Table 4-23. Savings in Transportation Costs for Phase 3.....	124
Table 4-24. Unit Rate Statistics for Types of Road Infrastructure Investment (US\$/lane km, rounded to '00).....	125
Table 4-25. Estimates in Road Maintenance Savings (US\$).....	126
Table 4-26. Changes in National Traffic Fatality Indices.....	127
Table 4-27. Road traffic deaths and proportion of road users by Country.....	128
Table 4-28. Distribution of Accidents and Casualties on Selected Major Highways (2011-2016).....	129
Table 4-29. Distribution of Accidents and Casualties on Selected Major Highways (2011-2016) Cont'd.	130
Table 4-30. Distribution of Accidents and Casualties on Selected Major Highways (2011-2016) Cont'd.	131
Table 4-31. Average ratio of road accident casualties per km in Ghana (2011-2016).	132
Table 4-32. Assumed affected Road Network.....	132
Table 4-33. Estimates in Road accident casualties' savings (US\$).	133
Table 4-34. Estimates in Savings in Passengers' Journey Time per year.....	135
Table 4-35. Estimates in Savings Greenhouse Gases Reduction per year.....	138
Table 4-36. Population Affected by the Railway network.....	140
Table 4-37. Total Population Affected by the Railway in Phase 0	140
Table 4-38. Total Population Affected by the Railway in Phase 1 (A+B).....	141
Table 4-39. Total Population Affected by the Railway in Phase 1C.....	141
Table 4-40. Total Population Affected by the Railway in Phase 2	142
Table 4-41. Total Population Affected by the Railway in Phase 3	143
Table 4-42. Socio-economic benefits per year for each phase at the first operating year	144
Table 4-43. Socio-Economic Benefits per year	145
Table 4-44. Main indicators in the Cost-Benefit Analysis.	147
Table 4-45. E-IRR and –NPV for different Phases	148
Table 4-46. Phases 1-3: Breakdown of Project Benefits (US\$ M)	149
Table 4-47. Outcome of the Economic Analysis for all Phases (1-3).....	150
Table 4-48. Outcome of the Economic Analysis for the entire Railway System (Phases 0-3).....	151
Table 4-49. Outcome of the Economic Analysis for Phase 1(A+B).....	152
Table 4-50. Outcome of the Economic Analysis for Phase 1C.....	153
Table 4-51. Outcome of the Economic Analysis for Phase 2.	154
Table 4-52. Outcome of the Economic Analysis for Phase 3	155
Table 4-53. Outcome of Sensitivity Test for the Cost Benefit Analysis	156
Table 4-54. Rail passenger rates for the new standard gauge railway in Ethiopia, Kenya and Nigeria.....	159
Table 4-55. Performance of the International Gateway Road Corridors in Africa	160
Table 4-56. Rail freight rates between Mombasa, Nairobi & Kampala.....	161

Table 6-1. Sample size of the Railway Market Research.....	173
Table 7-1. Railway freight traffic and revenues for 2015, 2016 and 2017 in Ghana.	181
Table 7-2. Current Tariffs and Fares for rail users in Ghana.	181
Table 7-3. Fares and tariffs values adopted in the Financial Analysis.	181
Table 7-4. Financial Investments for Railway Infrastructure.....	183
Table 7-5. Financial Investments for Rolling Stock Equipment.....	184
Table 7-6. Railway Master Plan – Outcome of the Financial Analysis.....	186
Table 7-7. Synthetic Income Statement (Public Operator).....	190
Table 7-8. Cash Flow Statement (Public Operator).....	191
Table 7-9. Outcome of Sensitivity Test for the Financial Analysis.....	192
Table 8-1. Africa: Import and Export trading partners.	201
Table 8-2. Funded/co-funded Railway projects in Africa by China.....	202
Table 8-3. Countries that signed cooperation documents related to the Belt and Road Initiative.	204
Table 9-1. PPP Options and Models.	207
Table 9-2. List of main PPP Railway Projects in Africa – Consultant’s elaboration	213

LIST OF FIGURES

Figure 2-1. Advantages in travel cost and comfort of various means of transportation	27
Figure 2-2. Perceived opportunities from Railway development: economy and employment.....	28
Figure 2-3. Perceived opportunities from Railway development: traffic and transportation time.....	28
Figure 3-1. Schematic Map of Proposed New Rail Network	32
Figure 3-2. Flowchart summarizing the Methodology followed for the Traffic Study	34
Figure 3-3. Freight Traffic - Road and Railway (Phase 0 - Phase 3)	35
Figure 3-4. Passenger Traffic - Road and Railway (Phase 0 - Phase 3).....	36
Figure 3-5. Freight traffic flows assigned for Phase 3 at year 2036 (entire Transport Network)	39
Figure 3-6. Freight traffic flows assigned for Phase 3 at year 2036 (Railway Network)	40
Figure 3-7. Passenger traffic flows assigned for Phase 3 at year 2036 (entire Transport Network)	41
Figure 3-8. Passenger traffic flows assigned for Phase 3 at year 2036 (Railway Network).....	42
Figure 3-9. Implementation Programme.	44
Figure 3-10. Morphology of the areas affected by the new railway lines.....	63
Figure 3-11. Type 1 installations	67
Figure 3-12. Type 2 installations	67
Figure 3-13. ETCS Level 1 and Level 2	79
Figure 3-14. Estimated number of trains per day at 2059.....	90
Figure 3-15. Locations for Maintenance of Railway Network	95
Figure 4-1. Inputs for Cost-Benefit Analysis.....	99
Figure 4-2. Logic approach to define the Social Discount Rate.....	102
Figure 4-3. Setting the SDR value.....	102
Figure 4-4. Cost Incidence by type of works in Phase 1(A+B).	116
Figure 4-5. Cost Incidence by type of works in Phase 1 C.....	116
Figure 4-6. Cost Incidence by type of works in Phase 2.	117
Figure 4-7. Cost Incidence by type of works in Phase 3.	117
Figure 4-8. Socio-Economic Benefits Overview	139
Figure 4-9. Average Tariffs for Passenger and Freight Traffic, 1995–2005	158
Figure 4-10. Average Tariffs by Commodity for Select Railways in Sub-Saharan Africa	160
Figure 6-1. Most used means of transportation.....	173
Figure 6-2. Advantages in travel cost and comfort of various means of transportation.....	174
Figure 6-3. Main effects of new Railway Infrastructure	175
Figure 6-4. Willingness to pay in comparison to trotro and bus fares	176
Figure 6-5. Willingness to pay a specific fare for rail services: Accra-Tema and Takoradi -Kumasi	176
Figure 6-6. Willingness to pay a specific fare for rail services: Kumasi-Paga and Tema-Tamale.....	177
Figure 7-1. Cash Flow profile of Railway MP	187
Figure 7-2. Operating Profit and Financial Interests	188

Figure 7-3. Financial IRR according to different compositions of Debt and Interest Rate cost	189
Figure 8-1. Sources of funding (Consultant's elaboration)	199
Figure 8-2. Top investor economies in Africa.....	200
Figure 8-3. OBOR Project: Main Corridors	203
Figure 9-1. Traditional Procurement model.....	208
Figure 9-2. Concession Scenarios: one or two private operators model	208
Figure 9-3. Railway Concession in Africa	209
Figure 9-4. SPV arrangement example	210
Figure 9-5. BOT model	210
Figure 9-6. BFMT model.....	211
Figure 9-7. Allocation of Responsibilities in Railway PPP arrangements.....	211
Figure 9-8. Cameroon (Camrail): Project Exposure Analysis.	217
Figure 9-9. Zambia (RSZ): Project Exposure analysis.	218
Figure 9-10. Morocco (ONCF): Project Exposure analysis.	220
Figure 9-11. France (South East Atlantic HSR) Project Exposure Analysis	221
Figure 9-12. Netherland (HSL Zuid): Project exposure analysis.....	222

LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Annual Average Daily Traffic
AAR	American Association of Railroad
AC	Alternating Current
ADF	African Development Fund
ADT	Average Daily Traffic
AER	Annual Environmental Report
AfDB	African Development Bank
AFTC	Audio Frequency Track Circuits
AICD	Africa Infrastructure Country Diagnostic
AIHSRN	African Integrated High Speed Railway Network
AMU/UMA	Arab Maghreb Union
AREMA	American Railway Engineering and Maintenance-of-Way Association
ARIs	Acute Respiratory Infections
ARTIN	African Regional Transport Infrastructure Network
A.S.B.	Auxiliary Services Building
ATP	Automatic Train Protection System
AU	African Union
AUC	African Union Commission
B/C	Benefit Cost
BCR	Benefit-Cost Ratio
BFMT	Build Finance Maintenance Transfer
BOG	Bank of Ghana
BoQ	Bill of Quantities
BOST	Bulk Oil Storage & Transportation Company
BOT	Build Operate Transfer
BROT	Build Rehabilitate Operate Transfer
BRT	Bus Rapid Transit
BTM	Balise Transmission Module
CAD	China Africa Development
CapEx	Capital Expenditures
CBA	Cost Benefit Analysis
CBN	Continental Business Network
CBO	Community Based Organizations
CCTTFA	Central Corridor Transit Transport Facilitation Agency
CEHRT	Certified Electronic Health Record Technology
CENSAD	Community of Sahel-Saharan States
CEPS	Customs Excise and Preventive Service
CERSGIS	Centre for Remote Sensing and Geographic Information System
CETMO	Centre for Transportation Studies for the Western Mediterranean
CFA	Communauté Financière Africaine

CFR	Code of Federal Rules (USA)
CIA	Central Intelligence Agency
CIC	China Investment Corporation
CL	Central Line
COMESA	Common Market for Eastern and Southern Africa (COMESA)
CPI	Consumer Price Index
CTCS	Chinese Train Control System
CWSA	Community Water and Sanitation Agency
DBFO	Develop Build Finance Operate
DBO	Develop Build Operate
DC	Direct Current
DCF	Discounted Cash Flow
DE	Diesel Electric
DFR	Department of Feeder Roads
dFR	Draft Final Report
DMI	Driver Machine Interface
DMU	Diesel Multiple Unit
CO₂	Carbon Dioxide
DP	Development Partner
DSCR	Debt Service Cover Ratio
DUR	Department of Urban Roads
EA	Environmental Assessment
EAC	East African Community
EAR	Environmental Assessment Regulations
EBRD	European Bank for Reconstruction and Development
ECA	Economic Commission for Africa
ECCAS	Economic Community of Central African States
ECF	Extended Credit Facility
ECG	Electricity Company of Ghana
ECOSOC	Economic and Social Council of the United Nations (UN)
ECOWAS	Economic Community of West African States
EHD	Environment and Health Department
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
EL	Eastern Line
EM	Environmental Management
EMP	Environmental Management Plan
EMU	Electric Multiple Unit
EN	European Norm
ENPV	Economic Net Present Value

EP	Environmental Permit
EPA	Environmental Protection Agency (USA)
EPC	Engineering, Procurement and Construction
ERP	Economic Recovery Programme
ERTMS	European Railway Traffic Management System
ESA	Environmental and Social Assessment
ESAs	Environmentally Sensitive Areas
ESM	Environmental and Social Management
ESMF	Environmental and Social Management Framework
ETCS	European Train Control System
EU	European Union
FC	Forestry Commission
FEED	Front End Engineering Design
FES	Fonds Economische Structuurversterking
FIRR	Financial Internal Rate of Return
FMoT	Federal Ministry of Transport
FNPV	Financial Net Present Value
FRA	Federal Railroad Administration (USA)
FSD	Forest Services Division
FTM	Future transport Model
FX	Foreign exchange
GAMA	Greater Accra Metropolitan Area
GCT	Ghana Chamber of Telecommunication
GDP	Gross Domestic Product
GH¢	Ghanaian Cedi
GHA	Ghana Highway Authority
GHG	GreenHouse Gases
GHS	Ghana Cedis (Standard ISO currency code)
GIP	Ghana Infrastructure Plan
GIPC	Ghana Investment Promotion Centre
GIS	Geographic Information System
GLSS	Ghana Living Standard Surveys
GoG	Government of Ghana
GoN	Government of Nigeria
GPHA	Ghana Ports and Harbours Authority
GPRS	Ghana Poverty Reduction Strategy
GPRTU	Ghana Private Road Transport Union (of the TUC)
GRCL/ GRC	Ghana Railway Company Ltd
GRDA	Ghana Railway Development Authority
GRMP	Ghana Railway Master Plan
GSGDA	Ghana Shared Growth and Development Agenda
GSM	Global System for Mobile Communications

GSM/R	Ground Satellite Mobile / Railways
GSS	Ghana Statistical Service
GT	Ghana Telecommunications Company (Vodafone)
GWCL	Ghana Water Company Limited
HDM-4	Highway Development and Management (software developed by World Bank and other institutions for the management of road networks)
HQ	Headquarters
HIV / AIDS	Human Immuno-deficiency Virus/ Acquired Immune Deficiency Syndrome
HASR	High-availability Seamless Redundancy
HSR	High-Speed Railway
I or IR	Inter-Regional
ICD	Inland Container Depots
ICT	Information and Communication Technology
ICRC	Infrastructure Concession Regulatory Commission
IEC	International Electrotechnical Committee
IFC	International Finance Corporation
IGAD	Intergovernmental Authority on Development
ILO	International Labour Organisation
IM	Infrastructure Manager
IMF	International Monetary Fund (United Nations)
IR	Inception Report
IRI	International Roughness Indexes
IRR	Internal Rate of Return
IS4D	Infrastructure Skills for Development
ISO	International Organization for Standardization
ITP	Integrated Transport Plan
ITP	Integrated Transport Plan
IWW	Internal Waterway
JRU	Juridical Recording Unit
LAPSSET	Lamu Port and Southern Sudan-Ethiopia Transport Corridor
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEU	Lineside Electronic Unit
LI	Legislative Instrument
LTNDP	Long-term National Development Plan
MDAs	Ministries, Departments and Agencies
MDGs	Millennium Development Goals
MESTI	Ministry of Environment, Science, Technology and Innovation
MLGRD	Ministry of Local Government and Rural Development
MKBF	Mean Kilometers Between Failures
MMDAs	Metropolitan, Municipal and District Assemblies
MOF	Ministry of Finance

MoFEP	Ministry of Finance and Economic Planning
MoH	Ministry of Health
MoRD	Ministry of Railways Development
MoT	Ministry of Transport
MoU	Memorandum of Understanding
M.P.O.	Minimum profile of the obstacles
MRG	Minimum Revenue Guarantee
MRH	Ministry of Roads and Highways
MTBF	Mean Time Between Failures
MTDP	Medium Term Development Plan
MTEF	Medium Term Expenditure Framework
MTTR	Mean Time to Repair
N	National
NC	Northern Corridor
NCA	National Communications Authority
NCTTA	Northern Corridor Transit and Transport Agreement
NDPC	National Development Planning Commission
NEAP	National Environmental Action Plan
NEPAD	New Partnership for Africa's Development
NG	Narrow Gauge
NGO	Non-Governmental Organization
NHIL	National Health Insurance Levy
NMT	Non-Motorized Transport
NMTDPF	National Medium-Term Development Policy Framework
NPV	Net Present Value
NRC	Nigerian Railway Corporation
NSDF	National Spatial Development Framework
NTF	Nigerian Trust Fund
O&M	Operation and Maintenance
O/D	Origin/Destination
OAU	Organization of African Union
OBC	Outline Business Case
OBOR	One Belt One Road (Initiative)
OECD	Organization for Economic Co-operation and Development
OIC	Organization of Islamic Cooperation
ONCF	Office National des Chemins de Fer (Morocco)
OPD	Out Patients' Department
OpEx	Operating Expenses
OSH	Occupational Safety and Health
OTN	Optical Transport Network
p/d	Average number of passengers boarding and disembarking on a week day
P/D	Total number of passengers foreseen on a week day

PAP	Priority Action Plan
PAX	Abbreviation for « Passengers »
PDD	Planning and Development Department
PEA	Preliminary Environmental Assessment
PER	Preliminary Environmental Report
PICI	Presidential Infrastructure Champion Initiative
PIDA	Programme for Infrastructure Development in Africa
PIDG	Private Infrastructure Development Group
PIU	Project Implementation Unit
PLWAs	People Living with AIDS
PMMP	Pavement Maintenance Management Programme
PMS	Pavement Management System
PNDC	Provisional National Defence Council
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PROTOA	Progressive Transport Owners' Association
PTM	Present Transport Model
PWD	Public Works Department
QA	Quality Assurance
R	Regional
R.S.	Rolling Stock
R.s.	Running surface
RAMS	Reliability, Availability, Maintainability, Safety
RBC	Radio Block Centre
RECs	Regional Economic Communities
REF	Reference
RFF	Reseau Ferre de France
RFP	Request for Financial Proposal
RIU	Radio In-fill Unit
RMP	Railway Master Plan
RN	Road Number
ROC	Rail Operating Costs
RoRo	Roll-on/Roll-off
RTTFP	Road Transport and Transit Facilitation Program
S&P	Standard and Poor's
SADC	Southern African Development Community
SAM	Social Accounting Matrix
SAM	Social Accounting Matrix
S.B.	Station Building/ Passenger Building
SDN	Synchronous Digital Hierarchy
SDR	Social Discount Rate

SE4ALL	Sustainable Energy for All
SEA	Strategic Environmental Assessment
SG	Standard Gauge
SGR	Standard Gauge Railway
shp	shapefile format
SMS	Safety Management Systems
SMS	Safety Management Systems
SMTDPs	Sectoral Medium Term Development Plans
SOC	Social Opportunity Cost of capital
SPV	Special Purpose Vehicle
SRTP	Social Rate of Time Preference
SSATP	Sub-Saharan Africa Transport Policy Program
STAP	Short Term Action Plan
STC	State Transport Company
STDs	Sexually Transmitted Diseases
STI	Sexually Transmitted Infections
STM	Synchronous Transport Module
STOCH	Stochastic
STS	Ship- to- Shore
SVP	Southern Voltaian Plateau
SW	Shadow Wages
SWF	Sovereign Wealth Funds
TACs	Track Access Charges
TAH	Trans-Africa
TAZ	Traffic Analysis Zones
T.B.	Technological Building
TEN-T	Trans-European Transport Networks
TEUs	Twenty-foot Equivalent Units
TI	Train Interface
TON/TONNE	Metric ton
ToR	Terms of Reference
T.R.	Transformer Room
TRANSCAD	Transportation Planning Software
TSDP	Transport Sector Development Programme
TUC	Trades Union Congress
UAR	Union of African Railways
UEMOA	West African Economic and Monetary Union
UIC	Union International des Chemins de Fer (International Railway Union)
UN	United Nations
UNECA	United Nations Economic Commission for Africa
UNTCDA	United Nations Transport and Communications Decade for Africa

URTI	Upper Respiratory Tract Infection
USA	United States of America
USAID	United States Agency for International Development
USD/US\$	United States Dollar
UTP	Urban Transport Planning Project
VAT	Value-Added Tax
VfM	Value for Money
VOC	Vehicle Operating Costs
VC	Vital Computer
VS	Voltaian Sandstone Basin
WACC	Weighted Average Cost of Capital
WAGRIC	West Africa Growth Ring Corridor
WB	World Bank
WD	Wildlife Division (of the Forestry Commission)
WFP	World Food Programme
WHO	World Health Organisation
WHT	Withholding Tax
WL	Western Line
WRC	Water Resources Commission
XOF	West African CFA Franc (standard ISO currency code)

1. PREFACE

The Ghana Railway Development Authority (GRDA), in conjunction with the Ministry of Railways Development, have decided to review the **Railway Master Plan** (2013) of Ghana, and committed this consultancy service to **TEAM Engineering S.p.A.** (Italy), an engineering and architecture consulting firm, highly qualified in civil engineering and public transport related fields, and particularly in railway infrastructures.

The objective of the assignment is to undertake a review of the Railway Master Plan (2013) by extending the rail network and creating an efficient transportation system linking important mineral potentials, communities and every regional capital.

The final scope of the Master Plan will be that of prefiguring a programmed development of the Rail Transport (and thence, the rail network and its ancillary facilities), which would strongly contribute to the socio-economic (besides environmental) status of the Country and, ultimately, elevating the role of Ghana within the West African context (ECOWAS), as well as in the whole of Africa.

This **FINAL REPORT (Ref. 379-00-MP-R-FN-0)** represents the last step of the assignment and it has the primary purpose of presenting the outcomes of the analyses carried out, which led to the definition of the New Ghanaian Rail Network to be developed in **three different Phases (2022-2036)**.

This Report presents an updated version of the study resulting from the **comments and observations**, received from the MoRD and GRDA, to the Draft Final Report rev.0 (Ref. 379-00-MP-R-DF-0) submitted on 19th July 2019, and presented officially on 8th August 2019. The Executive Summary of the Draft Final Report (Ref. 379-00-MP-R-DF-0) is appended to this Report in **Annex 4**. previous proposal FOR the railway development

The most important comments received from the MoRD and GRDA are summarized below:

1. The Ghana Railway Master Plan will have to contemplate the implementation of the various lines in three (3) macro phases instead of five phases, as follows:
 - Phase 1: within 10 years, everything that is already, to some degree, in the pipelines;
 - Phase 2: within 12 years, including the ECOWAS line
 - Phase 3, within 15 years, including the Western expansion and all the remaining links to the other Regional Capitals not reached with the previous phases
2. The period of development of the entire railway system will have to be between 2022 and 2036.
3. The railway link Kumasi-Techiman will have to be modified in Kumasi - Sunyani- Techiman
4. All Capitals of the new Regions will have to be reachable by rail
5. A railway line connecting to the Keta Port will have to be foreseen.

These inputs have led the Consultant to re-analyse the initial proposed scenarios, with the main purpose of redefining the development phases of the planned National Railway Network.

The modification of the phases also made it necessary to re-elaborate the Traffic Study, the results of which are presented in a new Revision of the Data Analysis Report (Ref. 379-00-MP-R-DA-1) submitted on 20th January 2020 to the MoRD and GRDA.

2. EXECUTIVE SUMMARY

2.1 INVESTMENT PLAN FOR THE NEW RAILWAY SYSTEM

The Proposed Expansion of the National Railway Network runs along several corridors in a north-south and east-west direction and, besides linking the main cities including all the new regional Capitals, also connects both existing and potential mineral deposits with the two important Ports in the Country (Takoradi and Tema) and the future Keta Harbour.

The expansion of the National Railway Network will be carried out with the **construction of new Standard Gauge lines** to ensure a more complete transportation service for the whole Country.

The study is based on the assumption that the expansion will be developed by **2035** in **three (3) main Phases of intervention** and be preceded by an **initial scenario (Phase 0)** which will be completed by the year **2022**, when the standard gauge railway lines, currently under construction, will be in operation.



Table 2-1. Proposed New Rail Network

The Table 2-1 shows the Schematic Map of the proposed phases for the expansion of the National Railway Network.

2.2 RESULTS OF THE TRAFFIC DEMAND FORECASTING

The Traffic Demand Forecasting was carried out for the (3) three proposed phases of railway development.

Despite the “conservative” approach followed, **the result of the traffic forecasts shows significant traffic flows**, both on the road network and on the railway network. In the long-term scenario (year 2036), the rail traffic demand on some corridors (mainly on Western and Eastern) will be represented by **high volumes** that are comparable to the existing volumes of some main European rail lines.

This is a consequence of both demographic development and economic development.

The outcomes of the Traffic Study indicate that the railway network will be able to absorb a percentage of the total national traffic:

- between 9.6% in 2022 and 39.4% in 2036, for freight transport
- between 4.7% in 2022 and 19.8% in 2036, for passenger transport

2.3 MAIN TECHNICAL CHARACTERISTICS

The development of the interventions has been spread over a period of 15 years. The interventions, foreseen by the Ghana Railway Master Plan, concern the construction of **3,844 km of new Standard Gauge railway lines**.

Physical characteristics and main constraints, which directly affect the technical aspects of the rail line and consequently the costs of the infrastructure, have been analysed for every rail corridor of the future National Railway System.

Starting from this analysis, the performance and Design Criteria for the New Standard Gauge Lines are proposed.

The Rolling Stock for the foreseen operations on each line of the railway network has been calculated in accordance with the Traffic Demand Forecasting.

At the 2059 horizon, the fleet results as having the following total composition

- ✓ Locomotives: N° 153
- ✓ Freight wagons: N° 1,913
- ✓ Passenger coaches: N° 975

2.4 ECONOMIC ANALYSIS

This study has been carried out according to a classical Cost-Benefit Analysis (CBA) to evaluate the economic feasibility of the foreseen investments, comparing them with the return that they will have in respect of the social benefits they produce.

The Economic Analysis is based on the comparison of the following two cases:

- The first case, called “**without Project**” is considered the normal evolution of the existing situation;

- The second case, called “**with Project**” takes into consideration the construction of new railway lines according to the plan.

The case “without Project” is represented by the **Phase 0**, which incorporates the “do nothing” scenario. New Scenarios (“with Project”), are represented by **Phases 1-2-3**, which are considered on a stand-alone basis according to an incremental approach versus Phase 0. Therefore, each Phase has been assessed on the basis of their specific capital expenditure, operating costs and benefits.

The analysis has a discontinuous characteristic, because the flow of costs and benefits may be produced at different times. For this reason, a discount rate must be used to take into account the depreciation of the currency. The Social Discount Rate in the analysis has been assumed to be 8%.

The **costs** used in the Economic Analysis, in the various phases of the Master Plan were:

- The investment over the years for the cost of the **infrastructure**, the financial value of which is approximately **US\$ 20,565.1** million, that has been reduced with a corrective factor of 0.8 to approximately **US\$ 16,452.1** million (deducting taxes, duties and excise) to obtain the **economic value**.
- The investment over the years for the cost of **rolling stock** to be purchased, the financial value of which is approximately US\$1,344.2 million, has been reduced with a corrective factor of 0.91 to approximately US\$1,223.3 million (deducting taxes, duties and excise) to obtain the **economic value**;
- The operating **costs (VOC)** per vehicle/km, as an average cost of the various categories and types of vehicles that travel on roads under various conditions.
- The cost of maintenance and operations of the infrastructures and the lines.
 - The cost of maintenance and operations of the trains (ROC), both freight and passenger. The cost per ton-km has also been calculated for heavy and standard trains and the cost per passenger-km on the basis of international experience and taking into account the local conditions.

The **benefits** that have been evaluated and quantified in the Economic Analysis in the various phases of the project are as follows:

- A **saving in transport costs** for passengers due to the lower cost of transportation by rail and for the financial operators in the various business sectors;
- A **saving on road maintenance** due to the reduced traffic and less damage as a consequence of the fewer heavy vehicles in circulation;
- A **saving due to the fewer road accidents** that will occur as a consequence of the reduced road traffic.

The CBA demonstrates a positive economic return of the Master Plan’s whole of life costs; the table below summarises the performance indicators’ results

Economic performance indicators	Value	Unit
Economic Net Present Value	8,064	M US\$
Economic Internal Rate of Return	12.7%	%
Economic Benefits to Cost Ratio	1.6	ratio

Table 2-2. Economic performance indicators

2.5 ENVIRONMENTAL AND SOCIAL ASSESSMENT

All the potential environmental and social impacts (positive and negative) associated with the implementation of the Ghana Railway Network have been adequately studied.

This analysis has been carried out for all projects under the RMP, including construction, re-construction, rehabilitation, decommissioning, scrapping, realignment, installations, etc., of the railway network and infrastructure in Ghana, and the results have been presented in the Environmental and Social Management Framework (ESMF) prepared by the Centre for Environment & Health Research & Training (CEHRT). The ESMF provides the required environmental and social assessment and safeguards framework, institutional arrangements and capacity required to identify and mitigate potential risks/impacts of actions (under the RMP), as well as monitoring the overall implementation. It also primarily guides the individual project-level EA screening, assessment and mitigation of impacts, as well as management and monitoring requirements.

Thus, the ESMF will enable GRDA and the Ministry of Railways Development (MoRD) to address the adverse environmental and social impacts arising from or induced by the RMP implementation; and to collaborate with various stakeholders in the rail transport sector. The ESMF also represents a statement of policy, guiding principles and procedures of reference with respect to railway sector projects, consistent with requirements of the LI 1652, and agreeable to key stakeholders.

The updated ESMF in full is attached to this report in the Annex 1: Environmental and Social Management Framework.

2.6 RAILWAY MARKET RESEARCH: OUTCOMES FROM A SURVEY

A Railway Market Research was undertaken to provide important information which will help to identify and analyse:

- the needs of the market in the railway sector in Ghana,
- the market size and the competition,
- the level of interest of private citizens/users in the development of the railway network in Ghana and
- the “willingness to pay” (i.e. the most a user will spend for the service).

The general results obtained have given an extremely positive outlook on the possibility of expanding and modernizing the railway system and improving rail services in Ghana.

Current railway users have a favourable opinion of the services provided and their benefits, and potential customers seem to be open to all the advantages they associate with railway travel.

Trains are perceived to be not only among the fastest means of transportations, but also among the safest, coming right behind private cars and taxis.

Unlike trains, cars and taxis are negatively impacted by the very relevant disadvantage of being also the most expensive ways to travel.

Trains are also considered to be comfortable, almost as much as the more expensive private cars and taxis, and more comfortable and faster than travelling by trotro/bus (see Figure 2-5).

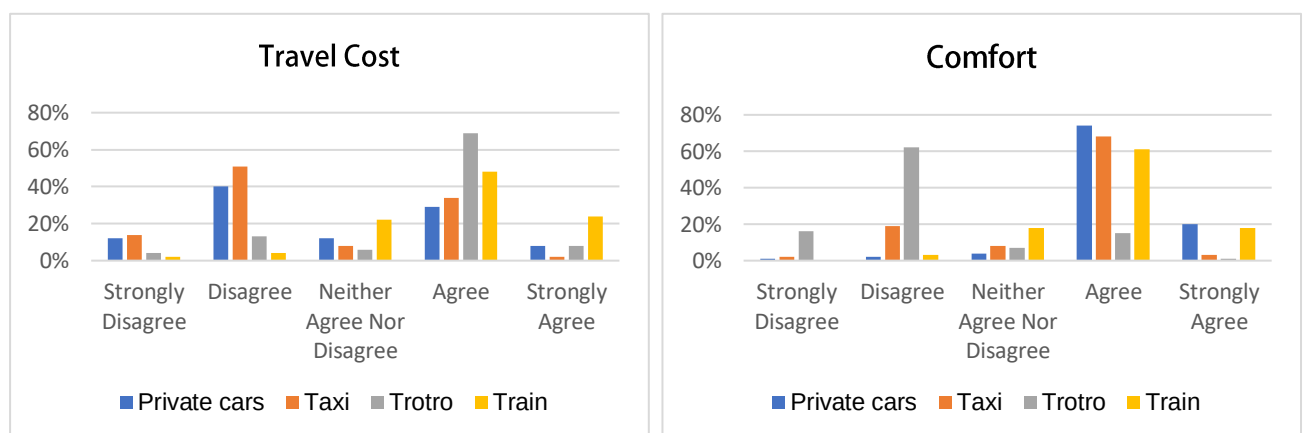


Figure 2-1. Advantages in travel cost and comfort of various means of transportation

According to potential users, the most important improvements that would be induced by this railway expansion, include a boost to trade, tourism and local economy (99% of interviewees), the growth of employment opportunities (98% of interviewees), the enhancement of socio-cultural integration (92% of interviewees), the reduction of transportation times (89% of interviewees), the enhancement of quality of community life (87%), the reduction of transportation cost and traffic congestion on roads (82% of respondents). The following Figure 2-6 shows the main effects of the railway expansions, according to interviewees.

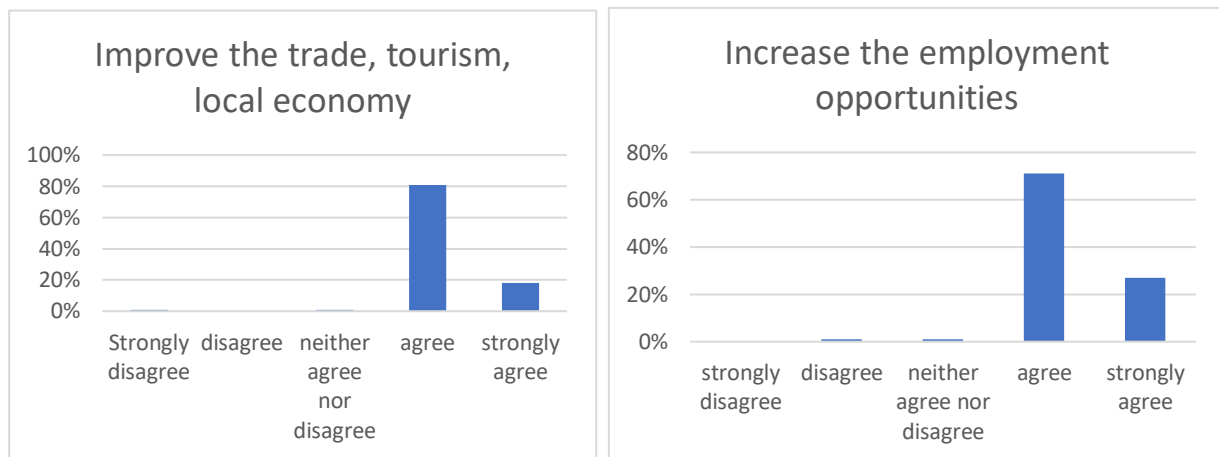


Figure 2-2. Perceived opportunities from Railway development: economy and employment

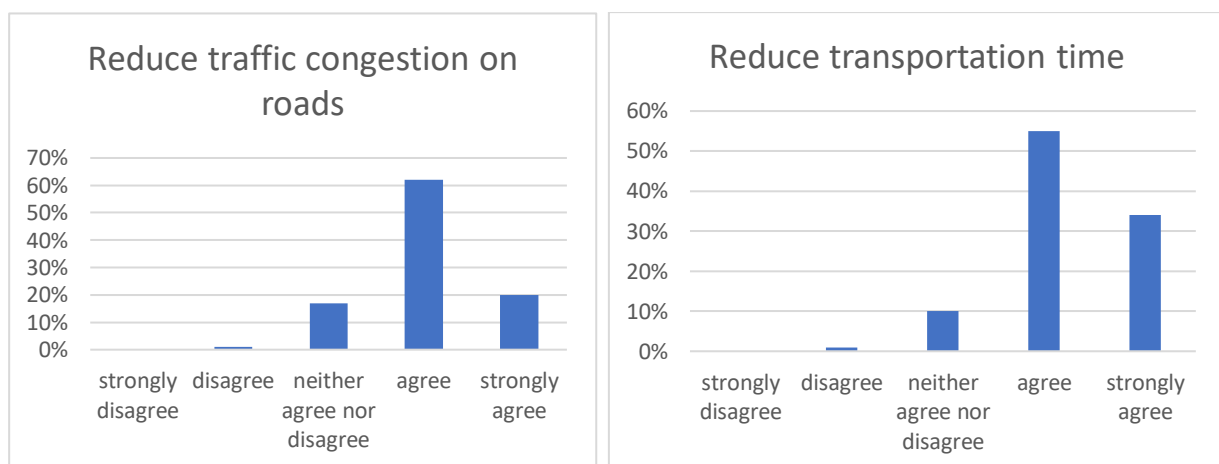


Figure 2-3. Perceived opportunities from Railway development: traffic and transportation time

2.7 FINANCIAL ANALYSIS

The Financial Analysis examines the financial investments of the total of the proposed Phases of the new Railway Master Plan (20,565.1 M US\$ for the infrastructure and 1,344.2 MUS\$ for the rolling stock), operating expenses and the operative revenues, according to the priority programme derived from the Economic Analysis.

The Financial Analysis is conducted over a **long period (2022 – 2059)**, thus providing the scenario with a 32 years analysis starting from the first phases to be implemented (Phase1A+B).

The outcomes of the Financial Analysis of all interventions are reported in the table below:

Financial performance indicators	Value	Unit
Financial Net Present Value	- 8,911	M US\$
Financial Internal Rate of Return	2.1%	%

Table 2-3. Financial performance indicators

The operating profit from operations (before deduction of financial interests) is positive from the 6th year of the analysed scenario. However, railways are very capital intensive projects with huge upfront disbursements: this means a great burden of financial interests to be paid, which offsets the same profitability from operations. In the Master Plan financial projection exercise carried out, this trend only inverts starting from the 16th year onwards, when profit (before tax computation) is generated.

The calculated financial F-IRR and the specific cost profile of railway operations induces the opportunity for conceiving some form of subsidy in order to render railway projects attractive also to private investors.

2.8 SOURCES OF FUNDING FOR THE MP IMPLEMENTATION

Considering that infrastructural projects implemented in Africa require an appropriate analysis of different available options, in Chapter 8 a carefully analysis of main national and international funding has been reported, suggesting that involvement of many (actual and potential) stakeholders in the railway scenario is a realistic and pragmatic approach in order to optimize achievements in the Master Plan's implementation

2.9 THE EVOLUTION OF PPP ARRANGEMENTS IN THE RAILWAY SECTOR

Africa is becoming more and more attractive for infrastructure financing in many sectors, such as energy, telecoms and transportation. Nevertheless, investment in railways is still small compared to other sectors.

Over recent years, with the assistance of International Financial Institutions, several countries in Africa have been concessioning their railways, through different typologies of PPPs, with the objective of attracting private finance to invest in rail infrastructure. For different reasons, however, the results have been mixed.

In order to better understand different PPP experiences, the study of the main PPP railway projects worldwide and in Africa has been carried out, highlighting in particular three distinct cases with diverse outcomes:

1. A good result in Cameroon: Camrail;
2. An unsuccessful case in Zambia: RSZ
3. A different approach in Morocco: ONCF (owed by Government)

At the same time, a few cases in European and international context are presented.

3. INVESTMENT PLAN FOR THE NEW RAILWAY SYSTEM

3.1 DESCRIPTION OF PHASES

The New Ghanaian Railway Network will be implemented in **(3) three successive Phases** in terms of traffic demand and national strategic development.

The Proposed Expansion of the National Railway Network runs along several corridors in a north-south and east-west direction and, besides linking the main cities including all the new regional Capitals, also connects both existing and potential mineral deposits with the two important Ports in the Country (Takoradi and Tema) and the future Keta Harbour.

The expansion of the National Railway Network will be carried out with the **construction of new Standard Gauge lines** to ensure a more complete transportation service for the whole Country.

The development of the New Railway Network will be implemented in successive phases, based on the priorities for the traffic demand and considering, simultaneously, the strategic importance of each railway link for the development of the Country.

The study assumes that the expansion will be developed by **2035** in **three (3) main Phases of intervention** as follows:

- **Phase 1** foresees the construction and operation by **2030** of the following lines:
 - the completion of the **SG Western Railway Line and its branch**, including the first section under construction from Takoradi to Tarkwa (66 km) and the two new sections Tarkwa- Kumasi (200 km) and Dunkwa-Awaso (73 km);
 - the **SG Eastern Railway Line and its spur to Kibi (351 km)**
 - the completion of the **Ghana - Burkina Faso Interconnectivity Project (690 km)**, of which the first section Tema-Akosombo-Mpakadan (93km) is already under construction
 - the **Central Spine Railway (383 km)**, linking Kumasi to the Ghana- Burkina Faso Railway through Tamale Central Spine.
- **Phase 2** introduces the new **TransECOWAS rail (557 km)** in operation by 2032. This new line will put in place the west-east connection and the integration of Ghana within the ECOWAS region.
- **Phase 3** is forecasted to be in operation by 2035, with:
 - the **Western Expansion** Awaso-Sunyani/Techiman-Sawla-Hamile **(602 km)**
 - the **Transversal Expansion (383 km)**, including the three following sections: Fufulsu-Sawla, Techiman-Atebubu-Kwadwokuro, Nyinahin-Kumasi;
 - the Links to the **new regional Capitals (336 km)**: Walewale-Nalerigu/ Dambai-Nkwanta/ Nyinahin-Goaso/Awaso-SefwiAwaso

- the connection of the Ghana - Burkina Faso Corridor with the **Keta Harbour (126 km)**.

Moreover, a **Phase 0** has been considered in this analysis, including the investments already made in the railway sector. These regard the railway lines listed below, which are forecasted to be operational starting from year 2022:

- Western line (Takoradi – Tarkwa)
- Ghana - Burkina Faso Lot. 1 (Tema - Akosombo - Mpakadan)
- Volta Lake Waterways System
- Eastern Line (rehabilitation Accra-Nsawam section)

Figure 3-1 shows the Schematic Map of the Proposed New Rail Network, on which all phases of the expansion are drawn.

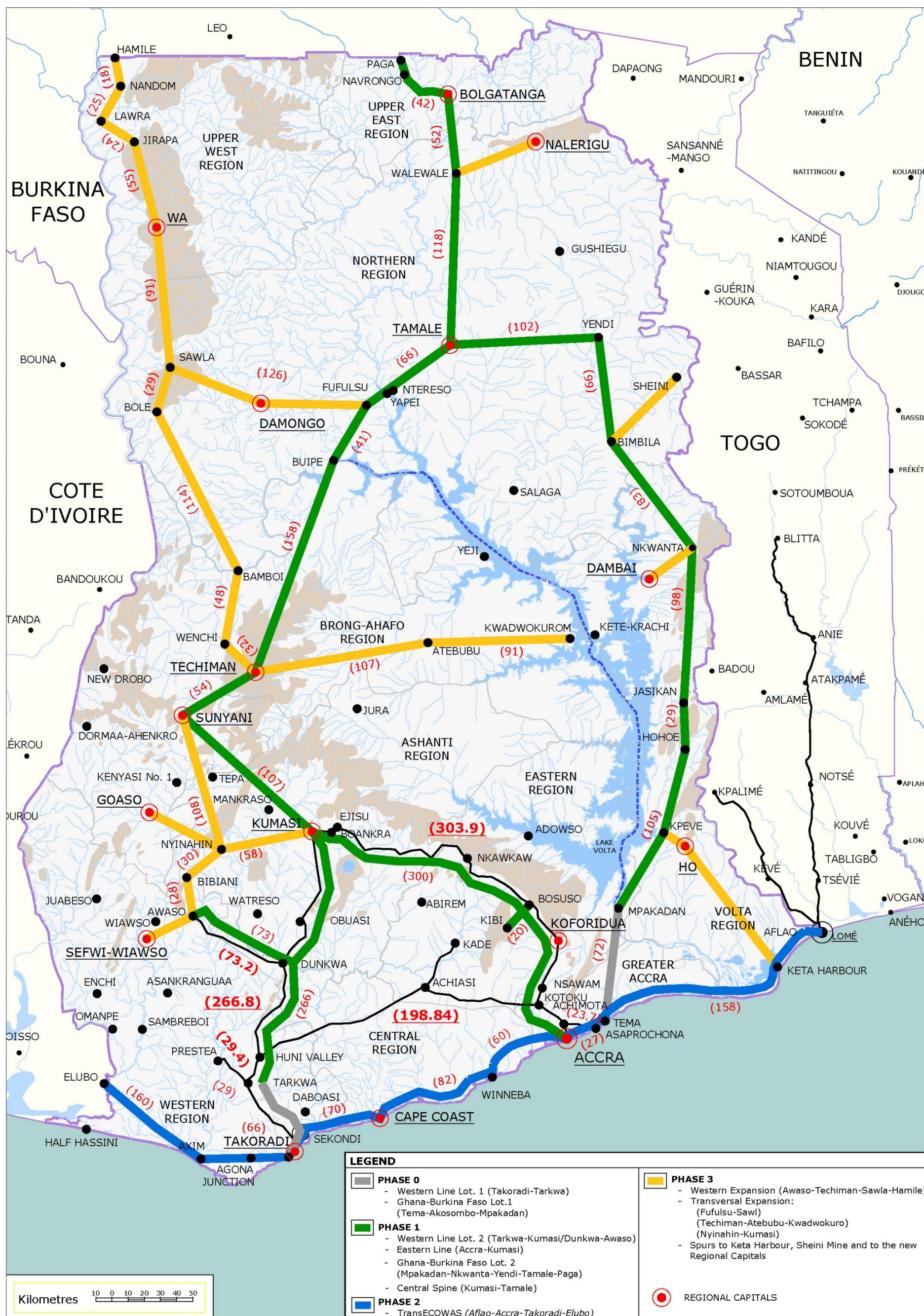


Figure 3-1. Schematic Map of Proposed New Rail Network

The following Table 3-1 summarizes the phases studied for the expansion of the National Railway Network, specifying each section and the related length.

PHASES	Length approx. (km)	Operational starting from
PHASE 0	163	
Western Line (Takoradi-Tarkwa)	66	2022
Ghana-Burkina Faso Lot. 1 (Tema-Akosombo-Mpakadan)	97	
PHASE 1 A	624	
Western Line (Tarkwa-Kumasi/Dunkwa-Awaso)	273	2027
<i>Tarkwa-Kumasi</i>	200	
<i>Dunkwa-Awaso</i>	73	
Eastern Line (Accra-Kumasi) spur to Kibi	351	
PHASE 1 B	690	
Ghana-Burkina Faso Lot. 2 (Mpakadan-Nkwanta-Yendi-Tamale-Paga)	690	2027
<i>Mpakadan-Nkwanta-Yendi</i>	376	
<i>Paga-Tamale-Yendi</i>	314	
PHASE 1 C	426	
Central Spine (Kumasi-Tamale)	426	2031
<i>Kumasi-Bechem-Sunyani</i>	107	
<i>Sunyani-Techiman</i>	54	
<i>Techiman-Tamale</i>	256	
PHASE 2	557	
TransEcowas (Aflao-Accra-Takoradi-Elubo)	557	2033
<i>Aflao-Tema-Accra</i>	185	
<i>Accra-Takoradi</i>	212	
<i>Takoradi - Elubo</i>	160	
PHASE 3	1,384	
Western Expansion (Awaso-Techiman-Sawla-Hamile)	602	2036
<i>Awaso-Sunyani</i>	166	
<i>Techiman-Sawla</i>	223	
<i>Sawla-Hamile</i>	213	
Transversal Expansions	383	
<i>(Transversal 1) Fufulsu-Sawl</i>	126	
<i>(Transversal 2) Techiman-Atebubu-Kwadwokuro</i>	199	
<i>(Transversal 3) Nyinahin-Kumasi</i>	58	
Links to new Capitals	210	
<i>Walewale-Nalerigu</i>	52	
<i>Nyinahin-Goaso</i>	70	
<i>Awaso -SefwiAwaso</i>	30	
<i>Dambai- Nkwanta</i>	58	
Link to Sheini	63	
Link to Keta Harbour	126	
TOTAL	3,844	2022-2036

Table 3-1. Proposed phases for the expansion of the National Railway Network

3.2 RESULTS OF THE TRAFFIC DEMAND FORECASTING

The Traffic Demand Forecasting was carried out for the development phases described in the previous paragraph 3.1.

Traffic forecasts are of outstanding importance for the estimation of the different investments, because they can give an idea of their relative impact. The approach followed was based on available statistical data and it can be defined as conservative.

The increase in passenger traffic demand has been linked only to the change in population in the areas of origin of the movements; and the increase in goods traffic to the variation of the gross domestic product. No additional expansive effects have been introduced. These choices were the consequences of a “reasoned path”, following a careful analysis of the available data and the recent macroeconomic and demographic developments in Ghana.

The updated transport model was based on TransCAD, following the same choices already carried out for the previous version of the Ghana Railway Master Plan. The update was elaborated by creating a calibrated scenario based on the situation at year 2018 (current situation) and, therefore, on a scenario of transport demand and offer that reflects the present fact of the absolute prevalence of road transport over the other modes (rail, internal waterways).

The following Figure 3-2 shows the flowchart summarizing the methodology followed for the Traffic Study

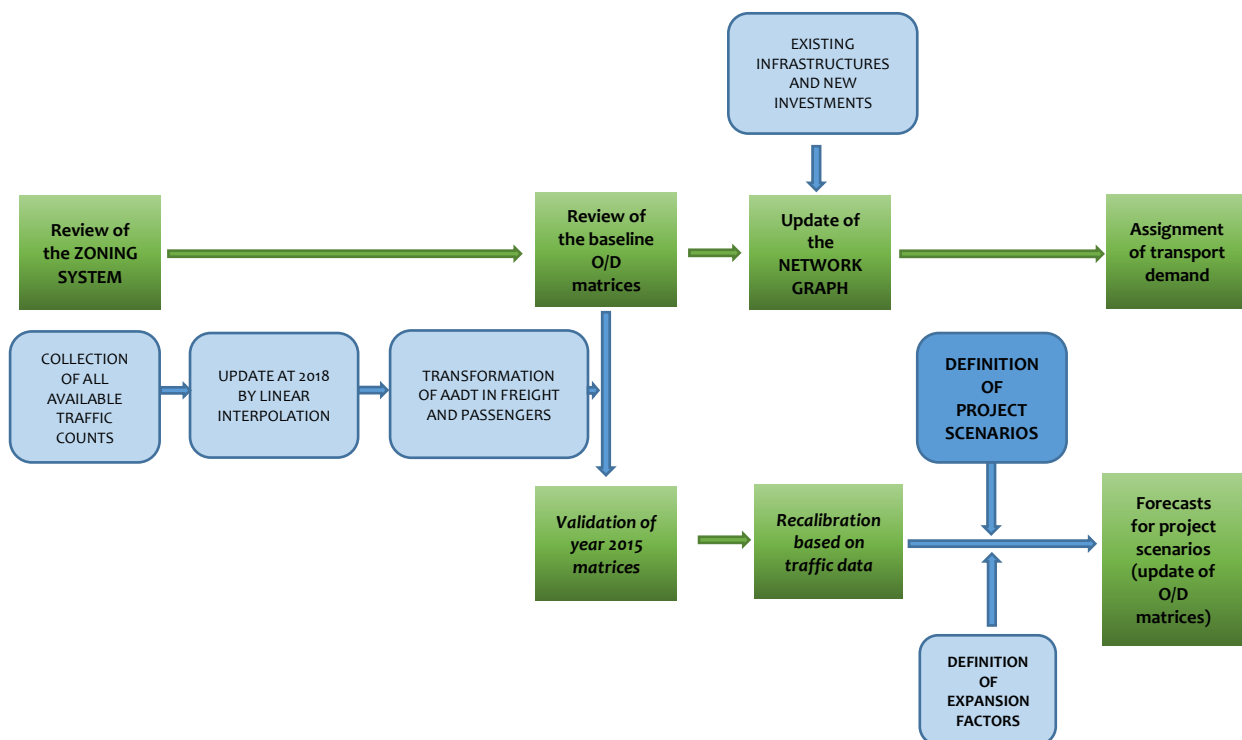


Figure 3-2. Flowchart summarizing the Methodology followed for the Traffic Study

Despite the “conservative” approach followed, **the result of the traffic forecasts shows significant traffic flows** both on the road network and on the railway network. In the long-term scenario, the rail traffic demand on some corridors (mainly on Western and Eastern) will be represented by high volumes that are comparable to the existing volumes of some main European rail lines. This is a consequence of both demographic development and economic development.

Clearly, the traffic forecast model is more reliable for short term scenarios and less reliable for long-term horizons. To quantify this reliability in terms of positive and negative percentages is a difficult exercise, given the number of variables involved; therefore, the Consultant prefers to give this information only as a qualitative factor. High rail traffic will be possible with a remarkable increase of population and GDP, but it must be supported by adequate investments and by a high-quality maintenance policy.

The results of the traffic model are widely presented in the **Data Analysis Report (Ref: 379-00-MP-R-DA-1)** submitted to GRDA and MoRD in January 2019, in which detailed information about rail and road traffic flows on the main corridors are given.

The outcomes of the Traffic Study indicate that the railway network will be able to absorb a percentage of the total national traffic:

- between 9.6% in 2022 and 39.4% in 2036, for freight transport
- between 4.7% in 2022 and 19.8% in 2036, for passenger transport

The distribution between road and rail networks of the freight and passenger traffic is shown in the graphs in Figure 3-3 and Figure 3-4 respectively.

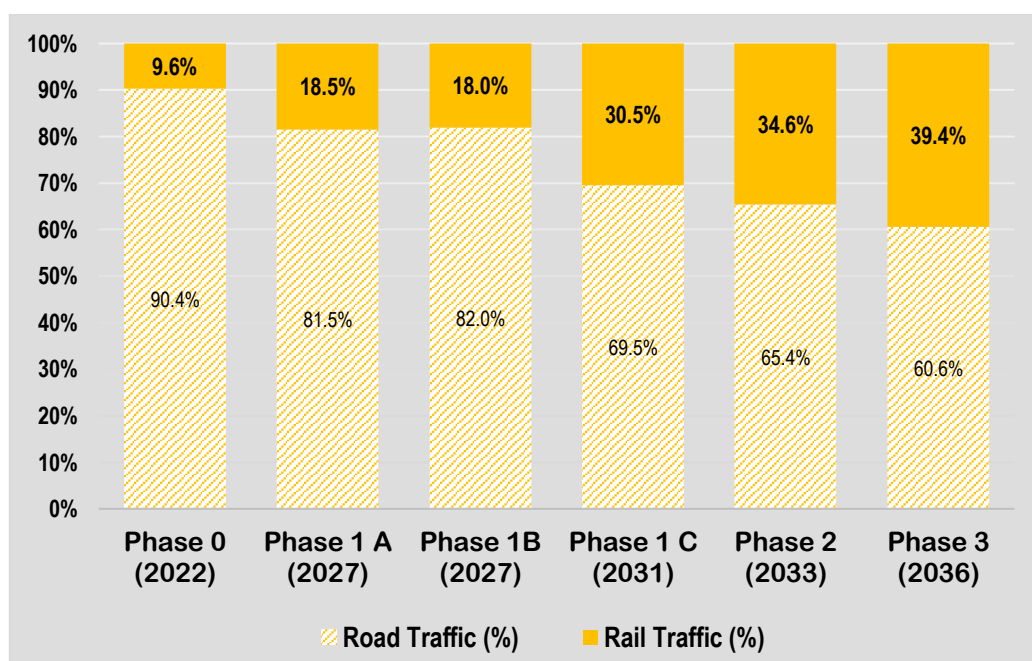


Figure 3-3. Freight Traffic - Road and Railway (Phase 0 - Phase 3)

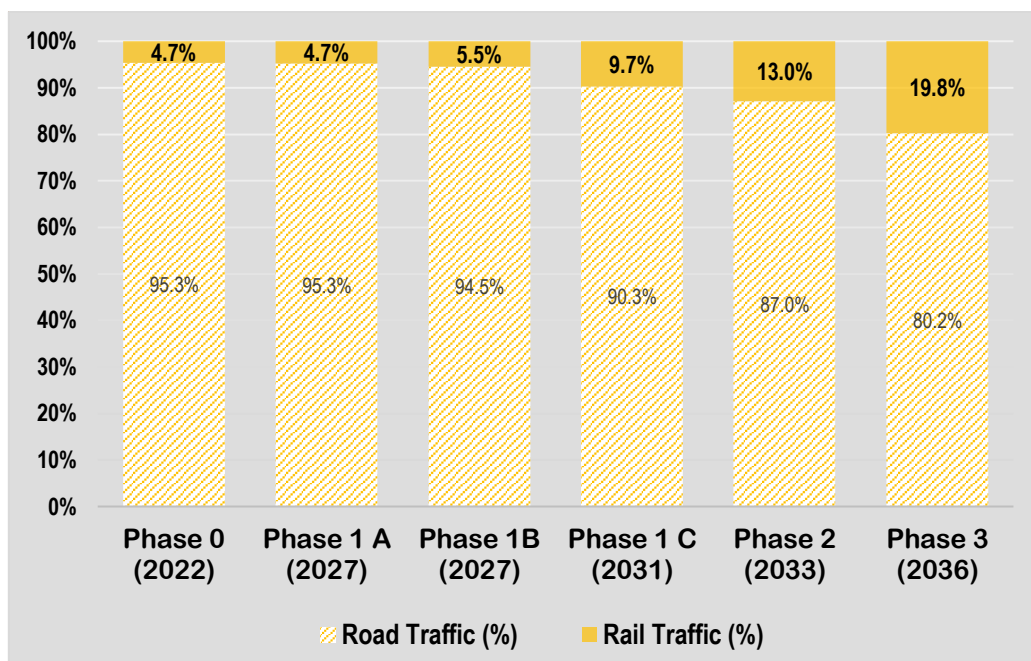


Figure 3-4. Passenger Traffic - Road and Railway (Phase 0 - Phase 3)

The following Table 3-2 and Table 3-3 summarize the results of the road and rail traffic demand forecasting for freight and passengers.

Table 3-2. Freight Traffic - Summary of all Phases

MAIN CORRIDORS	Phase 0			Phase 1 A			Phase 1B			Phase 1 C			Phase 2			Phase 3		
	Road (tons/day)	Rail (tons/day)	%Rail	Road (tons/day)	Rail (tons/day)	%Rail	Road (tons/day)	Rail (tons/day)	%Rail	Road (tons/day)	Rail (tons/day)	%Rail	Road (tons/day)	Rail (tons/day)	%Rail	Road (tons/day)	Rail (tons/day)	%Rail
Western Corridor	18,011	4,943	21.5%	17,083	9,635	36.1%	17,091	9,622	36.0%	17,332	13,905	44.5%	17,848	14,774	45.3%	17,029	18,049	51.5%
Eastern Corridor	22,697	206	0.9%	26,082	5,088	16.3%	26,273	5,774	18.0%	24,386	17,171	41.3%	25,185	18,616	42.5%	27,717	13,575	32.9%
Central Spine	5,365	0	0.0%	6,855	0	0.0%	6,536	0	0.0%	9,308	4,645	33.3%	9,984	5,087	33.8%	10,809	3,137	22.5%
ECOWAS Corridor	15,748	0	0.0%	18,238	0	0.0%	18,240	0	0.0%	20,206	0	0.0%	18,342	5,984	24.6%	16,199	9,455	36.9%
Western Expansion	7,495	0	0.0%	9,533	0	0.0%	9,533	0	0.0%	10,374	0	0.0%	11,139	0	0.0%	7,897	5,680	41.8%
Ghana-Burkina Faso	7,330	3,122	29.9%	8,384	5,069	37.7%	6,526	3,389	34.2%	7,569	4,016	34.7%	8,174	4,347	34.7%	9,951	3,637	26.8%
Transversal 1	453	0	0.0%	574	0	0.0%	574	0	0.0%	705	0	0.0%	836	0	0.0%	852	454	34.8%
Transversal 2	312	0	0.0%	396	0	0.0%	396	0	0.0%	485	0	0.0%	576	0	0.0%	-	704	n.a
Transversal 3	204	0	0.0%	259	0	0.0%	259	0	0.0%	317	0	0.0%	372	0	0.0%	3,866	20,408	84.1%
Link to Keta Port			0.0%			0.0%			0.0%			0.0%			0.0%	13,136	3,383	20.5%
Dambai - Nkwanta			0.0%			0.0%			0.0%			0.0%			0.0%	6,690	2,230	25.0%
Walewale - Nalerigu			0.0%			0.0%			0.0%			0.0%			0.0%	8,910	2,970	25.0%
Nyihain - Goaso			0.0%			0.0%			0.0%			0.0%			0.0%	2,400	800	25.0%
Awaso - Sefwi Wiawso			0.0%			0.0%			0.0%			0.0%			0.0%	8,952	2,984	25.0%

Table 3-3. Passenger Traffic- Resume of all Phases

MAIN CORRIDORS	Phase 0			Phase 1 A			Phase 1B			Phase 1C			Phase 2			Phase 3		
	Road (pass/day)	Rail (pass/day)	%Rail	Road (pass/day)	Rail (pass/day)	%Rail	Road (pass/day)	Rail (pass/day)	%Rail	Road (pass/day)	Rail (pass/day)	%Rail	Road (pass/day)	Rail (pass/day)	%Rail	Road (pass/day)	Rail (pass/day)	%Rail
Western Corridor	50,735	4,260	7.7%	54,532	5,544	9.2%	54,502	5,468	9.1%	54,532	8,969	17.1%	56,364	8,969	13.7%	58,547	9,355	13.8%
Eastern Corridor	75,933	7,671	9.2%	81,993	8,141	9.0%	82,014	8,141	7.7%	85,669	15,700	11.5%	85,666	15,700	15.5%	89,236	17,843	16.7%
Central Spine	18,746	0	0.0%	20,866	0	0.0%	20,866	0	0.0%	24,916	2,866	9.7%	27,282	2,866	9.5%	28,210	4,108	12.7%
ECOWAS Corridor	89,034	0	0.0%	97,400	0	0.0%	97,510	0	9.0%	103,547	15,944	0.0%	91,908	15,944	14.8%	100,877	23,565	16.6%
Western Expansion	16,774	0	0.0%	18,576	0	0.0%	18,576	0	0.0%	21,054	0	0.0%	21,088	0	0.0%	16,708	5,896	26.1%
Ghana-Burkina Faso	15,353	2,083	11.9%	17,040	3,022	15.1%	15,442	4,140	21.1%	15,437	4,369	21.1%	17,261	4,369	20.2%	18,477	4,366	19.9%
	0			0			0			0			0			0	0	
Transversal 1	1,428	0	0.00%	1,572	0	0.00%	1,573	0	0.0%	1,717	0	0.0%	1,928	0	0.0%	1,806	1,483	45.1%
Transversal 2	12,735	0	0.00%	14,111	0	0.00%	14,111	0	0.0%	15,186	0	0.0%	16,881	0	0.0%	11,257	5,338	32.2%
Transversal 3	5,134	0	0.00%	2,516	0	0.00%	2,520	0	0.0%	2,664	0	0.0%	3,004	0	0.0%	2,910	945	24.5%
	0			0												0	0	
Link to Keta Port		0	0.00%		0	0.00%			0.0%							26,471	11,717	30.7%
Dambai - Nkwanta		0	0.00%		0	0.00%			0.0%							2,350	1,300	35.6%
Walewale - Nalerigu		0	0.00%		0	0.00%			0.0%							1,750	500	22.2%
Nyihain - Goaso		0	0.00%		0	0.00%			0.0%							3,750	1,100	22.7%
Awaso - Sefwi Wiawso		0	0.00%		0	0.00%			0.0%							4,160	3,037	42.2%

The next figures, from Figure 3-5 to Figure 3-8, contain the rail and road traffic flow-diagrams for the freight and passenger transport demand at year 2036, when all the foreseen Phases of the National Railway Master Plan will be implemented.

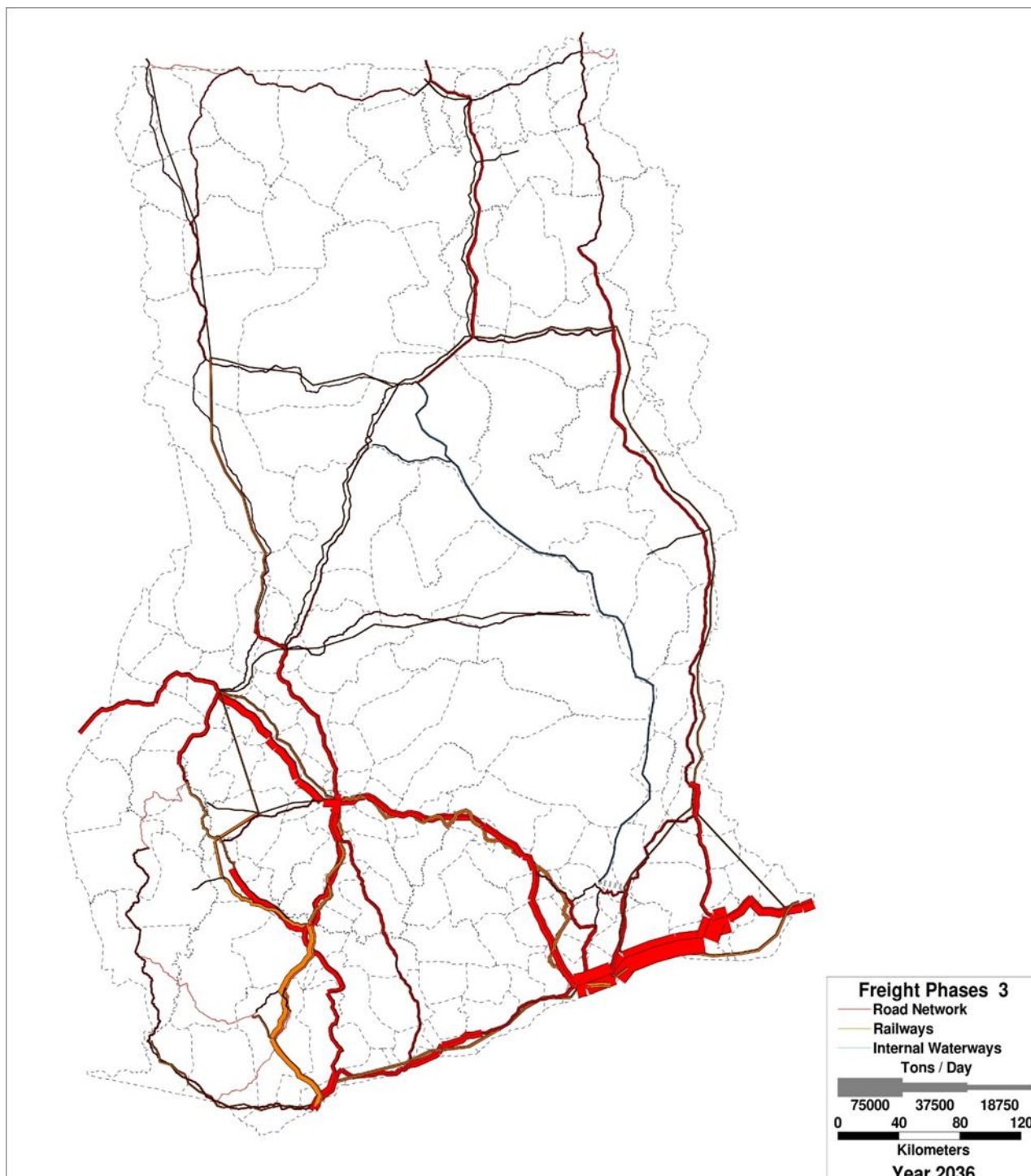


Figure 3-5. Freight traffic flows assigned for Phase 3 at year 2036 (entire Transport Network)

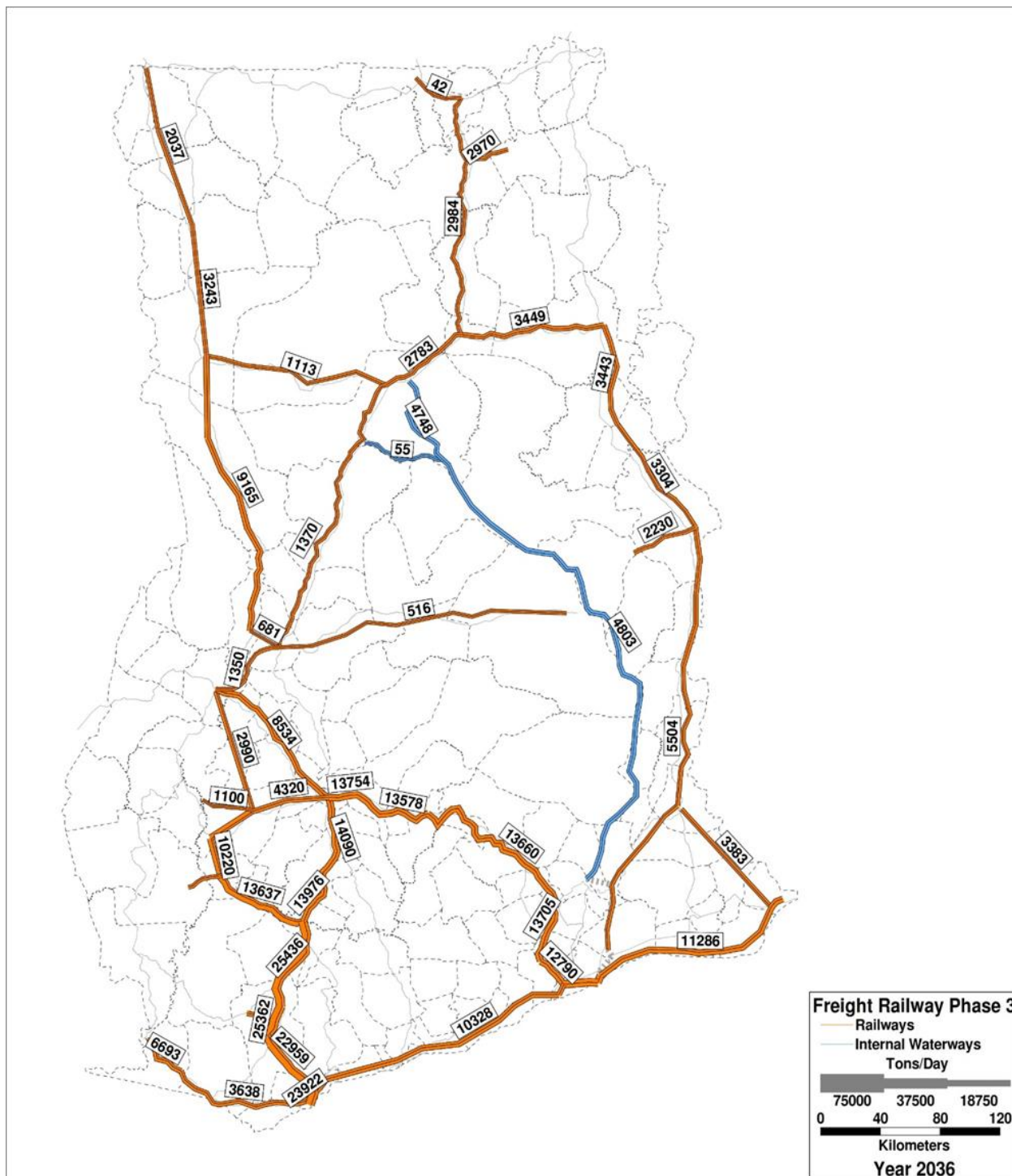


Figure 3-6. Freight traffic flows assigned for Phase 3 at year 2036 (Railway Network)

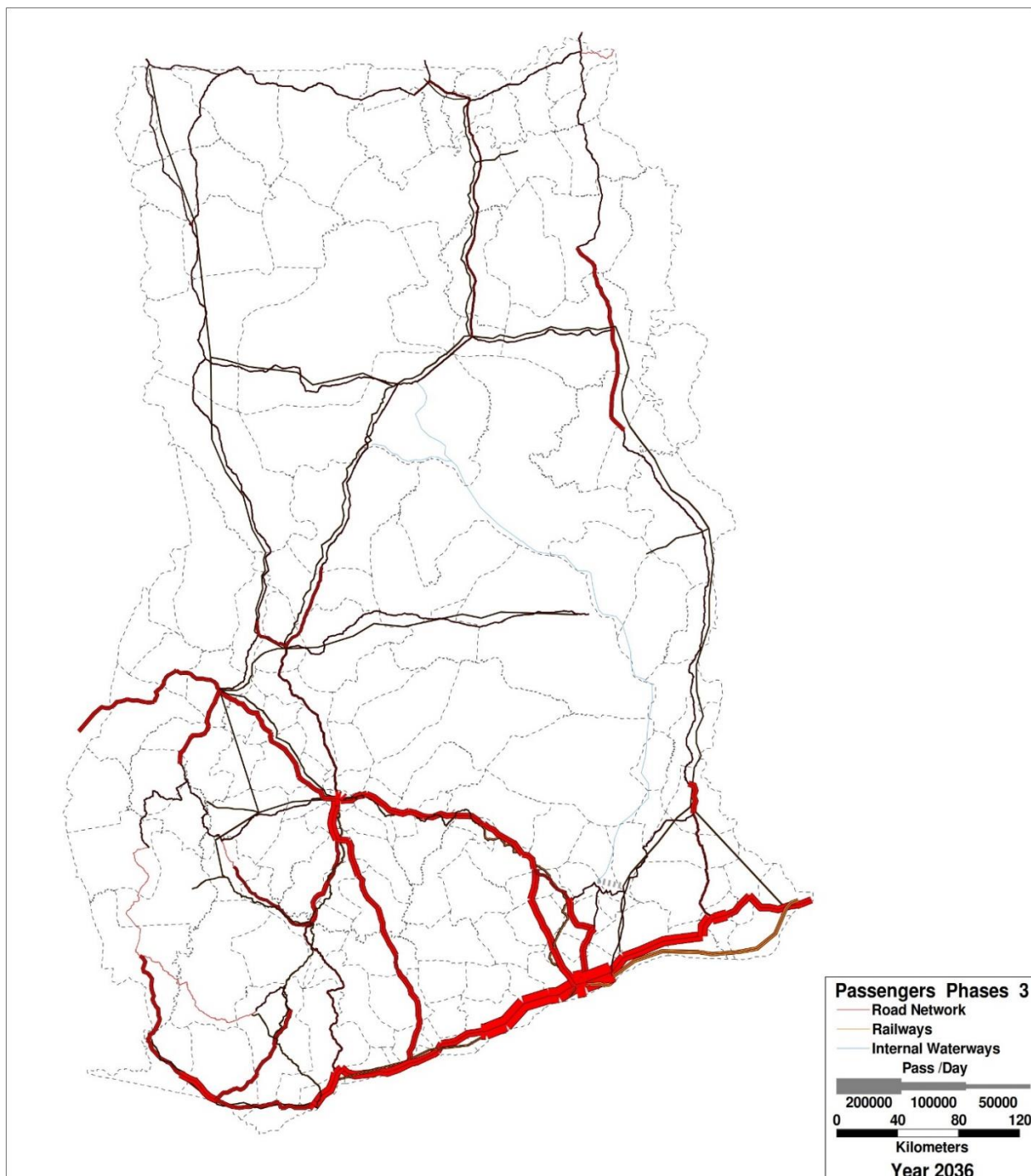


Figure 3-7. Passenger traffic flows assigned for Phase 3 at year 2036 (entire Transport Network)

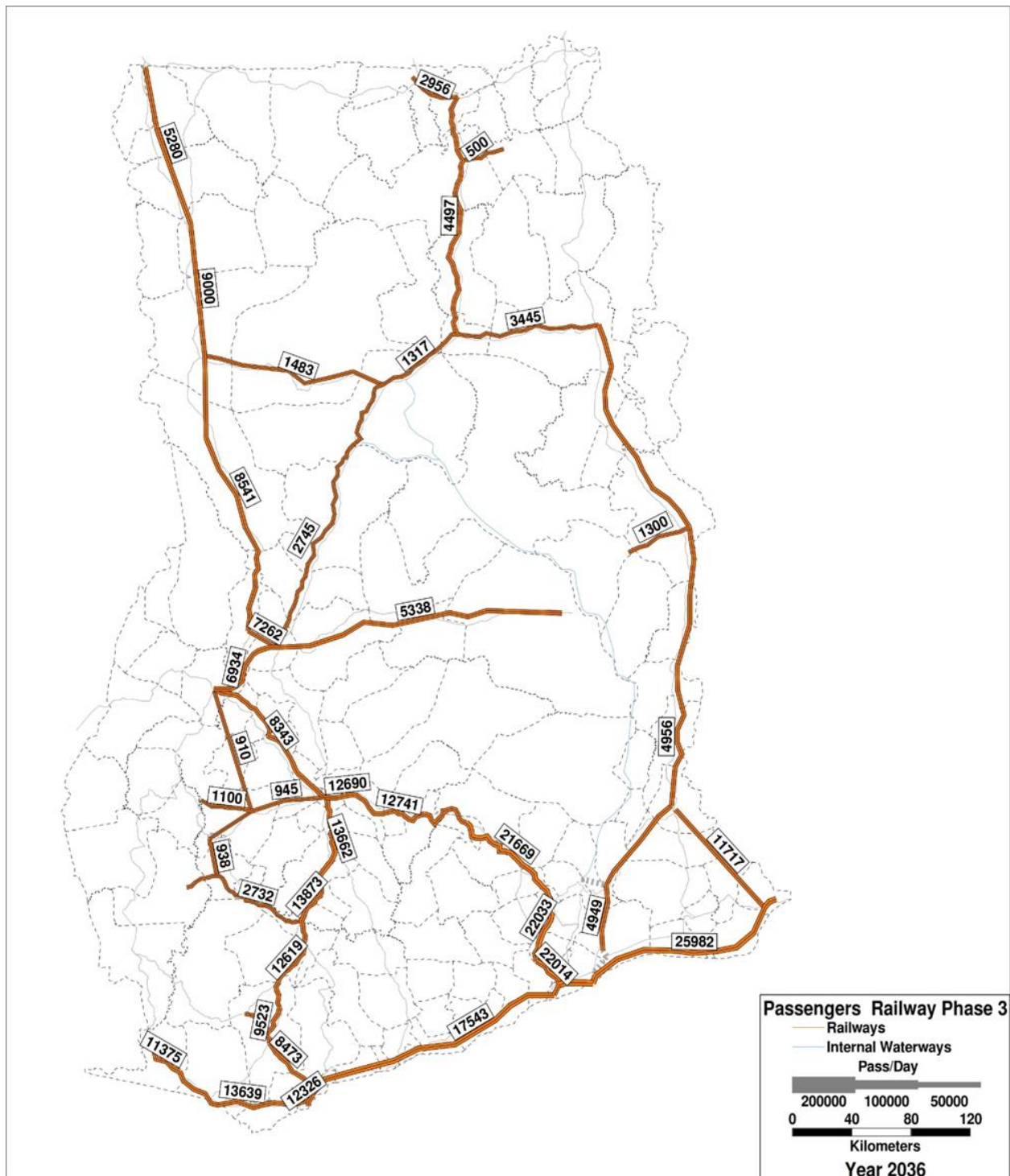


Figure 3-8. Passenger traffic flows assigned for Phase 3 at year 2036 (Railway Network)

3.3 OVERALL IMPLEMENTATION PLAN

The development of the interventions foreseen by the Ghana Railway Master Plan has been spread over a period of **15 years**. The interventions concern the construction of new standard gauge railway lines, for approximately a **total length of 3,844 km**. Two lines of the Phase 0, a section of the Western line and the Tema - Akosombo - Mpakadan line, are currently under construction.

		0123456789101112131415																						
YEAR		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035						
RAILWAY LINES	L (km)	PHASE 1 (A+B+C)												PHASE 2	PHASE 3	km/year								
PHASE 0	163																							
Western Line Lot.1	66																							
Takoradi - Tarkwa	66	1	1	1														22.0						
Ghana-Burkina Faso Lot.1	97																							
Tema-Akosombo-Mpakadan	97	1	1	1														32.3						
PHASE 1 A	624																							
Western Line Lot.2	273																							
Tarkwa-Kumasi	200			1	1	1	1	1	1									33.3						
Dunkwa-Awaso	73							1	1	1								24.3						
Eastern Line (spur to Kibi)	351			1	1	1	1	1	1									58.5						
PHASE 1 B	690																							
Ghana-Burkina Faso Lot.2	690																							
Mpakadan - Nkwanta - Yendi	376			1	1	1	1	1	1									62.7						
Yendi -Tamale - Paga	314			1	1	1	1	1	1									52.3						
PHASE 1 C	426																							
Central Spine (Kumasi-Tamale)	426																							
Kumasi-Bechem-Sunyani	107				1	1	1	1	1									21.4						
Sunyani-Techiman	54											1	1	1					18.0					
Techiman-Tamale	265											1	1	1	1					66.3				
PHASE 2	557																							
TransEcowas	557																							
Aflao - Tema - Accra	185										1	1	1	1	1	1				30.8				
Accra - Takoradi	212										1	1	1	1	1	1				35.3				
Takoradi - Elubo	160										1			1	1	1	1				32.0			
PHASE 3	1,384																							
Western Expansion	602																							
Awaso-Sunyani	166										1	1	1	1	1	1	1	1	1	18.4				
Techiman-Sawla	223										1	1	1	1	1	1	1	1	1	24.8				
Sawla-Hamile	213										1	1	1	1	1	1	1	1	1	23.7				
Transversal Expansions	383																							
Fufulsu-Sawla	126																		1	1	1	1	1	25.2
Techiman-Atebubu-Kwadwokurom	199																		1	1	1	1	1	39.8
Nyinahin-Kumasi	58																		1			1	1	19.3
Links to new Capitals	210																							
Walewale-Nalerigu	52																		1	1				26.0
Nyinahin-Goaso	70																		1			1	35.0	
Awaso -SefwiAwaso	30																		1			30.0		
Dambai- Nkwanta	58																		1			1	29.0	
Link to Sheini	63																		1			1	31.5	
Link to Keta Harbour	126																		1	1	1	1	1	25.2
Total km of railway under construction each year		54.3	54.3	261.2	228.2	228.2	252.6	252.6	252.6	217.3	249.3	249.3	231.3	281.3	281.3	241.4	271.9	236.9						

Figure 3-9. Implementation Programme.

3.4 PRESENT RAILWAY SYSTEM

3.4.1 INFRASTRUCTURE

Ghana's existing rail network is confined mostly to the southern part of the country which is economically more advanced and has a higher population density.

The railway network consists of approx. 940 km of 1067mm gauge tracks for a total of 1200km of track located in the south of Ghana. The railway is predominantly single-track (except for a 30km stretch from Takoradi to Manso which is double track) and uses diesel-electric motive power.

The main network lines are designated **Western Line** (Takoradi-Kumasi), **Eastern Line** (Accra-Kumasi), and **Central Line**, which connects the Western and Eastern Lines running parallel to the coast and about 80km inland. The network has five branch lines: the Sekondi, Prestea and Awaso Branches originating from the Western Line; the Tema Branch originating from the Eastern Line; and the Kade Branch originating from the Central Line.

Most of the network is currently in a poor condition and is either closed for operation or running very limited services. Out of a total length of 947 km of rail, only 120 kilometres were operational in 2017.

The **Central Line** and **Kade** Branches are not presently active.

The **Accra-Tema** line (of about 20 km), and **Nsawam-Accra** line (of 41 km), both used exclusively for passenger traffic, are currently the only two operative stretches of the **Eastern Line**.

The only railway lines operating along the **Western Line** are the **Nsuta - Takoradi Harbour** line for freight traffic (manganese) and the **Takoradi-Kojokrom-Sekondi** rail line for passengers.

Currently, the Government-owned Ghana Railway Company Ltd (GRCL) operates the railway system.

3.4.1.1 Track

Since construction, the Western Line has been partially realigned and the first 30.6km from Takoradi northward to Manso have been double-tracked. With the exception of the Prestea Branch, all GRC lines have favourable horizontal and vertical alignments, which should contribute to an efficient railway operation.

Passing Loop lengths vary from station to station, but are around 400m on the average over the network. Passing Loops at junction points and key stations are longer than at other stations. The most restrictive passing loop lengths are on the Eastern Line, where many of the loops are less than 300m in length. Main characteristics of railway alignment and axle load are summarized below.

NETWORK	LENGTH	GRADE	ALLOWABLE AXLE LOADING (tons)
Western Line	201m	1.25 %	16 t
Eastern Line	201m	1.25%	13.5 t
Central Line	201m	1.25%	12.5 t
Central Line	291m	1.00%	12.5 t
Prestea branch	103m	2.50%	12.5 t
Awaso Branch	291m	1.25%	16 t
Tema Branch	349m	1.00%	16 t
Kade Branch	201m	1.25%	12.5 t

Table 3-4. Alignment and Load Characteristics of Existing Railway Network

FROM	TO	DISTANCE	RAIL	SLEEPER	FASTENING
Takoradi	Manso	30.6km	80	Wood/steel	Rigid/elastic
Manso	Huni Valley	58.3km	90	Wood/steel	Rigid/elastic
Huni Valley	Kumasi	177.9km	80	Wood/steel	Rigid/elastic
Accra	Osino	122.4km	60/80	Wood/steel	Rigid/elastic
Osino	Konongo	121.5km	80	Steel	Rigid
Konongo	Kumasi	59.2km	80	Wood	Elastic
Huni Valley	Twifu	47.9km	80	Wood	Rigid/elastic
Twifu	Aperadi	60.4km	60	Wood/steel	Rigid/elastic
Aperadi	Kotoko jnc	90.5km	80	Wood/steel	Rigid/elastic
Kojokrom	Location	2.75km	60/75/80	Wood/steel	Rigid/elastic
Tarkwa	Prestea	29.4km	60	Wood/steel	Rigid/elastic
Dunkwa	Awaso	73.2km	75/80	Wood/steel	Rigid/elastic
Achimota jnc.	Tema	23.7km	80	Wood/steel	Rigid/elastic
Achiasi jnc.	Kade	40.25km	60	Wood/steel	Rigid/elastic

Table 3-5. Summary of Track Structure Characteristics on Existing Railway Network

3.4.1.2 Rails

All GRC tracks are 1067mm gauge (42") conventional track structures, using standard flat-bottom rail sections, steel or wooden sleepers and stone ballast. With the exception of one small (30km) double-track section (between Takoradi and Manso), the GRC uses single track for bi-directional running, with passing loops located every 9-10km.

The GRC uses rails of 30, 37.5, 40 and 45 kg/m (British and American standard 60, 75, 80 and 90 lb/yd rail sections). Rails are joined using 4-bolt fishplates. Some experimental use of Thermite welding has been made on the Western and Eastern lines where a few 60ft. (18.3m) and 120ft (36.6m) welded rail strings have been installed on the track. The GRC practice is to maintain square joints on straight tacks and staggered joints on curves

3.4.1.3 Sleepers

GRCL uses sleepers of two main types: Steel sleepers BS80 and domestic hardwood sleepers 127 x 254 x 1981 mm (5" x 10" x 6'6").

Although steel sleepers were once standard on the railway, in recent years the GRC has preferred the use of locally-sourced hardwood sleepers, which are less expensive and can be purchased with local currency.

The trend is currently reversing, as the type of hardwood species available for conversion to sleepers is giving a life span on the track of only between 2-4 years, against the 20÷30 years in previous years. Thus hardwood sleepers have become less cost-effective and GRCL is studying the use of concrete as a worth alternative for future maintenance and new construction operations.

Rails are fastened to steel sleepers using keys or ABK or Pandrol elastic clips, while the attachment to hardwood sleepers is done using dog spikes or elastic spikes in predrilled holes, the elastic spikes being preferred by GRC. The rail rests directly on the sleeper without the use of steel base plates.

Wooden sleepers are purchased from suppliers in a “raw” state (i.e. unseasoned and chemically untreated). The GRC then seasons the wood, adzes rail seats, drills spike holes and treat the sleepers using approved chemicals to prolong the service life. The sleeper preparation is carried out at a sleeper plant located at Quarry (near Kojokrom). Properly cured and treated sleepers should last about 15 years in service and some of the high-density hardwood varieties do not last much longer. Unfortunately, GRC has been skimping on the curing and treatment of sleepers, resulting in a reduced service life expectancy of 5 to 10 years.

Both steel and wooden sleepers are installed at an average spacing of about 714mm, or about 1400 sleepers per track km.

3.4.1.4 Ballast

The GRCL obtains ballast mainly from the mine tailing from the manganese mine at Nsuta.

The GRC ballast specification is simply the size range 19 – 51mm ($\frac{3}{4}$ ” – 2”), without any specified gradation.

GRC standards call for a ballast depth of 12” (305mm) below sleepers and a shoulder width of 6” (152mm) beyond the sleeper ends. This gives a theoretical average ballast volume of 1,200 m³/km for wooden-sleeper track and 900 m³/km for steel-sleepered track. However, currently, the quantity of ballast does not exceed 0.5 m³/m in most areas.

3.4.1.5 Turnouts

The GRC has a variety of turnout types, all having straight points and curved crossings; however, there are only two main types in common use. They are 1:12 and 1:8.5 and are set out in the

TYPE	POINT LENGTH	CURVE RADIUS	SPEED	PLACE OF USE
1:12	16’0” (4.88 m)	977’6” (298.5m)	40 km/h	Main tracks
1:8.5	13’0” (3.96 m)	480’4” (146.9m)	25 km/h	Secondary tracks

Table 3-6. Turnout Characteristics on the GRCL Network

3.4.1.6 Bridges

The Ghana Railway Network has 287 bridges with a total length of 3,217m. Approximately 80% of the bridges are steel girder or truss bridges with timber decks; the remainder being reinforced concrete bridges. The percentage of total track length supported by bridges is 0.34%, testimony to the favourable terrain on which most of the railway is constructed. The Prestea branch crosses difficult terrain and consequently has the highest concentration of bridges on the GRC, about 4 times greater than the network average. The important bridges and their distribution along the Railway Network are summarized in the Table 3-7 and Table 3-8 below.

LOCATION	TYPE	LENGTH	COMMENTS
Western km 57.4	Steel WP	57.4m	River Bonsa
Western Km 165.2	Steel Truss	91.5m	River Offin
Prestea Km 27.8	Steel WP and Truss	119.8m	River Ankobra – Future road/rail
Awaso Km 53.4	Steel Truss	34.1m	River Ankobra
Awaso Km 64.1	Steel Truss	37.8m	River Ankobra
Central Km 47.2	Steel WP	138.1m	River Pra – road/rail
Central Km 195.4	Steel WP	64.0m	River Densu
Kade Km 17.0	Steel WP and Truss	79.3m	River Birim – road/rail
Eastern km 1.85	RC slab	46.3m	Korle Lagoon
Tema Km 5.88	RC Ream	31.6m	Liberation Road (Accra)

Table 3-7. Important Bridges on the GRCL Network

LOCATION	LINE LENGTH	NUMBER OF BRIDGES	TOTAL LENGTH	% OF BRIDGES ON LINE LENGTH
Western Line	266.8	77	737.3m	0.28
Eastern Line	303.9	88	823.0m	0.27
Central Line	198.8	43	604.1m	0.30
Prestea Branch	29.4	26	393.2m	1.33
Awaso Branch	73.2	25	213.7m	0.29
Tema Branch	23.7	13	232.1m	0.98
Kade Branch	40.3	15	213.4m	0.53
TOTAL		287	3,216.8m	0.34

Table 3-8. The Distribution of Bridges on GRCL Network

In addition to railway bridges, the GRC owns and is responsible for maintaining a number of steel pedestrian overpasses in urban areas.

3.4.1.7 Buildings

The railway currently owns 1,088 buildings with a total floor area of 304,086.51 m². The majority are of concrete construction with corrugated asbestos roofs. GRDA buildings include stations, administrative offices, workshops, sheds, residential buildings and other structures. The buildings and their distribution over the railway network is summarized in the following Table 3-1.

RAILWAY LINE	LOCATION	NUMBER OF BUILDINGS	TOTAL FLOOR AREA SQM
Western Line	Takoradi-Tarkwa, Tarkwa-Kumasi, Tarkwa-Prestea, Dunkwa-Awaso	645	239,748.73
Eastern Line	Huni Valley-Kotoku, Achiasi-Kade	303	44,050.24
Central Line	Accra-Nsawam, Nsawam-Kumasi, Achimota-Tema	140	20,287.54
TOTAL		1,088	304,086.51

Table 3-9. GRDA Buildings

3.4.2 TECHNICAL INSTALLATIONS

3.4.2.1 Signals and Telecommunications

GRCL has two types of train control signals installed at discrete locations:

- **Mechanical interlocked signals and transmission system**, both fully-interlocked and semi-interlocked. This system is installed at all the stations on the double-track line between Takoradi and Manso, on the line from Achiasi Junction to Kotoku and at various other key stations on the network. Mechanical signal systems have two main functions: to operate turnout points and to provide visual signal indications to trains.
- Colour light signal system, with starting signals at main terminals and junction points. This system provides 2-aspect starting signals, 3-aspect home signals and uses electromagnetic treadle wheel detection. At present the colour light signals are defective and not used, thus causing undue delays to trains.

Track blocks between stations are not signalled. Dispatchers' offices are located at Takoradi, Kumasi and Accra.

The GRC has a large number of at-grade road crossings (level crossings), a few of which have electric signals and gates. Crossing keeper personnel at each crossing manually operate all such crossing-protection signal systems. The remaining crossings are equipped with mechanical gates if traffic levels so warrant. At low traffic locations the keeper uses a red flag to stop traffic for trains.

The GRC has several communication systems including various telephone, radio and microwave systems. In general, these systems have not been well structured to give adequate communication capabilities to GRC.

3.4.2.2 Telephone

The GRC has the following installed telephone systems:

- a) PABX telephone exchanges installed at Takoradi, Location and Kumasi;
- b) Manual exchanges installed at Accra and Takoradi;
- c) Block telephone system for station-to-station calling (Western Line); and
- d) Selector telephone system for dispatcher-to-station calling (Western Line)

The block and selector telephone systems on the Western Line use a 12-pair buried cable (installed in 1988) between Takoradi and Awaso and a pole line between Dunkwa and Kumasi. In addition to the above-mentioned telephone systems, there is some station-to-station telephone capability on the Central and Eastern Lines.

None of the telephone systems are currently working.

3.4.2.3 Radio

All radio systems have been taken out of service due to problems of frequency allocation and interference with third party frequencies (with the exception of a few HF transceivers and local hand-held VHF radio communication equipment). The GRC has a significant investment in radio communication equipment and infrastructure, much of which could be re-utilized to implement a future radio communication system. Radio equipment and infrastructure includes:

- a) VHF radio repeater system with microwave backup (17 sites on the Eastern and Central Lines)
- b) Local VHF base stations and mobile units (Takoradi, Kumasi and Accra); and
- c) HF radio transceiver sets at Takoradi, Dunkwa, Kumasi and Awaso.

Of all the shortcomings which hamper the GRC's efficiency, the lack of adequately functioning communications is the most serious, as it makes train control utterly inefficient, not to mention the safety risk which is of particular concern for passenger services.

Of the total 150 stations on the railway system, 11 stations are fully interlocked. About 15 other stations are semi-interlocked, most of them on the WL between Manso and Huni Valley and the CL between Achiasi and Kotoku. Switches are not motorized and, on the WL, interlocking devices for facing points have yet to be mounted. On the WL, all stations are equipped with directional mechanical signalling and electrical block signalling, manually operated.

The WABCO colour light signalling system installed in 1989, is also the means of transmission for the block system. This is currently only working from Takoradi to Huni Valley, leaving the remainder of the line out of the control of the train dispatcher.

On the EL and CL, it was anticipated that a normal situation was to be restored after the rehabilitation works, which included installation of entirely new signalling and telecommunication systems based on radio facilities. That was not to be, because the frequency chosen for the radio equipment were later found to conflict with that of the national security agencies and to date the frequency issue has not been resolved.

3.4.3 ROLLING STOCK

3.4.3.1 General

GRCL's rolling stock fleet consists of locomotives, freight wagons (Covered wagons, high and low sided wagon), passenger coaches and ballast bogie.

The rolling stock is conventional 1067mm gauge, bogie-mounted equipment with the following technical features:

- *Gauge*: all rolling stock has 1067mm gauge
- *Size*: the largest locomotives have 6 axles and are 18.7m long. All wagons and coaches have 4 axles and the longest are 15.2m and 18.9m respectively.
- *Weight*: the heaviest locomotives weigh 96 tons (16 tons axle load). The heaviest wagons weigh 60 tons loaded (15 tons per axle). The majority of wagons and all coaches weigh 10 tons per axle or less.
- *Couplers*: all rolling stock uses standard knuckle couplers and draft gear similar to the AAR Type E coupler.
- *Bearings*: all rolling stock is equipped with Timken-type roller bearings. Much of the equipment was converted to roller bearings from journal bearings in recent years.
- *Brakes*: all wagons and coaches are equipped with vacuum brakes. Some locomotives have dual train-braking systems (vacuum/air), but most are not equipped with dynamic brakes.

The fleet is getting old: almost all of the locomotives were purchased in the last 26 - 30 years and over two-thirds of the wagons were purchased over 20 years. All coaches were purchased in the late 1980s. The fleet is quite well maintained. Two locomotives and 10 coaches have been rehabilitated few months ago.

In general, the current fleet is insufficient to meet the current traffic demands. There is currently shortage of bauxite and log wagons, even though hauling of these two items have been suspended due to the condition of the tracks from Tarkwa and beyond, which will become critical as traffic increases. The coach fleet is small and will not be sufficient to handle future passenger operations. The GRCL has extensive well-equipped rolling stock maintenance facilities at Location and Takoradi, with supporting facilities at other terminal stations.

3.4.3.2 Locomotives Fleet

GRCL has a fleet of 36 Diesel Electric Locomotives, of which five are operational, and the others are defective.

The following table summarizes the current locomotive characteristic.

Series	Manufacture	Country	Year	Total Power (HP)	Max. Axle Load (T)	Adhesive Weight (T)	Max. Tractive Effort (kg)	Fuel Tank Capacity (ltr)	Max RPM	No. Available
541	Thyssen Henschel	West Germany	1975	540	14.2	42.6	1400	1450	1800	2
1651	Thyssen Henschel	West Germany	1978	1650	14	84	2132	4000	900	8
2601	GEC Astom	France	1993	2516	16	96	32600	4000	1000	9
1661	ABB Henschel	Germany	1995	1650	14.3	85.5	25184	4000	900	3
1670	Eletromotive Division	Canada	1996	1500	14.5	87	25184	3400	900	14

Table 3-10. Type of Diesel Electric Locomotive

3.4.3.3 Wagons

Over 60% of GRC's wagon fleet consists of low-sided and high sided wagons used to transport bauxite and manganese ore. The balance of the fleet consists mainly of covered wagons and various types of flat wagons. All wagons are equipped with roller bearings and air or vacuum brakes. Most of the wagon fleet is characterized by low axle loads (± 10 tons/axle) and relatively high tare ratios ($>35\%$).

The following Table 3-11 summarizes the current wagon fleet.

QUANTITY	DESCRIPTION	AXLES	BRAKES	LENGTH (M)	TARE (T)	GROSS (T)
1	Water Tank Wagon	4	V	11.5	17.3	39.8
89	SA Steel Open Wagon	4	V	12.2	17.1	60.1
150	Eng. Low Sided Wagon	4	V	11.7	14.7	39.7
92	36 Ton Steel Van	4	V	13.4	18.6	54.6
2	Flat Truck	4	V	13.6	12.9	28.2
40	Bolster/Container/Flat	4	V	13.6	12.8	52.8
1	Caboose	4	V	11.6	18.2	18.7
15	Ballast Hooper	4	V	11.5	15.5	43.4
3	Well Wagon	4	V	15.2	24.0	39.2
27	Tank Wagon	4	V	13.4	20.4	50.4
70	B.O.M Wagon	4	A	12.0	15.0	55.0
490	Total					

Table 3-11. Fleet of Wagons

(However, according to the more recent GRC data (2019), the total number of available wagons is increased to 490).

The main uses of the fleet are:

- SA steel open wagons (43-ton mineral wagons): these are refurbished units purchased in the past 15 years and mainly used on bauxite trains.
- B.O.M Wagon (55-ton mineral wagon): was purchased 2012 used to haul manganese.
- Low-sided wagons (25-ton mineral wagons): mostly purchased 1962-1972. Many of these wagons have wooden sides and floors and are mainly used on manganese trains.
- 36-ton steel vans: used for General Cargo, purchased in 1995.
- Bolster flats: used on log trains.
- Caboose (brake vans): The GRC places a brake van on all freight trains. Due to the shortage of cabooses, other equipment such as passenger coaches is often used.

3.4.3.4 Coaches

The entire GRCL equipment fleet was replaced in the late 1980s with new equipment manufactured in the then East Germany. The Table 3-12 below summarizes the GRCL passenger equipment fleet:

QUANTITY	DESCRIPTION	YEAR	AXLES	BRAKES	LENGTH (M)	TARE (T)	GROSS (T)	SEATS
4	2 nd Class Sitting	1987	4	V	18.9	27	34	93
10	2 nd Class Sitting	1990	4	V	18.9	27	34	93
4	Brake & Baggage	1987	4	V	18.9	29	34	30
5	2 nd Class Sleeping	1987	4	V	18.9	28	30	28
2	1 st Class Sitting	1987	4	V	18.9	27	31	56
4	1 st Class Sleeping	1987	4	V	18.9	28	29	18
29	Total							

Table 3-12. Fleet of Coaches

3.4.3.5 Other Equipment

The GRCL has a fleet of 97 vehicles, consisting of 16 on-track machines, 17 off-track machines and 65 road vehicles, as shown in the table below (enquiring updating):

DESCRIPTION	TYPE	TOTAL
Bus		
Operational	Road	8
Not-functional		9
Truck	Road	2
Light Vehicle		
Operational	Road	15
Not-functional		22
80 ton crane	On-track	2
Cranes	Road	2
Fork Lift	Off-track	5
Lister	Off-Track	6
Gang Trolley	On-track	11
KGT	On-track	1
Excavator	Off-track	1
Crushing Plant	Off-Track	2
Total		86

Table 3-13. Equipment and Vehicles

3.4.3.6 Summary of the Current Situation of the Rolling Stock

On the basis of the information gathered during the visits and interviews carried out with various people interested in the development of the railway system, the overall situation can be summarized as follows.

In general, apart from the four Chinese manufactured DMU used for passenger commuter services between Accra - Tema Harbour and Takoradi – Sekondi through Kojokrom, the rolling stock situation is very poor in terms of operational availability, state of maintenance and the very old technology.

The same situation applies to the maintenance installations and equipment for the rolling stock.

(i) DMUs

The four modern DMUs (Diesel Multiple Unit) mentioned above, two are about 10 years old and the other 3 years respectively. The Accra – Tema commercial service operate daily on a line approximately 20 km long, that has been rehabilitated, and permits a Vmax speed of approx. 55 km/h and Takoradi – Sekondi through Kojokrom commercial service operate daily on a line approximately 16km long and permits Vmax speed of approx. 80km/h.

The Tema – Accra DMUs have 6 coaches, with double automatic doors and access steps. The 6 coaches are inter-communicating. The seats are arranged lengthwise (metro-type) thus allowing the maximum

exploitation of the vehicle's capacity in terms of standing room. The capacity of the single train is estimated in approx. 600-650 passengers, between those seated and standing.

The two end coaches are motor coaches. The driving system for each motor coach includes:

- ✓ 1 Caterpillar diesel engine
- ✓ 1 alternator
- ✓ 2 Vossloh-Kiepe traction converters (1 for each bogie)
- ✓ 4 asynchronous three-phase traction engines (2 per bogie)
- ✓ 1 converter for auxiliary services
- ✓ 1 rheostat for electro-dynamic braking

The vehicles do not have any air conditioning system, but only simple ventilation,

While the Takoradi – Sekondi has been equipped with air-conditions system and disability friendly seats.

Approximately 15 Ghanaian technicians have carried out a training course in China for the maintenance of the DMUs and currently the maintenance support seems adequate, even if signs of deterioration are starting to show, especially due to the lack of and difficulty in procuring the spare parts.

The coordination of the maintenance activities of the four DMUs is currently carried out by technician from the company, at a small Depot located near Tema Harbour and Location workshop. The Tema Depot, approximately 120m long and 25m wide is equipped with two internal tracks, one of which has a partial central inspection pit, and some maintenance equipment, including a set of 4 lifting jacks to carry out changes of bogies.

The line that runs from Tema Harbour towards the city of Tema have been completed and is currently being extended by several kilometers.

(ii) Other Rolling Stock

From a technical point of view, the existing rolling stock is rather old, generally corresponding to a concept of approximately 35 years ago or older.

There are only a few more recent locomotives, dating back to the mid-'90s; they are manufactured by General Motors but most of them are out of operation due to lack of spare parts. We were informed that there are 5 in operation, of which 4 at Takoradi and 1 at Accra.

The few railway services carried out with the locomotives, both at Accra and Takoradi, use these GM locos.

The passenger coaches are older than the locomotives and in a very bad state of maintenance. In particular, the passenger coaches are from the '80s and were built in the ex-DDR. The coaches are old-fashioned in concept, with installations that are out-of-date from a technical point of view.

Some of the freight wagons are also rather old-fashioned and built a long time ago. They are mainly of English manufacture.

In the maintenance installations visited, a lot of abandoned rolling stock was seen, in terrible conditions,

considered unusable and ready for scrap.

(iii) Current Railway Services

The only railway services carried out today with locomotive and passenger coaches are from Accra to Nsawam (1 set of train a day), on a line approximately 40 km long and Takoradi to Tarkwa (1 set of train a day) approximately 66 km long.

For all the passenger railway services, there is a problem of ticket control because as the stations are not closed and the trains are overcrowded, checks are difficult to carry out. There is, therefore, considerable evasion, despite the low cost of the tickets.

3.4.4 *ANCILLARY FACILITIES*

Below is a description of the maintenance structures and related existing railway structures connected to them. The first part of the description regards the status of the structures dating before 2005; the information has been taken from the documents produced before that year. Whereas, in the second part, a summary of the current situation has been given, elaborated on the basis of the surveys and interviews carried out by the Rolling Stock Expert from the Work Team.

3.4.4.1 *Workshops and Stores*

Most of the GRCL rolling stock maintenance capabilities are concentrated at the Location Workshop complex near Sekondi, and about 10 km from Takoradi. The Location Workshop includes main shops, stores, laboratories and administrative buildings totaling 33,000 square meters of floor area. Secondary workshops and running sheds are located at Takoradi, Tarkwa, Dunkwa, Kumasi, Tema and Accra. Other disused rolling stock facilities remain at Nkawkaw, Koforidua and Achiasi Junction.

The main work facilities at Location consist of:

- Locomotive Workshops – including Rehabilitated diesel/Erecting Shop, Blacksmith Shop, Welding/Fabricating Shop, Copper Shop, Machine Shop, Foundry, Millwright Shop, Electrical Shop, Transport Pool and Laboratory; and
- Carriage and Wagon Workshops – including Wagon Shop, Coach Shop, Machine Shop, Blacksmith Shop, Paint Shop, Upholstery Shop, Train Lighting Shop, Sawmill and Furniture Shop.

In addition to the workshop facilities, there is a large rehabilitated training facility used mainly to train mechanical and electrical maintenance staff and locomotive drivers. There is also a smaller training facility at Takoradi.

Running maintenance of locomotives, wagons and coaches is carried out in all the workshops, whereas heavy maintenance is the main task of Location Workshop.

3.4.4.2 Electrical Workshop/Train Lighting

The Electrical Workshop is responsible for all the lighting needs of the stations, workshops and staff bungalows/quarters, with a total staff of 29. Train Lighting on the other hand is responsible for the lighting requirements of the trains and has a staff of 8.

Workshops for both sectors are located at Takoradi, Accra, Tarkwa, Kumasi and Dunkwa.

➤ Civil Engineering Workshops

The Civil Engineering Workshops are responsible for the maintenance of station and staff buildings. There are 105 staff and the workshops are located at Takoradi, Location, Accra, Kumasi, Tarkwa, Dunkwa and Achiasi Junction.

The GRC workshops and running sheds are well equipped with tools, machines and equipment for the maintenance of the rolling stock. In addition to a large selection of general metalworking equipment, there are 2 type-welding machines, 2 wheel lathes, 5 vertical boring machines and 2 under-floor wheel profiling machines.

➤ Stores

The GRC Stores Department operates 30 separate store facilities at various locations. Many of the stores are located at Takoradi and Location to support the rolling stock maintenance activities and hold tools, spare parts and raw materials for general maintenance of both the Infrastructures and Rolling Stock.

3.4.4.3 Sleeper Production Facility

GRCL has a wooden sleeper's facility at Quarry (near Kojokrom) that receives new sawn timbers and provides curing, adzing of canted rail seats, drilling of spike holes, treatment with approved chemicals and storage of the finished sleepers. The facility is equipped with:

- ✓ 2 – Sleeper adzing and drilling machines (one functioning)
- ✓ 2 – Creosoting cylinders (capacity 240 sleepers each); and
- ✓ assorted rail trolleys for moving sleepers within the facility.

Air curing of the sleepers requires from 6 weeks to 6 months, depending on the dryness of the season. Water content is estimated based on the weight of the sleepers. The facility has a normal throughput of 480 (maximum 960) sleepers per day. Properly maintained, the facility should be able to produce 100,000 per year.

3.4.4.4 Railway Central Training Institute

The Training Institute was established to provide technical and supervisory training to railway workers at all levels. The railway central training institute has been completely refurbished and plans are far advanced to convert it into a modern railway university.

3.4.4.5 Summary of the Current situation of Workshops for Rolling Stock

On the basis of the data collected and the meetings held, it was ascertained that there are a certain number of garaging and maintenance installations for rolling stock that are far superior to the current requirements in terms of quantity and available space. Only a few of these were visited, but on the basis of experience acquired, it can be concluded that they were conceived and built a long time ago (except for the small Depot at Tema for the two DMUs) and they are in a very poor state of maintenance as far as the buildings and general installations are concerned.

The maintenance machines and equipment are also rather obsolete and in a very bad state of up-keep.

In some cases, they are considerably more than the hypothetical requirements, probably because they derive from a time when a discrete railway service was operational and there was no possibility to use external companies for specific activities (for example, machine tools, foundries, etc.).

There is a general lack of special maintenance equipment and spare parts, which means that there are a lot of partially dismantled rolling stock and components that are awaiting missing parts in order to resume operations.

The skill of the technicians seems to be quite adequate for the type of rolling stock.

In fact, activities were being carried out regarding the repair and revision of bogies, traction engines, diesel engines and on-board systems, as well as the revision and restructuring of passenger coaches.

Furthermore, work is carried out on wheel sets and wheels, both substituting wheels and resurfacing the wheel flange by electric arc. This last operation is carried out using Japanese equipment that seems to be quite recent.

There are also small benches and test workshops for injection pumps, Woodward regulators, pneumatic components, etc.

The lack of spares and appropriate equipment leads, however, to a general lack of efficiency of the system.

Inside the Takoradi Workshop, there is also a foundry and a department for the manufacture of wooden sleepers, that is partially operational, and that could also work for third parties.

The only railway services operating today with locomotives and freight wagons are between Takoradi and the manganese mines in the area of Nsuta Wassaw.

All the other railway services carried out previously on the Western line, the Eastern Line and the Central Line have gradually been abandoned, due mainly to the deteriorated conditions of the railway infrastructure, both the civil works and the permanent way and signaling.

3.4.5 AREA MANAGEMENT SYSTEM

For administrative convenience, the rail network was divided into three areas in 1986 with their headquarters located at Tarkwa, Dumas and Accra. Area Managers were appointed to man these areas

to monitor all transport activities originating and terminating in the areas, and account for them to Corporate Headquarters.

3.4.6 RELEVANT FACTS IN THE RAILWAY SECTOR

In the last years different relevant “events” in the Ghanaian railway sector have happened, starting from the institution of the new Ministry of Railways Development (MoRD) in February, 2017 when Hon. Joe Ghartey, has been tasked with ensuring the rapid development of a modern rail network in Ghana.

The Government of Ghana is implementing many of the recommendations within the 2013 Railway Master Plan, in particular for the re-development of the existing railway network and starting the construction of the new railway line from Tema Port to Akosombo. A description of the relevant facts in the railway sector in Ghana is presented in the following

3.4.6.1 Western Railway Line

The first step was the initiatives undertaken for the substantial rehabilitation and up-grading of the Western Railway Line, with the complete reconstruction of the railway superstructure and the necessary realignment to achieve new standards (Axle load of 21 tons and Design speed of 120km/h)

The Front End Engineering Design (FEED) of the Western Railway Line, including the main line from Takoradi to Kumasi (267 km) and Dunkwa-Awaso branch line (73 km), was carried out. With the FEED of the Western Line, the Government of Ghana attained an essential tool to reduce risk and uncertainty during the following phases of the implementation of the project. In fact, the FEED provided a detailed project cost estimate and a well-defined technical framework, allowing a faster implementation of the project and a more controlled competition between contractors on well-defined rules.

In 2013, the Government started the re-construction of the first section of the Western Line from Sekondi to Takoradi via Kojokrom (Construction of the 10.1km Double track railway line from Takoradi to Kojokrom and a 4.5 km single track line to Sekondi).

The project, completed in 2017, consists of the rehabilitation and renovation of the first segment of the Western Line (narrow gauge, 1.067m) and the establishment of a suburban train service between the twin cities of Takoradi and Sekondi. It also included:

- (i) The renovation of one station building (Takoradi) and the construction of three new station buildings (Sekondi, Butua, Kojokrom);
- (ii) The supply of two DMU train sets, air conditioned on narrow gauge bogies.

In September 2017, the Development of the Standard Gauge Western Rail Line continued with the final engineering design of the second segment between the cities of Kojokrom and Tarkwa through Nsuta (54.5km).

The re-construction works are currently on-going along the section from Kojokrom to Manso (22 km) and rehabilitation works along sections of 54 km from Takoradi to Tarkwa to facilitate the haulage of manganese from Nsuta Mining siding and Takoradi Port.

3.4.6.2 Tema Port - Akosombo Railway Line

In 2016, the Government of the Republic of Ghana obtained credit facility from the Indian Exim Bank to construct the new railway line from Tema Port to Akosombo, to link the lake transport services on the Volta Lake to the northern parts of the country.

The Contract Agreement for the construction of the new line was signed between GRDA and Afcons Infrastructure Limited, India (AFCONS) on the 18th November 2016.

The Rail Project consists of Construction of Single Standard Gauge Railway line from Tema to Akosombo, Railhead facilities at Tema & Akosombo and provision of Rail Maintenance Facilities near Tema on Engineering, Procurement and Construction (EPC) Basis.

The railway line Tema-Akosombo passing in Southern Ghana from Greater Accra region to Eastern region with an original length of 84.832 km, has a total length of 97.78 km in the final alignment.

The commencement date has been given by GRDA on the 3rd day of July 2018 and works are expected to be completed within a 36 months period.

The progress of construction works achieved as at 31st May 2019 is overall equal to **32.77%** as indicated in the table below.

MILESTONE DESCRIPTION		Percentage of Progress
1	PRELIMINARIES	63,56 %
1.1	Contractor's Mobilization including Office, Camp Office, Laboratory, Workshop, Plants & Equipment, Accommodation for Staff and Workers, etc.	79,38%
1.2	Survey, Geotechnical Investigation, Engineering and detailed design including submission of Drawings for approval	40,71%
1.3	Identifying ROW and clearing it of hindrances such as hutments, Residential, Industrial or any other structures within ROW and taking possession of the land	75,95
1.4	Shifting of Utilities	58,94
1.5	Provision for Supervision Consultant (PMC)	40,00%
2	PROCUREMENT & CONSTRUCTION	26,69%
2.1	Site Clearance including clearing and grubbing, tree cutting, disposal all complete	50,00%
2.2	Earthwork in formation in Embankment/Cutting	49,99%
2.3	Culvert, Minor Bridges, Viaduct	49,71%
2.4	Tunnels	0.0%
2.5	Drainage – Longitudinal Drains and Protective Works	0.0%
2.6	Railway Track	22,28%
2.7	Signalling and Telecommunications	0.0%
2.8	Construction of Railway Stations	0.0%
2.9	Railway Maintenance Facility (Loco Shed, Wagon Workshop & Track Main Facility)	0.0%
2.10	Railhead Facility at Tema	0.0%
2.11	Railhead Facility at Akosombo	0.0%
2.12	Providing Training on Railway system including Railway Engineering, Railway Management, Operation and Maintenance	0.0%
Percentage overall Contract Price		32,77%

3.4.6.3 Eastern Railway Line

In 2017, the Feasibility studies for the Development of the Boankra Inland Port and the Eastern Railway Line Project on a PPP Basis were carried out. The project foresees the construction of the new 340-kilometre standard gauge rail line from Tema Port to Kumasi along the existing narrow gauge corridor.

Following the results of the feasibility study, the Ministry undertook a market sounding event in December 2017, with the aim to involve the private sector in the development of the Eastern Railway Line on a Build, Operate and Transfer (BOT) basis. Thereafter, in February 2018, 45 firms submitted their proposals indicating their interest and later, in July 2018, 8 out of the 15 shortlisted consortia were pre-qualified to the Request for Proposals stage to submit their Technical and Financial proposals.

Finally, Ghanaian-European Railway Consortium (GERC) was adjudged the preferred bidder to construct the US\$ 2.2 billion Eastern Railway line and on April 2019, the negotiations on the Concession Agreement for the new Eastern line (standard gauge) railway project have commenced.

3.4.6.4 Other initiatives in the railway sectors

The Government of Ghana has started the development of the railway sector, launching many other studies and initiatives to facilitate and encourage the expansion of the railway network. The most important are described below.

- In 2017, the MoRD engaged a Transaction Advisor for the development of the *Railway Line from Kumasi through Tamale to Paga (Central Spine)*. The objective of the assignment is to improve rail and logistics infrastructure as part of an integrated transport network in Ghana, helping to improve services to customers and reduce the cost of transport, especially, in trade to and from the hinterland and the Northern regions of Ghana.
- In the meantime, in April 2018, a Memorandum of Understanding (MoU) has been signed between the Government of Ghana and Messrs China Civil Engineering Construction Corporation (CCECC) to undertake feasibility studies and due diligence on the proposed rail line.
The project will be developed in sections, starting from the Kumasi -Bechem section (approx. 390km)
- In August 2018, the MoRD engaged a Transaction Advisor for the development of the *Ghana-Burkina Railway Interconnectivity Project*. The proposed railway project represents the first transnational railway initiative in Ghana. It involves the construction of a single standard gauge railway line from Ouagadougou, Capital of the landlocked Burkina Faso, to the Port of Tema, in Ghana, and will cross the Ghanaian cities of Yendi, Tamale and Paga. The Feasibility Study of this railway project is currently ongoing.

The Governments of Ghana and Burkina Faso intend to involve private sector partner(s) and to pursue a PPP arrangement for the development of the Ghana - Burkina Railway Line on a Build, Operate and Transfer (BOT) basis. In May 2018, the Governments started the procurement

process that is, to date, at the stage of evaluation of the qualification documents submitted during the Request for Qualification (RfQ) on May 2019 by the 4 out of 12 firms, that met the minimum evaluation criteria.

- Moreover, in June 2018, Ghana's Minister of Railway Development, Joe Ghartey revealed that the South Africa Company, Transnet International Holdings, will be supplying rolling stock, including 110 wagons, 22 coaches and 8 locomotives, to the Ghana Railway Company Limited by the end of 2018.
- Finally, the following initiatives are currently under way:
 - Feasibility Study for the development of a Metro Rail/Light Rail Transit System in Accra and its environs
 - Feasibility Study for the development of a Metro Rail/Light Rail Transit System in Kumasi and its environs
 - Feasibility Study for the development of the Trans-ECOWAS Railway Line from Aflao to Elubo.
 - Feasibility Studies for the redevelopment of the railway line from Kotoku to Huni Valley (Central Line)

3.5 INFRASTRUCTURE FEATURES AND MAIN TECHNICAL ASSUMPTIONS

3.5.1 MAIN FEATURES OF THE NEW RAILWAY LINES

A first analysis of the physical characteristics and main constraints of the rail corridor foreseen in the new Railway Master Plan has been carried out with the aim of identifying the main technical characteristics and design elements of the rail lines. Particularly, the morphology, which directly affects the technical aspects of the rail line and consequently the costs of the infrastructure, has been analysed for every rail corridor of the future National Railway System.

The following Figure 3-10 represents the incidence of flat, hill and mountain areas crossed by the railway. An area is considered “flat” when its grade slope is between 0 and 3 percent, “hill” when it’s between 3 and 7 percent and “mountain” when it’s more than 7 percent.

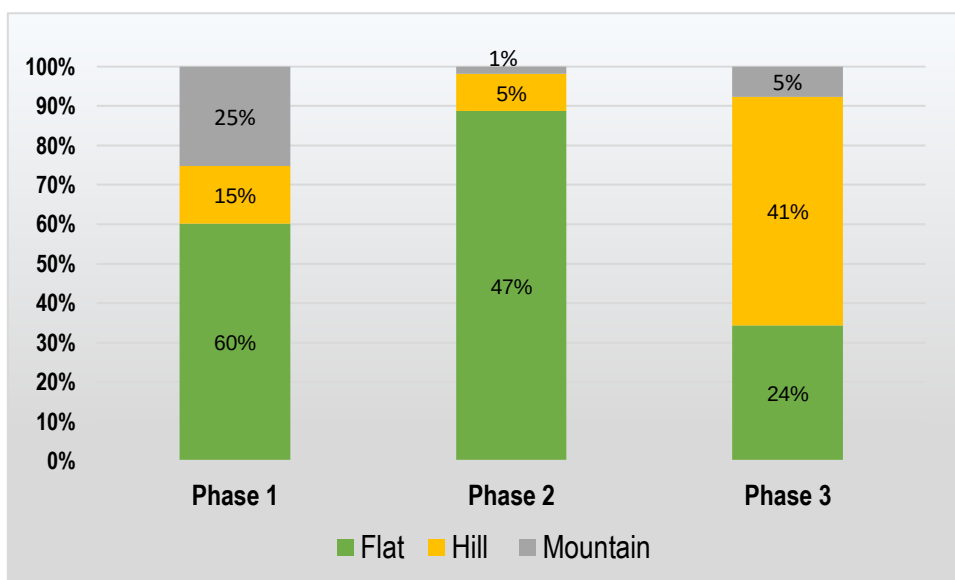


Figure 3-10. Morphology of the areas affected by the new railway lines.

The analysis of the alignments of the new railway lines, which is not in the scope of work of this study shall be carried out on the basis of the technical criteria below:

- by-pass the areas with irregular terrain
- avoid the areas with steep gradients
- avoid the areas prone to flooding
- avoid as much as possible the areas with the greatest constraints
- limit the crossings (over or under crossings)
- foresee the risks of flooding
- by-pass the built-up areas

3.5.2 MAIN DESIGN CRITERIA FOR CIVIL INFRASTRUCTURE

3.5.2.1 Performance and Design Criteria for new railway line

Performance and Design Criteria for the New Standard Gauge Lines are proposed below.

→ Formation:

Width

- In fill: 7.00m
- In cut: 7.00 + ditches
- On bridges: net between parapets 6.00 m

Slopes:

- In fill: 5/3 up to 2/1 (horizontal/vertical)
Protection: topsoiling (15cm thick) + wickerworks and seeding + drainage channel on one side
- In cut: variable according to soil characteristics;
Protection: in common soil seeding with wickerworks and topsoiling where necessary.

Sub-ballast:

- Course of granular material, average thickness 25cm

→ Structures:

Bridges & viaducts:

- Various standard spans will be foreseen, according to the height of the piers: approx. 9, 15, 25 and 30m.

Loads:

- To be assumed for the calculations: U.I.C. codes and/or British Standards.

Back filling:

- For abutments and culverts, by means of granular material.

→ Speeds:

- Passenger Express Trains: 160 km/h
- Passenger Local Trains: 120 km/h

→ Axle loads:

- Design value: 22.5 - 25 t

→ Planimetric curves:

Minimum Radii

- In flat terrain: 1,500 m
- In hilly terrain: 1,200 m
(max. possible speed 160 km/h)
- In exceptionally hilly terrain: 900 m
(max. possible speed 140 km/h)
- In branch lines & junctions: 500 m
(max. possible speed 100 km/h)
- In stations: 250 m, exceptionally up to 190 m
(max. possible speed resp. 43 and 38 km/h)

Cant

- Centrifugal acceleration admitted: 0.6 m/sec²
- Cant (h) according to various train speeds, with the following restrictions:
 - h = 150 mm on main track
 - h = 0 for other station tracks

→ Vertical alignment:

Gradients:

- Maximum in flat terrain 6‰
- In hilly terrain 10‰
- In exceptionally hilly terrain 16‰ corrected
- In stations 1.25‰

No vertical transition curves are to be designed for differences of contiguous gradients > 1,5‰.

→ Ballast profile:

Minimum thickness under sleeper on the vertical of the rail.

- Main line and crossing tracks: 0.30 m
- Sidings and service tracks: 0.20 m
- On bridges: 0.25 m

Total width at the top (at sleeper level): 3.44 m

Inclination of the slopes (horizontal/vertical) : 4/3

→ Track:

Rails

- 60 UIC, conforming to code 861-3
- 54 UIC - 54 E1
- Steel of “normal quality” as defined by UIC Code 860-0
- 50 UIC, normal quality, in the yards of loco depots, workshops, maintenance centres, steel factories and the like.

Sleepers

- Prestressed concrete sleepers B 70W-60 type with the following dimensions:
- Length (bottom level) 2,600 mm
- Width (maximum) 300 mm
- Height (under rail) 210 mm

Fastenings

- Elastic type. (e.g. Pandrol or Vossloh type).

3.5.2.2 Dimensioning and Design Criteria for the Stations

Stations represent the elements that, throughout the country, permit access to rail transportation, especially in regard to passenger services.

The following paragraphs define the main criteria on which design is based in order to favour accessibility, safety and comfort for passengers, a homogeneity of standard dimensions and equipment of the functional elements. However, these criteria cannot be considered complete and will be correlated to successive regulations, as well as to legal prescriptions and specific standards, regarding civil constructions and town planning. Materials, construction techniques, technological installations (that must, in any case, correspond to criteria of durability, economy and maintainability) and the relative regulations, will also be deferred to successive design phases.

→ Methodology for Dimensioning and Classification in Function of Configuration and Types of Access

The distribution of the stations has to be based on the principle of meeting the demand for passenger/freight traffic capacity, taking into consideration the terrain, landforms and geological engineering conditions, while also meeting the demands for railway operations and bearing in mind the socio-economic situation of the area.

The dimensioning standards and functional equipment of the main services to be foreseen in the new Stations should be in proportion with the forecasted passenger traffic and related to the specific local contexts in respect of the following main configurations and typologies that have been identified.

→ Main Configurations of Installations in function of the Forecasted Passenger Traffic and Type of Line (for stations on single or double track lines)

The configurations under examination refer to “transit” installations, in terms of their position in respect of the line, as they are the most common. Other possible configurations relating to the position (terminal stations, branch lines, island, crossing, etc.) can be evaluated by analogy.

▪ **Type 1**

Type 1 installations are directed towards services for low level passenger traffic (<200 p/d or < 400 p/d)

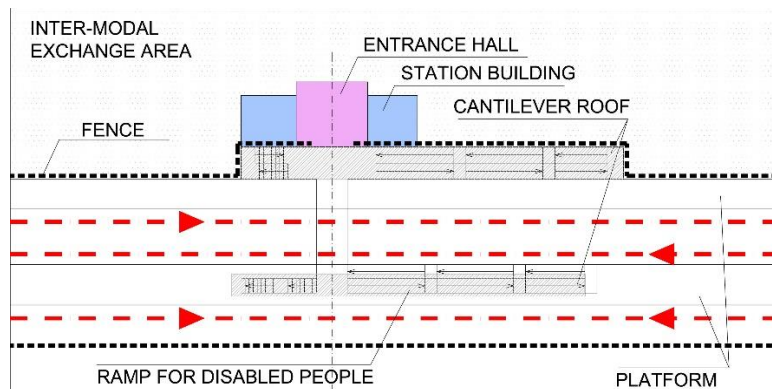


Figure 3-11. Type 1 installations

▪ **Type 2**

Type 2 installations are directed towards services for short, medium and long distances with passenger traffic of 200 p/d or 400 p/d.

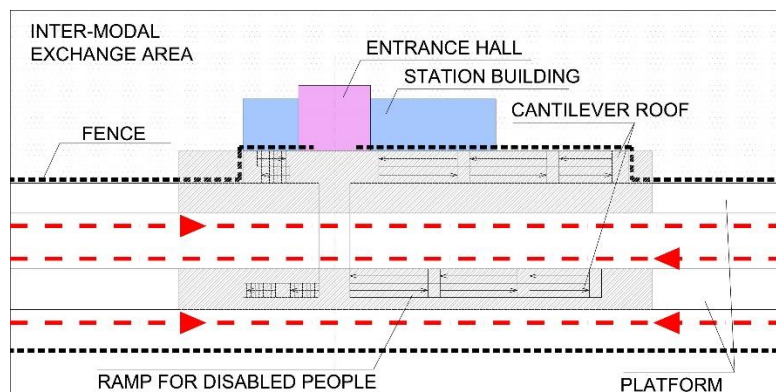


Figure 3-12. Type 2 installations

→ **Main Types of Access to the Station**

- A. Accesses at track level
- B. Accesses at a lower level than the track (stations located on embankment or viaduct)
- C. Accesses at a higher level than the track (stations located in cut)

→ **Characteristics of the Functional Elements**

GENERAL	
Location based on the characteristics of the line	The new stations will preferably be located on flat, straight stretches in order to limit inconveniences for passengers when boarding or disembarking from the train.

Accessibility	The new stations should overcome any architectural and sensory barriers according to these guide lines and the specifications indicated below. At least one route that is completely accessible from the entrance or from interchange points, if present, should connect all the main services of the station as far as the tracks, allowing use by passengers with motor or sensory handicaps. This route, with the exception of doors that are subject to specific regulations, must in any case have a net width of no less than 1.60m and a height free from obstacles of no less than 2.30m.
Finishing materials	The finishing materials must conform to proven standards of durability and strength and must allow easy maintenance and cleaning operations, and the removal of any stains or dirt (also through the use of preventive anti-graffiti treatment).
EXTERNAL FORECOURT: INTER-MODAL EXCHANGE AREA	
Stations located in an urban context or near minor settlements	Inter-modal exchange areas will usually be located near the stations, according to specific agreements with the Local Authorities. These areas will comprise: parking facilities for cars, motorcycles and bicycles, routes within the interchange area, kiss-and-ride and taxi lanes, green areas, street furniture and lighting systems. The number of parking places will be for spatial distribution in the quantity required and will be linked to specific local situations, town planning standards for spatial distribution and forecasted passenger flow in function of the other existing means of transport (buses, trams, metro, etc.) and on the available area.
Stations located in an extra-urban context away from any settlement	Near the stations, there will usually be parking facilities for cars, motorcycles and bicycles, internal access routes, pedestrian routes, green areas, street furniture and lighting. As far as dimensioning is concerned, as there are no specific town planning standards and in the absence of any indications from the Local Authorities, it is deemed useful to prescribe at least 40 sq.m of parking area for every 100 sq.m of gross built-up pavement area (excluding the road formation), to which should be added 1 sq.m for every 10 cu.m of construction. For both the above station locations, as a rule, the following should be present: - Accesses and eventual routes connected to other means of transport - parking places for private cars - parking places for handicapped people (1 every 50 places and at least 2) - parking places for motorcycles - parking places for bicycles - kiss-and-ride and taxi spaces or lanes near the entrance - Entry and space for emergency vehicles As far as the organization of the green areas, pedestrian paving and street furniture are concerned, they should be limited to the extent strictly necessary for the use of the station, with design solutions that optimize the use of the areas.
STATION PLATFORMS	
Equipment	As a rule, each track should be served by a single platform for passenger use. Eventual service platforms will be forbidden to passengers.

Dimensioning	For dimensioning purposes, in relation to the flow of passengers, indicatively the value of 1 sq.m/passenger can be considered. These areas are defined net of the safety area (between the yellow line and the edge of the platform).
Height of the platform	As a rule, platforms for passenger use will be at a height of 550mm above the running surface. Eventual service platforms will have a height of 250mm.
Length of the platforms	Platforms for passenger service will, as a rule, have a standard length of 350 m, in function of the type of traffic adopted, with trains composed of 12 passenger coaches.
Width of the platforms	The continuous width is in proportion to the forecasted passenger flow, the dimensions of the safety strip (according to the line speed) and to the size of the fixed obstacles and their relative distances from the yellow line. It is preferable that the continuous width should be used for the entire longitudinal length, taking into due account the areas dedicated to stairs/ramps/elevators and fixed obstacles (pillars, piles, etc.), for which the minimum clearances indicated below are valid. On side platforms, it is preferable to find solutions with space (fence side) for elements such as stairs and ramps. Eventual narrowing of the width, only possible at the end of the platforms, must in any case respect the minimum dimensions fixed by the specific regulations and allow, inside the safety strip and net of the area dedicated to eventual fixed obstacles, a minimum width of 1.60m for the transit for passengers.
Minimum distance between the yellow line (inside edge of platform border) and the fixed obstacle	- Obstacle with maximum length (measured parallel to track) of 1.00 m, D1 = 0.90 m - Obstacle with maximum length (measured parallel to track) of 10.00 m, D2 = 1.20 m - Obstacle with length superior (measured parallel to track) to 10.00 m, D3 = 1.60 m These distances take into account the European regulations relating to public routes that overcome architectural barriers. Distance between the yellow line and the inside edge of the nearest rail (S) (edge of service step at a height of 250mm from the running surface for H550 platforms or H250 platform edge): in function of the line speed.
Accessibility characteristics (architectural and sensorial barriers)	The platforms should conform to the guide lines that are adopted during successive design phases and be equipped with: - Paving with anti-slip characteristics - Tactile routes and tactile maps for the blind - Tactile yellow line to indicate the safety strip and the edge of the platform (to be positioned in conformity with the note quoted in the previous point)
ROUTES AND ACCESSES INSIDE THE STATION	
Routes and accesses	Relating to accessibility (overcoming architectural and sensorial barriers), the routes and accesses for both the public and for service, must conform to the regulations for escape routes for fire prevention safety. The width of the routes, in proportion to the passenger flow, should be multiples of M (M = 60 cm), with a minimum for a single module of 80 cm. Inside the routes, eventual lighting devices or other protrusions (e.g. transversal flag-type signs and/or from the ceiling) must be located at a height from the floor that is not less than 2.30m in areas frequented by the public and 2.20m in other areas.

	Emergency exits should have a height of not less than 2.10m and a width that is suitable to the flows and characteristics that correspond to the regulations mentioned above.
STRUCTURES THAT OVERCOME A DIFFERENCE IN LEVEL	
Stairs	Stairs are to be foreseen for all the station types (one stair for each platform and for every underpass or overhead gangway). The width of the stairs, in proportion with the flows, will be multiples of M (M = 60cm) and in any case not inferior to 180 cm. Lower widths (minimum 120 cm) could only be allowed for installations with low passenger frequency. The dimensions and the characteristics of the steps, landings and handrails must conform to the regulations for overcoming architectural and sensorial barriers (tactile codes) and for escape routes for fire prevention safety.
Ramps	Access ramps for the disabled in wheelchairs are to be installed for all types of stations (one ramp for each platform and for every underpass and overhead gangway). The width of the ramps, in proportion to the flows, will be multiples of M (M = 60cm) and, in any case, not less than 180 cm. Lower widths could only be allowed for installations with low passenger frequency.
Rising platforms and elevators	For station types equipped with overhead gangways (e.g. stations in cut) and only in cases where the effective difference in level to be overcome advises against the use of ramps (extremely long route), rising platforms or elevators could be installed. The presence of elevators means the installation of alarm systems with intercommunication and CCTV connections with control posts in the station or in other localities. Rising platforms and elevators should conform to the specific technical and operational regulations and to regulations for overcoming architectural and sensory barriers. At least two sides of the external walls and the cabin of these elevators should be transparent.
UNDERPASSES AND OVERHEAD GANGWAYS	
Underpasses for passengers	Underpasses for the use of passengers may be for the specific use of the station, or, on the basis of conventions with the Municipality, for a promiscuous use (connections with the tracks and urban connections through direct accesses to spaces outside the station). In the second case, they should foresee systems of separation (gates) to be suitably located for when the railway installations are closed. The width of the underpasses, in proportion with the flows, must be multiples of M (M = 60cm) and, in any case, no less than 3.00m. The net height from floor to ceiling should not be less than 2.50 m. The location of installations and lighting, advertising boards, signs, etc., should allow a fluid and safe transit of passengers across a "corridor free from obstacles" with a height of not less than 2.30 m and a minimum width of 2.40m. Fixed and variable signs disposed longitudinally along the walls of the underpass tunnel should be positioned at a height from the floor that is not less than 2.10m. The underpasses should conform to regulations for overcoming architectural and sensorial barriers and for escape routes for fire prevention safety.

Overhead gangways	Eventual overhead gangways, when it is not possible to introduce an alternative route, will be positioned with a minimum height from the running surface to the intrados of the foreseen horizontal structure in function of the gabarit. The width, according to the flow of passengers, should be multiples of M (M = 60 cm) and in any case, no less than 3.00m. The roof must have a minimum height from the floor of 2.30m. The location of station installations and lighting, advertising boards, signs, etc., should allow the smooth and safe transit of passengers through a “corridor free from obstacles” with a height of no less than 2.30m and a minimum width of 2.40m. Fixed and variable signs positioned horizontally along the walls of the gangway should be at a height of not less than 2.10m from the floor. The sides should have a protection, in order to prevent objects being thrown, with an overall height of not less than 2.00m. The protection should have closed surfaces (blind or transparent) for a minimum height of 1.00m from the floor and in the case they are equipped above with open elements (e.g. grilles), the latter will have a mesh that is no greater than 30 x 30mm. The overhead gangways must conform to the regulations regarding overcoming architectural and sensorial barriers and for escape routes for fire prevention safety.
STRUCTURES FOR THE PROTECTION OF PASSENGERS	
FENCING AND STATION ACCESSES	The stations will be protected from intruders by a suitable fence around the boundaries, with a height from the level of the external paving that is no less than 1.80m. Accesses for both the public and personnel should allow a safe exit for all users, in conformity with the regulations for overcoming architectural and sensorial barriers and escape routes for fire prevention safety, and will be equipped with gates for the closure of the station when not in operation and to allow the entry of emergency vehicles
Cantilevered roofs	The roofs will be long enough to generally cover the access and waiting areas, as well as the stairs and ramps in the event of underpasses (where specified in part IV). The maximum length, according to the conformation of these areas, should not exceed 70.00m. The cantilevered roofs will preferably be modular in order to allow eventual successive lengthening. The dimensions regarding the height of the intrados of the roof from the running surface and its projection from the edge of the platform, should respect the allowed clearance.
PASSENGER BUILDING, AUXILIARY SERVICES BUILDING, TECHNOLOGICAL BUILDING, OTHER BUILDINGS	
Passenger Buildings	For the dimensioning of the waiting areas in the Passenger Building, the areas indicated in point □ have been identified, for the configurations under examination, on the basis of the forecasted traffic during peak times, by adopting the following procedures: - 40% of passengers present in the morning time band (7:00 – 9:00) - 20% of passengers present in the afternoon time band (13:00 – 15:00) - 20% of passengers present in the evening time band (18:00 – 20:00) - 20% of passengers present in the remaining times.

	For small stations, the presence of people who are not passengers is negligible. Considering that passengers remain in the station for an average of 20', the total number of passengers during peak (P) time is: $P = (P \times 0.40) : 6$ Giving the standard of 1.00 sq.m per passenger, the area (S) is obtained which is sub-divided according to the type of waiting, in the concourse (60%) and on the platform (40%). For example, with a total of 2000 passengers per day (p/d) $P = (2000 \times 0.40) : 6 = 133$ S total = 133 sq.m S concourse = 133 x 0.6= 79.80 sq.m S waiting on platform = 33 x 0.4 = 53.20 sq.m. Main types of S.B. in function of their position in respect of the internal yard. - S.B. lateral (platform area on transit or terminal line) - S.B. bridge (platform area on transit line) - S.B. underground (platform area on transit or terminal line) - S.B. on viaduct (platform area on transit or terminal line) - S.B. terminus (platform area on terminal line)																																																						
Technological buildings and Transformer Rooms	Technological buildings and Transformer Rooms, where necessary will be modular and be dimensioned according to the necessities illustrated in the following paragraph.																																																						
Auxiliary services Buildings and Other Buildings	Auxiliary services Buildings and Other Buildings to be dedicated to specific functions and activities for: logistics, railway operations, transport companies, different types of transport, police, etc., are to be considered specific design elements.																																																						
TOILETS																																																							
Toilets	The number and size of toilet facilities must be in proportion with the passengers foreseen at peak time. Facilities should be provided within the buildings or in a separate structure, all in accordance with the available space and within the design restrictions. Adequate male, female and handicapped toilets should be provided as shown in the following schedule. <table><tr><td>Passengers</td><td>(n°)</td><td>100</td><td>250</td><td>500</td><td>750</td><td>1000</td><td>1500</td><td>2000</td></tr><tr><td>Standard value</td><td>(m2/pass)</td><td>0,15</td><td>0,14</td><td>0,13</td><td>0,12</td><td>0,11</td><td>0,10</td><td>0,09</td></tr><tr><td>Surface</td><td>(m2)</td><td>15</td><td>35</td><td>65</td><td>90</td><td>110</td><td>150</td><td>180</td></tr><tr><td>Water closet</td><td>(n°)</td><td>2 _ 4</td><td>4</td><td>8</td><td>10</td><td>12</td><td>14</td><td>18</td></tr><tr><td>Lavatory</td><td>(n°)</td><td>2 _ 4</td><td>4</td><td>8</td><td>10</td><td>12</td><td>14</td><td>18</td></tr><tr><td>Handicap toilet</td><td>(n°)</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>2</td><td>2</td></tr></table>	Passengers	(n°)	100	250	500	750	1000	1500	2000	Standard value	(m2/pass)	0,15	0,14	0,13	0,12	0,11	0,10	0,09	Surface	(m2)	15	35	65	90	110	150	180	Water closet	(n°)	2 _ 4	4	8	10	12	14	18	Lavatory	(n°)	2 _ 4	4	8	10	12	14	18	Handicap toilet	(n°)	1	1	1	1	1	2	2
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Handicap toilet	(n°)	1	1	1	1	1	2	2																																															
LIGHTING																																																							
Access areas, internal areas	The minimum lighting at floor level should not be lower than 100 Lux.																																																						

	The minimum lighting at floor level in the underpasses and on the connecting stairs and ramps should not be lower than 120 Lux
Area under cantilevered roof	The minimum lighting at floor level should not be lower than 70 Lux.
Open areas	In the sections of station pavement and other public areas in the open, the average lighting at floor level should not be lower than 20 Lux and not exceed 50 Lux, with in any case a minimum value of no less than 10 Lux. In the direction that the trains travel, any intense lighting that may interfere with the driving or operating signals must be avoided.
S.B. and other Buildings	These buildings must conform with the guide lines that will be adopted in the successive design phases In all cases emergency lighting must be foreseen.
FIXED MESSAGE SIGNS	
Fixed message signs	The type and location of signs with fixed messages giving directions, information or for safety and prohibition, shall conform to the specific instructions that will be used in successive design phases, as well as to the fire prevention signs according to the current national regulations
VARIABLE SIGNS AND PUBLIC ADDRESS SYSTEM	
Variable signs and public address system	The type and location of the signs for variable visual information (only for the main stations) and the public address system will conform to the specific instructions that will be assumed during successive design phases.
FURNISHINGS	
Furnishings	These should foresee : - Seats for internal waiting areas (S.B.) according to the furnishing scheme, that should be equipped with armrests or dividing elements between seats and be attached to the floor with small fixtures - Seats for waiting areas under the cantilevered roof, according to the furnishing scheme, that should be attached to the floor with small fixtures. - Seats in the external waiting area; further seating or benches could be foreseen in continuity with the architectural furnishing scheme. - Rubbish bins (of the type for common or differentiated collection), coordinated with the urban furnishing scheme. - Adverting furnishings: spaces allocated for advertising signs.
TURNSTILES THAT CONTROL ACCESS	
Turnstiles	The transport company may request the use of turnstiles in stations. Therefore, in the configurations indicated in the following paragraph, suitable, protected spaces should be allocated for their eventual successive installation. The turnstiles should be sufficient for the flow of passengers and, in any case, not less than 3 per access and 3 per exit of which one, in each direction, with the dimensions and characteristics suitable for disabled passengers in wheelchairs. The positioning of the turnstiles should not interfere with transit flow in an emergency or the entry of emergency vehicles.

FIRE PREVENTION	
Furnishings	The typologies considered in the following paragraph, should foresee for fire prevention, all or part of the installations listed below, dimensioned according to a functional fire prevention design, emergency and evacuation plan. - Inside the buildings and/or car parks, manual fire extinguishing systems, either fixed or portable, with a fire prevention hydraulic circuit; - Inside the technological premises, manual fire extinguishing and local and remote fire alarm systems; - Emergency and safety lighting systems; - Signs indicating the fire fighting equipment, the escape routes and access for rescue and emergency vehicles; - Remote intercom system connected to the nearest control post, to raise the alarm.
ENERGY SAVING	
Energy Saving	In the situations where buildings are present, care must be taken to save energy through the following design interventions: - Use and integration of bioclimatic technologies for energy supply (photovoltaic installations for the production of electricity and the use of solar heating for the production of hot water); - Control of energy use through devices to limit consumption; - Insulation with low conductivity materials, use of highly insulating materials, reduction of thermal bridges; - Interventions to control in-coming radiation and shading in summer by creating a system of natural cross ventilation, by inserting windows on the opposite wall of the rooms, and doors with transom windows, shutters and sun screens. Also for the cantilevered roofs, on the basis of their location in advantageous sunny conditions, they can be used in coordination with photovoltaic panels.

→ Dimensioning and Equipment of the Functional Elements for each Configuration and Access Typology

➤ Class 1A/1B/1C: Station with Low Frequency on a Single or Double Track

Configuration 1 (Access types A-B-C)

- Inter-modal exchange area
- Side platform(s) with a continuous minimum width of 3.50m with suitable widening for waiting, access, stairs and ramp areas and Island platform(s) with a continuous minimum width of 7,20 m (both to be increased in function of the safety factor according to the speed).
- Cantilever roof partially covering the width of each platform and long enough to protect the fixed stairs and ramps (max 70.00m), with areas (in special climatic conditions) with side facings, equipped with seats, arrivals/departures notice board, lighting, loudspeaker system, rubbish bins.
- Fencing and access gates.

- Structures, routes and equipment accessible for handicapped passengers.
- Tactile routes and maps for the blind
- Fixed message signs.
- Identification of station entrance with location name on the station building
- Station Illumination.
- Bicycle racks
- CCTV according to specific programmes controlled from a command post.
- Underpass (cases 1A and 1B) served by covered stairs and ramps or covered aerial footbridge (case 1C) served by covered stairs and ramps or rising platforms or elevators
- Technological Building or part of the Station Building dedicated to equipment and premises for the railway operations, according to the requirements of the line and installations, agreed with the Management of the competent Operations and Infrastructures Departments. Usually premises are required for: Electricity supply, MT/BT, Generators, UPS, ACC Switchboards (Computerized Central Command Unit) or ACEI (Signalling Railway Interlocking), Operations Manager (manned) + toilets, Signalling and Communication.

On the basis of the equipment, the technological premises should include air conditioning systems, ventilation, fire detection and extinguishing systems.

Indicatively, the area to be designed is approximately 120 - 200 sq.m.

- Section of the Station Building containing:
 - Concourse-waiting area equipped with arrival/departure boards, notice and information bulletin boards, loudspeaker system, seating, rubbish bins, arrangements for ticket issue and stamping machines, arrangements for drink distributors.
 - Connections to successively install toilets and storage rooms
- Overall area of approx. 80 sq.m (concourse-waiting area approx. 50 sq.m. toilets approx. 15 sq.m., storeroom approx. 15 sq.m).

➤ Class 2A/2B/2C: Station on a Single or Double Track Line

Configuration 2 (Access types A-B-C)

- Inter-modal exchange point
- Side platforms(s) with a continuous minimum width of 3.50m with suitable widening for waiting, access, stairs and ramp areas and Island platform(s) with a continuous minimum width of 7.20 m (both to be increased in function of the safety factor according to the speed).
- Cantilever roof partially covering the width of each platform and long enough to protect the fixed stairs and ramps (max 70.00m), with areas (in special climatic conditions) with side facings, equipped with seats, arrivals/departures notice board, lighting, public address system, rubbish bins.
- Fencing and access gates.
- Structures, routes and equipment accessible for handicapped passengers.
- Tactile routes and maps for the blind

- Fixed message signs.
- Identification of station entrance with location name in single letters on the station building
- Station Illumination.
- Bicycle racks covered by roofs
- CCTV according to specific programmes controlled from command post.
- Underpass (cases 2A and 2B) served by covered stairs and ramps or covered aerial footbridge (case 2C) served by covered stairs and ramps or rising platforms or elevators
- Technological Building for equipment and premises for railway operations according to the requirements of the line and installations, agreed with the Managements of the Operations and Maintenance Departments

Usually premises are required for: Electricity supply, MT/BT, Generators, UPS, ACC Switchboards or ACEI, Operations Manager (manned) + toilets, Signalling and Communication.

On the basis of the equipment, the technological premises should foresee air conditioning systems, ventilation, fire detection and extinguishing systems.

Indicatively, the area to be foreseen is between approx. 200 and 300 sq.m.

As an alternative to the insertion of a Technological Building, the above premises can be contained in dedicated spaces located inside the Station Buildings, or if present for other needs, in the Auxiliary Service Buildings.

- Station Building containing:
 - Concourse-waiting area equipped with arrival/departure boards, LED notice and information bulletin boards, loudspeaker system, seating, rubbish bins, arrangements for ticket issue and stamping machines, arrangements for drink distributors, heating/air conditioning systems according to climatic conditions.
 - Area, approx. 90 sq.m (for locations with more than 1000 p/d, foresee a further 4sqm every 100 p/d for the concourse-waiting area).
 - Premises for the ticket office (back office, management and cash desk, dressing rooms and toilets), as requested and quantified by the Transport company, with air conditioning systems
 - Area, approx.30 sq.m: Arrangements for commercial units (bar, ticket seller, tobacconist, newspapers)
 - Area, approx. 30 sq.m: Toilets with access near the commercial unit.
 - Area, approx. 30 sq.m: Arrangements in turnstile area for access control to the pavements (only if requested by Transport company).
 - Area, approx. 30 sq.m: Storage rooms
 - Area, approx. 30 sq.m.

➤ Auxiliary Services Building

Located according to operational necessities, to house functions and activities agreed with the Management of the Operations and Maintenance Departments.

Usually, premises and store rooms are requested for maintenance, checking, waiting rooms for mechanical staff and reserves, dining room, dressing rooms and toilets for personnel and suppliers, Police (Railway Police) offices, premises for technological equipment and others.

3.5.3 TECHNOLOGICAL INFRASTRUCTURE

3.5.3.1 Telecommunication System

A railway network operation must rely on an efficient and complete range of information systems: voice, data services, Integrated Services Digital Network, video, signalling safe data, etc.: all the stations along the line must be connected with a central dispatcher, and between stations signal data and block information shall be exchanged in an efficient and reliable system.

The proposed long distance Telecommunication System is based on Synchronous Digital Hierarchy (SDH) technologies. This system uses optical fibres to transmit digital data at different speeds, so that there are different solutions available, based on the total traffic requirements for any specific network.

The modularity of the system permits the configuration of the network and delivery of hardware with the best economical solution. A last but no less important aspect, is that the interfaces between the various levels of equipment are standardized, so that different vendors may supply any type of “multiplex” components. This means competitiveness and lower prices.

Thus, the backbone on which all data information is transmitted between the elements of a railway infrastructure, to each other and to the Operation Control Centre, is the Synchronous Digital Hierarchy (SDH) fibre optic network.

The functions of the SDH System are mainly to provide:

- access interfaces for users located in the sites involved in the Design;
- network for services required by the users.

Users shall be represented by other railway subsystems such as Signalling (e.g. Axle Counter System) and Telecommunications (Radio System, Telephone Network, Public Information System).

The SDH system shall be functionally divided into:

- Access network;
- Transmission network

The Access network shall be constituted by a flexible multiplexer (MUX-F) that may be considered a concentrator of low-speed services before they are brought into the local exchange for distribution.

The Transmission network shall be constituted by SDH equipment (ADM – Add/Drop Multiplex), that allows access to only the information that needs to be dropped or inserted in the site and to convert from electrical signal to optical signal and vice versa, and optical fibre cable.

The SDH components are connected to each other by means of an optical fibre cable laid along the railway tracks.

In order to obtain the ring structure required by the SDH standard, a forward fibre cable and return fibre cable shall be used.

The SDH ring shall provide for simultaneous digital flow transmission in two (clockwise and anti-clockwise) directions.

Moreover, a radio system must be available to connect loco drivers to the dispatcher (centralised and local), for staff in the yard, for work on the line and for any operations which cannot be based on fixed telephone equipment.

This type of service may be provided by using proprietary radio network on a UHF railway band (457-467 MHz). The radio system may start as standard analogue FM or start with a new DMR Digital Network, because the cost for such modern technology is comparable to the old PMR (Professional Mobile Radio) analogue network.

3.5.3.2 Signalling System

A modern Signalling System must guarantee safety, modularity and easy modification of the equipment following any changes of the rail. The proposed Signalling System for the new Ghana Railway System is based on the European Railway Traffic Management System (ERTMS) Level 1 initially, to be upgraded to ERTMS Level 2 in a subsequent phase.

The ERTMS is a train control standard, based on in-cab equipment able to supervise the train movements and to stop it according to the permitted speed at each line section, along with calculation and supervision of the maximum train speed at all times. The driver's response is continuously monitored, and if necessary the emergency brakes would be taken under control.

The objective of this comprehensive ATP (Automatic Train Protection System) is to constantly monitor the train speed, and compare it to the maximum values that are sent by trackside signalling.

The ETCS Level 1 involves continuous supervision of train movement with a non-continuous communication between train and trackside (normally by means of Eurobalises). Lineside visual signals are necessary and train detection is performed by the trackside equipment (usually track circuits or axle counters) out of the scope of ERTMS.

The communication between on-board and trackside equipment is instead provided by GSM-R radio connection for operations in ETCS Level 2. GSM-R (Global System for Mobile Communications - Railways) is the second subsystem forming, together with ERTMS, the ETCS (European Train Control System). The

GSM-R Radio Network is achieved by means of Base Transceiver Stations (BTS), with antennas, located along the railway line and operating on radio frequencies dedicated to the railway system.

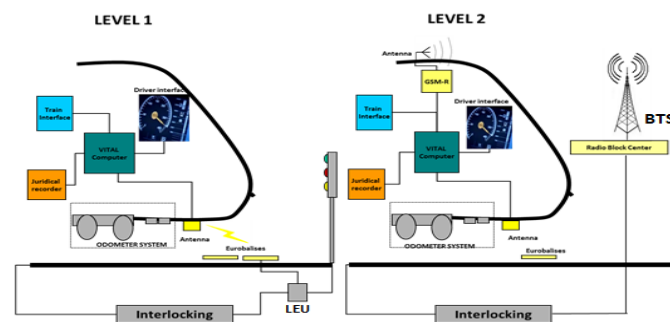


Figure 3-13. ETCS Level 1 and Level 2

Considering that the system (Level 2) allows circulation exclusively of the rolling stock equipped with sophisticated on-board equipment and GSM-R, but does not allow the circulation of traditional rolling stock, the installation of an ERTMS Level 2, which should remain as the final objective for the new lines serving high traffic at high speed and capacity (associated with a GSM-R telecommunication system) is not recommended as a first choice. Rather, the new lines should be equipped with a Level 1, with the option of further upgrading to Level 2.

ERTMS is divided into 2 subsystems: on-board and trackside

The ERTMS components installed on the trackside are:

1. Balise

The balise is a passive device that lays on the track, storing data (fixed or switchable, i.e. with the possibility of changing information content) related to the infrastructure, such as speed limits, position references, gradients, etc.). It is a passive device because it does not need a power supply, since it is the train antenna (BTM - Balise Transmission Module) that energizes it when passing over it.

2. LEU (Lineside Electronic Unit)

The LEU is the interface between the balise and interlocking. It acquires the information from the latter, and in concordance with the lineside signalling (if available) it sends the appropriate instruction to the balises.

3. RIU (Radio In-fill Unit)

The RIU is an optional component, applicable to ETCS Level 1 in order to increase system performance. It allows the message contained in a balise to be sent in advance to the train by GSM-R transmission. Thus, a train located in the coverage area of the radio infill can constantly receive updated information, e.g.: if the signal 'clears' the movement, authorisation will be updated without the train needing to read the balise located at the signal.

4. Radio Block Centre (RBC)

The RBC is a device used at ETCS Level 2 acting as a centralised safety unit which, using radio connection via GSM-R, receives train position information and sends movement authorisation and further information required by the train for its movement. The RBC interacts with the interlocking to obtain signalling-related information, route status, etc. It is also able to manage the transmission of selected trackside data and communicate with adjacent RBCs.

5. Interlocking

Interlocking is not an ERTMS component, but it plays an important role in the signalling system. Interlocking guarantees safety for train movements or routes and ensures that the route for a specific train is maintained and that incompatible routes are not simultaneously established. An interface between the interlocking and ERTMS trackside subsystem is necessary in almost all ERTMS structures.

Regarding the on-board components, the following can be mentioned:

1. Vital Computer (VC)

The VC is the core of the ETCS on-board device. It is part of the Automatic Train Protection logic and is the unit with which all the other train functions interact, such as the odometer or the GSM-R data reception.

2. Driver Machine Interface (DMI)

The DMI is the interface between the driver and the ETCS. In most cases, it is an LCD touch screen panel for control and indication functions, allowing the driver to enter the required input data to the system and to visualize the output data.

3. Train Interface (TI)

The TI is the interface that allows the ETCS to exchange information (e.g. ETCS will receive the status of the direction controller through the TI) and issue commands to the rolling stock (e.g. ETCS will send the rolling stock the command to apply the brakes)

4. Juridical Recording Unit (JRU)

The Juridical Recorder Unit provides 'black box' functions, i.e. it stores the most important data and variables from train journeys, allowing later analysis.

5. Balise Transmission Module (BTM)

The BTM is a module inside the ERTMS on-board equipment for intermittent transmission between track and train, which processes signals received from the on-board antenna and retrieves application data messages from a balise.

6. Odometer

The odometer is responsible for calculating the distance run by the train, typically consisting of redundant tachometry and radar, able to calculate distance, speed and acceleration.

The Level 1 equipment, as already said above, needs to be integrated with additional outdoor equipment, that detect the presence/position of the train along the line section to be safely travelled, i.e.

- track circuits, a simple electrical device used to detect the presence or absence of a train on a rail track section, used to inform signallers and control relevant signals;
- axle counters, that detect the passing of a train between two points on the track, where a counting head (or detection point) is installed.

The same values and objectives of the ERTMS, with a similar technological architecture as the ETCS are held by the Chinese Train Control System (CTCS).

3.5.3.3 Public Information System – Ticketing – Video Surveillance.

A modern railway line should be designed and implemented with the criteria of ensuring a high capacity of transport and speed; a further important requisite is to make the journey and the stops in the stations as comfortable as possible for the passengers.

“Comfort” is also achieved with the appropriate information, useability and safety offered to the passengers.

Public Information System

The stations will have variable message boards that clearly indicate the times of the trains arriving and departing, their destination and eventual variations to the original timetable.

These signs are usually located in the station entrance and in the waiting rooms; whereas monitors are located on the platforms that give information exclusively regarding the trains that stop or leave from that particular platform.

Through the audio system it will be possible to make vocal announcements in the premises of the single stations.

These systems, in the simplest terms, can be managed locally and in the more complex configurations be centralized (in the case of the realization of the OCC) and interfaced with the signalling system. In this case, the data coming from the signals is transmitted to the information system, that in real time updates the status of the train circulation and also permits the elaboration of automatic audio announcements. The announcements can be transmitted from the centre to the single stations, or be of a general nature and be sent to the entire line.

Ticketing

With the objective of making the railway system more useable by the passengers, automatic ticketing machines can be located in the stations. They can be programmed to accept coins, banknotes or credit cards and render the purchase of tickets “self service”.

Also in this case, the automatic ticketing system can be managed locally or be connected to the centre, to which the data from the single machines will be transmitted for statistical and diagnostic purposes.

Video surveillance

Passenger safety is an indispensable prerogative in modern mass transport systems; a system that renders this aspect more efficient is certainly a closed circuit television system.

The installation of cameras in the station areas open to the public allows the operators to supervise and identify any suspicious or dangerous behaviour.

The system can have a local or centralized management; in the second case the centre can select a single station and a single camera. The images can be memorized for several days and viewed in the cases it proves necessary.

3.5.3.4 Electrification of the railway line

The electrification of a railway line allows the circulation of electric trains which, due to their characteristics, have a higher speed than those with diesel traction and lower energy consumption.

The electric traction systems normally installed are distinguished by the value of the contact line voltage; those used in Europe are given below (continent that has the greatest diffusion of electrified railway lines):

- 15 kV - Alternating Current (AC)
- 25 kV AC (European standard for high speed lines)
- 750 V - Continuous Current (DC)
- 1,500 V DC
- 3.000 V DC

The electrification of a railway line involves the construction of infrastructures that will supply the circulating vehicles from the existing electricity lines (national grid); it is, therefore, necessary to create a system mainly consisting of:

- Yield points consisting of electrical substations that supply a line with high or medium voltage from the national electricity grid (on average 2 or 3 yield points for a line 150 - 200 km long).
- Medium or high voltage power line that runs parallel to the railway line.
- Substations (SSE) distributed along the railway line that allow the transformation of the voltage from the primary line to that required by the contact line; the number of these sub-stations depends both on the number of circulating trains and on their supply voltage (on average, substations are placed at intervals of between 3 and 8 km); in the case of a DC contact line, the SSE convert the alternating current into continuous current.
- Contact line that supplies power to the electric trains; this line consists of support poles placed beside the track and a catenary formed by a cord that supports the contact wire along which the pantographs of the vehicles crawl.
- Sectioning apparatus located along the contact line and in the stations.

- Possible centralized control point (SCADA) from where it is possible to supervise the system status and carry out remote commands.

The evaluation of the overall costs for the realization of the electrification of railway lines cannot go beyond the further interventions to be carried out to make the system reliable. The electrical network from which the traction supply is derived must have a very high continuity index. In practice, the yield points should be highly reliable with virtually no interruptions. As an example, it is reported that high voltage distribution networks (national networks) in Europe have a continuity index (annual availability time in hours / total yearly hours) above 0.99.

The average cost of installation depends on different factors and on the type of system to be realized; for the electrification system only (without the intervention costs on the national electricity lines) it is possible to indicate a mileage value of between 350,000 and 450,000 USD

3.6 ROLLING STOCK AND OPERATIONAL MODEL

3.6.1 TYPICAL TRAIN SIZE AND TRANSPORT CAPACITY

The selection of types and the definition of quantities of rolling stock to be utilized for railway operation of freight and passenger trains depends on a number of factors, which are examined separately for freight and passenger trains.

Some assumptions have been made in the study concerning passenger and freight train characteristics and transport capacity of the rail system.

These assumptions are related to the size of trains to be operated, in terms of maximum transport performance. The real transport flows will, in the actual situation, be affected by a load factor, which can be estimated, as a realistic minimum, as 40-50% for passenger trains and 60-70% for freight trains.

These load factors are mainly due, for passenger trains, to peak and off-peak hours (during the day) and peak and off-peak days (during the year); regarding freight trains this is mainly due to the need to also transport empty wagons during regular operations, as only transporting loaded wagons is not a realistic scenario.

In terms of transport capacity, it has been assumed:

- ➔ the standard freight train is composed of **30 wagons and one (or two) locomotives**, depending on the line gradient and expected maximum speed, with a total mass of around **1,500 tons**
- ➔ the standard passenger train is composed of **12 coaches and one locomotive** In terms of maximum transport capacity, such a train is suitable for **1,200 passengers**.

Moreover, the operation of the trains is foreseen as follows:

- 330 days/year for passenger trains (average value obtained considering a partial operation during public holidays), and
- 300 days/year for freight trains
- 20h/day operating time to allow 4h/day night maintenance
- 80% as a load factor for freight train, mainly due to the need to also transport empty wagons during regular operations. Therefore, the maximum effective capacity is approx. 1,200 tons
- 80% as a load factor for passenger train sets, mainly due to peak and off-peak hours (during the day) and peak and off-peak days (during the year). Thus, the effective capacity for passenger train is approx. 1,020 pax.
- The average commercial speed for running time calculation is assumed at 60 km/h (50km/h for freight train and 80km/h for passenger train).
- 25% of spare wagons and coaches, in addition to those in operational service, are needed to replace the quantity estimated to be under servicing and maintenance
- 30% of spare locomotives, in addition to those in operational service.

3.6.2 FREIGHT TRAIN

The considered standard freight train of 1,500 tons total mass can be hauled by one diesel-electric locomotive with 20 tons/axle, AC/AC system (power inverter and asynchronous traction motors), with a power rate of around 3000 HP, a starting traction effort of more than 300 kN and CoCo type bogies (two bogies with 3 motorized axles each).

The total length of a freight train with 30 wagons and one locomotive is around 625 m.

In the case that the railway line has some gradients with a length exceeding 1 km, it is necessary to utilize double traction.

This condition means that there are two locomotives at the head of the train, with only one driver. The second locomotive is controlled by the driver of the first one, through a wired or radio remote control system.

Utilizing double traction, a freight train of 1,500 tons total mass can be hauled at a speed of around 40 km/h on a 12 per thousand gradient. For steeper gradients the speed is reduced to values normally not considered compatible with ordinary operations.

In this case three or more locomotives could be utilized, two at the head of the train and one at the tail (for more than three, one or more locomotives should be “interposed”). The alternative is to cut the train into smaller trains, for the steep gradient route.

The locomotive pushing the train from the back can be controlled by the driver of the first locomotive through a remote control using a radio system (i.e. Locotrol)

Freight trains may be of many different types, especially depending on the nature of goods to be transported. Main types are described below.

a) Flat Wagons

Flat wagons are wagons with no end/lateral walls and roof. They are intended for the transportation of containers (20 and 40 feet) or heavy goods that have a large size and shape, and which are not particularly affected by external conditions like rain, wind, sand, etc.

If necessary, the goods can be covered with tarpaulins fixed to the wagon ends and sides, therefore the wagon structure is provided with dedicated hooks.

b) Box Wagons

Box wagons are open top and intended to transport bulk materials, filling the wagon by volume or by load, depending on the material density. Loading and unloading will be done from the top.

If necessary, the wagon can be covered with tarpaulins fixed to the wagon ends and sides, therefore the wagon structure is provided with dedicated hooks.

c) Covered Wagons

Covered wagons are similar to box wagons, but are provided with a fixed roof. They are intended to transport any kind of goods. They are normally provided with large lateral doors for loading and unloading bulk or palletized goods.

d) Open Hopper Wagons

Open hopper wagons have an open top and are equipped with a bottom discharge system to be operated with the provided equipment

Open hopper wagons are intended for the transport of bulk materials, filling the car from the roof by volume or by load and discharging by gravity.

e) Covered Hopper Wagons

Covered hopper wagons are equipped with a movable, closing roof and bottom discharge equipment.

Covered hopper wagons are intended to be loaded from the top by opening the roof, and unloaded by gravity, by opening the bottom of the wagon using the provided equipment. After loading, the roof is closed and the wagon can be put in circulation.

Covered hopper wagons are intended for the transport of bulk materials that must be protected from rain, filling the car by volume or by load, depending on the material density.

f) Tank Wagons

Tank wagons are intended to transport chemical and petroleum products, crude or refined, liquid or gas. Proposals for the different types can be presented on request by the rolling stock supplier.

Products can be loaded and unloaded from the top or the ends, through different devices to be proposed by the rolling stock supplier. If the density of the product is quite high, tank wagons shall be equipped with heating systems, to reduce product density and facilitate its discharge.

Many other types of wagons exist on the international market. All these kinds are generally available with two or four axle (2 bogies) wheelset arrangements.

Second hand freight wagons are available on the market.

3.6.3 PASSENGERS TRAINS

A passenger train with 12 coaches and 1 locomotive has a total mass of around 700 tons and a total length of around 350 m in single traction.

It is recommended to use the same type of locomotives used for freight trains to haul passenger trains, unless they are not compatible due to the maximum speed. The reason being that utilizing the same type of locomotive reduces the need for additional training of staff and, especially, the need for additional maintenance facilities and spare parts stock.

This train can be hauled on a maximum gradient of 4 per thousand, at a maximum speed of around 100 km/h. On a 12 per thousand gradient, the same passenger train can run at a speed of around 60 km/h.

For higher gradients or when a higher speed is required, it is necessary to utilize a double traction, following the same indications as per freight trains.

Passenger trains may be of the following main types:

a) Long Distance Passenger Trains

- b) Trains are considered to be Long distance, either Long distance day trains or Long Distance night trains, when the average passenger time on-board is more than two hours.

These trains require a level of comfort and on-board services related to this permanence and must be equipped with:

- Air conditioning equipment
- Appropriate toilets
- Eventual bar and restaurant facilities

The interiors have to be supplied with padded seats (divided into two or three classes), with enhanced seat equipment (table, battery charger, reclining backrest, etc.). In the case of long distance night trains, the interiors must be equipped with beds (one, two or three for each coach compartment) or couchettes.

On the basis of the above, the coaches to be procured on the international market shall be provided with suitable equipment, to be listed in the relevant technical specifications.

c) Regional and Commuter Trains

Trains are considered to be Regional and Commuter trains when the average passenger time on-board is less than two hours. For Commuter trains, the average passenger time on-board can be less than half an hour.

These trains require a level of comfort and on-board services related to this permanence and they must be equipped with:

- Air conditioning equipment or, in alternative, ventilation equipment
- Appropriate toilets or no toilets at all, for short distance Commuter trains

The interiors have to be provided with seats (divided or not into classes), with simple seating structure and equipment. On the basis of the above, the coaches to be procured on the international market shall be provided with suitable equipment to be listed in the relevant technical specifications.

The maximum speed of the coaches has to be defined in accordance with the rail infrastructure characteristics, the locomotive performance and the operation plan.

3.6.4 LOCOMOTIVES

The selection of the types of locomotives to be utilized for hauling trains also depends on many factors, of which the most important are:

- Power rate
- Starting Traction effort
- Maximum speed

In the specific case of Ghana Railways, it has been recommended above that the same type of locomotives should be used to haul both passenger and freight trains, reducing the overall operating costs.

The locomotives recommended for use in Ghana Railways are diesel electric units with the following main features:

- Power rate of around 3000 HP
- AC/AC traction system (power inverter and asynchronous traction motors)
- Diesel engine with low emission control of exhaust system
- Maximum speed of around 100 km/h
- 20 tons/axle
- Bogies type CoCo (two bogies 3 motorized axles each)
- 120 tons total mass
- Traction effort (at start) > 300 kN
- Max length around 25 m

3.6.5 PROCUREMENT OF ROLLING STOCK

A first hypothesis for the provision of locomotives, wagons and coaches (for main line and shunting operations) for the requirements of the Ghana Railway Network has been made.

The required rolling stock has to be defined by taking into account the number and type of trains to be operated and their schedules, and the need for spare locomotives, wagons and coaches due to the quantity estimated to be under servicing and maintenance.

This quantity can be considered to be:

- around 20-25% in addition to the coaches and wagons in operational service
- around 25-30% in addition to the locomotives in operational service

The Rolling Stock for the foreseen operations on each line of the railway network has been calculated in accordance with the Traffic Demand Forecasting.

At the 2059 horizon, the fleet results as having the following total composition, also taking into consideration the forecast for “collector” freight wagons (to be distributed in the stations along the line to facilitate the collection of freight) and a reserve of 30% for locomotives, and 25% for wagons and coaches:

- Locomotives: N° 153
- Freight wagons: N° 1,913
- Passenger coaches: N° 975

The following Table 3-14 shows the trend of the train sets' requirement for each phase of the development of the railway network.

Model Year	YEAR	Phase 1 (A+B)			Phase 1 C			Phase 2			Phase 3			ALL PHASES		
		L	W	C	L	W	C	L	W	C	L	W	C	L	W	C
1	2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	2027	34	450	210	-	-	-	-	-	-	-	-	-	34	450	210
7	2028	34	450	210	-	-	-	-	-	-	-	-	-	34	450	210
8	2029	34	450	210	-	-	-	-	-	-	-	-	-	34	450	210
9	2030	34	450	210	-	-	-	-	-	-	-	-	-	34	450	210
10	2031	34	450	210	19	338	75	-	-	-	-	-	-	53	788	285
11	2032	34	450	210	19	338	75	-	-	-	-	-	-	53	788	285
12	2033	34	450	210	19	338	75	21	225	150	-	-	-	74	1,013	435
13	2034	34	450	210	19	338	75	21	225	150	-	-	-	74	1,013	435
14	2035	39	600	210	21	413	75	21	225	150	-	-	-	81	1,238	435
15	2036	39	600	210	21	413	75	24	225	180	10	150	45	94	1,388	510
16	2037	39	600	210	21	413	75	28	225	225	11	150	60	99	1,388	570
17	2038	45	600	270	23	413	90	28	225	225	11	150	60	107	1,388	645
18	2039	45	600	270	23	413	90	28	225	225	11	150	60	107	1,388	645
19	2040	45	600	270	23	413	90	28	225	225	11	150	60	107	1,388	645
20	2041	45	600	270	23	413	90	28	225	225	11	150	60	107	1,388	645
21	2042	45	600	270	24	450	90	28	225	225	11	150	60	108	1,425	645
22	2043	45	600	270	24	450	90	28	225	225	11	150	60	108	1,425	645
23	2044	45	600	270	24	450	90	30	225	255	11	150	60	110	1,425	675
24	2045	45	600	270	24	450	90	30	225	255	24	300	150	123	1,575	765
25	2046	45	600	270	24	450	90	30	225	255	24	300	150	123	1,575	765
26	2047	45	600	270	24	450	90	30	225	255	24	300	150	123	1,575	765
27	2048	45	600	270	25	488	90	32	263	255	24	300	150	126	1,651	765
28	2049	45	600	270	25	488	90	32	263	255	24	300	150	126	1,651	765
29	2050	50	750	270	25	488	90	32	263	255	24	300	150	131	1,801	765
30	2051	50	750	270	25	488	90	34	263	285	24	300	150	133	1,801	795
31	2052	50	750	270	25	488	90	34	263	285	24	300	150	133	1,801	795
32	2053	50	750	270	25	488	90	34	263	285	24	300	150	133	1,801	795
33	2054	50	750	270	30	563	120	34	263	285	29	300	210	143	1,876	885
34	2055	55	750	330	30	563	120	34	263	285	29	300	210	148	1,876	945
35	2056	55	750	330	30	563	120	34	263	285	29	300	210	148	1,876	945
36	2057	55	750	330	30	563	120	37	263	315	29	300	210	151	1,876	975
37	2058	55	750	330	30	563	120	37	263	315	29	300	210	151	1,876	975
38	2059	55	750	330	32	600	120	37	263	315	29	300	210	153	1,913	975
TOTAL		55	750	330	32	600	120	37	263	315	29	300	210	153	1,913	975

L (Locomotives) W (Wagons) C (Coaches)

Table 3-14. Required Rolling Stock for each Phase

3.6.6 ROLLING STOCK MAINTENANCE ORGANIZATION AND FACILITIES

To guarantee an adequate level of availability of the train fleet, it will be necessary to organize and provide logistic support in terms of:

- Maintenance documentation
- Maintenance staff
- Maintenance facilities
- Spare parts

These aspects are crucial for efficient medium and long term railway system operations and require specific analysis and studies.

3.6.7 LINE CAPACITY

On the basis of a maximum allowable distance between stations equal to 30 km (critical section), taking into consideration the starting-up and braking time on arrival and departure from the stations, and the assumptions made above, the calculated train running time will be 30'.

Assuming the hours of operations of the line are 20h/day, the number of trains that can run in the critical section per day is 40 trains/day which is, therefore, the number of trains per day that can run along a critical section.

The line capacity is, therefore, 40 trains/day, which is higher than the total number of trains/day (passenger and freight) necessary to satisfy the traffic forecast at the scenario of 2059.

PHASES	Trains/day
PHASE 1 (A+B)	20
PHASE 1C	34
PHASE 2	30
PHASE 3	10

Figure 3-14. Estimated number of trains per day at 2059

3.6.8 MAINTENANCE DEPOTS AND WORKSHOPS

The concept of rolling stock maintenance facilities has to be revised on the basis of the fleet size and the type of operations (origin-destination of trains, number of passengers and freight trains, operating schedule, etc.)

Maintenance operations can be divided into three main levels, defined as shown in Table 3-15.

Each level can be assigned to an equivalent level maintenance facility, to be appropriately located along the network.

LEVELS	MAINTENANCE OPERATIONS
Level 0	Servicing
Level 1	Depot Workshop Service and Maintenance
Level 2	Main Workshop Maintenance

Table 3-15. Main levels of Maintenance Operations

Each of these levels requires different resources in terms of:

- Organization
- Skilled staff
- Spare parts
- Tools
- Infrastructure facilities and equipment

The main characteristics of the three levels are described below.

3.6.8.1 Level 0 - Servicing (Station Areas)

Level 0 Servicing operations are normally carried out at each end of the train route.

These operations can be performed on station tracks upon train arrival or before departure, depending on service needs.

Level 0 operations require the availability of one or two technical operators, skilled for routine checks and controls and for minor repairs.

Main operations assigned to Level 0 Servicing are the following:

- Restocking of onboard supplies
- Technical checks (on track)
- Functional controls by driver's cab
- Low level repairs and small parts replacement (in case of need)
- Interior cleaning
- Windscreen cleaning

It is necessary to have both a supply of spare parts and consumables (i.e. lamps, relays, filters, etc.) and a kit of transportable tools available for minor maintenance operations.

Cleaning and restocking of on-board supplies are not to be considered responsibility of the technical staff, but are normally carried out by a different team with specific equipment.

Refueling of diesel locomotives is another one of the tasks belonging to Level 0 operations.

3.6.8.2 Level 1 - Depot Workshop Service and Maintenance

Level 1 Service and Maintenance operations are normally carried out every three or four weeks or on a km basis.

These operations are normally executed in a Depot Workshop, following a schedule defined by the train management staff according to the maintenance manual and the train operating conditions.

Level 1 operations require the availability of a specialized Depot Workshop located in a suitable area, possibly close to a train terminal station.

The **Depot Workshop** shall be equipped with the following main facilities:

- Parking tracks
- External and underframe rolling stock washing installation
- Equipment for cleaning, washing and restoring coach toilets
- Shed equipped with tracks for rolling stock interior deep cleaning. The shed shall be equipped with electric power, water, compressed air, aspiration system, internal transport system, ...
- Shed equipped with tracks for rolling stock maintenance and components replacement. The shed shall be equipped with electric power, water, compressed air, aspiration system, internal transport system, cranes, ordinary and special equipment and tools
- Shed equipped with tracks for rolling stock checkout and final testing
- Shed (or part of a shed) dedicated to the storage of spare parts and components in stock and to be sent to the main workshop for major repairs

Some of the Depots of the network shall have an underfloor wheel lathe for reprofiling wheels without having to remove the wheelsets from the vehicle. The quantity and location of this equipment depends on the fleet size and the railway network extension.

Level 1 operations also require the availability of a complete technical staff, skilled for checks, controls, ordinary scheduled preventive maintenance, component replacement and repairs.

Administrative and Management Staff are also necessary.

The main operations assigned to Level 1 **Service and Maintenance** are the following:

- Interior deep cleaning
- External and underframe complete washing and cleaning
- Toilet treatment and restore to service (clean water tanks refilling)
- Restocking of onboard supplies
- Locomotive complete refuelling (including sand, windscreen water, oil, ...)
- Technical checks (to be done on track with central pit)
- Functional controls by driver's cab
- Repair and parts replacement (when necessary)
- Wheelsets grinding (when necessary)
- Wheelsets and bogies replacement (when necessary)

Cleaning is not to be considered the responsibility of the technical staff, but is normally carried out by a different team with specific equipment.

All the Preventive maintenance scheduled for Level 1 operations in regards to tasks and their frequency is carried out in accordance with the maintenance manual.

3.6.8.3 Level 2 – Main Workshop Maintenance

Level 2 Maintenance operations are normally carried out in a specialized workshop,

Two main types of intervention are carried out in this workshop:

- Preventive heavy maintenance interventions
- Components overhaul and repair

Preventive heavy maintenance operation frequency and its technical content are defined in the maintenance manual. Normally, the main workshop performs the complete overhaul and refurbishment of the different types of rolling stock (locomotives, passenger coaches, wagons) and their components.

Components overhaul and repair is done for the Main Workshop itself and for the Depots. When a component has to be stripped in a depot because of a serious breakdown, it is sent to the workshop for repair and return.

A serious breakdown means a breakdown requiring special equipment and staff specialized in the component disassembly, fault isolation and repair.

Level 2 operations require the availability of a specialized workshop, serving the entire rolling stock fleet and located in a suitable area connected to the line where the trains operate.

The **Main Workshop** shall be equipped with the following main facilities:

- Parking tracks
- Rolling stock external and underframe pressure washing installation
- Equipment for treatment, washing and restoring toilets
- Bogie replacement installation (for single bogie and for all the bogies of a vehicle)
- Shed equipped with tracks for train coupling and uncoupling
- Shed equipped with tracks for rolling stock final testing
- Shed equipped with tracks for rolling stock maintenance and components replacement. The shed shall be equipped with electric power, water, compressed air, aspiration system, internal transport system, cranes, ordinary and special equipment and tools
- Sheds (or areas of a shed) dedicated to the revision and repair of stripped components. The areas shall be equipped with electric power, water, compressed air, dust and smoke aspiration system, internal transport system, cranes, ordinary and special equipment and tools, welding equipment, components painting equipment, complete vehicle body sanding and painting equipment, work benches, machine tools, testing facilities, wheels disassembling and assembling, axles machining and testing, traction motors rewinding, gearboxes repair, brake system components control and

repair, axle boxes control and repair, suspension components and dampers control and repair, signaling and safety on board systems control and repair, bogie frame control and repair, ...

- Shed dedicated to storage of spare parts and components in stock and to be sent back to Depot Workshops following major repair.

Level 2 operations also require the availability of a complete technical staff, skilled for checks, controls, ordinary scheduled preventive maintenance, components replacement and repairs.

An Administrative and a Management staff are also necessary.

The **main operations** assigned to Level 2 Maintenance are the following:

- Repair of broken down components sent to the Main Workshop by the Depots
- General overhaul of rolling stock
- Car body heavy repair and re-painting
- Electrical, pneumatic and hydraulic systems overhaul and parts replacement
- Wheels and axles disassembling and replacement
- Bogies disassembling and overhaul
- Traction motors and gears disassembling and overhaul
- Air compressor disassembling and overhaul
- Main electrical machines and components disassembling and overhaul
- Toilets overhaul
- All the Preventive heavy maintenance scheduled operations on rolling stock and single components (different levels and frequency, according to the maintenance manual)

On the basis of the above described maintenance of the rolling stock, the various types of workshops necessary for the three levels of maintenance of the forecasted fleet for the new lines, have been positioned along the lines as the following map of shows.



Figure 3-15. Locations for Maintenance of Railway Network

4. ECONOMIC ANALYSIS

Financial and **Economic Analyses** share many common traits. Both involve the development of cash flows over the life of the project and the use of a discount or hurdle rate to test whether the project's impact is positive or negative. Both result in an **Internal Rate of Return (IRR)** and a **Net Present Value (NPV)**. The results are tested through a **Sensitivity Analysis**.

The fundamental conceptual difference between the two analyses could be described as follows:

The **Financial Analysis** is carried out from the point of view of a single entity, and measures the net profit or loss to that entity. **Economic Analysis** takes a broader view, in that it seeks to measure the positive or negative impact of the project on the society as a whole.

This major conceptual difference leads to the following differences in the methods and factors used in the two analyses.

Financial transactions, including revenues, are not included in the economic analysis, as these are considered transfer of payments rather than real economic benefits; instead, the analysis measures the resources used and the benefits to users and non-users, in particular.

- Various externalities or spill-over effects are incorporated in the analysis; these are effects of the project on parties other than the railway and its users (passengers and freight shippers).
- Subsidies, direct taxes and import duties are excluded from the analysis; like revenues, these are considered to represent transfer payments rather than true economic costs or benefits.
- A social discount rate (rather than a weighted average cost of capital) is used to develop net present values and to evaluate internal rates of return.
- Shadow prices could be applied to some factors used in the analysis.

4.1 GENERAL APPROACH AND METHODOLOGY

The Project's economic performance has been evaluated using the following indicators:

- **Economic Net Present Value (ENPV):** the difference between the discounted total social benefits and costs. The ENPV is expressed in monetary terms (US\$).
- **Economic Internal Rate of Return (EIRR):** the rate that produces a zero value for the ENPV
- **Benefit-Cost Ratio (BCR),** i.e. the ratio between discounted economic benefits and costs.

The **Economic Net Present Value** is defined as the sum that results when the expected investment and operating costs of the Project (suitably discounted) are deducted from the discounted value of the expected benefits:

$$ENPV = \sum_{k=0}^N \frac{C_k}{(1+i)^k}$$

where:

C_k = net cash flow at k-year

i = discount rate

N = number of years of the project scenario

The **discount rate** allows to transfer the cash flows at time zero, reflecting both the time value of money and the risk (procedure for discounting the cash flows).

The estimate of the value attributable to the discount rate takes into account the cost of capital and the systematic risk of the investment industry WACC (Weighted Average Cost of Capital).

The **Economic Internal Rate of Return** is defined as the discount rate that produces a zero ENPV:

$$ENPV = \sum_{k=0}^N \frac{C_k}{(1 + EIRR)^k} = 0$$

The EIRR is a pure number, and is scale-invariant. The Investment should be considered suitable if it generates a specific value of EIRR.

The **Benefit-Cost Ratio (BCR)** is defined by:

$$BCR = \frac{PV(I)}{PV(O)}$$

where: I are the inflows and O outflows.

If **BCR > 1** the Project is suitable because benefits, measured by the Present Value of the total inflows, are greater than costs, measured by the PV of the total outflows.

It is a pure number, as IRR, and it is independent of the size of the Investment.

Below a table summarising the characteristics of the three indicators, and showing the relative appropriateness accordingly to the analysed project scenario.

CBA Param.	Definition	Information conveyed	Pros	Cons
E-NPV	<i>discounted value of Costs and Benefits (net sum)</i>	<i>it measures the value for the society of the project initiative (in the currency used in the analysis)</i>	<i>It gives a real value to the Project</i>	<i>Proejcts of different size cannot be easily compared It depends by the Discount Rate applied</i>
E-IRR	<i>the social return on the project investment</i>	<i>it measures the % Economic Return for the society</i>	<i>easily comparable with other benchmark projects</i>	<i>technically "instable" in non-consistent cash flow profiles</i>
BC Ratio	<i>Ratio between (discounted) Benefits and Costs of the project initiative</i>	<i>a high BC Ratio (> 1) indicates the Project will generate social Benefits that are greater than Costs</i>	<i>independent from the size of the Project</i>	<i>Allocation of Benefits may not be so standardized Sensitive to Discount Rate</i>

Table 4-1. Analysis for CBA indicators - Consultant's elaboration.

4.2 SPECIFIC APPROACH AND METHODOLOGY

Based on the general approach of the **Cost Benefit Analysis (CBA)**, that is a well-established methodology for evaluation of investment feasibility in transportation projects, the Economic analysis is based on a comparison between two different cases:

- First case, called **"Without Project"**, that considers the normal evolution of the existing situation.
- Second case called **"With Project"**, that considers the construction of the new lines.

For the GRMP, the Consultant has developed separate economic analyses, one for each of the five Phases of the implementation of the new railway network as described in Chapter 3.1.

The case "without project" is represented by the **Phase 0**, which incorporates the "do nothing" scenario. New Scenarios ("with project"), are represented by **Phases 1-2-3**, which are considered on a stand-alone basis according to an incremental approach versus Phase 0. Therefore, each Phase has been assessed on the basis of their specific capital expenditure, operating costs and benefits.

The criterion for assessing the economic viability of the Investment is focused on the identification and quantification of variables able to produce a significant change in the use of resources available to the community with respect to the reference solution (**"without Project"**).

The criterion for assessing the economic viability of the Investment is incremental, focused on the identification and quantification of variables able to produce a significant change in the use of resources available to the community with respect to the reference solution (**"without Project"**).

These variables can be summarized as follows (see Figure 4-1):

- 1) **Project costs** (Infrastructure and Rolling Stock Investment costs, Capex)
- 2) **Rail Operating costs** (Opex)
- 3) **Benefits to the community**, in terms of:

- Reduction in transportation costs for the users, when travelling by rail instead of road
 - Savings in road maintenance costs, as there will be a reduction of the damages caused by the heavy load of trucks
 - Savings in road accidents, as a result of a lower volume of traffic on the primary road network
 - Saving in passengers' journey time
 - Greenhouse gases reduction
- 4) **Residual value** of the Infrastructure and Rolling Stock
- 5) **Socio-economic advantages**

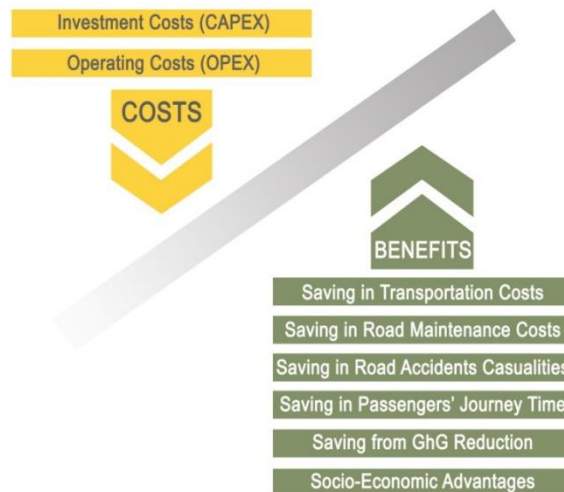


Figure 4-1. Inputs for Cost-Benefit Analysis

4.2.1 TRAFFIC FORECASTS INCREMENTAL SCENARIOS

The forecasts for passenger and freight traffic in the scenarios “**with Project**” and “**without Project**” are the result of the analysis of current transport demand and the hypotheses for its future evolution.

These forecasts take into account the increase of the Railway capacity (expressed in terms of trains/km/year) in response to the growing needs of transport demand.

The increments of the passenger (number) and freight (tons) traffic are shown in the following

MP Phase:		Phase 0		Phase 1 (A+B)		Phase 1 C		Phase 2		Phase 3	
Year:		Freight	Passeng.	Freight	Passeng.	Freight	Passeng.	Freight	Passeng.	Freight	Passeng.
1	2022	189,581,982	272,994,762	-	-	-	-	-	-	-	-
2	2023	199,853,581	278,982,436								
3	2024	210,125,181	284,970,109								
4	2025	220,396,780	290,957,782								
5	2026	230,668,380	296,945,456								
6	2027	240,939,979	302,933,129	2,194,817,176	2,182,539,970	-	-	-	-	-	-
7	2028	251,990,524	308,973,196	2,295,604,327	2,226,056,791						
8	2029	263,041,069	315,013,262	2,396,391,479	2,269,573,611						
9	2030	274,091,614	321,053,328	2,497,178,630	2,313,090,432						
10	2031	285,142,160	327,021,984	2,597,472,250	2,356,092,760	1,950,955,146	756,728,672	-	-	-	-
11	2032	296,260,428	333,133,461	2,698,752,933	2,400,124,073	2,027,026,823	778,148,363			-	-
12	2033	307,378,696	339,244,939	2,800,033,616	2,444,155,387	2,103,098,500	799,568,054	919,074,297	2,266,682,672	-	-
13	2034	311,107,324	345,445,730	2,833,999,165	2,488,830,181	2,128,609,942	814,182,730	930,223,042	2,308,078,084		
14	2035	314,835,953	351,646,521	2,867,964,713	2,533,504,974	2,154,121,384	828,797,405	941,371,788	2,349,473,496		
15	2036	318,564,582	357,847,313	2,901,930,262	2,578,179,768	2,179,632,825	843,412,081	952,520,534	2,390,868,908	803,181,886	1,185,444,524
16	2037	324,935,874	364,157,446	2,959,968,868	2,623,642,339	2,223,225,482	858,284,466	971,570,945	2,433,028,515	819,245,524	1,206,348,170
17	2038	331,434,591	370,578,850	3,019,168,245	2,669,906,578	2,267,689,992	873,419,104	991,002,364	2,475,931,548	835,630,435	1,227,620,421
18	2039	338,063,283	377,113,487	3,079,551,610	2,716,986,622	2,313,043,791	888,820,620	1,010,822,411	2,519,591,115	852,343,043	1,249,267,779
19	2040	344,824,549	383,763,352	3,141,142,642	2,764,896,856	2,359,304,667	904,493,721	1,031,038,859	2,564,020,557	869,389,904	1,271,296,858
20	2041	351,721,040	390,530,479	3,203,965,495	2,813,651,919	2,406,490,761	920,443,194	1,051,659,636	2,609,233,450	886,777,702	1,293,714,388
21	2042	358,755,461	397,416,934	3,268,044,805	2,863,266,710	2,454,620,576	936,673,914	1,072,692,829	2,655,243,609	904,513,256	1,316,527,220
22	2043	365,930,570	404,424,822	3,333,405,701	2,913,756,388	2,503,712,987	953,190,840	1,094,146,685	2,702,065,092	922,603,521	1,339,742,324
23	2044	373,249,181	411,556,284	3,400,073,815	2,965,136,380	2,553,787,247	969,999,018	1,116,029,619	2,749,712,206	941,055,592	1,363,366,794
24	2045	380,714,165	418,813,500	3,468,075,291	3,017,422,385	2,604,862,992	987,103,586	1,138,350,212	2,798,199,510	959,876,704	1,387,407,848
25	2046	388,328,448	426,198,686	3,537,436,797	3,070,630,381	2,656,960,252	1,004,509,768	1,161,117,216	2,847,541,819	979,074,238	1,411,872,833
26	2047	396,095,017	433,714,100	3,608,185,533	3,124,776,625	2,710,099,457	1,022,222,883	1,184,339,560	2,897,754,210	998,655,722	1,436,769,222
27	2048	404,016,917	441,362,038	3,680,349,244	3,179,877,662	2,764,301,446	1,040,248,345	1,208,026,351	2,948,852,026	1,018,628,837	1,462,104,625
28	2049	412,097,256	449,144,836	3,753,956,229	3,235,950,328	2,819,587,475	1,058,591,660	1,232,186,878	3,000,850,881	1,039,001,414	1,487,886,782
29	2050	420,339,201	457,064,873	3,829,035,353	3,293,011,757	2,875,979,225	1,077,258,434	1,256,830,616	3,053,766,661	1,059,781,442	1,514,123,570
30	2051	428,745,985	465,124,569	3,905,616,060	3,351,079,383	2,933,498,809	1,096,254,370	1,281,967,228	3,107,615,537	1,080,977,071	1,540,823,008
31	2052	437,320,904	473,326,386	3,983,728,381	3,410,170,951	2,992,168,785	1,115,585,272	1,307,606,573	3,162,413,963	1,102,596,612	1,567,993,253
32	2053	446,067,323	481,672,830	4,063,402,949	3,470,304,515	3,052,012,161	1,135,257,048	1,333,758,704	3,218,178,681	1,124,648,544	1,595,642,606
33	2054	454,988,669	490,166,452	4,144,671,008	3,531,498,450	3,113,052,404	1,155,275,708	1,360,433,878	3,274,926,731	1,147,141,515	1,623,779,517
34	2055	464,088,442	498,809,848	4,227,564,428	3,593,771,453	3,175,313,452	1,175,647,368	1,387,642,556	3,332,675,454	1,170,084,346	1,652,412,583
35	2056	473,370,211	507,605,657	4,312,115,717	3,657,142,554	3,238,819,721	1,196,378,255	1,415,395,407	3,391,442,494	1,193,486,032	1,681,550,553
36	2057	482,837,615	516,556,568	4,398,358,031	3,721,631,114	3,303,596,116	1,217,474,701	1,443,703,315	3,451,245,808	1,217,355,753	1,711,202,330
37	2058	492,494,368	525,665,316	4,486,325,192	3,787,256,840	3,369,668,038	1,238,943,153	1,472,577,381	3,512,103,669	1,241,702,868	1,741,376,974
38	2059	502,344,255	534,934,684	4,576,051,695	3,854,039,782	3,437,061,399	1,260,790,172	1,502,028,929	3,574,034,673	1,266,536,926	1,772,083,705

Table 4-2. Passenger and Freight Railway Traffic Increments of each Phase

4.3 ASSUMPTIONS AND PARAMETERS FOR THE ANALYSIS:

4.3.1 SOCIAL DISCOUNT RATE

The Social Discount Rate (SDR) is the interest rate a public body (government agency) should use when evaluating alternative proposed policies, programmes, or regulatory changes that require a stream of expenditures and produce a stream of expected benefits over several years into the future.

The Social Discount Rate should incorporate the value attributed by the society to current costs and benefits, versus future ones. Alternatively, the SDR is the % amount to be deducted (discounted) to future costs and benefits generated by project initiatives, in the assumption that these projects were already operational today. Finally, a consistent SDR allows public authorities to compare different projects that may be implemented at different moments over the timeline, thus making available a tool in the decision making process.

Theoretical literature and international practice show a wide range of approaches in interpreting and choosing the value of the social discount rate to be adopted. The international experience is very wide and has involved different countries, as well as various international organisations.

Generally speaking, the most common methods used to calculate the social discount rate are:

- the Social Rate of Time Preference (SRTTP): this approach tries to measure the society's willingness to postpone private consumption now, in order to consume later. The logic of this approach is that the government should consider the welfare of both the current and future generations and solve an optimal planning programme based on individual preferences for consumption. In this way, if the key question lies in what rate entices individuals to save rather than to consume, then a possible indicator of SRTTP could be the earning rate on personal savings (i.e., by individuals). It can be estimated by looking at the return on holding government bonds or other low risk marketable securities. SRTTP is typically the lower bound of the range within which an appropriate SDR should fall.
- the Social Opportunity Cost of capital (SOC). This approach is based on the argument that public investment crowds out private business investment and, therefore, the return from the public investment should be at least as big as what could be obtained from a private investment. As such, the discount rate is estimated based on the pre-tax real rate of return for private business investment, typically estimated using returns to private capital. So, a possible measure of SOC can be based on observed returns in the private financial markets. However, one additional concern should be posed on market volatility and imperfections of financial markets. SOC is typically the upper bound of the range within the SDR should be determined.

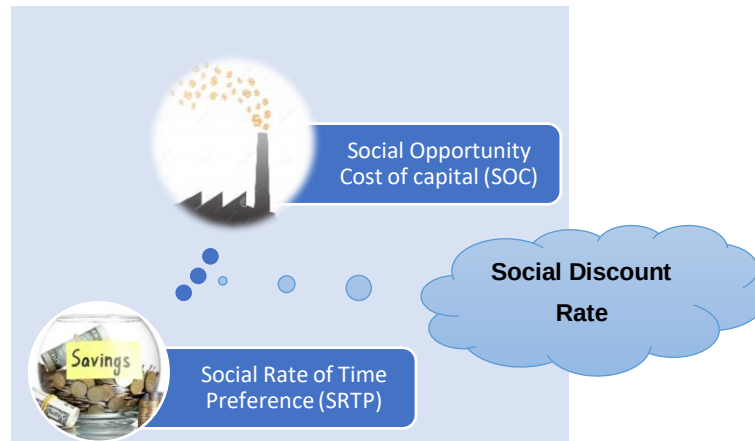


Figure 4-2. Logic approach to define the Social Discount Rate

High or Low rate: opportunities and implications

The choice of an appropriate discount rate generates significant implications in the results of the Cost-Benefit Analysis. Generally speaking, a higher SDR will mean a lower present value of future benefit and cost flows. This effect is most significant for benefits and costs that occur in the distant future. The more benefits and costs are separated by time, the more sensitive the sign of the net benefits calculation will be to the selection of the SDR. Thus, the SDR will be most important in cases where:

- large upfront costs produce flows of benefits in the distant future or
- large upfront benefits produce flows of costs in the distant future.

Putting money in the implicit alternative investment (e.g.: a risk-free asset) can be considered as the baseline investment scenario. Thus, discounting is a rule for comparing cash flows from alternative investment opportunities to a baseline alternative investment scenario. In this regard, the practice of discounting can be also thought of as an acknowledgment that the world being evaluated is not static.

At the same time, while a high SDR tends to postpone investments to future generations, a low SDR is a tool to promote investments in the present generation. This is also supported by the fact that a low SDR tends to incorporate the expectation and long-term viewpoint of a Governmental body, and not of single individuals with a limited perspective over time.

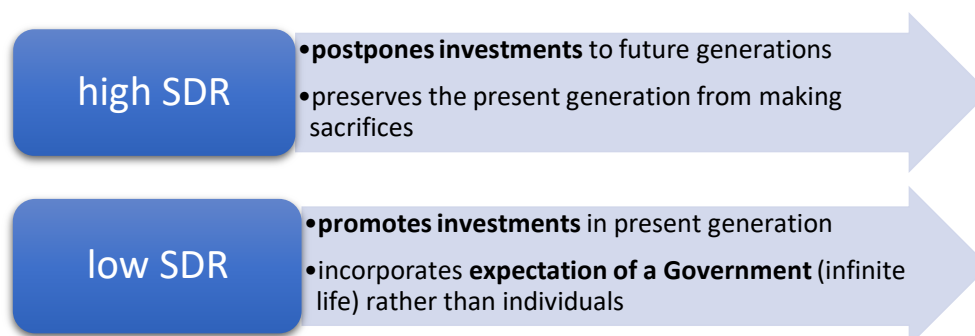


Figure 4-3. Setting the SDR value

To a certain extreme, some authors are also emphasizing the appropriateness of very low SDR, especially if applied to developing economies, where an extremely low social rate of time preference would seem to be equitable as well as wealth maximizing in the overall interest of the societyⁱ.

Low discounting rates are also applied in Europe. According to specific indications on CBA methodology, the European Commission recommends that, for the programming period 2014-2020, a social discount rate of 5 % be used for major projects in Cohesion countries and 3 % for the other Member Statesⁱⁱ.

An alternative rationale for measuring SDR is associating its meaning to the borrowing cost of the government that would, in most cases, be responsible for funding the project. Thus, using the sovereign borrowing rate as the social discount rate would enable one to match the projected cash inflows from the project to the cash outflows for the government responsible for financing it. This approach, in fact, reflects the current practice of most European governments, that link the social discount rate to their borrowing costs.

Issue Date	Yield-to-maturity (%)	Tenor	Amount (US\$ millions)
March 2019	7.875	7 years	1,000
March 2019	8.125	12 years	1,000
March 2019	8.95	31 years	1,000
May 2018	7.625	10 years	1,000
May 2018	8.627	30 years	1,000

Table 4-3. Recent US\$ Sovereign Debt Issuance by GoG

The use of sovereign borrowing rates (which, according to the figures of the table above would lead to an average of 8.24%) is a proxy for SDR, which implicitly assumes that the risk premium on public infrastructure projects is the same as the premium for the default risk of a country.

Lastly, specific studies have been conducted in the previous years on appropriate SDR for some developing economies. For Ghana, a range between 6.4% (lower bound) and 8.4% (upper bound) was suggested, with an average to 7.4%ⁱⁱⁱ.

In conclusion, the alternatives which were analysed led to the following results:

- SOC: it is perceived as too conservative, because a realistic SOC would be set substantially above the threshold of 10%, and would be less suitable for a country already committed to a strong infrastructure development, besides having a financial market that is still being consolidated. Furthermore, the discount rate to be used for a Master Plan should not be that of a single project investment (that is also linked to eventual private interests), but rather to a transport system (linked to the interests of the general public).
- Very low rates (for example between 3% and 5%) such as those recommended recently by the EU, do not seem to be suitable, even though they are important points of reference, but they are better

suited to the reality of more mature economies with lower growth rates and with more facilitated access to the capital markets.

To summarise, we deem the measurement of a Social Discount Rate based on the SRTP model to be the most appropriate to use, with an empirical confirmation in Ghana in the return on the government bonds. Therefore, **the value used for our analysis is 8%**, being an average between the studies in the sector and the latest important benchmarks relating to the real costs of indebtedness of the country's system.

4.3.2 ECONOMIC CONVERSION FACTORS

Economic analysis requires the application of conversion factors to financial costs (inputs) and outputs (revenues). The adjustment is aimed at fine-tuning the market value of resources in order to obtain a social opportunity value of resources, which is more appropriate for an economic analysis. In point of fact, markets are not perfect and may include distortions, namely:

- non-efficient markets where the public sector and/or operators exercise their power (e.g. subsidies introduced as incentives for delivering services in consideration of a Public Service Obligation, or prices including a mark-up over the marginal cost in the case of monopoly);
- some prices include fiscal requirements (e.g. duties on import, VAT and other indirect taxes, income taxation on wages, etc.).

The standard approach suggested by international practice is to move from financial to economic analysis. Starting from the account for the return on investment calculation, the following adjustments have been carried out to our analysis:

1. fiscal corrections: taxes and subsidies are transfer payments that do not represent real economic costs or benefits for society as they involve merely a transfer of control over certain resources from one group in society to another. In our analysis, the following adjustments have been applied:
 - prices for input have been considered net of VAT (and NHIL);
 - prices for input have been considered net of other direct taxes (duties, or WHT applied to specific input).
2. Conversion from market to shadow prices: if market prices do not reflect the opportunity cost of resources involved, the usual approach is to convert them into shadow prices to be applied to the financial value of such resources. This is particularly true for labour costs. In point of fact, the opportunity cost of labour (the wage level that individuals would accept to work) is affected not only by personal income taxation (a very high taxation would disincentive individuals to work) but also by the level of unemployment, which measures the realistic opportunity for individuals to work. So, a shadow wage may be inversely correlated to the level of unemployment. In our analysis, we considered such an effect, differentiated for unskilled and skilled manpower used on project construction sites. The following formula was applied: $SW = W \cdot (1-t) \cdot (1-u)$ where u is the unemployment rate of the Country and t is the tax rate on personal income.

Fiscal Corrections and unit Shadow wages above indicated have been applied to a typical Work Breakdown Structure of a railway project, induced by our experience, as follows:

	Major Element Description	Sub-element	Direct Costs								Indirect C.	
			Material		Labour		Plant/Equipment		Land Acquisition	Design	(% of Direct Cost)	
A	CONSTRUCTION WORKS COSTS		Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
A.1	GENERAL AND PRELIMINARY											
	1.1	ER Facilities & Services and Relocation works	60.0%	0.0%	31.3%	0.0%	8.8%	0.0%	0.0%	0.0%	10.0%	5.0%
	1.2	Right of Way-Land Acquisition	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	10.0%	5.0%
A.2	EARTHWORKS											
	2.1	Clear and Grubbing (41% Savannah+59% Forest)	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.2	Cutting Down tree(Dia 0.6m to 3.0m girth)	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.3	Removal Of Mud Structures and Obstructions	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.4	Removal Of Concrete Structures And Obstructions	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.5	Top Soil removal	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.6	Excavation Except Rock	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.7	Rock Excavation	0.0%	0.0%	34.0%	0.0%	66.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	2.8	Filling(Barrow,excavated and Improved B, including Haulage+Soil replacement)	65.0%	0.0%	27.5%	0.0%	7.5%	0.0%	0.0%	0.0%	20.0%	7.5%
A.3	ROAD PAVEMENTS & SURFACING											
	3.1	Road Pavements & Surfacing	48.0%	12.0%	25.0%	0.0%	15.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.4	RAILWAY BRIDGES											
	4.1	Railway Bridges(inclu. Box/Frame Bridges)	55.0%	0.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.5	CULVERTS & DRAINS											
	5.1	Culverts, Drains and Protection Works	55.0%	0.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.6	PERMANENT WAY WORKS											
	6.1	Supply and Installation of PW track, Turnouts, et	14.0%	56.0%	15.0%	0.0%	0.0%	15.0%	0.0%	0.0%	20.0%	7.5%
	6.2	PW equipment	0.0%	90.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.7	STATIONS											
	7.1	9nos Station Buildings and Ancillary facilities(1 Stand, 1semi-standard, and 7 small)	33.0%	22.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.8	POWER SUPPLY											
	8.1	Dedicated MV/Hybrid system with back-up gen	22.0%	33.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.9	COMMUNICATION SYSTEM											
	9.1	Wired Communication System	5.5%	49.5%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.10	SIGNALLING											
	10.1	Semi-auto blocking CTC Signalling System	5.5%	49.5%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.11	LOCOMOTIVE & ROLLING STOCK											
	11.1	Locomotive Depot & Rolling Stock	33.0%	22.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
	11.2	Freight Yard, each Platform area Warehouse	33.0%	22.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.12	PROTECTIVE WORKS											
	12.1	Pedestrian Bridge(1no)	55.0%	0.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
A.13	OVERBRIDGES											
	13.1	Overbridges(38nos)& one Semi-overpass bridge	55.0%	0.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%
		SURVEY & DESIGN										
	14.1	Survey and Design Activities	0.0%	0.0%	15.0%	0.0%	0.0%	0.0%	25.5%	59.5%	20.0%	7.5%
A.x	MISCELLANEOUS											
	x.1	Contingency	55.0%	0.0%	40.0%	0.0%	5.0%	0.0%	0.0%	0.0%	20.0%	7.5%

Table 4-4. Cost Breakdown Structure of a typical Railway Project. - Consultant's elaboration

In particular, some basic resources (input) were identified as essential “building blocks” to accomplish the construction work: Materials, Labour, Plants/Equipment, Land Acquisition, Design, other indirect costs (office/administrative costs). For each of them, their percentage contribution to the construction cost was established. Plants/Equipment (e.g: sleepers factory, crushing plants for ballast, etc...) were also further sub-divided to take into account Materials and Labour necessary for their realization in the Country.

Then, for each of these inputs, conversion factors were calculated, by applying the following adjustments to the unit cost:

- Materials: VAT deduction (+ NHIL) and Import taxes deductions (we assumed 10% for imported resources);
- Labour: shadow prices (as above indicated), where we assumed 13% and 19% as fiscal pressure on personal income (PAYE) for unskilled and skilled work respectively, which contribute in different proportions to the construction works of a railway infrastructure. Unemployment rates were set to 8.5% and 3.1% in 2018 (for unskilled and skilled work respectively), reconciling with average official one at 6.7%;
- Plant/Equipment: VAT deduction (+ NHIL) and Import tax deductions (we assumed 10% for imported resources). However, we assumed VAT exemption for imported duties, as a typical condition in most contracts for large infrastructural projects.
- Land Acquisition: in this case, we assumed no adjustment, in the assumption that land is paid at market prices.
- Design: many contractors typically refer to their HQ office (mother company) for Design activities. In addition, considering that no consolidated expertise in modern railway design is usually available in Sub-Saharan Africa, we assumed that this activity is to be referred outside the Country, therefore subject to WHT deduction (20%).
- Indirect costs: VAT deduction (+ NHIL) for local resources, and WHT for external resources.
- Finally, we also added Maintenance activities, typically included in railway EPC contracts (we assumed 2% of the construction cost) to which we applied the same adjustments of Indirect costs.

The final Conversion Factors obtained, calculated according to the above described approach, are the following:

	Material		Labour		Plant/Equipment		Land	Design	Indirect Cost		Maintenance
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local
Conversion Factor	0.87	0.91	0.55	1.00	0.87	0.91	1.00	0.83	0.87	1.00	0.87

Average Conversion Factor **0.80**

For Foreign Equipment only (e.g: Rolling Stock) **0.91**

Table 4-5. Conversion Factors used for Economic Analysis

with a weighted average **Conversion Factor of 0.80** to be applied to the construction cost of a railway line.

As far as Rolling Stock is concerned, we considered the **Conversion Factor applied to Equipment purchased abroad (0.91)**.

4.3.3 RESIDUAL VALUE

Railway infrastructures are a strategic asset traditionally developed by Governments. Their economic life can be very long, especially if supported by regular maintenance programmes.

Provided that such maintenance programmes are implemented, we have assumed, for the purpose of our analysis, an average life for the infrastructure of 75 years, after which important investments should be put in place (permanent way renovation with replacement of sleepers, rails, fastening, turnouts, not to mention rehabilitation of railway formation and main structures) in order to further extend its economic life.

The difference between the overall depreciation allocated in the analysis scenario (1/75 of the investment per each year of the scenario) and the same investment value is re-integrated as a Residual Value into the analysis, because still able to generate value for the future economic activities.

As far as Rolling Stock is concerned, we assumed an average economic life of 33 years which, according to our experience, is a threshold before deciding between scrapping or conducting important modernisation programmes (the value of which is usually not inferior to 70% of the value of new Rolling Stock).

4.4 INPUTS FOR COST BENEFITS ANALYSIS

4.4.1 RAILWAY OPERATING COSTS

Rail Operating Costs (ROC) have been estimated in order to subsequently determine the volume of passenger and of freight traffic diverted from road mode to rail mode.

The main categories of Rail Operating Costs (ROC) are summarised under the headings “**freight**” and “**passenger**”. These are generally either traffic-related (per train kilometre, train hour or gross tonne kilometres) or operation size related (such as number of staff). Unit costs have been developed for each of the main cost components.

The base data and the costs of railway operation and rolling stock maintenance are based on international practice, while wage rates and fuel cost are based on local conditions.

Particularly, locomotive crew costs and fuel costs are directly related to the size of the transport task. Most other costs relate to the size of the operation (and thus only indirectly to the task). Locomotive and wagon maintenance is assumed to be on a time based cycle.

The main passenger service costs are directly related to the number of train kilometres and train hours operated.

The basic data and specifications defined for each operating cost component used for the estimation of the ROC are reported in Table 4-6, Table 4-7 and Table 4-8.

Based on these above-described assumptions, the estimated ROC used in the analysis are:

Railway Operating Costs (ROC)		
FREIGHT	0.0036	US\$/ton-km
PAX	0.0054	US\$/pax-km

Table 4-6. ROC assumed for the analysis.

FREIGHT RAILWAY OPERATING COSTS

Basic Data

Freight train investment cost (Economic)	US\$/train
Total Line Length	km
Total Length by Freight Train per year	km
Freight Train maximum load	tons
Freight Train capacity (assumed load factor 80%)	tons
Commercial Speed - Freight Train	Km/h

Salary Rate (average)

Driver	US\$/month
Train-master	US\$/month
Ticket Inspector	US\$/month
Ground Staff	US\$/month
Cleaning Staff	US\$/month

Fuel and Lubricants

Fuel consumption for Freight Train	litres/1000tons/km
Diesel average cost per litre	US\$/litre
Lubricants	US\$/litre

Rolling Stock Maintenance material

Freight train (assumed)	of CAPEX/year
Overhaul Freight Train (assumed)	of CAPEX/year

Salary Cost

Driver

Working days per year	days/year
Assumed working hours per day	hours/day
Working hours per year	hours/year/driver
Average yearly Driver Salary cost	US\$/year
Driver cost per year worked	US\$/hour
Driver unit-km cost	US\$/km
Administrative Staff Charges (20%)	US\$/km
Driver unit-km cost incl. administrative staff charges	US\$/km

Ground Staff

Average yearly Ground Staff Salary cost	US\$/year
Ground Staff unit-km cost	US\$/km

Table 4-7. ROC components for Freight Train

PASSENGER RAILWAY OPERATING COSTS

Basic Data

Passenger train investment cost (Economic)	US\$/train
Total Line Length	km
Total Length by Passenger Train per year	km
Passenger Train maximum load	tons
Passenger Train capacity (assumed load factor 80%)	tons
Commercial Speed - Passenger Train	km/h

Salary Rate (average)

Driver	US\$/month
Train-master	US\$/month
Ticket Inspector	US\$/month
Ground Staff	US\$/month
Cleaning Staff	US\$/month

Fuel and Lubricants

Fuel consumption for Passenger Train	litres/1000tons/km
Diesel average cost per litre	US\$/litre
Lubricants	US\$/litre

Rolling Stock Maintenance material

Passenger train (assumed)	of CAPEX/year
Overhaul Passenger Train (assumed)	of CAPEX/year

Salary Cost

Driver

Working days per year	days/year
Assumed working hours per day	hours/day
Working hours per year	hours/year/driver
Average yearly Driver Salary cost	US\$/year
Driver cost per year worked	US\$/hour
Driver unit-km cost	US\$/km
Administrative Staff Charges (20%)	US\$/km

Driver unit-km cost incl. administrative staff charges

US\$/km

Commercial Passenger Train Crew

Train master	n
Ticket inspector	n
Commercial passenger trains crew work	days/year
Effective on-board time, hours per day	hours/day
Commercial on-board staff working hours per day	hours/year/driver
Average yearly train master salary	US\$/year
Average yearly ticket inspector salary	US\$/year
No.1 train master cost per hour worked	US\$/hour
No.2 ticket inspectors cost per hour worked	US\$/hour
No.1 train master unit-km cost	US\$/km
No.2 train inspectors unit-km cost	US\$/km
Administrative Staff Charges (15%)	US\$/km

Train crew unit-km cost including administrative staff charges

US\$/km

Ground Staff

Average yearly Ground Staff Salary cost	US\$/year
Ground Staff unit-km cost	US\$/km

Cleaning Staff

Average yearly Cleaning Staff Salary cost	US\$/year
Cleaning Staff unit kilometre cost	US\$/km

Table 4-8. ROC components for Passenger Train

4.4.2 VEHICLE OPERATING COSTS

Vehicle Operating Costs (VOC) are the costs associated with owning, operating, and maintaining a vehicle and include fuel consumption, oil and lubrication, tyre wear, repair and maintenance, depreciation, and maintenance and licence.

Vehicle costs are categorized as fixed (such as vehicle purchase or lease, depreciation and registration and vehicle taxes) and variable costs (such as maintenance and repair, fuel, fuel taxes and oil, paid parking and tolls, etc.).

Vehicle Operating Costs (VOC) have been calculated by means of the Roads Economic Decision Model, Highway Development and Management Model (HDM-4) Vehicle Operating Costs Module developed by World Bank, in order to estimate the Annual Average VOC per vehicle-km travelled for the various categories of vehicles used in Ghana under the different road surface conditions for each type of road facility.

4.4.2.1 Vehicle Fleet Characteristics

Taking into account the vehicle fleet observed in Ghana, the following categories of vehicles are considered:

- Cars
- Taxis
- Light Buses
- Medium Buses
- Heavy Buses
- Light Trucks
- Medium Trucks
- Heavy Trucks
- Articulated Trucks

Vehicle fleet characteristics, their utilisation and unit costs have been updated starting from Ghana Railway Master Plan 2013. Vehicle fleet characteristics are illustrated in the following Table 4-9

ECONOMIC UNIT COSTS	PASSENGERS					FREIGHT			
	CAR	TAXI	BUS			TRUCK			
			Light	Medium	Heavy	Light	Medium	Heavy	Articulated
New Vehicle Cost (\$/vehicle)	22,000	20,000	33,000	80,000	180,000	22,000	75,000	78,000	155,000
Fuel Cost (\$/litre for MT, \$/MJ for NMT)	0.43	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Lubricant Cost (\$/litre)	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
New Tire Cost (\$/tyre)	45.00	55.00	80.00	180.00	180.00	180.00	255.00	255.00	320.00
Maintenance Labour Cost (\$/hour)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Crew Cost (\$/hour)	0.00	0.40	0.50	0.70	0.70	0.70	0.80	0.90	1.00
Interest Rate (%)	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00

Table 4-9. Vehicle Fleet Characteristics, Ghana Railway Master Plan 2013

The vehicle utilization parameters are illustrated in Table 4-10

	PASSENGERS					FREIGHT			
	CAR	TAXI	BUS			TRUCK			
			Light	Medium	Heavy	Light	Medium	Heavy	Articulated
Kilometres Driven per Year (km)	15,000	30,000	30,000	40,000	55,000	50,000	50,000	70,000	80,000
Hours Driven per Year (hr)	500	1,300	1,300	2,000	2,000	1,720	1,720	1,720	1,720
Service Life (years)	12	12	12	12	12	12	12	12	12
Percent of Time for Private Use (%)	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-10. Vehicles Utilisation, Ghana Railway Master Plan 2013

4.4.2.2 Assumptions on the Road Characteristics

Common to many of VOC components is a road roughness factor, used to describe the conditions of the road, generally measured through the International Roughness Index (IRI). Road characteristics comprise the existing road and environmental factors. These include:

- Road surface condition (good, fair, poor)
- Surface type (paved, concrete, unsealed)
- Terrain type (flat, rolling, mountainous)
- Length of road
- Pavement structure and strength
- Altitude and rainfall

The following road characteristics according to surface type were used in the model as illustrated in the following table.

Carriageway	Width (m)	Speed Limit (km/h)
Bituminous	7.0	100
Concrete	6.0	80
Unsealed	5.0	70

Table 4-11. Road Characteristics by Surface Type

The Roughness rate according to the types of road surface (Bituminous, Concrete and Unsealed) and conditions modelled (from very good to very poor condition) is shown in the following table. These road roughness indexes (IRI) have been applied to the model for the calculation of the VOC.

ROAD TYPE	ROAD CONDITION CLASS				
	Very Good	Good	Fair	Poor	Very Poor
Bituminous	2.0	3.0	5.0	8.0	12.0
Concrete	2.0	3.0	4.0	6.0	22.0
Unsealed	4.0	5.0	7.0	9.0	25.0

Table 4-12. Road Condition Classes Roughness (IRI)

4.4.2.3 Vehicle Operating Costs Results

The values of VOC and speeds per each category of vehicle and per surface condition and terrain, on a paved road in Ghana have been presented in Annex 2: Vehicle Operating Costs used inside the model of the **Data Analysis Report** (Doc Ref: 379-00-MP-R-DA-0).

In this step of the study, the VOC used are related to four selected categories of vehicles (Car and Bus for passengers and Truck light and Truck heavy for freight), and referred to bituminous paved surfaces in poor and fair surface condition. For Car, assumed as the light vehicle for passengers' transportation, the VOC is the averaged cost between Car Medium, Taxi and Bus Light. For Bus, the VOC is the averaged cost between Bus Medium and Bus Heavy. The VOC for Truck Light is the averaged cost between Truck Light and Truck Medium and for Truck Heavy the VOC is the average of Truck Heavy and Truck Articulated VOC.

The following Table 4-13, Table 4-14 and Table 4-15 show the values of VOC and speeds per category of vehicle, per surface condition and terrain, on a paved road.

AVERAGE VOC (\$/Veh-km)

	Road Condition	IRI	Passenger		Freight	
			Car	Bus	Truck L	Truck H
Terrain: A Flat	Fair	5	0,22	0,60	0,39	0,97
	Poor	8	0,24	0,72	0,44	1,08
Terrain: B Rolling	Fair	5	0,22	0,61	0,39	0,98
	Poor	8	0,24	0,72	0,45	1,10
Terrain: C Mountainous	Fair	5	0,22	0,64	0,43	1,11
	Poor	8	0,24	0,76	0,49	1,24

Table 4-13. Average VOC (\$/veh-km)
AVERAGE SPEED (Km/h)

	Road Condition	IRI	Passenger		Freight	
			Car	Bus	Truck L	Truck H
Terrain: A Flat	Fair	5	93,67	84,60	83,73	84,69
	Poor	8	74,47	69,42	70,56	64,67
Terrain: B Rolling	Fair	5	86,64	77,15	73,90	74,19
	Poor	8	72,70	67,18	66,08	63,35
Terrain: C Mountainous	Fair	5	75,21	65,08	58,75	60,73
	Poor	8	68,24	61,02	55,58	57,39

Table 4-14. Average speed (Km/h)

4.4.2.4 Vehicle Operating Costs used in the analysis

The average Vehicle Operating Costs obtained for the four representative types of vehicles and for three types of terrain (Flat, Rolling, Mountainous) are shown in the following table.

Road Condition	IRI	PASSENGER		FREIGHT	
		Car	Bus	Truck L	Truck H
Fair	5	0.62	0.22	0.40	1.02
Poor	8	0.73	0.24	0.46	1.14

Table 4-15. Vehicle Operating Costs for CBA

It is here assumed that the average occupation of each category of vehicles follows the same hypotheses applied for the transformation of traffic data (from AADT in tons and passengers), shown in the following Table 4-16.

Vehicle	Passengers	Tons of freight
Light	5.5	0.2
Medium	20.1	3.0
Heavy	2.0	20.2

Table 4-16. Average occupation of each category of vehicles

It is assumed that:

- 1) the composition of the passenger traffic is 30% buses and 70% cars
- 2) the repartition for freight traffic is 50% for light trucks and articulated trucks
- 3) the averaged load transported is of 10.1 tons for trucks (i.e. average load between light and heavy truck).

Based on these above-described assumptions, the estimated VOC to be used in the analysis are:

Vehicle Operating Costs (VOC)		
FREIGHT	0.070	US\$/ton-km
PAX	0.037	US\$/pax-km

Table 4-17. VOC assumed for the Analysis.

4.4.3 INFRASTRUCTURE INVESTMENT COSTS

Based on the assumptions concerning the Railway Infrastructure, presented previously in Chapter 3.5, the Infrastructure Investment streams have been estimated for each Phases of the development of the national railway system. Such investments have been evaluated starting from the assessment of the technical features and design elements of each railway line foreseen in the new Railway Master Plan. The results were conveyed in the breakdown of the infrastructure costs which include earthworks, roadworks, bridgeworks and tunnels, permanent way, stations, system installations, hydraulic and protection works. The following graphs (from Figure 4-4 to Figure 4-7) show the estimated cost incidence by type of works for each phase of development.

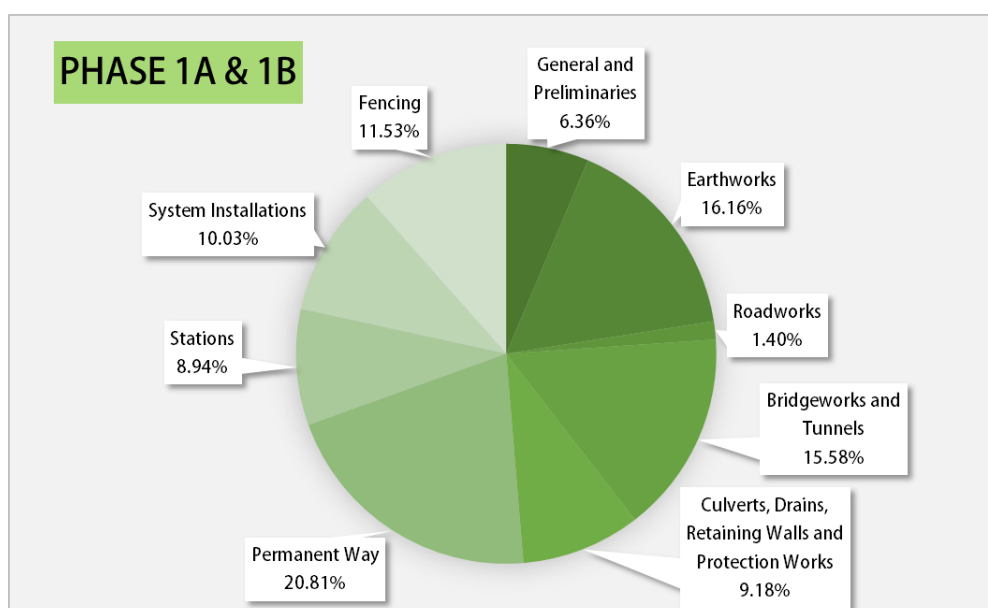


Figure 4-4. Cost Incidence by type of works in Phase 1(A+B).

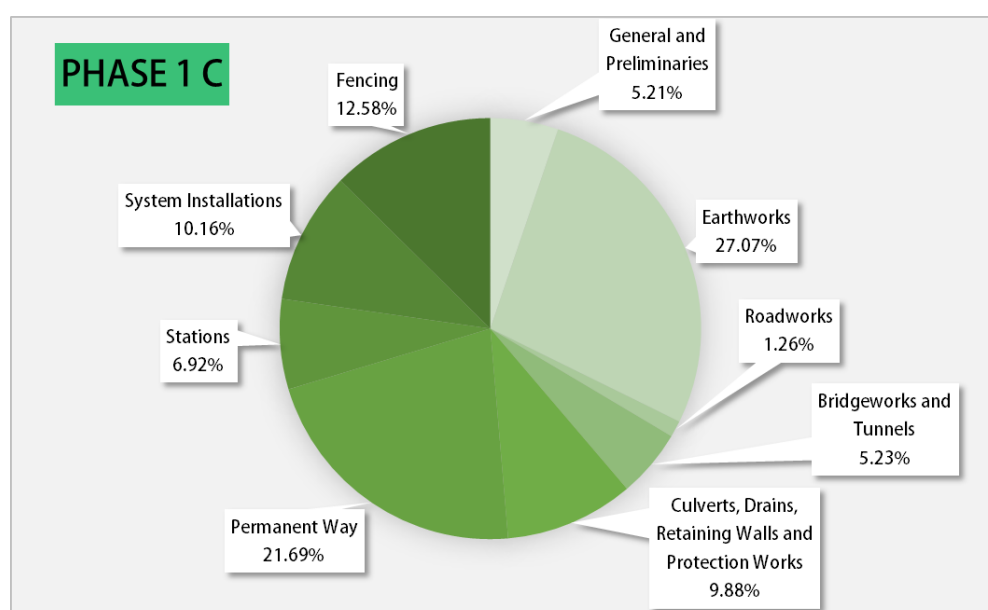


Figure 4-5. Cost Incidence by type of works in Phase 1 C.

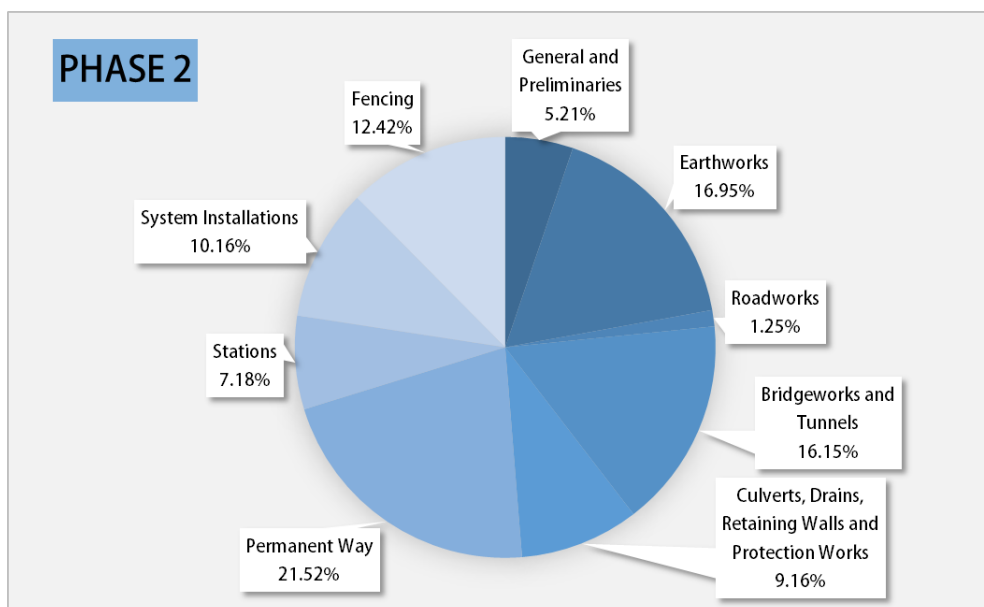


Figure 4-6. Cost Incidence by type of works in Phase 2.

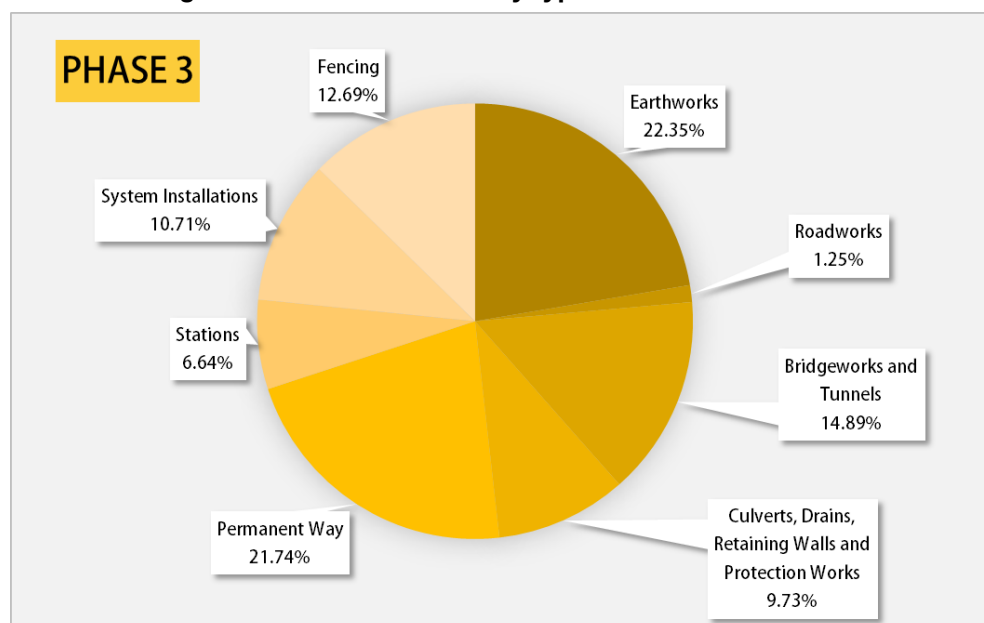


Figure 4-7. Cost Incidence by type of works in Phase 3.

Finally, the financial cost per km of the infrastructure of each phase of the railway system development has been estimated

Based on the preceding results, the total Economic investment for Infrastructure is evaluated in **16,452.1 Million US\$**.

The following Table 4-18 shows the **Economic Investment Plan** for the Infrastructure.

Model Year	YEAR	PHASE 1(A+B)	PHASE 1C	PHASE 2	PHASE 3	ALL PHASES
1	2022	1,239.5	204.6	-	-	1,444.1
2	2023	1,239.5	204.6	-	-	1,444.1
3	2024	1,239.5	204.6	-	-	1,444.1
4	2025	1,239.5	204.6	-	-	1,444.1
5	2026	1,239.5	204.6	-	-	1,444.1
6	2027	-	204.6	406.5	302.5	913.6
7	2028	-	204.6	406.5	302.5	913.6
8	2029	-	204.6	406.5	302.5	913.6
9	2030	-	204.6	406.5	302.5	913.6
10	2031	-	-	406.5	952.8	1,359.3
11	2032	-	-	406.5	952.8	1,359.3
12	2033	-	-	-	952.8	952.8
13	2034	-	-	-	952.8	952.8
14	2035	-	-	-	952.8	952.8
15	2036	-	-	-	-	-
TOTAL		4,958.0	1,636.9	2,438.8	5,974.3	16,452.1

Table 4-18. Economic Investment Plan for Infrastructure.

4.4.4 ROLLING STOCK INVESTMENT COSTS

Based on the assumptions on the rolling stock needed for the operation of the Ghana Railway Network, presented in previous Chapter 3.6, the Economic Investment in Rolling Stock has been estimated for each phases of the development of the national railway system. The following Table 4-19 shows the Economic Investment Plan for the Rolling Stock.

Model Year	YEAR	PHASE 1(A+B)	PHASE 1C	PHASE 2	PHASE 3	ALL PHASES
1	2022	-	-	-	-	-
2	2023	-	-	-	-	-
3	2024	-	-	-	-	-
4	2025	-	-	-	-	-
5	2026	134.9	-	-	-	134.9
6	2027	134.9	-	-	-	134.9
7	2028	-	-	-	-	-
8	2029	-	-	-	-	-
9	2030	-	65.1	-	-	65.1
10	2031	-	65.1	-	-	65.1
11	2032	-	-	87.6	-	87.6
12	2033	-	-	87.6	-	87.6
13	2034	13.4	6.1	-	-	19.5
14	2035	13.4	6.1	13.9	34.8	68.2
15	2036	-	-	13.9	34.8	48.7
16	2037	27.8	7.5	40.4	12.7	88.4
17	2038	27.8	7.5	-	-	35.3
18	2039	-	-	-	-	-
19	2040	-	-	-	-	-
20	2041	-	3.0	-	-	3.0
21	2042	-	3.0	-	-	3.0
22	2043	-	-	12.7	-	12.7
23	2044	-	-	12.7	53.8	66.5
24	2045	-	-	-	53.8	53.8
25	2046	-	-	-	-	-
26	2047	-	3.1	4.3	-	7.4
27	2048	-	3.1	4.3	-	7.4
28	2049	13.4	-	-	-	13.4
29	2050	13.4	-	12.7	-	26.0
30	2051	-	-	12.7	-	12.7
31	2052	-	-	-	-	-
32	2053	-	20.0	-	26.5	46.5
33	2054	26.5	20.0	-	26.5	73.0
34	2055	26.5	-	-	-	26.5
35	2056	-	-	13.9	-	13.9
36	2057	-	-	13.9	-	13.9
37	2058	-	4.2	-	-	4.2
38	2059	-	4.2	-	-	4.2
TOTAL		431.8	218.1	330.4	242.9	1,223.3

Table 4-19. Economic Investment Plan for Rolling Stock

4.5 BENEFITS OF THE PROJECT - DIRECT BENEFITS

In order to evaluate the feasibility of the implementation of the interventions planned in the new Railway Master Plan, we have evaluated different categories of benefits, which mainly concern:

- Reduction in transportation costs for the users, when travelling by rail instead of road
- Savings in road maintenance costs, as there will be a reduction of damages caused by the heavy load of trucks
- Savings in road accidents, as a result of a lower volume of traffic on the primary road network
- Saving in passengers' journey time
- Saving from greenhouse gases (GhG) reduction
- Residual value of the Infrastructure and Rolling Stock
- Socio-economic advantages.

4.5.1 SAVINGS IN TRANSPORTATION COSTS

It is clear that there is a difference in cost between rail and road transportation, with a lower cost for the rail mode, as can easily be seen by comparing the value of the Railway Operating Costs (ROC) shown in Table 4-6 with the value of the Vehicle Operating Costs (VOC) in Table 4-17.

Moreover, the use of railway transportation will directly improve transport conditions for the whole population and, more particularly, for the Economic Operators, in all sectors of activities. The decrease in transportation costs, in situations of free entry in the public transport market, will stimulate competition for transport services and hence the decrease of fares. This advantage can be considered accruing directly to the different classes of the population.

The **reduction in transportation costs** represents the principal category of benefits generated by the realisation of the Project and is calculated by the comparison of the "Without Project" situation and the "With Project" situation represented step-by-step, by incrementing the realisation of Railway Network Phase after Phase, following the forecasted implementation plan.

The different flows of **benefits in transportation costs** are expressed in US\$ and presented in the following Tables (from Table 4-20 to Table 4-23). Bold font years and relative figures are those of the opening year of the railway lines.

PHASE 1 (A +B)			
YEAR	FREIGHT	PASSENGERS	TOTAL
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	145,314,954	69,586,026	214,900,981
2028	151,987,893	70,973,475	222,961,368
2029	158,660,832	72,360,924	231,021,756
2030	165,333,770	73,748,373	239,082,143
2031	171,974,033	75,119,418	247,093,451
2032	178,679,648	76,523,271	255,202,918
2033	185,385,262	77,927,123	263,312,385
2034	187,634,061	79,351,492	266,985,553
2035	189,882,860	80,775,860	270,658,720
2036	192,131,658	82,200,229	274,331,887
2037	195,974,291	83,649,714	279,624,006
2038	199,893,777	85,124,759	285,018,537
2039	203,891,653	86,625,815	290,517,467
2040	207,969,486	88,153,339	296,122,825
2041	212,128,876	89,707,799	301,836,675
2042	216,371,453	91,289,670	307,661,123
2043	220,698,882	92,899,434	313,598,317
2044	225,112,860	94,537,585	319,650,445
2045	229,615,117	96,204,622	325,819,740
2046	234,207,419	97,901,056	332,108,475
2047	238,891,568	99,627,403	338,518,971
2048	243,669,399	101,384,192	345,053,591
2049	248,542,787	103,171,959	351,714,746
2050	253,513,643	104,991,252	358,504,894
2051	258,583,916	106,842,625	365,426,540
2052	263,755,594	108,726,644	372,482,238
2053	269,030,706	110,643,885	379,674,591
2054	274,411,320	112,594,934	387,006,254
2055	279,899,546	114,580,387	394,479,934
2056	285,497,537	116,600,851	402,098,389
2057	291,207,488	118,656,943	409,864,431
2058	297,031,638	120,749,291	417,780,929
2059	302,972,271	122,878,535	425,850,806
2022-2059	7,379,856,199	3,106,108,887	10,485,965,086

Table 4-20. Savings in Transportation Costs (US\$) for Phase 1 (A+B)

PHASE 1C			
YEAR	FREIGHT	PASSENGERS	TOTAL
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	129,169,282	24,126,816	153,296,098
2032	134,205,853	24,809,742	159,015,594
2033	139,242,423	25,492,667	164,735,090
2034	140,931,491	25,958,627	166,890,118
2035	142,620,558	26,424,587	169,045,146
2036	144,309,625	26,890,548	171,200,173
2037	147,195,818	27,364,725	174,560,543
2038	150,139,734	27,847,263	177,986,997
2039	153,142,529	28,338,310	181,480,839
2040	156,205,380	28,838,017	185,043,396
2041	159,329,487	29,346,534	188,676,022
2042	162,516,077	29,864,019	192,380,096
2043	165,766,398	30,390,629	196,157,028
2044	169,081,726	30,926,525	200,008,252
2045	172,463,361	31,471,871	203,935,232
2046	175,912,628	32,026,833	207,939,461
2047	179,430,881	32,591,581	212,022,462
2048	183,019,498	33,166,288	216,185,786
2049	186,679,888	33,751,129	220,431,017
2050	190,413,486	34,346,282	224,759,768
2051	194,221,756	34,951,931	229,173,686
2052	198,106,191	35,568,259	233,674,450
2053	202,068,315	36,195,455	238,263,770
2054	206,109,681	36,833,711	242,943,392
2055	210,231,875	37,483,221	247,715,096
2056	214,436,512	38,144,185	252,580,697
2057	218,725,242	38,816,804	257,542,047
2058	223,099,747	39,501,284	262,601,031
2059	227,561,742	40,197,833	267,759,576
2022-2059	5,076,337,186	921,665,676	5,998,002,863

Table 4-21. Savings in Transportation Costs for Phase 1C

PHASE 2			
YEAR	FREIGHT	PASSENGERS	TOTAL
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	60,850,280	72,268,752	133,119,032
2034	61,588,419	73,588,564	135,176,983
2035	62,326,557	74,908,376	137,234,933
2036	63,064,696	76,228,188	139,292,884
2037	64,325,990	77,572,365	141,898,355
2038	65,612,510	78,940,244	144,552,754
2039	66,924,760	80,332,244	147,257,004
2040	68,263,255	81,748,790	150,012,045
2041	69,628,520	83,190,315	152,818,835
2042	71,021,091	84,657,259	155,678,350
2043	72,441,512	86,150,071	158,591,583
2044	73,890,343	87,669,206	161,559,549
2045	75,368,150	89,215,129	164,583,279
2046	76,875,513	90,788,312	167,663,825
2047	78,413,023	92,389,236	170,802,259
2048	79,981,283	94,018,390	173,999,674
2049	81,580,909	95,676,272	177,257,181
2050	83,212,527	97,363,389	180,575,916
2051	84,876,778	99,080,255	183,957,033
2052	86,574,313	100,827,396	187,401,709
2053	88,305,799	102,605,345	190,911,144
2054	90,071,915	104,414,646	194,486,561
2055	91,873,354	106,255,851	198,129,205
2056	93,710,821	108,129,523	201,840,344
2057	95,585,037	110,036,235	205,621,273
2058	97,496,738	111,976,570	209,473,307
2059	99,446,673	113,951,119	213,397,791
2022-2059	2,103,310,764	2,473,982,044	4,577,292,808

Table 4-22. Savings in Transportation Costs for Phase 2

PHASE 3			
YEAR	FREIGHT	PASSENGERS	TOTAL
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	53,177,249	37,795,585	90,972,833
2037	54,240,794	38,462,056	92,702,850
2038	55,325,610	39,140,281	94,465,890
2039	56,432,122	39,830,464	96,262,586
2040	57,560,764	40,532,819	98,093,583
2041	58,711,980	41,247,558	99,959,537
2042	59,886,219	41,974,900	101,861,120
2043	61,083,944	42,715,069	103,799,012
2044	62,305,622	43,468,289	105,773,911
2045	63,551,735	44,234,791	107,786,526
2046	64,822,770	45,014,809	109,837,579
2047	66,119,225	45,808,582	111,927,807
2048	67,441,610	46,616,352	114,057,961
2049	68,790,442	47,438,366	116,228,807
2050	70,166,251	48,274,874	118,441,125
2051	71,569,576	49,126,134	120,695,709
2052	73,000,967	49,992,404	122,993,371
2053	74,460,986	50,873,950	125,334,936
2054	75,950,206	51,771,040	127,721,246
2055	77,469,210	52,683,950	130,153,160
2056	79,018,594	53,612,957	132,631,551
2057	80,598,966	54,558,346	135,157,312
2058	82,210,946	55,520,405	137,731,351
2059	83,855,165	56,499,430	140,354,594
2022-2059	1,617,750,952	1,117,193,409	2,734,944,361

Table 4-23. Savings in Transportation Costs for Phase 3

4.5.2 SAVINGS IN ROAD MAINTENANCE

Road surfaces deteriorate mainly as a consequence of traffic load. The rate of deterioration is directly affected by the standards of maintenance applied to repair defects on the road surface (such as cracking, travelling, potholes, etc.), or to preserve the structural integrity of the road (for example, surface treatments, overlays, etc.). Consequently, in addition to the capital costs of road construction, the total costs that are incurred by road agencies will depend on the standards of maintenance and improvement applied to road networks.

It is obvious, that a reduction of traffic flows (especially heavy trucks) on the road network leads to a lower rate of deterioration of the road pavement and, therefore, to a lower maintenance cost of the Infrastructure. In order to estimate the probable **savings in terms of maintenance costs on the road network**, after the modal repartition of traffic on the rail and road networks, the following assumptions have been made:

1. the savings in terms of maintenance costs is referred to bitumen or concrete paved roads
2. the average cost for periodic maintenance of paved roads per km per year is equal to 64,600 US\$, as stated in the “*Study on Road Infrastructure Costs: Analysis of Unit Costs and Cost Overruns of Road Infrastructure Projects in Africa*” of the African Development Bank and shown in the Table 4-24 below.
3. the savings in road maintenance of the cost per km per year is equal to 10% of the maintenance of the cost per km per year

Therefore, the savings in road maintenance of the cost per km per year is equal to **6,460 US\$**.

Type of Road Infrastructure Investment	Regraveling/ Periodic Maintenance of Unpaved Roads	Periodic Maintenance of Paved Roads	Rehabilitation of Paved Roads	Construction and Upgrading of Paved Roads
< 100 lane km				
Quartile 3	10,500	N/A	290,000	425,400
Median	9,600	N/A	180,300	227,800
Quartile 1	8,100	N/A	109,800	166,300
≥ 100 lane km				
Quartile 3	12,800	72,200	130,500	162,000
Median	11,300	64,600	84,400	147,100
Quartile 1	9,600	56,900	47,400	115,900

Table 4-24. Unit Rate Statistics for Types of Road Infrastructure Investment (US\$/lane km, rounded to '00).

Source: African Development Bank, “*Study on Road Infrastructure Costs: Analysis of Unit Costs and Cost Overruns of Road Infrastructure Projects in Africa*”, 2014; p.2

Therefore, the estimated annual cost of road maintenance savings is between 1,474,172 US\$ at the beginning of the analysis and 88,486,496 US\$ at the end, when all the lines will be operating.

Based on the preceding assumptions, the savings in road maintenance per year and accumulated for the economic analysis, are detailed in the following Table 4-25.

YEAR	SAVINGS IN ROAD MAINTENANCE (US\$)
2022	1,474,172
2023	1,474,172
2024	1,474,172
2025	1,474,172
2026	1,474,172
2027	14,832,160
2028	14,832,160
2029	14,832,160
2030	14,832,160
2031	32,042,892
2032	32,042,892
2033	54,291,132
2034	54,291,132
2035	54,291,132
2036	88,486,496
2037	88,486,496
2038	88,486,496
2039	88,486,496
2040	88,486,496
2041	88,486,496
2042	88,486,496
2043	88,486,496
2044	88,486,496
2045	88,486,496
2046	88,486,496
2047	88,486,496
2048	88,486,496
2049	88,486,496
2050	88,486,496
2051	88,486,496
2052	88,486,496
2053	88,486,496
2054	88,486,496
2055	88,486,496
2056	88,486,496
2057	88,486,496
2058	88,486,496
2059	88,486,496
2022-2059	2,417,334,584

Table 4-25. Estimates in Road Maintenance Savings (US\$).

4.5.3 SAVINGS IN ROAD ACCIDENT CASUALTIES

As the number of road accidents could increase with the increase of traffic, the specific road accident rate should diminish with the modal shift of part of road traffic to rail. Therefore, it has been evaluated what would be the **savings in the cost of reduced road casualties** that could be assigned to the realisation of the National Railways Network in Ghana.

As declared also by the World Health Organization in the “*World Report On Road Traffic Injury Prevention*”, road safety is a serious problem in Ghana, where fatality rates are some 30 to 40 times greater than those in industrialized countries. The excessive vehicle speeds that prevail on the country’s inter-urban highways and on roads in built-up areas are a key contributory factor in serious traffic crashes. (see Table 4-27).

Data on the existing road network in Ghana has been identified and carefully analysed.

The crash statistics in 2016 represents an increase of 15.6% in fatalities (resulting in 2,084 traffic deaths) as against a reduction of 11.7% in crashes (equal to 8,651) over the 2015 figures, with a general annual increase in fatal crashes of 7.6%. At the regional level, the Northern region recorded the highest percentage increase in fatal crashes by 34.9%, followed by the Volta region (34.5%), Eastern (30.4%), Brong-Ahafo (26.1%), Upper East (20.5%), Central (18.8%), Ashanti (11.3%) and Western (3.7%). Reductions in fatal crashes were recorded in the Greater Accra (-22.1%) and Upper West region (-2.5%).

The Traffic System Risk indicator, supposed to reflect the risk of fatality associated with vehicular transport in the country, is equal to 9.2 fatalities/10,000 vehicles in 2016 and increased by 5.2% over 2015. (see Table 4-26)

Year	All Crashes	All Casualties	Fatalities	Estimated Population (X10 ⁶)	Registered Vehicles	Fatalities per 10,000 Vehicles	Fatalities per 100,000 Population	Fatalities per 100 Casualties	Fatalities per 100 Crashes
1991	8370	9693	920	14.821	132051	69.67	6.21	9.5	11.0
1992	6922	10030	914	15.222	137966	66.25	6.00	9.1	13.2
1993	6467	8578	901	15.634	157782	57.10	5.76	10.5	13.9
1994	6584	8488	824	16.056	193198	42.65	5.13	9.7	12.5
1995	8313	10132	1026	16.491	234962	43.67	6.22	10.1	12.3
1996	8488	10952	1049	16.937	297475	35.26	6.19	9.6	12.4
1997	9918	11448	1015	17.395	340913	29.77	5.84	8.9	10.2
1998	10996	13205	1419	17.865	393255	36.08	7.94	10.7	12.9
1999	8763	11439	1237	18.349	458182	27.00	6.74	10.8	14.1
2000	11087	13747	1437	18.845	511063	28.12	7.63	10.5	13.0
2001	11293	14838	1660	19.328	567780	29.24	8.59	11.2	14.7
2002	10715	15077	1665	19.811	613153	27.15	8.40	11.0	15.5
2003	10542	16185	1716	20.508	643824	26.65	8.37	10.6	16.3
2004	12175	18445	2186	21.093	703372	31.08	10.36	11.9	18.0
2005	11320	15813	1779	21.694	767067	23.19	8.20	11.3	15.7
2006	11668	16348	1856	22.294	841314	22.06	8.33	11.4	15.9
2007	12038	16416	2043	22.911	922748	22.14	8.92	12.4	17.0
2008	11214	16455	1938	23.544	942000	20.57	8.23	11.8	17.3
2009	12299	18496	2237	24.196	1030000	21.72	9.25	12.1	18.2
2010	11506	16904	1986	24.865	1122722	17.69	7.99	11.7	17.3
2011	10887	16219	2199	25.099	1225754	17.94	8.76	13.6	20.2
2012	12083	15241	2240	25.510	1532080	14.62	8.78	14.7	18.5
2013	9200	12509	1898	26.004	1708958	11.11	7.30	15.2	20.6
2014	9152	12863	1836	26.505	1885836	9.74	6.93	14.3	20.1
2015	9796	12367	1802	26.942	2062714	8.74	6.69	14.6	18.4
2016	8651	12522	2084	27.424	2256180	9.24	7.60	16.6	24.1

Table 4-26. Changes in National Traffic Fatality Indices.

Source: “Road Traffic Crashes in Ghana. Statistics 2016”, Ministry of Transport. National Road Safety Commission, Ghana

Country/Area	GENERAL INFORMATION			ROAD TRAFFIC DEATHS			ROAD USER DEATH (%)			
	Population numbers for 2016	GNI per capita for 2016 in US dollars	Income level	Reported number of road traffic deaths	Estimated road traffic death rate per 100 000 population	Drivers/Passengers of 4-wheeled vehicles	Drivers/Passengers of 2- or 3-wheelers	Cyclists	Pedestrians	Other or unspecified users
Benin	10,872,298	820	Low	637 ^e	27.5	16.8	56.5	0.8	16.8	9.1
Burkina Faso	18,646,432	640	Low	878	30.5					
Côte d'Ivoire	23,695,920	1,520	Middle	991	23.6	11.1	35	0.3	40.2	13.4
Ghana	28,206,728	1,380	Middle	1,802	24.9	12	17.9	3.3	46.1	20.7
Italy	59,429,936	31,590	High	3,428	5.6	42.8	25.6	7.3	17.6	6.7
Mali	17,994,836	750	Low	541	23.1	27.9	42.3	2.4	11.5	15.9
Niger	20,672,988	370	Low	978	26.2					
Nigeria	185,989,632	2,450	Middle	5,053	21.4					
Togo	7,606,374	540	Low	514	29.2	17.3	71.6			11.1

Table 4-27. Road traffic deaths and proportion of road users by Country.
Consultant's elaboration from "Global status report on road safety 2018", World Health Organization

Statistics on road accident casualties, related to paved roads, have been extracted from the “Road Traffic Crashes in Ghana. Statistics 2016”, elaborated by the National Road Safety Commission of the Ministry of Transport. (See Table 4-28, Table 4-29 and Table 4-30)

Year	Route No.	Route Name	Length	Accidents						Casualties				
				Total	Acc/km	Fatal	Serious	Slight	Damage	Total	Cas/km	Killed	Serious	Slight
2016	N1	Aflao-Cape Coast-Elubo	552.3	1458	2.6	272	405	292	489	2008	3.6	324	828	856
		Aflao - Accra	193.0	776	4.0	152	229	129	266	967	5.0	172	472	323
		Accra - Cape Coast	141.0	483	3.4	78	117	119	169	677	4.8	105	222	350
		Cape Coast-Takoradi	78.4	148	1.9	27	39	35	47	259	3.3	29	87	143
		Takoradi-Elubo	139.9	51	0.4	15	20	9	7	105	0.8	18	47	40
2015	N1	Aflao-Cape Coast-Elubo	552.3	881	1.6	164	201	198	318	1164	2.1	197	391	576
		Aflao - Accra	193.0	234	1.2	42	68	47	77	325	1.7	49	136	140
		Accra - Cape Coast	141.0	441	3.1	72	96	93	180	553	3.9	90	170	293
		Cape Coast-Takoradi	78.4	170	2.2	36	30	50	54	234	3.0	43	67	124
		Takoradi-Elubo	139.9	36	0.3	14	7	8	7	52	0.4	15	18	19
2014	N1	Aflao-Cape Coast-Elubo	552.3	1316	2.4	206	331	290	489	1659	3.0	269	676	714
		Aflao - Accra	193.0	457	2.4	78	127	82	170	683	3.5	103	336	244
		Accra - Cape Coast	141.0	631	4.5	90	137	158	246	696	4.9	119	241	336
		Cape Coast-Takoradi	78.4	178	2.3	30	49	42	57	222	2.8	37	72	113
		Takoradi-Elubo	139.9	50	0.4	8	18	8	16	58	0.4	10	27	21
2013	N1	Aflao-Cape Coast-Elubo	552.3	1350	2.4	212	270	308	560	1503	2.7	284	501	718
		Aflao - Accra	193.0	467	2.4	75	93	95	204	528	2.7	94	203	231
		Accra - Cape Coast	141.0	656	4.7	97	131	148	280	697	4.9	136	217	344
		Cape Coast-Takoradi	78.4	157	2.0	25	29	48	55	193	2.5	39	48	106
		Takoradi-Elubo	139.9	70	0.5	15	17	17	21	85	0.6	15	33	37
2011	N1	Aflao-Cape Coast-Elubo	552.3	1281	2.3	203	246	343	489	1680	3.0	281	502	897
		Aflao - Accra	193.0	387	2.0	70	69	106	142	601	3.1	106	186	309
		Accra - Cape Coast	141.0	673	4.8	94	127	173	279	792	5.6	128	222	442
		Cape Coast-Takoradi	78.4	166	2.1	28	34	51	53	195	2.5	32	51	112
		Takoradi-Elubo	139.9	55	0.4	11	16	13	15	92	0.7	15	43	34
2016	N10	Kumasi -Kintampo-Bolga	552.3	413	0.7	120	124	87	82	911	1.6	234	357	320
		Kumasi - Techiman	118.1	231	2.0	64	81	45	41	398	3.4	79	172	147
		Techiman-Kintampo	61.0	35	0.6	15	9	6	5	86	1.4	16	51	19
		Kintampo-Tamale	202.0	58	0.3	14	14	16	14	232	1.1	105	70	57
		Tamale-Bolga	171.2	89	0.5	27	20	20	22	195	1.1	34	64	97
2015	N10	Kumasi -Kintampo-Bolga	552.3	442	0.8	116	133	89	104	772	1.4	138	313	321
		Kumasi - Techiman	118.1	233	2.0	56	78	46	53	404	3.4	62	158	184
		Techiman-Kintampo	61.0	31	0.5	13	6	7	5	67	1.1	16	31	20
		Kintampo-Tamale	202.0	88	0.4	22	20	21	25	145	0.7	26	60	59
		Tamale-Bolga	171.2	90	0.5	25	29	15	21	156	0.9	34	64	58
2014	N10	Kumasi -Kintampo-Bolga	552.3	405	0.7	109	111	96	89	781	1.4	128	329	324
		Kumasi - Techiman	118.1	164	1.4	38	50	40	36	297	2.5	50	146	101
		Techiman-Kintampo	61.0	47	0.8	15	13	11	8	111	1.8	18	37	56
		Kintampo-Tamale	202.0	93	0.5	24	19	24	26	158	0.8	28	63	67
		Tamale-Bolga	171.2	101	0.6	32	29	21	19	215	1.3	32	83	100
2013	N10	Kumasi -Kintampo-Bolga	552.3	422	0.8	125	114	95	88	875	1.6	171	288	416
		Kumasi - Techiman	118.1	170	1.4	57	63	28	22	293	2.5	63	115	115
		Techiman-Kintampo	61.0	78	1.3	23	22	16	17	102	1.7	25	37	40
		Kintampo-Tamale	202.0	105	0.5	20	18	30	37	227	1.1	46	42	139
		Tamale-Bolga	171.2	69	0.4	25	11	21	12	253	1.5	37	94	122
2011	N10	Kumasi -Kintampo-Bolga	552.3	492	0.9	123	150	96	123	1147	2.1	238	418	491
		Kumasi - Techiman	118.1	224	1.9	55	74	48	47	435	3.7	89	181	165
		Techiman-Kintampo	61.0	60	1.0	17	17	8	18	190	3.1	62	80	48
		Kintampo-Tamale	202.0	126	0.6	27	25	31	43	210	1.0	30	41	139
		Tamale-Bolga	171.2	82	0.5	24	34	9	15	312	1.8	57	116	139

Table 4-28. Distribution of Accidents and Casualties on Selected Major Highways (2011-2016).

Source: “Road Traffic Crashes in Ghana. Statistics 2016”, Ministry of Transport. National Road Safety Commission, Ghana

Year	Route No.	Route Name	Length	Accidents						Casualties				
				Total	Acc/km	Fatal	Serious	Slight	Damage	Total	Cas/km	Killed	Serious	Slight
2016	N2	Tema-Hohoe-Yendi	472.9	126	0.3	28	34	37	27	211	0.4	31	55	125
		Tema-Hohoe	191.8	97	0.5	20	28	27	22	156	0.8	21	42	93
		Hohoe-Nkwanta	124.0	15	0.1	3	4	6	2	32	0.3	3	9	20
		Nkwanta-Yendi	157.1	14	0.1	5	2	4	3	23	0.1	7	4	12
2015	N2	Tema-Hohoe-Yendi	472.9	146	0.3	32	42	42	30	230	0.5	48	85	97
		Tema-Hohoe	191.8	94	0.5	23	31	23	17	146	0.8	31	64	51
		Hohoe-Nkwanta	124.0	28	0.2	6	5	10	7	45	0.4	14	13	18
		Nkwanta-Yendi	157.1	24	0.2	3	6	9	6	39	0.2	3	8	28
2014	N2	Tema-Hohoe-Yendi	472.9	198	0.4	39	61	46	52	298	0.6	40	112	146
		Tema-Hohoe	191.8	168	0.9	34	52	35	47	249	1.3	35	98	116
		Hohoe-Nkwanta	124.0	16	0.1	3	4	5	4	14	0.1	3	4	7
		Nkwanta-Yendi	157.1	14	0.1	2	5	6	1	35	0.2	2	10	23
2013	N2	Tema-Hohoe-Yendi	472.9	282	0.6	49	62	67	43	408	0.9	55	150	203
		Tema-Hohoe	191.8	175	0.9	39	46	52	38	307	1.6	45	117	145
		Hohoe-Nkwanta	124.0	19	0.2	5	7	7	0	44	0.4	5	19	20
		Nkwanta-Yendi	157.1	27	0.2	5	9	8	5	57	0.4	5	14	38
2011	N2	Tema-Hohoe-Yendi	472.9	268	0.6	48	78	88	54	604	1.3	56	185	363
		Tema-Hohoe	191.8	242	1.3	41	71	81	49	514	2.7	48	151	315
		Hohoe-Nkwanta	124.0	11	0.1	0	6	4	1	49	0.4	0	12	37
		Nkwanta-Yendi	157.1	15	0.1	7	1	3	4	41	0.3	8	22	11
2016	N12	Sunyani-Bamboi-Wa	360.4	154	0.4	54	62	22	16	351	1.0	63	187	101
		Sunyani-Bamboi	114.0	55	0.5	21	20	11	3	136	1.2	22	68	46
		Bamboi-Wa	246.4	99	0.4	33	42	11	13	215	0.9	41	119	55
2015	N12	Sunyani-Bamboi-Wa	360.4	123	0.3	38	45	29	11	230	0.6	52	102	76
		Sunyani-Bamboi	114.0	50	0.4	15	19	12	4	104	0.9	21	49	34
		Bamboi-Wa	246.4	73	0.3	23	26	17	7	126	0.5	31	53	42
2014	N12	Sunyani-Bamboi-Wa	360.4	132	0.4	39	43	31	19	227	0.6	53	92	82
		Sunyani-Bamboi	114.0	59	0.5	15	19	15	10	88	0.8	16	35	37
		Bamboi-Wa	246.4	73	0.3	24	24	16	9	139	0.6	37	57	45
2013	N12	Sunyani-Bamboi-Wa	360.4	116	0.3	46	30	24	16	277	0.8	64	125	88
		Sunyani-Bamboi	114.0	41	0.4	14	8	10	9	99	0.9	16	56	27
		Bamboi-Wa	246.4	75	0.3	32	22	14	7	178	0.7	48	69	61
2011	N12	Sunyani-Bamboi-Wa	360.4	122	0.3	44	33	26	19	269	0.7	68	110	91
		Sunyani-Bamboi	114.0	54	0.5	19	15	10	10	120	1.1	28	56	36
		Bamboi-Wa	246.4	68	0.3	25	18	16	9	149	0.6	40	54	55

Table 4-29. Distribution of Accidents and Casualties on Selected Major Highways (2011-2016)
Cont'd.

Source: "Road Traffic Crashes in Ghana. Statistics 2016", Ministry of Transport. National Road Safety Commission, Ghana

Year	Route No.	Route Name	Length	Accidents						Casualties				
				Total	Acc/km	Fatal	Serious	Slight	Damage	Total	Cas/km	Killed	Serious	Slight
2016	N6	Accra-UST-Abuakwa-Gonokrom	400.4	832	2.1	222	238	155	217	1407	3.5	267	600	540
		Accra-Nsawam	30.9	234	7.6	62	55	35	82	239	7.7	66	99	74
		Nsawam-Dadieso	130.1	255	2.0	59	71	54	71	494	3.8	72	198	224
		Dadieso - Kumasi (UST)	82.1	212	2.6	59	66	38	49	402	4.9	81	182	139
		Sofoline R/abt, Kumasi - Abuakwa	8.2	28	3.4	10	9	4	5	55	6.7	10	25	20
		Abuakwa-Sunyani	57.1	70	1.2	18	28	16	8	165	2.9	23	76	66
		Sunyani - Gonokrom	92.0	33	0.4	14	9	8	2	52	0.6	15	20	17
2015	N6	Accra-UST-Abuakwa-Gonokrom	400.4	626	1.6	122	195	143	166	1135	2.8	137	471	527
		Accra-Nsawam	30.9	92	3.0	11	27	12	42	83	2.7	13	39	31
		Nsawam-Dadieso	130.1	227	1.7	50	60	63	54	459	3.5	56	179	224
		Dadieso - Kumasi (UST)	82.1	172	2.1	32	55	36	49	370	4.5	37	148	185
		Sofoline R/abt, Kumasi - Abuakwa	8.2	13	1.6	2	8	2	1	17	2.1	2	12	3
		Abuakwa-Sunyani	57.1	90	1.6	14	31	26	19	140	2.5	13	67	60
		Sunyani - Gonokrom	92.0	32	0.3	13	14	4	1	66	0.7	16	26	24
2014	N6	Accra-UST-Abuakwa-Gonokrom	400.4	777	1.9	159	193	192	233	1385	3.5	249	491	645
		Accra-Nsawam	30.9	253	8.2	38	39	61	115	261	8.4	43	65	153
		Nsawam-Dadieso	130.1	217	1.7	42	58	63	54	465	3.6	72	167	226
		Dadieso - Kumasi (UST)	82.1	162	2.0	36	50	36	40	318	3.9	66	110	142
		Sofoline R/abt, Kumasi - Abuakwa	8.2	17	2.1	4	7	3	3	22	2.7	4	8	10
		Abuakwa-Sunyani	57.1	82	1.4	21	25	23	13	169	3.0	25	71	73
		Sunyani - Gonokrom	92.0	46	0.5	18	14	6	8	150	1.6	39	70	41
2013	N6	Accra-UST-Abuakwa-Gonokrom	400.4	938	2.3	164	238	237	299	1419	3.5	211	480	728
		Accra-Nsawam	30.9	309	10.0	30	50	84	145	280	8.4	34	71	155
		Nsawam-Dadieso	130.1	244	1.9	44	65	79	56	477	3.7	47	147	283
		Dadieso - Kumasi (UST)	82.1	213	2.6	51	66	39	57	392	4.8	71	150	171
		Sofoline R/abt, Kumasi - Abuakwa	8.2	24	2.9	4	8	4	8	21	2.6	4	9	8
		Abuakwa-Sunyani	57.1	107	1.9	27	35	20	25	192	3.4	38	75	79
		Sunyani - Gonokrom	92.0	41	0.4	8	14	11	8	77	0.8	17	28	32
2011	N6	Accra-UST-Abuakwa-Gonokrom	400.4	893	2.2	179	232	238	244	1650	4.1	238	591	821
		Accra-Nsawam	30.9	166	5.4	33	31	38	64	254	8.2	36	68	150
		Nsawam-Dadieso	130.1	227	1.7	47	51	65	64	463	3.6	63	177	223
		Dadieso - Kumasi (UST)	82.1	242	2.9	52	77	58	55	486	5.9	87	204	195
		Sofoline R/abt, Kumasi - Abuakwa	8.2	48	5.9	1	9	29	9	57	7.0	0	10	47
		Abuakwa-Sunyani	57.1	141	2.5	26	44	34	37	227	4.0	28	83	116
		Sunyani - Gonokrom	92.0	69	0.8	20	20	14	15	163	1.8	24	49	90
2016	N3	Koforidua - Oterkpolu - Kpong	55.1	35	0.6	3	22	6	4	71	1.3	4	43	24
2015			55.1	46	0.8	5	18	15	8	99	1.8	8	58	33
2014			55.1	33	0.6	6	12	11	4	64	1.2	6	25	33
2013			55.1	48	0.9	8	20	11	9	117	2.1	10	72	35
2011			55.1	56	1.0	9	18	16	13	109	2.0	12	35	62
2016	N4	Bunso Jct - Koforidua - TTQ Int	112.7	194	1.7	34	50	45	65	275	2.4	38	109	128
2015			112.7	277	2.5	58	71	62	86	416	3.7	74	188	154
2014			112.7	331	2.9	45	76	97	113	467	4.1	44	173	250
2013			112.7	327	2.9	37	98	79	113	400	3.5	41	157	202
2011	N5	Asikuma Jct. - Ho	112.7	246	2.2	36	61	70	79	437	3.9	45	157	235
2016			44.5	32	0.7	5	2	11	14	28	0.6	5	4	19
2015			44.5	74	1.7	7	10	21	36	55	1.2	8	13	34
2014			44.5	42	0.9	8	11	9	14	65	1.5	13	27	25
2013			44.5	54	1.2	10	3	20	21	68	1.5	11	4	53
2011			44.5	37	0.8	3	8	19	7	96	2.2	3	19	74

Table 4-30. Distribution of Accidents and Casualties on Selected Major Highways (2011-2016) Cont'd.

Source: "Road Traffic Crashes in Ghana. Statistics 2016", Ministry of Transport. National Road Safety Commission, Ghana

The data on accidents and casualties in Ghana have been processed and the averaged ratio per km of persons killed and injured has been calculated for the period 2011-2016, as shown in the following Table 4-31.

ROAD ACCIDENT CASUALTIES PER KM

YEAR	Killed/km	Serious/km	Slight/km
2016	0.30	0.76	0.75
2015	0.27	0.74	0.76
2014	0.30	0.77	0.93
2013	0.30	0.76	1.02
2011	0.31	0.78	1.29
2011-2016	0.30	0.76	0.95

Table 4-31. Average ratio of road accident casualties per km in Ghana (2011-2016).

Consultant's elaboration from "Road Traffic Crashes in Ghana. Statistics 2016", Ministry of Transport. National Road Safety Commission, Ghana

Based on the preceding table an average (2011-2016) number of 0.30 persons killed/km and 0.76 injured persons/km has been determined for the examined portion of road network.

Assuming:

- a road network of variable extension (km) as shown in the following Table 4-32:

YEAR	AVAILABLE RAIL INFRASTRUCTURE		ASSUMED AFFECTED ROAD NETWORK
	PHASES	TOTAL (Km)	TOTAL (km)
2022	Phase 0	163	228.2
2027	Phase 1(A+B)	1477	2067.8
2031	Phase 1C	1903	2664.2
2033	Phase 2	2460	3444.0
2036	Phase 3	3781	5293.4

Table 4-32. Assumed affected Road Network

- a social cost of a person killed of 100,000 US\$
- a social cost of a person injured 120,000 US\$

The total cost of road accidents saved per year is between **27,728,651 US\$** at the beginning of the analysis (2022) and **6,432,026,409.5 US\$** at the end, when all the lines will be operating (2036).

The estimates in road accident savings per phase, have been calculated and the results are shown in the following Table 4-33.

YEAR	SAVINGS IN ROAD ACCIDENT CAUSALITIES (US\$)
2022	27,728,651
2023	27,728,651
2024	27,728,651
2025	27,728,651
2026	27,728,651
2027	251,259,006
2028	251,259,006
2029	251,259,006
2030	251,259,006
2031	323,727,751
2032	323,727,751
2033	418,481,486
2034	418,481,486
2035	418,481,486
2036	643,202,641
2037	643,202,641
2038	643,202,641
2039	643,202,641
2040	643,202,641
2041	643,202,641
2042	643,202,641
2043	643,202,641
2044	643,202,641
2045	643,202,641
2046	643,202,641
2047	643,202,641
2048	643,202,641
2049	643,202,641
2050	643,202,641
2051	643,202,641
2052	643,202,641
2053	643,202,641
2054	643,202,641
2055	643,202,641
2056	643,202,641
2057	643,202,641
2058	643,202,641
2059	643,202,641
2022-2059	18,483,442,620

Table 4-33. Estimates in Road accident casualties' savings (US\$).

4.5.4 SAVINGS IN PASSENGERS' JOURNEY TIME

The future passengers will save time using railways instead of road transport due to the shorter length of the itinerary between the towns. Assuming:

- 1,920 hours worked per year (48 weeks and 40 worked hours per week)
- an average salary of 450 US\$ per month

the revenue per person is 2.81 US\$ per working hour.

The revenue per non-working hour is estimated to be 30% of the working hour and, therefore, it is 0.84 US\$. The average hourly revenue is 2.22 US\$ [i.e. $(2.81 \times 0.7) + (0.84 \times 0.3)$], hypothesizing a presence on the train of 70% workers and 30% non-workers. Assuming that the time saved could be 0.5 hour per day, we have 120 hours per year saved per passenger and an annual saving cost per passenger of 266.63 US\$.

Based on this value, the yearly savings in passengers' journey time is shown in the following Table 4-34.

SAVINGS IN PASSENGERS' JOURNEY TIME PER YEAR (US\$)

YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2022	5,782,182	-	-	-	-
2023	5,897,826	-	-	-	-
2024	6,015,783	-	-	-	-
2025	6,136,098	-	-	-	-
2026	6,258,820	-	-	-	-
2027	6,383,997	4,378,770	-	-	-
2028	6,511,677	4,466,345	-	-	-
2029	6,641,910	4,555,672	-	-	-
2030	6,774,748	4,646,786	-	-	-
2031	6,910,243	4,739,721	8,740,501	-	-
2032	7,048,448	4,834,516	8,915,311	-	-
2033	7,189,417	4,931,206	9,093,617	12,757,473	-
2034	7,333,205	5,029,830	9,275,489	13,012,622	-
2035	7,479,870	5,130,427	9,460,999	13,272,875	-
2036	7,629,467	5,233,035	9,650,219	13,538,332	19,436,696
2037	7,782,056	5,337,696	9,843,223	13,809,099	19,825,430
2038	7,937,697	5,444,450	10,040,088	14,085,281	20,221,938
2039	8,096,451	5,553,339	10,240,890	14,366,987	20,626,377
2040	8,258,380	5,664,406	10,445,707	14,654,326	21,038,905
2041	8,423,548	5,777,694	10,654,622	14,947,413	21,459,683
2042	8,592,019	5,893,248	10,867,714	15,246,361	21,888,876
2043	8,763,859	6,011,113	11,085,068	15,551,288	22,326,654
2044	8,939,137	6,131,335	11,306,770	15,862,314	22,773,187
2045	9,117,919	6,253,962	11,532,905	16,179,560	23,228,651
2046	9,300,278	6,379,041	11,763,563	16,503,152	23,693,224
2047	9,486,283	6,506,622	11,998,834	16,833,215	24,167,088
2048	9,676,009	6,636,754	12,238,811	17,169,879	24,650,430
2049	9,869,529	6,769,489	12,483,587	17,513,277	25,143,439
2050	10,066,920	6,904,879	12,733,259	17,863,542	25,646,307
2051	10,268,258	7,042,977	12,987,924	18,220,813	26,159,234
2052	10,473,623	7,183,836	13,247,683	18,585,229	26,682,418
2053	10,683,096	7,327,513	13,512,636	18,956,934	27,216,067
2054	10,896,758	7,474,063	13,782,889	19,336,072	27,760,388
2055	11,114,693	7,623,544	14,058,547	19,722,794	28,315,596
2056	11,336,987	7,776,015	14,339,718	20,117,250	28,881,908
2057	11,563,726	7,931,536	14,626,512	20,519,595	29,459,546
2058	11,795,001	8,090,166	14,919,043	20,929,987	30,048,737
2059	12,030,901	8,251,970	15,217,423	21,348,586	30,649,711
TOTAL	324,466,819	201,911,956	339,063,555	450,904,257	591,300,489

Table 4-34. Estimates in Savings in Passengers' Journey Time per year

4.5.5 SAVING FROM GREENHOUSE GASES REDUCTION

It is world widely recognized that road trucks emit much more CO₂ (carbon dioxide) than rail. Based on the Report “Africa Infrastructure Country Diagnostic: Railways in Sub-Saharan Africa” (World Bank, 2009), it has been estimated that **savings in Greenhouse Gases** (GHG) will be 0.001 US\$ per ton-km.

According to the freight traffic volumes, the

SAVINGS IN GREENHOUSE GASES REDUCTION PER YEAR (US\$)					
YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2022	189,582	-	-	-	-
2023	199,854	-	-	-	-
2024	210,125	-	-	-	-
2025	220,397	-	-	-	-
2026	230,668	-	-	-	-
2027	240,940	2,194,817	-	-	-
2028	251,991	2,295,604	-	-	-
2029	263,041	2,396,391	-	-	-
2030	274,092	2,497,179	-	-	-
2031	285,142	2,597,472	1,950,955	-	-
2032	296,260	2,698,753	2,027,027	-	-
2033	307,379	2,800,034	2,103,098	919,074	-
2034	311,107	2,833,999	2,128,610	930,223	-
2035	314,836	2,867,965	2,154,121	941,372	-
2036	318,565	2,901,930	2,179,633	952,521	803,182
2037	324,936	2,959,969	2,223,225	971,571	819,246
2038	331,435	3,019,168	2,267,690	991,002	835,630
2039	338,063	3,079,552	2,313,044	1,010,822	852,343
2040	344,825	3,141,143	2,359,305	1,031,039	869,390
2041	351,721	3,203,965	2,406,491	1,051,660	886,778
2042	358,755	3,268,045	2,454,621	1,072,693	904,513
2043	365,931	3,333,406	2,503,713	1,094,147	922,604
2044	373,249	3,400,074	2,553,787	1,116,030	941,056
2045	380,714	3,468,075	2,604,863	1,138,350	959,877
2046	388,328	3,537,437	2,656,960	1,161,117	979,074
2047	396,095	3,608,186	2,710,099	1,184,340	998,656
2048	404,017	3,680,349	2,764,301	1,208,026	1,018,629
2049	412,097	3,753,956	2,819,587	1,232,187	1,039,001
2050	420,339	3,829,035	2,875,979	1,256,831	1,059,781
2051	428,746	3,905,616	2,933,499	1,281,967	1,080,977
2052	437,321	3,983,728	2,992,169	1,307,607	1,102,597
2053	446,067	4,063,403	3,052,012	1,333,759	1,124,649
2054	454,989	4,144,671	3,113,052	1,360,434	1,147,142
2055	464,088	4,227,564	3,175,313	1,387,643	1,170,084
2056	473,370	4,312,116	3,238,820	1,415,395	1,193,486
2057	482,838	4,398,358	3,303,596	1,443,703	1,217,356
2058	492,494	4,486,325	3,369,668	1,472,577	1,241,703

SAVINGS IN GREENHOUSE GASES REDUCTION PER YEAR (US\$)					
YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2059	502,344	4,576,052	3,437,061	1,502,029	1,266,537
TOTAL	13,286,742	111,464,338	76,672,302	31,768,118	24,434,289

Table 4-35 shows the yearly savings in greenhouse gases.

SAVINGS IN GREENHOUSE GASES REDUCTION PER YEAR (US\$)					
YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2022	189,582	-	-	-	-
2023	199,854	-	-	-	-
2024	210,125	-	-	-	-
2025	220,397	-	-	-	-
2026	230,668	-	-	-	-
2027	240,940	2,194,817	-	-	-
2028	251,991	2,295,604	-	-	-
2029	263,041	2,396,391	-	-	-
2030	274,092	2,497,179	-	-	-
2031	285,142	2,597,472	1,950,955	-	-
2032	296,260	2,698,753	2,027,027	-	-
2033	307,379	2,800,034	2,103,098	919,074	-
2034	311,107	2,833,999	2,128,610	930,223	-
2035	314,836	2,867,965	2,154,121	941,372	-
2036	318,565	2,901,930	2,179,633	952,521	803,182
2037	324,936	2,959,969	2,223,225	971,571	819,246
2038	331,435	3,019,168	2,267,690	991,002	835,630
2039	338,063	3,079,552	2,313,044	1,010,822	852,343
2040	344,825	3,141,143	2,359,305	1,031,039	869,390
2041	351,721	3,203,965	2,406,491	1,051,660	886,778
2042	358,755	3,268,045	2,454,621	1,072,693	904,513
2043	365,931	3,333,406	2,503,713	1,094,147	922,604
2044	373,249	3,400,074	2,553,787	1,116,030	941,056
2045	380,714	3,468,075	2,604,863	1,138,350	959,877
2046	388,328	3,537,437	2,656,960	1,161,117	979,074
2047	396,095	3,608,186	2,710,099	1,184,340	998,656
2048	404,017	3,680,349	2,764,301	1,208,026	1,018,629
2049	412,097	3,753,956	2,819,587	1,232,187	1,039,001
2050	420,339	3,829,035	2,875,979	1,256,831	1,059,781
2051	428,746	3,905,616	2,933,499	1,281,967	1,080,977
2052	437,321	3,983,728	2,992,169	1,307,607	1,102,597
2053	446,067	4,063,403	3,052,012	1,333,759	1,124,649
2054	454,989	4,144,671	3,113,052	1,360,434	1,147,142
2055	464,088	4,227,564	3,175,313	1,387,643	1,170,084
2056	473,370	4,312,116	3,238,820	1,415,395	1,193,486

SAVINGS IN GREENHOUSE GASES REDUCTION PER YEAR (US\$)					
YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2057	482,838	4,398,358	3,303,596	1,443,703	1,217,356
2058	492,494	4,486,325	3,369,668	1,472,577	1,241,703
2059	502,344	4,576,052	3,437,061	1,502,029	1,266,537
TOTAL	13,286,742	111,464,338	76,672,302	31,768,118	24,434,289

Table 4-35. Estimates in Savings Greenhouse Gases Reduction per year

4.5.6 ADDITIONAL SOCIO-ECONOMIC BENEFITS

The implementation of the new National Railway Network will bring a considerable amount of socio-economic benefits in the Country. While the preceding categories of benefits are directly linked to the “transportation phenomenon”, this socio-economic category should be considered as *indirect benefits*, which is why it has been introduced as separate benefits in respect of the previous categories.

The hypothesis is that the realisation of the railway network will have a positive impact on the population and especially at lower social levels. The figure below summarises the main benefits, which create additional added-value for the society.

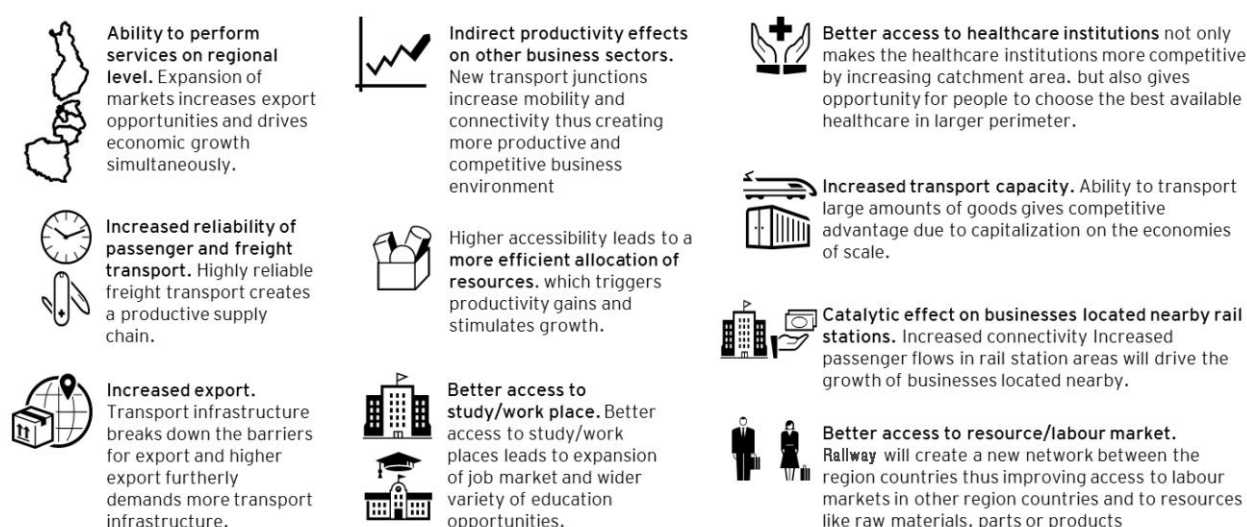


Figure 4-8. Socio-Economic Benefits Overview

In particular, the rail network will permit a higher regular access to the education centres, implying a better level of instruction for an increased number of people who will obtain a better job in terms of salary.

Furthermore, creation of new settlements (or the expansion of the existing ones) along the areas influenced by the railway will create better “**welfare**”, welfare being the provision of a minimal level of well-being and social support for all citizens. The welfare state expands on this concept to include services such as universal healthcare and unemployment insurance.

Although the new railway network will indirectly affect the entire population of the Country, for a more conservative scenario of the evaluation, only the population of the major affected districts or municipalities, for each phase of the implementation of the new Railway Master Plan, has been considered.

The total population that will benefit from the railway network is estimated to be equal **20,256,460** namely the **65.4%** of the population of Ghana. (See Table 4-36)

This figure results considering the census data of the Ghana Statistical Service on the projected population by region and districts in 2020.

PHASES	Population Affected	% on National Population
PHASE 0	1,174,719	3.8%
PHASE 1 (A+B)	7,947,662	25.7%
PHASE 1 C	1,778,634	5.7%
PHASE 2	4,603,658	14.9%
PHASE 3	4,751,786	15.4%
TOTAL	20,256,460	65.4%

Table 4-36. Population Affected by the Railway network

The tables below (from Table 4-37 to Table 4-41) show the population that has been considered in each phase of intervention.

PHASE 0	
DISTRICTS	AFFECTED POPULATION
Asuogyaman	82,026
Shai Osudoku	42,333
Ningo Prampram	87,248
Kpone Katamanso	89,901
Tema Metropolis	240,449
Tarkwa Nsuaem Municipal	80,147
Mpohor	56,948
Sekondi Takoradi Metropolis	495,668
TOTAL	1,174,719

Table 4-37. Total Population Affected by the Railway in Phase 0

PHASE 1 (A+B)	
DISTRICTS	AFFECTED POPULATION
PHASE 1A	
Sefwi Bibiani-Ahwiaso Bekwai	109,673
Upper Denkyira West	72,584
Upper Denkyira East Municipal	88,713
Kumasi Metropolis	1,077,148
Bosumtwi	119,034
Atwima Kwanwoma	113,073
Amansie Central	113,220
Adansi North	130,920
Obuasi Municipal	208,285
Adansi South	142,831
Wassa Amenfi East	110,731
Prestea/Huni Valley	211,977
Tarkwa Nsuaem Municipal	40,073
Ejisu Juaben Municipal	178,531
Asante Akim South	148,780
Birim North	99,760
Atiwa	139,668
East Akim Municipal	212,834
New Juaben Municipal	232,776

PHASE 1 (A+B)	
DISTRICTS	AFFECTED POPULATION
Akwapem North	172,924
Akwapim South	46,559
Ga West Municipal	274,617
Accra Metropolis	1,425,889
Sub-Total (Phase 1 A)	5,470,600
PHASE 1B	
Kasena Nankana West	88,498
Kasena Nankana East	136,646
Bolgatanga Municipal	163,965
Talensi	101,505
West Mamprusi	102,309
Savelugu Nanton	175,379
Tamale Metropolis	187,907
Yendi Municipal	150,324
Mion	103,338
Nanumba North	178,522
Nanumba South	119,003
Nkwanta North	53,320
Nkwanta South	99,531
Kadjebi	74,651
Jasikan	74,640
Kpando Municipal	66,648
Hohoe Municipal	210,620
Ho West	79,975
Ho Municipal	149,297
Afadzato South	119,971
Asuogyaman	41,013
Sub-Total (Phase 1 B)	2,477,062
TOTAL - Phase 1 (A+B)	7,947,662

Table 4-38. Total Population Affected by the Railway in Phase 1 (A+B)

PHASE 1 C	
DISTRICTS	AFFECTED POPULATION
Tamale Metropolis	93,954
Gonja Central	73,069
Kintampo North Municipal	119,797
Kintampo South	102,269
Techiman North	50,648
Techiman Municipal	124,693
Sunyani West	72,074
Sunyani Municipal	103,253
Tano South	98,863
Tano North	68,180
Offinso North	71,410
Offinso Municipal	95,214
Afigya Kwabre	166,636
Kumasi Metropolis	538,574
TOTAL	1,778,634

Table 4-39. Total Population Affected by the Railway in Phase 1C

PHASE 2	
DISTRICTS	AFFECTED POPULATION
Sekondi Takoradi Metropolis	245,356
Shama	107,564
Komenda-Edina-Egyafo-Abirem Municipal	162,065
Cape Coast Metropolis	189,060
Abura-Asebu-Kwamankese	130,156
Mfantsiman	162,078
Ajumako-Enyan-Essiam	154,717
Ekumfi	62,746
Gomoa West	163,979
Effutu Municipal	83,339
Ewutu Senya	104,850
Ga South Municipal	532,348
Accra Metropolis	712,944
La Dade Kotopon Municipal	226,047
Ledzokuku/Krowor Municipal	281,179
Tema Metropolis	120,224
Kpone Katamanso	44,951
Shai Osudoku	21,166
Ada East	87,820
Ada West	72,653
South Tongu	75,038
Keta Municipal	186,615
Ketu South	135,751
Ahanta West	142,368
Nzema East	82,304
Ellembelle	117,073
Jomoro	199,266
TOTAL	4,603,658

Table 4-40. Total Population Affected by the Railway in Phase 2

PHASE 3	
DISTRICTS	AFFECTED POPULATION
Lambussie Karni	64,079
Nandom	57,145
Lawra	67,537
Jirapa	109,095
Nadowli-Kaleo	76,195
Daffiama Bussie	40,697
Wa Municipal	132,487
Wa East	89,182
Sawla-Tuna-Kalba	125,266
Bole	78,297
Wenchi Municipal	113,956
Techiman North	25,324
Techiman Municipal	62,347
Sunyani West	36,037
Sunyani Municipal	51,627
Asutifi North	67,206
Asutifi South	67,196
Tano North	34,090
Ahafo Ano North	119,024

PHASE 3	
DISTRICTS	AFFECTED POPULATION
Ahafo Ano South	148,782
Atwima Mponua	148,781
Sefwi Wiawso	124,439
Sefwi Akontombra	73,820
West Gonja	52,911
Gonja Central	36,535
Atwima Nwabiagya	184,489
Kumasi Metropolis	538,574
Sefwi Bibiani-Ahwiaso Bekwai	54,837
Nkoranza North	84,727
Nkoranza South	116,880
Atebubu Amantin	134,408
Sene West	73,053
Sene East	75,972
Zabzugu	81,434
East Mamprusi	153,464
West Mamprusi	51,154
Bunkpurugu Yonyo	153,463
Nkwanta North	26,660
Nkwanta South	49,765
Krachi East	146,637
Krachi Nchumuru	90,640
Ho West	39,988
Ho Municipal	74,649
South Dayi	58,665
North Tongu	111,978
South Tongu	36,959
Ketu South	66,863
Ketu North	125,366
Akatsi	119,979
Sefwi Wiawso	62,219
Sefwi Akontombra	36,910
TOTAL	4,751,786

Table 4-41. Total Population Affected by the Railway in Phase 3

Assuming:

- 30% of the population affected by a better salary;
- an increase in salaries of 10 US\$ per month due to better education.

The increase of salaries estimated due to better education is estimated to be between 42.29 M US\$/year in Phase 0 and 171.06 US\$/year of the Phase 3.

It was assumed that better welfare will develop in the considered districts and that the increase in salaries, almost symbolically, is equal to 2 US\$ per person and per month.

Therefore, the estimated increase of salaries due to better welfare is estimated to be between 28.19 M US\$/year in Phase 0 and 114.04 M US\$/year of the Phase 3.

(US\$/year)	PHASE 0	PHASE 1(A+B)	PHASE 1C	PHASE 2	PHASE 3
Major education	42,289,896	286,115,838	64,030,839	165,731,677	171,064,298
Major welfare	28,193,264	190,743,892	42,687,226	110,487,785	114,042,865
TOTAL SOCIO-ECONOMIC BENEFITS	70,483,160	476,859,730	106,718,065	276,219,462	285,107,163

Table 4-42. Socio-economic benefits per year for each phase at the first operating year

Based on the preceding values, the total socio-economic benefit is evaluated in **56,763,288,178 US\$**. The Table 4-43 shows the yearly socio-economic benefits.

SOCIO-ECONOMIC BENEFITS PER YEAR (US\$)					
YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2022	70,483,160	-	-	-	-
2023	71,892,823	-	-	-	-
2024	73,330,680	-	-	-	-
2025	74,797,293	-	-	-	-
2026	76,293,239	-	-	-	-
2027	77,819,104	526,491,674	-	-	-
2028	79,375,486	537,021,507	-	-	-
2029	80,962,996	547,761,937	-	-	-
2030	82,582,256	558,717,176	-	-	-
2031	84,233,901	569,891,520	127,537,966	-	-
2032	85,918,579	581,289,350	130,088,726	-	-
2033	87,636,950	592,915,137	132,690,500	343,444,182	-
2034	89,389,689	604,773,440	135,344,310	350,313,066	-
2035	91,177,483	616,868,909	138,051,196	357,319,327	-
2036	93,001,033	629,206,287	140,812,220	364,465,714	376,192,847
2037	94,861,053	641,790,412	143,628,465	371,755,028	383,716,703
2038	96,758,274	654,626,221	146,501,034	379,190,129	391,391,038
2039	98,693,440	667,718,745	149,431,055	386,773,931	399,218,858
2040	100,667,309	681,073,120	152,419,676	394,509,410	407,203,235
2041	102,680,655	694,694,582	155,468,069	402,399,598	415,347,300
2042	104,734,268	708,588,474	158,577,431	410,447,590	423,654,246
2043	106,828,953	722,760,244	161,748,979	418,656,542	432,127,331
2044	108,965,532	737,215,448	164,983,959	427,029,673	440,769,878
2045	111,144,843	751,959,757	168,283,638	435,570,266	449,585,275
2046	113,367,740	766,998,953	171,649,311	444,281,671	458,576,981
2047	115,635,095	782,338,932	175,082,297	453,167,305	467,748,520
2048	117,947,797	797,985,710	178,583,943	462,230,651	477,103,491
2049	120,306,753	813,945,424	182,155,622	471,475,264	486,645,561

SOCIO-ECONOMIC BENEFITS PER YEAR (US\$)

YEAR	Phase 0	Phase 1(A+B)	Phase 1C	Phase 2	Phase 3
2050	122,712,888	830,224,333	185,798,734	480,904,769	496,378,472
2051	125,167,145	846,828,820	189,514,709	490,522,865	506,306,041
2052	127,670,488	863,765,396	193,305,003	500,333,322	516,432,162
2053	130,223,898	881,040,704	197,171,103	510,339,988	526,760,805
2054	132,828,376	898,661,518	201,114,525	520,546,788	537,296,021
2055	135,484,944	916,634,748	205,136,816	530,957,724	548,041,942
2056	138,194,642	934,967,443	209,239,552	541,576,878	559,002,781
2057	140,958,535	953,666,792	213,424,343	552,408,416	570,182,836
2058	143,777,706	972,740,128	217,692,830	563,456,584	581,586,493
2059	146,653,260	992,194,931	222,046,687	574,725,716	593,218,223
TOTAL	3,955,158,268	24,277,357,771	4,947,482,703	12,138,802,397	11,444,487,040

Table 4-43. Socio-Economic Benefits per year
4.5.6.1 Impact on employment: some references

Historically, the Railway Sector has always been the catalyst for the development of a Country, not only from the purely logistic point of view, but also for the great impact on the socio-economic transformation of urban and rural communities. Long-distance connection favours intra-regional cohesion; railway suburban connectivity bridges the gap between the ever-more crowded cities and the peripheral towns, which become satellites of a synergic system. By reaching out to a wider part of society, railway transport (as opposed to car or air travel) can help to enhance the competitive position and economic performance of underdeveloped regions and communities. Stations are fundamental points for social inclusion and the development of commercial activities. The impact of rail transit on land valorisation and property values is also a well-known factor.

Railway systems are regarded as infrastructures that generate very important employment needs. In fact, the importance of railway transport is reflected not only in infrastructure numbers and passenger and freight volumes but, also, in a variety of types of economic effects, that can be categorised as direct and indirect:

- Direct effects created by operations within the railway transport. These include, for example, employment resulting directly from the transport of persons and freight and the associated infrastructure management, together with the value added created by these activities.
- Indirect effects created through upstream supplier relations. This covers, for example, the jobs and value added that depend on supply relationships with railway transport operations (e.g. manufacture of locomotives, maintenance, accounting, etc.). In addition, indirect effects are generated through the jobs and value added created through railway infrastructure investments (e.g. laying tracks or building activities). It is internationally recognised that one job in railway transport creates far more than one other job in Manufacturing, Building services, Food services, Advertising, Financial services, Accounting, Market research, etc...

According to reputable studies^{iv}, in 2012 the railway sector in Europe could count on more than 2.3 million persons directly or indirectly employed and generating a Gross Value Added of more than 140 Bill Euro.

Based on international benchmarks, it is possible to affirm that the Ghanaian railway transport system will generate not only a great employment effect during the construction period, but especially after the infrastructure is fully deployed, when it is possible to estimate that more than 200,000 jobs will be permanently created, as a sum of the direct and indirect effects, as described above.

Furthermore, on top of this, the existence of the railway infrastructure will have wider economic impacts for both the users of rail transport and for all the other economic actors, whose activities are affected by the development of the infrastructure. This is why, by adopting a more holistic approach, additional effects, categorised as socio-economic benefits (and already quantified above), could be classified in terms of:

- Induced effects, also often called “income effects”, that reflect the jobs and value-added created as a result of spending by those workers who, directly or indirectly, earn incomes from railway transport.
- Wider effects that cover broader economic outcomes linked to rail transport activities and infrastructure. These include labour and product market effects caused by lower transport times and/or costs, as well as agglomeration effects (spatial concentration effects) e.g. local business development, local real estate markets.

4.6 ECONOMIC ANALYSIS - RESULTS

4.6.1 MAIN OUTCOMES

From the analysis of the economic results we can ascertain the following:

1. The scenarios 1-2 present an interesting E-IRR (11.7%, 11.2% and 15.5%), that justifies the implementation of the structural plan by the GoG, as it generates a return in the form of substantial benefits for the community.
2. For Phase 3 the economic viability is reported at a lesser amount (7.9%%), the reason being the lower traffic volumes that can be foreseen for the less populated areas of the country; however, being these infrastructural interventions scheduled for the last span of this Master Plan, the Government will have time to re-evaluate said interventions according to the evolution of the country system and in the future Railway Master Plan updates.
3. All the 1-3 phases generate an average E-IRR of 11.4%, that increases to 12.7% if benefits from Phase 0 are also taken into consideration; even though these do not come into play in evaluating the choice of new corridors, they are part of the Railway System in its integrity.
4. In terms of economic valuation (E-NPV), the net benefits for the community are attested at over 8,000 MUS\$, with a very solid BC total median Ratio of 1.6.
5. Lastly, we can outline a consistent value of E-IRR, always above 11%, in all combined (cumulated) Phases from 1 to 3.

Cost-Benefit Analysis - RESULTS								
		Phase 0	Phase 1 (A+B)	Phase 1 C	Phase 2	Phase 3	NEW Phases ALL	RAILWAY SYSTEM
		Outcome from Incremental Scenarios						
Single	E-NPV (Million US\$)	"Do Nothing" Scenario	3,353	898	1,873	-41	6,083	8,054
	E-IRR		11.7%	11.2%	15.5%	7.9%	11.4%	12.7%
	BC Ratio		1.5	1.5	2.1	1.0	1.4	1.6
Combined (Cumulated)	E-NPV (Million US\$)	"Do Nothing" Scenario	3,353	4,251	6,124	6,083		
	E-IRR		11.7%	11.6%	12.2%	11.4%		
	BC Ratio		1.5	1.5	1.6	1.4		

Table 4-44. Main indicators in the Cost-Benefit Analysis.

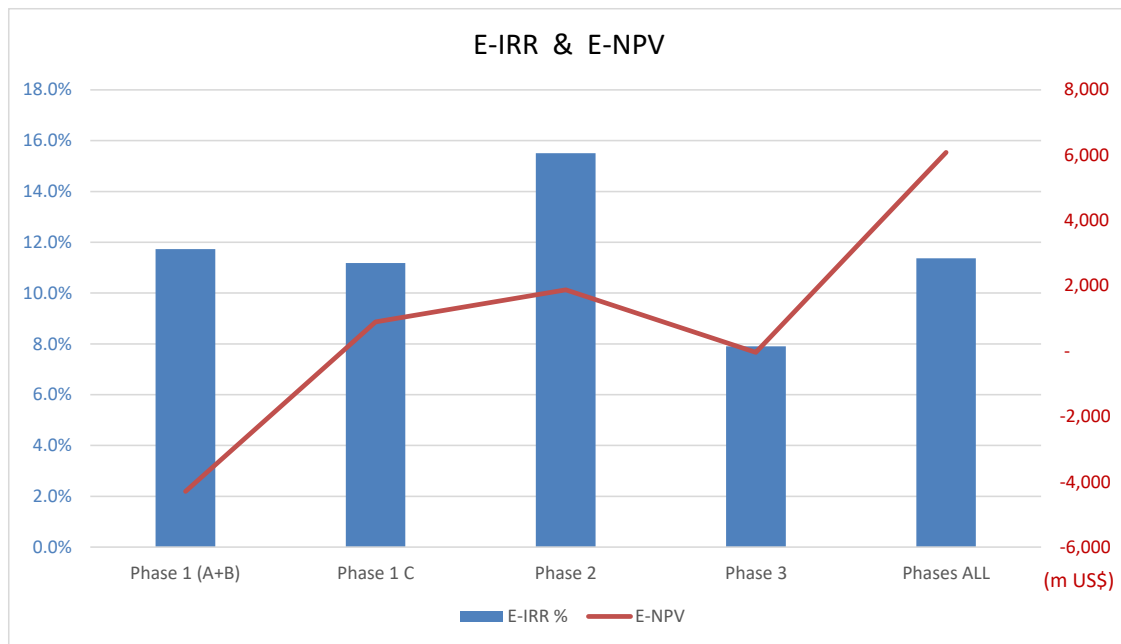


Table 4-45. E-IRR and –NPV for different Phases

In terms of the analysis of the economic values of Costs and Benefits it is possible to appreciate that:

- The Master Plan contemplates a Capex of 21,909 MUS\$. Such investments, set up as the main Cost component related to the execution of the Master Plan, are more than compensated by the community's savings on transport costs following the migration of traffic from road to railway, an extremely more efficient infrastructure. These benefits are attested, within the framework of the scenario analysis, at 23,796 MUS\$ (see Table 4-46).
- The second most important category of direct Benefits is passenger transport safety. In fact, it is estimated that, following the migration of passenger traffic to railway, the strong reduction of road transport accidents will bring over 17,000 MUS\$ in savings to the community in terms of lower social costs.
- The huge provision of socio-economic benefits to the system country brought on by a transport infrastructure that, at plan conclusion, will reach almost 2/3 of the population, is also confirmed. In line with what has historically already taken place in other countries in the world, this will facilitate commerce and the increment of the country's average income, with estimated benefits of 52,808 MUS\$.
- Lastly, other (direct) Benefits that the execution of the railway development plan concurs to generate for the community that can be underlined are:
 - Lower road network maintenance costs, estimated at 2,361 MUS\$, especially due to the traffic reduction of heavy vehicles, which are the main cause of road deterioration;
 - Benefits generated by the saving of time, now dedicated to transport via car, that will be allocated to revenue generating activities in the future (1,583 MUS\$);

- Reduction of emissions that are harmful to the environment, which are estimated, based on international parameters, at around 250 MUS\$ during the scope of this Master Plan.
- In total, in the 30 years of evaluation of this Master Plan, starting from the beginning of operations of Phase 1, the execution of the railway infrastructure generates a series of Benefits for the community that are estimated at 98 Bill US\$ (details can be seen in Table 4-46).

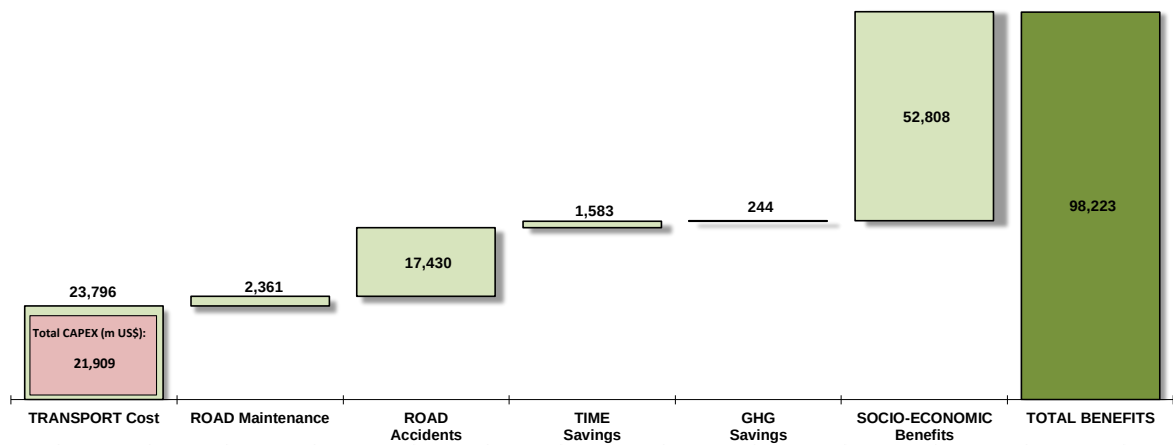


Table 4-46. Phases 1-3: Breakdown of Project Benefits (US\$ M)

Below are the tables giving evidence of costs and benefits for the entire Master Plan and for each stand-alone phase.

PHASE - ALL		ECONOMIC ANALYSIS without socio-economic benefits - SUMMARY TABLE																
(Phases 1-3)		discount rate = 8.00%																
MODEL YEAR	YEAR	COSTS (MUS\$)				BENEFITS (MUS\$)						CASH FLOW (MUS\$)						
		LINE Investment	ROLLING STOCK Investment	Maintenance Cost	TOTAL	TRANSPORT Cost	Residual Value	ROAD Maintenance	ROAD Accidents	TIME Savings	GHG Savings	SOCIO-ECONOMIC Benefits	TOTAL	Yearly Cash FLOW	Disc. Cash Flow	CUM. Disc. Cash Flow		
					1								1					
1	2022	1,444.1	-	123.3	1,567.4	-	-	-	-	-	-	-	-	- 1,567.4	- 1,567.4	- 1,567.4		
2	2023	1,444.1	-	123.3	1,567.4	-	-	-	-	-	-	-	-	- 1,567.4	- 1,451.3	- 3,018.6		
3	2024	1,444.1	-	123.3	1,567.4	-	-	-	-	-	-	-	-	- 1,567.4	- 1,343.8	- 4,362.4		
4	2025	1,444.1	-	123.3	1,567.4	-	-	-	-	-	-	-	-	- 1,567.4	- 1,244.2	- 5,606.6		
5	2026	1,444.1	134.9	123.3	1,702.2	-	-	-	-	-	-	-	-	- 1,702.2	- 1,251.2	- 6,857.8		
6	2027	913.6	134.9	123.3	1,171.7	214.9	-	13.4	223.5	4.4	2.2	526.5	984.9	- 186.8	- 127.2	- 6,985.0		
7	2028	913.6	-	123.3	1,036.8	223.0	-	13.4	223.5	4.5	2.3	537.0	1,002.6	- 33.2	- 20.9	- 7,005.9		
8	2029	913.6	-	256.3	1,169.9	231.0	-	13.4	223.5	4.6	2.4	547.8	1,026.3	- 147.2	- 85.9	- 7,091.8		
9	2030	913.6	66.1	256.3	1,235.0	239.1	-	13.4	223.5	4.6	2.5	553.7	1,041.8	- 193.2	- 104.4	- 7,196.2		
10	2031	1,359.3	66.1	256.3	1,680.7	400.4	-	30.6	296.0	13.5	4.5	697.4	1,444.4	- 238.3	- 119.2	- 7,315.4		
11	2032	1,359.3	87.6	256.3	1,703.2	414.2	-	30.6	296.0	13.7	4.7	711.4	1,470.6	- 232.6	- 107.2	- 7,423.1		
12	2033	952.8	87.6	256.3	1,296.8	551.2	-	52.8	300.8	26.8	5.8	1,069.0	2,106.4	- 809.6	- 347.2	- 7,075.9		
13	2034	952.8	19.5	256.3	1,226.6	569.1	-	52.8	300.8	27.3	5.9	1,090.4	2,136.3	- 907.7	- 360.4	- 6,715.4		
14	2035	952.8	68.2	256.3	1,277.3	576.9	-	52.8	300.8	27.9	6.0	1,112.2	2,166.6	- 889.3	- 327.0	- 6,388.4		
15	2036	-	48.7	256.3	305.0	675.8	-	87.0	615.5	47.9	6.8	1,510.7	2,943.7	- 2,638.7	- 898.4	- 5,490.1		
16	2037	-	88.4	256.3	344.6	698.8	-	87.0	615.5	48.8	7.0	1,540.9	2,988.0	- 2,643.3	- 833.3	- 4,656.8		
17	2038	-	35.3	256.3	291.6	702.0	-	87.0	615.5	49.8	7.1	1,571.7	3,033.1	- 2,741.6	- 800.2	- 3,856.6		
18	2039	-	-	256.3	256.3	715.5	-	87.0	615.5	50.8	7.3	1,603.1	3,078.2	- 2,822.9	- 762.9	- 3,093.6		
19	2040	-	-	256.3	256.3	729.3	-	87.0	615.5	51.8	7.4	1,635.2	3,126.2	- 2,869.9	- 718.2	- 2,375.4		
20	2041	-	3.0	256.3	259.3	743.3	-	87.0	615.5	52.8	7.5	1,667.9	3,174.1	- 2,914.8	- 675.4	- 1,700.0		
21	2042	-	3.0	256.3	259.3	757.6	-	87.0	615.5	53.9	7.7	1,701.3	3,222.9	- 2,963.6	- 633.8	- 1,064.2		
22	2043	-	12.7	256.3	268.9	772.1	-	87.0	615.5	55.0	7.9	1,735.3	3,272.8	- 3,003.8	- 596.7	- 467.5		
23	2044	-	66.5	256.3	327.7	787.0	-	87.0	615.5	56.1	8.0	1,770.0	3,323.6	- 3,000.8	- 552.0	- 606.6		
24	2045	-	53.8	256.3	310.1	802.1	-	87.0	615.5	57.2	8.2	1,805.4	3,374.4	- 3,065.3	- 522.1	- 1,106.8		
25	2046	-	-	256.3	256.3	817.5	-	87.0	615.5	58.3	8.3	1,841.5	3,428.2	- 3,171.9	- 500.2	- 1,156.8		
26	2047	-	7.4	256.3	263.6	833.3	-	87.0	615.5	59.5	8.5	1,878.3	3,482.1	- 3,218.5	- 470.0	- 1,576.8		
27	2048	-	7.4	256.3	263.6	849.3	-	87.0	615.5	60.7	8.7	1,915.9	3,537.1	- 3,273.4	- 442.6	- 2,019.3		
28	2049	-	13.4	256.3	268.7	865.6	-	87.0	615.5	61.9	8.8	1,954.2	3,593.1	- 3,323.4	- 416.0	- 2,435.4		
29	2050	-	26.0	256.3	282.3	882.3	-	87.0	615.5	63.1	9.0	1,993.3	3,650.2	- 3,367.9	- 390.4	- 2,825.8		
30	2051	-	12.7	256.3	268.9	899.3	-	87.0	615.5	64.4	9.2	2,033.2	3,708.5	- 3,439.6	- 368.2	- 3,194.9		
31	2052	-	-	256.3	256.3	916.6	-	87.0	615.5	65.7	9.4	2,073.8	3,768.0	- 3,511.7	- 340.0	- 3,543.9		
32	2053	-	46.5	256.3	302.8	934.2	-	87.0	615.5	67.0	9.6	2,115.3	3,826.6	- 3,525.8	- 324.4	- 3,868.3		
33	2054	-	73.0	256.3	323.3	952.2	-	87.0	615.5	68.4	9.8	2,157.6	3,890.4	- 3,581.1	- 303.4	- 4,171.7		
34	2055	-	26.5	256.3	282.8	970.5	-	87.0	615.5	69.7	10.0	2,200.8	3,953.4	- 3,670.6	- 286.6	- 4,461.3		
35	2056	-	13.9	256.3	270.2	989.2	-	87.0	615.5	71.1	10.2	2,244.8	4,017.7	- 3,747.5	- 273.7	- 4,735.1		
36	2057	-	13.9	256.3	270.2	1,008.2	-	87.0	615.5	72.5	10.4	2,289.7	4,083.3	- 3,813.1	- 257.9	- 4,993.0		
37	2058	-	4.2	256.3	260.5	1,027.6	-	87.0	615.5	74.0	10.6	2,335.5	4,150.1	- 3,889.6	- 243.6	- 5,236.5		
38	2059	-	4.2	256.3	260.5	1,047.4	-	87.0	615.5	75.5	10.8	2,382.2	4,186.1	- 4,600.7	- 846.6	- 6,083.2		
		16,452.1	1,223.3	8,807.3	26,482.6	23,796.2	10,642.9	2,361.3	17,429.8	1,583.2	244.3	52,808.1	108,865.9					
																	ENPV (US\$)	6,083
																	EIRR	11.37%
																	BCR	1.42

PHASE - ALL (RAILWAY SYSTEM)		ECONOMIC ANALYSIS without socio-economic benefits - SUMMARY TABLE													discount rate = 8.00%		
MODEL YEAR	YEAR	COSTS (MUS\$)				BENEFITS (MUS\$)							CASHFLOW (MUS\$)				
		LINE Investment	ROLLING STOCK Investment	Maintenance Cost	TOTAL	TRANSPORT Cost	Residual Value	ROAD Maintenance	ROAD Accidents	TIME Savings	GHG Savings	SOCIO- ECONOMIC Benefits	TOTAL	Yearly Cash FLOW	Disc. Cash Flow	CUM. Disc. Cash Flow	
1	2022	1,444.1	-	123.3	1,567.4	21.3	-	1.5	27.7	5.8	0.2	70.5	126.9	1,440.5	1,440.5	1,440.5	
2	2023	1,444.1	-	123.3	1,567.4	22.1	-	1.5	27.7	5.9	0.2	71.9	129.3	1,438.0	1,331.5	2,772.0	
3	2024	1,444.1	-	123.3	1,567.4	23.0	-	1.5	27.7	6.0	0.2	73.3	131.8	1,435.6	1,230.8	4,002.8	
4	2025	1,444.1	-	123.3	1,567.4	23.9	-	1.5	27.7	6.1	0.2	74.8	134.2	1,433.1	1,137.7	5,140.5	
5	2026	1,444.1	134.9	123.3	1,702.2	24.7	-	1.5	27.7	6.3	0.2	76.3	136.7	1,365.5	1,150.7	6,291.1	
6	2027	913.6	134.9	123.3	1,171.7	24.05	-	14.8	25.13	10.8	2.4	604.3	1,124.1	47.6	32.4	6,323.5	
7	2028	913.6	-	123.3	1,036.8	24.95	-	14.8	25.13	11.0	2.5	616.4	1,145.5	108.7	68.5	6,255.0	
8	2029	913.6	-	256.3	1,169.9	25.85	-	14.8	25.13	11.2	2.7	628.7	1,167.2	27	16	6,256.6	
9	2030	913.6	65.1	256.3	1,235.0	26.75	-	14.8	25.13	11.4	2.8	641.3	1,189.0	46.0	24.8	6,281.4	
10	2031	1,359.3	65.1	256.3	1,680.7	429.7	-	32.0	32.37	20.4	4.8	781.7	1,592.4	88.4	44.2	6,325.7	
11	2032	1,359.3	87.6	256.3	1,703.2	444.5	-	32.0	32.37	20.8	5.0	797.3	1,623.3	79.9	37.0	6,362.7	
12	2033	952.8	87.6	256.3	1,296.8	592.3	-	54.3	418.5	34.0	6.1	1,156.7	2,261.9	965.1	413.9	5,948.7	
13	2034	952.8	19.5	256.3	1,228.6	600.7	-	54.3	418.5	34.7	6.2	1,179.8	2,294.1	1,065.5	423.1	5,525.6	
14	2035	952.8	68.2	256.3	1,277.3	609.0	-	54.3	418.5	35.3	6.3	1,203.4	2,326.8	1,049.5	385.9	5,139.7	
15	2036	-	48.7	256.3	305.0	70.3	-	88.5	643.2	55.5	7.2	1,603.7	3,106.3	2,801.3	953.8	4,185.9	
16	2037	-	88.4	256.3	344.6	721.9	-	88.5	643.2	56.6	7.3	1,635.8	3,153.2	2,808.6	885.4	3,300.6	
17	2038	-	35.3	256.3	291.6	735.8	-	88.5	643.2	57.7	7.4	1,668.5	3,201.1	2,909.5	849.3	2,451.3	
18	2039	-	-	256.3	256.3	749.9	-	88.5	643.2	58.9	7.6	1,701.8	3,249.9	2,993.7	809.1	1,642.2	
19	2040	-	-	256.3	256.3	764.3	-	88.5	643.2	60.1	7.7	1,735.9	3,299.7	3,043.4	761.6	880.6	
20	2041	-	3.0	256.3	259.3	779.0	-	88.5	643.2	61.3	7.9	1,770.6	3,350.5	3,091.2	716.3	164.3	
21	2042	-	3.0	256.3	259.3	794.0	-	88.5	643.2	62.5	8.1	1,806.0	3,402.2	3,142.9	674.3	510.0	
22	2043	-	12.7	256.3	268.9	809.3	-	88.5	643.2	63.7	8.2	1,842.1	3,455.0	3,186.1	632.9	1,142.9	
23	2044	-	66.5	256.3	322.7	824.8	-	88.5	643.2	65.0	8.4	1,879.0	3,508.9	3,186.1	586.1	1,729.0	
24	2045	-	53.8	256.3	310.1	840.7	-	88.5	643.2	66.3	8.6	1,916.5	3,563.8	3,253.7	554.2	2,283.2	
25	2046	-	-	256.3	256.3	856.8	-	88.5	643.2	67.6	8.7	1,954.9	3,619.8	3,363.5	530.4	2,813.6	
26	2047	-	7.4	256.3	263.6	873.3	-	88.5	643.2	69.0	8.9	1,994.0	3,676.9	3,413.2	498.4	3,312.0	
27	2048	-	7.4	256.3	263.6	890.1	-	88.5	643.2	70.4	9.1	2,033.9	3,735.1	3,471.5	469.4	3,781.3	
28	2049	-	13.4	256.3	269.7	907.2	-	88.5	643.2	71.8	9.3	2,074.5	3,794.5	3,524.8	441.3	4,222.6	
29	2050	-	26.0	256.3	282.3	924.7	-	88.5	643.2	73.2	9.4	2,116.0	3,855.0	3,572.7	414.1	4,636.7	
30	2051	-	12.7	256.3	268.9	942.5	-	88.5	643.2	74.7	9.6	2,158.3	3,916.8	3,647.9	391.5	5,028.2	
31	2052	-	-	256.3	256.3	960.6	-	88.5	643.2	76.2	9.8	2,201.5	3,979.8	3,723.5	370.0	5,398.3	
32	2053	-	46.5	256.3	302.8	979.1	-	88.5	643.2	77.7	10.0	2,245.5	4,044.0	3,741.2	344.3	5,742.5	
33	2054	-	73.0	256.3	329.3	997.9	-	88.5	643.2	79.3	10.2	2,290.4	4,109.5	3,780.2	322.1	6,064.6	
34	2055	-	26.5	256.3	282.8	1,017.1	-	88.5	643.2	80.8	10.4	2,336.3	4,176.3	3,893.5	307.2	6,371.7	
35	2056	-	13.9	256.3	270.2	1,036.7	-	88.5	643.2	82.5	10.6	2,383.0	4,244.4	3,974.3	280.3	6,662.0	
36	2057	-	13.9	256.3	270.2	1,056.6	-	88.5	643.2	84.1	10.8	2,430.6	4,313.9	4,043.7	273.5	6,935.5	
37	2058	-	4.2	256.3	260.5	1,077.0	-	88.5	643.2	85.8	11.1	2,479.3	4,384.7	4,124.2	258.3	7,193.8	
38	2059	-	4.2	256.3	260.5	1,097.7	10,642.9	88.5	643.2	87.5	11.3	2,528.8	15,099.9	14,839.4	860.5	8,054.3	
		16,452.1	1,223.3	8,807.3	26,482.6	25,152.4	10,642.9	2,417.3	18,483.4	1,907.6	257.6	56,763.3	115,624.7				
														ENPV (US\$)	8,054		
														EIRR	12.55%		
														BCR	1.58		

ECONOMIC ANALYSIS without socio-economic benefits - SUMMARY TABLE													
Phase 1 (A+B)													
Western Line (Tarkwa-Kumasi/Dunkwa-Awaso) & Eastern Line (Accra-Kumasi) & Ghana-Burkina Faso Lot. 2(Mpakadan-Nkwanta-Yendi-Tamale-Paga)													
MODEL YEAR	YEAR	LINE Investment	ROLLING STOCK Investment	Maintenance Cost	TOTAL	BENEFITS (MUS\$)						COSTS (MUS\$)	
						TRANSPORT Cost	Residual Value	ROAD Maintenance	ROAD Accidents	TIME Savings	GHG Savings	SOCIO-ECONOMIC Benefits	TOTAL
1	2022	1,238.5	-	93.1	1,332.6	-	-	-	-	-	-	-	-
2	2023	1,239.5	-	93.1	1,332.6	-	-	-	-	-	-	-	-
3	2024	1,239.5	-	93.1	1,332.6	-	-	-	-	-	-	-	-
4	2025	1,239.5	-	93.1	1,332.6	-	-	-	-	-	-	-	-
5	2026	1,239.5	134.9	93.1	1,467.4	-	-	-	-	-	-	-	-
6	2027	-	134.9	93.1	227.9	214.9	13.4	223.5	4.4	2.2	526.5	984.9	984.9
7	2028	-	-	93.1	93.1	223.0	13.4	223.5	4.5	2.3	537.0	910.6	910.6
8	2029	-	-	93.1	93.1	231.0	13.4	223.5	4.6	2.4	547.8	929.5	929.5
9	2030	-	-	93.1	93.1	239.1	13.4	223.5	4.6	2.5	558.7	948.8	948.8
10	2031	-	-	93.1	93.1	247.1	13.4	223.5	4.7	2.6	569.9	968.1	968.1
11	2032	-	-	93.1	93.1	255.2	13.4	223.5	4.8	2.7	581.3	987.8	987.8
12	2033	-	-	93.1	93.1	263.3	13.4	223.5	4.9	2.8	592.9	1,007.8	1,007.8
13	2034	-	13.4	93.1	106.5	267.0	13.4	223.5	5.0	2.8	604.8	1,010.0	1,010.0
14	2035	-	13.4	93.1	106.5	270.7	13.4	223.5	5.1	2.9	616.9	1,026.0	1,026.0
15	2036	-	-	93.1	93.1	274.3	13.4	223.5	5.2	2.9	629.2	1,043.6	1,043.6
16	2037	-	27.8	93.1	120.8	279.6	13.4	223.5	5.3	3.0	641.8	1,066.6	1,066.6
17	2038	-	27.8	93.1	120.8	285.0	13.4	223.5	5.4	3.0	654.6	1,090.0	1,090.0
18	2039	-	-	93.1	93.1	290.5	13.4	223.5	5.6	3.1	667.7	1,110.7	1,110.7
19	2040	-	-	93.1	93.1	296.1	13.4	223.5	5.7	3.1	681.1	1,129.8	1,129.8
20	2041	-	-	93.1	93.1	301.8	13.4	223.5	5.8	3.2	694.7	1,149.3	1,149.3
21	2042	-	-	93.1	93.1	307.7	13.4	223.5	5.9	3.3	708.6	1,169.2	1,169.2
22	2043	-	-	93.1	93.1	313.6	13.4	223.5	6.0	3.3	722.8	1,189.5	1,189.5
23	2044	-	-	93.1	93.1	319.7	13.4	223.5	6.1	3.4	737.2	1,210.2	1,210.2
24	2045	-	-	93.1	93.1	325.8	13.4	223.5	6.3	3.5	752.0	1,231.3	1,231.3
25	2046	-	-	93.1	93.1	332.1	13.4	223.5	6.4	3.5	767.0	1,252.8	1,252.8
26	2047	-	-	93.1	93.1	338.5	13.4	223.5	6.5	3.6	782.3	1,274.8	1,274.8
27	2048	-	-	93.1	93.1	345.1	13.4	223.5	6.6	3.7	798.0	1,297.2	1,297.2
28	2049	-	13.4	93.1	106.5	351.7	13.4	223.5	6.8	3.8	813.9	1,319.1	1,319.1
29	2050	-	13.4	93.1	106.5	358.5	13.4	223.5	6.9	3.8	830.2	1,339.4	1,339.4
30	2051	-	-	93.1	93.1	365.4	13.4	223.5	7.0	3.9	846.8	1,360.1	1,360.1
31	2052	-	-	93.1	93.1	372.5	13.4	223.5	7.2	4.0	863.8	1,381.2	1,381.2
32	2053	-	-	93.1	93.1	379.7	13.4	223.5	7.3	4.1	881.0	1,402.2	1,402.2
33	2054	-	26.5	93.1	119.6	387.0	13.4	223.5	7.5	4.1	898.7	1,424.6	1,424.6
34	2055	-	26.5	93.1	119.6	394.5	13.4	223.5	7.6	4.2	916.6	1,446.5	1,446.5
35	2056	-	-	93.1	93.1	402.1	13.4	223.5	7.8	4.3	935.0	1,469.0	1,469.0
36	2057	-	-	93.1	93.1	409.9	13.4	223.5	7.9	4.4	953.7	1,492.0	1,492.0
37	2058	-	-	93.1	93.1	417.8	13.4	223.5	8.1	4.5	972.7	1,515.9	1,515.9
38	2059	-	-	93.1	93.1	425.9	13.4	223.5	8.3	4.6	992.2	1,540.0	1,540.0
		6,197.6	431.8	3,536.9	10,166.2	10,486.0	3,570.5	440.8	7,376.5	201.9	111.5	24,277.4	46,464.6

ENPV (US\$)	3,353
EIRR	11.73%
BCR	1.50

Table 4-49. Outcome of the Economic Analysis for Phase 1(A+B)

Phase 1 C			ECONOMIC ANALYSIS without socio-economic benefits - SUMMARY TABLE														discount rate = 8.00%		
Central Spine (Kumasi-Tamale)			COSTS (MUS\$)				BENEFITS (MUS\$)							CASHFLOW (MUS\$)					
MODEL YEAR	YEAR	LINE Investment	ROLLING STOCK Investment	Maintenance Cost	TOTAL	TRANSPORT Cost	Residual Value	ROAD Maintenance	ROAD Accidents	TIME Savings	GHG Savings	SOCIO-ECONOMIC Benefits	TOTAL	Yearly Cash FLOW	Disc. Cash Flow	CUM. Disc. Cash Flow			
1	2022	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	234.8	- 234.8			
2	2023	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	234.8	- 452.2			
3	2024	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	201.3	- 653.5			
4	2025	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	186.4	- 839.8			
5	2026	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	172.6	- 1,012.4			
6	2027	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	159.8	- 1,172.4			
7	2028	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	148.0	- 1,320.1			
8	2029	204.6	-	30.2	234.8	-	-	-	-	-	-	-	-	234.8	137.0	- 1,457.1			
9	2030	204.6	65.1	30.2	299.9	-	-	-	-	-	-	-	-	299.9	162.0	- 1,619.2			
10	2031	-	65.1	30.2	95.3	153.3	-	17.2	72.5	8.7	2.0	127.5	381.2	285.9	143.0	- 1,476.2			
11	2032	-	-	30.2	30.2	159.0	-	17.2	72.5	8.9	2.0	130.1	389.7	359.6	166.5	- 1,309.6			
12	2033	-	-	30.2	30.2	164.7	-	17.2	72.5	9.1	2.1	132.7	398.3	368.1	157.9	- 1,151.7			
13	2034	-	6.1	30.2	36.3	166.9	-	17.2	72.5	9.3	2.1	135.3	403.3	367.1	145.8	- 1,006.0			
14	2035	-	6.1	30.2	36.3	169.0	-	17.2	72.5	9.5	2.2	138.1	408.4	372.1	136.8	- 869.1			
15	2036	-	-	30.2	30.2	171.2	-	17.2	72.5	9.7	2.2	140.8	413.5	383.3	130.5	- 738.6			
16	2037	-	7.5	30.2	37.7	174.6	-	17.2	72.5	9.8	2.2	143.6	419.9	382.2	120.5	- 618.1			
17	2038	-	7.5	30.2	37.7	178.0	-	17.2	72.5	10.0	2.3	146.5	426.5	388.8	113.5	- 504.7			
18	2039	-	-	30.2	30.2	181.5	-	17.2	72.5	10.2	2.3	149.4	433.1	403.0	108.9	- 395.8			
19	2040	-	-	30.2	30.2	185.0	-	17.2	72.5	10.4	2.4	152.4	439.9	409.8	102.5	- 293.2			
20	2041	-	3.0	30.2	33.2	188.7	-	17.2	72.5	10.7	2.4	155.5	446.9	413.7	95.9	- 197.4			
21	2042	-	3.0	30.2	33.2	192.4	-	17.2	72.5	10.9	2.5	158.6	454.0	420.8	90.3	- 107.1			
22	2043	-	-	30.2	30.2	196.2	-	17.2	72.5	11.1	2.5	161.7	461.2	431.0	85.6	- 21.5			
23	2044	-	-	30.2	30.2	200.0	-	17.2	72.5	11.3	2.6	165.0	468.5	438.4	80.6	59.2			
24	2045	-	-	30.2	30.2	203.9	-	17.2	72.5	11.5	2.6	168.3	476.0	445.9	75.9	135.1			
25	2046	-	-	30.2	30.2	207.9	-	17.2	72.5	11.8	2.7	171.6	483.7	453.5	71.5	206.6			
26	2047	-	3.1	30.2	33.2	212.0	-	17.2	72.5	12.0	2.7	175.1	491.5	458.3	66.9	273.5			
27	2048	-	3.1	30.2	33.2	216.2	-	17.2	72.5	12.2	2.8	178.6	499.5	466.2	63.0	336.6			
28	2049	-	-	30.2	30.2	220.4	-	17.2	72.5	12.5	2.8	182.2	507.6	477.4	59.8	396.3			
29	2050	-	-	30.2	30.2	224.8	-	17.2	72.5	12.7	2.9	185.8	515.8	485.7	56.3	452.6			
30	2051	-	-	30.2	30.2	229.2	-	17.2	72.5	13.0	2.9	189.5	524.3	494.1	53.0	505.7			
31	2052	-	-	30.2	30.2	233.7	-	17.2	72.5	13.2	3.0	193.3	532.9	502.7	50.0	555.6			
32	2053	-	20.0	30.2	50.1	238.3	-	17.2	72.5	13.5	3.1	197.2	541.7	491.5	45.2	600.9			
33	2054	-	20.0	30.2	50.1	242.9	-	17.2	72.5	13.8	3.1	201.1	550.6	500.5	42.6	643.5			
34	2055	-	-	30.2	30.2	247.7	-	17.2	72.5	14.1	3.2	205.1	559.8	529.6	41.8	685.3			
35	2056	-	-	30.2	30.2	252.6	-	17.2	72.5	14.3	3.2	209.2	569.1	538.9	39.4	724.6			
36	2057	-	-	30.2	30.2	257.5	-	17.2	72.5	14.6	3.3	213.4	578.6	548.4	37.1	761.7			
37	2058	-	4.2	30.2	34.4	262.6	-	17.2	72.5	14.9	3.4	217.7	588.3	553.9	34.7	796.4			
38	2059	-	4.2	30.2	34.4	267.8	1,188.9	17.2	72.5	15.2	3.4	222.0	1,787.0	1,752.6	101.6	898.0			
		1,841.5	218.1	1,146.7	3,206.2	5,998.0	1,188.9	499.1	2,101.6	339.1	76.7	4,947.5	15,150.8						
																ENPV (US\$)	898		
																EIRR	11.18%		
																BCR	1.49		

Table 4-50. Outcome of the Economic Analysis for Phase 1C

Phase 2		ECONOMIC ANALYSIS without socio-economic benefits - SUMMARY TABLE															discount rate = 8.00%		
TransEowas(Afao-Accra-Takoradi-Elubo)		COSTS (MU\$)					BENEFITS (MU\$)					CASH FLOW (MU\$)							
MODEL YEAR	YEAR	LINE Investment	ROLLING STOCK Investment	Maintenance Cost	TOTAL	TRANSPORT Cost	Residual Value	ROAD Maintenance	ROAD Accidents	TIME Savings	GHG Savings	SOCIO-ECONOMIC Benefits	TOTAL	Yearly Cash FLOW	Disc. Cash Flow	CUM. Disc. Cash Flow			
						1	1	1	1	1	1	1							
1	2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
2	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
3	2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
4	2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
5	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
6	2027	406.5	-	-	406.5	-	-	-	-	-	-	-	-	-	406.5	276.8			
7	2028	406.5	-	-	406.5	-	-	-	-	-	-	-	-	-	532.8	532.8			
8	2029	406.5	-	39.5	445.9	-	-	-	-	-	-	-	-	-	445.9	793.0			
9	2030	406.5	-	39.5	445.9	-	-	-	-	-	-	-	-	-	445.9	1033.9			
10	2031	406.5	-	39.5	445.9	-	-	-	-	-	-	-	-	-	445.9	1257.0			
11	2032	406.5	87.6	39.5	533.6	-	-	-	-	-	-	-	-	-	533.6	1594.1			
12	2033	-	87.6	39.5	127.1	133.1	22.2	94.8	94.8	12.8	0.9	343.4	607.2	480.2	205.9	1298.2			
13	2034	-	-	39.5	39.5	135.2	22.2	94.8	94.8	13.0	0.9	350.3	616.4	577.0	229.1	1089.0			
14	2035	-	13.9	39.5	53.3	137.2	22.2	94.8	94.8	13.3	0.9	357.3	623.8	572.4	210.5	858.6			
15	2036	-	13.9	39.5	53.3	139.3	22.2	94.8	94.8	13.5	1.0	364.5	635.3	581.9	198.1	680.4			
16	2037	-	40.4	39.5	79.9	141.9	22.2	94.8	94.8	13.8	1.0	371.8	645.4	585.6	178.3	482.2			
17	2038	-	-	39.5	39.5	144.6	22.2	94.8	94.8	14.1	1.0	379.2	655.8	616.4	179.9	302.2			
18	2039	-	-	39.5	39.5	147.3	22.2	94.8	94.8	14.4	1.0	386.8	666.4	627.0	169.4	132.8			
19	2040	-	-	39.5	39.5	150.0	22.2	94.8	94.8	14.7	1.0	394.5	677.2	637.8	159.6	26.8			
20	2041	-	-	39.5	39.5	152.8	22.2	94.8	94.8	14.9	1.1	402.4	688.2	648.8	150.3	177.1			
21	2042	-	-	39.5	39.5	155.7	22.2	94.8	94.8	15.2	1.1	410.4	699.4	660.0	141.6	318.7			
22	2043	-	12.7	39.5	52.1	158.6	22.2	94.8	94.8	15.6	1.1	418.7	710.9	658.8	130.9	449.6			
23	2044	-	12.7	39.5	52.1	161.6	22.2	94.8	94.8	15.9	1.1	427.0	722.6	670.5	123.3	572.9			
24	2045	-	-	39.5	39.5	164.6	22.2	94.8	94.8	16.2	1.1	435.6	734.5	695.0	118.4	691.3			
25	2046	-	-	39.5	39.5	167.7	22.2	94.8	94.8	16.5	1.2	444.3	746.6	707.2	111.5	802.8			
26	2047	-	4.3	39.5	43.7	170.8	22.2	94.8	94.8	16.8	1.2	453.2	759.0	715.3	104.4	907.3			
27	2048	-	4.3	39.5	43.7	174.0	22.2	94.8	94.8	17.2	1.2	462.2	771.6	727.9	98.4	1005.7			
28	2049	-	-	39.5	39.5	177.3	22.2	94.8	94.8	17.5	1.2	471.5	784.5	745.0	93.3	1098.9			
29	2050	-	12.7	39.5	52.1	180.6	22.2	94.8	94.8	17.9	1.3	480.9	797.6	745.5	86.4	1185.3			
30	2051	-	12.7	39.5	52.1	184.0	22.2	94.8	94.8	18.2	1.3	490.5	811.0	758.9	81.4	1266.8			
31	2052	-	-	39.5	39.5	187.4	22.2	94.8	94.8	18.6	1.3	500.3	824.6	785.2	78.0	1344.8			
32	2053	-	-	39.5	39.5	190.9	22.2	94.8	94.8	19.0	1.3	510.3	838.5	799.1	73.5	1418.4			
33	2054	-	-	39.5	39.5	194.5	22.2	94.8	94.8	19.3	1.4	520.5	852.7	813.3	69.3	1487.6			
34	2055	-	-	39.5	39.5	198.1	22.2	94.8	94.8	19.7	1.4	531.0	867.2	827.7	65.3	1552.9			
35	2056	-	13.9	39.5	53.3	201.8	22.2	94.8	94.8	20.1	1.4	541.6	882.0	828.6	60.5	1613.5			
36	2057	-	13.9	39.5	53.3	205.6	22.2	94.8	94.8	20.5	1.4	552.4	897.0	843.7	57.1	1670.5			
37	2058	-	-	39.5	39.5	209.5	22.2	94.8	94.8	20.9	1.5	563.5	912.3	872.9	54.7	1725.2			
38	2059	-	-	39.5	39.5	213.4	1,666.0	22.2	94.8	21.3	1.5	574.7	2,594.0	2,554.6	148.1	1873.3			
		2,438.8	330.4	1,223.1	3,992.3	4,577.3	1,666.0	600.7	2,558.4	450.9	31.8	12,138.8	22,023.9						
																	ENPV (US\$)	1,873	
																	EIRR	15.51%	
																	BCR	2.06	

Table 4-51. Outcome of the Economic Analysis for Phase 2.

Phase 3		ECONOMIC ANALYSIS without socio-economic benefits - SUMMARY TABLE															
Western Expansion (Awaso-Techiman-Sawla-Hamile) + Transversal Expansions + Links to New Capitals																	
MODEL YEAR	YEAR	COSTS (MUS\$)				BENEFITS (MUS\$)							CASH FLOW (MUS\$)				
		LINE Investment	ROLLING STOCK Investment	Maintenance Cost	TOTAL	TRANSPORT Cost	Residual Value	ROAD Maintenance	ROAD Accidents	TIME Savings	GHG Savings	SOCIO-ECONOMIC Benefits	TOTAL	Yearly Cash FLOW	Disc. Cash Flow	CUM. Disc. Cash Flow	
						1	1	1	1	1	1	1					
1	2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
3	2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
5	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6	2027	302.5	-	-	302.5	-	-	-	-	-	-	-	-	302.5	-	205.9	
7	2028	302.5	-	-	302.5	-	-	-	-	-	-	-	-	302.5	-	396.5	
8	2029	302.5	-	93.6	396.1	-	-	-	-	-	-	-	-	396.1	-	841.6	
9	2030	302.5	-	93.6	396.1	-	-	-	-	-	-	-	-	396.1	-	1365.1	
10	2031	952.8	-	93.6	1,046.4	-	-	-	-	-	-	-	-	1,046.4	-	2298.6	
11	2032	952.8	-	93.6	1,046.4	-	-	-	-	-	-	-	-	1,046.4	-	2714.1	
12	2033	952.8	-	93.6	1,046.4	-	-	-	-	-	-	-	-	1,046.4	-	3111.7	
13	2034	952.8	-	93.6	1,046.4	-	-	-	-	-	-	-	-	1,046.4	-	3619.3	
14	2035	952.8	34.8	93.6	1,081.2	-	-	-	-	-	-	-	-	1,081.2	-	4125.5	
15	2036	-	34.8	93.6	128.4	91.0	-	34.2	224.7	19.4	0.8	376.2	746.3	617.9	210.4	2901.3	
16	2037	-	12.7	93.6	106.2	92.7	-	34.2	224.7	19.8	0.8	383.7	756.0	649.8	204.8	2696.5	
17	2038	-	-	93.6	93.6	94.5	-	34.2	224.7	20.2	0.8	391.4	765.8	672.3	196.2	2500.2	
18	2039	-	-	93.6	93.6	96.3	-	34.2	224.7	20.6	0.9	399.2	775.9	682.3	184.4	2315.8	
19	2040	-	-	93.6	93.6	98.1	-	34.2	224.7	21.0	0.9	407.2	786.1	692.6	173.3	2142.5	
20	2041	-	-	93.6	93.6	100.0	-	34.2	224.7	21.5	0.9	415.3	796.6	703.0	162.9	1979.6	
21	2042	-	-	93.6	93.6	101.9	-	34.2	224.7	21.9	0.9	423.7	807.2	713.7	153.1	1826.5	
22	2043	-	-	93.6	93.6	103.8	-	34.2	224.7	22.3	0.9	432.1	818.1	724.5	143.9	1682.6	
23	2044	-	53.8	93.6	147.4	105.8	-	34.2	224.7	22.8	0.9	440.8	829.2	681.8	125.4	1557.2	
24	2045	-	53.8	93.6	147.4	107.8	-	34.2	224.7	23.2	1.0	449.6	840.5	693.1	118.9	1439.1	
25	2046	-	-	93.6	93.6	109.8	-	34.2	224.7	23.7	1.0	458.6	852.0	758.4	119.6	1319.5	
26	2047	-	-	93.6	93.6	111.9	-	34.2	224.7	24.2	1.0	467.7	863.8	770.2	112.5	1207.1	
27	2048	-	-	93.6	93.6	114.1	-	34.2	224.7	24.7	1.0	477.1	875.7	782.2	105.8	1101.3	
28	2049	-	-	93.6	93.6	116.2	-	34.2	224.7	25.1	1.0	486.6	888.0	794.4	99.4	1001.9	
29	2050	-	-	93.6	93.6	118.4	-	34.2	224.7	25.6	1.1	496.4	900.4	806.9	93.5	908.3	
30	2051	-	-	93.6	93.6	120.7	-	34.2	224.7	26.2	1.1	506.3	913.2	819.6	88.0	820.4	
31	2052	-	-	93.6	93.6	123.0	-	34.2	224.7	26.7	1.1	516.4	926.1	832.6	82.7	737.6	
32	2053	-	26.5	93.6	120.1	125.3	-	34.2	224.7	27.2	1.1	526.8	939.4	819.2	75.4	662.3	
33	2054	-	26.5	93.6	120.1	127.7	-	34.2	224.7	27.8	1.1	537.3	952.8	832.7	70.9	591.3	
34	2055	-	-	93.6	93.6	130.2	-	34.2	224.7	28.3	1.2	548.0	966.6	873.0	68.9	522.4	
35	2056	-	-	93.6	93.6	132.6	-	34.2	224.7	28.9	1.2	559.0	980.6	887.1	64.8	457.6	
36	2057	-	-	93.6	93.6	135.2	-	34.2	224.7	29.5	1.2	570.2	994.9	901.4	61.0	396.7	
37	2058	-	-	93.6	93.6	137.7	-	34.2	224.7	30.0	1.2	581.6	1,009.5	916.0	57.4	339.3	
38	2059	-	-	93.6	93.6	140.4	4,217.5	34.2	224.7	30.6	1.3	593.2	5,241.9	5,148.3	-	40.8	
		5,974.3	242.9	2,900.7	9,117.9	2,734.9	4,217.5	820.7	5,393.3	591.3	24.4	11,444.5	25,226.6				
															ENPV (US\$)	-	41
															EIRR	7.90%	7.90%
															BCR		0.99

Table 4-52. Outcome of the Economic Analysis for Phase 3

4.6.2 SENSITIVITY ANALYSIS

A Sensitivity Test was conducted on the E-IRR of the Railway System, starting from the 12.7% obtained as a basic scenario, in the dual assumption of attributing progressive, increasing/decreasing factors (in the range up to -25%/+25%) to benefits and costs.

The results are summarised in the Table 4-53 which shows a good robustness of the overall Project performance, with E-IRR spanning from 7.5% (low bound – pessimistic scenario) to 19.5% (upper bound – optimistic scenario).

		<i>Benefits</i>										
<i>Costs</i>	12.7%	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25
	1.25	7.5%	8.1%	8.7%	9.2%	9.7%	10.3%	10.8%	11.2%	11.7%	12.2%	12.7%
	1.20	7.9%	8.5%	9.1%	9.6%	10.1%	10.7%	11.2%	11.7%	12.2%	12.7%	13.1%
	1.15	8.3%	8.9%	9.5%	10.0%	10.6%	11.1%	11.6%	12.2%	12.7%	13.1%	13.6%
	1.10	8.7%	9.3%	9.9%	10.5%	11.0%	11.6%	12.1%	12.7%	13.2%	13.7%	14.2%
	1.05	9.1%	9.8%	10.4%	11.0%	11.5%	12.1%	12.7%	13.2%	13.7%	14.2%	14.7%
	1.00	9.6%	10.3%	10.9%	11.5%	12.1%	12.7%	13.2%	13.8%	14.3%	14.8%	15.4%
	0.95	10.1%	10.8%	11.4%	12.0%	12.7%	13.2%	13.8%	14.4%	15.0%	15.5%	16.1%
	0.90	10.7%	11.3%	12.0%	12.7%	13.3%	13.9%	14.5%	15.1%	15.7%	16.2%	16.8%
	0.85	11.3%	12.0%	12.7%	13.3%	14.0%	14.6%	15.2%	15.8%	16.4%	17.0%	17.6%
	0.80	11.9%	12.7%	13.4%	14.0%	14.7%	15.4%	16.0%	16.7%	17.3%	17.9%	18.5%
	0.75	12.7%	13.4%	14.1%	14.8%	15.5%	16.2%	16.9%	17.6%	18.2%	18.9%	19.5%

Table 4-53. Outcome of Sensitivity Test for the Cost Benefit Analysis

4.7 RELEVANT ASPECTS FOR DEFINITION OF RAILWAY FARES

4.7.1 USUAL TARIFF SCHEMES FOR RAILWAY MARKET

Railway prices generally do not follow a pre-determined worldwide scheme, especially in regards to freight. Where the railway market is open to different competitors it is impossible to define fares: in this case, operators and clients set a price based on a trade deal. The operator knows its internal costs and based on such costs he sets a negotiation with its client. Moreover, frequently the operator only offers the traction, i.e. the service of its locomotives for the haulage of rolling stock owned by others. This is the situation that is habitually present in Europe, where the separation between infrastructure and services fostered the presence of different rail operators offering competing services on the same tracks. But the system still has imperfections and it is well known that at the moment, in some cases, the separation between infrastructure and services is not yet complete^v, therefore in some countries, private operators must still deal with “incumbent” operators that are linked with the former traditional railway structure.

The scenario is partially similar for passenger traffic. When the market is open (again, the case of the EU) there is a difference between financially profitable and unprofitable trains. Financially profitable trains (mainly high speed trains and part of inter-city trains) are managed under a purely commercial scheme: there are different combinations of classes and prices that are sold to final users (frequently on-line), using the same commercial techniques adopted by airlines (discount on tickets bought in advance, etc.). This is not now the case of the African rail market, but this scenario may be considered in a longer perspective.

Nevertheless, financially unprofitable rail services still operate when the rail market is open, because they are in any case necessary due to their positive social impact (such as, for example, local trains for commuters): in this case they are publicly subsidized and their prices are based on more traditional schemes.

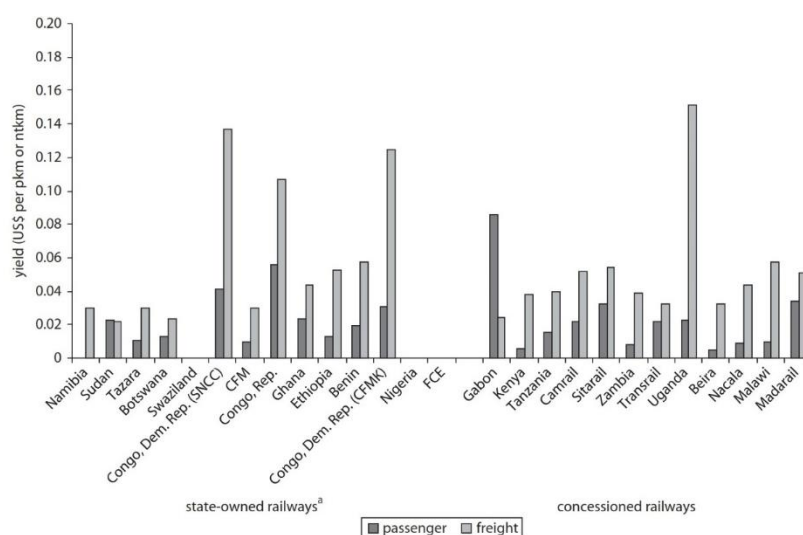
Other scenarios are possible where the railway market is not open to different competitors and not characterized by the separation between owner of the infrastructure and providers of the services. In this case, a mix of different scenarios can exist, such as:

- The owner of the infrastructure and the provider of the services coincide and are a publicly owned company (usually state-owned)
- The infrastructure is publicly owned, but both infrastructure maintenance and services are assigned to a private company under a concession scheme
- The infrastructure is owned by a private company that also operates the services (in this case a concession from public authorities is necessary)

The combinations can be many and those listed are just the most frequent examples. Fixed tariffs are therefore most frequent when an operator is publicly owned, as is the case in many African countries.

4.7.2 RAIL TARIFFS USED IN SOME AFRICAN COUNTRIES

The Consultant did a review of rail rates in different African countries based on both its own experience and data collected from different sources (One of the most significant sources of information was "*Africa's Transport Infrastructure*", by Kenneth Gwilliam and others, World Bank, 2011). It must be observed that rail freight fares in Africa were generally based on the value of the transported goods until around 2005. Fares were obviously lower for low-value goods (such as fertilizers) and higher for more valuable items (such as manufactured goods), and they were typically between 0.03 – 0.05 USD per ton x km. More recently, tariffs are starting to be linked to market conditions: where competition with other modes of transport (especially road) is higher, tariffs are lower, and where other modes of transport are less competitive they are higher. But the old tariff schemes are still influencing the market. As reported by the WB in 2011, "*Despite the pressure from road competition, tariffs still vary substantially both among commodities and among countries. Tariffs for petroleum products and container traffic are generally high, while those for agricultural products and semi bulk commodities such as cement and fertilizer are low.*" Figure 4-9, extracted from said WB document, shows the average passenger and freight tariffs during the 1995 – 2005 decade.



Source: Bullock 2009.

Note: CFM = Caminhos de Ferro de Moçambique; FCE = Fianarantsoa Côte Est Railway. No data are available for FCE, Nigeria, and Swaziland.

a. Figures drawn from Bullock (2009) follow his distinction between systems that have been concessioned and those that remain in government ownership and operation.

Figure 4-9. Average Tariffs for Passenger and Freight Traffic, 1995–2005

Source: "*Africa's Transport Infrastructure*", by Kenneth Gwilliam and others, World Bank, 2011

The values presented in this figure show higher tariffs for the Republic of Congo and the DPR of Congo and for Uganda, but apart from these exceptions freight tariffs were aligned to the above-mentioned values.

Figure 4-9 also contains values for passenger services. In regards to passengers the following observations can be made:

- There are no significant differences between state-owned and concessioned railways: values are generally between 0.02 and 0.04 USD per pass x km, except for Gabon, where a significantly higher tariff is present
- Also, in this case values are referred to the year 2009, and therefore can be partially outdated

Kenya, Ethiopia and Nigeria recently made important rail investments, with the construction of new standard gauge railways (Mombasa - Nairobi in Kenya, Djibouti – Addis Ababa in Ethiopia and Idu - Kaduna in Nigeria). This led to a significant improvement of the quality of the service. In any case it has to be observed that the existing fares are now:

- In Kenya, 9.62 USD for a 485 km trip (Mombasa – Nairobi) in economy class and 28.87 USD in first class, i.e. 0.02 and 0.06 USD per pass x km respectively
- In Ethiopia, 17.11 USD for a 728 km trip (Djibouti – Addis Ababa) for a basic seat, 34.11 USD for a hard sleeper and 45.60 USD for a soft sleeper, i.e. nationals pay 0.02, 0.05 and 0.06 USD per pass x km respectively. These are the prices for local citizens, while foreigners pay double the amount
- In Nigeria, ₦ 3,050 (8.47 US\$) for a 186 km trip (Idu-Kaduna) in first class and ₦ 1,550 (4.3 US\$) economy class, i.e. 0.023 and 0.045 USD per pass x km respectively

Country	Railway section	Distance (km)	1 st Class (US\$)	2 nd Class (US\$)	2 nd Class (US\$/km)
Ethiopia	Djibouti - Addis Ababa	728	34.11	17.11	0.02
Kenya	Mombasa - Nairobi	485	28.87	9.62	0.02
Nigeria	Idu - Kaduna	186	8.47	4.3	0.023

Table 4-54. Rail passenger rates for the new standard gauge railway in Ethiopia, Kenya and Nigeria.

In both cases there was an increase in fares from those applied in 2009, but the increase was not such to bring the values far beyond the prices shown in Figure 4-9.

The next Figure 4-10 shows tariffs separated by commodities. In general, tariffs for petroleum products and containers are higher.

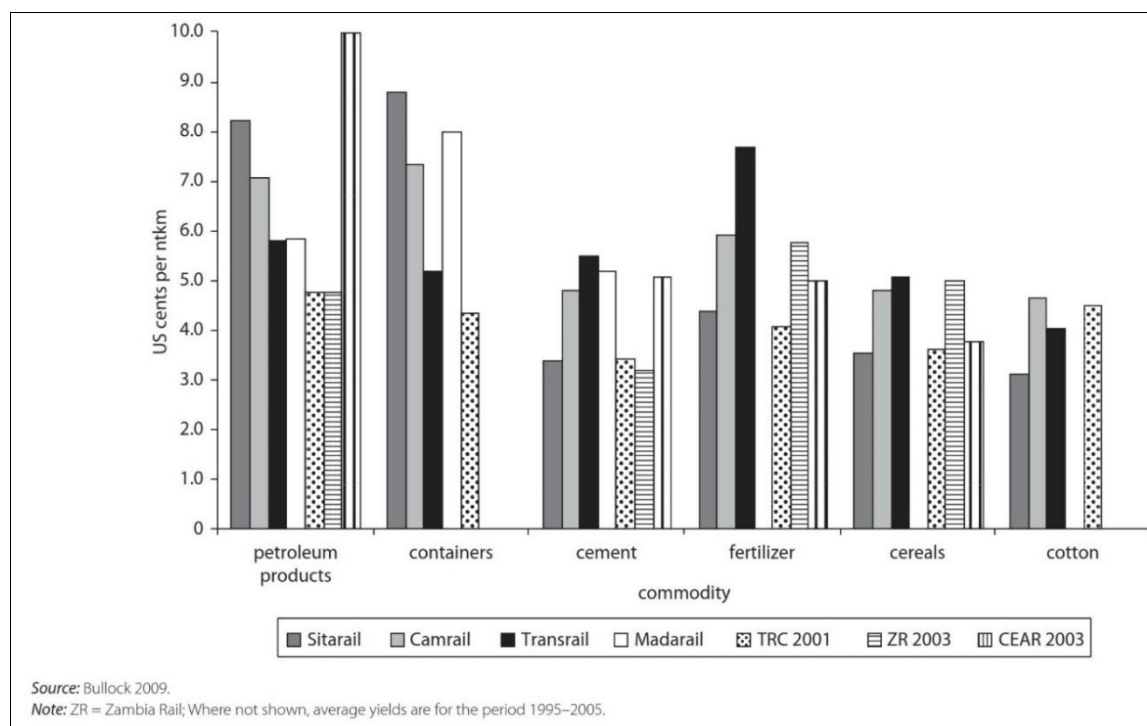


Figure 4-10. Average Tariffs by Commodity for Select Railways in Sub-Saharan Africa

Source: “Africa’s Transport Infrastructure”, by Kenneth Gwilliam and others, World Bank, 2011

As reported by the WB, tariffs are also influenced by volumes and local circumstances. Therefore, petroleum products have higher tariffs because they require the use of specific wagons and, being the demand generally one-directional, these wagons must return empty in the opposite direction; this aspect has a lower impact on bulk freight. The presence of freight sidings at the actual origin and destinations has a positive impact on tariffs, because the necessity of additional road transport to/from the railway can cost up to the equivalent of 200/300 km of additional road transport. Nevertheless, specialised railway sidings are often built only when a high volume of a specific product is transported, thus optimizing costs when the volumes are high: mining products, cement, etc. are typical examples.

Tariffs are in theory competitive with road prices. The same document from the WB also includes the table that is presented as Table 4-55 below.

Region Gateway	Distance		Transit	Price per	Price per
	Destination	(km)	time (days)	tonne (US\$)	tonne-km (US\$)
East Mombasa	Kampala	1,100	5–6	90	0,081
Mombasa	Kigali	1,700	8–10	100–110	.059–.065
West Lomé	Ouagadougou	1,050	6–8	60–70	.057–.067
Cotonou	Niamey	1,000	6–8	65–95	.065–.095
Central Douala	Ndjamena	1,850	12–15	200–210	.108–.113
Douala	Bangui	1,450	8–10	200–210	.138–.145
South Durban	Lusaka	2,300	8–9	90–130	.039–.057
Durban	Ndola	2,700	9–10	130–170	.048–.063

Table 4-55. Performance of the International Gateway Road Corridors in Africa

Source: Teravaninthorn and Raballand 2008.

Unfortunately, other factors penalize rail's competitiveness. They are mainly (1) the additional costs of pickup and delivery of freight to/from rail terminals by road and (2) the general poor quality of the service. Moreover, (3) rail companies frequently have low flexibility in establishing competitive tariffs and (4) there often are very long transit times for international traffic at borders. And, finally, (5) there is unfair competition from road transport due to the frequent practice of overloading, which is often not adequately sanctioned.

4.7.3 OPPORTUNITIES FOR A MORE COMPETITIVE RAILWAY

In terms of competition, tariffs represent only a partial aspect of the overall question. Different opportunities can arise from specific actions, such as:

4.7.3.1 Improving the intermodal services on railway infrastructure

Containerization is a trend that has been spreading over the entire freight transport sector for decades. Railways must follow this trend in order to become an integral part of the freight chain. In general terms, from this point of view there is a delay in Africa, due to the poor availability of intermodal terminals and to the bad conditions of the rail infrastructure. Tariffs for intermodal services are generally not easily identifiable, the rail segment being only one part of a more complex logistic chain. As an indication, Table 4-56 gives the freight rates applied by KRC (Kenya Railways Corporation) for shipping 20 ft and 40 ft containers between Mombasa and Nairobi (about 500 km) / Kampala (about 1400 km).

		From MOMBASA		To MOMBASA	
		NAIROBI	KAMPALA	NAIROBI	KAMPALA
1	20 ft	USD 500	USD 1250	USD 200	USD 600
2	40 ft	USD 1000	USD 2200	USD 400	USD 700

Table 4-56. Rail freight rates between Mombasa, Nairobi & Kampala

Source: 2015, East Africa Logistics Performance Survey, KRC Tariffs

Tariffs from the above table appear to be high, considering the average market tariffs. Though it must be observed that in 2015 (when this table was published) the new standard gauge railway between Mombasa and Nairobi was still not operating.

4.7.3.2 Creating a more competitive market for freight

Concessioning may be a solution, given the fact that the concessionaire may operate under more efficient premises. As previously stated, many public-owned railway companies have no flexibility for setting more competitive and market-based tariffs. But concessioning cannot be considered as a universal solution, given the fact that frequently such agreements were unsuccessful for various reasons: contracting errors (with poor protection of the public interest, monopolistic positions, etc.), inadequate traffic forecasts, technical inadequacy of concessionaire and/or the public controller, etc.

Market-oriented solutions can be seen as the medium-long-term solution. The choice of introducing a competitive approach in the management of railway transport has been made by the EU in the early 90s. The goal was to have railways reenter the mainstream of the economic development, forcing them to counteract the decline through the introduction of managerial driven actions in the administration of their tasks. The overall reform of the European railway system finds its crucial point in the right of access to the infrastructure given to any subject entitled (in case of Ghana, GRDA has the duty of licensing, as established by the Railway Act 2008 - Act 779) in order to provide railway services to the final customers, both passenger and freight. The differentiation between the rail infrastructure regime (monopoly) and the rail service providing regime (authorization) opened the railway market to new companies, creating the opportunity to compete and it promoted a reorganization of the traditional railway operators. But the adoption of a full competitive model for railways in the Ghanaian situation will require firstly an adequate infrastructure and then a training period in performing national and international services.

4.7.3.3 Specializing the rail market

Specialization is also one of the opportunities for the development of the rail market. There are categories of freight that are more predisposed to be transported by rail, while others are less prone. This is an opportunity that can be developed in parallel with those related to the containerization. Although intermodal transport is the fastest-growing freight type for railways in developed countries, other successful railways began their reversal of the declining modal share by consolidating the traditional bulk transportation. Railway has a competitive advantage in moving large volumes over long distances at low costs. In this segment, block trains with specialized wagon equipment operate highly efficient shuttle services between origins and destinations. These services are often the core business for most successful railways, because they play to the strengths of rail-centric logistics.

4.7.3.4 Offering competitive services and tariffs for passengers

Ethiopia and Kenya raised tariffs for passengers' services to a level that is much higher than previous ones, but not so different to those that many African railways applied ten years ago. In both cases tariffs are still fixed and dependant on the length of the ride and not on contingent market conditions (variability of demand, seasonality, etc.). This is a model that can be followed, while instead the adoption of the aggressive tariff schemes that are applied in Europe for commercial services can be seen only as a long-term hypothesis for Ghana (as well as for other African countries). As a matter of fact, these aggressive fare schemes require conditions that are not present in Ghana, such as:

- An open market with frequent, fast services competing with one another
- An infrastructure that is capable of hosting services with the performances described
- A high level of demand
- A widespread attitude towards online purchasing, with the use of electronic money (regarding this aspect there has been a change in trend in Ghana, so within a few years the scenario may be different from the current one, see below).

Instead, it appears much more realistic to start with a more traditional fare scheme with prices that can be considered adequate to the average salaries in Ghana, considering the tariffs of the parallel bus services as comparison. Tariffs from the main bus companies can be taken as a sample. For example, average reference tariffs are:

- 1st sample: Accra – Kumasi (250 km): 40 GHS, i.e. 7.39 USD corresponding to 0.03 USD per pass x km
- 2nd sample: Accra – Tamale (623 km via Kumasi): 100 GHS, i.e. 18.47 USD corresponding to 0.03 USD per pass x km
- 3rd sample: Accra – Takoradi (222 km): 35 GHS, i.e. 6.46 USD corresponding to 0.03 USD per pass x km^{vi}

Interestingly, bus fares are based on a basic amount of 0.03 USD per pass x km, which is still very close to the values presented inside Figure 4-9. Moreover, online ticketing is also beginning to be available in Ghana (<https://portal.myticketgh.com/bus/tickets> was one of the sources of information, see note vi) and payments can be made both by using the services offered by the local mobile phone providers, as well as by card. The future providers of railway services will therefore have to start from these type of rates and then only later elaborate more sophisticated schemes. It is clear that the benefits of the railway, in terms of reducing the cost of road congestion, increasing safety for travellers and reducing pollution, will be a factor that may also justify the introduction of subsidies, including temporary ones, at least until the intercity rail services may reach their own financial sustainability. It goes without saying that the quality of the rail services, in terms of punctuality, travel comfort, cleaning must be high, in order to avoid the risk of failure of a high strategic value investment.

A further suggestion about passenger tariffs can be also represented by the introduction of discounts for specific categories of passengers, such as students, elderly people and families travelling together. As regards this latter aspect, it has to be emphasized that moving an entire family paying tickets at full cost can be too much expensive especially for a low-income country such Ghana is at the moment. This could lead householders to choose another cheaper mean of transportation for family trips, and therefore discourage the use of trains for trips of this type.

4.7.4 SUGGESTIONS ABOUT GENERAL TRANSPORT POLICIES

Improving the share of rail transport requires specific strategies as regards the general transport policies. It must be highlighted that a modal shift that is favourable to railways generally produces benefits that are not directly quantifiable from the financial point of view. This means that even with a high performance infrastructure, the modal shift cannot be always taken for granted, especially if there are “hidden subsidies” favourable to road transport. These “hidden subsidies” can be represented, for example, by an inadequate enforcement on aspects such as truck overloading, maximum working times for drivers, etc.

It is also necessary to objectively admit that the main reasons of the success of road freight transport towards rail transport are its flexibility and the capacity of giving a door-to-door service that would be

impossible for railways to offer. Tariffs, or more in general transport costs, are not the real discriminator, as discussed before.

As regards passenger services, the main drawbacks for the African markets are represented by the unsatisfactory quality of the rail services and from the objectively poor presence of them (with some lines used only by freight trains, and/or with very scarce and low-quality passenger services).

Nevertheless, railways have advantages over the road mode that are not perceived as direct utilities by the freight shippers and sometimes also by the passengers, but that represent real benefits for the entire community: these are mainly lower environmental impact, but also fewer accidents, lower soil consumption, etc. This is the reason why a general transport policy that is favourable to the use of railway should be necessary. As an example, the high rate of traffic transported by rail across the Swiss Alps in Europe is justified not only by the high quality of the rail infrastructure, but also by specific policies, i.e. taxations on heavy vehicles^{vii}. France for many years has prohibited the use of intercity bus lines along routes already served by the railway. This is no longer valid after the application of EU directives concerning the liberalization of the transport market, but in the past this decision encouraged the use of the train. On the contrary, the use of motorway tolls that are not proportionate to the actual impact of heavy vehicles on the road infrastructure is a sort of cross-subsidy in favour of road haulage, where other road users (above all, car drivers) are obliged to forcefully subsidize the hauliers. This is a practice that even if not officially recognized is still widespread in Europe and outside, often favoured also by lobbying interests and political conveniences.

In the case of Ghana, it is therefore recommended to carefully analyse these possibilities, and to encourage the use of the railway by:

- Raising the quality of service, both for goods and passengers. For the latter, it should be necessary to provide services of a quality comparable to that of European intercity trains, with trains with an acceptable speed and good comfort and cleanliness. The experience of the new Mombasa – Nairobi railway line in Kenya is a good example, at least now;
- Giving to the managers of the future freight services the possibility of establishing commercially competitive/aggressive tariffs;
- Increasing both the intermodal transport capacity of the railway, and at the same time the transport of goods that can be attracted specifically by the railway. The availability of efficient terminals will, therefore, be a must, in parallel with the quality of the rail infrastructure itself;
- Establish affordable fares for passengers, giving at the same time a better service than that offered by intercity buses at comparable prices (in this case, even with public subsidies, at least until the service can achieve financial autonomy, as said before), with enough flexibility and discounts for specific categories of users (as already mentioned, students, elderly people and families), in line with a Passenger Service Obligation;
- Establishing a broader national transport policy, led at political level, and shared amongst all Ministries and entities involved, aimed at emphasizing the importance of rail transport and defining a common strategy for the valorisation of the investments sustained/to be sustained on railways;

- Once a proper railway system is available, an appropriate marketing campaign will be needed to inform potential users and encourage them to switch to rail services;
- Another final recommendation is the accessibility of the passenger stations. These should be as close as possible to inhabited centres, if not possibly within them. One of the strengths of the railway in Europe is precisely the location of the stations, which for historical reasons are generally in the central areas of the cities. This gives advantages over both air transport, due to the distance of the airports from the cities, and bus transport, due to the dead times lost for urban road congestion.

5. ENVIRONMENTAL AND SOCIAL ASSESSMENT

5.1.1 *APPROACH AND METHODOLOGY*

All the potential environmental and social impacts (positive and negative) associated with the implementation of the Ghana Railway Network have been adequately studied.

In spite of enormous benefits, considered in the previous Chapter 4.5, the railway sector developments would also exert some adverse effects on the social and physical environment. These negative effects may include: air and water quality deterioration, noise and vibration impacts, soil erosion and sedimentation, public and occupational health risks, disruption of public utility services and train-vehicular conflict, landscape disturbance and habitat fragmentation, and expropriation of farmlands and property.

At this stage of planning (i.e. Master Plan), the specific scope of the various project types and their detailed designs are not determined; consequently, the potential impacts of the individual projects (under RMP) cannot be assessed. Furthermore, the multiple railway projects to be financed under the RMP are geographically spread (country-wide) with several phases of implementation over a long timeframe. For such a precisely programmed undertaking, an **Environmental and Social Management Framework** (its equivalent being Strategic Environmental Assessment for policies) is, therefore, the appropriate Environmental Assessment (EA) tool to apply.

This Environmental and Social Management Framework (ESMF) has been prepared by the Centre for Environment & Health Research & Training (CEHRT), for all projects under the RMP, including construction, re-construction, rehabilitation, decommissioning, scrapping, realignment, installations, etc., of the railway network and infrastructure in Ghana. The ESMF provides the required environmental and social assessment and safeguards framework, institutional arrangements and capacity required to identify and mitigate potential risks/impacts of actions (under the RMP), as well as monitor the overall implementation. It also primarily guides the individual project-level EA screening, assessment and mitigation of impacts, as well as management and monitoring requirements.

Thus, the ESMF will enable GRDA and the Ministry of Railways Development (MoRD) to address the adverse environmental and social impacts arising from or induced by the RMP implementation; and to collaborate with various stakeholders in the rail transport sector. The ESMF also represents a statement of policy, guiding principles and procedures of reference with respect to railway sector projects, consistent with requirements of the LI 1652, and agreeable to key stakeholders.

5.1.2 *UPDATING THE ESMF*

The updated ESMF (which is attached in full to this report in the **Annex 1: Environmental and Social Management Framework**) was derived from the January 2013 version, which was submitted to EPA for an Environmental Permit to implement the RMP. For over six years after receiving the permit, the ESMF was not implemented and, therefore, required an update to make the ESMF current, responsive and

acceptable for renewal of the environmental permit, by addressing some significant changes that have occurred. Some of the changes include:

- New corridors now introduced to the RMP,
- New policies and legal frameworks now applicable, e.g.
 - Electrical and Electronic Waste Control and Management Act, 2016 (Act 917); and
 - Hazardous, Electronic and Other Wastes (Classification), Control and Management Regulations, 2016 (LI 2250);
 - National Policy on Public Private Partnerships for consistency with the strong private sector involvement for the railway sector development;
- Other changes include:
 - Economic characteristics updates;
 - Ghana Landfill Guidelines to address old railway buildings, Asbestos roofing sheets disposal;
 - The Local Governance Act, 2016 (Act 936);
 - Land Use and Spatial Planning Act, 2016 (Act 925);
 - Riparian Buffer Zone Policy (2011);
- The sector's institutional oversight now residing at the Ministry of Railways Development;
- New additional key stakeholders

A railway market survey (see next Chapter 6) was also conducted in March/April 2019 to ascertain the needs of the market, the market size and competition with other modes of transportation, willingness to pay and the level of interest of actual and potential patrons of the planned developments under the RMP, among others. The results showed that rail service is patronized by people from various backgrounds - formal workers, artisans, students, market women, etc. Trains ranked favourably to private car, taxi and trotro/bus in terms of their use as a primary means of transportation, saving travel time, increasing safety, comfort and flexibility.

5.1.3 STAKEHOLDER INVOLVEMENT

Institutions/organisations relating to railway project (environmental) approvals, planning, road crossings, interference with utility provision and service lines and natural resource management in the corridor selection were mapped out for consultation. These included the following:

- Environmental Protection Agency;
- Metropolitan, Municipal and District Assemblies;
- Department of Urban Roads;
- Ghana Highway Authority;
- Department of Feeder Roads;
- Forest Services Division of the Forestry Commission;
- Water Resources Commission;
- Electricity Company of Ghana;

- Ghana Water Company Limited;
- Volta River Authority;
- National Communications Authority;
- Ministry of Environment, Science, Technology and Innovation;
- Ghana Chamber of Telecommunications/Vodafone Ghana Limited; and
- Bulk Oil Storage and Transportation Company.

5.1.4 **POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS**

The environmental and social (E&S) impacts and risks section presents the following four main significant components of the ESMF:

1. Criteria for screening the specific projects to be implemented under the RMP;
2. Methodology for assessing and ranking RMP project impacts and risks;
3. Generic E&S beneficial and adverse impacts of the RMP; and
4. Assessment of the potential E&S impacts on the individual (RMP) project implementation phase.

The ESMF provides a listing of environmental and social concerns common to rail infrastructure construction and their potential degree of significance. Out of twenty-four potential concerns presented, a stakeholder participatory review identified the most common and significant potential impacts in rail infrastructure development to include dust emission, noise and vibration, occupational/public accident, forestry concerns and waste disposal. Four of the concerns identified as most significant (dust, noise and vibration, accident and waste) also fell within the first six common rail infrastructure development impacts.

With respect to the rail (transport) operation phase, the stakeholder participatory review identified level crossing accidents, train accidents, noise and vibration, and lack of track maintenance as the most common and significant issues to consider during assessment of the impacts of projects. From the stakeholder responses, four out of the six most common issues were also deemed to be significant.

The main adverse potential impacts of rail projects identified and assessed to apply to the RMP projects included:

1. Land acquisition and property loss;
2. Potential train accident risk;
3. Public health and safety risk;
4. Occupational health and safety impacts;
5. Asbestos roofing sheets removal and disposal risks;
6. Risk of spread of HIV/AIDS;
7. Water resource impacts;
8. Noise and vibration impacts;
9. Impacts on cultural resources;
10. Habitat destruction and disruption;
11. Waste disposal impacts;

12. Potential human rights abuse and gender disparity;
13. Traffic disruption and diversion impacts; and
14. Utility disruption.

5.1.5 ENVIRONMENTAL AND SOCIAL SAFEGUARDS AND MITIGATION PRINCIPLES

The ESMF offers safeguard options and other mitigation principles for preventing, minimizing, compensating or managing various environmental and social impacts, as an integral part of rail project design and planning, or for implementation at the construction or operation phase. The highlights of the environmental and social mitigation plan include the following:

- Enhancing beneficial aspects of railway services by incorporating recommendations from the market survey results in design or construction or operational stages;
- Resettlement and compensation measures for land-take (acquisition) and property losses;
- Train safety principles to prevent or minimize potential accidents through training and by enforcing requisite safety and maintenance protocols, with supervision;
- Public health and safety principles to safeguard the public or passengers and pedestrians against project related or induced risks and hazards;
- Occupational health and safety principles to prevent work-related accidents and other health risk exposures;
- Workplace HIV/AIDS policy and sensitisation programme;
- Water resource protection principles to prevent, minimize or manage impacts on water bodies and quality from railway projects;
- Noise and vibration control principles by raising worker awareness and adherence to relevant operational standards, with supervision, while enforcing corridor reservation;
- Cultural resources preservation principles by designing and aligning permanent ways to avoid culturally sensitive sites;
- Habitat protection principles by identifying ecologically sensitive sites and instituting habitat and biodiversity preservation measures, where avoidance is not possible;
- Waste disposal and management principles to ensure awareness and sound handling of generated waste during rehabilitation, construction and operation phases;
- Traffic avoidance and safety principles to control potential congestion and accidents due to construction or rehabilitation activities interfering with road transport; and
- Utility disruption avoidance principles through effective pre-planning and alternative installation or provision of services in advance of the proposed civil works or tampering with affected utility or service lines.

5.1.6 ESMF IMPLEMENTATION AND MANAGEMENT

The ease of implementation of the ESMF and its success depends on the commitment of the railway sector and other key institutions, as well as the capacity within the respective institutions to effectively apply the

framework. The GRDA and MoRD were fully involved in the preparation of the ESMF, as well as the other relevant institutions such as EPA. Though knowledge about this ESMF and its implementation demands are well known, the following have been clearly defined to facilitate its application and ensure effective safeguards implementation for sustainable outcomes:

- GRDA's implementation role of the ESMF;
- Capacity building needs; and
- Institutional arrangements.

The GRDA is the implementing agency of the RMP, under the Ministry of Railways Development (MoRD). Other institutions whose functions influence railway development, corridor selection, acquisition and management, rail-road crossings and project approvals, etc., were grouped into four. These institutions were involved in the assessment processes to define their respective interests, in line with agreed procedures to be followed in the implementation of the RMP projects. These included the following:

Lead environmental regulator and the planning authorities:

Environmental Protection Agency (EPA); and

- Metropolitan/Municipal and District Assemblies (Town and Country Planning Department).
- Road sector institutions:
- Department of Urban Roads;
- Ghana Highway Authority;
- Department of Feeder Roads;

Resource management institutions:

- Wildlife Division (WD) of the Forestry Commission;
- Forest Services Division (FSD) of the Forestry Commission;
- Lands Commission;
- Water Resources Commission (WRC)

Utility and service providing (pipeline, electricity lines and telecommunications) companies:

- Electricity Company of Ghana (ECG);
- Ghana Water Company Limited (GWCL);
- Ghana Chamber of Telecommunications (GCT);
- Vodafone Ghana Limited;
- National Communications Authority; and
- Bulk Oil Storage & Transportation Company (BOST).

The Environment and Health Department (EHD) of GRDA will be involved at all stages of project planning, rehabilitation or decommissioning, by initiating the registration and Initial Assessment of proposals with the respective EPA (Regional) Office. The functions to be performed by EHD have been specified both at the environmental and social assessment and the management phases. The collaborative and supervisory role

of the Site Engineer during construction phases has also been defined, and relevant environmental and social clauses for the Contractor provided.

Capacity building needs for the EHD to enable regular application of relevant tools and EA procedures in their normal functions have been determined. The capacity enhancement programme will among others, cover the three distinct tools developed in the ESMF below. These include the Railway Sector-Specific:

- Sensitivity Screening Criteria;
- Initial Assessment Form; and
- EA Procedures for undertakings under the RMP.

6. RAILWAY MARKET RESEARCH: OUTCOMES FROM A SURVEY

A Railway Market Research was undertaken to provide important information which will help to identify and analyse:

- the needs of the market in the railway sector in Ghana,
- the market size and the competition,
- the level of interest of private citizens/users on the development of the railway network in Ghana and
- the “willingness to pay” (i.e. the most a user will spend for the service).

The Railway Market Research was conducted by Centre for Environment & Health Research & Training (CEHRT), a specialized consulting firm of Ghana.

This market research was achieved by administering a social survey that was carefully put together with the specific purpose of providing thorough information to help better understand the needs and expectations of the current and potential users of the railway network in Ghana.

In the following paragraphs, the main results of this research are presented, however the full research are attached to this report (see Annex 2. Railway Market Survey)

6.1.1 *METHODOLOGY*

The survey was conducted in eight (8) urban areas in Ghana namely:

- Accra,
- Tema,
- Nsawam,
- Sekondi-Takoradi,
- Kumasi,
- Sunyani,
- Tamale and
- Paga.

These towns were grouped, according to specific characteristics of the urban area, as follows:

- urban areas where the railway services currently are operational:
 - Tema, Accra and Sekondi-Takoradi;
- urban areas where the railway infrastructure exists but not currently operational
 - Nsawam and Kumasi; and
- urban areas where the infrastructure is non-existent and therefore never been operational
 - Paga and Tamale.

The sample size of each of the town is presented in Table 6-1 below. The respondents were chosen based on the proximity to railway infrastructure (about 500m radius from railway infrastructure). Where railway infrastructure is non-existent and therefore never been operational (Paga and Tamale), the survey was conducted in the central business area.

Town	Sample Size	Town	Sample Size
Accra	100	Nsawam	50
Tema	50	Sekondi-Takoradi	50
Kumasi	100	Tamale	50
Sunyani	50	Paga	50

Table 6-1. Sample size of the Railway Market Research

Three groups of respondents were purposively targeted;

- those who currently use the service,
- those who have ever used the service and
- potential users.

6.1.2 RESULTS

The general results obtained have given an extremely positive outlook on the possibility of expanding and modernizing the railway system and improving rail services in Ghana.

6.1.2.1 Means of transportation and their perceived advantages

Considering that only 3 surveyed locations currently have the rail service operational, trotro and bus undoubtedly results the primary means of intra and inter city transportation respectively in Ghana, recording the highest percentage of 43%. (see Figure 6-1 below).

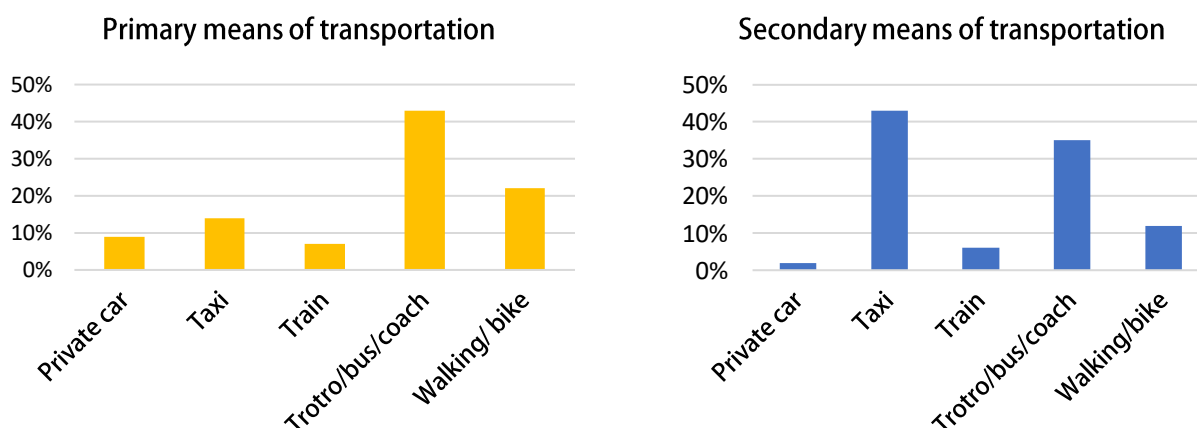


Figure 6-1. Most used means of transportation

The train expectedly results the least means of primary transportation due to its limited current services, and being the rail user only the 15% of the respondents.

However, analyzing the results on the advantages of the various means of transport, it emerges that the expansion of the railway service in the country is desired by the travellers. The advantages of the various means of transport included:

- Travel cost;
- Travel time;
- Safety;
- Comfort; and
- Flexibility.

Current railway users have a favourable opinion of the services provided and their benefits, and potential customers seem to be open to all the advantages they associate with railway travel.

Trains are perceived to be not only among the fastest means of transportations, but also among the safest, coming right behind private cars and taxis. (see Figure 6-2)

Unlike trains, cars and taxis are negatively impacted by the very relevant disadvantage of being also the most expensive ways to travel.

Trains are also considered to be comfortable, almost as much as the more expensive private cars and taxis and more comfortable and faster than moving by trotro/bus. (see Figure 6-2)

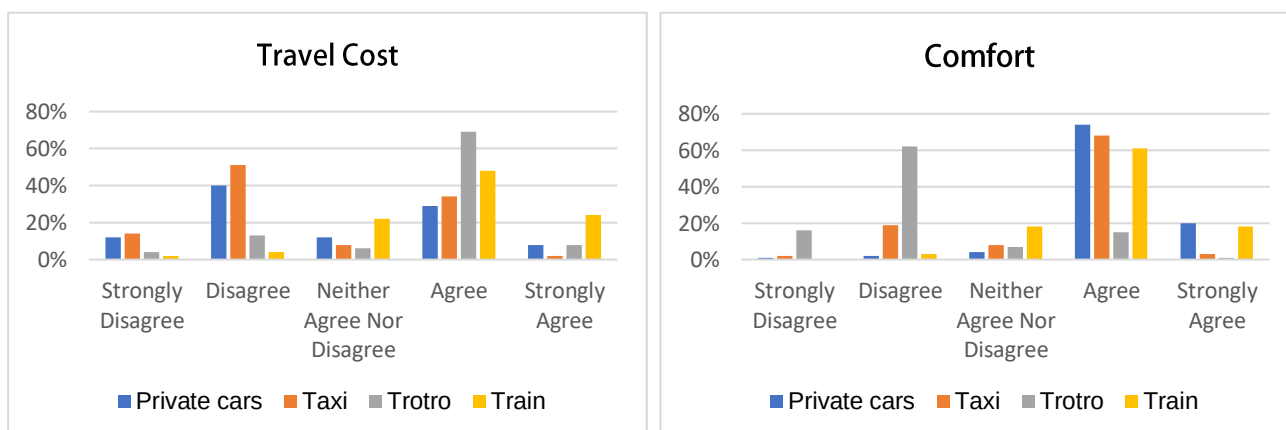


Figure 6-2. Advantages in travel cost and comfort of various means of transportation

6.1.2.2 Perceived effects of the development of the new railway network

Utterior encouraging results regard the answers given by respondents living in areas not yet serviced by the railway network. In these cities (Sunyani, Tamale and Paga) the surveyed population agrees that there would be many benefits associated with the development of the railway service.

According to potential users, the most important improvements that would be brought on by this railway expansion, include a boost to trade, tourism and local economy (99% of interviewees), the growth of

employment opportunities (98% of interviewees), the enhancement of socio-cultural integration (92% of interviewees), the reduction of transportation times (89% of interviewees), the enhancement of quality of community life (87%), the reduction of transportation cost and traffic congestion on roads (82% of respondents). The following Figure 6-3 shows the main effects of the railway expansions, according to interviewees.

Only a small percentage of the respondents didn't discern specific benefits associated with a railway expansion (30% of interviewees).

This single negative aspect is, however, far outweighed by the numerous opportunities that an expansion of the railway network would bring to these currently not serviced areas of Ghana.



Figure 6-3. Main effects of new Railway Infrastructure

6.1.2.3 Improvements of the railway service

Respondents in areas where the rail service is currently (Accra, Tema and Sekondi-Takoradi) and where it was previously (Kumasi and Nsawam) gave their perceptions on how the rail services can be improved.

Respondents were in agreement on what are considered to be the most important aspects for a good railway service, which include frequency of trains and connections with other public transports, punctuality/reliability, security on both trains and platforms, and cleanliness/good maintenance of the trains.

6.1.2.4 Willingness to pay for the rail service

In comparison to trotro/bus, the trend is to pay 'something less'. These responses may have been influenced by the cost of travelling by bus which generally is moderately high for the average income earner. This expectation of paying something less to travel on a train is very significant if the percentage of those who specifically said 'half or less' of the cost of trotro/bus is added to those who said 'something less'. Thus it is expected costs of travelling by train should be significantly less than that of trotro/bus. These results are shown in the Figure 6-4 below.

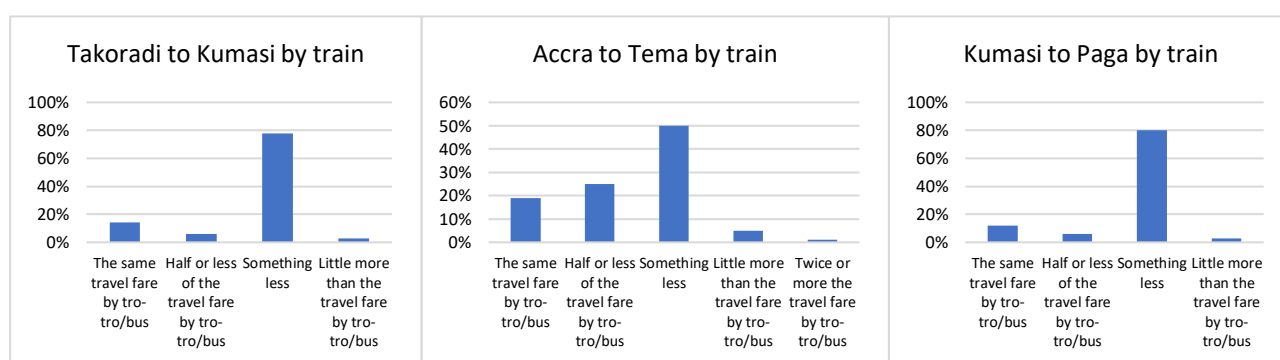


Figure 6-4. Willingness to pay in comparison to trotro and bus fares

However, when specific costs were put on the travel distance, except for the cost of GH¢100 for Kumasi to Paga where 8% more respondents said 'No' than those who said 'Yes', the other scenarios were either equally divided or were willing to travel at that cost. This is illustrated by the graphs in the following Figure 6-5 and Figure 6-6.

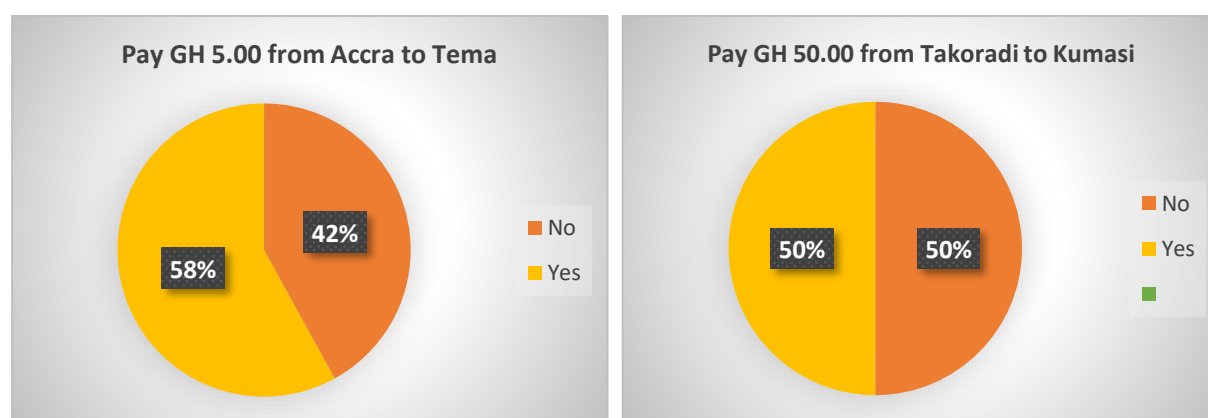


Figure 6-5. Willingness to pay a specific fare for rail services: Accra-Tema and Takoradi -Kumasi

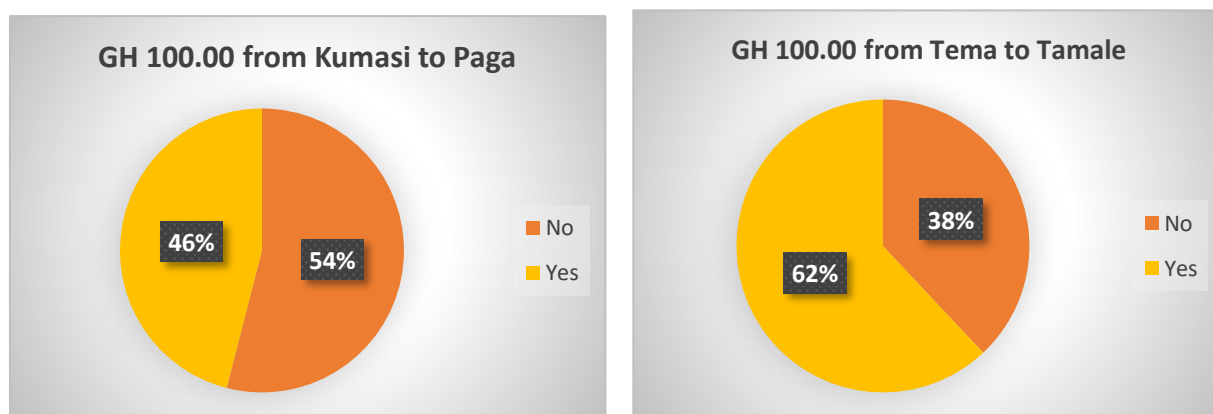


Figure 6-6. Willingness to pay a specific fare for rail services: Kumasi-Paga and Tema-Tamale

In case of a long distance trip (Tema to Tamale), the perceived advantage of travelling by train, and therefore the willingness to pay to use this means of transport, is higher (the majority of interviewees were willing to pay the proposed fare).

Generally speaking, the unwillingness to pay more for railway travel that has emerged in the survey was, in large part, due to the scarce first-hand experience that the interviewees had of this mean of transportation.

However, this seems to be a non-issue, as, in time, it will solve itself as more and more people experience the reality of travelling by train. This process could also be supported by an appropriate awareness campaign that could change people's perception on railway travel.

7. FINANCIAL ANALYSIS

7.1 GENERAL CONSIDERATIONS

The Financial Analysis examines the financial investment, operating expenses and the operative revenues of the total of the 3 Phases of the new Railway Master Plan, according to the priority programme derived from the Economic Analysis (see Chapter 4).

The analysis is conducted from the public sector point of view and includes the investment costs for infrastructure and rolling stock, the maintenance and operative (O&M) costs and the revenues coming from tariffs of transport services (freight and passengers) and the track access charges (TACs).

The financial analysis is conducted over a long period (**2022 – 2059**), thus providing the scenario with 30 years analysis starting from the beginning of the operations of the first phase to be implemented (Phase1 A-B-C). This will generate an overall scenario of 38 years, which foresees initial capital investment and a standard maintenance programme for the infrastructure, before the implementation of a new modernization programme.

In the basic scenario, infrastructure and rolling stock investment expenses (see Par. 4.4.3 and Par. 4.4.4) are supposed to be covered by the public sector through taxpayers revenues. This scenario was tested under this assumption because it is similar to the one of a third party investor bringing private equity into the project. The aim of the analysis was, in fact, to capture the pure financial attractiveness of the investment scenario for potential external investors, whereas the decision-making process for the Public Sector is based, instead, on the Cost-Benefit Analysis.

The methodology used is based on the **Discounted Cash Flow (DCF) method**, where the following main rules are adopted:

- ✓ only cash inflows and outflows are considered in the Analysis, all items that do not correspond to actual flows are disregarded;
- ✓ an appropriate **discount rate** is adopted in order to calculate the present value of the future cash flows; it reflects the opportunity cost of capital;
- ✓ Project cash-flow forecasts cover a period appropriate to the Project's economically useful life and its likely long term impacts. The number of years for which forecasts are provided correspond to the Project's time horizon;
- ✓ the Analysis is carried out with constant (real) prices, i.e. with prices fixed at a base-year. The use of current (nominal) prices [i.e. prices adjusted by the Consumer Price Index (CPI)] would involve a forecast of CPI that does not seem necessary for the scope of the analysis. If applied, inflation effect should then be offset by the discount factor, so the exercise would only bring unnecessary distortions to the nominal values represented;
- ✓ the Analysis is carried out net of VAT, both on purchase (cost) and sales (revenues), because this is recoverable by the project promoter;
- ✓ the residual financial value of the Project is considered to be the last year of economic life.

7.2 FINANCIAL APPROACH AND METHODOLOGY

In the Financial Analysis, when all costs and incomes have been valued, a decision has to be taken on the Project's viability and performance.

A number of decision rules that can be applied within a financial or cost-benefit framework have been developed. The financial indicators that are commonly seen as useful for assessing viability and profitability of railway investments, are the following:

- ✓ **Financial Net Present Value (F-NPV):** the difference between the discounted revenues and the discounted costs. The F-NPV is expressed in monetary terms (US\$);
- ✓ **Financial Internal Rate of Return (F-IRR):** the rate that produces a zero value for the FNPV

The formula of the Financial Net Present Value is defined as follows.

$$FNPV = \sum_{k=0}^N \frac{C_k}{(1+i)^k}$$

where:

C_k = net cash flow at k-year

i = discount rate

N = number of years of the investment

The discount rate allows to transfer the cash flows at time zero, reflecting both the time value of money and the risk (procedure for discounting the cash flows).

The estimate of the value attributable to the discount rate takes into account the cost of capital and the systematic risk of the investment industry WACC (Weighted Average Cost of Capital).

An investment is recommended if the **FNPV** is **positive**.

The **Financial Internal Rate of Return** is defined as the discount rate that produces FNPV equal to zero:

$$FNPV = \sum_{k=0}^N \frac{C_k}{(1+FIRR)^k} = 0$$

In other terms, if F-NPV is equal to zero, this means that the cash profile of the project initiative is exactly consistent with the expected remuneration of the investor (F-IRR). By contrast, values above or below zero would imply an over performance or an under performance, respectively, of the project versus the expectation of the investor.

The FIRR is a pure number, and is scale-invariant. The Investment should be considered suitable if it generates a specific value of FIRR.

7.3 ASSUMPTIONS ON TARIFFS

Earnings from the Railway investment mainly include transport revenue from cargo transport, passenger transport, recovery of residual value of fixed assets for infrastructure and rolling stock, recovery of liquidity, non-operating income, and toll payments of other users of the railway line.

Transport revenue includes passenger ticket revenue, and freight revenue from fares. The method for calculating revenues is based on unit prices of tariffs and fares, and on the assessment of relevant passenger and freight volumes (as described in previous Par. 3.2).

Fare setting and pricing of freight rates does not depend only on the ownership of the railway company, as international experience shows.

In most countries, the fare setting process was originally designed to maintain a balance between the financial requirements of railways and broader public interests such as affordability, service, safety and a clean environment. In principle, the fare setting process seeks to minimize the need for subsidies by ensuring railways can generate sufficient profits to recover their operating costs and to undertake capital intensive projects.

In public transportation, fares are based internationally on the following key principles:

- Fares must be realistic and regularly revised to account for justifiable cost increases;
- Fares must at least be able to recover the direct operating costs necessary to deliver transport services;
- Fare revenue must be adequate to recover depreciation and asset replacement costs;
- Market and competitive forces should be used to stimulate operating efficiency and higher service levels.

In comparison to passenger fares, freight rates depend on the cost rates of the direct competitors, mainly trucks.

Fares and tariffs values have been determined, starting from the current ones declared by GRCL and reported in the following

Table 7-1 and Table 7-2.

YEAR	FREIGHT (tons)	REVENUES (GH¢)	GH¢/tons
2015	495,033	10,230,879.64	20.67 GHS
2016	641,916	14,154,017.45	22.05 GHS
2017	630,366	15,669,580.71	24.86 GHS
Average	589,105	13,351,492.60	22.52 GHS
Average per ton			US\$ 5.52
Average per ton-km			US\$ 0.084

Table 7-1. Railway freight traffic and revenues for 2015, 2016 and 2017 in Ghana.
Source: Consultant's elaboration from declaration by GRCL during the consultation meeting.

FREIGHT per ton	PASSENGER per person
US\$ 5.95	GH¢2.00

Table 7-2. Current Tariffs and Fares for rail users in Ghana.
Source: Consultant's elaboration from declaration by GRCL during the consultation meeting.

The fares and tariffs values adopted in the Financial Analysis are shown in Table 7-3 below. Considering that the level of the service will be higher than the current service, the fare value could be further raised.

TARIFFS AND FARES			
FREIGHT	(ton-km)	0.084	US\$
PASSENGER	(pax-km)	0.041	US\$

Table 7-3. Fares and tariffs values adopted in the Financial Analysis.

7.4 USE OF THE INFRASTRUCTURE (DEPRECIATION)

The cost of investments is accounted as depreciation, which generates an annual cost on Profit & Loss Statement. According to international practice, we have considered the following assumptions:

- for Infrastructure: average economic life equal to 75 years, corresponding to depreciation of **1.33%** per year
- for Rolling Stock: average economic life equal to 33 years, corresponding to depreciation of **3%** per year

Conversely, the residual value of the assets produced by the investment at the end of the operating period depends on the remaining functionality of the project components. It will usually be positive if the Rolling Stock can still run without major problems and the infrastructure and superstructure are still operational.

In terms of a Financial Analysis however, the residual value is calculated as the non-depreciated part of the asset.

7.5 OPERATING AND MAINTENANCE (O&M) COSTS

The costs in the Financial Analysis of railway projects generally include total investment, railway operating cost, maintenance cost, cost of financing and tax payable by law.

Operating costs (Opex) are those associated with operating a railway service. They are usually referred to one year of service and can be aggregated in many different ways. According to international experience, the proposed approach includes the following components: traction, maintenance of Rolling Stock, salary for driving crew and on-board crew, as follows:

$$C_{op} = C_{tr} + C_{man} + C_{sal}$$

Traction (C_{tr}) and maintenance (C_{man}) costs are related to the number of train-km, defined as the product of the number of runs (round-trip) and the total length of the line; salary cost (C_{sal}) is related to the amount of employees. (see also Par. 4.4.1)

In the Financial Analysis, the maintenance and operation costs have been considered on the basis of an average cost of **36,957 US\$/km per year**.

7.6 FINANCIAL INVESTMENTS AND REQUIREMENTS

The projected Financial Investments for the Railway Master Plan are shown below, articulated between Infrastructure investments and Rolling Stock investments.

Model Year	YEAR	PHASE 1(A+B)	PHASE 1C	PHASE 2	PHASE 3	ALL PHASES
1	2022	1,549.4	255.8	-	-	1,805.1
2	2023	1,549.4	255.8	-	-	1,805.1
3	2024	1,549.4	255.8	-	-	1,805.1
4	2025	1,549.4	255.8	-	-	1,805.1
5	2026	1,549.4	255.8	-	-	1,805.1
6	2027	-	255.8	508.1	378.1	1,142.0
7	2028	-	255.8	508.1	378.1	1,142.0
8	2029	-	255.8	508.1	378.1	1,142.0
9	2030	-	255.8	508.1	378.1	1,142.0
10	2031	-	-	508.1	1,191.1	1,699.1
11	2032	-	-	508.1	1,191.1	1,699.1
12	2033	-	-	-	1,191.1	1,191.1
13	2034	-	-	-	1,191.1	1,191.1
14	2035	-	-	-	1,191.1	1,191.1
15	2036	-	-	-	-	-
16	2037	-	-	-	-	-
17	2038	-	-	-	-	-
18	2039	-	-	-	-	-
19	2040	-	-	-	-	-
20	2041	-	-	-	-	-
21	2042	-	-	-	-	-
22	2043	-	-	-	-	-
23	2044	-	-	-	-	-
24	2045	-	-	-	-	-
25	2046	-	-	-	-	-
26	2047	-	-	-	-	-
27	2048	-	-	-	-	-
28	2049	-	-	-	-	-
29	2050	-	-	-	-	-
30	2051	-	-	-	-	-
31	2052	-	-	-	-	-
32	2053	-	-	-	-	-
33	2054	-	-	-	-	-
34	2055	-	-	-	-	-
35	2056	-	-	-	-	-
36	2057	-	-	-	-	-
37	2058	-	-	-	-	-
38	2059	-	-	-	-	-
TOTAL		7,746.9	2,301.8	3,048.5	7,467.9	20,565.1

Table 7-4. Financial Investments for Railway Infrastructure.

Model Year	YEAR	PHASE 1(A+B)	PHASE 1C	PHASE 2	PHASE 3	ALL PHASES
1	2022	-	-	-	-	-
2	2023	-	-	-	-	-
3	2024	Implementation Plan				-
4	2025	-	-	-	-	-
5	2026	148.2	-	-	-	148.2
6	2027	148.2	-	-	-	148.2
7	2028	-	-	-	-	-
8	2029	-	-	-	-	-
9	2030	-	71.6	-	-	71.6
10	2031	-	71.6	-	-	71.6
11	2032	-	-	96.3	-	96.3
12	2033	-	-	96.3	-	96.3
13	2034	14.7	6.7	-	-	21.4
14	2035	14.7	6.7	15.2	38.3	74.9
15	2036	-	-	15.2	38.3	53.5
16	2037	30.5	8.3	44.4	13.9	97.1
17	2038	30.5	8.3	-	-	38.8
18	2039	-	-	-	-	-
19	2040	Up-grading of transport capacity				-
20	2041	-	3.3	-	-	3.3
21	2042	-	3.3	-	-	3.3
22	2043	-	-	13.9	-	13.9
23	2044	-	-	13.9	59.1	73.0
24	2045	-	-	-	59.1	59.1
25	2046	-	-	-	-	-
26	2047	-	3.4	4.7	-	8.1
27	2048	-	3.4	4.7	-	8.1
28	2049	14.7	-	-	-	14.7
29	2050	14.7	-	13.9	-	28.6
30	2051	-	-	13.9	-	13.9
31	2052	-	-	-	-	-
32	2053	-	21.9	-	29.2	51.1
33	2054	29.2	21.9	-	29.2	80.3
34	2055	29.2	-	-	-	29.2
35	2056	-	-	15.2	-	15.2
36	2057	-	-	15.2	-	15.2
37	2058	-	4.7	-	-	4.7
38	2059	-	4.7	-	-	4.7
TOTAL		474.5	239.7	363.1	267.0	1,344.2

Table 7-5. Financial Investments for Rolling Stock Equipment.

The financial impact of the proposed investments was assessed through the use of a specific model. As an indicative overall evaluation, the implementation of the Master Plan was assessed considering the financial perspective of a single entity responsible for the realization of both the infrastructure program and the transport services operations. This single entity cannot be other than the Government of Ghana, through their Ministry of Railways Development, Ghana Railway Development Authority and Ghana Railway Company Limited. This scenario, albeit being the traditional one (and still very common in most countries), provides evidence of the potential profitability of the railway business as a whole (when run by an efficient entity), before conceiving alternative arrangements involving other parties.

In this regard, in order to identify the overall financial profile of the Master Plan, the following additional assumptions were adopted in the model:

- Financing: in the Basic Scenario, 100% will be directly financed by the Government, with no recur to debt; a sensitivity was also carried out with possible recur to debt under various compositions of debt/equity ratios;
- Debt conditions (when applicable): a 15-year term with an average 7% interest rate, under the assumption that the Government may also enjoy more favourable conditions than the current GoG EuroBonds (set at around 8% interest rate), by resorting to other cheaper forms of financing (e.g.: concessionary loans from foreign partners);
- Corporate income tax, for the company involved in the investment and operations, at 25%;
- Discount rate at 8%.

7.7 MAIN OUTCOMES OF THE FINANCIAL ANALYSIS

With the assumptions described in the previous paragraphs, the model generated a financial profile of each stand-alone new Phase of the network development, plus the combined (cumulated) effect of the progressive deployment of the various Phases. Finally, the financial profile of the entire Railway System (inclusive of Phase 0, corresponding to on-going activities on the Western and Eastern Lines) is also represented.

The table below summarises all the key figures.

Financial Analysis - RESULTS							
		Phase 0	Phase 1 (A+B)	Phase 1 C	Phase 2	Phase 3	ALL PHASES
Single	NPV (Million US\$)	"Do Nothing" Scenario	- 4,294	- 734	- 1,053	- 2,923	- 8,911
	FIRR		2.4%	4.8%	2.8%	-0.4%	2.1%
Combined (Cumulated)	NPV (Million US\$)	"Do Nothing" Scenario	- 4,294	- 5,012	- 6,046	- 8,911	
	FIRR		2.4%	3.0%	3.0%	2.1%	

Table 7-6. Railway Master Plan – Outcome of the Financial Analysis

The outcome of the Financial Analysis leads to the following considerations:

- The Overall Financial Internal Rate of Return is quite low (2.1%), however it is consistent with international benchmarks of other railway infrastructures. It is worthwhile recalling that the correct approach to the decision making process from the Public perspective is the Cost Benefit analysis, which, in fact, generates interesting returns for this Master Plan.
- The Net Present Value is negative (MUS\$ -8,911), this because the expected remuneration of the potential investor (the discount rate, set in this analysis at 8%) is not met by a FIRR of 2.1%.
- Phases 1-3 represent railway corridors with distinct financial profiles: in particular, Phase 1 and Phase 2 show more interesting returns (from a minimum of 2.4% up to 4.8%), however still not fully attractive to a private investor as sole investor for these projects.

It is also important to note that, as shown in the following figures, the greatest volume of revenues (and the positive net cash flow) is only generated in the second half of the project scenario. However, the present value of such positive flows is considerably lower, due to the strong discount applied to financial flows that will occur in the future.

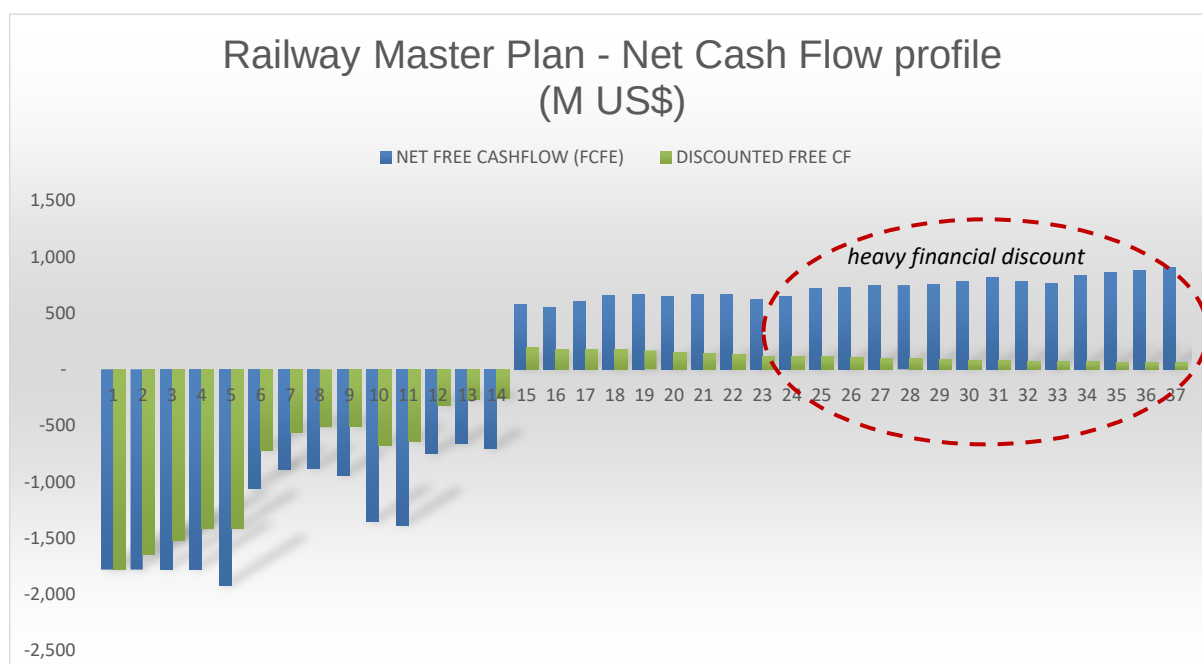


Figure 7-1. Cash Flow profile of Railway MP

As a matter of fact, the operating profit from operations (before deduction of financial interests) is positive from the 6th year (see Figure 7-2). Railways are very capital-intensive projects with huge upfront disbursements: this means that, if equity is not sufficient to cover the project financing needs, recur to debt will generate an important burden of financial interests to be paid. In Figure 7-2, it is clear how cost of debt may offset the same profitability from operations. In the Master Plan financial projection exercise carried out, this trend only inverts starting from the 18th year onwards, when profit (before tax computation) is generated. These observations suggest that a private investor will be reluctant to recur to debt, especially when that means introducing an extra economic burden (financial interests) into a business characterized by low financial profitability.

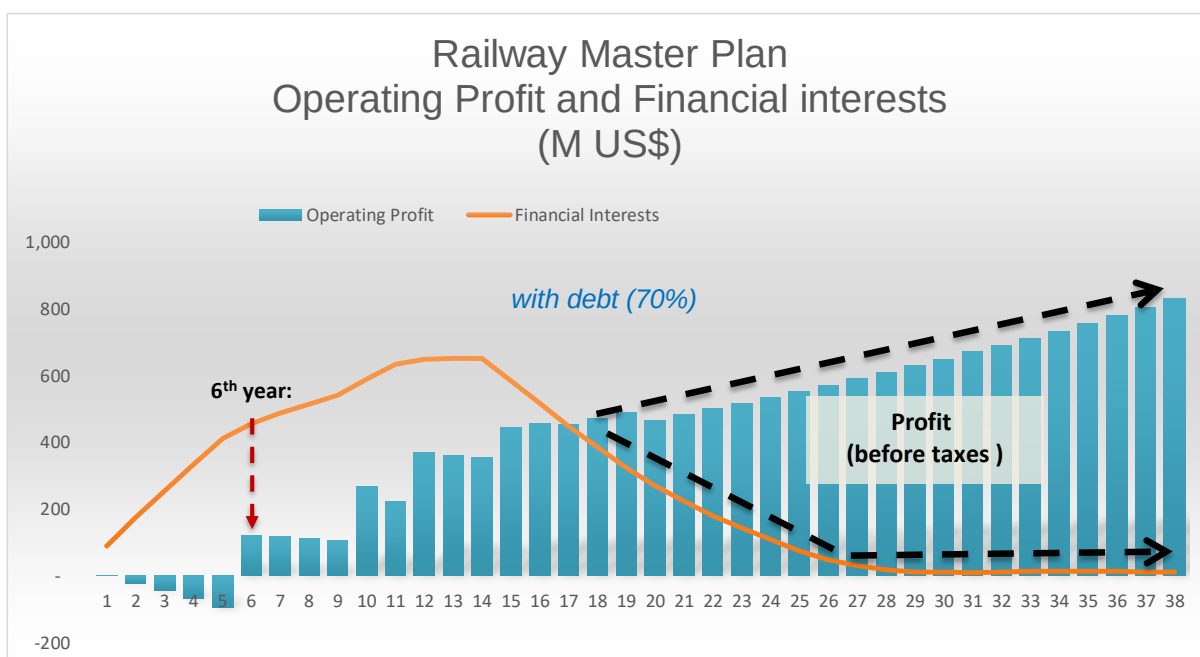
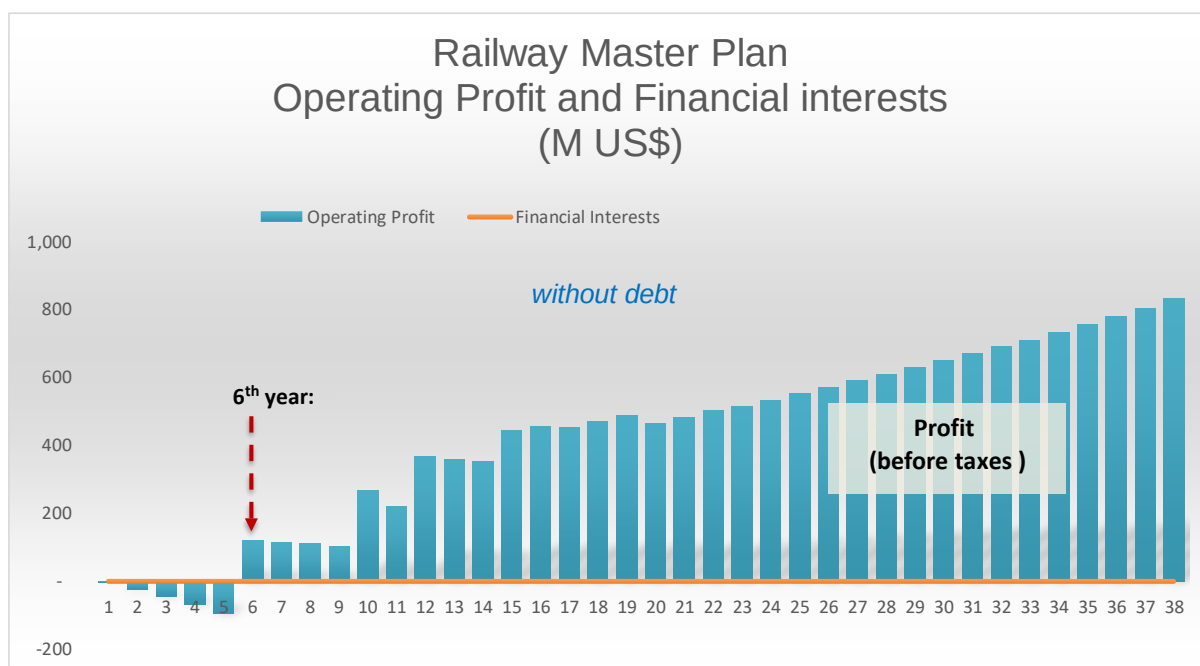


Figure 7-2. Operating Profit and Financial Interests

However, a simulation with different financial structures (% Debt) was carried out to better appreciate the above conclusion. In fact, the basic scenario (with no debt) is the scenario associated with the best Financial IRR. In the assumption of full financial coverage through Debt (Debt=100%), Financial IRR would be negative (-0.12%, with Interest Rate=7%).

		% Debt										
Interest Rate (Debt)	2.1%	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	9.0%	2.10%	1.87%	1.61%	1.33%	1.03%	0.71%	0.39%	0.06%	-0.27%	-0.60%	-0.92%
	8.5%	2.10%	1.89%	1.65%	1.40%	1.11%	0.82%	0.52%	0.21%	-0.10%	-0.41%	-0.73%
	8.0%	2.10%	1.91%	1.69%	1.46%	1.20%	0.93%	0.65%	0.36%	0.06%	-0.23%	-0.53%
	7.5%	2.10%	1.92%	1.73%	1.52%	1.29%	1.04%	0.78%	0.51%	0.23%	-0.04%	-0.33%
	7.0%	2.10%	1.94%	1.77%	1.58%	1.37%	1.14%	0.91%	0.66%	0.41%	0.15%	-0.12%
	6.5%	2.10%	1.96%	1.81%	1.64%	1.45%	1.25%	1.04%	0.81%	0.58%	0.34%	0.09%
	6.0%	2.10%	1.98%	1.85%	1.70%	1.54%	1.36%	1.17%	0.97%	0.76%	0.54%	0.31%
	5.5%	2.10%	2.00%	1.88%	1.76%	1.62%	1.46%	1.30%	1.12%	0.93%	0.74%	0.53%
	5.0%	2.10%	2.01%	1.92%	1.81%	1.69%	1.57%	1.43%	1.27%	1.11%	0.94%	0.76%

Figure 7-3. Financial IRR according to different compositions of Debt and Interest Rate cost

Nevertheless, it is important to note that low overall financial returns do not necessarily exclude the private sector from the picture, as a private party can provide an important support, both from the operational and financial side, once the most suitable and appropriate investment areas are identified.

It must be recalled that in the last few years the Government has laid the ground for numerous initiatives aimed at stimulating private involvement in the railway business. This to promote efficiency, coupled with possible capital funding, especially in the line operations, which traditionally is the area where private operators enter the market. In this case, a private party will mainly invest in rolling stock equipment.

In this regard, tailored business cases have been recently implemented in Ghana to establish the specific profitability profiles of different railway lines. These feasibility studies, supported by transaction advisory expertise, will help define the financial conditions to be proposed and negotiated with the candidate concessionaires.

For easy reference, Income Statement and Cash Flow Statement for the Railway Master Plan project are attached below, with evidence to the key figures.

Railway Master Plan:

Schematic Income Statement (Railway Owner/Operator) - USD m

PHASE 0										PHASE 1 (A+B)					PHASE 1C					PHASE 2					PHASE 3					ALL PHASES									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22																		
2022	2023	2024	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043																	
REVENUES																																							
Freight	16	17	18	18	19	204	213	222	232	404	420	513	519	525	599	611	623	635	648	661	674	688																	
Passenger	11	12	12	12	12	103	105	107	109	142	145	241	246	250	304	309	314	320	325	331	337	343																	
Total Revenues	27	28	29	30	32	306	318	329	341	546	565	754	765	775	902	919	937	955	973	992	1,011	1,031																	
R.S. O&M EXPENSES																																							
Freight	1	1	1	1	1	10	11	11	12	21	21	26	27	27	31	31	32	32	33	34	35																		
Passenger	2	2	2	2	2	16	16	17	17	22	22	37	38	39	47	48	49	49	50	51	52	53																	
Total R.S. O&M Expenses	3	3	3	3	3	26	27	28	29	43	44	64	65	66	78	79	80	82	83	85	87	88																	
LINE O&M EXPENSES																																							
Maintenance Costs	1	1	1	1	1	16	16	16	16	19	58	62	62	62	84	84	101	101	101	140	140																		
Total Line O&M Expenses	1	1	1	1	1	16	16	16	16	19	58	62	62	62	84	84	101	101	101	140	140																		
DEPRN & AMORTIZATION																																							
Line	24	48	72	96	120	136	151	166	181	204	227	242	258	274	274	274	274	274	274	274	274	274																	
Rolling Stock	-	-	-	-	4	9	9	9	11	13	16	19	20	22	23	26	28	28	28	28	28	28																	
Total Depreciation	24	48	72	96	125	144	160	175	192	217	243	261	278	296	298	301	302	302	302	302	302	302																	
EBIT (NET OPERATING PROFIT)	-	1	-	24	-	70	-	97	120	115	111	104	268	221	367	360	352	443	456	454	471	488																	
Interest on CapEx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
Net Income Before Tax	-	1	-	24	-	70	-	97	120	115	111	104	268	221	367	360	352	443	456	454	471	488																	
Income Tax	-	-	-	-	-	30	29	28	26	67	55	92	90	88	111	114	114	118	122	116	121	125																	
NET INCOME	-	1	-	24	-	70	-	97	90	86	83	78	201	166	275	270	264	332	342	341	353	366																	
ALL PHASES																																							
Model Year	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38																							
Year	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059																							
REVENUES																																							
Freight	701	715	730	744	759	774	790	806	822	838	855	872	889	907	925	944																							
Passenger	349	355	361	368	374	381	388	395	401	409	416	423	431	438	446	454																							
Total Revenues	1,050	1,071	1,091	1,112	1,133	1,155	1,177	1,200	1,223	1,247	1,271	1,295	1,320	1,345	1,371	1,398						32,027																	
R.S. O&M EXPENSES																																							
Freight	36	37	37	38	39	40	40	41	42	43	44	45	45	46	47	48																							
Passenger	54	55	56	57	58	59	60	61	62	63	64	65	67	68	69	70																							
Total R.S. O&M Expenses	90	92	93	95	97	99	100	102	104	106	108	110	112	114	116	118						2,723																	
LINE O&M EXPENSES																																							
Operating Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																							
Maintenance Costs	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140																							
Total Line O&M Expenses	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140						3,457																	
DEPRN & AMORTIZATION																																							
Line	274	274	274	274	274	274	274	274	274	274	274	274	274	274	274	274																							
Rolling Stock	30	32	32	32	33	33	34	34	34	36	38	38	38	38	38	38																							
Total Depreciation	305	306	306	307	307	307	308	309	309	310	312	312	312	312	312	312						9,685																	
EBIT (NET OPERATING PROFIT)	516	533	552	571	590	610	629	650	671	691	710	733	756	779	803	831						16,163																	
Interest on CapEx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																							
Net Income Before Tax	516	533	552	571	590	610	629	650	671	691	710	733	756	779	803	831																							
Income Tax	129	133	138	143	148	152	157	162	168	173	178	183	189	195	201	208																							
NET INCOME	387	400	414	428	443	457	472	487	503	518	533	550	567	584	602	624						12,063																	

Railway Master Plan:

Schematic Cash Flow Statement (Railway Owner/Operator) - USD m

	PHASE 0			PHASE 1 (A+B)					PHASE 1C					PHASE 2			PHASE 3				ALL PHASES																							
	1 2022	2 2023	3 2024	4 2025	5 2026	6 2027	7 2028	8 2029	9 2030	10 2031	11 2032	12 2033	13 2034	14 2035	15 2036	16 2037	17 2038	18 2039	19 2040	20 2041	21 2042	22 2043																						
OPERATING ACTIVITIES																																												
	-	1	-	24	-	47	-	70	-	97	-	90	86	83	78	-	201	166	275	270	264	-	332	342	341	353	366	349	362	375														
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-														
	24	48	72	96	125	144	160	175	192	217	243	261	278	296	298	301	302	302	302	302	302	302	302	302	302	302	302	302	302	302														
NET CASH FROM INVESTMENT ACTIVITIES	23	24	25	26	27	234	246	258	270	418	408	537	548	560	630	642	642	655	667	651	664	678																						
INVESTMENT ACTIVITIES																																												
	-	1,805	-	1,805	-	1,905	-	1,805	-	1,953	-	1,290	-	1,142	-	1,142	-	1,214	-	1,771	-	1,795	-	1,287	-	1,212	-	1,266	-	54	-	97	-	39	-	3	-	3	-	14				
NET CASH FROM INVESTMENT ACTIVITIES	-	1,805	-	1,805	-	1,805	-	1,805	-	1,953	-	1,290	-	1,142	-	1,142	-	1,214	-	1,771	-	1,795	-	1,287	-	1,212	-	1,266	-	54	-	97	-	39	-	3	-	3	-	14				
FINANCING ACTIVITIES																																												
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
NET CASH FROM FINANCING ACTIVITIES	-	1,782	-	1,781	-	1,780	-	1,779	-	1,926	-	1,056	-	896	-	884	-	943	-	1,353	-	1,387	-	750	-	664	-	706	-	576	-	545	-	604	-	655	-	667	-	648	-	661	-	664
NET FREE CASHFLOW (FCFE)	-	1,782	-	1,649	-	1,526	-	1,412	-	1,416	-	719	-	565	-	516	-	510	-	677	-	643	-	322	-	264	-	260	-	196	-	172	-	176	-	177	-	167	-	150	-	142	-	132
DISCOUNTED FREE CF	-	1,782	-	3,431	-	4,956	-	6,368	-	7,784	-	8,503	-	9,067	-	9,583	-	10,093	-	10,770	-	11,412	-	11,734	-	11,998	-	12,257	-	12,061	-	11,889	-	11,713	-	11,536	-	11,219	-	11,077	-	10,946		
CUMULATED DISC. FREE CF	-	1,782	-	3,431	-	4,956	-	6,368	-	7,784	-	8,503	-	9,067	-	9,583	-	10,093	-	10,770	-	11,412	-	11,734	-	11,998	-	12,257	-	12,061	-	11,889	-	11,713	-	11,536	-	11,219	-	11,077	-	10,946		

			ALL PHASES																															
	Model Year		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38																
	Year		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059																
OPERATING ACTIVITIES																																		
Net income			387	400	414	428	443	457	472	487	503	518	533	550	567	584	602	624																
	Adjustment for non-cash c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																
Depreciation			305	306	306	307	307	307	308	309	309	310	312	312	312	312	312	308																
NET CASH FROM			692	706	720	735	749	765	780	796	812	828	845	862	879	897	915	932																
OPERATING ACTIVITIES																																		
INVESTMENT ACTIVITIES																																		
CAPEX			-	73	-	-	8	-	15	-	29	-	14	-	51	-	80	-	29	-	15	-	15	-	5	-	12,225							
Terminal Value			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
NET CASH FROM			-	73	-	-	8	-	15	-	29	-	14	-	51	-	80	-	29	-	15	-	15	-	5	-	12,221							
INVESTMENT ACTIVITIES																																		
FINANCING ACTIVITIES																																		
NET CASH FROM FINANCING			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
ACTIVITIES																																		
NET FREE CASHFLOW			619	647	720	727	741	750	751	782	812	777	765	833	864	881	910	13,152																
(FCFE)			114	110	114	106	100	94	87	84	81	72	65	66	63	60	57	763																
DISCOUNTED FREE CF			-	10,832	-	10,722	-	10,608	-	10,502	-	10,402	-	10,308	-	10,221	-	10,137	-	10,056	-	9,985	-	9,919	-	9,854	-	9,791	-	9,731	-	9,674	-	9,611
CUMULATED DISC. FREE CF			-	10,832	-	10,722	-	10,608	-	10,502	-	10,402	-	10,308	-	10,221	-	10,137	-	10,056	-	9,985	-	9,919	-	9,854	-	9,791	-	9,731	-	9,674	-	9,611

FINANCIAL RESULTS

NPV	\$	-8,911
FIRR		2.10%

Table 7-8. Cash Flow Statement (Public Operator)

7.8 SENSITIVITY ANALYSIS

A Sensitivity Test was conducted on the overall F-IRR of all Phases, starting from the 2.10% obtained as a basic scenario, in the dual assumption of attributing progressive, increasing/decreasing factors (in the range up to -25%/+25%) to Revenues and Operating Costs.

The results are summarised in the Table 7-9 which shows a low elasticity of the model to alterations of significant parameters affecting the Project performance, this is mainly due to the compression of margins in the operation activities, considering that this margin should also cover the cost for financing of the infrastructure. As a matter of fact, in the assumption a sole operator is responsible for both infrastructure development and operations, the F-IRR spans from 1.00 % (low bound – pessimistic scenario) to 3.12% (upper bound – optimistic scenario).

Revenues (Traffic/Tariff combined effect)												
Operating Costs	2.1%	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25
	1.25	1.00%	1.21%	1.42%	1.62%	1.82%	2.02%	2.21%	2.40%	2.59%	2.78%	2.97%
	1.20	1.02%	1.23%	1.43%	1.64%	1.84%	2.03%	2.23%	2.42%	2.61%	2.80%	2.98%
	1.15	1.04%	1.25%	1.45%	1.65%	1.85%	2.05%	2.25%	2.44%	2.63%	2.81%	3.00%
	1.10	1.06%	1.26%	1.47%	1.67%	1.87%	2.07%	2.26%	2.45%	2.64%	2.83%	3.01%
	1.05	1.07%	1.28%	1.49%	1.69%	1.89%	2.08%	2.28%	2.47%	2.66%	2.85%	3.03%
	1.00	1.09%	1.30%	1.50%	1.71%	1.90%	2.10%	2.29%	2.49%	2.67%	2.86%	3.05%
	0.95	1.11%	1.32%	1.52%	1.72%	1.92%	2.12%	2.31%	2.50%	2.69%	2.88%	3.06%
	0.90	1.13%	1.33%	1.54%	1.74%	1.94%	2.13%	2.33%	2.52%	2.71%	2.89%	3.08%
	0.85	1.14%	1.35%	1.56%	1.76%	1.95%	2.15%	2.34%	2.53%	2.72%	2.91%	3.09%
	0.80	1.16%	1.37%	1.57%	1.77%	1.97%	2.17%	2.36%	2.55%	2.74%	2.92%	3.11%
	0.75	1.18%	1.39%	1.59%	1.79%	1.99%	2.18%	2.38%	2.57%	2.75%	2.94%	3.12%

Table 7-9. Outcome of Sensitivity Test for the Financial Analysis

By contrast, a financial support from the Government in railway infrastructure development is a key and pragmatic component to make the railway sector financially viable for third parties.

8. SOURCES OF FUNDING FOR THE MP IMPLEMENTATION

African countries typically find difficulties in relying on long-term financing for infrastructure development. The reasons lie mainly on the following issues:

- Infrastructure projects tend to have longer payback and build-out periods, thus they must rely on stable Governmental policies for their continuity. Eventually, they are also more susceptible to political and regulatory interference.
- Most African countries have very low or sometimes non-existent sovereign credit ratings, which limits the public sector's ability to attract private/foreign investors. This, however, is not exactly the case of Ghana, which is benefiting from a good standing in the international context.
- Most local financial markets have limited capacity to finance infrastructure projects: PPP arrangements are relatively new (or still non-consolidated) structures, with regulatory frameworks that still do not encourage a long-term commitment of financial resources.

In the light of these constraints, infrastructural projects implemented in Africa require an appropriate analysis of different available options, leading to long term planning and involving numerous stakeholders.

8.1 NATIONAL FUNDING

- **GoG Public Funds:** this is the most traditional source for financing infrastructures (in principle, these are public funds obtained from taxable sources). Worldwide, railway systems were historically financed by governments, because of the strong public interest involved in such capital-intensive infrastructures. GoG has been making important commitments on the public budget in this regard. In 2019, GoG increased its infrastructure budgetary allocation to GHC4,632 million, from GHC1,804 million in 2018. GHC 636 million was allocated to the Railway sector. However, in order to guarantee the long term development of strategic infrastructure projects, alternative sources of funding should be integrated to the GoG allocation.
- **Ghana Petroleum Funds:** in consideration of exploration activities, revenues from the oil sector could generate considerable resources that can be allocated to infrastructure development. The 2018 Annual Report on Petroleum Funds highlights that an amount of GHC1,546.38 million was programmed for Annual Budget allocation in the same year. According to the Petroleum Revenue Management Act, 2011, not more than 30 percent of the allocated amount is to be spent on goods and services and not less than 70 percent on capital investments. In terms of investments, priority areas were revised to give the necessary relevance to agriculture, education, health, road, rail and other critical infrastructure development.
- **Ghana Infrastructure Investment Fund (GIIF):** GIIF invest directly in Ghanaian infrastructure projects through debt, equity or other financial instruments. They partner with other investors through the use of strategic investment platforms such as public-private partnerships (PPPs). The GIIF raises funds on commercial terms for strategic projects, and has recently promoted and accomplished important Government initiatives, such as the new airport Terminal in Accra.

- Pension Funds:** Pension funds in countries with fully funded pension systems are a potential investor for infrastructure financing. The risk-averse, long-term nature of pension funds fits well with the long-term nature of infrastructure cash flows. The increasing role of the pension industry in financing infrastructure is regarded as a win-win situation. On the one hand, pension funds offer local long-term financing, particularly crucial when capital markets are underdeveloped. On the other hand, infrastructure investments offer pension funds long-term yields, higher and stable returns that are linked to inflation, and risk diversification. However, there are common challenges to mobilising pensions, some of which are associated with particular features of infrastructure projects. In Ghana, the Social Security and National Insurance Trust (SSNIT) is the main provider of pensions. Pension funds typically require listed securities with good credit rating. The industry is putting structures in place for new entrants. At the same time, with the aim of developing the equity market, in 2018 Ghana doubled to 20% the proportion of assets that pension funds can invest in stocks.
- Insurance Funds:** similar to pension funds, insurance funds could be an appropriate source for infrastructure financing which fits with the payout schedule of life insurance policies. The size of the life insurance industry in Ghana is still small in relation to pension funds, but the sector is quite well structured with the NIC (National Insurance Commission) providing guidelines on investment mixes for the industry, to ensure that accounts are sound and investments of insurance companies are adequately spread. The proposed investment strategy for Insurance companies has to be approved by the NIC, including details of the diversification, currency and the estimated proportion which will be represented by each type of investment and the arrangements for the maintenance of adequate liquidity. According to the latest Regulations, life insurance companies should respect the following investment ceilings: up to 30 percent in listed stocks, 20 percent in unlisted stocks (10 percent for nonlife insurance companies), 20 percent in mutual funds, 10-30 percent in investment properties (0-20 percent for nonlife), and up to 10 percent in investments approved by the same NIC. Furthermore, the guidelines stipulate that at any point in time, the ratio of investments to total assets should not be less than 55 percent (that is, at least 55 percent of the total assets of the company must be in direct investments, the latter defined as assets that directly earn cash income or appreciate in value over time).
- GPHA:** it is pertinent to recall that until 1976, railways and ports in Ghana were jointly administered under the Ghana Railway & Ports Authority. While the need for financial and administrative independence was achieved thorough the creation of the Ghana Railway Corporation (Limited Company since 2001), natural synergies between railways and ports have become more and more evident. In the 4th Annual Africa Port & Rail and Cargo Capacity Upgrading Summit, held in Accra in 2016, the need for Integrated logistics & seamless multimodality was shared among all relevant stakeholders. At the same time, international experience in recent years (both in Africa and other contexts) suggests that a more holistic strategy involving ports and railways is essential to make an efficient and integrated transport platform available to the country. This could eventually include Ghana Port Harbour Authority as a possible finance partner for developing railway projects which

certainly impact port activities, especially with regard to heavy freight transport of raw materials (bauxite, manganese, etc...).

- Commercial banks:** The banking and financial sectors have undergone a profound change, started in 2016 with the implementation of an Asset Quality Review undertaken by the Bank of Ghana. This has highlighted important financial fragilities of a number of banks, which resulted as being undercapitalized. The sector has been partially consolidated to address capital and liquidity shortfalls, with the process still under development in recent times, including interventions on specific critical cases. New capital requirements have been set as compulsory by end-2018, and other regulatory measures have been introduced to address remaining financial sector weaknesses, which would help improve the availability of credit to the private sector. Nevertheless, while the size of local commercial banks is still small in relation to the levels of financing required for large infrastructure projects, the same banks are a key partner for large transactions involving international players. This is testified by the consortiums which have participated in the bid for the railway corridors in Ghana under current PPP structuring. The more the banking system becomes sound and efficient, the more the private sector will have access to affordable lending rates, thus increasing the opportunities for a growing intervention of private actors and, ultimately, for PPP based projects.
- Capital Market:** while long-term domestic financing - often available only in local capital markets - is well suited for infrastructure projects, to date this market is limited in Africa. Ghana's domestic market and the Ghana Stock Exchange are still not of an appreciable size to address the need for important infrastructure development. Generally, only a few developing countries are equipped with local capital markets that can provide such financing consistently and in significant amounts. These countries are characterized by having larger economies than almost all African countries. Furthermore, their financial markets are sophisticated enough to provide currency forwards and interest rate swaps. Nevertheless, local capital markets have to be considered as an interesting option for future development, in line with the growing dimension of the economy and consolidation of PPP deals.
- Sale of Public Assets:** the sale of public assets is a useful source of funds. Additionally, it can generate internal efficiency with the removal of annual operating losses from the national accounts of state-held companies. This applies especially to attracting businesses where the private party can enjoy interesting rates of return (by way of example, in the emerging telecom sector of some years ago, the sale of Ghana Telecoms to Vodafone was a virtuous example of privatisation). Sales of public assets is a common approach of many countries with an important, but poorly performing, public apparatus. Thus the role of the private party can generate immediate financial resources (which can be allocated to the development of strategic assets) and also introduce efficiency into the business management. If the sale involves a key asset, the Government usually retains a shareholding, allowing it to still play a decisive role, but without other financial obligations.

8.2 INTERNATIONAL FINANCING

The government of Ghana has been particularly active, in the last few years, in seeking for possible sources of funding within the international context. In the railway sector, after the deal signed with the Indian Government for financing of Tema-Akosombo SG project, another important impact has come from the \$2bn deal with the Chinese Government. The firm, in exchange for access to part of Ghana's extensive bauxite deposits in the Eastern Region, will contribute in bridging the Country infrastructure gap, by implementing roads and railways. Nevertheless, the international scenario is quite structured and sees many actors playing a very active role in Africa.

- **GoG Bonds:** the issuance of the recent 3USD billion Eurobonds in March 2019 (with a tenor of 7, 12 and 31 years) was successful; the 2USD billion Eurobonds in May 2018 (with 10 and 30 year maturities), was four times over-subscribed. This testifies the general attractiveness of the country by financial markets, confirmed by the up-grading of Ghana's credit rating in 2018 (S&P Global Ratings). In the future, GoG Bonds could play an important role to access foreign financing.
- **International Commercial banks:** Commercial banks are important investors in infrastructure projects, particularly through senior loans and guarantee products, such as performance guarantees and letters of credit. Despite the fact that their activity is often necessary to support the financial strength of local financial markets, international banks can be seen to be in synergy with the same local banks. International banks normally have the size, technical capacity and willingness to enter into complex and long-term project financing, if the project and overall scenario can provide the necessary confidence, and bankability parameters are met.
- **Equity funds:** Private equity funds (often called "infrastructure funds") can play an important role in providing mezzanine financing to a project, taking more risk than traditional lenders, but less than the sponsors. An equity fund is a way for investors to invest with other investors in order to benefit from the inherent advantages of working as part of a group (professional investment management, diversification, economies of scale and risk management). Worldwide, large markets have developed around collective investment and these account for a substantial portion of all trading on major stock exchanges. The nature of intervention by a private equity fund may vary, depending on the nature of that fund. In particular, some may be simply focused on financial investment, whereas others may also bring significant infrastructure finance experience, and can help improve project management and cost effectiveness.
- **Export credit agencies:** Export Credit Agencies (ECAs) act as an intermediary between national governments and exporters to issue export financing. The financing can take the form of credits (financial support) or credit insurance and guarantees (pure cover) or both. ECAs are active in numerous developing countries and are increasingly investing in infrastructure. ECAs provide different forms of support to an importing entity:
 - Direct lending - the loan is conditional on the purchase of goods or services from businesses in the ECA country.

- Financial intermediary loans – the ECA lends funds to a financial intermediary, such as a commercial bank, that in turn lends to the importing entity.
- Interest rate (or exchange rate) equalization – a commercial lender provides a loan to the importing entity at below-market interest rates, and in turn receives compensation from the ECA for the difference between the below-market rate and the commercial rate. Financial coverage may apply to exchange rate risk, for transactions where revenues may be denominated in local currency and investments in foreign currency.
- Country risk normalisation: ECA – directly or through specialised entities – may absorb the country risk where the project is under development, in the form of insurance service. This reduces the cost of credit significantly for potential players who need to borrow funds, but are new to that specific business environment.

Generally speaking, despite ECAs tend not to cover the commercial risk of a deal, they provide an important form of direct (or indirect) financial support to business development and stabilisation, fundamental when infrastructure expansion is driven by a business initiative with private parties involved. This applies to most PPP transactions in various sectors.

- **Development banks and bilateral funding:**

- Multilateral Development Banks: Multilateral Development Banks provide financial support and professional advice for economic and social development activities in developing countries. The African Development Bank, World Bank, European Bank for Reconstruction and Development are very active in the African context. These institutions traditionally do not provide funds for capital investments in the railway sector, but they finance feasibility studies and technical assistance to Governments and other public bodies in the sector, thus providing some key tools for long-term sustainability of the same investments.
- Traditional Bi-Lateral Funding: at international level, traditional bi-lateral funding – country to country – has generally been replaced by multilateral and joint development partner arrangements to ensure coordination of investments and avoid duplication of efforts. The numerous agencies (many of them from European countries/Governments, not to mention USA, Australia, etc..), provide funding through grants directly or through multilateral and regional agencies and trust funds. Pure bilateral funding is in the form of direct grants or the supply of vehicles and equipment to specific projects.
- “Structured” Bi-Lateral funding: in the last 10-15 years, a more structured bilateral funding (tied to parallel agreements on mineral exploitation or other concessions) has become quite common, especially in Africa. The long term nature of such arrangements is often reflected in long term loans (20 years plus) at market or concessionary interest rates and five-year principal grace periods. These agreements have particularly involved China (through China EXIM Bank), but more recently also India, Korea and Turkey, all active in the African context. Agreements foresee commitment to specific technology and suppliers of infrastructure / operating equipment, not to mention construction contractors.

- Other financing Agencies: The development community has made available a number of funds/facilitates geared towards supporting infrastructure financing. These are channelled through other agencies, still falling in the government sphere of influence, and playing a strategic role in promoting infrastructure development in various countries worldwide. By way of example:
 - The EU-Africa Infrastructure Trust Fund supports Africa's efforts to identify and address the missing links in existing networks, harmonize transport policies, develop integrated water management, develop cross-border and regional energy infrastructure. They provide:
 - ✓ Technical assistance in support of all project phases
 - ✓ Interest rate subsidies to decrease the EU-AITF Financiers' loan interest rates
 - ✓ Investment Grants to finance project components or part of the investment
 - ✓ Financial Instruments like guarantees, risk mitigation measures, equity or quasi-equity investments or participations
 - Private Infrastructure Development Group (PIDG) is a coalition of donors mobilizing private sector investment to assist developing countries in providing infrastructure vital to boost their economic development and combat poverty. The original Trust, founded in 2002, was recently integrated by PIDG Ltd, established in 2018 with the aim of monitoring the operations and ensuring the group achieves the planned objectives. PIDG has been assisting Ghana in the implementation of the energy project "Quantum Terminal II".
 - the United States Foreign Trade Institute, founded in 1995, is dedicated to fostering global trade and investment. Its banking and finance division supports possible avenues for project financing or joint ventures and channels loans and investments for companies in the process of expansion by working with government entities, private banking and international investment groups.
- **Sovereign wealth funds:** Sovereign wealth funds (SWF) are state-owned investment funds composed of financial assets such as stocks, bonds, property, precious metals or other financial instruments. They may represent an important source of funding for infrastructure projects. The first Sovereign Wealth Fund is the Kuwait Investment Authority, founded in 1953, today the 5th largest sovereign wealth fund in the world, with assets of around \$600 billion. In this regard, the Arab Peninsula is home to many of the most important and rich SWF, by way of example:
 - Qatar Sovereign Fund (Qatar Investment Authority): QIA was founded in 2005 to strengthen the country's economy by diversifying into new asset classes, both in Qatar and in the international environment. The fund plays important roles in various sectors, with important participation in automotive, telecom, retail, oil&gas. The fund was recently active in sub-Saharan Africa with proposals in the railway sector in Nigeria.

- The Abu Dhabi Investment Authority (ADIA): it invests in all the international markets – equities, fixed income and treasury, infrastructure, real estate, private equity and commodities related financial products. Assets are estimated to be above \$800 billion with an interesting exposure on emerging market equities and projects.

The Far East, particularly China (including Hong Kong), Singapore, South Korea and Malaysia owns large SWF. USA, Russia, France, are also key players with international strategies, particularly in developing economies.

Below a representation of these sources of funding which are currently characterizing the Ghanaian context. Main considerations are:

1. Public Funds (both in the form of traditional public budgets or originated by extraordinary funds supported by oil revenues) are a basic component for infrastructure development;
2. Bilateral Funding (typically, from foreign governments or government entities) may be the quantitative leverage for a significant acceleration of the infrastructure projects;
3. Interesting opportunities can be explored and capitalised by involving private financing (both in the form of debt or equity) from the international context;
4. Positive future prospects are envisaged in local capital markets and banking sector, currently under strengthening and consolidation.

Due to economic development and growth of the Country, it is very likely that the same representation may be considerably different in a future scenario.

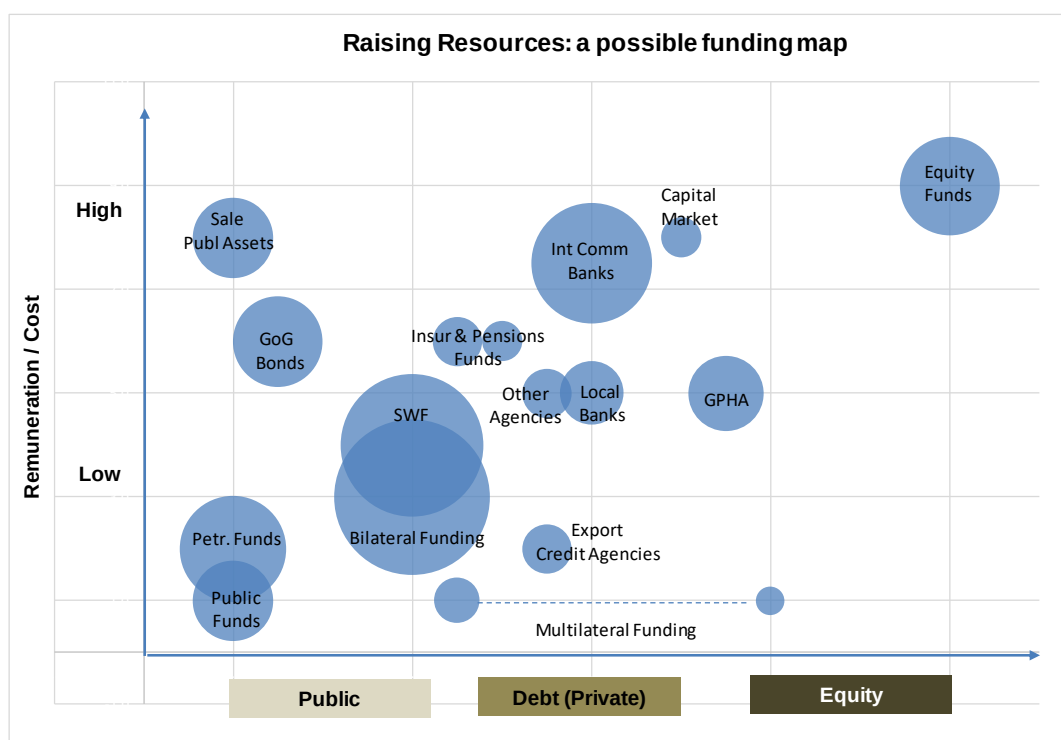


Figure 8-1. Sources of funding (Consultant's elaboration).

8.3 CHINA AND AFRICA

China-Africa engagement has considerably expanded over the past decade. Since its inception in 2000, the Forum on China-Africa Cooperation (FOCAC), has served as a vehicle for strategic collaboration, and diplomatic and cooperation initiatives have greatly increased.

China's engagement with Africa is marked by close links between trade, investment and finance. Many African countries are benefiting from Chinese foreign direct investment (FDI), which extends across the continent, and is increasingly diversified.

Despite China not being the largest investor in Africa (see figure below), in recent years China's FDI stocks in Africa have exceeded 40 Billion \$ making China the fifth biggest investor in Africa in terms of stocks.

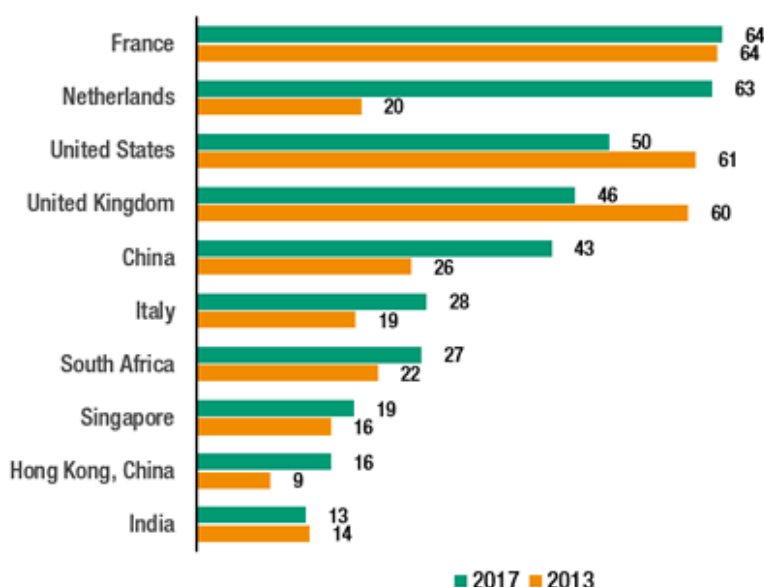


Figure 8-2. Top investor economies in Africa
(Source: UNCTAD, World Investment Report 2018)

The FOCAC that was held in Beijing in September 2018 continued this trend: China will extend US\$ 60 billion of financing to Africa in the form of government assistance as well as investment and financing by financial institutions and companies. This will include US\$ 15 billion of grants, interest-free loans and concessional loans, US\$ 20 billion of credit lines, the setting up of a US\$ 10 billion special fund for development financing and a US\$ 5 billion special fund for financing imports from Africa.

In West Africa, Ghana (\$3.3 billion) overtook Nigeria as the largest recipient of FDI in 2018.

It is worthwhile to note that while China's level of foreign direct investment (FDI) is relatively low, two-way trade is very strong and consolidated. China surpassed the US in 2009 to become Africa's largest trading partner, with trade growing 40 times over the last 20 years and today exceeding \$200 billion.

Import	Trade (US\$ Mil)	Partner share(%)
China	37,387	16.42
South Africa	14,891	6.54
Germany	13,443	5.90
India	13,148	5.77
United States	11,742	5.16
Export	Trade (US\$ Mil)	Partner share(%)
India	19,685	9.28
China	18,520	8.73
United States	14,919	7.03
Netherlands	9,617	4.53
Spain	8,458	3.99

Table 8-1. Africa: Import and Export trading partners.

More recently, there has been a surge in Chinese private investment combined with a continued, but more limited, state engagement. A 2017 McKinsey study reports that there are more than 10,000 Chinese-owned firms operating in Africa today, about a third of which are involved in manufacturing. It should be pointed out that the overwhelming majority of these enterprises are small and micro businesses.

In Particular, China's investment in Ghana has increased, with trade volumes between the two countries reaching US\$ 2.1 billion in 2010 and increasing to US\$ 5.4 billion in 2012, a 163% increase since 2010.

This explains the huge investments in vital infrastructure and support services that play a decisive role in enhancing productivity and reducing poverty. In addition, the China-Africa Development Fund (CAD Fund) has facilitated projects in Africa as a whole, and Ghana in particular, by building a US\$ 600 million Sunon Asogli Thermal Power Plant, jointly invested by CAD Fund and Shenzhen Energy Group (Sackitey, 2012) to help with the erratic power crisis that has hit Ghana over the years.

In 2017, Ghana agreed to a bauxite exploration deal with the government of China aimed at further exploiting the West African country's vast solid mineral deposits.

Nowadays, China seeks resources for its growing consumption, and African countries seek funds to develop their infrastructures.

Large-scale structural projects, often accompanied by a soft loan, are proposed to African countries rich in natural resources. China commonly funds the construction of infrastructure such as roads and railroads, dams, ports, and airports.

The following is a list of the major railway projects on the Chinese agenda for Africa:

Name	Location	Constructed	Company	Cost
High Plateau line, Algeria	Relizane, Saida, Tiaret, Tissemsilt, Boughezoul to M'Sila, Algeria	2009-2013	China Railway Group & China Civil Engineering Construction Corporation	US\$2.8bn
Benguela Railway	Lobito to Luau, Angola	2006-2014 Railway was rebuilt following civil war	China Railway Construction Corporation Limited	US\$1.83bn
Chad Railway	Ngaoundéré, Cameroon to Nyala, Sudan via Moundou, N'Djamena and Abéché in Chad	2012-ongoing (Construction over three phases)	China Civil Engineering Construction Corporation	US\$5.6bn
Addis Ababa–Djibouti Railway (electrified line)	Addis Ababa, Ethiopia to Djibouti City, Djibouti	2011-2016	China Railway Group & China Civil Engineering Construction Corporation	US\$4bn
Mombasa-Nairobi Railway	Mombasa to Nairobi, Kenya (extended to Naivasha, Kenya in 2016)	2014-2017	China Communications Construction	US\$3.6bn
Kenya-Uganda border	Naivasha, Kisumu to Malaba, Kenya	2016-ongoing	China Road and Bridge Corporation (subsidiary of China Communications Construction)	US\$5.42bn
Mali-Guinea Railway	Bamako, Mali to Conakry, Guinea	2016-ongoing	China Railway Construction Corporation Limited	US\$8bn
Mali-Senegal Railway	Bamako, Mali to Dakar, Senegal	2016-ongoing	China Railway Construction Corporation Limited	US\$2.7bn
Nigeria Coastal Railway	Lagos to Calabar, Nigeria	2014-ongoing	China Civil Engineering Construction Corporation	US\$11.1bn
Lagos-Kano Railway	Lagos to Kano, Nigeria	2011-ongoing, Abuja to Kajuna completed in 2016	China Civil Engineering Construction Corporation	US\$8.3bn
Sudan Railway	Khartoum to Port Sudan, Sudan	2007-2012, 2014 opened	China Railway Engineering Corporation	US\$1.5bn
TAZARA Railway	Dar es Salaam, Tanzania to Kapiri Mposhi, Zambia	1970-1975 (Currently in need of reinvestment)	Railway Engineering Corps (now CRCC), Ministry of Railways (now CCECC)	US\$500m
Uganda Railway	Malaba, Kampala, Kasese, Uganda to Rwanda and South Sudan	2015-ongoing	China Harbour Engineering (subsidiary of China Communications Construction)	US\$8bn
Chipata-Serenje Railway	Chpata, Petauke, Serenje Zambia	2016-ongoing	Railway Engineering Corps (now CRCC), Ministry of Railways (now CCECC)	US\$2,3bn

Table 8-2. Funded/co-funded Railway projects in Africa by China

8.3.1 THE BELT AND ROAD INITIATIVE: OPPORTUNITIES FOR INFRASTRUCTURE DEVELOPMENT

In September 2013, China introduced a plan for a New Silk Road from China to Europe. The latest iterations of this plan, dubbed the "Belt and Road Initiative" (BRI), includes a land-based Silk Road Economic Belt and a 21st Century Maritime Silk Road.

Essentially, the "belt" was originally conceived to connect the countries situated on the original Silk Road through Central Asia, West Asia, the Middle East, and Europe. The initiative would create a cohesive economic area by building both hard infrastructures, such as rail and road links, and soft infrastructures such as trade agreements and a common commercial legal structure with a court system to police the agreements.

Further expanded in 2014, the project has significantly enlarged its horizons (One Belt One Road – OBOR), by leveraging on Africa as a key continent of the strategic plan. As the early focus of OBOR, East Africa has developed into a central node in the Maritime Silk Road, connected by planned and finished ports, pipelines, railways, and power plants built and funded by Chinese companies and lenders.

A standard gauge railway connecting Mombasa to Nairobi—the biggest investment in Kenya since its independence—is a flagship OBOR project in East Africa.

The electric railway from Addis Ababa to Djibouti, where China established its first overseas naval base and has stakes in a strategic deep water port, is another.

From Djibouti, the Maritime Silk Road connects planned and completed Chinese port clusters in Sudan, Mauritania, Senegal, Ghana, Nigeria, Gambia, Guinea, São Tomé and Príncipe, Cameroon, Angola, and Namibia. Another route links Djibouti to Gwadar, Hambantota, Colombo, Myanmar, and Hong Kong. The final arc of this corridor connects Walvis Bay to Chinese port clusters in Mozambique, Tanzania, and Kenya before also connecting to Gwadar.

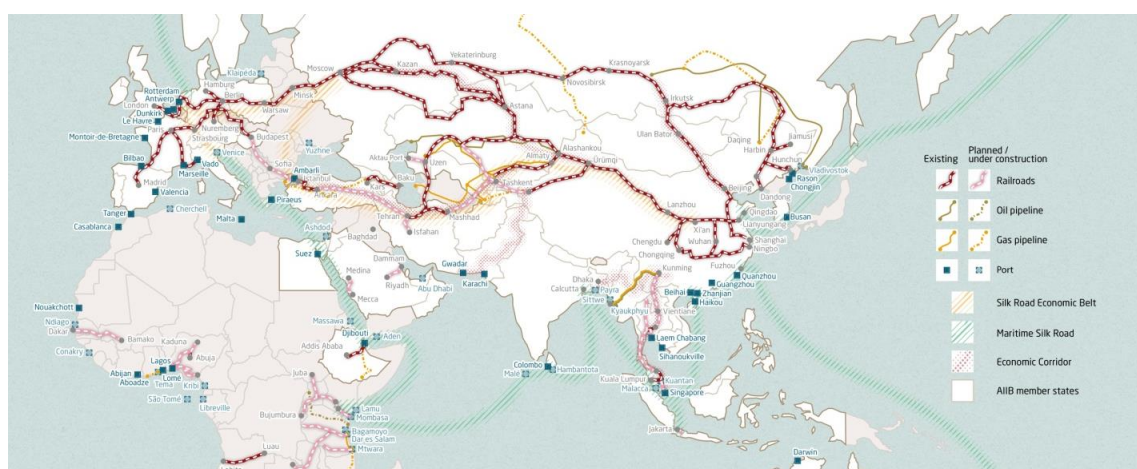


Figure 8-3. OBOR Project: Main Corridors
(Source: MERICS)

Today, OBOR establishes six land corridors connecting China's interior to Central Asia and Europe. It includes railroads to Europe, oil and gas pipelines from the Caspian Sea to China, and a high-speed train network connecting Southeast Asia to China's eastern seaboard. The Maritime Silk Road establishes three "blue economic passages" knitted together through a chain of sea ports from the South China Sea to Africa that also direct trade to and from China.

In the last few years, China has signed a cooperation document on the belt and road initiative with 126 countries (including approximately 20 from Africa) and 29 international organisations which account for 30 percent of the world's GDP and 75 percent of its energy reserves. Some 50 Chinese state owned companies are implementing 1,700 infrastructure projects around the world, worth about \$900 billion.

The immense project is China's signature vision for reshaping its global engagements, spanning three continents and touching 60 percent of the world's population.

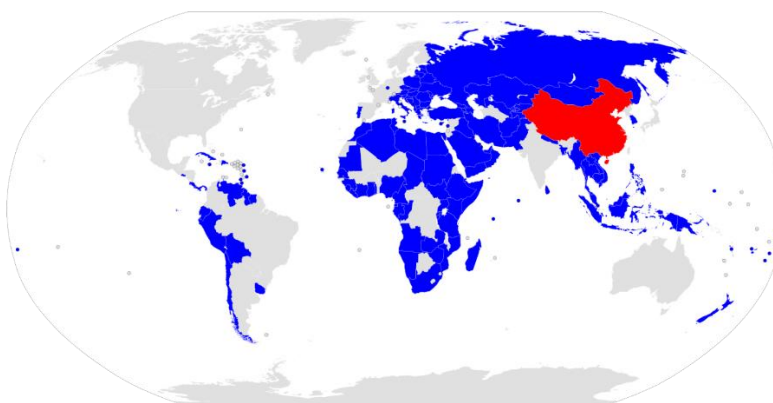


Table 8-3. Countries that signed cooperation documents related to the Belt and Road Initiative.

Advocates of OBOR see the project as a catalyst for African regional economic integration and competitiveness.

One Belt One Road can have positive net benefits for African countries, but much will depend on whether the China-Africa relationship can be placed on more equal footing. The challenge for Africa is in establishing where its interests converge with China's, where they diverge, and how areas of convergence can be shaped to advance African development priorities.

9. THE EVOLUTION OF PPP ARRANGEMENTS IN THE RAILWAY SECTOR

9.1 PPP MODELS AND OPTIONS

The term “public-private partnership” (PPP) has been in general use since the 1990s; however, there is no single definition or model of a PPP.

The term PPP covers, in fact, a range of different structures where the Private Sector delivers a Public Project or service.

Concession-based transport and utilities Projects have existed for many years, with revenues derived from payments by end-users, e.g. passenger tickets and goods fares.

The use of PPPs has now spread to many countries and depending on the country and the politics of the time, the term can cover a spectrum of models. These range from relatively short term management contracts (with little or no capital expenditure), through concession contracts (which may encompass the design and build of substantial capital assets along with the provision of a range of services and the financing of the entire construction and operation), to joint ventures and partial privatisations where there is a sharing of ownership between the public and private sectors.

The key contrast between PPPs and traditional procurement is that with PPPs the Private Sector returns are linked to service outcomes and performance of the asset over the contract life. The Private Sector service provider is responsible not just for asset delivery, but for overall project management and implementation, and successful operation for several years thereafter.

The timing of payments by the public sector to the private sector for the assets and services delivered is, therefore, dramatically different, as illustrated in the following figure.

Therefore, PPP can be defined as “*forms of cooperation between the Public and Private sectors for the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service*”.

Different types of PPPs tend to share some common characteristics. These include contracting between the Public and Private sectors for the delivery of services, often involving infrastructure development and management, where risks are shared between the parties. Risks are allocated to the party that is best able to manage them, i.e. reduce their impact and/or absorb their consequences.

Appropriate risk allocation should, therefore, minimise the cost of risks. The need to utilise Private Sector management and experience, and not only the capability of raising finance, is also key.

According to recent international studies and papers, PPP projects are characterised by:

- relatively long relationships, involving cooperation between the Public partner and the Private partner on different aspects of a planned Project

- funding structures that combine Private and Public funds
- the operator plays an important role at each stage in the Project (design, completion, implementation, funding)
- the Public partner concentrating on defining the objectives to be attained
- the distribution of risks between the Public sector partner and the Private Sector partner.

Ultimately, a PPP should:

- involve a clearly defined Project
- involve the sharing of risks with the Private Sector
- be based on a contractual relationship which is limited in time
- have a clear separation between the Public Sector and the borrower, i.e. there should be a Private Sector party raising project-finance based debt.

The PPP models vary from short-term simple management contracts (with or without investment requirements) to long-term and very complex “BOT” contracts.

These models vary mainly by:

- Ownership of capital assets
- Responsibility for investment
- Assumption of risks, and
- Duration of contract.

The PPP models can be classified into three broad categories in order of generally (but not always) increased involvement and assumption of risks by the private sector. The three broad categorizations of participation are:

- Service and management contracts (including Lease)
- Concessions and BOT models
- Private ownership of assets (including Joint Ventures)

The following Table 9-1 shows the different PPP options and models.

PPP Options and Models



increasing involvement / risk assumed by Private Sector

	Service/Management/Lease			Concessions				Private Ownership of Assets		Joint Ventures
	Service Contracts	Management Contracts	Lease Contracts	Standard Concession	Franchise	BOT (Build Operate Transfer)	BROT (Build Rehabilitate Operate Transfer)	BOO (Build Own Operate)	PFI (Private Finance Initiatives)	Joint Ventures
Private Actor	Private Service company	Private Service company	Leaseholder	Concessionaire	Franchisee	Private firm		Private firm	Private firm	Private firm
Scope	Support services	Entire operation	Management & operations	All operations	All Operations	Greenfield investment	Existing/ partially built facility	Build + operations		shared ownership
Characteristics	Service is clearly defined	Private sector interacts with Customers, Tariffs set by Public Sector	- Revenue from customers - Lease fee to contractor	- Government delegates service provision to Priv. - Government may partially fund the Concessionaire	Services are fully specified by the franchising authority	Standards and service quality parameters set by Contracting Authority		As for the Concession	Private sector may have less stringent constraints	Good corporate governance required for success
Compensation Terms	Unit Prices/ fee	Fixed fee + incentives	Portion of Tariff revenues	All or part of Tariff Revenues	All or part of Tariff Revenues	Related to production parameters		Production parameters	Production parameters	Varies
Ownership of Capital Assets	Public	Public	Public	Public	Public	Public		Private	Private	Public/Private
O&M Responsibility	Public	Private	Private	Private	Private	Private		Private	Private	Public/Private
Commercial Risk	Public	Public	Shared	Private	Private	Private		Private	Private	Public/Private
Overall level of Risk assumed by Private Sector	Minimal	Minimal / Moderate	Moderate	High	High	High		High / very High	High / very High	High
Duration of Contracts	1-3 years	2-5 years	10-15 years	25-30 years	25-30 years	Up to 50 years		Varies	Varies	Indefinite
PROS	- Improved efficiency - Private sector development - Technology Transfer	Interim solution for possible Concession	Operational and commercial efficiency	- Improves efficiency - Concessionaire can give priorities	- Quality standards well defined	- Way of attracting private financing for construction or renovation of infrastructure		Private sector can better express entrepreneurial potential		May also be an interim solution to Concession
CONS	- not suitable if demand level is not certain - Multiple contracts (complexity)	performance monitoring crucial when payments are based on incentives	Definition of tariffs	- Tariffs and performance monitoring - Maintenance problems (last years)	- Contractual aspects may take longer	- Limited competition - Long term commitment		Risk of excessive degree of freedom if contracts are not well defined		- Conflict of interests - Inefficiency
General cases	Assets Maintenance	Health care	Airport/seaport terminals in Asia	Railways in: Argentina, Brazil, Burkina Faso, Chile, Ivory Coast, Mexico	Bus or rail services - Franchise passenger traffic (U.K., 2005)	Railway connections and Stations		Power sector. <u>Licensing</u> variant of BOO		International Airports (Bangalore), ports, etc...

Table 9-1. PPP Options and Models.

The paragraphs below describe the most common financing schemes for the railway sector.

→ **Traditional procurement**

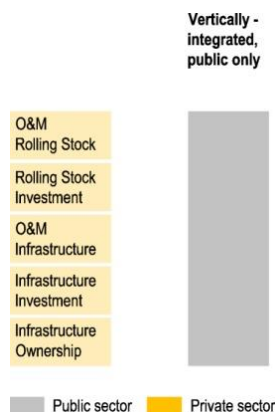


Figure 9-1. Traditional Procurement model

In this model, the **Public Sponsor** borrows/guarantees the required loans for the Railway Project.

Since the Project promoter is a public body, the success of the Project (or return on investment) is calculated based not only on the Internal Rate of Return of the infrastructure, but also on the social **welfare** generated for the country.

This is the most common financing scheme in Africa, but most countries have difficulties to access capital markets and usually have to rely on International Financial Institutions (IFIs) such as the World Bank or the African Development Bank to raise the required capital at a lower interest rate.

However, IFIs have traditionally been reluctant to grant the entire loans needed for big infrastructure projects such as a greenfield railway project, as their core aim is not to act as a private investor but to act as a catalyst for the Project development.

As a consequence, their contribution is often limited to a certain percentage of the total credit required and a substantial gap exists between the Project's financial needs and the loans available from the Government.

In this model, all the main risks (construction, O&M, revenue and financial risk) are charged to the Public Sector.

→ **PPP Model: Concession Scenarios**

The Concession is an effective way to increase **Private Sector participation**.

This scenario involves a contract between the Infrastructure Owner (generally the Government) and Private Parties, also called **Concessionaire**, to provide some railway related services (infrastructure, operations, or both).

Concession introduces a so-called vertical segregation between the ownership of the infrastructure (retained by the Public Sector), and the right to operate rail services (transferred to a Private Company) during the contract period (usually longer-term arrangements).

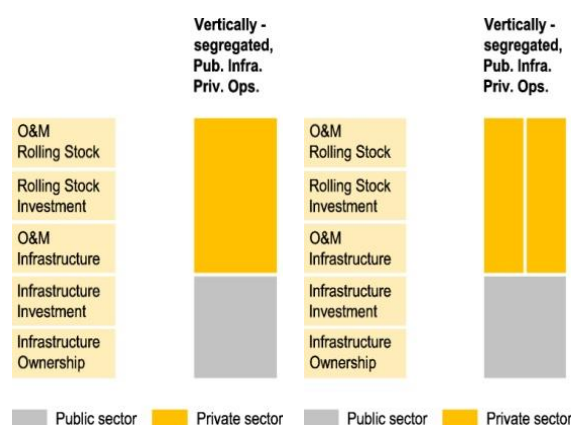


Figure 9-2. Concession Scenarios: one or two private operators model

Concessioning has been used in Europe, Latin America and Africa (see following Figure 9-3.), and in many other parts of the world, with generally positive results.

The suggested models have the following characteristics:

- Concession period of 30 years to allow the Concessionaire to invest in long-term assets to improve its performance;
- the Concession operator has the exclusive right to maintain and operate the infrastructure, and invest, maintain and operate the Rolling Stock;
- assets revert to the Government ownership at the end of the Concession;
- given that the investment generates unsatisfactory profit margins (especially for passenger services, as usually occurs in this type of investments), public subsidies (often, in the form of **minimum revenue guarantee**) have been introduced in order to guarantee the sustainability of the Project;
- among operators, passenger and freight activities show strong differences that tend to promote distinct models (with two distinct operators).

In this model, some risks (O&M and revenue risk) are transferred from the Public Sector to Private Sector.

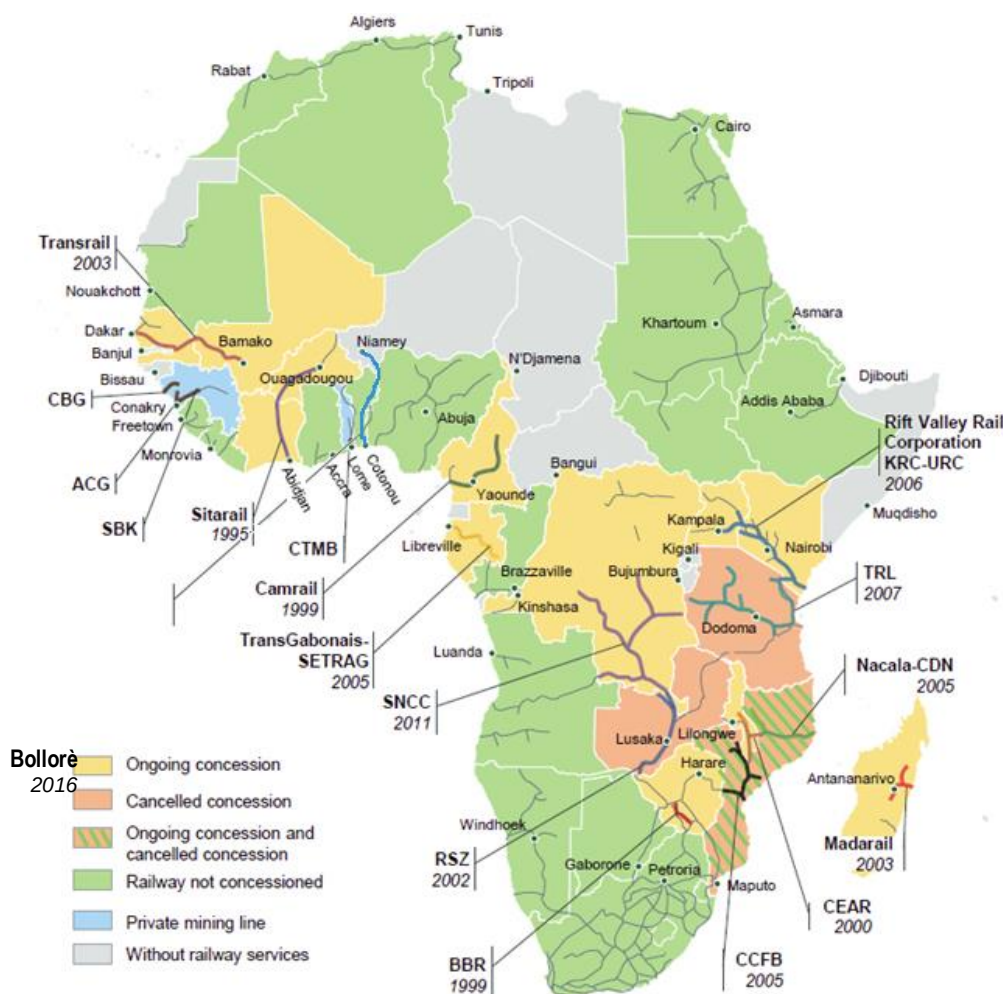


Figure 9-3. Railway Concession in Africa

Source: "Rail Infrastructure in Africa, Financing Policy Options", African Development Bank

→ PPP Model: BOT (Build Operate & Transfer) Scenario

BOT model is based on the convergence of two fundamental interests:

- the Public Sector is interested in minimising its financial commitment, as well as maintaining control of infrastructure and pricing;
- the Private Sector is interested in having a long service life and sufficient fee flexibility to maximize profits.

With the aim to satisfy these interests, a **Special Purpose Vehicle (SPV)** is constituted with the possible arrangement shown in the following Figure 9-4..

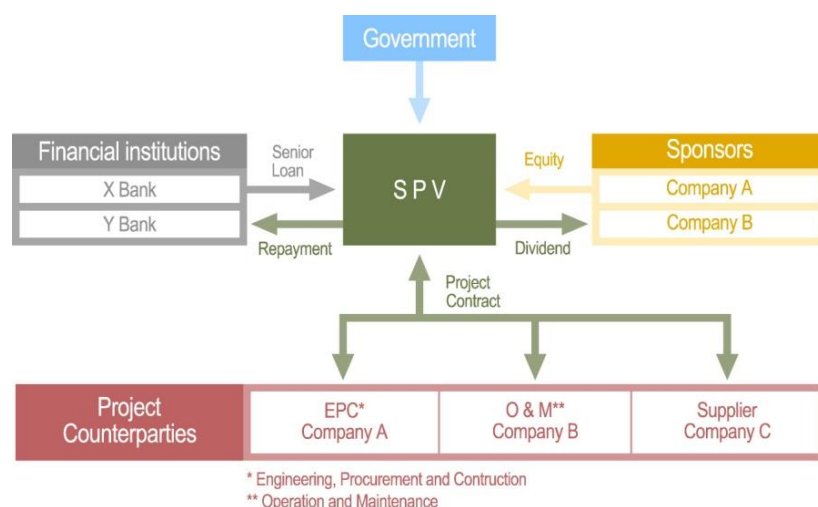


Figure 9-4. SPV arrangement example

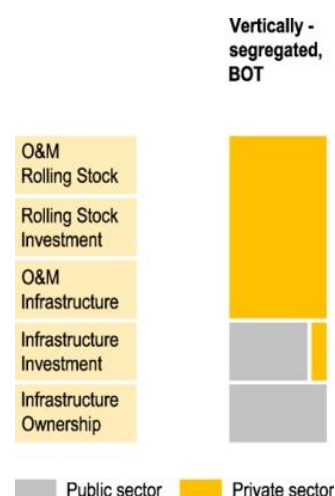


Figure 9-5. BOT model

The SPV ensures:

- the management of a service of public interest
- the transfer of a significant part of the risks to the private sector (construction, O&M, revenue and partially financial risk)
- the best practice and the know-how of the private sector in the supply and management of the service
- maintaining a high public participation in the share capital of the SPV, in order to control the decision making policies and standards of quality.

The scheme clearly shows how the cooperation between the public and private sectors is implemented through a distinct entity, which differentiates the BOT model from the Concession.

Also in this case, if the business model doesn't result to be financially viable, the need for public aid is foreseen, under the form of capital expenditure or minimum guaranteed revenue for the operator.

➔ **PPP Model: BFMT (Build Finance Maintenance & Transfer) Scenario**

In the BFMT Scenario, the private sector is assigned the design, financing, construction and maintenance of the project, whereas it does not assume the risk of demand.

The role of the public sector is focused on the management of the project and the relative risk of demand; in particular, the overall management of the infrastructure includes activities such as the commercialization of the infrastructure (definition of track access charges and tariffs), the operation management and the facilities/installations management, while the Private Sector is responsible for the maintenance and renewal.

BFMT, already internationally widely used for the realization of infrastructure projects and adapted for railway projects, allows to transfer exclusively and totally the risk of construction and maintenance to the Private Sector, in return for availability charges guaranteed by the public.

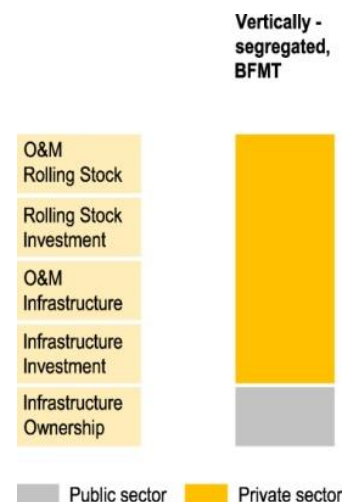


Figure 9-6. BFMT model

The following scheme summarises the allocation of the Project's components between the Public and Private sectors.

	Traditional Procurement	Concession Scenarios		BOT Scenario	BFMT Scenario
		One Operator	Two operators		
Construction of Infrastructure	Public Sector	Public Sector	Public Sector	Public Sector Private Sector	Private Sector
R.S. Procurement	Public Sector	Public Sector	Public Sector	Private Sector	Private Sector
Line O&M	Public Operator	Private Operator	Private Operators (freight/passengers)	Private Operator	Private Operator
Rolling Stock O&M	Public Operator	Private Operator	Private Operators (freight/passengers)	Private Operator	Private Operator
Demand	Public Operator	Private Operator	Private Operators (freight/passengers)	Private Operator	Public Operator
Infrastructure Owner	Public Sector	Public Sector	Public Sector	Public Sector	Public Sector

Figure 9-7. Allocation of Responsibilities in Railway PPP arrangements

9.2 RAILWAY CONCESSIONS IN AFRICA

Africa is currently experiencing an unprecedented economic recovery, with strong growth projections over the next three to four decades. This growth is mainly driven by:

- a fast- increasing demographic;
- a large-scale urbanization;
- new mines and gas and oil fields;
- an increase in intra-regional and international trade

The transport sector can accelerate and intensify trade in Africa. Rail transport, as a result of its energy efficiency, reduced greenhouse gas emissions and lower cost per tonne-kilometre, is expected to play an increasingly important role in the conveyance of freight over long distances. In comparison to other means of transportation, railways are particularly useful in mass transit systems for both inter-city and urban settings.

However, the current condition of existing railway infrastructure and rolling stock is poor in many African countries. This shortfall has undermined the potential of the rail systems to play a strong contributing role in economic development. In fact, rail transport's market share is below 20% of the total volume of freight transport in most countries on the continent, this lack is mainly due to:

- scarce investment in infrastructure;
- absence of a supporting institutional framework.

Rail transport is inevitably critical in supporting economic development and, unless this mode of transport is developed, Africa may not realise its full potential in exploiting its abundant natural resources and wealth.

Over the last years, with the assistance of International Financial Institutions, several countries in Africa have been concessioning their railways, through different typologies of PPPs, with the objective of attracting private finance to invest in rail infrastructure. For different reasons however, the results have been mixed. Sometimes the situation has not improved, and today railway infrastructure remains in poor condition in many African countries.

A specific study on the status of African railways has been provided in 2015 by a publication of the Africa Development Bank (ADB) "Rail Infrastructure in Africa. Financing Policy Options".

In analysing the situation there are many issues to be faced due to the scarce availability of the data necessary to assess the financial performance of railway concessions, as such data isn't public. Having taken this into consideration, the general performance of these concessions varies and isn't always encouraging.

In this document the situation of the main railway concessions has been deeply analysed and, in summary, it is stated that "the concessions have prevented the collapse of the railways in some countries but have not met all the requirements of their original expectations".

In the next table, and in those found in Annex 3., the previous analysis has been updated with the latest info available on the main concessions and has been integrated with various new projects, mainly involving Chinese companies; these companies have been making significant investments in African railways in the last years, mainly aimed at facilitating the transportation of raw materials from inland Africa to its ports.

Country	Railway Concession/ Construction (Route)	Railway Concession/ Construction (length)	Type of Investment: R = Rehabilitate G = Green field	Concession/ Construction Company	Current status
Ivory Coast, Burkina Faso	Abidjan – Kaya	1.260	R	Sitarail	Active
Cameroon	Main Cameroon railways	1.104	R	Camrail (Freight) Mobirail	Active
Madagascar	Nother railway	685	R	Madarail	Active
Nigeria	Lagos–Kano	1.180	G	CCECC (construction)	a) completed phase 1 b) in progress nexts
Nigeria	Main Nigeria railways	3.505	R/G	Transnet (concession)	Active
Ethiopia - Djibouti	Addis Ababa (Ethiopia) Port of Doraleh (Djibouti)	759	G	JV CREC - CCECC (Construction)	a) completed phase 1 b) in progress nexts
Ethiopia - Djibouti	Addis Ababa (Ethiopia) Port of Doraleh (Djibouti)	759	G	EDR (concession)	Active
Kenia - Uganda	Monbasa - Nairobi Nairobi - Nanyuki Naiorbi - Kitale	2.541	R	RVR (concession)	Ended in 2017
Kenia - Uganda	Mombasa - Nairobi	485	G	CBRC (concession - costruction)	Active
Zambia	Main Zambia railways	1.200	R	RSZ (concession)	Ended in 2012
Morocco	Morocco railways (including Atlantic corridor)	2.295	R/G	ONCF (public company)	Active
Senegal - Mali	Dakar-Bamako	1.287	R	Transrail	Ended in 2015
Tanzania	North and East of Tanzania	2.720	R	TRL (now public, previous concession)	Ended in 2010
Tanzania - Zambia	Dar es Salaam (Tanzania) - New Kapiri Mposhi (Zambia)	1.860	R	TAZARA (concession)	Active

Table 9-2. List of main PPP Railway Projects in Africa – Consultant’s elaboration

As a result of the analysis the AfDB gives a number of indications based on more than 20 years of PPP:

- Most of the cases studied have consisted of concessions being awarded to holders who have either failed to perform as expected, have become very unstable, or both. This has been due to them having been burdened with obligations that coexist uncomfortably with their core business and

expose them to major challenges, costs, risks and scrutiny. Most concessions have required multiple restructurings and amendments to stay operative. However, freight concession operators with strong logistics/mining synergies have performed better, suggesting that this might be a more appropriate model moving forward.

- b) Most concessions require operators to be engaged in infrastructure renewal or maintenance to a varying degree. This means that most African concessions involve a hybrid business model that requires operators to be involved to a certain level in civil works activities.
- c) Most concessions have underestimated the amount of investment required and the sums committed have had limited impact on improving railway performance. Some railway packages currently being discussed are several times larger than the initial ones proposed in the late 1990s and early 2000s. However, even these may still be underestimating the real magnitude of investment required to upgrade railways to a level that allows rail to compete effectively with road transport. Additionally, in most cases, the competitive environment that railway transport is in, especially regarding roads, has not been adequately addressed, either at the planning stage, at implementation or at enforcement level. This may also be the case in current road and rail schemes that are being promoted simultaneously.
- d) Public Sector railways in Africa have generally performed well, whilst this does not mean that concessions are not a way forward, there are basic lessons that can be taken from these public sector railways that are also applicable to concession railways, namely: organisational and institutional reform and financial commitment from the Government.
- e) Most countries have reached the conclusion that railway management and financing have to be reviewed, but are still struggling to define the financial models, especially in relation to how infrastructure maintenance should be managed and funded.
- f) Freight and passenger railways are very different and require different approaches. Future passenger operations are likely to be limited to commuter railways in the main African cities.
- g) Most of the considered countries have significant new railway projects, aimed both at freight (mostly mining) and passenger segments, as well as schemes at a regional level. There is wide acceptance that PPPs should be explored to access the huge amounts of funding that would be required, but no new approaches have so far been identified.

Africa is becoming more and more attractive for infrastructure financing in many sectors, such as energy, telecoms and transportation. Nevertheless, investment in railways is still small compared to other sectors (AfDB reports that, as of 2012, the private sector financed 8.9% of the overall financial need for infrastructure financing). Institutional reforms and more mature financial markets may help implement new approaches to infrastructure finance that are common in developed countries.

In order to better understand different PPP experiences, three brief distinct cases with diverse outcomes are reported:

- a) A good result in Cameroon: Camrail;

- b) An unsuccessful case in Zambia: RSZ
- c) A different approach in Morocco: ONCF (owed by Government)

9.2.1 CAMEROON: CAMRAIL

Cameroon represents one of the examples of successful concessions in Africa, both from an operational and a financial point of view.

After a tendering project the concession was granted to Camrail. Said concession started in 1999 with an initial predicted duration of 20 years, later extended to 30 years starting from 2005. All the operating network (around 1,104 km) has been conceded to a single private operator. Passenger services are managed through a separate unit within CAMRAIL denominated Mobirail in partnership with Cameroon's Government.

The initial agreement involved a comprehensive concession in which the concessionaire took full financial responsibility to fund infrastructure, rolling stock and operations. The initial concession has been amended through time, to balance public and private interests and keep the service afloat.



The Concessionaire acquired part of the existing rolling stock from the state railways and kept a part of its personnel. The Concessionaire finances any additional rolling stock purchases unless it is part of a public service obligation. The concession agreement conceded to CAMRAIL includes:

- Technical and commercial management of the railway System,
- Maintenance, development and the exploitation of Railways infrastructure,
- Management of the railway estate.

A concession fee is to be paid to the Government and it's required that any new kilometre of rail will be built according to international standards. The concessionaire is free to set tariffs to customers (except passenger services). There is a restriction for third parties to access the track except in specific circumstances (e.g. public service, mining).

There were some changes in the composition of the SPV of the concession, based on the last information the latest shareholding structure is now:

- SCCF (Groupe Bolloré): 77,4 %;
- Etat Camerounais: 13,5 %;
- TOTAL Cameroun: 5,3%;
- SEBC (Groupe Thanry): 3,8 %.

In addition to the initial structure of the agreement, the current good standing of the concession is due to changes that were set after the concession was awarded. The first amendment (2005) was carried out to prevent the reoccurrence of the bad financial situation that had to be faced after the first years of the concession. This amendment included the following provisions: partial debt relief for CAMRAIL and payment of arrears from GoC regarding Public Service Obligation; the establishment of a flat rate amount

for the concession fees of \$3 million; fiscal stability of the concession; government mobilizing additional resources from bilateral and multi-lateral donors to finance additional track rehabilitation and renewal works from 2008 onward; extension of the concession period to 30 years as of January 1, 2005.

Notwithstanding the operations did not generate enough margin to cover full responsibility for the infrastructure renewal. So, another major amendment was signed in 2008. This second amendment changed the financial risk-sharing between the Government (who became responsible for infrastructure financing), and the Concessionaire, who remained in charge of operations and rolling stock financing. While to compensate the higher risk and financial burden to the Government, the revenues from the concession were further increased by the establishment of a variable fee consisting in 50 percent of the benefits. According to the amendment, responsibilities regarding the infrastructure are split in the following way:

- Ordinary maintenance: Camrail
- New works, rehabilitation, etc. Government

The sources of infrastructure funding up to 2012 included World Bank (\$113 million), European Investment Bank (\$10.8 million), Agence Française de Développement (\$16.6 million), Proparco (AFD group) and other commercial banks (\$9.2 million). This leads to a total of about \$150 million without including the recent investment made by the Government in passenger rolling stock.

According to Camrail's Income statement: Freight transportation was the main income generator with more than 80% of the Operating income, subventions represented only 8.3% of the Total Company Income, while the EBITDA/Income ratio was 27.3% in 2013, improving from 26.7% in 2012 and the Net profit grew 46.9% from 2012 to 2013.

In conclusion, we can sum up the main factors of the success of this PPP as being:

- Certain sections of the railway network were in better conditions than is true for other countries.
- The financial package for the concession (about \$150 million) was bigger than in other African examples.
- Government and Concessionaire have been flexible to negotiate amendments that have allowed the concession to stay afloat.
- The concession shareholding has been more or less stable

Project Exposure (Risk) analysis

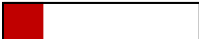
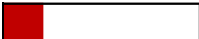
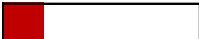
Project: Cameroon (CamRail)		Notes
Technical		<i>moderate refurbishment of existing line</i>
Commercial		<i>stable freight traffic</i>
Financial		<i>robust financial support</i>
Partnership/Governance		<i>stable partnership</i>
Contractual		<i>good compromise of both interests</i>
Regulatory/monitoring		<i>renegotiation but fair attitude of the parties</i>

Figure 9-8. Cameroon (Camrail): Project Exposure Analysis.

9.2.2 ZAMBIA: RSZ

In 2003 the Zambia Government signed a concession with NLPI (majority) and Transnet (South African, minority) for TAZARA, the second rail system in Zambia. That railway line was jointly and equally owned by Governments of Tanzania and Zambia and has never been put into a concession agreement. TAZARA covers a distance of 1,860km and operates two types of freight trains i.e. through traffic and local traffic trains.

The duration of the concession was supposed to be 20 years, but it terminated in Feb. 2012. It was structured to perform on a net/t-km basis. In the beginning Transnet (for the first three years)/Spoornet have been involved. The initial agreement (2003) was for a fixed fee of \$235.5 million spread over 20 years, plus a variable fee of 5% at turnover. In addition, a \$6.1 million initial capital investment, together with an agreement for a further \$14.8 million investment within the first 5 years, were also part of the deal.



Whilst the concession was running, the concessionaire paid the concession fees as contracted. However, it did not supply the monitoring agency with the information required (track conditions, investments made, operating expenses and revenues). These facts were disputed by both sides, leading to a breakdown in relations and the cancellation of the contract; this was also due to the fact that the concessionaire realized that the agreement wasn't working. He tried to revisit the contract, but the renegotiation was unsuccessful, mainly because of:

- bad relations with the Government,
- unclear contract language;
- lack of a rail regulator with clear powers to impose sanctions for breaking the agreed upon terms;

All these factors contributed to the poor performance of this concession so, at the end of 2012, it was cancelled by the Government due to the deterioration of the infrastructure and the significantly decreased quality and performance of the rail services.

Today, the Minister of Finance is concentrating on financing projects such as infrastructure rehabilitation and new corridors and certain enhancement projects will be financed through public loans (Eurobond). The first \$120 million has now been granted to the railway sector for infrastructure maintenance for a period of 5 years (2014-18). The idea is to create a dedicated Railway fund with a Regulator monitoring body.

The Ministry of Transport is looking for market opportunities and railway development projects, aimed at solving the typical transport issues of a landlocked country.

With the idea of promoting local and international trade, in 2016 the Government of Zambia signed a \$2.3 billion contract with China Civil Engineering Construction Company (CECC) for the construction of a 388.8km railway line in Zambia. The railway line will run from Chipata via Petauke in eastern Zambia to Serenje in central Zambia. The line will also connect the Zambian railway with the Malawian railway at Chipata, which is the terminus of a 1,067km line from Malawi.

Project Exposure (Risk) analysis		
Project: Zambia (RSZ)		Notes
Technical		<i>track conditions revealed to be a problem</i>
Commercial		<i>some critical aspects for the concessionaire</i>
Financial		<i>moderate investment - but the project was terminated</i>
Partnership/Governance		<i>lack of clear info during monitoring process</i>
Contractual		<i>agreement non enough clear</i>
Regulatory/monitoring		<i>lack of a rail regulator with sanctioning power</i>

Figure 9-9. Zambia (RSZ): Project Exposure analysis.

9.2.3 MOROCCO: ONCF

Morocco's approach to railway reform has been fundamentally different from that of other African countries. Morocco has managed to implement a reform of its state monopoly ONCF following a market-oriented strategy, instead of moving to a system of concessions, to provide enough financial resources and expertise from private partners.

The Moroccan National Railway Office "ONCF" is a public body with both industrial and commercial character and financial autonomy. The ONCF carries out the following operations:

- Management of the national railway infrastructure
- Study, construction and maintenance of railway lines in the network
- Exploit all activities directly or indirectly related to the railway services of the ONCF.

The opening of the market and the privatization of the ONCF were not considered adequate solutions, for several reasons: first, the Ministry of Finance was already able to find financial resources to save the ONCF from the crisis, and to develop a business model, which required profound organizational changes; second, the Moroccan network was not considered large enough to bear the costs of regulation; finally, the managers and staff were technically competent and therefore the situation did not require special private expertise.



The reform of the public body was made possible by the appointment of dynamic managers with international experience with other railway business models. Involving the financial department in key decisions helped build a sustainable business model.

For the Government of Morocco, the decision to maintain the development and management of the railway as a public entity and the important financial efforts made are elements of the strategic choice which make the railway system play a central role in the economic and industrial guidelines. The government has demonstrated a commitment to the development of the railways by ensuring that both financial resources and an educated workforce were developed accordingly to serve as tools to support the railway strategy.

The achievement of the objectives of quality and extension of the rail system in Morocco was made possible by:

- important investment plans to improve and expand the network;
- coordinated logistics and transport strategies to ensure economic benefits.
- continuous training to ensure that staff are effectively involved in the construction, operation and management of the system.

The parallel development of these components has contributed significantly to the maintenance of a competitive state railway. To guarantee a coherent strategy, railway development in Morocco follows three actively coordinated levels of planning and assessing: high speed railway, conventional railways and rapid transit system in urban areas (RER).

Coordinating different levels implies continuous regulation support from the Government to adapt a legal framework that must answer developmental needs. This currently involves preparing a regulatory framework to make sure new railway actors can possibly enter the market if the environment seems apt.

The ONCF has been commissioned with the management, maintenance and construction of the railway infrastructure and defines the financing mechanisms. If the revenues from the ONCF's activities cover both operating and maintenance costs, the additional revenues will be used to increase infrastructure investments if the results exceed expectations. To achieve this, the Government has relieved the ONCF of significant debt prior to the reform and has reduced intrusion into operational decisions in order to establish appropriate tariff regimes.

The connection of the concession to the mining/logistic industry has been very important for the development of the system. The investment programs and development plans include the construction of

several dry ports to provide with an integrated logistics chain, such as Casablanca MITA. Connections between ports and hinterland through railway are a strategic decision to support industrial development and international cost competitiveness.

Project Exposure (Risk) analysis		
Project: Morocco (ONCF)		Notes
Technical		<i>good technical start up supported by technical training</i>
Commercial		<i>consistent traffic volumes</i>
Financial		<i>internal financial resources plus foreign support</i>
Partnership/Governance		<i>experienced managers made the difference</i>
Contractual		<i>absence of a true external concessionnaire</i>
Regulatory/monitoring		<i>structured Country legal/regulatory framework</i>

Figure 9-10. Morocco (ONCF): Project Exposure analysis.

9.3 RAILWAY CONCESSIONS WORLDWIDE

9.3.1 EUROPE

According to the European PPP Expertise Centre (EPEC), 1,749 PPP projects worth a total of €336 billion reached financial close in the EU PPP market between 1990 and 2016. Most projects were in the transport sector, which in 2016 accounted for one-third of all PPP investments, followed by healthcare and education. Before the financial and economic crisis, the PPP market was experiencing a sharp increase in volume, but since 2008 the number of new PPP projects has decreased considerably. According to the EIB (European Investment Bank) report, in 2018, the aggregate value of PPP transactions that reached financial close in the European market totalled €14.6 billion, a 4% decrease from 2017 (€15.2 billion) and the number of PPP transactions reaching financial close fell to 39, compared to the 44 of 2017.

For the purpose of this document we will analyse three different railway PPP experiences:

- France: South East Atlantic HSR
- Netherland: (HSL Zuid)
- Portugal-Spain: HSR Lisbon – Madrid

9.3.2 FRANCE (SOUTH EAST ATLANTIC HSR)

In June 2011, the Government authority (RFF - Réseau Ferre de France) signed a 50-year concession with the LISEA consortium for the development of a new high-speed railway line (302 km long, with 38 km of

connecting line) between Tours and Bordeaux. At €7.8 billion it is the largest PPP project in France and one of the largest in Europe.

The concession provides for the financing, design, construction, operation and maintenance of the project for a 50-year period. The design-build contract has been awarded to a consortium led by VINCI Construction. An SPV company called MESEA has been formed by VINCI Concessions (70%) and Inexia (30%) to operate and maintain the new high-speed line with a projected construction period of 6 years. The project was completed on time and the line has been operating since early July 2017.



The consortium will be remunerated in the form of traffic-related fees paid by users operating trains on the new line.

The Tours-Bordeaux High-Speed Rail was funded through a public-private partnership:

Private (€3.8 billion): LISEA is responsible for financing €3.8 billion of the project cost. Sources for LISEA's financing include equity contribution by LISEA shareholders, the European Investment Bank (EIB), Fonds d'Epargne, bank debts guaranteed by the French Government, and non-guaranteed bank debts.

Public (€4 billion): subsidies offered by the French Government, local communities, and the EU will amount to nearly €3 billion, while RFF (Réseau ferré de France) invested €1 billion in the project.

Project Exposure (Risk) analysis

Project: France (South East Atlantic HSR)		Notes
Technical		<i>A state of the art of HSR</i>
Commercial		<i>good competition to road/air connection</i>
Financial		<i>the biggest PPP project in France (€ 7.8 billion)</i>
Partnership/Governance		<i>Private company monitored with a set of KPI</i>
Contractual		<i>50 years concession for better value for money financing</i>
Regulatory/monitoring		<i>clear rules set by the Regulatory Authority</i>

Figure 9-11. France (South East Atlantic HSR) Project Exposure Analysis

9.3.3 NETHERLAND: (HSL ZUID)

HSL Zuid is a 125km high speed railway line stopping at three stations: Amsterdam Zuid, Amsterdam Schiphol Airport and Rotterdam, before continuing to the Belgian border to connect with services to Antwerp, Brussels and Paris. The principal objectives of the project were to connect Rotterdam, Schiphol and Amsterdam to the European High Speed Rail Network, to encourage economic development, and to

provide an alternative to air travel to European destinations. HSL Zuid is a dedicated double track infrastructure project, designed for a maximum line speed of 300km per hour.

The HSL started operating in 2009, after a four-year delay. The delays were caused by a variety of factors: there was public opposition to the route and disagreements in government prolonged the decision-making process; the choice of security system also caused delays: the specifications of the standard were confirmed late, which also delayed the ordering and supplying of trains.



The Dutch Ministry of Transport was the client and financier of all civil works (including tunnels, bridges and elevated sections) throughout the project, and retains ownership of the line. Construction of the railway civil works was divided into several contracts, each worth about €400 million, awarded to different contracting consortia. A key feature of the project was the separation of the construction works package from track and signalling to achieve a better risk allocation.

Total cost was approximately €5 billion, of which:

- Public contribution was €4 billion, with €2.6 billion coming from the Transport Ministry and around €1.7 billion provided by the FES (Fonds Economische Structuurversterking) a fund for strengthening the economic structure based on revenues from gas exports
- Private funding amounted to €940 million.

Following the privatisation of Dutch railways, HSL Zuid was the first rail project developed with minimal influence from the national rail operator, NS, however the concession for operating the new line was awarded to a joint venture between NS and another company, then taken over by the same NS in 2015.

Project Exposure (Risk) analysis

Project: Netherland (HSL Zuid)		Notes
Technical		4 years delay due to technical (and political) issues
Commercial		sinergies with the European High Speed Rail Network
Financial		Most of the investments were financed by the public
Partnership/Governance		concession was taken over by National Railways in 2015
Contractual		Availability charge paid to construction company
Regulatory/monitoring		Netherlands Authority for Consumers and Markets (ACM)

Figure 9-12. Netherland (HSL Zuid): Project exposure analysis

9.3.4 PORTUGAL - SPAIN: HSR LISBON - MADRID

The Portuguese HSR network was intended to establish a high-speed railway link between Lisbon and Madrid. The project would have involved the construction of new lines totalling approximately 650 kilometres between Lisbon, Porto and Madrid, with the project's total investment value being approximately €8 billion. The project was to be financed by a mixture of European Union grants and public and private finance. The project was divided into six separate packages ready for procurement using a PPP model.

However, the project was abandoned in March 2012 by the Portuguese Government. There were a number of factors: the European financial crisis, the discovery of illegal clauses in the contracts and irregularities in the concession and the tender process.

9.3.5 INDIA

India owns one of the most extensive railways in the world, notwithstanding PPP hasn't occurred for a long time due to the high degree of control by the Government.

In the context of the relatively slow progress in attracting PPPs, the Government brought on a new approach in 2012, by classifying PPP investment groups and modes in a systematic view. The policy is known as "Participative Policy of Investment in Railway Infrastructure", and was launched in 2012 to invite the participation of investors. Both foreign and domestic, and private, semi government and government entities can participate in the development of railway infrastructure.

Besides laying the general provisions, the new policy gives specific projects on a case-to-case basis depending on the model of private investment. The Ministry of Railways either grants direct permission or starts a competitive bidding to award a project.

As per the 2012 Policy, the following entities can participate in the development of railway infrastructures:

- State Governments and Local bodies
- Beneficiary industries and Ports
- Large import and export companies
- Infrastructure and Logistics providers
- Foreign Direct Investors

Private sector investment in PPP will be selective and the specific issues will be determined on a case by case basis.

The policy was modified and more liberalized in 2014. A major feature of the PPP initiatives after the 2012 policy is that many projects are aimed at building connectivity between railway stations and ports or last mile connectivity to commodity (like coal) production locations.

As one of the first projects, Indian Railways has identified 600 stations for redevelopment under existing public private partnership (PPP); the project for the first 50 stations should begin by 2019.

9.3.6 CHINA

In 2017 China signed an agreement for its first PPP rail project.

This agreement was for the Hangzhou-Shaoxing-Taizhou railway (269 km line with 9 stations), China's first high-speed line with private investors taking the controlling stake. This is one of eight railway projects approved by China's National Development and Reform Commission that involve a PPP scheme.

A group of private investors led by the Chinese conglomerate Fosun International will invest around \$6.2 billion in the project and will hold a majority stake. Thus, the investor consortium will take a controlling 51% stake. Under the PPP contract, the project company will set the ticket price, while China Railway Corp and its Shanghai Railway Bureau will be in charge of the daily operation of the railway line.

Construction of the line will take four years and the joint operation period will be of 30 years. As the project will adopt a build-own-operate-transfer cooperation mode, the ownership of the railway will be transferred to the government for free after the 30-year period ends. The construction companies for the railway project will be appointed through a separate bid and the consortium of privately-owned enterprises and the Zhejiang government will set up a project company that will be responsible for the construction.

9.4 RECOMMENDATIONS

In view of the knowledge gained by analysing the last 30 or more years of worldwide PPP experiences, we can say that this model can be considered to be one of the main ways to manage a long term investment in the railway sector.

However, in order to make sure that both ongoing and new PPPs have a positive outcome, the following potential issues from past experiences must be taken into consideration:

1. Unclear project identification, lack of an adequate business plan and underestimation of investment/costs needs:

- **Analysis:** one of the main reasons of PPP failure has been a poor preventive analysis. At the beginning of the project an adequate assessment of the existing infrastructure and rolling stock wasn't made. This came to light only after the concession was awarded and changing the original business plan became necessary. It is possible that suitable technical assistance during the first stages could have highlighted these elements and helped develop a better contract, thus avoiding some of the problems. Consequently, most concessions have underestimated the amount of investment required and the sums committed have had limited impact on improving railway performance. The underestimation of costs often implied lack of maintenance, that has been one of the main reasons why African railways have lost their original capacity;
- **Recommendation:** the engagement of a specialized third party advisor could help the government define a consistent economical evaluation of the project, both in the initial phase and during the following operation activities. A correct investment/cost plan is crucial in avoiding further increases in the viability gap. The economical evaluation is not only fundamental in defining an investment/cost plan, but is also crucial in the definition of the revenue business model, which is often too approximate and doesn't highlight potential high volume generating markets (such as mining areas, dense freight corridors and large metropolitan areas). In Africa freight railways carry out the most profitability activities, especially if taking into consideration the whole logistics chain.

2. Most concessionaries didn't have a robust shareholding

- **Analysis:** due to insufficient due diligence on the financial capabilities of the original shareholders, the project company has not performed as expected, becoming very unstable and not only unable to commit to additional investments, but also incapable of maintaining the infrastructure at an acceptable standard: in some cases the concessionaire returned the infrastructure in extremely poor conditions, so much so that the government had to put investments in place to assure a minimal service. Furthermore, to stay operative the

concessionaire needed multiple restructurings and amendments, draining resources from the Government of International Finance Institutions.

- **Recommendation:** during the bidding and awarding process, specific attention and due diligence should be focused on the financial stability of the project company and its shareholders and to the equity put into the project, both for the initial phase and for the following operations.

2. The competitive environment (especially with road) in which railways operate has not been adequately evaluated and addressed

- **Analysis:** most of the successful PPPs show that it's important to create a synergetic transport environment. Some current road and rail schemes are being promoted simultaneously without full consideration of competition between both modes;
- **Recommendation:** before laying out a railway business plan, a master plan that includes all transports and coordinating policies with road transportation should be defined. In this document the railway's economic (shifting from road to diesel railway may potentially significantly reduce external costs), social and environmental contributions should be monetised, especially in the case of large cities, where it's crucial to develop and effectively implement policies that shift traffic from road to rail.

3. Operators burdened with public service obligations and legacies from the past

- **Analysis:** freight and passenger transport are different businesses with very different profitability, but railway concessionaires (most of them freight-driven) have often been burdened with passenger obligations. These obligations coexist uncomfortably with their core business and expose them to major complexities, costs, risks and scrutiny. Moreover, they have been obliged to take over a substantial share of state railways legacy.
- **Recommendation:** a new approach to passenger service is required; the creation of separate contracts could solve this issue. If this solution is not possible, then the creation of different cost centres is at least required, in order to have a clear view of the costs that the concessionaire must bear. This is because any passenger services will need to be subsidised and, eventually, this should be done through separate financing schemes.

4. Separation of responsibilities for infrastructure renewal or maintenance is a source of instability

- **Analysis:** most concessions require operators to be engaged to some degree in infrastructure renewal or maintenance. This means that most African concessions involve a hybrid business model between vertically integrated railways and segregated ones, making room for interpretations, disagreements and, eventually, termination.
- **Recommendation:** the construction company has to be separate from the concessionaire. The management of different contracts and companies (i.e. in some new Chinese projects) could

be a good solution, especially if a grey period to transfer expertise and capabilities from the construction to the operative team has been defined in the project. Then, after the initial

investment, a systematic and structured approach to maintenance is mandatory as a cornerstone to guarantee railway performance and a long-lasting infrastructure.

5. The concession model has to be reformulated to find the best balancing public and private investment

- **Analysis:** most countries with concessions have reached the conclusion that infrastructure assets should be kept and managed by the public sector. However, they are still struggling to define the financial models and funding sources for infrastructure maintenance. In other cases, countries with a less powerful public sector are more actively engaged in looking for private investments, but there is still too little experience and familiarity with railways to build robust business models.
- **Recommendation:** notwithstanding the widely accepted fact that PPPs should be explored to put together the huge amounts of funding required in these big projects, a cautious approach is recommended. Railway is a long-term project, so the concession period should be of at least 30 years. The involvement of Financial Institutions – especially if it's possible to create interstate projects – will help the success of the project, both on the financing front and with the ability to define a robust business plan that could attract investments from the private sector. The railway sector has to consider that the increase in trade between African countries will be a source of development; larger railway markets in Africa should be promoted through increased cross-border cooperation.

6. Creation of a good relationship between Government and Concessionaire

- **Analysis:** most failed PPPs experienced bad relationships and unclear law environment in the PPP. Unclear contract language and the lack of a rail regulator with clear powers to impose sanctions for breaking the agreed upon terms may contribute to the poor performance of the concessionaire.
- **Recommendation:** The institutional setting (Government ministers and Law) and a clear contract including all necessary terms and conditions is essential to create and manage a PPP project. The shared objective of government and concessionaire is to provide a good service at the correct cost, so, if needed, the concession has to be renegotiated and improved over time, so both government and concessionaire have to be flexible to negotiate amendments that allow the concession to stay afloat. Furthermore, the contract needs to include clauses for the implementation of risk mitigation mechanisms to protect the concessionaire from circumstances such as Force Majeure events (mainly cyclones), political instability, exchange rate risk, inflation risk and market risk.

7. Concessionaire managers and workers

- **Analysis:** inadequate management and low motivated workers have been additional reasons of failure. In some cases, managers and workers move from a government resource policy to a private model without any incentive plan and training.
- **Recommendation:** The appointment of technically competent and economic return focused team managers and staff is another milestone for the success of a PPP project. In case of transferring personnel from public to private, a specific plan that includes training and salary incentives agreed upon during the business case preparation is highly recommended.

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ANNEXES

ANNEX 1: ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK



REPUBLIC OF GHANA

Ministry of Railways Development

Ghana Railway Development Authority

Updated Environmental & Social Management Framework

GHANA RAILWAY MASTER PLAN

December 2019



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List of Acronyms

AER	Annual Environmental Report
ARIs	Acute Respiratory Infections
BOST	Bulk Oil Storage & Transportation Company
BRT	Bus Rapid Transit
CBO	Community Based Organizations
CL	Central Line
CERSGIS	Centre for Remote Sensing and Geographic Information System
CWSA	Community Water and Sanitation Agency
DFR	Department of Feeder Roads
DUR	Department of Urban Roads
EA	Environmental Assessment
EAR	Environmental Assessment Regulations
ECG	Electricity Company of Ghana
ECOWAS	Economic Community of West African States
EHD	Environment and Health Department
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Eastern Line
EM	Environmental management
EMP	Environmental Management Plan
EMU	Environmental Monitoring Unit
EP	Environmental permit
EPA	Environmental Protection Agency
ESA	Environmental and Social Assessment
ESAs	Environmentally Sensitive Areas
ESM	Environmental and Social Management
ESMF	Environmental and Social Management Framework
FC	Forestry Commission
FSD	Forest Services Division
GAMA	Greater Accra Metropolitan Area
GCT	Ghana Chamber of Telecommunication
GDP	Gross Domestic Product
GHA	Ghana Highway Authority
GoG	Government of Ghana
GPRS	Ghana Poverty Reduction Strategy
GPRTU	Ghana Private Road Transport Union (of the TUC)
GRCL	Ghana Railway Company Limited
GRDA	Ghana Railway Development Authority
GSGDA	Ghana Shared Growth Development Agenda
GT	Ghana Telecommunications Company (Vodafone)
GWCL	Ghana Water Company Limited
HIV/AIDS	Human Immuno-deficiency Virus/ Acquired Immune Deficiency Syndrome
ILO	International Labour Organisation
LI	Legislative Instrument
MDAs	Ministries, Departments and Agencies
MESTI	Ministry of Environment, Science, Technology and Innovation
MLGRD	Ministry of Local Government and Rural Development
MMDAs	Metropolitan, Municipal and District Assemblies

MoH	Ministry of Health
MoT	Ministry of Transport
MoRD	Ministry of Railways Development
MRH	Ministry of Roads and Highways
MTDP	Medium Term Development Plan
MTEF	Medium Term Expenditure Framework
NCA	National Communications Authority
NDPC	National Development Planning Commission
NEAP	National Environmental Action Plan
NGO	Non-Governmental Organization
NMT	Non-Motorised Transport
OPD	Out Patients' Department
OSH	Occupational Safety and Health
PEA	Preliminary Environmental Assessment
PER	Preliminary Environmental Report
PDD	Planning and Development Department
PLWAs	People Living with AIDS
PNDC	Provisional National Defence Council
PROTOA	Progressive Transport Owners' Association
PPE	Personal Protective Equipment
PWD	Public Works Department
RMP	Railway Master plan
RTTFP	Road Transport and Transit Facilitation Program
SEA	Strategic Environmental Assessment
SMTDPs	Sectoral Medium Term Development Plans
STI	Sexually Transmitted Infections
STDs	Sexually Transmitted Diseases
SVP	Southern Voltaian Plateau
ToR	Terms of Reference
TSDP	Transport Sector Development Program
TUC	Trades Union Congress
UEMOA	West African Economic and Monetary Union
URTI	Upper Respiratory Tract Infection
UTP	Urban Transport Planning Project
VSB	Voltaian Sandstone Basin
WB	World Bank
WD	Wildlife Division (of the Forestry Commission)
WHO	World Health Organisation
WL	Western Line
WRC	Water Resources Commission

EXECUTIVE SUMMARY

Introduction

The Government of Ghana has developed a Railway Master Plan to rehabilitate, expand and modernise the railway system and improve the provision of rail transport services. Among others, the master plan will specifically deliver the following:

- Work-plans to up-grade and thereafter in sequential phases, construct new lines;
- Construction of new standard gauge lines covering the whole country (for both existing and new line);
- Construction of new standard gauge sub-urban lines in the regional capitals;
- Financial plan for investment on the existing and proposed network and rolling stock (including infrastructural interventions on the network and at the stations);
- Transport policies capable of ensuring the transfer of traffic from road to rail;
- Intermodal links with other priority projects and increasing the rail transport capacity of goods and passengers; and
- Specifications for railway infrastructure including – track, signal and telecommunication, buildings (including stations, workshops and other structures).

The RMP implementation and its proposed nation-wide expanded coverage will contribute significantly to economic growth by:

- Lowering transportation cost;
- Ensuring economies of scale;
- Reducing domestic production cost;
- Enhancing market access and opportunities for remote rural communities; and
- Expanding trade and market integration.

Enhanced operations will enable rail transport become the bulk carrier. This would reduce the volume of bulk cargo using road transport and thereby prolong the longevity of roads as well as render the roads safe for travellers. Enhanced rail transport will also reduce transit time and facilitate cross border transportation. The significant contribution of the transport sector to emissions and pollution, especially greenhouse gases (GHG) emissions will reduce considerably with rail transport taking up greater part of cargo transportation.

In spite of enormous benefits, the railway sector developments would also exert adverse effects on the social and physical environment within which they are executed. The negative effects of rail development may include: air and water quality deterioration, noise and vibration impacts, soil erosion and sedimentation, public and occupational health risks, disruption of public utility services and train-vehicular conflict, landscape disturbance and habitat fragmentation, and expropriation of farmlands and property.

At this stage the specific scope of the various project types and their detailed designs are not determined; consequently, the potential impacts of the individual projects (under RMP) cannot be assessed. Furthermore, the multiple railway projects to be financed under the RMP are geographically spread the (country-wide) with several phases of implementation over a long timeframe. For such a programme-type of undertaking, Environmental and Social Management Framework (its equivalent being Strategic Environmental Assessment for policies) is therefore the appropriate Environmental Assessment (EA) tool applied.

This Environmental and Social Management Framework (ESMF) has been prepared for projects under the RMP, including construction, re-construction, rehabilitation, decommissioning, scrapping, realignment, installations, etc. of the railway network and infrastructure in Ghana. The ESMF provides the required environmental and social assessment and safeguards framework, institutional arrangements and capacity required to identify and mitigate potential risks/impacts of actions (under the RMP), as well as monitor the overall implementation. It also primarily guides the individual project-level EA screening, assessment and mitigation of impacts as well as management and monitoring requirements.

Thus, the ESMF will enable GRDA and the Ministry of Railways Development (MoRD) to address the adverse environmental and social impacts arising from or induced by the RMP implementation; and to collaborate with various stakeholders in the rail transport sector. The ESMF also represents a statement of policy, guiding principles and procedures of reference with respect to railway sector projects, consistent with requirements of the LI 1652, and agreeable to key stakeholders.

Updating the ESMF

This updated ESMF was derived from the January 2013 version, which was submitted to EPA for an Environmental Permit to implement the RMP. For over six years post-permit, the ESMF was not implemented, and therefore required an update to make the ESMF current, responsive and acceptable for renewal of the environmental permit, by addressing some significant changes that have occurred. Some of the changes include:

- New corridors now introduced to the RMP, e.g. Takoradi to Elubo, and Sekondi to Shama additional/branch lines;
- New policies and legal frameworks now applicable, e.g. –
 - a. Electrical and Electronic Waste Control and Management Act, 2016 (Act 917); and
 - b. Hazardous, Electronic and Other Wastes (Classification), Control and Management Regulations, 2016 (LI 2250);
 - c. National Policy on Public Private Partnerships for consistency with the strong private sector involvement for the railway sector development;
- Other changes include –
 - a. Economic characteristics updates;
 - b. Ghana Landfill Guidelines to address old railway buildings Asbestos roofing sheets disposal;
 - c. The Local Governance Act, 2016 (Act 936);
 - d. Land Use and Spatial Planning Act, 2016 (Act 925);
 - e. Riparian Buffer Zone Policy (2011);
- The sector's institutional oversight now residing at the Ministry of Railways Development;
- New additional key stakeholders

A railway market survey was also conducted in March/April 2019 to inform the needs of the market, the market size and competition with other modes of transportation, willingness to pay and the level of interest of actual and potential patrons of the planned developments under the RMP, among others. The results showed that rail service was patronized by people from various backgrounds - formal workers, artisans, students, market women, etc. It also showed a good potential for patronage of the rail service, though some level of unwillingness to pay comparable fares as other transport services was recorded. Trains ranked favourably to private car, taxi and trotro/bus in terms of its use as a primary means of transportation, saving travel time, safety, comfortability and flexibility.

Key Policy, Legal and Institutional Framework

The key policy, legal and institutional framework references used for the assessment and in the preparation of the ESMF are summed up below.

1. Ghana's Environmental Policy, which defines a set of policy and other actions, intended to make Ghana's development strategy environmentally sustainable.
2. Environmental Protection Agency Act of 1994 (Act 490), which grants enforcement and standards setting powers to the EPA, as well as the power to ensure compliance with the EA requirements and regulations for proposed undertakings.
3. The Environmental Assessment Regulations (LI 1652) which combine both environmental assessment and management systems; prohibiting commencing a "undertaking" without prior registration and environmental permit, and define the relevant stages of the EA procedures and the environmental management system.
4. Others included:
 - The Railways Act, 2008 (Act 779);
 - Town and Country Planning (Amendment) Act, 1960 (Act 33) / the Local Governance Act;
 - Labour Act, 2003 (Act 651);
 - Occupational Safety and Health Policy of Ghana (Draft);
 - Forestry Commission Act;
 - Water Resources Commission Act;
 - Lands Commission Act; and
 - Ghana Shared Growth and Development Agenda, etc.

General Physical and Socio-Economic Baseline

The nature of the terrain and land form in Ghana affects rail infrastructure planning. The expansion of the right of way to a 60m width for double track development will have implications for existing land cover and land use system, and water resources, among others, described in the physical and socio-economic baseline.

Ghana has ten administrative regions. The total surface area, including areas occupied by water bodies is 238,539km². There are various land use systems, including human settlement, agriculture, forestry and wildlife areas. Wildlife and biodiversity resources comprise a diverse array of species including several of conservation concern. Over 3,600 plant species, representing the three major taxonomic groups occur in Ghana. The three major drainage basins are the Volta Systems, the South Western River and the Coastal River Systems. Over 90 lagoons and associated wetlands found mainly along the coast also occur.

The topography consists of forests dissected plateau, savannah high plains, Voltaian sandstone basin, ridges and escarpments. Land is governed by pieces of legislation relevant in the consideration of land tenure and acquisition for right of way for rail infrastructure development. These include:

- The Administration of Lands Act, 1962 (Act 123);
- State Lands Act, 1962 (Act 125);
- State Lands Regulations 1962 (LI 230);
- State Lands (Amendment) (No. 2) Regulations 1963 (LI 285);
- Lands (Statutory Way Leaves) Act, 1963 (Act 186); and
- Office of the Administrator of Stool Lands Act, 1994 (Act 481).

Other baseline areas described include: climate which has been classified into four main regions, the South-Western Equatorial, Dry Equatorial, Wet Semi-Equatorial and the Tropical Continental (Savannah) Climatic

Zones; and socio-cultural and economic characteristics, which include population distribution, cultural resources and poverty profile of Ghana.

Existing Railway Network and Infrastructure

Infrastructure

The railway network is single-tracked, except the first 30.6km of the WL from Takoradi to Manso, which has been partially realigned and double-tracked. The tracks of the network are 1067mm gauge conventional track structures, using standard flat-bottom rail sections, steel or wooden sleepers and stone ballast. The two main types of sleepers are the steel and domestic hardwood sleepers. Steel sleepers used to be the standard, until preference in recent years for locally-sourced hardwood sleepers. The ballast materials used do not have adequate abrasion resistance for use as railway ballast.

The network has 287 bridges, about 80% of which are steel girder or truss bridges with timber decks, with the remaining as reinforced concrete bridges. Communication systems available include various types of telephone, radio and microwave systems. The systems generally have not been well structured to provide adequate communication capabilities for train operations.

The fleet of locomotives is 36, of which 5 are operational and the others defective. The total number of wagons available is about 490, over 60% of which consist of low-sided wagons for Bauxite and Manganese ore haulage. There are other on-track and off-track equipment, as well as ancillary facilities such as the rolling stock maintenance facilities concentrated at the Location Workshop Complex near Sekondi.

The GRCL has a fleet of 97 vehicles, consisting of 16 on-track machines, 17 off-track machines and 65 road vehicles. The GRCL has two types of train control signals installed at discrete locations; mechanical interlocked signals and transmission system and colour light signal system

Overview of the Railway Master Plan

The RMP is designed to revamp and transform the railway sector to meet current demands of the transport sector, while introducing efficient, high speed rolling stock to run on standard gauges from south to north of Ghana. The three main components of the Plan include:

- Improvement and modernisation of the existing railway infrastructure;
- Expansion of railway infrastructure to other parts of the country and linking with neighbouring countries such as the Ivory Coast, Togo and Burkina Faso; and
- Interconnection of railway infrastructure with other modes of transportation (inter-modalism).

The planned improvement or modernisation of the existing railway infrastructure includes conversion of the existing lines to standard gauge.

As part of the long-term development plan of Government, it is envisaged that the expansion of the existing network will pave the way for linking Ghana to its neighbouring countries. It is also proposed to expand the existing Central Line to link the eastern and western neighbouring countries of Togo and the Ivory Coast. The expansion is in line with the objective of the Economic Community of West African States (ECOWAS) to link all member states by rail. This is also to facilitate the achievement of the broad objective of the Union of African Railways to link member countries by rail.

Some of the projects envisaged under the RMP may include the following:

- **New Construction Projects**

- Construction of new double track rail lines with standard gauge
- Construction of new bridges
- Construction of railway stations
- Construction of administrative offices
- Construction of passenger waiting sheds, parking spaces and boarding areas
- Construction of workshops and stores
- Ballast quarry and aggregates quarries
- **Decommissioning and Re-construction Projects**
 - Reconstruction of about 287 steel and concrete, short and long span bridges
 - Reconstruction of the WL, EL and CL and branched lines into double tracks, with standard gauge, new alignments and reinforced permanent way.
- **Decommissioning and Scrapping Projects**
 - Unserviceable locomotives, coaches, wagons, etc scrapping project
 - Signalling and telecommunication systems scrapping project
 - Old steel bridges scrapping project.

Stakeholder Involvement

Institution/organisations relating to railway project (environmental) approvals, planning, road crossings, interference with utility provision and service lines and natural resource management in the corridor selection were mapped out for consultation. These included the following:

- Environmental Protection Agency;
- Metropolitan, Municipal and District Assemblies;
- Department of Urban Roads;
- Ghana Highway Authority;
- Department of Feeder Roads;
- Forest Services Division of the Forestry Commission;
- Water Resources Commission;
- Electricity Company of Ghana;
- Ghana Water Company Limited;
- Volta River Authority;
- National Communications Authority;
- Ministry of Environment, Science, Technology and Innovation ;
- Ghana Chamber of Telecommunications/Vodafone Ghana Limited; and
- Bulk Oil Storage and Transportation Company.

Potential Environmental and Social Impacts

The environmental and social (E&S) impacts and risks section presents the following four main significant components of the ESMF:

- Criteria for screening the specific projects to be implemented under the RMP;
- Methodology for assessing and ranking RMP project impacts and risks;
- Generic E&S beneficial and adverse impacts of the RMP; and
- Assessment of the individual (RMP) project implementation phase potential E&S impacts.

The ESMF provides a listing of environmental and social concerns common to rail infrastructure construction and their potential degree of significance. Out of twenty-four potential concerns presented,

stakeholder participatory review identified the most common and significant potential impacts in rail infrastructure development to include dust emission, noise and vibration, occupational/public accident, forestry concerns and waste disposal. Four of the concerns identified as most significant (dust, noise and vibration, accident and waste) also fell within the first six common rail infrastructure development impacts.

With respect to rail (transport) operation phase, the stakeholder participatory review identified level crossing accident, train accident, noise and vibration, and lack of track maintenance as the most common and significant issues to consider during assessment of impacts of projects. From the stakeholder responses, four out of the six commonest issues were also deemed to be significant.

The main adverse potential impacts of rail projects identified and assessed to apply to the RMP projects included:

- Land acquisition and property loss;
- Potential train accident risk;
- Public health and safety risk;
- Occupational health and safety impacts;
- Asbestos roofing sheets removal and disposal risks;
- Risk of spread of HIV/AIDS;
- Water resource impacts;
- Noise and vibration impacts;
- Impacts on cultural resources;
- Habitat destruction and disruption;
- Waste disposal impacts;
- Potential human rights abuse and gender disparity;
- Traffic disruption and diversion impacts; and
- Utility disruption.

Environmental and Social Safeguards and Mitigation Principles

The ESMF offers safeguards options and other mitigation principles for preventing, minimizing, compensating or managing various environmental and social impacts (Appendix 2), as an integral part of rail project design and planning, or for implementation at the construction or operation phase. The highlights of the environmental and social mitigation plan include the following:

- Enhancing beneficial aspects of railway services by incorporating recommendations from the market survey results in design or construction or operational stages;
- Resettlement and compensation measures for land-take (acquisition) and property losses;
- Train safety principles to prevent or minimize potential accidents through training and by enforcing requisite safety and maintenance protocols, with supervision;
- Public health and safety principles to safeguard the public or passengers and pedestrians against project related or induced risks and hazards;
- Occupational health and safety principles to prevent work-related accidents and other health risk exposures;
- Workplace HIV/AIDS policy and sensitisation programme;
- Water resource protection principles to prevent, minimize or manage impacts on water bodies and quality from railway projects;
- Noise and vibration control principles by raising worker awareness and adherence to relevant operational standards, with supervision, while enforcing corridor reservation;

- Cultural resources preservation principles by designing and aligning permanent ways to avoid culturally sensitive sites;
- Habitat protection principles by identifying ecologically sensitive sites and instituting habitat and biodiversity preservation measures, where avoidance is not possible;
- Waste disposal and management principles to ensure awareness and sound handling of generated waste during rehabilitation, construction and operation phases;
- Traffic avoidance and safety principles to control potential congestion and accidents due to construction or rehabilitation activities interfering with road transport; and
- Utility disruption avoidance principles through effective pre-planning and alternative installation or provision of services in advance of the proposed civil works or tampering with affected utility or service line.

ESMF Implementation and Management

The ease of implementation of the ESMF and its success depends on the commitment of the railway sector and other key institutions, as well as the capacity within the respective institutions to effectively apply the framework. The GRDA and MoRD were fully involved in the preparation of the ESMF, as well as the other relevant institutions such as EPA. Though knowledge about this ESMF and its implementation demands are well disseminated, the following have been clearly defined to facilitate application and effective safeguards implementation for sustainable outcomes:

- GRDA's implementation role of the ESMF;
- Capacity building needs; and
- Institutional arrangements.

The GRDA is the implementing agency of the RMP, under the Ministry of Railways Development (MoRD). Other institutions whose functions bear on railway development, corridor selection, acquisition and management, rail-road crossings and project approvals, etc. were grouped into four. These institutions were involved in the assessment processes to defined their respective interests, in line with agreed procedures to follow in implementation of the RMP projects. These included the following:

Lead environmental regulator and the planning authority –

- Environmental Protection Agency (EPA); and
- Metropolitan/Municipal and District Assemblies (Town and Country Planning Department).

Road sector institutions –

- Department of Urban Roads;
- Ghana Highway Authority;
- Department of Feeder Roads;

Resource management institutions –

- Wildlife Division (WD) of the Forestry Commission;
- Forest Services Division (FSD) of the Forestry Commission;
- Lands Commission;
- Water Resources Commission (WRC)

Utility and service providing (pipeline, electricity lines and telecommunications) companies –

- Electricity Company of Ghana (ECG);
- Ghana Water Company Limited (GWCL);
- Ghana Chamber of Telecommunications (GCT);
- Vodafone Ghana Limited;
- National Communications Authority; and

- Bulk Oil Storage & Transportation Company (BOST).

The Environment and Health Department (EHD) of GRDA will be involved at all stages of project planning, rehabilitation or decommissioning, by initiating the registration and Initial Assessment of proposals with the respective EPA (Regional) Office. The functions to be performed by EHD have been specified both at the environmental and social assessment and the management phases. The collaborative and supervisory role of the Site Engineer during construction phases has also been defined, and relevant environmental and social clauses for the contractor provided.

Capacity building needs for the EHD to enable regular application of relevant tools and EA procedures in their normal functions have been determined. The capacity enhancement programme will among others, cover the three distinct tools developed in the ESMF below. These include the Railway Sector-Specific:

- Sensitivity Screening Criteria;
- Initial Assessment Form; and
- EA Procedures for undertakings under the RMP.

CHAPTER ONE

Introduction

- ❖ Background
- ❖ Rail Infrastructure Needs
- ❖ Environmental and Social Context of Railway Development
- ❖ Purpose and Objectives of the ESMF
- ❖ Methodology of the ESMF Process
- ❖ Structure of the ESMF Report

1.0 Introduction

1.1 Background

This report is an updated version of the Environmental and Social Management Framework (ESMF) for the Railway Master Plan (RMP) of Ghana prepared in January 2013, and submitted to EPA for an Environmental Permit for the RMP implementation. For over the six-year period that the ESMF was not implemented, some significant changes have occurred, which need to be addressed in order to make the ESMF current, responsive and acceptable for renewal of the environmental permit, among others. Some of the changes include the following:

- New corridors now introduced, for instance, two additional/branch lines (Takoradi to Elubo, and Sekondi to Shama) and need for Resettlement Action Plans for new Right of Way acquisitions;
- New policies and legal frameworks, e.g. –
 - a. Electrical and Electronic Waste Control and Management Act, 2016 (Act 917); and
 - b. Hazardous, Electronic and Other Wastes (Classification), Control and Management Regulations, 2016 (LI 2250) to deal with communications and related electronic and electrical waste equipment;
 - c. Strong private sector involvement – for consistency with the
 - d. National Policy on Public Private Partnerships for consistency with the strong private sector involvement for the railway sector development;
- Other changes include –
 - a. Economic characteristics - selected current indicators of the national economy (World Bank: Country Brief (2019));
 - b. Ghana Landfill Guidelines (2002) to address the major disposal concerns of old Asbestos roofing sheets from decommissioned railway buildings;
 - c. The Local Governance Act, 2016 (Act 936); and
 - d. Land Use and Spatial Planning Act, 2016 (Act 925) for linkage of the RMP with the Spatial Development Framework and the Planning and Zoning Standards;
 - e. Riparian Buffer Zone Policy (2011) to address drainage and watershed issues along the railway corridors;
- The sector's institutional oversight now resides in the Ministry of Railways Development (not Ministry of Transportation);
- New additional stakeholders such as –
 - a. Ministry of Environment, Science, Technology and Innovation;
 - b. National Communications Authority; and
 - c. Ghana Gas Company Limited, etc.

The RMP is designed to revamp and transform the railway sector to meet current demands of the transport sector, while introducing efficient, high speed rolling stock to run on standard gauges from south to north of Ghana. The three main components of the Plan are the:

- Improvement and modernisation of the existing railway infrastructure;
- Expansion of railway infrastructure to other parts of the country and linking with neighbouring countries such as the Ivory Coast, Togo and Burkina Faso; and
- Interconnection of railway infrastructure with other modes of transportation (inter-modalism).

As part of the long-term development plan of Government, it is envisaged that the expansion of the existing network will pave the way for linking Ghana to its neighbouring countries. It is also proposed to expand the existing Central Line to link the eastern and western neighbouring countries of Togo and the Ivory Coast.

The expansion is in line with the objective of the Economic Community of West African States (ECOWAS) to link all member states by rail. This is also to facilitate the achievement of the broad objective of the Union of African Railways to link member countries by rail.

At this stage the specific scope of the various project types, the time-frame for their implementation, and the detailed designs are not determined or carried out; consequently, the impacts cannot be assessed on project by project basis. Furthermore, the multiple railway projects to be financed under the RMP are geographically spread throughout the country and yet to be precisely defined. The appropriate Environmental Assessment tool to use is therefore the ESMF (its equivalent being the Strategic Environmental Assessment (SEA) for policies).

1.2 Rail Infrastructure Needs

The various modes of transportation in Ghana include road, aviation, water and rail transport. The Ghana Poverty Reduction Strategy (GPRS), as well as the Ghana Shared Growth Development Agenda (GSGDA) defined transport improvement as an integral component for opening up the country for productivity. The transport sector accounts for approximately 9% of GDP and generates a significant share of the total budgetary revenue of the country. Road is the dominant means of transport, while Ghana's existing rail network is confined mostly to the southern part of the country, with limited operability and contribution to Ghana's socio-economy.

The total rail track length is about 940km. Minerals constitute the main bulk of the goods traffic on the network, though cocoa and timber traffic used to be substantial. Very limited passenger train services are provided on selected lines. The current rail network is characterized by old tracks and inadequate railway terminals and platforms. The existing railway network will be rehabilitated in some cases, and totally rebuilt in others, modernized and expanded to re-create a largely efficient system that will support the new oil and gas industry as well as ease pressure and congestion on the roads and highways

Transport improvement is known to be essential to accelerate connections to main food growing and potential agricultural growth areas of the country. The fundamental policy objective of the Ministry of Transport (MoT)/MoRD in this respect is to establish an efficient, modally complementary and integrated transportation network for the movement of goods and people at the least possible cost. The RMP has been formulated within the framework of this policy direction to ensure the transport sector policies are met.

A railway market research conducted in March/April 2019 provided useful information on the needs of the market, the market size and competition with other modes of transportation, the level of interest of actual and potential patrons of the development of the railway network in Ghana, as well as the "willingness to pay" (i.e. the most a user will spend for the service). The results indicated the rail service was patronized by people from various backgrounds - formal workers, artisans, students, market women, etc. It also showed a good potential for patronage of the rail service, though some level of unwillingness to pay comparable fares as other transport services was recorded. Trains ranked favourably to private car, taxi and trotro/bus in terms of its use as a primary means of transportation, saving travel time, safety, comfortability and flexibility.

1.3 Environment and Social Context of Railway Development

Transport development aims to improve the quality of life. A wide range of social benefits arise as a result of rail development or rail improvement interventions. These may include economic benefits, employment generation, social services, travel and transport, enhanced safety and gender opportunities, fuel economy and reduced pollution.

Nonetheless, rail developments also exert adverse effects on the social and physical environment within which they are executed. The negative effects of rail development may include: air and water resource quality deterioration, noise and vibration, soil erosion and sedimentation, public health impacts, disruption of public utility services and train-vehicular conflict, landscape and habitat modification, and expropriation of farmlands and structures.

1.4 Purpose and Objective of the ESMF

The Environmental Assessment (EA) Regulations of Ghana provide the general framework and procedures for EA and environmental management (EM) of development actions of all sectors (including the transport/railway sector). The ESMF, deriving from the EA Regulations is intended to facilitate sector-specific assessment, mitigation and management of railway projects under the RMP. The ESMF will enable GRDA and the Ministry of Railways Development (MoRD) to address the adverse environmental and social impacts arising from or induced by the RMP implementation, and to collaborate with various stakeholders in the rail transport sector.

The ESMF provides GRDA with an environmental and social safeguards framework, institutional arrangements and capacity available to identify and mitigate potential risks of actions (under the RMP). With application of the ESMF, the requirements of the LI 1652 for sustainable railway sector development will be met. The ESMF also represents a statement of policy, standard principles and processes agreeable to all relevant stakeholders; and a tool for mainstreaming environmentally sound principles and approaches into the design and implementation of the RMP. The main objectives of the ESMF include:

- Assessment of potential adverse environmental and social impacts commonly associated with rail project activities and the ways to avoid, minimize or mitigate them;
- Establishment of clear procedures and methodologies for the environmental and social planning, review, approval and implementation of projects financed under the RMP;
- Development of screening criteria and guidelines; and
- Institutional arrangement for effective implementation of the framework;
- Specification of roles and responsibilities and the necessary reporting procedures for monitoring and managing railway sector environmental and social safeguards and risks.

1.5 Methodology for the ESMF Process

The ESMF assessment process and preparation involved visits to selected sites, review of reports and relevant documents and consultation with key stakeholders. The main reference documents reviewed included the following:

- Environmental Protection Agency Act, 1994 (Act 490);
- Environmental Assessment Regulations, 1999 (LI 1652);
- The National Environmental Action Plan;
- The Railways Act, 2008 (Act 779);
- Town and Country Planning (Amendment) Act, 1960 (Act 33) / the Local Governance Act, 2016;
- Labour Act, 2003 (Act 651);
- Occupational Safety and Health Policy of Ghana (Draft 2004);
- Water Resources Commission Act;
- Lands Commission Act;
- Forestry Commission Act; and
- Ghana Shared Growth and Development Agenda (GSGDA, 2010).

The stakeholder participatory processes involved use of questionnaire and discussion sessions. About nine sets of questionnaire were used (Appendices 15A, 15B, 16, 17A, 17B, 17C, 17D, 17E, and 17F). The key stakeholders were grouped into four as follows:

- Lead environmental regulator and the planning institutions –
 - Environmental Protection Agency (EPA);
 - Town and Country Planning Department (of Metropolitan, Municipal and District Assemblies); and
 - Ministry of Environment, Science, Technology and Innovation
- Road sector institutions –
 - Department of Urban Roads;
 - Ghana Highway Authority;
 - Department of Feeder Roads;
- Resource management institutions –
 - Wildlife Division (WD) (of the Forestry Commission);
 - Forest Services Division (FSD) (of the Forestry Commission);
 - Water Resources Commission (WRC);
 - Lands Commission Act
- Utility and service providing and pipeline institutions –
 - Electricity Company of Ghana (ECG);
 - Ghana Water Company Limited (GWCL);
 - Ghana Chamber of Telecommunications (GCT);
 - Vodafone Ghana Limited;
 - Bulk Oil Storage & Transportation Company (BOST); and
 - National Communications Authority

1.6 Structure of the ESMF Report

This Updated ESMF report is divided into nine main sections and appendices preceded by a non-technical executive summary. The sections are as follows:

- Introduction;
- Key policy, legal and institutional framework;
- General physical and socio-economic baseline;
- Existing railway network and infrastructure;
- The railway master plan overview;
- Stakeholder involvement;
- Potential environmental and social impacts;
- Environmental and social mitigation principles; and
- ESMF implementation and management.

CHAPTER TWO

EXISTING POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

- ❖ National Environmental Requirements
- ❖ National Labour, Safety and Health Requirements
- ❖ National Strategic Development Goals
- ❖ Railway Sector Institutions
- ❖ Relevant Institutions

2.0 Existing Policy, legal and Administrative Framework

2.1 Introduction

This section covers the review of policy and legal framework relevant to railway infrastructure development and transport sector, as well as institutional procedures for Environmental Assessment (EA) and management. These include the following:

- National environmental policy requirements;
- Railways Act, 2008 (Act 779);
- National Policy on Public Private Partnerships;
- National labour, safety and health requirements;
- National planning requirements;
- National strategic development goals;
- Railway sector institutions; and
- Relevant institutions.

2.2 National Environmental Policy and Requirements

The review covered the following broad areas:

- Ghana's Environmental Policy;
- Environmental Protection Agency Act, 1999 (Act 490); and
- Environmental Assessment Regulations 1999 (LI 1652).

2.2.1 Ghana's Environmental Policy

The environmental policy of Ghana formulated in the National Environmental Action Plan (NEAP) of 1993 hinged on 'prevention' as the effective tool for environmental protection. The policy aimed at a sound management of resources and environment and the reconciliation between economic planning and environmental resource utilization for sustainable national development. The policy sought among others to institute and implement an environmental quality control and sustainable development programme by requiring prior Environmental Assessment (EA) of all developments.

The new National Environmental Policy builds on the previous one, and aims at managing the environment to sustain society at large. The vision is based on an integrated and holistic management system for the environment in Ghana, and aims at sustainable development.

The policy seeks to unite Ghanaians in working toward a society where all residents of the country have access to sufficient and wholesome food, clean air and water, decent housing and transportation among other necessities of life. The Government of Ghana has envisage the expansion of the existing railway network to pave way for linking Ghana to other neighbouring countries.

2.2.2 Environmental Protection Agency Act, 1999 (Act 490)

The Act grants the EPA enforcement and standard setting powers, and the power to ensure compliance with such standards and guidelines. The Act also mandates the EPA to ensure compliance with the Ghana EA requirements and procedures. The Agency is also required among others to:

- Control and prevent the discharge of waste and the generation, treatment, storage, transportation and disposal of waste;
- Control and monitor use and advice on regulation and management of hazardous substances;

- Develop environmental standards such as the EPA's Ambient Noise Level Guidelines, Effluent Discharge Guidelines to guide compliance and aid effective enforcement; and
- Develop comprehensive database on environment and environmental protection for promotion of sound ecological systems, effective planning and sustainable development.

The Agency is also vested with the power to determine what constitutes an 'adverse effect on the environment' or an activity posing 'a serious threat to the environment or public health', to require EAs (EMPs, and AERs of 'undertakings', to regulate and serve an Enforcement Notice for any offending or non-complying undertakings. The Agency is required to conduct monitoring to verify compliance with approval/permit conditions.

2.2.3 Environmental Assessment Regulations, 1999 (LI 1652)

The regulations prohibit commencing an "undertaking" (including railway infrastructure development, investments, etc.), without prior registration and environmental permit (EP). An "undertaking" according to the LI 1652 means any activity, scheme of development, construction, project, structure, building, work, investment, plan, programme and any modification, extension, abandonment, demolition, rehabilitation or decommissioning of such undertaking, the implementation of which may have a significant impact. Undertakings are grouped into schedules for ease of screening and registration, and for environmental permit. The schedules include undertakings requiring registration and environmental permit (Schedule 1), EIA mandatory undertakings (schedule 2), as well as Schedule 5-relevant undertakings (located in environmentally sensitive areas).

2.3 Railways Act, 2008 (Act 779)

The Act established the Ghana Railway Development Authority (GRDA) and provides for the operation of railways, and mandates GRDA to promote the development of railways and railway services. GRDA is required "to initiate, conduct, promote and encourage studies necessary for the growth and development of railways, including the development of Master Plans, in accordance with the Schedule to the Act".

GRDA is to regulate the railway industry in Ghana, to operate as the railway landlord, to develop and expand the rail and railway systems, to link the systems to neighbouring countries. It is to exercise ownership rights over the infrastructure and all safety/security regulations and to hold, administer and improve the assets transferred to the Authority, including the following:

- Plan and promote the development and management of suburban railways in Ghana;
- Regulate railways in Ghana, covering the granting of licenses, concessions and leases, set and enforce technical standards for the construction and operation of railways, and monitor and ensure compliance;
- Advise the Government on railway matters generally;
- Establish and oversee the administration of the Railway Development Fund;
- Provide for the transitional mechanisms to allow for the operations of railway service by the Ghana Railway Company Limited.

2.4 National Policy on Public Private Partnerships

The key objectives of this policy are to:

- a) Leverage public assets and funds with private sector resources from local and international markets to accelerate needed investments in infrastructure and services;
- b) Encourage and facilitate investment by the private sector by creating an enabling environment PPPs where value for money for government can be clearly demonstrated;
- c) Increase the availability of public infrastructure and services and improve service quality and efficiency of projects;

- d) Ensure attainment of required and acceptable local and international social and environmental standards;
- e) Protect the interests of stakeholders including end users, affected people, government and private sector;
- f) Set up efficient and transparent institutional arrangements for the identification, structuring and competitive tendering of PPP projects;
- g) Provide a framework for developing efficient risk sharing mechanisms; and
- h) Encourage and promote indigenous Ghanaian private sector participation in the delivery of public structure and services.

This Policy is structured to encourage the provision of a wide variety of quality and timely public infrastructure and services. This will be achieved through faster project implementation, maximum leveraging of public funds, enhanced accountability and a shift to whole-life costing and infrastructure management by the private sector.

2.5 National Labour, Safety and Health Requirements

The following were reviewed:

- Occupational Safety and Health Policy of Ghana (Draft) 2017;
- Labour Act, 2003 (Act 651);
- Fire precaution Regulations 2003 (LI 1724); and
- National Health Policy.

2.5.1 Occupational Safety and Health Policy of Ghana (Draft, 2017)

The policy statement of the OSH Policy (Draft, 2017) is: ‘to prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing as far as reasonably practicable the cause of the hazards in the working environment and, therefore the risk to which employees and the public may be exposed’. The policy is derived from provisions of the International Labour Organization (ILO) Conventions 155 and 161. The policy document highlights specific strategies, activities promotion and awareness creation which ensure that workers engaged at the construction and operation stages of the project are protected.

2.5.2 Labour Act, 2003 (Act 651)

The purpose of the Labour Act, 2003 (Act 651) is to amend and consolidate existing laws relating to labour, employers, trade unions and industrial relations. The Act provides for the rights and duties of employers and workers; legal or illegal strike; guarantees trade unions and freedom of associations, and establishes the Labour Commission to mediate and act in respect of all labour issues. The provisions under Part XV (Occupational Health, Safety and Environment), where the Act explicitly prescribes the duty of an employer to ensure that every worker works under satisfactory, safe and healthy conditions, is relied on extensively to cater for workers at both construction and operation phase of the project.

2.5.3 Fire Precaution (Premises) Regulations, 2003 (LI 1724)

The Ghana National Fire Service Act, 1997 (Act 537) states that a fire certificate shall be required for premises used as a public place or place of work. This requirement is reinforced by the Fire Precaution (premises) Regulations, 2003 (LI 1724). It is incumbent on any project developer to ensure that adequate provision and measures are introduced to minimize or prevent fire outbreaks.

2.6 National Planning Requirements

The following were reviewed under this section:

- Town and Country Planning (Amendment) Act, 1960 (Act 33);
- The Local Governance Act, 2016 (Act 936);
- Land Use and Spatial Planning Act, 2016 (Act 925);
- Ghana Building Codes (2012);
- Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917);
- Hazardous, Electronic and Other Wastes (Classification), Control and Management Regulations, 2016;
- Ghana Landfill Guidelines, 2002; and
- Riparian Buffer Zone Policy, 2011

2.6.1 Town and Country Planning (Amendment) Act, 1960 (Act 33)

The Act 33 empowers the Town and Country Planning Department (TCDP) to create Planning Areas (Zones) within districts. When an area is declared a planning area, no person shall undertake a development of land or construction, demolition, an alternation, extension, a repair or renewal of a building until a final scheme is approved under section 13 of the TCP Ordinance, 1945 (Cap 84). However, the power to approve the undertaken are vested in the relevant local government authority by virtue of the Local Government Act, 1993, (Act 462).

2.6.2 The Local Governance Act, 2016 (Act 936)

The Ministry of Local Government and Rural Development is responsible for the 16 administrative regions of Ghana. These regions are sub-divided into 260 Metropolitan, Municipal and District Assemblies (MMDAs). The Local Governance Act mandates the MMDAs to take charge for the overall development of their respective areas. This makes them representatives of the Central Government at the local level. Under Act 936 the assembly is:

- The planning authority and therefore responsible for physical/spatial planning of customary land in conjunction with the stools;
- Responsible for the development of plans of the district to the National Development Planning Commission for approval;
- Responsible for approval of all planning schemes before it can take effect within the district; and
- Responsible for development control through the grant of permit for development.

The MMDAs have in place various by-laws on environmental management, which are in accordance with the Act. Some of these include by-laws on environmental health and sanitation. Other issues that these by laws seek to control include: abatement of litter, solid and liquid waste management, control of pollution, noise making, and building erection, alteration or extension.

2.6.3 Land Use and Spatial Planning Act, 2016 (Act 925)

This Act revises and consolidates the laws on land use and spatial planning, provides for sustainable development of land and human settlements, ensures judicious use of land in order to improve quality of life, and promotes health and safety in respect of human settlements.

2.6.4 Ghana Building Codes (2012)

The Ghana Building Code contains regulations that can be adopted or enacted for use by various departments, metropolitan, municipal and district assemblies, private and public bodies. It lays down a set of minimum regulations designed to protect the safety of the public with regard to structural efficiency, fire hazards and health aspects of buildings.

The Code achieves the foregoing by covering aspects of administrative regulations; development control rules and general building requirements; stipulations regarding structural loads and design; materials; building services; measures to ensure safety of workers and the public during construction and rules for erection of signs and outdoor display structures.

2.6.5 Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917)

This Act provides for the control, management and disposal of hazardous, electrical and electronic waste and related purposes. Under the Act, a person shall not deposit hazardous waste or other wastes on any land in the country or in the territorial waters of the country. The Act also states that a person involved in the management of hazardous wastes or other wastes shall:

- Take the steps that are necessary to prevent pollution from hazardous wastes and other wastes arising from the management; and
- Where pollution occurs, minimize the consequences of the pollution on human health and the environment.

2.6.6 Hazardous, Electronic and Other Wastes, Control and Management Regulations, 2016

The regulations apply principally to waste generators, waste transporters and waste managers, but not to the generation of domestic waste which is collected by a District Assembly. The purpose of the regulations includes:

- Regulating the classification, control and management of wastes;
- Prescribing general duties of waste generators, waste transporters and waste managers; and
- Prescribing requirements for the disposal of wastes.

A key requirement for a waste generator is to ensure that the waste generated is classified in accordance with the Ghana Waste List specified in the First Schedule, among others.

2.6.7 Ghana Landfill Guidelines, 2002

The uncontrolled disposal of solid waste in inappropriate places in the country led to the formulation of the Ghana Landfill Guidelines, with the objectives to:

- Improve standard of waste disposal in Ghana;
- Set out options for the environmentally acceptable disposal of solid waste; and
- Provide a framework of sustainable waste disposal standards within which to operate.

The Guidelines emphasize on site closure and aftercare management of a landfill site when it ceases operation. The management involves shaping, final cover, and vegetating and drainage maintenance. It agrees on restoring closed solid waste landfill site to productive agricultural uses or passive recreational uses, but prohibit buildings.

The application of these Guidelines are relevant to the safe disposal and management of particularly decommissioned old Asbestos roofing sheets of the numerous railway buildings.

2.6.8 Riparian Buffer Zone Policy, 2011

The buffer zone policy aims at ensuring that all designated buffer zones along rivers, streams, lakes, reservoirs and other water bodies are sustainably managed for all. The overall objectives of the policy include:

- Protection, restoration and maintenance of the ecological and livelihood support functions of the buffer zone;

- Equitable and sustainable utilization and management of buffer zone conservation areas, which will contribute to long-term wellbeing of both resident and downstream communities; and
- Encouraging the development and management of buffer zones in urban and peri-urban areas by integrating natural systems into development planning.

The recommended buffer widths are:

- Municipal reservoir shoreline protective buffer: 60 to 90 meters (e.g. Weija dam and lake Bosomtwe);
- Major perennial rivers/streams: 10 to 60 meters (e.g. Volta, Tano and Offin);
- Minor perennial streams: 10 to 20m;
- Important seasonal streams: 10 to 15m;
- Streams within forest reserves: 10 to 50m; and
- Wetlands: 30m around the perimeter as defined from the high water elevation.

Construction activities associated with railway infrastructure development will result in the cutting down of trees in buffer zones of rivers along the railway corridor. Engagement with EPA revealed the re-vegetation of affected buffer zones with trees after construction as a key mitigation measure..

2.7 National Strategic Development Goals

2.7.1 Ghana Shared Growth and Development Agenda (GSGDA)

The GSGDA (2010-2013) is intended to enhance human development, transparent and accountable governance and infrastructure development particularly transport, ICT, housing and energy in support of agriculture modernisation, value added natural resource development with emphasis on oil and gas, and private sector development. The framework also envisages protecting the environment and minimizing the impacts of climate change.

The medium-term plan for the transport sector aims at placing special emphasis on the rehabilitation, modernisation and expansion of the railway network to support the new oil and gas industry and also ease the pressure and congestion on the roads and highways network. Some issues identified with the railway network in the context of this development strategy included; limited and poor rail network, un-integrated approach to transport planning and development (lack of effective interfaces between road, rail and ports) and inadequate maintenance of rail transport (archaic railway tracks and rolling stocks).

The GSGDA seeks to address these challenges by developing rail-based mass transport system in: Accra-Tema, Kumasi-Ejisu, Accra-Nsawam, and Takoradi- Kojokrom as part of an integrated transport plan, implement existing recommendations for institutional reform in the Railways sub-sector and ultimately develop a functional railway master plan for the entire country.

2.8 International Requirements

2.8.1 IFC Performance Standards on Environmental and Social Sustainability

In addition to being designed and operated in compliance with Ghanaian requirements, Investors also intends to meet international environmental and social standards. The most commonly accepted standard is the IFC Performance Standards (PS) on Environmental and Social Sustainability, 2012. This is an integrated set of eight environmental, social, health and safety standards. The standards are listed below with their relevance established.

PS 1: Assessment and Management of Environmental and Social Risks and Impacts

PS 1 establishes the importance of developing an Environmental and Social Management System (ESMS) to ensure the consistent and systematic identification and management of risks and impacts. The key elements of an ESMS include: a Policy, a documented process to identify risks and impacts, a management program, organizational capacity and competency, emergency preparedness and response, monitoring and review, and stakeholder engagement. PS 1 is applicable to this development and an ESMS will be developed for construction and operations.

PS 2: Labor and Working Conditions

PS 2 is about the fair treatment of workers and includes: working conditions and terms of employment, workers organizations, non-discrimination and equal opportunity, retrenchment, worker grievance mechanism, child labor, forced labor, occupational health and safety, contracted workers, and supply chains. PS 2 also references the World Bank Group (WBG) Environmental Health and Safety (EHS) Guidelines as an information source for occupational health and safety practices. Not all of the PS 2 elements are applicable to this development (for example supply chains or retrenchment) but the ones that are will be applied to ensure fair treatment of workers during construction and operations. These requirements are largely already required under Ghanaian requirements as Ghana has ratified the core ILO standards.

PS 3: Resource Efficiency and Pollution Prevention

The objectives of PS 3 are to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, to promote the sustainable use of resources such as energy and water, and to reduce project-related GHG emissions. PS 3 also references the WBG EHS Guidelines as an information source for technically and financially feasible resource efficiency and pollution prevention principles and techniques. PS 3 will be applied to the railway infrastructure development during design and operations along with the applicable portions of the WBG General EHS Guideline.

PS 4: Community Health, Safety, and Security

The objectives of PS 4 are to anticipate and to avoid adverse impacts on the health and safety of affected community from both routine and non-routine circumstances and to ensure the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected community. PS 4 is applicable to the railway infrastructure development and will be applied during design and operations.

PS 5: Land Acquisition and Involuntary Resettlement

PS 5 is designed to minimize the impacts on people from project-related land acquisition and restrictions on land use. PS 5 is triggered when affected persons do not have the right to refuse land acquisition or restrictions. Compensation will be paid to landowners of the newly acquired land. Resettlement action plan will be prepared.

PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

The objectives of PS 6 are to protect and conserve biodiversity, to maintain benefits from ecosystem services and to promote the sustainable management of living natural resources. Forest reserves or globally biodiversity significant areas will be avoided.

PS 8: Cultural Heritage

The objectives of PS 8 are to protect cultural heritage and to promote equitable sharing of benefits from the use of cultural heritage. Relevant stakeholders, particularly traditional authorities will be engaged to identify cultural heritages within their jurisdiction. The railway routes will be designed to avoid passing through cultural heritage sites. Where it is unavoidable, customary rights will be performed in connection with traditional authorities to relocated cultural heritage sites.

2.9 Railway Sector Institution

This section presents the key railway sector agencies, as well as the other stakeholder institutions whose statutory functions bear on or relate to the sector and its related activities. The institutions include:

- Ministry of Railways Development
- Ghana Railway Development Authority (GRDA)
- Ghana Railway Company Limited (GRCL)

2.9.1 Ministry of Railways Development

The Ministry of Railways Development was established by the President of the Republic of Ghana in February, 2017. The Ministry has been tasked with ensuring the rapid development of a modern rail network in Ghana to connect major cities of Accra, Kumasi, Sekondi-Takoradi and Tamale. The ministry is also tasked to use Ghana as the route for transporting goods from landlocked countries north of Ghana, such as Burkina Faso, to the ports of Tema and Takoradi and from the ports to the landlocked countries.

2.9.2 Ghana Railway Development Authority

The Ghana Railway Development Authority (GRDA) established under the Railways Act, 2008 (Act 779) has the responsibility to promote the development of railways and railway services, hold, administer and improve the railway assets and promote the development and management of sub-urban railway.

GRDA under the Act is to regulate the railway industry in Ghana, to operate as the railway landlord, to develop the rail systems in Ghana, including the development of master plans, to expand the railway systems, to link the railway systems to neighbouring countries and to exercise ownership rights over the infrastructure and all assets. In this respect GRDA will be responsible, especially for technical and safety/security regulations. Other roles include granting licenses, concessions and leases, which are necessary for the operation of railways and railway services, as well as perform other related functions including the keeping of a register of railway operations, licensees and sub-licenses and setting standards.

The organogram of GRDA does not present full representation of environment and social needs. However, there is provision for Principal Health and Safety Manager under Directorate of Human Resource and Administration. The responsibility of the Principal Health and Safety Manager will be modified to include environment and social management. Hence, the recommended position under the Directorate of Human Resource is Environment, Health and Safety Manager.

2.9.3 Ghana Railway Company Limited

The Ghana Railway Company Limited (GRCL) was established in 2001 under the Company Code, 1963 (Act 179) as a public-sector body. It was to operate the railways of Ghana with responsibility for the efficient management of the national rail system and to enhance the smooth movement of goods and passengers. Up until 2008 when the GRDA was established, GRCL was in-charge of all railway development and services in Ghana. However, until private sector operators are brought on board, the existing GRCL, subject to transitional arrangements with the GRDA, will continue to operate the railway services.

2.10 Other Relevant Institutions

Relevant institutions whose functions relate to railway project corridor selection, project approval and infrastructure development, regulation and operation of railways are grouped into four. These are the lead regulatory and planning authorities, the road sector agencies, resource management institutions, and utility service, telecommunication and pipeline operators. The respective institutions under these four categories are listed below:

- Lead regulatory and planning authorities -
 - Environmental Protection Agency (EPA); and
- Road sector agencies -
 - Department of Urban Roads;
 - Ghana Highway Authority; and
 - Department of Feeder Roads;
- Resource management institutions -
 - Wildlife Division (WD) (of the Forestry Commission);
 - Forest Services Division (FSD) (of the Forestry Commission);
 - Water Resources Commission (WRC); and
 - Lands Commission (LC)
- Utility service, telecommunication and pipeline operators -
 - Electricity Company of Ghana (ECG);
 - Ghana Water Company Limited (GWCL);
 - Ghana Chamber of Telecommunications (GCT);
 - Vodafone Ghana Limited; and
 - Bulk Oil Storage & Transportation Company (BOST).

2.10.1 Environmental Protection Agency

The EPA has the mandate to decide on project screening, guide the conduct of EAs (including this ESMF) and to grant environmental approval for railway sector projects to commence. Its mandate also covers monitoring of construction and operation phases of railway projects to ensure compliance with approval conditions, mitigation measures, and other environmental quality standards e.g. air and noise quality (Appendix 18). The Environmental Assessment and Audit Department of EPA has the capacity to handle this mandate.

2.10.2 Department of Urban Roads

The Department of Urban Roads (DUR) is responsible for the provision of roads other than trunk roads in the metropolitan areas. It was established in 1989 as an implementing agency within the then Ministry of Roads and Highways. Prior to its establishment the responsibility for the roads were with the PWD and the then City Councils (now Municipal and Metropolitan Assemblies), and later with the GHA. DUR has an Environmental Desk Officer responsible for handling environmental and social issues that arise in the pursuit of the DUR's functions and activities.

2.10.3 Ghana Highway Authority (GHA)

The GHA is a semi-autonomous body with a responsible for the provision and management of trunk roads. It was originally established in 1974 as the organisation responsible for the development and administration of the entire national road network. Since the GHA Act of December 1997, its role has been limited to the administration, control, development and maintenance of trunk roads and related facilities subject to the policies of the MoT. GHA has a 4-person Environmental Management Unit (EMU) that has oversight on environmental and social issues. The EMU operates under the Road Safety and Environment Division.

2.10.4 Department of Feeder Roads (DFR)

The DFR is a civil service institution responsible for rural roads. It was set up under Government instrument in 1981 to have the sole responsibility for the planning, development and maintenance of rural roads. Prior to its establishment the responsibility for rural roads shifted from one agency to the other, such as the Public Works Department (PWD), Department of Social Welfare, Department of Rural Development, GHA, and the then Cocoa Marketing Board. The DFR has an Environmental Desk Officer responsible for environmental and social issues associated with the feeder road sub-sector.

2.10.5 Resource Management Institutions

The resource management institutions include: the Wildlife Division (WD) and Forest Services Division (FSD) of the Forestry Commission, the Lands Commission and the Water Resources Commission (WRC).

These institutions are relevant because the resources under their management are likely to be impacted on or implicated in the proposed projects under the RMP. These stakeholder institutions therefore need to be consulted in the planning and decision processing to avoid, prevent, reduce or mitigate the likely impact of the project on the resources they manage.

The Water Resources Commission Act, 1996 (Act 522) and the Water Use Regulations, 2001 provide for the regulation and management of all water resources and related matters. The Regulations define the different types of water use that require water use permit, for instance to divert, impound, convey and use water from a river, stream, etc and the procedure and public hearing requirements, etc.

The Community Water and Sanitation Agency (CWSA) Act, 1998 establishes the CWSA to facilitate mainly the provision of safe water services to rural communities and also small towns. The CWSA has the mandate to prescribe safe water supply (and sanitation related services) standards and guidelines. It also ensures safe water sustainability, hygiene education and public awareness on water related health hazards, and provides technical assistance in their planning and execution to District Assemblies and others.

The Forestry Commission Act, 1999 (Act 571) establishes the Commission to be responsible for the regulation of the utilization of forest and wildlife resources, the conservation and management of those resources and the co-ordination of policies related to them.

The Lands Commission Act, 2008 (Act 767) establishes the Lands Commission to integrate the operations of public service land institutions in order to secure effective and efficient land administration to provide for related matters. The objectives of the Commission include among others to:

- Promote the judicious use of land by the society and ensure that land use is in accordance with sustainable management principles and the maintenance of a sound eco-system; and
- Ensure that land development is effected in conformity with the nation's development goals.

2.10.6 Utility Service and Pipeline Institutions

ECG, GWCL, BOST, and GCT and Vodafone are public/private institutions that provide and/or manage utility services including, electricity, water and petroleum pipelines and telecommunications transmission infrastructure. These are all linear transmission facilities either through underground pipes or overhead lines, often along existing railway network corridors (where rail lines exist). New railway double-track construction or re-construction and other railway services and interventions could affect such transmission lines. These often require relocation, realignment, etc to make room for the rail project, which calls for the involvement of the respective companies or institutions to be consulted in the rail project decision-making processes as appropriate.

CHAPTER THREE

GENERAL PHYSICAL AND SOCIO-ECONOMIC BASELINE

- ❖ Natural Resources
- ❖ Topography and Landscape
- ❖ Land Use
- ❖ Socio-cultural Characteristics
- ❖ Economic Characteristics
- ❖ Potential Market for Railway Services in Ghana
- ❖ Health
- ❖ Air Quality
- ❖ Climate

3.0 General Physical and Socio-Economic Baseline

This section describes natural resources, social and climatic conditions as well as land form, land use and related features that have relevance or some implications for railway infrastructure planning and development, and for the railway sector generally.

3.1 Natural Resources

3.1.1 Drainage and Water Resources

Three major drainage systems exist in Ghana, covering about 5% (911,800Km²) of the total area of Ghana (Figure 3.1). These are the Volta River System (70%), South Western River System (22%) and Coastal River System (8%) (EPA, 2005). Within the Volta River Basin lies nearly three-fourth of the total land surface area of the country. The basin can be subdivided into smaller basins – the Black Volta, the White Volta, the Oti and the Volta. The numerous streams and tributaries of rivers in northern Ghana, all of which are tributaries of the Volta System dwindle in the dry season and flood in the rainy season (Dickson and Benneh, 1988).

The Tano, Ankobra and Pra basins form the South Western River Systems. The Pra has the largest basin in the closed forest. Unlike the rivers in northern Ghana, the forest rivers are perennial with higher flow pattern. The Ayensu and Densu rivers make up the coastal river system. The only area of internal drainage in Ghana is Lake Bosumtwi, a natural lake with a surface area of about 39km² and numerous streams flow into the lake. It is surrounded by hills and located about 34km to the south-east of Kumasi (Dickson & Benneh, 1988).

The characteristic widespread seasonal flooding in northern Ghana requires careful route selection and/or the need to elevate the base of rails significantly above the general elevation of the corridor surroundings.

The 2011 Riparian Buffer Zone Policy aims at ensuring that all designated buffer zones along rivers, streams, lakes, reservoirs and other water bodies are sustainably managed. It emphasises five major areas including maintaining the ecological and life-support functions of buffer zones, sustaining the multi-functionality of buffer zones and the maintenance of riparian buffer zones specific to urban and peri-urban areas (MWRWH, 2011).

3.1.2 Wildlife and Biodiversity Resources

The fauna of Ghana, though thought to be relatively impoverished, comprise a diverse array of species including several of conservation concern (MES, 2000). Many of the ecologically important areas are protected (Figure 3.2). These include the:

- Bia and Kakum Conservation Areas;
- Bomfobiri, Owabi and Agumatsa Wildlife Sanctuary;
- Kogya Strict Nature Reserve;
- Digya National Park; and
- Kalakpa Resource Reserve.

Current records indicate that there could be as many as 221 species of amphibians and reptiles, 724 species of birds and 225 mammalian species, with 93 recorded to inhabit the savannah ecological zone (MES, 2002). Threatened species in Ghana include four species of marine turtles and three species of crocodiles. Three species of frogs (*Hyperolius baumanni*, *H. fusciventris* and *H. sylvaticus*) and the lizard, *Agama sylvanus* have been found to be endemic in the country (MES, 2002).

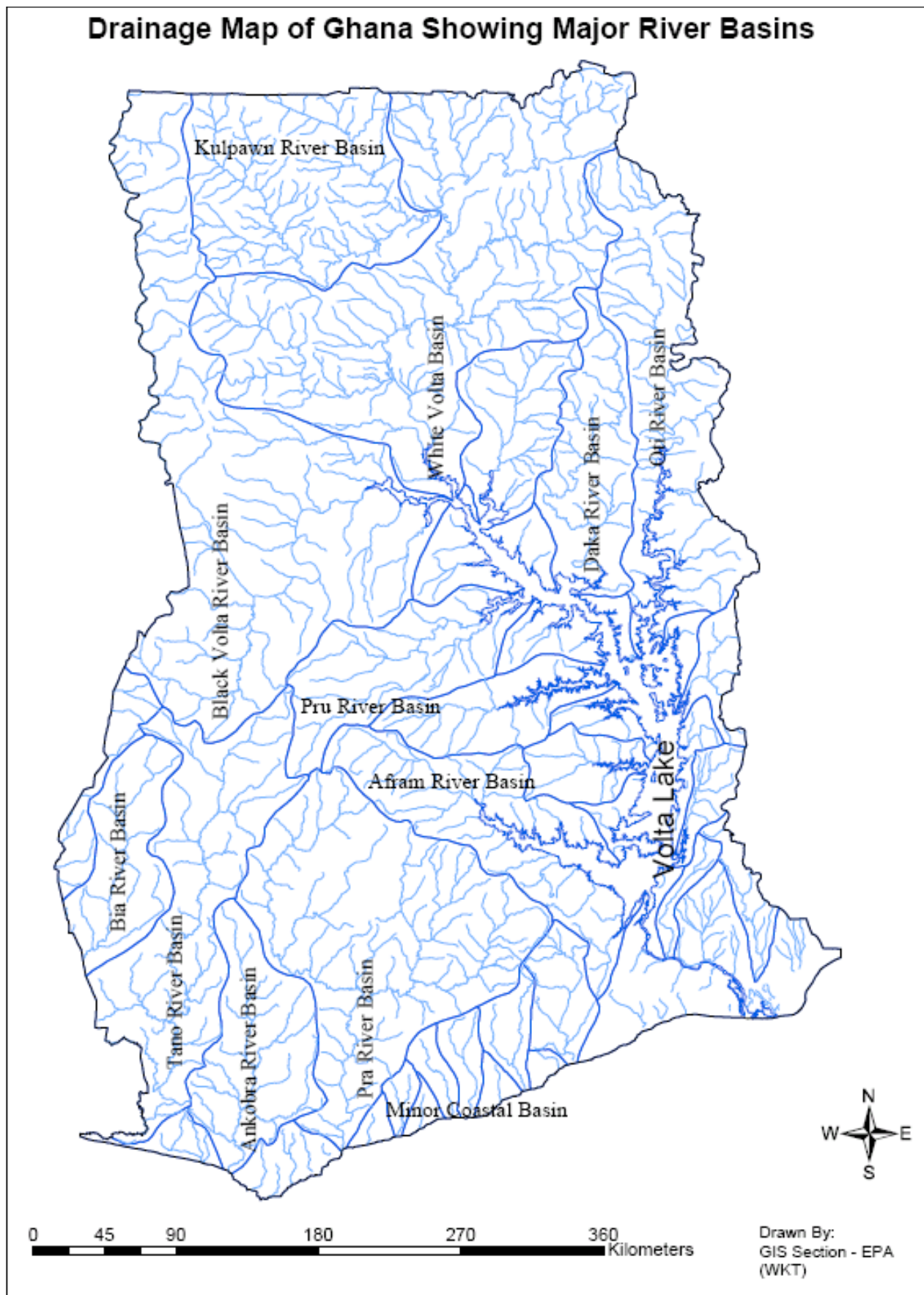


Figure 3.1 *Drainage Map of Ghana Showing Major River Basins*

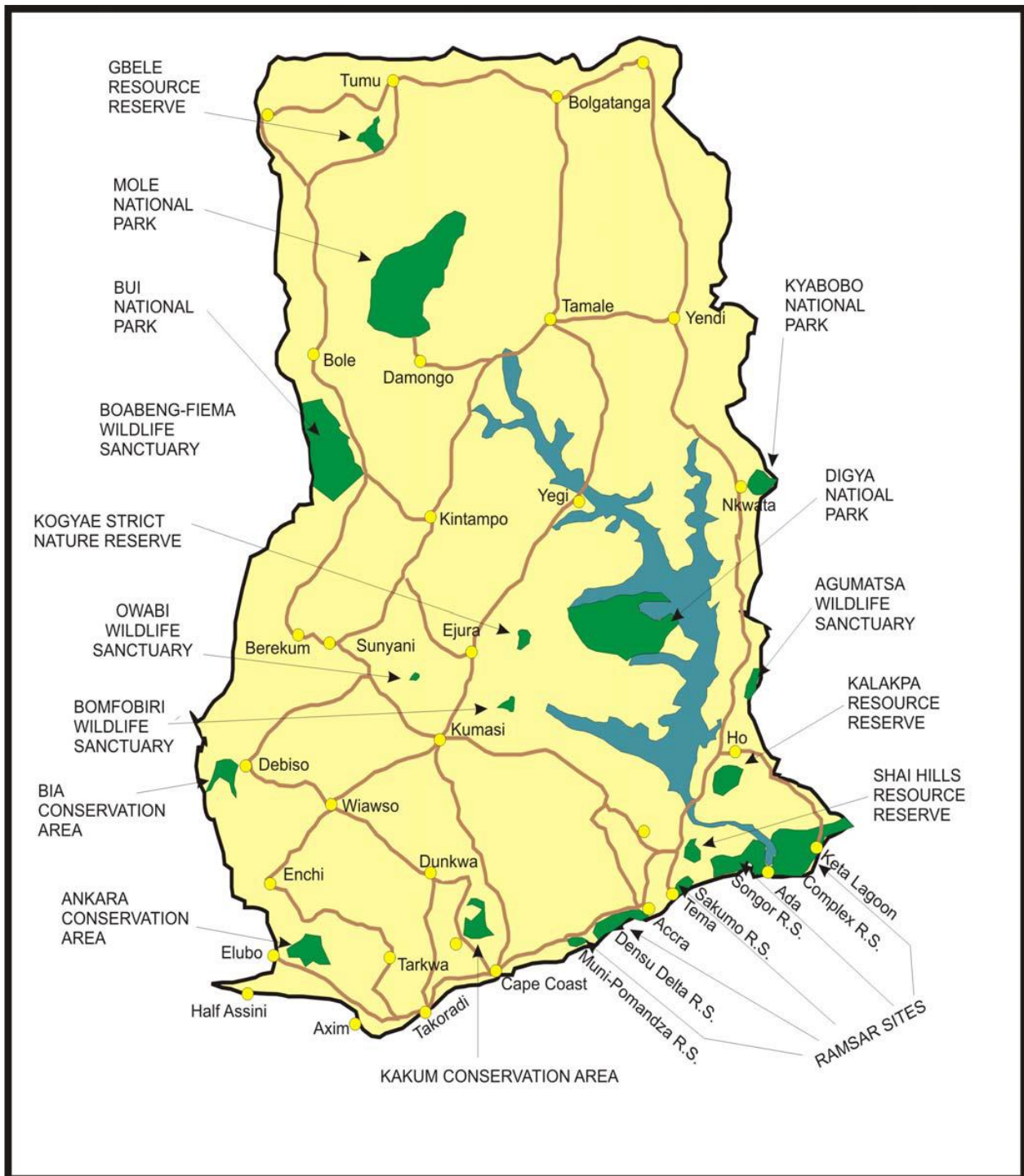


Figure 3.2 Map of Ghana showing some Protected Areas and Ramsar Sites

A total of over 3,600 plant species, representing the three major taxonomic groups can be found in Ghana (MES, 2002). The wet evergreen forest exhibits the most diverse level of endemism and species richness in Ghana. The Ankasa and Nini-Suhien Conservation Areas are biological ‘hotspot’, because of their high biological diversity (CI, 2002, cited in EPA, 2005).

Noise and vibration which are associated with rail construction could exert severe adverse effects on wildlife and biological resources, and might drive wildlife away from their natural habitat. The sensitivity of wildlife resources and conservation areas must always be taken into account in rail construction. The Wild Animals Preservation Act, 1961 (Act 43) and its subsidiary regulations, the Wildlife Conservation Regulations, 1971

and Wildlife Reserves Regulations are significant provisions for wildlife resource protection. The Wildlife Reserves Regulations for instance, establish and designate 6 Reserves, namely: Mole National Park; Digya National Park; Bui National Park; Shai Hills Game Production Reserve; Kogyae Strict Nature Reserve; and Owabi Wildlife Sanctuary.

The regulations provide for restricted entry to and protection of animals and plants life in the reserves, protection of amenities, and the prohibition to light fire, pollute water, litter or clear any area of the reserves.

3.1.3 Coastal and Wetland Resources

There are over 90 lagoons and associated wetlands in Ghana (Figure 3.2) constituting the coastal zone of Ghana (Figure 3.3). Most coastal resources (lagoons, beaches, and wetlands), etc are very important in the cultural lives of the coastal communities. Many of such resources are gradually losing their integrity, quality and aquatic life because of the level of pollution. Typical examples are the Chemu, Kpeshie and Korle lagoons. Besides, five of the six Ramsar Sites in Ghana are located in the coastal areas. Environmental degradation is common in coastal areas, because of population pressure and intense infrastructure development and use.

The Wetlands Management (Ramsar Sites) Regulations, 1999 were made pursuant to the Wild Animals Preservation Act, 1961 (Act 43) and constitutes an important provision for sensitive coastal resource protection. The accession to the Convention on Wetlands of International Importance, especially as Waterfowl Habitat was adopted at Ramsar in 1971, but the Convention entered into force in Ghana in 1988.

The Regulations establish and designates six Ramsar Sites where certain activities are restricted or proscribed. The six Ramsar sites are: the Keta, Songor, Sakumo, Densu Delta, Muni-Pomadze and Owabi Wildlife Sanctuary. The Owabi Wildlife Sanctuary is the only in-land Ramsar Site. The site protects the source of drinking water for Kumasi and its environs (MES, 2002).

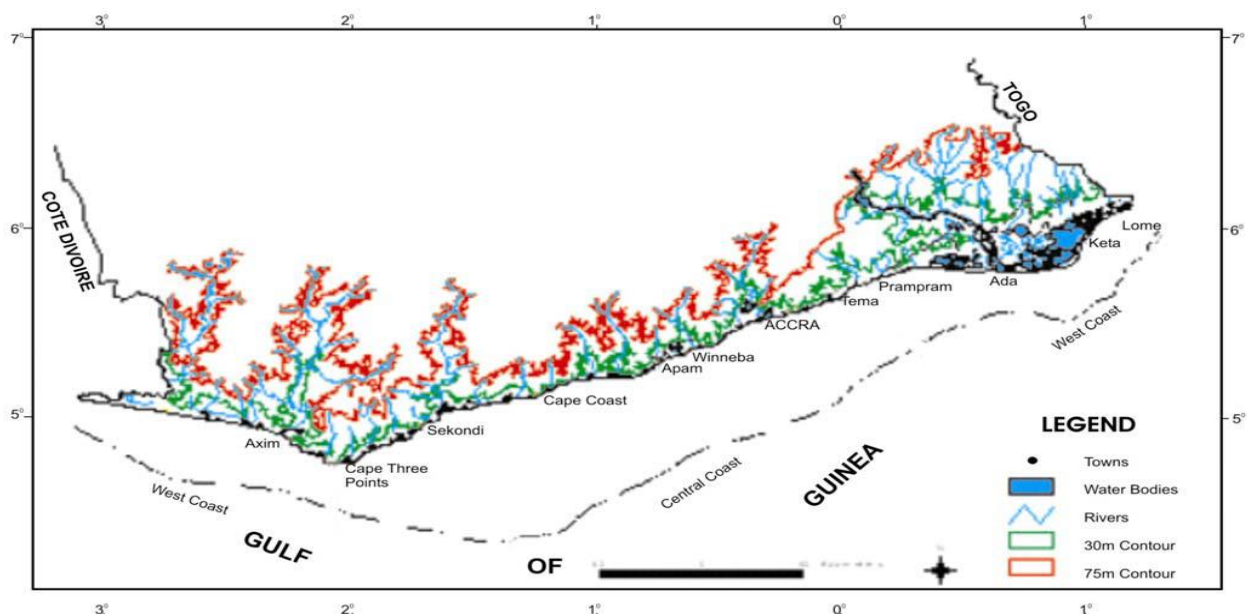


Figure 3.3 Coastal Zone of Ghana

3.2 Topography and Landscape

The physiographic regions of Ghana are broadly the Coastal Plains, the Forest Dissected Plateau, the Savannah High Plains, the Voltaian Sandstone Basin (VSB) and the ridges and escarpments bordering the VSB. These are differentiated by varying elevation or heights above sea level (Figure 3.4).



Figure 3.4 Topographic Map of Ghana

3.2.1 The Forest Dissected Plateau

Many years of intensive erosion have reduced this area to uniformly low height between 240m and 300m above sea level. The different rock formations in this region have given rise to different relief types, ranging from hills that stand up to 60 - 90 metres above sea level to steep sided hills rising above 240m above the flat valley bottom (Dickson and Benneh, 1988).

3.2.2 The Savannah High Plains

The topography is gently rolling with average height of the plain ranging between 180m and 300m above sea level. Small rounded hills composed mainly of granite are scattered on this plain (Dickson and Benneh, 1988).

3.2.3 The Voltaian Sandstone Basin (VSB)

Covering an area of about 112,768km², the VSB is made up of an almost flat extensive plain with heights ranging between 60m and 150m in that part of the basin south of the east-west Black Volta and up to about 180m above sea level in that part north of the river (Dickson and Benneh, 1988).

3.2.4 Ridges and Escarpments

These comprise the Southern Voltaian Plateau (SVP), the Gambaga escarpment and the Akwapim-Togo Ranges. The SVP marks the southern boundary of the Volta Basin while the Gambaga scarp marks the northern limit of the VSB. Average elevation does not exceed 450m above sea level. The Akwapim-Togo Ranges are folded mountains forming the eastern boundary of the VSB. The ranges start from near the mouth of the Densu, west of Accra, and run in a north-easterly direction across the Volta Region and Togo and beyond (Dickson and Benneh, 1988).

3.3 Land Use

3.3.1 Land Use Categories

The total surface area of Ghana, including the area occupied by water bodies is 238,539km² (EPA, 2005). The land use pattern of Ghana has been determined by its environmental resources endowments. Within the framework of unsatisfactory land tenure and land administration operating in the country, increasing recognition of soil nutrient depletion, conservation requirements, desertification and urbanisation, the main land uses remain agriculture, forestry and wildlife, mining as well as settlement and industrial estates developments. The general pattern of land use, as indicated in Table 3.1, may be agricultural or non agricultural.

Table 3.1 Land Use Cover and Area Coverage

Land Use	Area ('000 Sq. km)	% of Total
Savanna Woodland	71	30
Bush Fallow and other uses	60	25
Unimproved Pasture	36	15
Forest Reserves	26	11
Tree Crops	17	7
Annual Crops	12	5
Wildlife Reserves	12	5
Unreserved Forest	5	2
Total	239	100

Source: Ministry of Food and Agriculture (1990)

3.3.2 Land Tenure and Acquisition

There are pieces of legislation relevant in the consideration of land, land tenure, right of way and acquisition. These include:

- The Administration of Lands Act, 1962 (Act 123);
- State Lands Act, 1962 (Act 125);
- State Lands Regulations 1962 (LI 230);

- State Lands (Amendment) (No. 2) Regulations 1963 (LI 285);
- Lands (Statutory Way Leaves) Act, 1963 (Act 186); and
- Office of the Administrator of Stool Lands Act, 1994 (Act 481).

The Administration of Lands Act, 1962 consolidates with amendments the enactments relating to the administration of Stool and other lands. The Act concerns in particular Stool Land and Kumasi Town Lands, which may authorize the occupation and use of land (any Stool or Kumasi Town Land) for any purpose which is conducive to the public welfare or the interests of the State.

The State Lands Act, 1962 provides for the acquisition of land by the State whenever this is of national interest and other purposes connected therewith. The Act concerns land other than land covered by the Administration of Lands Act, 1962.

The State Lands Regulations were put in place following the State Lands Act and contains procedures, instructions and directives for the acquisition of land by the State for national interests and related purposes.

The Office of the Administrator of Stool Lands Act, 1994 generally provide for the administration of Stool Lands. The Act sets out among others the procedures for the administration of Stool Lands. The Administration of Lands Act, 1962 and the State Lands Act, 1962 are still in effect, however, with modifications necessary to give effect to the Office of the Administrator of Stool Lands Act. The Act defines the distribution of any revenue accruing from stool lands.

3.4 Socio-Cultural Characteristics

3.4.1 Population Distribution

According to the 2010 population and housing census, Ghana's population is about 24,658,823. This is made up of 51.2% females and 48.8% males. The distribution of the population across the ten administrative regions is uneven. The Upper East, Upper West and Northern Regions, all in the Savannah Zone together have 17.5% of the total population. The Ashanti Region has 19.1% and Brong Ahafo Region which lies in the middle belt has 9.6%, while the Greater Accra Region (with the national capital) has 15.4%. The Western Region has 10.2%, while the Volta, Central and Eastern Regions have 8.6%, 8.4% and 11.1% respectively.

The census figures depict high population densities in the urban centres, therefore a good network of urban railway infrastructure could help reduce traffic congestion characteristic of the more populous urban southern cities of Kumasi, Accra, Takoradi and Koforidua, while properly planned rural networks could open up such areas to socio-economic transformation. The construction of railway infrastructure in high population centres however carries greater liabilities and public health risks, than in sparsely populated rural communities.

3.4.2 Cultural Resources

The Fourth Republican Constitution (1992) recognizes culture as a necessary tool for national integration and development. Ghana has over 50 ethnic groups whose common values and institutions represent collective national heritage. Each of these ethnic groups has unique cultural features and traditions that give identity, self-respect and pride to the people. The cultural features include language, sacred groves and shrines, religious artefacts and places of worship, cemeteries, etc, which people tend to have emotional attachments and sensibility towards.

There are over 25 language groups in Ghana. The most commonly used include the Akan, Ga and Ewe languages with several more dialects. Akan, the most widely spoken is used as first language by a little over

42% of the population, and many more speak it as a second language. There are over 90 festivals celebrated, notable among them are the Asafotufiam and Homowo festival of the Ga Adangme and the Gas, Akwasidae Kese of the Ashantis and the Fetu Afahye in Cape Coast.

It is necessary to cultural resources during railway construction, in order not to offend the sensibilities of people, but rather preserve cultural heritage. Furthermore, good and efficient railway networks could facilitate the movement of people to festivals, which is a major element of the culture of the Ghanaian.

3.5 Economic Characteristics

Selected indicators of the national economy are presented below (World Bank Website: Ghana: Country Brief (2019)):

- Ghana's GDP is \$58.997 billion (2016 estimate).
- Monetary policy rate was 16% as at January 2019 (BOG)
- Overall poverty reduced marginally from 24.2% to 23.4% between 2005-2017(GSS)
- Average inflation rate as at January 2019 was 9% (BOG)
- Ghana had a positive trade balance of \$1,640,368,107 in the year 2017.
- The fiscal deficit narrowed to 5.9% of GDP in 2017 from 9.3% in 2016 mostly represented by expenditure measures as revenues remained weak.
- On the external sector, the current account registered a smaller deficit of 1.4% of GDP in September 2018 compared with 2% a year ago.
- Cocoa exports dropped by 21.4% from \$2.6b in 2017 to \$2.09 in 2018.
- Receipts form oil exports increased from \$3.1b in 2017 to \$4.5b in 2018
- Cost of food in Ghana increased 8.4% in March 2019 over the same month in the previous year. Food inflation in Ghana averaged 7.58% from 2013 until 2019, reaching an all-time high of 9.7% in December of 2016 and a record low of %% in July of 2014.

3.5.1 The poverty profile in Ghana as at 2012

- About 37.9% of population in Ghana live in slums
- Intentional homicide rate per 100,000 people - 6 (WHO, 2018)
- Poverty headcount ratio at urban poverty line - 10.6%
- Poverty gap at urban poverty line - 2.5%
- Number of poor at \$1.90 a day (2011 PPP) - 3.2million
- Number of poor at \$3.10 a day (10.76 PPP) - 10.76 million
- Income share by lowest 20% - 5.4%
- Income share held by second 20% - 9.8%
- Income share held by third 20% - 14.6%
- Income share held by fourth 20% - 21.9%
- Income share held by highest 20% - 31.7%

3.6 Potential Market for Railway Services in Ghana

A railway market research (March/April 2019) in the form of a quantitative social survey was undertaken in 8 towns in Ghana; Tema, Accra, Nsawam, Kumasi, Sunyani, Sekondi-Takoradi, Tamale and Paga. These towns were selected for having the service currently operational, previously operational and never had operational railway services before. The purpose was to provide important information which will help to identify and analyse the needs of the market, the market size and the competition, the level of interest of private citizens/users on the development

of the railway network in Ghana and the “willingness to pay” (i.e. the most a user will spend for the service).

Results obtained indicated the rail service was patronised by people from various backgrounds, including formal workers, artisans, students, and market women. Analysis showed a good potential for patronage of the rail service, albeit some level of unwillingness of patrons to pay comparable fares as other transport services. Trains ranked favourably to private car, taxi and trotro/bus in terms of its use as a primary means of transportation, saving travel time, safety, comfortability and flexibility.

3.7 Health

As at the end of 2017, there were 8,318 health facilities in Ghana. The breakdown is presented in Table 3.2 below. Malaria is hyper-endemic and constitutes one of the leading causes of morbidity and mortality in Ghana. In 2017, 114, 411 reported cases of malaria with a morbidity rate of 24.27% was recorded in all regional and district hospitals in Ghana excluding Komfo Anokye Teaching Hospital and Korle-Bu Teaching Hospital in Ashanti and Greater Accra Regions respectively (Table 3.3). Malaria accounts for over 20% of all Outpatient cases in the country (Table 3.4)

Table 3.2 Health Facilities in Ghana by Type (2017)

Region	CHPS	Clinic	District Hospital	Health Centre	Hospital	Maternity Home	Mines	Polyclinic	Psychiatric Hospital
Ashanti	1122	149	25	164	128	69	1	1	0
Brong Ahafo	665	74	20	131	19	39	0	4	0
Central	364	78	12	75	17	36	0	3	1
Eastern	747	81	18	131	18	29	0	3	0
Greater Accra	498	322	8	40	99	104	0	14	2
Northern	459	57	17	105	16	8	0	5	0
Upper East	255	46	6	55	4	2	0	0	0
Upper West	256	13	1	71	11	5	0	4	0
Volta	454	44	17	154	11	14	0	4	0
Western	601	134	16	78	34	40	10	0	0
National	5421	998	140	1004	357	346	11	38	3

Source: GHS Facts and Figures, 2018

Table 3.3 Major Causes of Admissions and Death in Ghana - 2017

	Cause of Admission	Total Cases Seen	Proportional Morbidity Rate (%)
1	Malaria	114411	24.27
2	Gastroenteritis	33803	7.17
3	Hypertension	22326	4.74
4	Anaemia	20178	4.28
5	Pneumonia	19216	4.08
6	Septicaemia	17784	3.77
7	UTI	14266	3.03
8	Delivery	13498	2.86

9	Abortion	10542	2.24
10	Diabetes	9470	2.01
11	All other cases	195,902	41.56
	Total	471396	100.00

Source: GHS Facts and Figures, 2018

3.8 Air Quality

Air quality monitoring has been carried out by the EPA since 2005 at 12 sites including residential, industrial, commercial and roadside locations in Accra, six of the sites were located along major road routes. The results indicated that the 2006-2008 annual average PM₁₀ levels for roadside exceeded the WHO guidelines of 20µg/m³. Seventy five percent (75%) of samples collected at 4 roadside sites (2005-2008) exceeded the EPA 24 hour PM₁₀ guideline of 70µg/m³, while 87% exceeded the WHO guideline for 24-hour PM₁₀ of 50µg/m³.

Even though air quality data for the rural areas of Ghana is not available, activities such as charcoal, bush fires and refuse burning which are common could be expected to impact negatively on the air quality. The whole country also comes under the dusty effects of the Harmattan mainly in December and January, which contribute to elevated levels of particulates. Besides, vehicular movement on untarred rural roads produces dust in addition to exhaust fumes generated by vehicles. Other sources of air quality deterioration in Ghana include mining, agriculture and manufacturing. In spite of the above, air quality in rural Ghana is generally considered to be good.

3.9 Climate

Using the average characteristics of rainfall, temperature and humidity for a period of 25 – 30 years, Ghana can be classified into four main climatic regions. These are the South-western Equatorial Climatic Zone, Dry Equatorial Climatic Zone, Wet-semi Equatorial Climatic Zone and Tropical Continental (savannah) Climatic Zone.

3.9.1 South-Western Climatic Zone

Being the wettest climatic region in Ghana, it has a double maxima rainfall regime. Mean annual rainfall is above 190cm and an average monthly precipitation of not less than 2.5cm. The highest monthly temperature of about 30°C occurs between March and April and the lowest of about 26°C in August. Monthly relative humidity is averagely 75-80% during the two rainy seasons and records the lowest of 70-80% during the rest of the year (Benneh and Dickson, 1988).

Table 3.4 Top 10 Causes of Outpatient Morbidity in Ghana (2015 – 2017)

2017				2016				2015			
No	Disease	No of Cases	% of Total	No	Diseases	No of cases	% of Total	No	Diseases	No of cases	% of Total
1	Malaria	6,133,302	20.3	1	Malaria	6,959,525	31.1	1	Malarial	6,961,077	26.1
2	Otitis Media	4,814,040	15.9	2	Upper respiratory tract infection	3,840,246	17.2	2	Upper respiratory tract infection	3,896,550	14.6
3	Upper respiratory tract infection	3,534,102	11.7	3	Rheumatism and other joint pain	1,612,609	7.2	3	Rheumatism and other joint pain	1,546,744	5.8
4	Rheumatism and other joint pain	1,585,302	5.2	4	Diarrhoea diseases	1,570,557	7	4	Diarrhoea diseases	1,515,189	5.7
5	Diarrhoea disease	1,429,990	4.7	5	Skin diseases	1,143,556	5.1	5	Skin diseases	1,187,674	4.4
6	Anaemia	1,082,467	3.6	6	Anaemia	1,069,138	4.8	6	Anaemia	1,007,335	3.8
7	Skin disease	1,051,166	3.5	7	Intestinal Worms	816,106	3.6	7	Intestinal Worms	830,557	3.1
8	Intestinal worms	772,277	2.6	8	Acute urinary tract infection	671,144	3	8	Hypertension	715,247	2.7
9	Acute urinary tract infection	724,569	2.4	9	Hypertension	606,721	2.7	9	Acute urinary tract infection	606,471	2.3
10	Hypertension	603,334	2.0	10	Acute eye infection	538,089	2.4		Acute eye infection	503,153	1.9
11	All other disease	8,500,354	28.1	11	All other disease	3,556,159	15.9	11	All other disease	7,906,934	29.6
	Total	30,250,370	100.0		Total	22,365,777	100.0		Total	36,714,616	100.0

Source: GHS Facts and Figures, 2018

3.9.2 Dry Equatorial Climatic Zone

This climatic zone also has double rainfall maxima, however, with a more marked dry season. Mean annual rainfall of between 74 and 89cm are recorded. Surprisingly, this region is the driest in the country also recording mean monthly temperatures of 30°C between March and April and 26°C in August. Highest average relative humidity does not exceed 75%, with the lowest being about 60% (Benneh and Dickson, 1988).

3.9.3 Wet Semi Equatorial Zone

A double maxima rainfall regime, and with a mean annual rainfall of between 125 and 200cm are recorded. Some of the wetter areas include the Akwapim-Togo Ranges and the Southern Voltaian Plateau where annual rainfall exceeds 165cm. The first rainy season is from May to June and the second rainy season is from September to October. With a more pronounced dry season, temperatures and relative humidity are, however, as in the south-western equatorial and the dry equatorial climatic zone (Benneh and Dickson, 1988).

3.9.4 Tropical Continental Climatic Zone

This climatic region, unlike the three others has a single rainy season which starts in May and ends in October, followed by a prolonged dry season. Mean annual rainfall of between 100 and 115cm is recorded. Mean annual temperatures vary from about 36°C in March to about 27°C in August. Relative humidity of between 70 and 90% may be recorded during the rainy season, but may fall to as low as 20% during the dry season. The zone between the wet-semi equatorial region and Salaga, however, experiences a modified form of the typical interior Savannah and the wet-equatorial climatic. Here a double maxima rainfall regime is experienced, recording mean annual rainfall of between 115 and 125cm. here, the first season (May to June), is rather the minor season. Mean monthly temperatures range from 30°C in March to about 24°C in August. Higher relative humidity of 90 to 95% and 75 to 80% are recorded in the rainy seasons respectively (Benneh and Dickson, 1988).

Table 3. 5 Summary of Rainfall Characteristics of the different Climatic Zones

Climatic Zone	Rainfall Characteristics	Impact of Rainfall on Rail Line Construction
South-Western Equatorial Climatic Zone	*Wettest climatic zone in Ghana *Double rainfall maxima: -May to June -September to October *Mean annual rainfall is over 190cm * Average monthly rainfall of not less than 2.5cm.	Dust generation during rail line construction will be minimal. However, between May and June construction may be heavily impeded. Movement of heavy machinery may be difficult because of the amount of rainfall. Heaped construction materials could be washed into water bodies, thus causing siltation.
Wet Semi Equatorial	*Double maxima rainfall regime: -May to June -September to October *Mean annual rainfall is 125cm *Akwapim -Togo ranges however, records average annual rainfall of over 165cm	Rail construction between the May and June would be problematic. Movement of heavy construction machinery in areas of the Akwapim Togo Ranges could cause landslides (and mudslides during the rainy season)

Climatic Zone	Rainfall Characteristics	Impact of Rainfall on Rail Line Construction
Dry Equatorial Climatic Zone	*Driest climatic zone in the country *Double rainfall maxima: -May to June -September to October *Mean annual rainfall of between 74cm and 89cm	Due to relatively low level of rainfall, rail line construction might not face much difficulty even during the rainy. However, due to poor drainage network in Accra, flooding is common in rainy seasons, which could impede rail construction (between May and June).
Tropical Continental Climatic Zone	*Single rainy season : -May to October *Mean annual rainfall is between 100cm and 115cm	Long dry period (November to April) gives enough ideal time for rail line construction. Though rainfall amount is relatively low, the existence of the iron pan implies that relatively small amount of rainfall could still cause flooding.

CHAPTER FOUR

PRESENT RAILWAY SYSTEM

- ❖ Infrastructure
- ❖ Tracks
- ❖ Rails
- ❖ Sleepers
- ❖ Ballasts
- ❖ Turnouts
- ❖ Bridges
- ❖ Buildings
- ❖ Technical Installations
- ❖ Rolling Stock
- ❖ Other Equipment
- ❖ Ancillary Facilities

4.0 PRESENT RAILWAY SYSTEM

4.1 Infrastructure

Ghana's existing rail network is confined mostly to the southern part of the country which is economically more advanced and has a higher population density. The railway network consists of approx. 940 km of 1067mm gauge tracks for a total of 1200km of track located in the south of Ghana. The railway is predominantly single-track (except for a 30km stretch from Takoradi to Manso which is double track) and uses diesel-electric motive power.

The main network lines are designated **Western Line** (Takoradi-Kumasi), **Eastern Line** (Accra-Kumasi), and **Central Line**, which connects the Western and Eastern Lines running parallel to the coast and about 80km inland. The network has five branch lines: the Sekondi, Prestea and Awaso Branches originating from the Western Line; the Tema Branch originating from the Eastern Line; and the Kade Branch originating from the Central Line.

Most of the network is currently in a poor condition and is either closed for operation or running very limited services. Out of a total length of 947 km of rail, only 120 kilometres were operational in 2017. The **Central Line** and **Kade** Branches are not presently active. The **Accra-Tema** line (of about 20 km), and **Nsawam-Accra** line (of 41 km), both used exclusively for passenger traffic, are currently the only two operative stretches of the **Eastern Line**.

The only railway lines operating along the **Western Line** are the **Nsuta - Takoradi Harbour** line for freight traffic (manganese) and the **Takoradi-Kojokrom-Sekondi** rail line for passengers. Currently, the Government-owned Ghana Railway Company Ltd (GRCL) operates the railway system. The existing railway network is shown in Figure 4.1.

4.2 Track

Since construction, the Western Line has been partially realigned and the first 30.6km from Takoradi northward to Manso have been double tracked. With the exception of the Prestea Branch, all GRC lines have favourable horizontal and vertical alignments, which should contribute to an efficient railway operation.

Passing Loop lengths vary from station to station, but are around 400m on the average over the network. Passing Loops at junction points and key stations are longer than at other stations. The most restrictive passing loop lengths are on the Eastern Line, where many of the loops are less than 300m in length. The main characteristics of railway alignment, axle load and track structure are provided in Tables 4.1 and 4.2

4.3 Rails

All GRC tracks are 1067mm gauge (42") conventional track structures, using standard flat-bottom rail sections, steel or wooden sleepers and stone ballast. With the exception of one small (30km) double-track section (between Takoradi and Manso), the GRC uses single track for bi-directional running, with passing loops located every 9-10km.

The GRC uses rails of 30, 37.5, 40 and 45kg/m (British and American standard 60, 75, 80 and 90lb/yd rail sections). Rails are joined using 4-bolt fishplates. Some experimental use of thermite welding has been made on the Western and Eastern lines where a few 60ft (18.3m) and 120ft (36.6m) welded rail strings have been installed on the track. The GRC practice is to maintain square joints on straight tracks and staggered joints on curves.

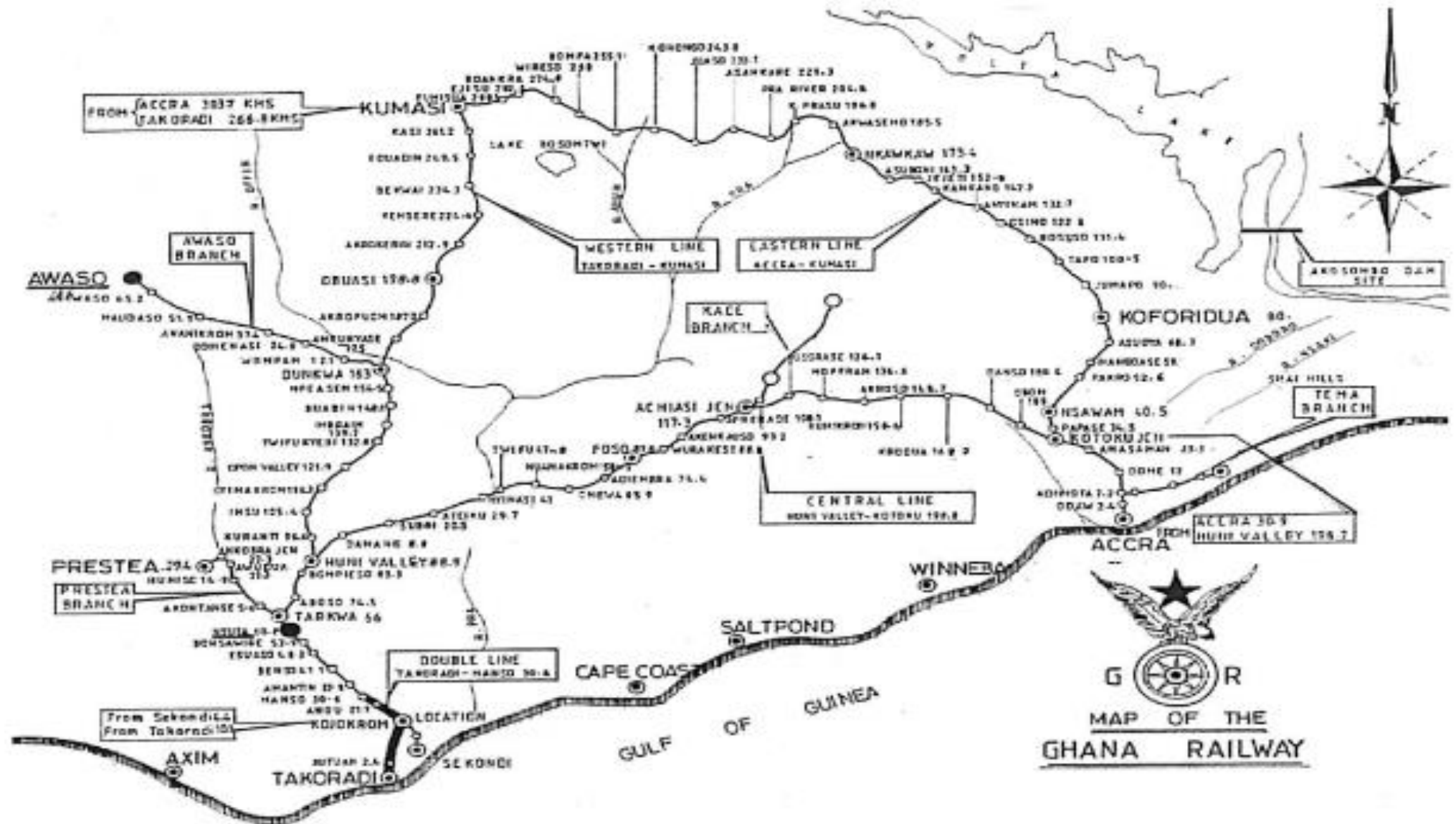


Figure 4.1 Existing Railway Network in Ghana

Table 4.1 Alignment and Load Characteristics of the Network

Network	Length	Grade	Allowable axle loading (tons)
Western Line	201m	1.25 %	16 t
Eastern Line	201m	1.25%	13.5 t
Central Line	201m	1.25%	12.5 t
Central Line	291m	1.00%	12.5 t
Prestea Branch	103m	2.50%	12.5 t
Awaso Branch	291m	1.25%	16 t
Tema Branch	349m	1.00%	16 t
Kade Branch	201m	1.25%	12.5 t

Source: GRCL/IRCON

Table 4.2 Summary of Track Structure Characteristics

From	To	Distance	Rail	Sleeper	Fastening
Takoradi	Manso	30.6km	80	Wood/steel	Rigid/elastic
Manso	Huni Valley	58.3km	90	Wood/steel	Rigid/elastic
Huni Valley	Kumasi	177.9k	80	Wood/steel	Rigid/elastic
Accra	Osino	122.4km	60/80	Wood/steel	Rigid/elastic
Osino	Konongo	121.5km	80	Steel	Rigid
Konongo	Kumasi	59.2km	80	Wood	Elastic
Huni Valley	Twifu	47.9km	80	Wood	Rigid/Elastic
Twifu	Apoeradi	60.4km	60	Wood/steel	Rigid/elastic
Aperadi	Kotoko Junction	90.5km	80	Wood/steel	Rigid/elastic
Kotodrom	Location	2.75km	60/75/80	Wood/steel	Rigid/elastic
Tarkwa	Prestea	29.4km	60	Wood/steel	Rigid/elastic
Dunkwa	Awaso	73.2km	75/80	Wood/steel	Rigid/elastic
Achimota Junction	Tema	23.7km	80	Wood/steel	Rigid/elastic
Achiasi Junction	Kade	40.25km	60	Wood/steel	Rigid/elastic

Source: GRCL/IRCON

4.4 Sleepers

The GRCL uses sleepers of two main types: Steel sleepers BS80 and domestic hardwood sleepers 127 x 254 x 1981mm (5" x 10" x 6'6"). Although steel sleepers were once standard on the railway, but in recent years the GRC has preferred the use of locally-sourced hardwood sleepers, which are less expensive and can be purchased with local currency. The trend, is currently reversing, as the type of hardwood species available for conversion to sleepers is giving a life span on the track of only between 2-4 years, against the 20÷30 years in previous years. Thus, hardwood sleepers have become less cost-effective and GRCL is studying the use of concrete as a worth alternative for future maintenance and new construction operations.

Rails are fastened to steel sleepers using keys or ABK or Pandrol elastic clips, while the attachment to hardwood sleepers is done using dog spikes or elastic spikes in predrilled holes, the elastic spikes being preferred by GRC.. The rail rests directly on the sleeper without the use of steel base plates.

Wooden sleepers are purchased from suppliers in a “raw” state (i.e. unseasoned and chemically untreated). The GRC then seasons the wood, adzes rail seats, drills spike holes and treat the sleepers using approved chemicals to prolong the service life. The sleeper preparation is carried out at a sleeper plant located at Quarry (near Kojokrom). Properly cured and treated sleepers should last about 15 years in service and some of the high-density hardwood varieties do not last much longer. Unfortunately, GRC has been skimping on the curing and treatment of sleepers, resulting in a reduced service life expectancy of 5 to 10 years. Both steel and wooden sleepers are installed at an average spacing of about 714mm, or about 1400 sleepers per track kilometer.

4.5 Ballast

The GRCL obtains ballast mainly from the mine tailing from the manganese mine at Nsuta. The GRC ballast specification is simply the size range 19 – 51mm ($\frac{3}{4}$ ” – 2”), without any specified gradation.

The GRC standards call for a ballast depth of 12” (305mm) below sleepers and a shoulder width of 6” (152mm) beyond the sleeper ends. This gives a theoretical average ballast volume of 1200m³/km for wooden-sleeper tracks, and 900m³/km for steel-sleeper tracks. However, currently, the quantity of ballast does not exceed 0.5 m³/m in most areas.

4.6 Turnouts

The GRC has a variety of turnout types, all having straight points and curved crossings. However, there are only two main types in common use. They are 1:12 and 1:8.5 as set out in Table 4.3.

Table 4.3 Turnout Characteristics on the GRCL Network

Type	Point Length	Curve Radius	Speed	Place of Use
1:12	16’0” (4.88m)	977’6” (298.5m)	40 km/h	Main tracks
1:8.5	13’0” (3.96m)	480’4” (146.9m)	25 km/h	Secondary tracks

Source: GRCL/IRCON

4.7 Bridges

The network has 287 bridges with a total length of 3,217m. About 80% of the bridges are steel girder or truss bridges with timber decks, with the remainder as reinforced concrete bridges. The percentage of total track length supported by bridges is 0.34%, an indication of the favourable terrain for the network. The Prestea branch crosses difficult terrain, hence has the highest concentration of bridges, about 4 times greater than the network average. The important bridges and distribution along the network are given in Tables 4.4 and 4.5.

Table 4.4 Important Bridges on the GRCL Network

Location	Type	Length	Comments
Western km 57.4	Steel WP	57.4m	River Bonsa
Western Km 165.2	Steel Truss	91.5m	River Offin
Prestea Km 27.8	Steel WP and Truss	119.8m	River Ankobra – future Road/Rail
Awaso Km 53.4	Steel Truss	34.1m	River Ankobra

Awaso Km 64.1	Steel Truss	37.8m	River Ankobra
Central Km 47.2	Steel WP	138.1m	River Pra – Road/Rail
Central Km 195.4	Steel WP	64.0m	River Densu
Kade Km 17.0	Steel WP and Truss	79.3m	River Birim – Road/Rail
Eastern km 1.85	RC Slab	46.3m	Korle Lagoon
Tema Km 5.88	RC Ream	31.6m	Liberation Road (Accra)

Source: GRCL/IRCON

Table 4.5 Distribution of Bridges on GRCL Network

Location	Line Length	Number of Bridges	Total Length	Bridges/Line Length (%)
Western Line	266.8	77	737.3m	0.28
Eastern Line	303.9	88	823.0m	0.27
Central Line	198.8	43	604.1m	0.30
Prestea Branch	29.4	26	393.2m	1.33
Awaso Branch	73.2	25	213.7m	0.29
Tema Branch	23.7	13	232.1m	0.98
Kade Branch	40.3	15	213.4m	0.53
TOTAL		287	3,216.8m	0.34

Source: Consultant Elaboration from IRCON

In addition to railway bridges, the GRC owns and is responsible for maintaining a number of steel pedestrian overpasses in urban areas.

4.8 Buildings

The railway currently owns 1,088 buildings with a total floor area of 304,086.51 m². The majority are of concrete construction with corrugated asbestos roofs. GRDA buildings include stations, administrative offices, workshops, sheds, residential buildings and other structures. The buildings and their distribution over the railway network are listed in Table 4.6.

Table 4.6 GRDA Buildings

No.	Railway Line	Location	Number of Buildings	Total Floor Area/m ²
1	Western Line	Takoradi – Tarkwa	467	219,207
		Tarkwa – Kumasi	461	34,984
2	Prestea Branch	Tarkwa - Prestea	40	2,977
3	Awaso Branch	Dunkwa - Awaso	132	9,994
4	Central Line	Huni Valley - Kotoku	406	33,213
5	Kade Branch	Achiasi - Kade	108	9,030
6	Eastern Line	Accra – Nsawam	324	53,787
		Nsawam – Kumasi	561	68,964

7	Tema Branch	Achimota - Tema	144	10,265
8	Total		2,643	442,420

Source: GRCL/IRCON

4.9 Technical Installations

4.9.1 Signals and Telecommunications

GRCL has two types of train control signals installed at discrete locations:

- **Mechanical interlocked signals and transmission system**, both fully-interlocked and semi-interlocked. This system is installed at all the stations on the double-track line between Takoradi and Manso, on the line from Achiasi Junction to Kotoku and at various other key stations on the network. Mechanical signal systems have two main functions: to operate turnout points and to provide visual signal indications to trains.
- **Colour light signal system**, with starting signals at main terminals and junction points. This system provides 2-aspect starting signals, 3-aspect home signals and uses electromagnetic treadle wheel detection. At present the colour light signals are defective and not used, thus causing undue delays to trains.

Track blocks between stations are not signalled. Dispatchers' offices are located at Takoradi, Kumasi and Accra. The GRC has a large number of at-grade road crossings (level crossings), a few of which have electric signals and gates. Crossing keeper personnel at each crossing manually operate all such crossing-protection signal systems. The remaining crossings are equipped with mechanical gates if traffic levels so warrant. At low traffic locations the keeper uses a red flag to stop traffic for trains. The GRC has several communication systems including various telephone, radio and microwave systems. In general, these systems have not been well structured to give adequate communication capabilities to GRC.

4.9.2 Telephone

The GRC has the following installed telephone systems:

- PABX telephone exchanges installed at Takoradi, Location and Kumasi;
- Manual exchanges installed at Accra and Takoradi;
- Block telephone system for station-to-station calling (Western Line); and
- Selector telephone system for dispatcher-to-station calling (Western Line).

The block and selector telephone systems on the Western Line use a 12-pair buried cable (installed in 1988) between Takoradi and Awaso and a pole line between Dunkwa and Kumasi. In addition to the above-mentioned telephone systems, there is some station-to-station telephone capability on the Central and Eastern Lines. None of the telephone systems are currently working.

4.9.3 Telephone

All radio systems have been taken out of service due to problems of frequency allocation and interference with third party frequencies (with the exception of a few HF transceivers and local hand-held VHF radio communication equipment). The GRC has a significant investment in radio communication equipment and infrastructure, much of which could be re-utilized to implement a future radio communication system. Radio equipment and infrastructure includes:

- VHF radio repeater system with microwave backup (17 sites on the EL and CL);
- Local VHF base stations and mobile units (Takoradi, Kumasi and Accra); and
- HF radio transceiver sets at Takoradi, Dunkwa, Kumasi and Awaso.

Of all the shortcomings which hamper the GRC's efficiency, the lack of adequately functioning communications is the most serious, as it makes train control utterly inefficient, not to mention the safety risk which is of particular concern for passenger services.

Of the total 150 stations on the railway system, 11 stations are fully interlocked. About 15 other stations are semi-interlocked, most of them on the WL between Manso and Huni Valley and the CL between Achiasi and Kotoku. Switches are not motorized and, on the WL, interlocking devices for facing points have yet to be mounted. On the WL, all stations are equipped with directional mechanical signalling and electrical block signalling, manually operated.

The WABCO colour light signalling system installed in 1989, is also the means of transmission for the block system. This is currently only working from Takoradi to Huni Valley, leaving the remainder of the line out of the control of the train dispatcher.

On the EL and CL, it was anticipated that a normal situation was to be restored after the works, which included installation of entirely new signalling and telecommunication systems based on radio facilities. That was not to be, because the frequency chosen for the radio equipment were later found to conflict with that of the national security agencies and to date the frequency issue has not been resolved.

4.10 Rolling Stock

4.10.1 General

GRCL's rolling stock fleet consists of locomotives, freight wagons (Covered wagons, high and low sided wagon), passenger coaches and ballast bogie. The rolling stock is conventional 1067mm gauge, bogie-mounted equipment with the following technical features:

- *Gauge*: all rolling stock has 1067mm gauge
- *Size*: the largest locomotives have 6 axles and are 18.7m long. All wagons and coaches have 4 axles and the longest are 15.2m and 18.9m respectively.
- *Weight*: the heaviest locomotives weigh 96 tons (16 tons axle load). The heaviest wagons weigh 60 tons loaded (15 tons per axle). The majority of wagons and all coaches weigh 10 tons per axle or less.
- *Couplers*: all rolling stock uses standard knuckle couplers and draft gear similar to the AAR Type E coupler.
- *Bearings*: all rolling stock is equipped with Timken-type roller bearings. Much of the equipment was converted to roller bearings from journal bearings in recent years.
- *Brakes*: all wagons and coaches are equipped with vacuum brakes. Some locomotives have dual train-braking systems (vacuum/air), but most are not equipped with dynamic brakes.

The fleet is getting old; almost all of the locomotives were purchased in the last 26-30 years and over two-thirds of the wagons were purchased over 20 years. All coaches were purchased in the late 1980s. The fleet is quite well maintained. Two locomotives and 10 coaches have been rehabilitated few months ago.

In general, the current fleet is insufficient to meet the current traffic demands. There is currently shortage of bauxite and log wagons, even though hauling of these two items have been suspended due to the condition of the tracks from Tarkwa and beyond, which will become critical as traffic increases. The coach fleet is small and will not be sufficient to handle future passenger operations. The GRCL has extensive well-equipped rolling stock maintenance facilities at Location and Takoradi, with supporting facilities at other terminal stations.

4.10.2 Locomotives Fleet

The GRCL has a fleet of 36 Diesel Electric Locomotives, of which five are operational, and the others are defective. Table 4.7 summarizes the current locomotive characteristic.

Table 4.7 Type of Diesel Electric Locomotive

Series	Manufacturer	Country	Average Year	Total Power (HP)	Max. Axle Load (T)	Adhesive Weight (T)	Max. Tractive Effort (kg)	Fuel Tank Capacity (ltr)	Max RPM	No. Available
541	Thyssen Henschel	West Germany	1975	540	14.2	42.6	1400	1450	1800	2
1651	Thyssen Henschel	West Germany	1978	1650	14	84	2132	4000	900	8
2601	GEC Astom	France	1993	2516	16	96	32600	4000	1000	9
1661	ABB Henschel	Germany	1995	1650	14.3	85.5	25184	4000	900	3
1670	Eletromotive Division	Canada	1996	1500	14.5	87	25184	3400	900	14

4.10.3 Wagons

Over 60% of GRC's wagon fleet consists of low-sided and high sided wagons used to transport bauxite and manganese ore. The balance of the fleet consists mainly of covered wagons and various types of flat wagons. All wagons are equipped with roller bearings and air or vacuum brakes. Most of the wagon fleet is characterized by low axle loads (± 10 tons/axle) and relatively high tare ratios ($>35\%$). However, according to the more recent GRC data (2019), the total number of available wagons is increased to 490. Table 4.8 summarizes the current wagon fleet.

Table 4.8 Fleet of Wagons

Quantity	Description	Axles	Brakes	Length (m)	Tare (T)	Gross (T)
1	Water Tank Wagon	4	V	11.5	17.3	39.8
89	SA Steel Open Wagon	4	V	12.2	17.1	60.1
150	Eng. Low Sided Wagon	4	V	11.7	14.7	39.7
92	36 Ton Steel Van	4	V	13.4	18.6	54.6
2	Flat Truck	4	V	13.6	12.9	28.2
40	Bolster/Container/Flat	4	V	13.6	12.8	52.8
1	Caboose	4	V	11.6	18.2	18.7
15	Ballast Hooper	4	V	11.5	15.5	43.4
3	Well Wagon	4	V	15.2	24.0	39.2
27	Tank Wagon	4	V	13.4	20.4	50.4
70	B.O.M Wagon	4	A	12.0	15.0	55.0
490	Total					

Note: Braking System: Vacuum (V)/Air(A)/Dynamic(D)

The main uses of the fleet are:

- SA steel open wagons (43-ton mineral wagons): these are refurbished units purchased in the past 15 years and mainly used on bauxite trains;
- B.O.M Wagon (55-ton mineral wagon): was purchased 2012 used to haul manganese;

- Low-sided wagons (25-ton mineral wagons): mostly purchased 1962-1972. Many of these wagons have wooden sides and floors and are mainly used on manganese trains;
- 36-ton steel vans: used for General Cargo, purchased in 1995;
- Bolster flats: used on log trains; and
- Caboose (brake vans): The GRC places a brake van on all freight trains. Due to the shortage of cabooses, other equipment such as passenger coaches is often used.

4.10.4 Coaches

The entire GRCL equipment fleet was replaced in the late 1980s with new equipment manufactured in the then East Germany. The GRCL passenger equipment fleet is summarized in Table 4.9.

Table 4.9 Fleet of Coaches

Quantity	Description	Year	Axles	Brakes	Length/m	Tare/t	Gross/t	Seats
4	2 nd Class Sitting	1987	4	V	18.9	27	34	93
10	2 nd Class Sitting	1990	4	V	18.9	27	34	93
4	Brake & Baggage	1987	4	V	18.9	29	34	30
5	2 nd Class Sleeping	1987	4	V	18.9	28	30	28
2	1 st Class Sitting	1987	4	V	18.9	27	31	56
4	1 st Class Sleeping	1987	4	V	18.9	28	29	18
29	Total							

4.10.5 Other Equipment

The GRCL has a fleet of 97 vehicles, consisting of 16 on-track machines, 17 off-track machines and 65 road vehicles, as shown in Table 4.10 below.

Table 4.10 Equipment and Vehicles

Description	Type	Total
Bus		
Operational	Road	8
Not-functional		9
Truck	Road	2
Light Vehicle		
Operational	Road	15
Not-functional		22
80-ton crane	On-track	2
Cranes	Road	2
Fork Lift	Off-track	5
Lister	Off-Track	6
Gang Trolley	On-track	11
KGT	On-track	1
Excavator	Off-track	1
Crushing Plant	Off-Track	2

Total	86

4.10.6 Summary of Current Situation of the Rolling Stock

Information gathered during the visits and interviews carried out with various people interested in the development of the railway system, indicate that in general, apart from the four Chinese manufactured Diesel Multiple Units (DMUs) used for passenger commuter services between Accra – Tema Harbour and Takoradi – Sekondi through Kojokrom, the rolling stock situation is very poor in terms of operational availability, state of maintenance and the very old technology. The same situation applies to the maintenance installations and equipment for the rolling stock.

DMUs

The four modern DMUs mentioned above, two are about 10 years old and the other 3 years respectively. The Accra – Tema commercial service operate daily on a line approximately 20 km long, that has been rehabilitated, and permits a Vmax speed of approx. 55 km/h and Takoradi – Sekondi through Kojokrom commercial service operate daily on a line approximately 16km long and permits Vmax speed of approximately 80km/h.

The Tema – Accra DMUs have 6 coaches, with double automatic doors and access steps. The 6 coaches are inter-communicating. The seats are arranged lengthwise (metro-type) thus allowing the maximum exploitation of the vehicle's capacity in terms of standing room. The capacity of the single train is estimated in approximately 600-650 passengers, between those seated and standing.

The two end coaches are motor coaches. The driving system for each motor coach includes:

- 1 Caterpillar diesel engine
- 1 alternator
- 2 Vossloh-Kiepe traction converters (1 for each bogie)
- 4 asynchronous three-phase traction engines (2 per bogie)
- 1 converter for auxiliary services
- 1 rheostat for electro-dynamic braking

The vehicles do not have any air conditioning system, but only simple ventilation. Whiles the Takoradi – Sekondi has been equipped with air-conditions system and disability friendly seats. Approximately 15 Ghanaian technicians have carried out a training course in China for the maintenance of the DMUs and currently the maintenance support seems adequate, even if signs of deterioration are starting to show, especially due to the lack of and difficulty in procuring the spare parts.

The coordination of the maintenance activities of the four DMUs is currently carried out by technician from the company, at a small Depot located near Tema Harbour and Location workshop. The Tema Depot, approximately 120m long and 25m wide is equipped with two internal tracks, one of which has a partial central inspection pit, and some maintenance equipment, including a set of 4 lifting jacks to carry out changes of bogies. The line that runs from Tema Harbour towards the city of Tema has been completed and is currently being extended by several kilometers.

Other Rolling Stock

From a technical point of view, the existing rolling stock is rather old, generally corresponding to a concept of approximately 35 years ago or older. There are only a few more recent locomotives, dating back to the mid-90s; they are manufactured by General Motors but most of them are out of operation due to lack of spare parts. We were informed that there are 5 in operation, of which 4 at Takoradi and 1 at Accra. The few railway services carried out with the locomotives, both at Accra and Takoradi, use these GM locos.

The passenger coaches are older than the locomotives and in a very bad state of maintenance. In particular, the passenger coaches are from the '80s and were built in the ex-DDR. The coaches are old-fashioned in concept, with installations that are out-of-date from a technical point of view. Some of the freight wagons are also rather old-fashioned and built a long time ago. They are mainly of English manufacture. In the maintenance installations visited, a lot of abandoned rolling stock was seen, in terrible conditions, considered unusable and ready for scrap.

Current Railway Services

The only railway services carried out today with locomotive and passenger coaches are from Accra to Nsawam (1 set of train a day), on a line approximately 40 km long and Takoradi to Tarkwa (1 set of train a day) approximately 66 km long.

For all the passenger railway services, there is a problem of ticket control because as the stations are not closed and the trains are overcrowded, checks are difficult to carry out. There is, therefore, considerable evasion, despite the low cost of the tickets.

4.11 Ancillary Facilities

Below is a description of the maintenance structures and related existing railway structures connected to them. The first part of the description regards the status of the structures dating before 2005; the information has been taken from the documents produced before that year. Whereas, in the second part, a summary of the current situation has been given, elaborated based on the surveys and interviews carried out by the Rolling Stock Expert from the Work Team.

4.11.1 Workshops and Stores

Most of the GRCL rolling stock maintenance capabilities are concentrated at the Location Workshop complex near Sekondi, and about 10 km from Takoradi. The Location Workshop includes main shops, stores, laboratories and administrative buildings totaling 33,000 square meters of floor area. Secondary workshops and running sheds are located at Takoradi, Tarkwa, Dunkwa, Kumasi, Tema and Accra. Other disused rolling stock facilities remain at Nkawkaw, Koforidua and Achiasi Junction.

The main work facilities at Location consist of:

- Locomotive Workshops – including Rehabilitated diesel/Erecting Shop, Blacksmith Shop, Welding/Fabricating Shop, Copper Shop, Machine Shop, Foundry, Millwright Shop, Electrical Shop, Transport Pool and Laboratory; and
- Carriage and Wagon Workshops – including Wagon Shop, Coach Shop, Machine Shop, Blacksmith Shop, Paint Shop, Upholstery Shop, Train Lighting Shop, Sawmill and Furniture Shop.

In addition to the workshop facilities, there is a large rehabilitated training facility used mainly to train mechanical and electrical maintenance staff and locomotive drivers. There is also a smaller training facility at Takoradi. Running maintenance of locomotives, wagons and coaches is carried out in all the workshops, whereas heavy maintenance is the main task of Location Workshop.

4.11.2 Electrical Workshop/Train Lighting

The Electrical Workshop is responsible for all the lighting needs of the stations, workshops and staff bungalows/quarters, with a total staff of 29. Train Lighting on the other hand is responsible for the lighting requirements of the trains and has a staff of 8. Workshops for both sectors are located at Takoradi, Accra, Tarkwa, Kumasi and Dunkwa.

Civil Engineering Workshops

The Civil Engineering Workshops are responsible for the maintenance of station and staff buildings. There are 105 staff and the workshops are located at Takoradi, Location, Accra, Kumasi, Tarkwa, Dunkwa and Achiasi Junction. The GRC workshops and running sheds are well equipped with tools, machines and equipment for the maintenance of the rolling stock. In addition to a large selection of general metalworking equipment, there are 2 type-welding machines, 2-wheel lathes, 5 vertical boring machines and 2 under-floor wheel profiling machines.

Stores

The GRC Stores Department operates 30 separate store facilities at various locations. Many of the stores are located at Takoradi and Location to support the rolling stock maintenance activities and hold tools, spare parts and raw materials for general maintenance of both the Infrastructures and Rolling Stock.

4.11.3 Sleeper Production Facility

GRCL has a wooden sleeper's facility at Quarry (near Kojokrom) that receives new sawn timbers and provides curing, adzing of canted rail seats, drilling of spike holes, treatment with approved chemicals and storage of the finished sleepers. The facility is equipped with:

- 2 – Sleeper adzing and drilling machines (one functioning)
- 2 – Creosoting cylinders (capacity 240 sleepers each); and
- Assorted rail trolleys for moving sleepers within the facility.

Air curing of the sleepers requires from 6 weeks to 6 months, depending on the dryness of the season. Water content is estimated based on the weight of the sleepers. The facility has a normal throughput of 480 (maximum 960) sleepers per day. Properly maintained, the facility should be able to produce 100,000 per year.

4.11.4 Railway Central Training Institute

The Training Institute was established to provide technical and supervisory training to railway workers at all levels. The railway central training institute has been completely refurbished and plans are far advanced to convert it into a modern railway university.

4.11.5 Summary of the Current situation of Workshops for Rolling Stock

On the basis of the data collected and the meetings held, it was ascertained that there are a certain number of garaging and maintenance installations for rolling stock that are far superior to the current requirements in terms of quantity and available space. Only a few of these were visited, but on the basis of experience acquired, it can be concluded that they were conceived and built a long time ago (except for the small Depot at Tema for the two DMUs) and they are in a very poor state of maintenance as far as the buildings and general installations are concerned.

The maintenance machines and equipment are also rather obsolete and in a very bad state of up-keep. In some cases, they are considerably more than the hypothetical requirements, probably because they derive from a time when a discrete railway service was operational and there was no possibility to use external companies for specific activities (for example, machine tools, foundries, etc.). There is a general lack of special maintenance equipment and spare parts, which means that there are a lot of partially dismantled rolling stock and components that are awaiting missing parts in order to resume operations.

The skill of the technicians seems to be quite adequate for the type of rolling stock. In fact, activities were being carried out regarding the repair and revision of bogies, traction engines, diesel engines and on-board

systems, as well as the revision and restructuring of passenger coaches. Furthermore, work is carried out on wheel sets and wheels, both substituting wheels and resurfacing the wheel flange by electric arc. This last operation is carried out using Japanese equipment that seems to be quite recent.

There are also small benches and test workshops for injection pumps, Woodward regulators, pneumatic components, etc.

The lack of spares and appropriate equipment leads, however, to a general lack of efficiency of the system. Inside the Takoradi Workshop, there is also a foundry and a department for the manufacture of wooden sleepers, that is partially operational, and that could also work for third parties. The only railway services operating today with locomotives and freight wagons are between Takoradi and the manganese mines in the area of Nsuta Wassaw. All the other railway services carried out previously on the Western line, the Eastern Line and the Central Line have gradually been abandoned, due mainly to the deteriorated conditions of the railway infrastructure, both the civil works and the permanent way and signaling.

4.12 Area Management System

For administrative convenience, the rail network was divided into three areas in 1986 with their headquarters located at Tarkwa, Dumas and Accra. Area Managers were appointed to man these areas to monitor all transport activities originating and terminating in the areas, and account for them to Corporate Headquarters.

4.13 Relevant Facts in the Railway Sector

In the last years different relevant “events” in the Ghanaian railway sector have happened, starting from the institution of the new Ministry of Railways Development (MoRD) in February, 2017 when Hon. Joe Ghartey, has been tasked with ensuring the rapid development of a modern rail network in Ghana. GoG is implementing many of the recommendations within the 2013 Railway Master Plan, in particular for the re-development of the existing railway network and starting the construction of the new railway line from Tema Port to Akosombo. A description of the relevant facts in the railway sector in Ghana is presented below.

4.13.1 Western Railway Line

The first step was the initiatives undertaken for the substantial rehabilitation and up-grading of the Western Railway Line, with the complete reconstruction of the railway superstructure and the necessary realignment to achieve new standards (Axle load of 21 tons and Design speed of 120km/h). The Front-End Engineering Design (FEED) of the Western Railway Line, including the main line from Takoradi to Kumasi (267km) and Dunkwa-Awaso branch line (73km), was carried out. With the FEED of the Western Line, GoG attained an essential tool to reduce risk and uncertainty during the following phases of the implementation of the project. In fact, the FEED provided a detailed project cost estimate and a well-defined technical framework, allowing a faster implementation of the project and a more controlled competition between contractors on well-defined rules.

In 2013, the Government started the re-construction of the first section of the Western Line from Sekondi to Takoradi via Kojokrom (Construction of the 10.1km Double track railway line from Takoradi to Kojokrom and a 4.5 km single track line to Sekondi). The project, completed in 2017, consists of the rehabilitation and renovation of the first segment of the Western Line (narrow gauge, 1.067m) and the establishment of a suburban train service between the twin cities of Takoradi and Sekondi. It also included:

- The renovation of one station building (Takoradi) and the construction of three new station buildings (Sekondi, Butua, Kojokrom); and
- The supply of two DMU train sets, air conditioned on narrow gauge bogies.

In September 2017, the Development of the Standard Gauge Western Rail Line continued with the final engineering design of the second segment between the cities of Kojokrom and Tarkwa through Nsuta (54.5km). The re-construction works are currently on-going along the section from Kojokrom to Manso (22km) and rehabilitation works along sections of 54km from Takoradi to Tarkwa to facilitate the haulage of manganese from Nsuta Mining siding and Takoradi Port.

4.13.2 Tema Port – Akosombo Railway Line

In 2016, GoG obtained credit facility from the Indian Exim Bank to construct the new railway line from Tema Port to Akosombo, to link the lake transport services on the Volta Lake to the northern parts of the country. The Contract Agreement for the construction of the new line was signed between GRDA and Afcons Infrastructure Limited, India (AFCONS) on the 18th November 2016.

The Rail Project consists of Construction of Single Standard Gauge Railway line from Tema to Akosombo, Railhead facilities at Tema & Akosombo and provision of Rail Maintenance Facilities near Tema on Engineering, Procurement and Construction (EPC) Basis.

The railway line Tema-Akosombo passing in Southern Ghana from Greater Accra Region to Eastern Region with an original length of 84.832km, has a total length of 97.78km in the final alignment. The commencement date has been given by GRDA on the 3rd day of July 2018 and works are expected to be completed within a 36-month period. The progress of construction works achieved as at 31st May 2019 is overall equal to **32.77%** as indicated in Table 4.11 below.

Table 4.11 Progress of Construction Works

Milestone Description		Percentage of Progress
1.0	PRELIMINARIES	63,56 %
1.1	Contractor's Mobilization including Office, Camp Office, Laboratory, Workshop, Plants & Equipment, Accommodation for Staff and Workers, etc.	79,38%
1.2	Survey, Geotechnical Investigation, Engineering and detailed design including submission of Drawings for approval	40,71%
1.3	Identifying ROW and clearing it of hindrances such as hutments, Residential, Industrial or any other structures within ROW and taking possession of the land	75,95
1.4	Shifting of Utilities	58,94
1.5	Provision for Supervision Consultant (PMC)	40,00%
2.0	PROCUREMENT & CONSTRUCTION	26,69%
2.1	Site Clearance including clearing and grubbing, tree cutting, disposal all complete	50,00%
2.2	Earthwork in formation in Embankment/Cutting	49,99%
2.3	Culvert, Minor Bridges, Viaduct	49,71%
2.4	Tunnels	0.0%
2.5	Drainage – Longitudinal Drains and Protective Works	0.0%
2.6	Railway Track	22,28%
2.7	Signalling and Telecommunications	0.0%
2.8	Construction of Railway Stations	0.0%
2.9	Railway Maintenance Facility (Loco Shed, Wagon Workshop & Track Main Facility)	0.0%
2.10	Railhead Facility at Tema	0.0%
2.11	Railhead Facility at Akosombo	0.0%

2.12	Providing Training on Railway system including Railway Engineering, Railway Management, Operation and Maintenance	0.0%
Percentage Overall Contract Price		32,77%

4.13.3 Eastern Railway Line

In 2017, the Feasibility studies for the Development of the Boankra Inland Port and the Eastern Railway Line Project on a PPP Basis were carried out. The project foresees the construction of the new 340-kilometre standard gauge rail line from Tema Port to Kumasi along the existing narrow-gauge corridor.

Following the results of the feasibility study, the Ministry undertook a market sounding event in December 2017, with the aim to involve the private sector in the development of the Eastern Railway Line on a Build, Operate and Transfer (BOT) basis. Thereafter, in February 2018, 45 firms submitted their proposals indicating their interest and later, in July 2018, 8 out of the 15 shortlisted consortia were pre-qualified to the Request for Proposals stage to submit their Technical and Financial proposals.

Finally, Ghanaian-European Railway Consortium (GERC) was adjudged the preferred bidder to construct the US\$ 2.2 billion Eastern Railway line and on April 2019, the negotiations on the Concession Agreement for the new Eastern line (standard gauge) railway project have commenced.

4.13.4 Other Initiatives in the Railway Sectors

The Government of Ghana has started the development of the railway sector, launching many other studies and initiatives to facilitate and encourage the expansion of the railway network. The most important are described below:

- In 2017, the MoRD engaged a Transaction Advisor for the development of the *Railway Line from Kumasi through Tamale to Paga (Central Spine)*. The objective of the assignment is to improve rail and logistics infrastructure as part of an integrated transport network in Ghana, helping to improve services to customers and reduce the cost of transport, especially, in trade to and from the hinterland and the Northern regions of Ghana.
- In the meantime, in April 2018, a Memorandum of Understanding (MoU) has been signed between the Government of Ghana and Messrs China Civil Engineering Construction Corporation (CCECC) to undertake feasibility studies and due diligence on the proposed rail line.
- The project will be developed in sections, starting from the Kumasi-Bechem section (approx. 390km).
- In August 2018, the MoRD engaged a Transaction Advisor for the development of the *Ghana-Burkina Railway Interconnectivity Project*. The proposed railway project represents the first transnational railway initiative in Ghana. It involves the construction of a single standard gauge railway line from Ouagadougou, Capital of the landlocked Burkina Faso, to the Port of Tema, in Ghana, and will cross the Ghanaian cities of Yendi, Tamale and Paga. The Feasibility Study of this railway project is currently ongoing.
- The Governments of Ghana and Burkina Faso intend to involve private sector partner(s) and to pursue a PPP arrangement for the development of the Ghana - Burkina Railway Line on a Build, Operate and Transfer (BOT) basis. In May 2018, the Governments started the procurement process that is, to date, at the stage of evaluation of the qualification documents submitted during the Request for Qualification (RfQ) on May 2019 by the 4 out of 12 firms, that met the minimum evaluation criteria.
- Moreover, in June 2018, Ghana's Minister of Railway Development, Joe Ghartey revealed that the South Africa Company, Transnet International Holdings, will be supplying rolling stock, including 110 wagons, 22 coaches and 8 locomotives, to the Ghana Railway Company Limited by the end of 2018.

- Finally, the following initiatives are currently under way:
 - Feasibility Study for the development of a Metro Rail/Light Rail Transit System in Accra and its environs;
 - Feasibility Study for the development of a Metro Rail/Light Rail Transit System in Kumasi and its environs;
 - Feasibility Study for the development of the Trans-ECOWAS Railway Line from Aflao to Elubo; and
 - Feasibility Studies for the redevelopment of the railway line from Kotoku to Huni Valley (Central Line)

CHAPTER FIVE

THE RAILWAY MASTER PLAN

- ❖ Overview of the Master Plan
- ❖ Main Aspects of the Plan
- ❖ Proposed Expansion of the Railway Network
- ❖ Specific Construction, Rehabilitation and Other Projects

5.0 THE RAILWAY MASTER PLAN

5.1 Overview of the Master Plan

The aim of the Ghana Railway Master Plan (RMP) is to suggest a national strategy for expanding the railway system and creating an efficient transportation link to important mineral potentials, communities and every regional capital. With the objective of ensuring the modernization and development of the railway system both national and sub-urban, the Master Plan will include and deliver the following:

- Review of the traffic forecasts carried out for the previous release (year 2013) of the RMP, in light of the availability of more recent data about passenger and freight transport in Ghana and the analysis of the most recent macro-economic trends at national and regional level; and
- The plans for the construction/extension of new Standard Gauge (SG) lines covering the following sections outlined in Table 5.1 below.

Table 5.1 Section and Links of the Tracks

Section	Link	Distance (km)
Western	Awaso - Nyinahin	58
	Eshiem - Shama	20
	Oppon Valley - Oppon Mansi	6
Eastern	Kaase - Offinso	20
	Ejisu - Offinso	20
	Busoso - Kibi	12
Eastern Expansion	Tema - Akosombo	From 70km to cross the Volta River to opposite side at Mpakadan; 20km approx.
Trans-ECOWAS Expansion	Takoradi - Elubo	160

- The inclusion of on-going investments and future investments for the proposed extensions and rolling stock; such investments should include infrastructural interventions on the network and in the stations, the application of new technologies and the purchase and maintenance of rolling stock;
- The systematic estimation of demand and financial revenues generated by the interventions;
- A comprehensive set out of the Cost and Benefits associated with the development of an investment plan, aimed at assessing the financial, social and economic viability of investments;
- Reviewed and updated specifications for the railway infrastructure, also in consideration of the up-dated technologic scenario:
 - Track;
 - Signalling and Telecommunication; and
 - Buildings including stations, workshops and other structures.
- The recommended number and types of rolling stock:
 - Locomotives;
 - Wagons; and
 - Coaches.

5.2 Main Aspects of the Plan

The Ghana Railway Master Plan (RMP) is designed to revamp and transform the railway sector to meet current demands of the transport sector, while introducing efficient, high speed rolling stock to run on

standard gauges from the southern to the northern parts of the country. The Master Plan has the main components:

- Expansion of railway infrastructure to the main communities and regional capitals, important and potential mineral and other economic sites of the country;
- Expansion of railway infrastructure to other parts of the country and linking with neighbouring countries such as the Ivory Coast, Togo and Burkina Faso; and
- Interconnection of railway infrastructure with other modes of transportation (inter-modalism).

As part of the long-term (8-25 years), it is envisaged to expand the existing railway network from southern to northern and from eastern to western Ghana. This will pave the way for linking Ghana to neighbouring countries, including Burkina Faso, Mali and Niger in the north by railway. It is also proposed to develop the Trans-Ecowas to link the eastern and western neighbouring countries of Togo and the Ivory Coast. The expansion is in line with the objective of the Economic Community of West African States (ECOWAS) to link all member states by rail. This is also to facilitate the achievement of the broad objective of the Union of African Railways to link member countries by rail. Finally, it is envisaged to improve the national connection through three transversal rail link and four rail spurs to connect the 4 new regional capitals of Goaso, Sefwi-Wiawso, Nalerigu and Dabai.

5.3 Proposed Expansion of the Railway Network

The existing railway network is proposed to be expanded within a period of 15 years, with more than 3,780km of new Standard Gauge lines to be put in operation to ensure a complete transportation service for the whole country.

The proposed expansion of the National Railway Network runs along several corridors in a north-south and east-west direction and, besides linking the main cities, also connects both existing and potential mineral deposits with the two main ports (Takoradi and Tema) in the country.

The New Railway Network is comprised mainly of three north-south routes (Ghana-Burkina Faso, Central Spine and Western Expansion), a coastal line running in an east-west direction (Trans-ECOWAS Corridor), the three Transversal connections, the rail connections with the new regional capitals and the rail link to the new Keta Port. In particular, the planned railway lines are:

- **Western Line Lot 2** (273km approx.): Takoradi - Dunkwa – (Awaso) – Kumasi
- **Eastern Line** (351 km approx.): Accra – (Bosuso – Kibi) – Kumasi
- **Ghana-Burkina Faso Railway Interconnectivity Project** (690 km approx.): (Mpakadan-Nkwanta-Yendi -Tamale- Paga)
- **Trans-ECOWAS Line** (557km approx.): Aflao – Tema –Accra – Cape Coast- (Shama) - Takoradi – Axim- Elubo
- **Central Spine** (383km approx.): Kumasi - Bechem - Sunyani-Techiman - Fufulsu – Tamale;
- **Trans-ECOWAS Line** (557 km approx.): Aflao – Tema –Accra – Cape Coast- (Shama) - Takoradi – Axim- Elubo;
- **Western Expansion** (656 km approx.): Awaso - Sunyani – Techiman – Sawla – Hamile;
- **Trasversal Expansions** (383km approx.): Fufulsu-Sawla (126km), Techiman-Atebubu-Kwadwokurom (199km) and Nyinahin-Kumasi (58km),
- **Railway Spur lines:** Walewale-Gambaga (52 km), Nyinahin-Goaso (70km), Awaso-Sefwi Awaso (30km), Dambai- Nkwanta (58km); and
- **Link to Keta Harbour** (126km).

The development of the New Standard Gauge Railway Network will be implemented in successive phases, identified on the basis of the priorities for the traffic demand and considering, simultaneously, the strategic importance of each railway link for the development of the country. Figure 5.1 shows the expanded coverage and also new lines for development under the Railway Master Plan on a map of Ghana.



Figure 5.1 Re-designation of the Existing Railway Lines

CHAPTER SIX

STAKEHOLDER INVOLVEMENT

- ❖ Objective of Public Involvement
- ❖ Stakeholder Identification
- ❖ Outcome of Consultation

6.0 STAKEHOLDER INVOLVEMENT

6.1 Objective of Public Involvement

Public involvement in the assessment process ensures transparency and engages relevant stakeholders, including those likely to be affected (either positively or negatively) by the railway infrastructure development. This helps identify potential conflict and minimize misinformation. It promotes the feeling of ownership and cooperation and also helps to establish good rapport. For these reasons, a number of relevant stakeholders were identified and consulted.

6.2 Stakeholder Identification

Institution/organisations relating to railway project (environmental) approvals, planning, road crossings, interference with utility provision and service lines and natural resource management in the corridor selection were mapped out for consultation. These included the following:

- Environmental Protection Agency (EPA);
- Metropolitan, Municipal and District Assemblies (MMDAs);
- Department of Urban Roads (DUR);
- Ghana Highway Authority (GHA);
- Department of Feeder Roads (DFR);
- Forest Services Division of the Forestry Commission;
- Water Resources Commission (WRC);
- Electricity Company of Ghana (ECG);
- Ghana Water Company Limited (GWCL);
- Volta River Authority (VRA);
- National Communications Authority (NCA);
- Ministry of Environment, Science, Technology and Innovation (MESTI);
- Ghana Chamber of Telecommunications/Vodafone Ghana Limited; and
- Bulk Oil Storage and Transportation Company (BOST).

6.3 Outcome of Consultations

Stakeholder consultations were held between October and December 2012. Further consultations were held in March and April 2019 to update the ESMF. A summary of outcome of the consultations are provided in the Table 6.1 below. Details of the outcome of consultations is provided in Appendices 7 to 13 and Appendices 20A to 20D.

Table 6.1 Summary of Outcome of Stakeholder Consultations

Stakeholder	Concern/Information Received
EPA	• SEA of Transport Policy has useful information on railway sector • Emissions from trains during operations, terminal waste management and induced commercial activities must be carefully looked at • Opportunity to look at intra-city light rail as an option, distinct from the inter-city ones
ECG	• GRDA should notify ECG with project plan and planned schedule of development • ECG will acknowledge receipt and will do an assessment
GRDA	GRDA's responsibilities include: • Promote the development of railway and railway services • Hold, administer and improve the railway assets and • Promote the development and management of suburban railways by -

Stakeholder	Concern/Information Received
	- Setting and enforcing safety and security standards for construction and operation of railways - Granting licences, concessions and leases which are necessary for the operation of railways and railway services. - Regulate and monitor the activities of licensees, concessionaires and operators of railways - Initiate, conduct, promote and encourage studies necessary for the growth and development of railways etc.
GRCL	The relevant institutions must do their duties, e.g. the Assemblies must designate waste disposal sites and be seen to enforce their by-laws. They must not allow indiscriminate dumping. The Road Sector Agencies should ensure their contractors to the right thing in road-drain construction.
GHA	- Build roads to accommodate the existing rail lines - Develop a comprehensive integrated transport plan that addresses all the various modes of transports
DUR	Review the layout and plan of development, as well as proposed scope of work and implementation timeframe
Wildlife Division of Forestry Commission	- Railway lines constructed through reserves will be detrimental to the reserves and its wildlife resource. There could be train accidents caused by wild animals crossing. The animals would be killed by trains. Their habitats, breeding and feeding ranges, etc. could be fragmented; besides other negative effects like noise and vibration. - No go areas must be avoided at all cost
Forest Services Division of Forestry Commission	- The existing railway lines date far back, most of them before law established the current reserves. - Any new rail infrastructure development through a reserve will need FSD's approval.
Further Consultations in 2019	
VRA	- The route from Tema to Akosombo as indicated on the drawing should be revised since currently that is not the case. The railway line no more passes through Akosombo directly. - In addition, we would like to propose an additional route from Yendi to Paga to serve as an alternative route since it is an economic route linking Ghana and Burkina. This will also help reduce the bottleneck at Tamale.
EPA	- Some significant baseline condition change might have happened within existing railway corridors or need to account for new corridors to acquire, e.g. with the two main additional / branch lines (Takoradi to Elubo, and Sekondi to Shama), among others now introduced; - New policies and legal frameworks might have occasioned, e.g. the new Hazardous and Electronic Waste Control and Management Act and Regulations (Act 917) in place; - The current strong push for and role of private sector involvement in the railway development, making the Public Private Partnership Policy now applicable; - The subject of Asbestos roofing sheets decommissioning is a major source of concern for both occupational and public.
GWCL	- The cost of relocation of GWCL's existing pipelines affected by the Railway Master Plan should be catered for in the Plan's budget - Make Provision for ducts to enable crossing of pipelines/utilities across railway lines within urban areas. - Make available surveyed data (in AutoCAD format) for areas that are earmarked for immediate development in advance to enable us identify our pipe facilities within the railway route.

Stakeholder	Concern/Information Received
	• Compensation must be paid to the land owners for the additional branch lines
MESTI	• Ensure/establish linkage between Railway Master Plan and the Spatial Development Framework as well as planning and zoning standards in accordance with the Land Use and Spatial Planning Act, 2016 (Act 925) • Undertake environmental and social safeguards of the RMP in accordance with the environmental laws of the country.
NCA	• GRDA should follow the activities of International Telecommunication Union (ITU) , Study Group 5, Working Party (WP) 5A. • WP 5A is responsible for studies on World Radio Communication Conference – 2019 (WRC-19) Agenda Item 1.11 which considers efficient communication in railway system
Vodafone	• Vodafone has extensive underground fibre infrastructure along most of the existing rail routes. Details of the fibre locations are provided in Appendix 20B

CHAPTER SEVEN

POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

- ❖ **RMP-Specific Screening Criteria**
- ❖ **Methodology for Assessing and Ranking Impacts and Risks**
- ❖ **Beneficial Impacts of the RMP**
 - **General Benefits**
 - **Specific Benefits**
- ❖ **Potential Adverse Impact Identification**
 - **Assessment of Railway Sector Project Impacts**
 - **Risk of spread of HIV/AIDS**
 - **Potential train accident risk**
 - **Public health and safety risk**
 - **Occupational health and safety impacts**
 - **Water resource impacts**
 - **Land acquisition and property loss**
 - **Noise and vibration impacts**
 - **Impacts on cultural resources**
 - **Habitat destruction and disruption**
 - **Waste disposal impacts**
 - **Traffic disruption and diversion impacts**
 - **Utility disruption**

7.0 Potential Environmental and Social Impacts

Rail infrastructure and indeed the transport sector play a strategic role in the socio-economy of Ghana. A wide range of environmental and social (E&S) benefits will arise as a result of the RMP implementation. These will include socio-economic benefits, employment generation, social services, travel and transport enhancement, gender opportunities, fuel economy and reduced pollution. In spite of the numerous benefits, the projects under the RMP will also have adverse E&S impacts which need to be addressed relying on the implementation of the Environmental and Social Management Framework (ESMF). This section presents the following, as significant components of the ESMF:

- Criteria for screening the specific projects to be implemented under the RMP;
- Methodology for assessing and ranking RMP project impacts and risks;
- Overall E&S beneficial and adverse impacts of the RMP generally; and
- Assessment of the individual (RMP) project implementation phase potential E&S impacts.

7.1. RMP-Specific Screening Criteria

The Ghana EIA Procedures and the EA Regulations (LI 1652), list construction of railways as:

- Undertakings requiring registration with the EPA (i.e. Schedule 1 Undertaking); and
- Undertakings for which EIA is mandatory (i.e. Schedule 2 Undertaking).

The RMP consists of several types of railway infrastructure projects, of which their specific scope and exact routing and/or locations, as well as their specific designs and timing are at this stage not determined. Thus, screening for these future activities cannot be performed simply by lumping the RMP projects under the generalized Schedules 1 or 2 above. Furthermore, the multiple railway projects to be implemented are geographically spread throughout the country; hence the appropriate Environmental Assessment (EA) tool used is therefore the ESMF (the equivalent of Strategic Environmental Assessment).

The screening process is an initial stage in any EA process. The RMP ESMF also requires a screening tool for its effective implementation, which has been duly derived and developed from the Schedules 1 and 2 and also Schedule 5 (Appendix 4). The Schedule 5 of LI 1652 lists the twelve Environmentally Sensitive Areas (ESAs) in Ghana. The importance of the ESAs list is that it helps avoid all areas considered sensitive for purposes of development. Where a given project for lack of feasible alternatives must proceed within or near an ESA, a detailed EIA is required, irrespective of the scale and nature of the project. Table 7.1 gives the RMP-specific E&S screening criteria, which show the possible range of projects, and the various screening outcomes. The screening process involves matching a given potential project with a corresponding applicable E&S variable or threshold for an outcome. This will apply in the ESMF for screening all railway projects and for route/corridor/location selection under the RMP.

Table 7.1 Screening Criteria for Railway Projects under the RMP

Type of Railway Projects (Infrastructure / Service)	Environmental and Social Sensitivity Criteria and Project Thresholds	Screening Outcome (Level of EA)
• Scrapping of Coaches, Telecommunication, Wagons, Locomotives, etc. • Rehabilitation of Coaches Locomotives, Wagons, etc. • Construction/Demolition/ Rehabilitation of Railway	Non-environmentally and socially sensitive site/route Impacts generally localized, less severe, short-term and reversible Not involving removal/decommissioning of Asbestos roofing sheets	Initial Assessment
	Within / Bordering or < 0.20km from • Known historical, archaeological or scientific site or structure	

Buildings (Offices, Stores, Workshops, Platform, etc.) • Installation of Signalling and Telecommunications systems	• Cultural resource or site (e.g. cemetery, sacred grove, shrine, church, mosque) • Medical or health facility (e.g. hospital or clinic) • Educational or research facility • Houses or residential areas	Preliminary Environmental Assessment
• Scrapping of Rails • Decommissioning of Section of (Rail) Track • Decommissioning of Bridges • Production of Ballast • Production of Aggregates • Production of Sleeper • Rehabilitation of Railway Track/ Line (double track, standard gauge) • Rehabilitation of Rail-Road Crossing • Rehabilitation of Railway Buildings (Offices, Workshops, Stores, Platform, Shed, etc.) • Reconstruction of Bridges • Reconstruction of Railway Track (double track, standard gauge) • Construction of Bridges • Construction of Railway Track/Line (double track, standard gauge)	Non-environmentally and socially sensitive site/route Impacts are shorter-term and reversible and mitigation measures easy to design and implement Not requiring any or much primary data (baseline) Where Bridges are < than 100m-span (Reconstruction) Where Bridges are < than 50m-span (New construction) Where Railway Track is < than 50km in length (Reconstruction) Where Railway Track is < than 25km in length (New construction)	Preliminary Environmental Assessment
	Within / Bordering or < 0.20km from • Known historical, archaeological or scientific site or structure • Cultural resource/site e.g. cemetery, sacred grove, shrine, church, mosque • Medical or health facility (e.g. a hospital or clinic) • Educational or research facility • Houses/residential areas or affecting more than 20 persons or 10 families or may lead to compensation, relocation, or resettlement	Environmental Impact Assessment
	Within/Bordering or < 0.5 km from (an area) • Forest Reserves or Globally Significant Biodiversity Areas • Constituting the head water region of a river or stream or the bank of a water body/drainage channel • Susceptible to erosion, flooding, geological hazards (including earthquake, tremor and landslide) • Low lying area (or wetland) acting as natural buffer against shore erosion or for storm floods • Hilly area with gradient >45 degrees and prone to erosion or rock fall or mudslide or landslide	Environmental Impact Assessment
Rehabilitation/Reconstruction of: • Western Line • Eastern Line • Central Line • Branch and other Lines • Construction of new Railway Track (double track/standard gauge) and associated facilities	Mandatory Environmental Impact Assessment	Environmental Impact Assessment
Any type of Railway Facility / Infrastructure or any related Development	Any area: Declared by law as Wildlife Conservation Areas (including National Parks, Resource Reserves, Wildlife Reserves, Strict Nature Reserves, Ramsar Sites and Wildlife Sanctuaries); or Constituting the natural habitat of any threatened (endangered, data deficient and vulnerable), rare or endemic flora and fauna.	“No go” / Not Allowed
	Involving land acquisition, or leading to displacement of people, affecting property (crops and structures) and livelihoods, requiring relocation of structures or businesses and payment of compensation, etc.	Resettlement Action Plan

7.2 Methodology for Assessing and Ranking Impacts and Risks

A modified method for assessing and ranking impacts adapted from the ISO 14001 Environmental Systems Handbook (Whitelaw, 2004) is recommended for use in helping determine the level of significance of environmental and social risks and impacts associated with projects under the RMP. The ranking system will be based on eight assessing criteria using a qualitative scoring of low, medium or high scores for the likelihood of occurrence and significance of particular impacts. The criteria include:

- Level of risk of impact;
- Knowledge about similar/past projects;
- Actual or potential nuisance;
- Spatial scale of impacts (spatial extent);
- Time-scale of impacts (temporal extent);
- Inducing future incompatible activities;
- Legislative requirements and standards; and
- Information availability.

Level of Risk of Impact

This will look at the probability of impact (or risk) occurrence (i.e. likelihood), and the likely consequences should an incident occur. It will also assess concerns such as whether there could be associated risks before and even after mitigation measures have been taken (residual risks).

Knowledge of Similar/Past Projects

The history of similar projects in relation to the various RMP projects will apply. Aspects and related activities that have had environmental and social problems in the past would have a higher score, since they would have a higher likelihood of occurrence as compared to incident-free record of other activities. Likewise, aspects that generated complaints in the past will be deemed significant.

Actual or Potential Nuisance

This will be based on actual or potential damage or nuisance to surrounding areas or recipients. Impacts addressed can relate to any potential nuisance resulting from proposed RMP project activity to the public or other sensitive receptacle, within the area of project influence.

Spatial Scale of Impacts

The criterion relate to the spatial extent of impacts, grouping impacts (both direct and indirect) into local, regional or national effects. Local effects will be those occurring within the local vicinity of the cause; regional effects extended beyond the locality of the cause (though still spatially limited); while national effects consider those occurring on a national scale.

Time Scale of Impacts

The duration over which impacts occur or experienced will be considered (duration of exposure). Impacts which were intermittent or occasional, but have no acute or long-term consequence will be viewed as less serious than effects likely to occur frequently with serious and/or long-term consequences. Furthermore, occasional impacts, but which can have acute or long-term consequence will be viewed as significant.

Future Activities

This will consider the likelihood of induced activities or adverse situations that may arise in the future due to the presence of the project, and what the nature or scale of these potential activities or situations can be

(social- or environmental- or health-wise). The likelihood of future incompatible activities or situations around the area of influence that may defeat the objective of the project is also considered.

Legislative Requirements and Standards

The available legislation, policy, standards/discharge limits or guidelines in place to facilitate evaluation of significance and management of impacts will be considered; where available the relevant impacts will be considered less significant, or otherwise (where there is none in place) will be considered significant.

Information Availability

Where there is lack of information on which to base a satisfactory assessment, then the relevant aspect or impact will be considered significant. In other words, knowledge gaps in the assessment means that the assessment will be based on inadequate information/data, potentially introducing a high degree of uncertainty, hence an evaluation of significance.

7.3 Beneficial Impacts of the RMP

7.3.1 General Benefits

At the national level railways will contribute to economic growth by lowering transport costs, access, ensuring economies of scale and reducing domestic production costs. It will help enhance market opportunities, trade expansions and market integration and effective competition. Enhanced operations will specifically reduce transport costs and transit time, facilitating cross border transport. It will address the impact of international transport on the population bordering major transit corridors. It will also ensure the removal of non-tariff barriers to transit.

In urban areas, poor transportation results in the lack of affordable access to public transit services. For instance, the sub-urban railway system under the RMP will provide efficient rail network that will improve traffic management in cities. It will reduce the extreme traffic congestion, with the beneficial effects extended to the entire nation and improve general welfare, including significant reduction in greenhouse gas emissions.

In rural areas transport plays a direct role in poverty reduction by enhancing economic development, and by facilitating income generation activities linked to agriculture and other sectors, due to their dependence on agricultural livelihoods.

7.3.2 Specific Benefits

The socio-economic and environmental benefits that will specifically accrue from the RMP include:

- Economic benefits to rural areas;
- Enhanced travel and transport;
- Economic opportunities for rural women (gender benefits);
- Reduced impacts on the physical environment; and
- Boost export industries.

Economic Benefits to Rural Areas

Railway improvement will provide socio-economic benefits as accessibility and commercial activities are enhanced to facilitate economic integration at all levels. Railway development will attract in-migration of people to settle along the railway routes, creating more villages and towns and increasing the population of the district that is benefiting from the rail intervention. This in turn will result in the increase in the demand for goods, which causes more people to engage in various economic activities.

Increased production will result in employment generation. It will also generate increased farm employment and reduce out-migration in search of jobs in the urban centres. In the construction phase, opportunities for skilled as well as unskilled labour will be available to earn income. The impact on employment and income is considered to be significant and positive.

At the local level trading in farm produce will intensify as production levels are increased and diversified and access is gained to wider markets. This will contribute to GDP growth. New industry tends to locate where land is available and infrastructure exists; railway corridors are logical choices. Rail side commercial development takes place in response to speculation that improved access and greater visibility will bring more customers. Incomes earned directly or indirectly will bring improvements in the standard of living of the people involved with the project.

Enhanced Travel and Transport

Improvement in rail transportation will complement other modes of transport, especially road transport, in the haulage of bulk cargo and passenger transit. This will ensure rapid growth and development of both the formal and informal sectors of the economy, as well as improve general wellbeing through increased access to health care, education, and other social services, rendered closer due to enhanced accessibility.

In the absence of rail transportation, bulk and heavy cargo take a heavy toll on our roads with consequent rapid deterioration of road networks, regular breakdown of cargo trucks, frequent involvement in road accidents and loss of perishable cargos. With the revamping of the railway system, there will be less road cargo haulage, less cargo truck breakdown, safer road transportation, lower vehicular traffic, and increased life span of road infrastructure. Rural communities that had railway as the only means of transport and therefore had their mode of transit cut off will be re-connected with the completion of the project.

High-speed trains (120km/h) will provide a cheap, safe and reliable means of transportation to beneficiary communities along the rail lines, otherwise inaccessible by road, especially in the rainy season. The realignment of curves along the rail lines will reduce the incidence of train derailment making it a safer and faster way to travel as compared to the 'carnage on road networks'. An improved rail transport will reduce the pressure on roads in the country.

Economic Opportunities for Rural Women (Gender Benefits)

The program will bring new economic openings for women such as improvement in the agriculture and trading sectors. As more settlements spring up following the new rail intervention, women will expand their opportunities for catering and trading, since there will be increased demand for food, goods and services, both in the construction and operation phases. Railway availability will indirectly benefit women by easing the drudgery of long distance walking with children to healthcare centres, etc. The transportation of people and products between the villages will become faster and safer.

Reduced Impacts on Physical Environment

Railway sector will contribute to the ease of movement of goods and services that would otherwise be transported by vehicles. The trains will have the capacity to transport bulk cargo and large quantity of goods and services compared to road vehicles, thereby resulting in effective fuel consumption and reduced exhaust fumes and other emissions. This in turn will contribute to air quality improvement and reduction in greenhouse gas emissions (responsible for global warming).

Boost Export Industries

The bulk of the country's export commodities, such as cocoa, rubber, bauxite, manganese and timber are produced in the Western Region. These commodities used to be transported by rail to the port at Takoradi for export, strategically located along a rail line. In view of the poor state of the railway system, the produce buying companies (for instance of Cocoa), use the more expensive and unsafe road haulage.

The Awaso and Nsuta mines which produce bauxite and manganese respectively are served by limited operations of rail transport to the Takoradi Port. However, since 2007, much of the bauxite and manganese ores go to the Takoradi Port by road due to the increasingly failing state of the railway sector in the region. There are substantial deposits of iron at OponManso/Valley in the WassaAmenfi East District which covers an area of about 24 square miles, and is yet to be exploited due to increased cost of production with transportation being a key component (AseiduMarfo, 2009).

The revamping of rail transport will serve as a catalyst for their exploitation together with several other untapped mineral deposits in the Western and other region. It will also provide incentive to both local and foreign investors in the form of a cheaper and more reliable means of transportation to invest in these areas. On completion, the project will provide the needed business climate for exploration and production of natural resources in the mining and other sectors, which will help boost the Gross Domestic Product (GDP), increase government revenue and stimulate general economic growth in the country.

7.4 Potential Adverse Impact Identification

The implementation of RMP projects could exert adverse effects on the social and physical environment. Stakeholder views on E&S impacts common and significant to rail sector activities were surveyed (using questionnaire - Appendices 15A and 15B), as part of the ESMF participatory process. Analysed and ranked responses are in Appendices 3A and 3B. Summarized results are in Tables 7.2 and 7.3.

Table 7.2 Common and Significant E&S Impacts of Railway Infrastructure Projects

	Environmental / Social Issues	Common (Ranked)	Significant (Ranked)
1	Dust	High	High
2	Noise and Vibration	High	High
3	Level crossing accidents	High	Medium
4	Forestry concerns (e.g. access through)	High	Medium
5	Construction waste generation	High	Medium
6	Top soil removal within corridor	High	High
7	Tree/vegetation removal within corridor	High	High
8	Public safety/accident	Medium	Medium
9	Compensation issues	Medium	Medium
10	Induced development	Medium	Medium
11	Cultural concerns	Medium	Low
12	Utility lines (e.g. water, power) relocation	Medium	Medium
13	Risk of HIV/AIDS spread	Medium	Low
14	Wildlife concerns	Medium	Medium
15	Habitat disruption/fragmentation	Medium	Medium
16	Water contamination	Medium	Low
17	Stream diversion / blocking	Medium	Low
18	Inadequate drains along railway tracks	Medium	Medium
19	Run off	Medium	Medium
20	Pits / trenches near railway tracks	Medium	Medium
21	Archaeological losses	Low	Low
22	Flooding	Low	Low
23	Blasting	Low	Low
24	Tunnelling	Low	Low

The survey was based on twenty-four E&S issues and sources of impacts. The results identified the most common and significant potential impacts associated with rail infrastructure development. Four of the sources of impacts identified as most significant (dust, noise and vibration, forestry concerns and topsoil removal) also fell within the seven ranked ‘common impacts’ (Table 6.2) for rail infrastructure construction. Despite the cumulative stakeholder rankings, the EPA deemed issues 17, 21 and 23 in Table 6.2 as of potential priority concern, and have therefore been appropriately considered in the assessment.

The results also identified the following as the most common and significant sources of impacts to consider during railway operations under the RMP: noise and vibration, level crossing train accidents, lack of track maintenance and induced development. Thus, four out of the six commonest ranked issues were deemed to be significant sources of impacts from the stakeholder review (Table 7.3).

Table 7.3 Common and Significant E&S Impacts of Railway Operations

	Environmental / Social Issues	Common (Ranked)	Significant (Ranked)
1	Noise and vibration	High	High
2	Level crossing traffic and accidents	High	High
3	Track maintenance	High	High
4	Induced development	High	High
5	Waste generation at stations	High	Medium
6	Inadequate drains along railway tracks	High	Medium
7	Dust	Medium	High
8	Public safety/accident risk	Medium	Medium
9	Train maintenance	Medium	Medium
10	Train derailment/skidding	Medium	Medium
11	Littering from trains	Medium	Medium
12	Oil spills and oil waste generation	Medium	Medium
13	Concerns to wildlife (e.g. Reserve)	Medium	Medium
14	Train breakdown	Low	Medium
15	Water contamination	Low	Medium
16	Flooding	Low	Low
17	Pits / trenches near railway tracks	Low	Low

The stakeholder review also indicated the need to include twenty (20) out of the twenty-four (24) E&S potential impacts relating to railway infrastructure construction in the ESMF; as well as thirteen (13) out of the seventeen (17) presented for railway operations and activities.

The potential impacts that some respondents had doubts about or disagreed with their inclusion and in the ESMF included:

- Induced development;
- Archaeological losses;
- Flooding;
- Water contamination; and
- Pit/trenches near railway tracks.

The potential impact lists and the weights assigned (ranking), on the whole will provide some useful guide at the initial impact identification for PEAs, and the scoping stage and terms of reference preparation for EIAs of the individual RMP projects (Appendices 3A and 3B).

7.5 Assessment of Railway Sector Project Impacts

The main potential adverse environmental and social impacts of projects under the RMP (identified in 7.4 above) and others (asbestos exposure risk and human rights abuse), are assessed and presented in this section. These include:

1. Land acquisition and property loss;
2. Potential train accident risk;
3. Public health and safety risk;
4. Occupational health and safety impacts;
5. Risk of spread of HIV/AIDS;
6. Water resource impacts;
7. Noise and vibration impacts;
8. Impacts on cultural resources;
9. Habitat destruction and disruption;
10. Waste disposal impacts;
11. Potential human rights abuse and gender disparity;
12. Traffic disruption and diversion impacts; and
13. Utility disruption.

7.5.1 Land Acquisition and Property Loss

Compulsory land acquisition and property loss (expropriation of property for public projects) associated with railway developments (e.g. new tracks, bridges, buildings, etc.) can result in displacement of households and businesses, and loss of properties, livelihoods and incomes. Other attendant problems include social stress and psychosocial disruption for the affected individuals and families. This would be more significant for areas where new infrastructure would be developed such as the Takoradi-Elubo line and the Shama branch; and/or existing rail infrastructure where the RoW has been encroached. Currently several rail corridors are compromised in urban areas and any expansion works would have to deal with challenging social impacts and conflicts.

7.5.2 Potential Train Accident Risks

Train accidents usually occur as a result of mechanical or civil engineering failure on rail and/or human error. The specific causes of accident could be associated with:

- Defective railway lines and fastenings;
- Poor braking system and faulty wheels;
- Growth of weeds and accumulation of soil in railway lines;
- Train fires (over heating in faulty diesel engine); and
- Overlooking warning signs.

Rail surface and fastening defects would lead to rail failures which will results in train accidents. Rail surface defects (e.g. wheel burns, wheel break, rail corrosion, etc.) (Fig.7.1a) could cause wheel slips leading to an accident. Also broken and misaligned rails and defective fastenings (e.g. missing or raised up fastenings from the base of the rail) affect the effectiveness of the rail and could result in accident.

Derailment is a major source of train accident caused by several factors such as rail breaks, misaligned railroad tracks and excessive speed. Some rail breaks occur at joints when ballast and broken sleepers do not provide enough support underneath track joints or when joint fastenings become weak and over time, breaks or cracks occur on rail at joints leading to derailment (Fig 7.1b).

Tracks could wear out from train traffic and develop uneven track surface patterns and gauge widening causing improperly positioned rail, which could lead to roll or derailment of train travelling on high speed. Derailment can also occur as a secondary effect in the aftermath of a collision. Negligence by a fatigued train operator could result in failure to for instance, decrease speed along dangerous sections (e.g. curves) potentially causing derailment. Miscommunication between the train operators and conductors and improper operation of signal (e.g. wrong or broken warning lights) can cause train accident. Objects trapped within the wheels of the trains could cause the train to derail.

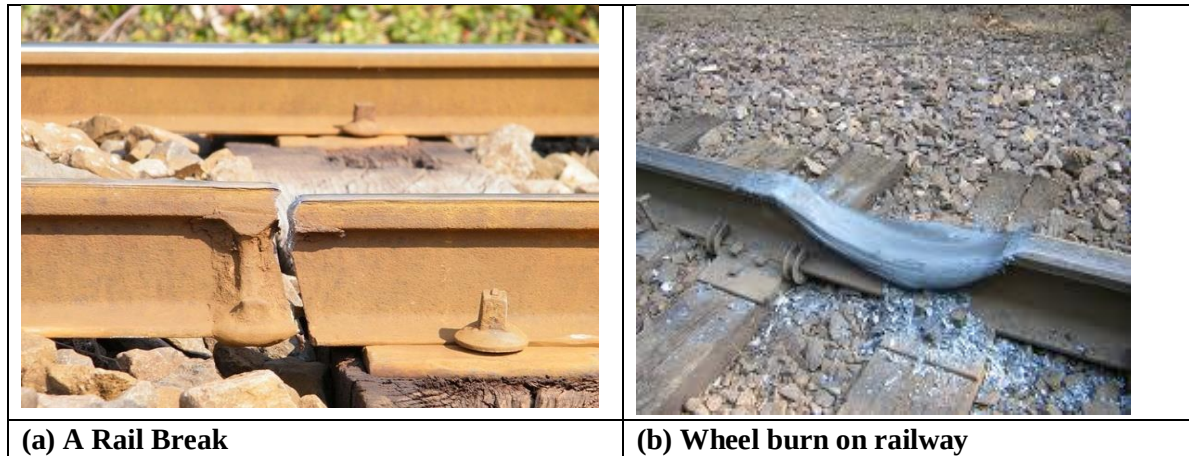


Figure 7.1 Damages in Railway tracks

Bad weather conditions (e.g. heavy rain, storm) can limit the visual ability of operators on the track ahead and cause accident.

Poor and ineffective braking system would affect grip and cause accident, in the instance where high speed train encounters an obstruction on the rail. Growth of grass and erosion deposit of soil within ballast and on tracks could cause derailment.

Deterioration on bridges such as cracking and flaking of concrete base of bridges, hidden defect in cast iron, bridge wash out under pressure from debris movement from high runoff and flooding could cause bridge failure and affect rail tracks created on them leading to an accident. Derailment and other forms of train accidents would affect passengers and crew with potential injuries or fatalities.

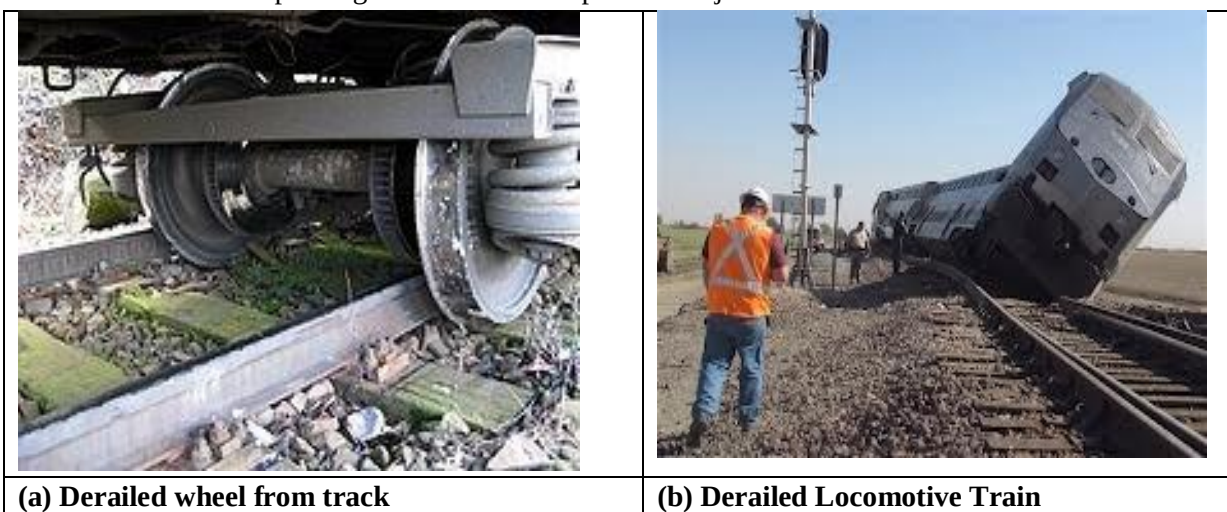


Figure 7.2 Incidence of Derailed Trains

7.5.3 Public Health and Safety Risks

Construction Phase

Rail track construction results in excessive noise generation, vibration, air and water pollution and increased fatalities if proper safeguards are not implemented. Pits and trenches abandoned and unfilled, and inadequate or lack of proper drainage and sanitary systems during and after rail construction allow rainwater and run-off to collect in such depressions and pits. These become good breeding grounds for mosquitoes and other vectors, which cause malaria and other diseases. Communities along such railway corridors may become exposed and suffer higher incidence of malaria. Moreover, air pollution could affect the health of people exposed to particulate matter as a result of railway construction and/or operation.

Operation Phase

Level crossings are a potential major point of conflict between trains and vehicles. Vandalism of signal and level crossing facilities could immobilize control operations leading to train-vehicular and pedestrian accidents, which could end up with fatalities. Passengers hanging on to moving trains, trying to board trains in motion, people trading along rail tracks or using rail tracks as thoroughfare or pathways potentially expose the public to serious safety risks, as people could be over-run or crashed by trains. Passengers could also slip and fall at gaps between trains and platforms as they board or alight. Disabled persons (crippled) and children could be at high risk of slips and falls when boarding and alighting from trains.

Unsecured or overloaded wagons could cause derailment and spilling of cargo or contents. If the contents are hazardous, public health and safety could be at risk. Tall trees could fall across rail tracks or wildlife (animals) cross the fast moving trains in forested or wildlife reserves respectively, or livestock crossing trains with disastrous consequences for public safety. Dust emission during transportation of cargo by the fast moving trains through communities and townships could deteriorate air quality with health effects such as irritation of eyes, nose, throat, headaches and upper respiratory diseases (e.g. asthma attacks, pneumonia, etc).

7.5.4 Occupational Health and Safety Impacts

Construction Phase

Occupational health and safety risks (mainly accidents, knockdowns and dust emissions) likely to be associated with the construction and rehabilitation phase of the project will be posed during land preparation and construction activities, operation of crushing plant and movement of construction vehicles and machinery to and from construction site.

Movement of construction machinery and equipment for haulage of raw materials and for the construction and rehabilitation works could cause accidents and knockdown of workers. Operations of equipment such as excavators, bulldozers, crushing plant, back-hoe, compactors, cranes, etc. have the potential to cause abrasion, injury and sometimes death to workers.

Land clearing, excavation, stone crushing and drainage construction activities (including heaping and loading of excavated spoil) during land preparation could generate dust. Workers involved in the excavation works, those manning the crush plant as well as those supervising the tipping and stock piling will be at risk of dust inhalation. Blow up of dust from moving trucks during haulage could cause nuisance to public, especially pedestrians and other vehicles and road users. Dust emitted could cause temporary discomfort such as gritty eyes and when inhaled may lead to respiratory problems. Other resultant effects are acute respiratory disorders, lung and heart diseases; with the type of ailment dependent on the size of particulates as well as the materials adsorbed in on them. Larger particulates cause acute irritation of the upper airways resulting in coughs and colds, while particulates with diameters of the order of 25µ to 10µ are inhaled into

the lower airways, (bronchi and bronchioles) and may enter the lungs. Acute manifestations of its effects include inflammatory conditions like bronchitis, bronchiolitis and pneumonia which may be rapidly fatal. Dust emissions would adversely affect health of people engaged directly or indirectly in rail construction activities.

7.5.5 HIV/AIDS Risks

The HIV/AIDS pandemic should continue to engage the attention of authorities in the transport sector and in the management of workers in the sector. The facts below support the need for the inclusion of clear principles on HIV/AIDS in the RMP implementation.

Findings of international studies of HIV/AIDS in work places suggest that the transport sector is a breeding ground and a vehicle for the HIV/AIDS epidemic. People working in the rail sector construction have to be mobile, they have to spend much time away from their homes and may be desirous to satisfy their sexual needs along the rail. Migration - short term or long term, increases opportunities to have sexual relationship with multiple partners, thus becoming a critical factor in the spread of HIV/AIDS.

Ministry of Health (MoH) national sentinel surveys indicate that in 2005 the most affected age groups are those between 20 - 34 years. Considering the youthful nature of the age group most affected and the fact that the construction and transport sector is largely made up of a youthful population, any impact of the epidemic on the sector will adversely affect the overall national development. Despite a reduction in prevalence of the infection from 3.1% in 2004 to 2.7 in the country indicating that the situation is stabilising, there is a need for concerted action to maintain those interventions that have led to this reduction. The interventions must also be scaled up to ensure that their impacts are felt as far as possible.

Ghana currently experiences severe manpower shortages largely professional, but also artisanal, due to brain drain, and an explosive HIV infection would worsen this situation. Some of the grave consequences for the society as a whole will include losses in productivity, healthcare costs, and people management costs such as recruitment, retraining, absence and relief. Although awareness of the disease is said to be very high amongst the Ghanaian population, behavioural change lags far behind this awareness. This is likely to be the case among road sector workers as well.

7.5.6 Water Resources Impacts

Construction Phase

Rail track development activities can modify the hydrology of an area, affect aquifer re-charge, groundwater discharge, and the water table and flow characteristics. There can also be deterioration in water quality of both surface and groundwater. Potential sources of impacts are site preparation and clearing activities, heaping of materials, blocking and narrowing water channels and flows at certain points. In some cases the speed of flow may be increased resulting in flooding, pounding, soil erosion, channel modification and siltation of streams. Earthworks, road drainage and excavation, erection of embankments and structures can reduce or raise the water table (through restricting flow), especially in the Western Region where most of the lines are within valleys. The tracks get flooded and affect motors under the trains and other machinery. Sections of tracks are also washed off by flooding/run-off from roadside drains.

Other sources of water pollution include sedimentation, changes in biological activity in streams and on their banks, chemical spillage, and contaminated run off from petroleum product seepage, exhaust emissions, pavement run-off, and corrosion of metals, among others.

7.5.7 Noise and Vibration Impacts

Construction Phase

Main sources of noise and vibration during construction and rehabilitation phase activities could include use of heavy-duty machinery and equipment, e.g. crushing plant for making ballast, dumpers, excavators, etc. Rock blasting, tunnelling, stone crashing and haulage of ballast and other materials contribute to noise production. Others include civil works such as piling for bridge construction, and compaction of the sub-bed for the sleepers and rails.

Operation Phase

The main sources of noise during operation of trains include friction between trains and the rail surface, honking by train, resonance from traffic and piling (especially for level crossing and bridge construction).

These sources could increase ambient noise and vibration beyond the immediate railway corridor to nearby residential and sensitive wildlife areas. The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. These could cause elevated stress levels and associated behavioural and health problems. They can also cause auditory fatigue, sleep disorders, and even contribute to learning problems in children. Vibrations can damage rail-side structures. Noise also has the potential to disrupt wildlife behaviour, habitats and movement in sensitive areas.

7.5.8 Impacts on Cultural Resources

Construction Phase

Rail development could lead to damage in areas of historic, scientific, social and amenity values, and also affect the aesthetics of cultural monuments and archaeological resources. This can occur where rail design and construction do not take account of such cultural heritage and resources. Damage may also be caused by rail construction related works such as quarry and burrow site activities, and unregulated access to cultural heritage sites.

7.5.9 Habitat Destruction and Disruption (Flora and Fauna Impacts)

Construction Phase

Important wildlife habitats, threatened and endangered species of flora and fauna may be destroyed in rail projects. Laying of the permanent way, particularly for new construction may cut through ecosystems and compromise their stability and health. Plant and animal communities may be fragmented into weaker ecological sub-units, rendering them vulnerable to invasions and degradation. The opening up of burrow pits and quarries to support rail construction could equally be destructive to wildlife and habitats.

Operation Phase

Erosion from poorly constructed and rehabilitated sites (of both rail and related areas) can lead to downstream siltation, contaminating water resources and ruining fish spawning grounds. Alterations of flow regimes, flood cycles, tidal flows and water levels can upset trophic dynamics by affecting the life cycle of plankton, with corresponding effects on the entire food chain. Re-channelling of waterways could be undertaken as part of rail construction to avoid flooding and make crossing structures simpler. In the process, natural streambeds could be interfered with, with adverse consequences.

7.5.10 Waste Generation and Disposal Impacts

Construction Phase

Land preparation activities for expansion of RoW and construction of new rail tracks and train stations, would involve vegetation clearing and earth removal and would generate vegetative waste and excavated spoil. Metal, wood, rock and oil wastes would also be generated in the production or assembly of the

sleepers, tracks, ballast and from the use of construction equipments respectively. Construction workers will also generate waste in the form food packaging material, plastic waste and liquid waste, including sewage. These could create insanitary conditions, leading to diseases and ill-health of workers and the public, if the wastes are not properly handled and disposed of

Operation Phase

The provision of toilet facilities in long- and medium-distant travelling trains as well as at train stations would generate sewage. Sewage from trains can pose health hazards for train staff involved in maintenance works and for passengers and the public, if deposited off on train tracks. Passengers and the general public using trains and train stations would generate waste in the form of food packaging material, plastic waste, etc which could end up littering as well as choking drains at train stations and along railway lines. Choked drains could be responsible for flooding and attendant hazards during the rainy season, and trapped water would be ideal places for mosquito breeding, the causative agent of malaria.

Considerable amount of waste oil would also be generated during maintenance works on train engines and fuelling of trains. The spilled (waste) oil could soil and contaminate the maintenance bays and surface/ground-water.

7.5.11 Potential Human Rights Abuse and Gender Disparity

Labour and working conditions are put in place to promote fair treatment, non-discrimination and equal opportunity for all workers. People may be discriminated based on ethnicity, gender, religion, age, disability and HIV status during employment. Women in particular are under-represented in all construction occupations and activities, mainly due to cultural and structural barriers such as harassment and discrimination, limited networking opportunities and long and inflexible working hours. These often result in poor career prospects and high levels of stress for women.

Women employees may be exposed to awkward situations when faced with sharing washrooms or changing rooms with their male colleagues. They may feel they have no privacy and be uncomfortable. This could create a hostile working environment because women feel neglected or more inferior to their male colleagues. Workers may be prohibited from joining trade unions of their own. This could result in intimidation, harassment, fear of reprisal from complaining and lack of collective bargaining power.

7.5.12 Traffic Disruption and Diversion Impacts

Disruptions to local traffic during construction on level crossing could cause accidents in rail construction and rehabilitation stages. The situation can be aggravated without carefully planned detours and road closures. The effect of traffic disruptions includes increased travel time, congestion, social stress and agitations. Injuries may also arise from road traffic accidents, which may occur when parts of level crossings are being plied while rail construction work is still underway.

7.5.13 Utility Disruption Impacts

Construction activities usually require re-alignment of utility supply lines such as water, telephone and electricity. This can disrupt the supply of essential services to communities for rather long periods, especially where rail project execution takes unusually long duration.

CHAPTER EIGHT

ENVIRONMENTAL AND SOCIAL MITIGATION AND ENHANCEMENT PRINCIPLES

- ❖ **Enhancing Railway Services**
- ❖ **Land Acquisition and Economic Impact Principles**
- ❖ **Train Safety Principles**
- ❖ **Public Health and Safety Safeguards Principles**
- ❖ **Occupational Health and Safety Measures**
- ❖ **HIV/AIDS Mitigation Principles**
- ❖ **Water Resource Protection Principles**
- ❖ **Noise and Vibration Reduction and Control Principles**
- ❖ **Cultural Resources Preservation Principles**
- ❖ **Habitat Protection Principles**
- ❖ **Waste Generation and Disposal Principles**
- ❖ **Gender Equality and Human Rights Protection Principles**
- ❖ **Traffic Disruption Mitigation Principles**
- ❖ **Utility Disruptions Mitigation Principles**

8. ENVIRONMENTAL AND SOCIAL MITIGATION AND ENHANCEMENT PRINCIPLES

This section covers enhancement of beneficial aspects of railway services and general railway sector mitigation principles in the ESMF covering fourteen (14) areas for use in the project EAs under the RMP. Furthermore, relevant environmental and social clauses have been detailed out for observance and adherence by contractors (Appendix 1), as part of standard E&S management/stewardship good practice. The following mitigation principles and enhancement measures have been defined to address the afore-evaluated impacts:

- Enhancing beneficial aspects of railway services;
- Land acquisition and economic impact principles;
- Train safety principles;
- Public health and safety safeguards principles;
- Occupational health and safety measures;
- Principles for safe removal and handling of asbestos roofing sheets;
- HIV/AIDS mitigation principles;
- Water resource protection principles;
- Noise and vibration reduction and control principles;
- Cultural resources preservation principles;
- Habitat protection principles;
- Waste generation and disposal principles;
- Gender equality and human rights protection principles;
- Traffic disruption mitigation principles; and
- Utility disruptions mitigation principles.

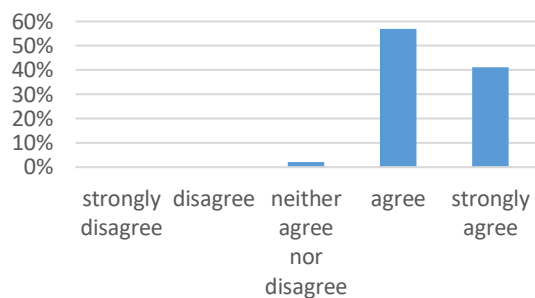
8.1 Enhancing Railway Services

From the Railway Market Research, the following measures have been outlined to have potential to improve railway services and patronage:

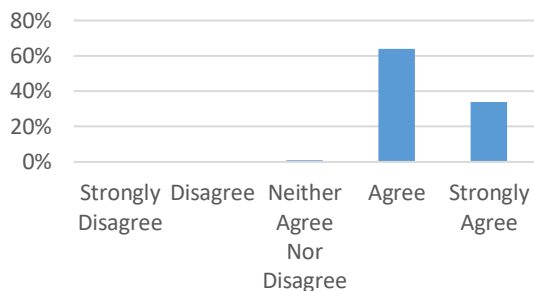
- Reliable time table for movement of trains;
- Cleanliness and good maintenance of the train;
- Connection with other mode of public transport;
- Segregation of coaches;
- Personal security at railway stations and on board of trains; and
- Banning noise making (i.e. preaching and selling) in trains.

Figure 8.1 shows respondents view on the means to improve railway.

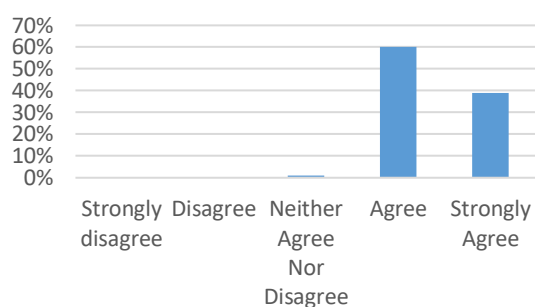
Punctuality/reliability of the services



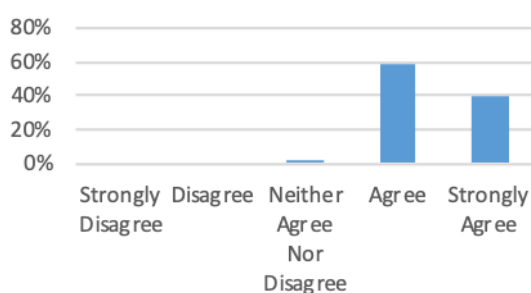
Personal security in stations and on board trains



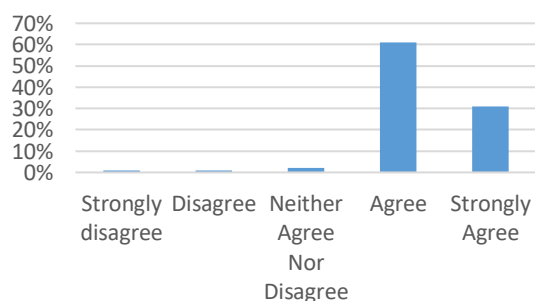
Cleanliness/good maintenance of rail coaches/stations



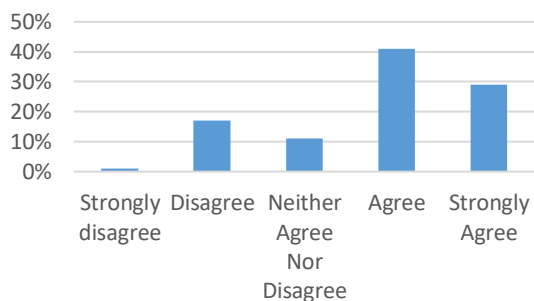
Provision of reliable real-time information



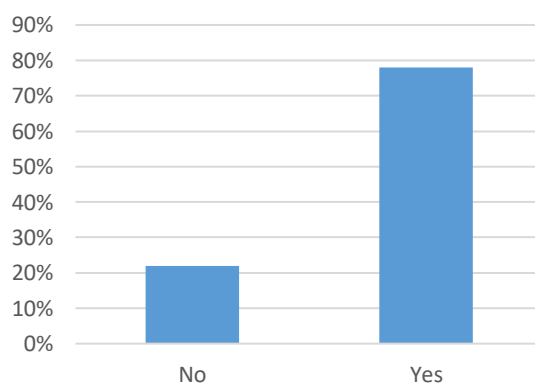
Connections with other modes of public transport



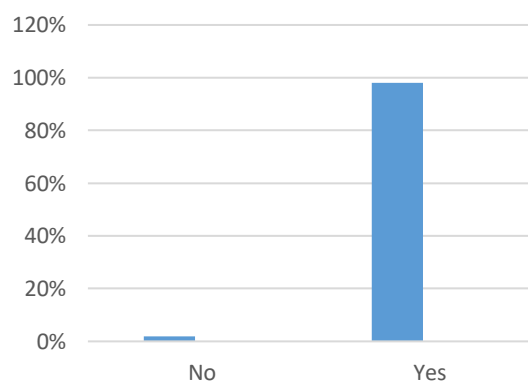
Banning noise-generating activities



Segregation of Coaches



Notification of Delays



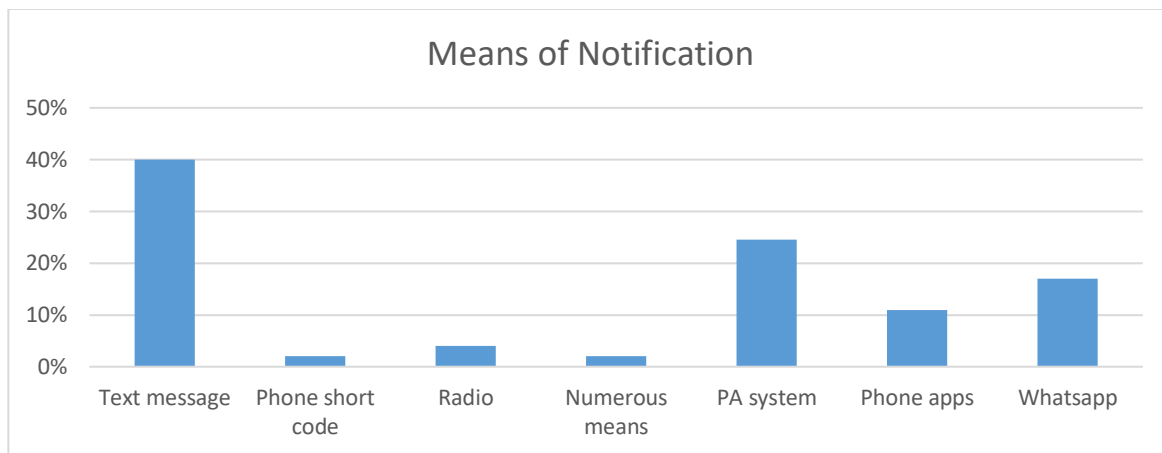


Figure 8.1 Means to Improve Rail Services

8.2 Land Acquisition and Economic Impact Principles

Construction Phase

The following mitigation principles will be followed to prevent or reduce impacts of/from land acquisition and loss of property:

- Choosing route locations away from built-up areas especially where new railway lines is to be developed and restricting the extent of railway works to avoid interference with existing activities;
- Alternative considerations in route selection;
- Adoption of design that reduce right-of-way land requirements, or design changes (underground tunnel, for instance where possible) to reduce impacts on properties and activities;
- Integration of mitigation measures in rail designs, where appropriate;
- Compensation rates for owners of the land, properties, etc that reflect current market realities; and
- Resettlement/rehabilitation of affected persons where possible (preparation of resettlement action plan).

8.3 Train Safety Principles

Operation Phase

Mitigation principles to address train accidents would include:

- Scheduled inspection of rail tracks for early detection of faults to ensure tracks remain in good condition;
- Maintenance and replacement of defective rail tracks and fastenings, tightening loose track components, lining tracks to keep sections straight, re-levelling (tamping) of ballast, check for correct gauge widening;
- Use of non-destructive testing methods such as handheld devices to detect internal rail flaws;
- Train brake testing and replacement of faulty wheels;
- Use of communication equipment such as mobile radio (by operators) and emergency communication by satellite phones;
- Use of concrete and metal sleepers, instead of wooded which could deteriorate over time when exposed to excessive amount of water;
- Regular inspection of rail signals to ensure their effectiveness;
- Regular/routine clearing of weeds from rail tracks to prevent weed growth;
- Regular removal of accumulated soil on rail tracks;

- Trains to observe speed limit of up to 80km/hr in bad or poor weather conditions (e.g. heavy rainstorm);
- Record and maintain maintenance records for reporting half-yearly;
- Rotate Train operators every 4 hours to reduce risk of fatigue and carelessness; and
- Organise safety training sessions every half-year for train operators and crew, security guards, and maintenance engineers to heighten consciousness and avoid human errors.

8.4 Public Health and Safety Safeguards Principles

Operation Phase

To safeguard public health and ensure safety, the following principles would be applied:

- Community outreach programs to be factored in all new projects planned for in any location to protect the communities from injury or ill-health caused directly or indirectly by the rail transport activities;
- Public awareness raising through announcements at Train Stations on safety measures, etc to observe;
- Installation of fence and safety barriers at level crossings, especially areas with high human activities;
- Use of trained (professional) security guards at all level crossings;
- Use of boarding aids such as moveable steps to aid boarding and alighting, and use of ramps for disabled (crippled) persons;
- Clear warning signals and repeated announcement at stations to caution passengers of any gaps between train and the platform;
- Installation of auto-signal systems at crossings;
- Promote construction of flyovers or underpasses for vehicular traffic and pedestrians;
- Regular training and enhanced professional development for train operators and staff;
- Random checks on drivers for driving under the influence of alcohol or narcotic drugs;
- Secure the 60m wide railway corridor, especially at sections liable to trespassing to prevent unauthorised crossings and encroachment and regularly inspect for breaches;
- Secure all flyable cargo to avoid losses and reduce dust generation;
- Provide First Aid kits at all Train Stations;
- Declare wildlife reserves 'no-go areas' for development of railway infrastructure;
- Provide adequate barriers to restrain wildlife, where rail tracks pass close to wildlife reserves;
- Remove all trees closer than 20m from the 60m rail track right of way;
- Record and keep accident records;
- Develop a hazard identification and risk assessment system;
- Provide detailed procedures to respond to accidents and emergencies and to conduct time bound investigations (Rail Accident Investigation Unit) to prevent recurrence, as well as for rescue operations; and
- Community outreach programs will be factored in all new projects planned for in any location. This will help protect the communities from injury or ill-health caused directly or indirectly by the rail transport activities.

8.5 Occupational Health and Safety Measures

Accident Prevention Principles

To reduce incidence of occupational accidents, pre-employment training would be provided for all recruited workers on safety procedures associated with basic construction works, equipment and machinery handling, etc, as well as environmental hygiene and sanitation education. Personal Protective Equipment (PPE) such

as helmets, earmuffs, gloves, boots, etc. would be made available to employees. The use of PPE would be mandatory, and close supervision maintained.

First aid kits would be provided, with trained personnel taking charge. Warning signs would be clearly displayed at excavations and other obstructions objects to caution the workers and the public. Reversing alarms would be installed on all machinery and vehicles to alert people in order to avoid accidents. Contractors would apply a Safety First rule to govern all activities and operations.

Dust Control Principles

The principles to follow to reduce dust impacts, especially particulate matter by the contractor will include:

- Provision of PPE for workers;
- Covering of hauling trucks carrying sand and ballast to avoid dust emission;
- Locating material storage areas away from communities and environmentally sensitive receptors; and
- Vehicles will travel at the speed limits of 40km/h, but reduce to 20km/h within sensitive areas or communities.

8.6 HIV/AIDS Mitigation Principles

The national strategic plan for HIV enjoins each sector to develop sector specific plans and strategies, hence the provision in the MoT's organisational structure in figure 2.1, to cater for the rail transport sector specific workplace policy. There is commitment at all levels of management to ensure that necessary budgetary allocations are made towards HIV issues, and that the policy is implemented as intended. Highlights of the principles which will be followed are set out below, based on ILO guidelines and those of the Ghana AIDS Commission.

- It will be applicable to all employees of the sector, and the provisions binding on contractors.
- HIV/AIDS prevention clauses will be incorporated into works contracts and the bills of quantity.
- The ethical principles governing handling of persons with other medical conditions will apply. Relationships of infected /potential workers will be governed by the basic human rights as enshrined in the Constitution of Ghana. Dismissals will not be based on HIV status.
- Provisions regarding HIV/AIDS will be integrated as far as practicable with existing labour relations policies and regulations.
- An HIV/AIDS prevention and treatment policy for work places will be prepared.
- Due care and confidentiality will be exercised in handling information regarding the HIV status of workers in the sector.
- The policy will advocate for the establishment of workplace programs on HIV for rail contractors and will include preventive activities through:
 - Advocacy via information provision, education and communication;
 - Peer education and counselling;
 - Condom use promotion and distribution;
 - Counselling and care for people living with AIDS (PLWAs):
 - Facilitation of voluntary counselling and testing of HIV status of workers,
 - Provisions for management of sexually transmitted infections (STI),
 - Assistance to bereaved families,
 - HIV /AIDS education to communities in which workers of the sector are working will be included in target groups for education and information provision.

8.7 Water Resource Protection Principles

Construction Phase

Mitigation principles to prevent, minimize and manage impacts on water resources from railway projects will include:

- Avoiding alignments which are susceptible to erosion, such as those crossing steep slopes;
- Minimizing the number of water crossings through alternative route surveys;
- Using clean fill materials around watercourses such as quarried rock containing no fine soil;
- Providing reservations/buffer zones of undisturbed vegetation between railway sites and water bodies;
- Constructing adequate drains, run-off channels, contouring or other means of erosion control along railway tracks;
- Paving sections of corridor susceptible to erosion; and
- Compensating by providing alternative source of water such as bore holes for communities adversely affected.

8.8 Noise and Vibration Reduction and Control Principles

Construction Phase

Noise and vibration will be minimized through the following mitigation principles:

- Seclusion of noise generating activities (e.g. blasting) and heavy-duty equipment from public access to safeguard the public against noise impact;
- Provision of ear muffs and ear plugs to heavy equipment operators;
- Rail design will avoid steep gradients and sharp corners to reduce noise resulting from acceleration, braking and gear change at critical locations, and also use of engine brakes;
- Provision of noise barriers, including “tree belt” or “tree buffer”, particularly in major settlements and noise sensitive locations;
- Provision of environmental specifications for contractors in the railway construction, quarrying and other such activities in noise and vibration sensitive areas (with special attention paid to equipment noise standards, hours of operation, material haulage routes, and other aspects of work-site management); and
- Adherence to the recommended EPA noise level (Appendix 18)

8.9 Cultural Resources Preservation Principles

Construction Phase

- Rail construction will avoid alignments that cut through known cultural sites;
- Cultural resources uncovered during rail works will be handed over to the National Museums and Monuments Board for preservation or preservation of the site;
- Salvaging excavation and relocation of artefacts or ruins from a cultural site;
- Collaboration between the Transport Agencies and the Museums and Monuments Board in determining and avoiding damage to cultural sites and resources; and
- Marking and fencing important cultural sites during the construction period.

8.10 Habitat Protection Principles

Construction Phase

Mitigation principles to address habitat destruction and disruption impact in rail projects by contractor will include the following:

- Avoiding environmentally sensitive areas to prevent severe impacts on flora and fauna. (While wildlife reserves will be no-go areas for infrastructure development, RoW within forest reserves will be limited to only half the normal width);
- Minimising water body crossings, and creation of buffer zones of undisturbed vegetation between tracks and watercourses;
- Replanting along the permanent way and adjacent areas to accelerate re-vegetation and succession;
- Re-engineering rail cross-section designs by using narrower widths, lower vertical alignments, smaller cuts and fills, flatter side slopes, and less clearing of existing vegetation;
- Providing wildlife and animal crossings to facilitate movements;
- Fencing or planting barriers to reduce the risk of collisions between animals and trains;
- Providing "aquatic crossings" with culverts designed with the needs of migratory aquatic species in mind;
- Enforcing traffic control measures, e.g. speed limits, particularly at night in areas of frequent animal crossing, erection of warning signs, etc; and
- Installing rail-side reflectors to scare animals away from the permanent way when trains approach at night.

8.11 Waste Generation and Disposal Principles

Construction Phase

The waste management principles for consideration in rehabilitation, project construction phase activities include:

- Provision for segregation of construction waste into rocks and soil, wood (including vegetation), plastics, metals, glass and bottles and general waste;
- Worker awareness to practice waste segregation and proper management measures;
- Introduction of waste minimisation measures including reuse of excavated spoil as fill material (where appropriate), topsoil stockpile for landscaping, concrete crushed for filling and construction works, wood for the community as fuel for cooking, and sale of oil waste and metal scrap to dealers, etc;
- Contracting a waste management company such as Zoomlion Ghana Ltd. to dispose off the general and un-reusable wastes at designated waste dumps;
- Sensitisation of workers to observe environmental and personal hygiene;
- Provision of mobile toilets for use by construction workers;
- Collection of waste oils for re-use in concrete works or treatment by contracting a waste management company such as Zoil Services Ltd.; and
- Enforcement of appropriate district sanitation and waste disposal bye-laws.

Operation Phase

During operation of the trains (and use of train stations) the following mitigation principles will be implemented:

- Segregation of waste at train stations and in trains using a colour coded system to facilitate identification of segregation containers as shown in Table 8.1;
- Public (passenger) sensitization to practice waste segregation through repeated announcements at stations and in trains;
- Development of waste management plans for major railway terminals. This would include an institutional system for managing waste.

Table 8.1 Colour Code for Segregating Waste

Colour	General Description	Waste Streams
Grey	General waste	General waste – food leftovers, bottles
Green	Plastics	Plastics, rubber
Blue	Paper	Paper, cardboards,
Black	Metal	Metal cans

- Trains will be provided with segregation bins for plastics, cans and general waste to aid segregation.
- Recycling of segregated waste will be undertaken as listed below:
 - Plastics and paper will be given to plastic and paper manufacturing companies as raw material; and
 - Metals will be sold to recycling companies;
- Train stations will have toilets (septic tanks) with attendants to maintain them;
- Trains with toilet facilities will also have retention tanks which will be emptied at train stations; and
- Collection of waste oils into oil containers for sale to waste oil treatment companies.

8.12 Gender Equality and Human Rights Protection Principles

Human resources, labour improvement and gender equality measures will be put in place to ensure fairness. These will include:

- Issuance of employment contract to all workers with code of conduct for workers included in the contract. As part of the requirement, the employer/ contractor will sign to protect the human rights and entitlements of the employees;
- Provision of extensive education on human rights protection to the contractor's team during the kick-off meeting;
- Provision of complaints desk for workers and public;
- Provision of changing areas/washrooms for women;
- Filing of all cases of human rights abuses and appropriate sanctioning of offenders;
- Formation of trade unions to protect the interests of the workers;
- Provision of condoms to workers and availability at vantage points; and
- Punishing of workers who discriminate against and harass women and children; act violently against women employees; and sexually abuse women.

8.13 Traffic Disruption Mitigation Principles

Construction Phase

- Provision of carefully planned diversion routes during construction;
- Use of signboards and other public information mechanisms to inform the public in advance of construction work, schedule closure or diversion, etc.;
- Re-routing traffic away from populated areas and reducing traffic congestion;
- Selecting rail alignments which avoids houses, schools, and workplaces;
- Working at night to avoid to avoid traffic at level crossings; and
- Positioning Crossing Keepers along the roads to control traffic congestion.

8.14 Utility Disruptions Mitigation Principles

Construction Phase

The following mitigation principles will be followed by the Rail Sector Agencies to minimize impacts of utility disruptions:

- Issuance of advance public notices about disruptions;
- Collaboration with utility providers to plan and quickly re-align utility services;
- Provision of alternative supplies where applicable, e.g. water supply by tankers to affected communities; and
- Restoration of utility lines and other structures damaged during the construction.

CHAPTER NINE

ESMF IMPLEMENTATION AND MANAGEMENT

- ❖ GRDA's Implementation Role of the ESMF
- ❖ Institutional Arrangements
- ❖ Capacity Building

9. ESMF IMPLEMENTATION AND MANAGEMENT

The ease of implementation of the ESMF and its success will depend on the commitment of the railway sector and other key institutions, as well as the capacity within the respective institutions to effectively apply the framework. It is important in this respect that the appropriate and functional institutional arrangements and coordination are in place.

The GRDA and MoT were fully involved in the development of ToR for this assignment and in the preparation of the ESMF. Furthermore, the other relevant institutions such as EPA have been actively involved as a key stakeholder. Thus, knowledge about the ESMF for the RMP has been well disseminated, as well as its implementation demands. This section deals with aspects of the ESMF that will facilitate effective (E&S) implementation and management of projects under the RMP for sustainable outcomes. The broad aspects include:

1. GRDA's Implementation Role of the ESMF;
2. Capacity building needs; and
3. Institutional arrangements.

9.1 GRDA's Implementation Role of the ESMF

The EA processes and planning phase activities of proposed railway projects leading to environmental approval of projects, award of contracts, and required construction phase E&S management are illustrated in Figures 9.1 and 9.2. The Figure 9.2 in particular shows the railway sector-specific EA procedure for projects under the RMP, and the linkage with project planning and implementation phase monitoring and evaluation.

The E&S planning phase covers the impact assessment (IA) and the pre-project/project planning processes (Figure 9.1). The key stages of IA include proposal Registration/Initial Assessment, PEA or EIA with the relevant mitigations and E&S safeguards, while the pre-project/planning process involves project concept, site/route selection, design and technical appraisal (feasibility).

The IA process links up with the pre-project/planning process, and influence one another in order to evolve a given railway project that is a product of these two processes. In the context of the ESMF, E&S planning is a process that identifies and assesses (through "consultation") the impacts and alternatives of a proposed railway project (under the RMP). This will influence the design, engineering options and decisions, for environmentally sound, socially acceptable and sustainable project development.

The Environment and Health Department (EHD) of GRDA will be involved at all stages of the planning of projects, rehabilitation or decommissioning, by initiating the Registration and Initial Assessment of proposals with the respective EPA (Regional) Offices (Appendix 5). The EHD will perform the following based on Figure 9.2:

- Conduct screening of proposed project (Table 61);
- Conduct Initial Assessment of projects (relying/using on Appendices 2 and 5);
- Prepare the terms of reference for PEA or EIA of projects (Appendices 3A and 3B);
- Facilitate the award of consultancy contracts;
- Guide the conduct of the PEA or EIA;
- Lead the review of draft PERs or EISs submitted by consultants;
- Submit the Registration/Initial Assessment Form, PER or draft EIS to EPA;
- Pay the required fee (processing and permit);

- Take custody of the Environmental Permit granted by the EPA; and
- Provide E&S clauses in contract documentation for award of construction contracts (Appendix 1).

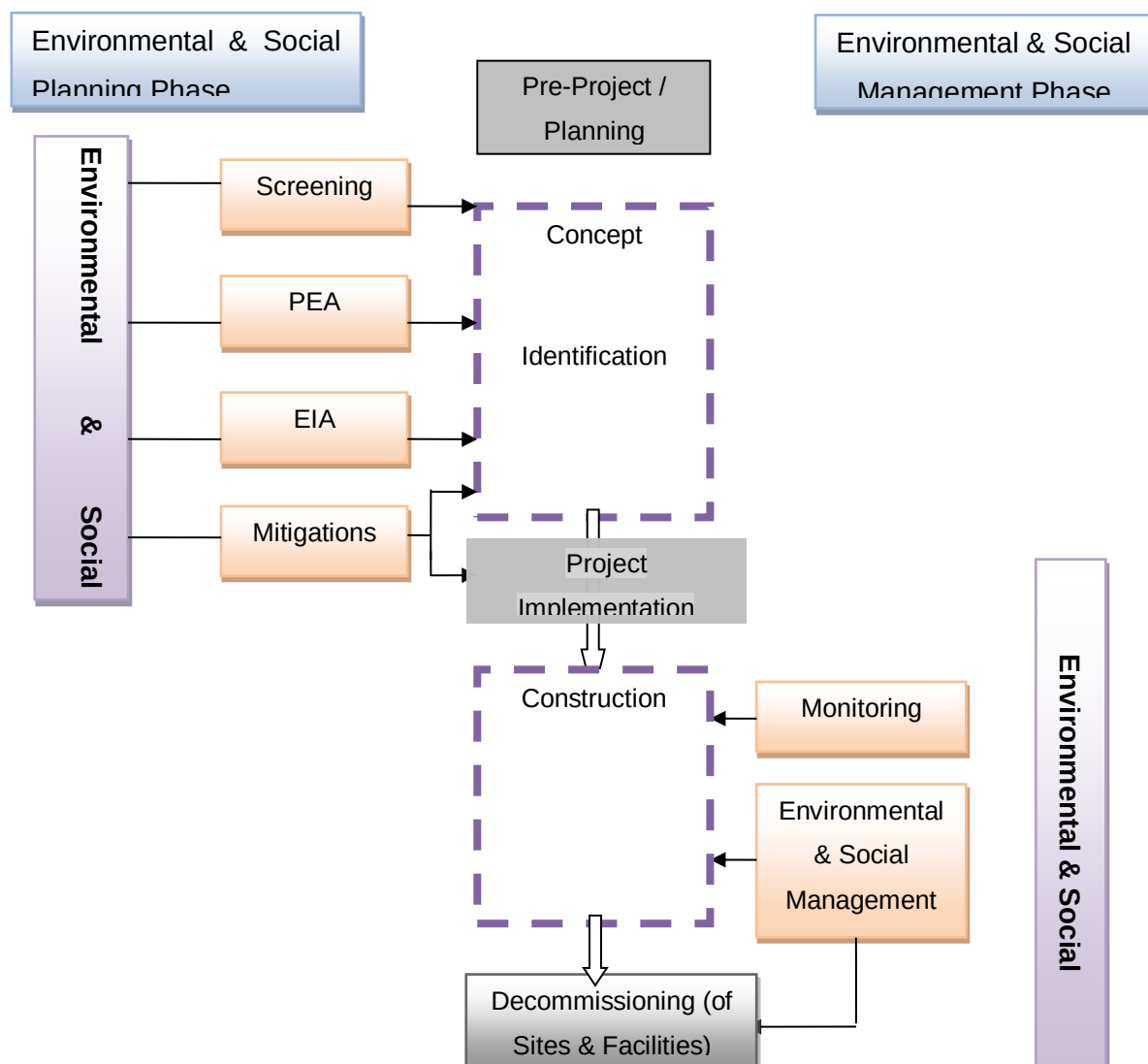


Figure 9.1 Environmental and Social Planning and Management Scheme for Railway Sector Projects

Source: Derived from the Environmental Assessment in Ghana: A Guide Context of EIA within Environmental Planning & Management

The project environmental and social management (ESM) as shown in figure 8.1 is also linked to the project implementation activities. The ESM comprises monitoring and supervision (of E&S safeguard measures and permit conditions being implemented), and reporting (Annual Environmental Report, EMP, etc). The project implementation activities include construction, rehabilitation, decommissioning of sites, facilities, equipment and machinery, etc. The EHD will also be involved in the following at the ESM stage:

- Provide guidance to contractors for compliance with E&S safeguards (Appendix 1), and permit conditions;
- Monitor construction phase for implementation of mitigations and permit conditions;
- Receive E&S implementation reports from the contractors through the Site Engineer; and

- Prepare and submit E&S monitoring reports to MoT and AER to EPA and MoT.

The Site Engineer, during the construction (ESM) phase will supervise and verify these activities:

- Adequacy of the environmental and social considerations and assumptions;
- Effectiveness of mitigation measures being implemented;
- Compliance with mitigation and other environmental and social requirements;
- Unanticipated or residual impacts that have arisen requiring remedial action;
- Adherence of contractor to required E&S principles, standards and commitments; and
- Extent to which project monitoring and reporting requirements are met.

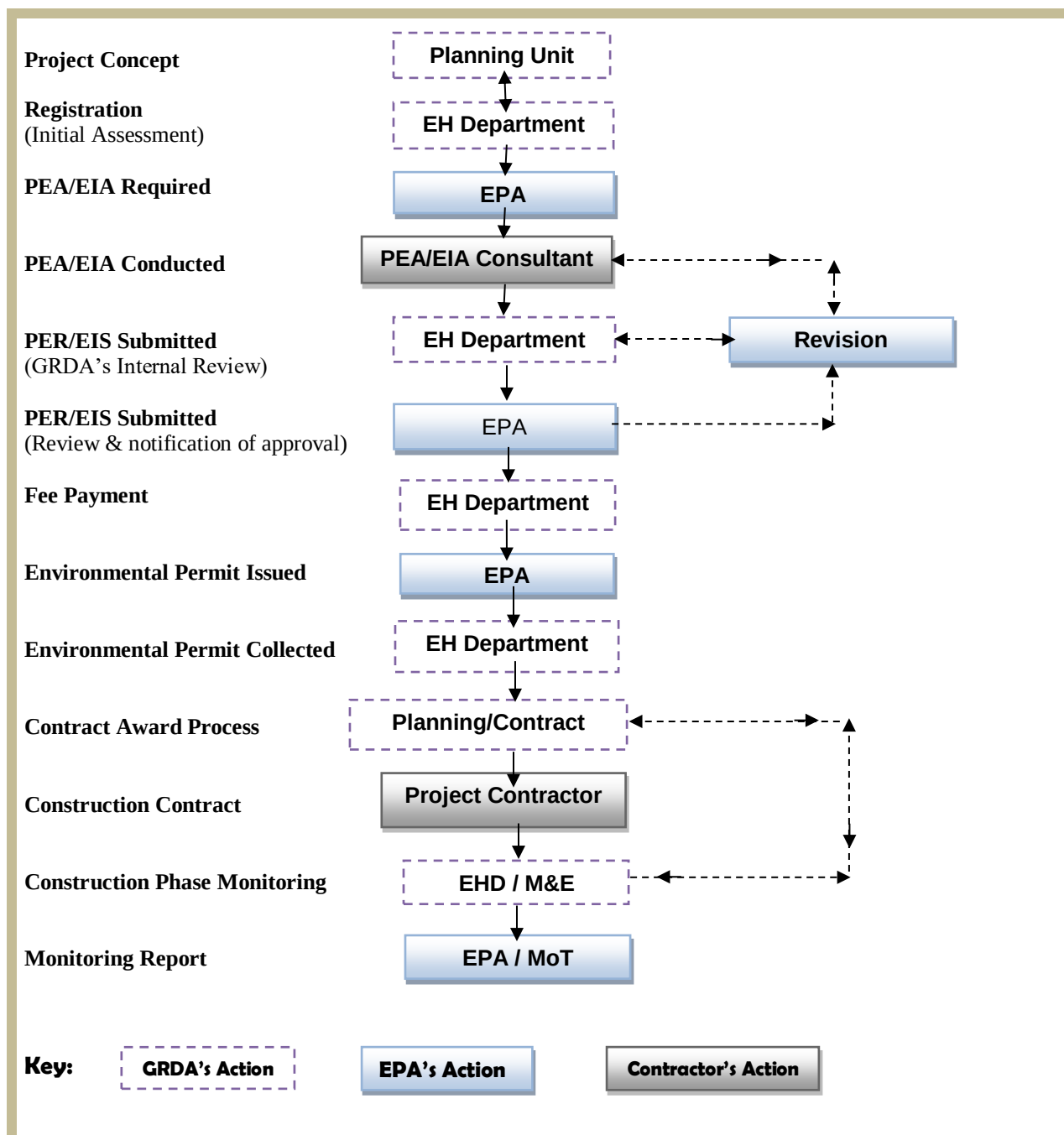


Figure 9.2 Sector-Specific EA Procedure for Projects under the RMP

The connection between mitigation measures and the planning and construction phases of railway projects is shown in Figure 8.1. The mitigation measures once identified will be incorporated into the project design. In this way, the outcomes of the ESA become integral part of a railway project design and costing, but not as an add-on after project design and planning are completed. The linkages between the ESA and the pre-project/ planning, and between the ESM and project construction activities (Figure 8.1), reflect the relationship that should exist between the EHD and the Planning and Development Department (PDD) of the GRDA

The EHD will be required to regularly apply three different tools in their normal functions. These are the RMP Sector-Specific:

- Screening Criteria (Table 7.1);
- Initial Assessment/Registration Form (Appendix 5); and
- EA Procedures for undertakings under the RMP (Figure 9.2).

Table 7.1 gives the Railway Sector Screening Criteria that will guide route / corridor selection and screening of projects under the RMP. The Screening Criteria were derived from the Schedules 1, 2 and 5 (screening tools) of the Ghana EA Regulations into a Railway Sector-Specific EA Screening Criteria for undertakings under the RMP. The Railway Sector-Specific Initial Assessment Form (Appendix 5) for registration of proposed railway projects (with EPA), has also been developed from the generic EA Registration Form 1. Furthermore, Figure 9.2 is the Railway Sector-Specific EA Procedures (for the RMP), derived from the generic EA procedures of Ghana, which is acceptable to the EPA. These are important outputs of the ESMF, which render the ESMF responsive to the objectives of good EA practice.

One or a combination of E&S variables in the Table 7.1 facilitates assigning screening outcome or decision of an appropriate level of EA for a particular railway project. The screening guideline is detailed and specific on E&S sensitivity and/or project threshold, to help avoid sensitive sections or selected route or alignment; and for consideration of preferred alternative routes or construction corridors.

9.2 Institutional Arrangements

The GRDA is the main railway sector executing agency under MoT. The institutional roles and areas of collaboration, with respect to (environmental) approvals, planning, interference with utility provision and service lines, road crossings, and natural resource management in corridor selection for railway projects are presented in this section. The key collaborating institutions whose roles are highlighted include:

- Environmental Protection Agency (EPA);
- Metropolitan, Municipal and District Assemblies;
- Department of Urban Roads;
- Ghana Highway Authority;
- Department of Feeder Roads;
- Forestry Commission - Wildlife Division (WD) and Forest Services Division (FSD);
- Water Resources Commission (WRC);
- Electricity Company of Ghana (ECG);
- Ghana Water Company Limited (GWCL);
- Ghana Chamber of Telecommunications (GCT) / Vodafone Ghana Limited; and
- Bulk Oil Storage & Transportation Company (BOST).

9.2.1 Environmental Protection Agency (EPA)

The role of the EPA is fundamental as a lead environmental regulator that oversees compliance with EA requirements in Ghana. The agency will facilitate conduct of IA and review, and issue environmental permits for the individual projects under the RMP, following approval for this ESMF to commence implementation. The agency made significant input in the ESMF preparation, including the RMP-Specific Screening Criteria and Initial Assessment Form (Table 7.1 and Appendix 5). The EAA Department, Accra East (Tema) and Western Regional (Takoradi) Offices of EPA were consulted (Appendices 9, 15A and 15B), and the RMP duly registered with the EPA.

The EPA will also carry out its compliance monitoring to satisfy itself that the permit conditions and mitigation measures of approved projects are fulfilled by GRDA. The AER from GRDA will form the basis for EPA's compliance monitoring of the RMP projects.

9.2.2 Metropolitan, Municipal and District Assemblies

The Metropolitan, Municipal and District Assemblies (MMDAs) are required to take charge of the overall developments within their respective areas. As representatives of the central Government at the local level, and by virtue of Act 462:

- The MMDA is the planning authority and therefore responsible for physical/spatial planning;
- Approval of all planning schemes before it can take effect within the district; and
- Responsible for development control through the grant of permit for development.

The MMDAs are therefore expected to integrate the RoW of railway corridors into their planning schemes, and take necessary enforcement action against encroachers of and unauthorized development on railway land. Waste management and waste infrastructure planning are primary mandates of MMDAs. GRDA must liaise with MMDAs to address the misuse and abuse of railway land for waste disposal.

9.2.3 Ghana Chamber of Telecommunications/Vodafone

The procedure to follow to ensure smooth relocation and alignment of telecommunication lines and fibre deployment in relation to railway infrastructure (e.g. rail track) development are provided in Table 9.1. The procedure was arrived at following consultations with GCT and its members Vodafone and TIGO (Appendices 14 and 17E).

Table 9.1 Procedures for Telecommunication Lines/Fibre Deployment Relocation and Alignment

GRDA's responsible will include the following	GCT/Vodafone will perform the following tasks
1. Submit development plans for future rail tracks (once available) to the GTC (for information and planning of its members). GRDC shall notify members of GCT at least 6 months prior to any Railway Development"	1. Receive/acknowledge receipt of the Development Plans for future rail tracks and notify members of any Railway re-development Planning.
2. Submit a Detailed Layout Plan for proposed development, indicating scope of impact on existing network, implementation plan with timeframe (once feasibility is complete)	2. Receive/acknowledge receipt of Detailed Layout Plans from GRDA and sets date for joint assessment meeting Review Layout Plan, and survey scope of impact on existing network and proposed scope of work and timeframe
3. Engage the relevant GCT members in joint sessions to synchronize plans, finalize assessment (if for instance there is need for relocation or new cables, etc), scope of work, plan of development, etc.	3. Meet with GRDA for joint sessions to finalize assessment, scope of work, plan of development and implementation timeframe;

4. A memorandum of understanding with GCT member is signed for implementation of the agreed works	4. GCT member and GRDA sign a memorandum of understanding
5. Provide the required budget for implementation 6. Hold and coordinate regular site meetings to ensure aligned implementation	5. Carry out implementation 6. GTC member bears supplementary cost of any new/additional fibre that they request to be incorporated into any rail re-development.

9.2.4 Road Sector Institutions

The road sector agencies include: the Department of Urban Roads, Ghana Highway Authority, and the Department of Feeder Roads. Consultations with these agencies provided agreeable procedures to follow in order to address potential safeguard risks associated with planned rail-road crossings, as well as opportunities for effective institutional collaboration. The consultation outcome and procedure for decisions on the construction of rail-road crossings are in Table 9.2 below, with details in Appendices 11 and 17B.

Table 9.2 Agreeable Procedures for the construction of Road-Rail Line Crossings

GRDA's responsibilities include the following	GHA/DUR will perform the following tasks
1. Prepare and submit: - plan of development and layout of the proposed railway line for development, - scope of the potential road-rail conflict, - proposed initial measures to address the potential conflict, and - timeframe of implementation	1. Receive and acknowledges submission from GRDA and sets date for joint assessment meeting Review the layout and plan of development, as well as proposed scope of work and implementation timeframe
2. Meet with GHA/DUR for joint sessions (including inspection if necessary) to finalize assessment of plan of development, scope of work and implementation timeframe	2. Meet with GRDA for joint sessions (including inspection if necessary) to finalize assessment of plan of development, scope of work and implementation timeframe
3. GHA/DUR submits an implementation budget	3. Prepare implementation budget for GRDA
4. Sign a memorandum of understanding with GHA/DUR for implementation of the 'conflict section'	4. GHA/DUR and GRDA sign a memorandum of understanding for implementation
5. Provide the required budget for implementation	5. GHA/DUR receives funds for implementation and contracts the work out
6. Joint Site meeting to review progress of implementation, etc	6. Joint site meeting and consultations

Feeder roads occur often in rural areas where vehicular traffic tends to be rather low on the roads. Railway crossings are therefore not considered a major social and safety risk for feeder roads. It is enough for a flagman to alert and stop vehicles when the train is passing. Therefore no rigid procedures as such are required. However, the Director must be notified in any such instance, so that the DFR Regional Engineers can be duly informed to supervise construction of crossings.

9.2.5 Electricity Company of Ghana

The consultation processes and outcomes are provided in details in Appendices 13 and 17D. Table 9.3 gives a summary of the procedure proposed to follow to ensure effective relocation of electricity lines affected in a railway project.

Table 9.3 Proposed procedure for Relocation of Electricity Lines

GRDA's responsibilities include the following	ECG will perform the following tasks
1. GRDA notifies ECG at address provided, with project plan and planned schedule of development	1. ECG acknowledges receipt and ECG does an assessment
2. GRDA may meet ECG for joint session on plan of development and visit to site	2. ECG studies the plan and time duration. Given access and prepares cost estimates.
3. GRDA receives cost estimates from ECG and provide the budget for implementation	3. Submit costs to GRDA, and once paid ECG awards contract. Pro-activeness - well in advance in order to save time
4. Sign a memorandum of understanding with ECG	4. Contact person: Divisional Manager - Rural Projects Directorate: Network Projects, ECG Head Office, Box 521, Accra – signs the MoU with GRDA

9.2.6 Ghana Water Company (Ghana Urban Water Limited)

Consultations with GWCL provided some guidance on minimizing cost for relocation, especially of major transmission lines, which could be very expensive and not easy to manage, relative to distribution and service lines (Appendices 13 and 17D). The proposed guidance is as follows:

- Pre-project knowledge/information (as a mitigation measure) must be shared with GWCL;
- Preferably GRDA must make future railway development plans available to GWCL to inform GWCL's planning;
- For specific projects, GRDA must submit layout plan of the line matched with the existing layout to determine the conflict points for existing and proposed (3 months minimum advance notice needed);
- GWCL will assess the budget required for execution of changes with existing lines;
- Budget for relocation of the pipeline will be borne by GRDA;
- Contact person: Chief Manager/District Manager.

9.2.7 Wildlife Division of the Forestry Commission

The Wildlife Division considered areas declared by law as wildlife reserves 'no go areas' for railway infrastructure and network development (Appendices 12 and 17C). The detrimental effects to the reserves, and wildlife and biodiversity resources will be irreversible and cumulative. Fragmentation of habitats, breeding and feeding ranges, etc besides other adverse effects like noise and vibration are considered unacceptable. This is appropriately reflected in the RMP Screening Criteria.

9.2.8 Forest Services Division of the Forestry Commission

The position of FSD is that railway lines could pass through forest reserves in principle (Appendices 12 and 17C). Stringent conditions are, however, required to allow routing railway lines through reserves, include the following:

- FSD must be contacted with the required information;
- There must evidence of duly exploring other feasible alternatives (in a EIA);
- The option of selection a corridor (RoW) with a forest reserve must always be the final, unavoidable alternative;

- The RoW design would reduce to half the standard width requirement, to minimize impacts;
- Trees along the RoW would be removed to safeguard the risk of falling across the track and causing accident;
- Provision of safe wildlife (animal) corridors or passages, etc;

9.3 Capacity Building

The institutions (following consultations), understand and appreciate the purpose of the ESMF, their expected roles and the extent to which the ESMF will facilitate their statutory mandates and in the performance of their functions. The GRDA as the executing agency was fully involved in the preparation of the ToR for the ESMF assignment. This will help craft and stimulate the necessary collaboration in the implementation of the ESMF. There were however, certain capacity gaps identified from the needs assessment that requires capacity building to ensure effective implementation of the ESMF (Appendices 6 and 16). These include capacity for the EHD in the use of the RMP Sector-Specific:

- Screening Criteria;
- Initial Assessment/Registration Form; and
- EA Procedures for undertakings under the RMP

The other general areas for capacity building within GRDA to enhance the ESMF implementation and collaboration with relevant institutions include the following:

1. General project screening techniques and the applicable EA legislations and procedures;
2. General project planning and management inter-faced with E&S assessment and management;
3. PEA, EIA and ToR preparation for EIA;
4. Review techniques and specifically review of PER and EIS;
5. Monitoring and reporting;
6. Annual Environmental Report preparation and other reporting requirements; and
7. Public participation techniques and public hearing procedure.

The key ESA and ESM functional areas and the respective institutional capacity of GRDA to discharge those functions need strengthening (as shown in Appendix 6). The other area includes the E&S clauses for contractors, required to be enforced by GRDA. Sufficient capacity in the application of and compliance with the clauses must be built in the EHD of GRDA. Development of the environmental monitoring system or capacity is also essential to enable the authority continuously develop an environmentally friendly railway system. Areas for monitoring include noise and vibration, air quality, ROW, waste management at terminals, public safety, accidents etc.

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APPENDICES

Appendix 1	Environmental and Social Clauses (for Contractors)
Appendix 2	Summary of Potential Impacts & Mitigations of Railway Sector Projects
Appendix 3A	Common & Significant E&S Impacts of Railway Infrastructure Projects - Ranked
Appendix 3B	Common & Significant E&S Impacts of Railway Operations - Ranked
Appendix 4	Environmentally Sensitive Areas – Schedule 5 of LI 1652
Appendix 5	Initial Assessment/Registration Form for RMP Projects
Appendix 6	GRDA Needs Assessment Results
Appendix 7	Consultation with GRDA
Appendix 8	Consultation with GRCL
Appendix 9	Consultation with EPA
Appendix 10	Consultation with Ministry of Transport
Appendix 11	Consultation with Road Sector Institutions
Appendix 12	Consultation with Resource Management Institutions
Appendix 13	Consultation with Utility Service and Pipeline Institutions
Appendix 14	Consultation with Telecommunication Organization/Companies
Appendix 15A	Questionnaire for Ranking (Common & Significant) E&S Impacts of Railway Infrastructure Projects
Appendix 15B	Questionnaire for Ranking (Common & Significant) E&S Impacts of Railway Operations
Appendix 16	Questionnaire – Needs Assessment for GRDA
Appendix 17A	Consultation Outline – GRDA and GRCL
Appendix 17B	Consultation Outline – Road Sector Institutions
Appendix 17C	Consultation Outline – Resource Management Institutions
Appendix 17D	Consultation Outline – Utility Service and Pipeline Institutions
Appendix 17E	Consultation Outline – Telecommunication Organization/Companies
Appendix 17F	Consultation Outline – Bulk Oil Storage and Transport Company Limited
Appendix 18	EPA's Ambient Noise Level Guidelines
Appendix 19	EPA Review Comments on Draft ESMF
Appendix 20	Further Consultation

APPENDIX 1

Environmental and Social Clauses (for Contractors)

1.0 General Clauses

- a) The Contractor shall comply with any specific E&S Management Plan (ESMP) for the works he/she is responsible for; inform him/herself about such an ESMP, and prepare work strategy and plan to fully take into account relevant provisions of that ESMP.
- b) Indicate the period within which to maintain status on sites after completion of civil works to ensure that significant adverse impacts arising from such works have been appropriately addressed (in decommissioning plan).
- c) Adhere to the proposed activity implementation schedule and the monitoring plan to ensure effective feedback of monitoring information to project management, and if necessary, adapt to changing and unforeseen conditions.
- d) Besides the regular inspection of the sites by the Supervising Engineer (SE) for adherence to the contract conditions and specifications, the GRDA may appoint an Inspector to oversee the compliance with these E&S conditions and proposed mitigation measures. The EPA and MoT may carry out similar inspection duties.
- e) Implement all measures necessary to avoid undesirable adverse E&S impacts wherever possible, restore work sites to acceptable standards, and abide by any E&S performance requirements specified in an ESMP.

2.0 Noise Due to Construction Activities

- a) Ensure the noise levels emanating from machinery, vehicles and noisy construction activities (e.g. excavation) are kept at a minimum for the safety, health and protection of workers within the vicinity of high noise levels and nearby communities. The EPA Noise Guidelines for Residential Area in day time is 55dB, while at night is 45dB.

3.0 Water Resource (e.g. River, Stream, Creek, Wetland, etc) Obstruction and Contamination

- a) Ensure existing water flow regimes in drainages are maintained and/or re-established where disrupted due to works.
- b) Take all necessary steps to prevent pollution of streams, rivers and other natural water bodies and reservoirs.

4.0 Temporary Construction Camp Sites

- a) Prevent and minimize the impacts of piling of construction materials and building of temporary structures on the biophysical environment (including protected areas and arable lands, local communities/settlements).
- b) As much as possible restore/rehabilitate all sites to acceptable standards.

5.0 Protection of Cultural, Archaeological and Historical Sites

- a) Upon discovery of any cultural resources, heritage, relics or anything that might be or is believed to be of cultural, archaeological or historical importance during execution of works, immediately suspend activity and report such findings to the SE so that the National Museums and Monuments Board (NMMB) may be expeditiously contacted for measures to protect such resources.
- b) The Supervising Engineer shall take the following measures:
 - Notify the NMMB, and request for site inspection by a representative;
 - Cessation of work in the vicinity of the find, until the visit of the representative; and
 - Decision by the NMMB on possible salvage or excavation within 48-72 hours of notification.

6.0 Quarrying, Burrowing, etc.

- a) Prevent and minimize the impacts of quarrying and burrowing (e.g. for ballast, aggregates, laterite), piling and haulage access routes on the environment (including protected areas and farmlands, local communities; and restore/rehabilitate all sites to acceptable standards.

7.0 Vegetation, Biodiversity and other Sensitive Ecosystems

- a) Discourage construction workers from engaging in the exploitation of natural resources e.g. hunting, fishing, and collection of forest products or any other activity that might have a negative impact on the social and economic welfare of the local communities.
- b) Avoid fragmentation of critical terrestrial habitats such as patches of remaining forest, valuable trees and where the presence of wildlife has been noted, including aquatic habitats by planning and siting railways, rail yards, spoil, stockpile, support facilities, and maintenance roads to avoid such locations or by utilizing existing transport corridors whenever possible. Where fragmentation is unavoidable, ensure the availability of animal crossings (e.g. bridges, culverts, and over-crossings) and provide jointing chambers to allow small animals a means of escape from the railway.
- c) Plan, construct, maintain and operate temporary works such as camps, stockpile and construction facilities, to avoid damage to sensitive areas where railway lines could be laid, such as patches of remaining forest and wildlife areas.
- d) No valuable trees or crops shall be disturbed/damaged during execution of works without prior consent of the SE.

8.0 Use of Local Materials

- a) Use local materials (where available) to avoid importation of foreign material and long distance transport.

9.0 Work Site/Camp Site Waste Management

- a) All vessels (drums, containers, bags, etc.) containing oil/fuel/surfacing materials and other chemicals shall be bonded in order to contain spillage. Used oil and hydraulic fluid generated on the construction sites must be collected in a closed container and stored temporarily in a safe place and sent to an authorized users or recyclers.
- b) All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before discharged in line with applicable discharge standards/regulations.
- c) Entry of runoff to the site shall be restricted by constructing diversion channels or holding structures such as banks, drains, dams, etc. to reduce the potential of soil erosion and water pollution.
- d) Prevent pollution of water sources at or in the vicinity of the site and comply with applicable laws and regulations.
- e) Construction waste shall not be left in stockpiles along the railway lines, but removed and reused or disposed of daily.
- f) Provide sanitary facilities (e.g. waste bins and disposal, drinking water and toilet facilities, etc.) in construction camps.

10.0 Rehabilitation and Soil Erosion Prevention

- a) Always retain topsoil for subsequent rehabilitation. Soils shall not be stripped when wet, to avoid soil compaction and loss of structure.
- b) Locate stockpiles where they will not be disturbed by future construction activities.
- c) Reinstatement natural drainage patterns where they have been altered or impaired.
- d) Ensure restored land is inherently stable, adequately drained and suitable for the desired long-term land use.
- e) Minimize erosion by wind and water both during and after the process of reinstatement.
- f) Re-vegetate with plant species that will control erosion, selection of species shall be done in consultation with appropriate institutions.

11.0 Material Excavation and Deposit

- a) Obtain appropriate licenses/permits from the EPA and Mineral Commission to operate quarries or burrow areas.
- b) Location of quarries and burrow areas shall be subject to relevant approvals, including traditional authorities where necessary.
- c) New extraction sites:
- Shall not be located in the vicinity of settlement areas, cultural and historical sites, wetlands or any valued ecosystem area.
 - Shall not be located in archaeological areas, or where excavations are close by, great care shall be taken, and in the presence of government authorities having a mandate for their protection.
 - Shall not be located in forest reserves, or where no other alternatives is available, shall be with the consent of the appropriate authorities and EIA duly conducted.
 - Shall be rehabilitated or restored.
 - Shall have clearly demarcated and marked boundaries to minimize vegetation clearing and unnecessary damage on resources.
- d) Vegetation clearing shall be restricted to the area required for safe construction work, and not done more than two months in advance.
- e) Stockpile areas shall be covered to prevent dust pollution.
- f) Deposit any excess material in accordance with the applicable ESMP, in areas approved by local authorities and/or the SE.

12.0 Water Resources Management

- a) Avoid conflict with water demands of local communities.
- b) Abstraction of surface and underground water shall be in consultation with local community and permission of the WRC.
- c) Abstraction of water from wetlands shall be avoided, except with the permission of the WRC.
- d) No construction water containing spoils or site effluent, especially oil, shall be allowed to flow into natural water or drainage courses.
- e) Waste water from washing of equipment shall not be discharged into water courses without pre treatment.
- f) Site spoils and temporary stockpiles shall be located away from drainage system/channel, and runoff directed away from stockpiles.

13.0 Traffic Management

- a) Location of railway access shall be done in consultation with the local community, especially in important or sensitive environments.
- b) Upon completion of civil works, all accesses to the railway works sites shall be ripped and rehabilitated.
- c) Access roads shall be watered or treated with non hazardous chemical regularly to suppress dust emission

14.0 Disposal of Unusable Elements

- a) Unusable and construction materials such as demolished structures will be disposed of in a manner approved by the SE, and agree on what to surrender to the Client, recycled or reused or disposed of at approved sites.
- b) Unsuitable rail elements shall be dismantled to a size fitting on ordinary trucks for transport.

15.0 Replacement/Compensation of Private Property

- a) Any deliberately or accidentally damage of private property, shall be repaired or replaced to the owner's satisfaction, a certificate that the damage has been fixed satisfactorily issued to the Contractor.
- b) In cases where compensation for inconveniences, damage of crops etc. are claimed by the owner, GRDA has to be informed by the Contractor through the SE. This compensation is in general settled under the responsibility of the GRDA before signing the Contract.

16.0 Contractor's Environmental and Social Management Plan (ESMP)

Prepare an ESMP (emphasis on Health and Safety) within 6 weeks of signing the Contract, to ensure adequate management of the health, safety, environmental and social aspects of the works. The ESMP will serve two main purposes:

- a) For Contractor - to ensure measures are in place for EHS management, and as an operational manual for workers/staff.
- b) For GRDA - to ensure Contractor is fully prepared for the adequate management of the EHS aspects of the project, and as a basis for monitoring of the Contractor's EHS performance by the SE and EHD of GRDA. The Contractor's ESMP shall provide at least:
 - Procedures and methods for complying with these general environmental management conditions, and others in Project EMP;
 - Specific mitigation measures that will be implemented in order to minimize adverse impacts;
 - Planned monitoring activities (e.g. sediment discharges from burrow areas) and the reporting thereof; and
 - Internal organizational, management and reporting mechanisms put in place.

The Contractor's ESMP will be reviewed and approved by GRDA before start of the works.

16.1. Health and Safety

- a) As part of initial (preparatory) construction activities, the Contractor shall mount an awareness and hygiene campaign to sensitize workers and local residents on health risks particularly of HIV/AIDS.
- b) Adequate signs to warn pedestrians and motorists of construction activities, diversions, etc. (provided at appropriate points).
- c) Construction vehicles shall not exceed a maximum speed limit of 40km per hour.

16.2. Traffic Safety

- a) Ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents.
- b) Ensure safety along the railway lines related to the site, and protection of workers and the safety of the public on the railway and roads affected by his activities.
- c) Railway lines subject to interference by the work shall be kept open or suitable detours provided and maintained, also provide, erect, and maintain all necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs.
- d) Submit bi-weekly activities schedule and the locations of his work along the railway (RoW) to GRDA, and obtain all necessary approvals prior to commencement of the respective work.
- e) At railway crossings or in heavy traffic locations, carry out the work within the working hours as directed by the engineer, and after the completion of the work, immediately make the necessary backfill and pavement at the crossings.
- f) Provide temporary passes/bridges to give an access to affected villages/communities, houses, etc. to the satisfaction of SE and GRDA.

17.0 Reporting

Prepare monthly progress reports to the SE on compliance with these general Clauses, the Project EMP, and Contractor's ESMP (including Environment, Health and Safety (EHS)) to cover:

- EHS management actions/measures taken, including approvals sought from local or national authorities;
- Problems encountered in relation to EHS aspects (incidents, including delays, cost consequences, etc.);
- Lack of compliance with contract requirements on the part of the Contractor;
- Changes of assumptions, conditions, measures, designs and actual works in relation to EHS aspects; and
- Observations, concerns raised and/or decisions taken with regard to EHS management during site meetings.

Reporting of significant EHS incidents must be done as soon as practicable to the SE. Keep records on health, safety and welfare of persons, and damage to property. Include such records, as well as copies of incident reports, as appendices to the bi-weekly reports. Details of EHS performance will be reported to GRDA through the SE's reports.

18.0 Training of Contractor's Personnel

Provide sufficient training to workers/personnel for adequate knowledge on these general conditions, Project EMP, and Contractor's ESMP, to be able to fulfil their expected roles and functions, those employees that have particular responsibilities associated with the implementation of the ESMP. General topics should be:

- EHS in general (working procedures);
- Emergency procedures; and
- Social and cultural aspects (awareness creation).

19.0 Cost of Compliance

Compliance with these conditions is expected to be part of standard E&S management/stewardship practice as generally required. The item "Compliance with Environmental Management Conditions" in the Bill of Quantities covers these costs.

No other payments will be made to the Contractor for compliance with any request to avoid and/or mitigate an avoidable HS impact.

APPENDIX 2

Summary of Potential Impacts Associated with Railway Projects and Mitigation Measures

Noise and Vibration Effect on human welfare and hearing impairment, communication problem, elevated stress level Auditory fatigue, temporary and permanent loss of hearing, sleep disorder, and learning difficulty in children. Damage to railway side structures and buildings through vibration Effect on wildlife reproduction and behavior	Train movement - friction between train and rail Driver behaviour- using horns Construction and maintenance activities Production of ballast and sleepers Piling for bridges construction	• Smooth, well-maintained rail surface grooves and cracks • Rail track design should avoid steep sharp corners to reduce noise resulting acceleration and braking • Provision of noise barriers – concrete plants/trees, etc. • Environmental specifications for construction, quarrying, such activities in noise-sensitive areas attention may have to be paid to equipment standards, hours of operation, material routes, and other aspects of work-site management.
Landscape Alteration and Aesthetics	Lack of harmony between the railway and land-scape features such as natural relief and morphology, vegetation, recreational areas, cultural heritage site. Quarrying, borrow pits and gravel winning associated with rail construction	• Reforestation • Landscaping of route • Selection of alignment that best fit the landscape e.g. vertical and horizontal alignment should follow the natural • Reclamation of degraded lands
Impact on Communities and Economic Activities Splitting of Communities Increased land and property values leading to higher rental values, a turnover in occupancy, and displacement of lower-income tenants	Introduction of faster trains and access control generally cuts traditional lines of travel or communication in communities Provision of longer alternative routes for local movements affects businesses and pedestrian movements Disruption of links between villagers and their farmlands by a new rail or increased traffic. Conflicts and safety concerns arise with rail-road crossing, creation of diversion routes	• Resettlement and compensation for those whose housing, land or livelihood is directly affected by a project. • Make provision for improved crossing alternative access routes. • Provision of alternative space for displaced activities and service areas adjacent to routes for displaced businesses
Impacts from land Acquisition and Resettlement Displacement and loss of business, property and income, social disruption for the affected individuals and their families.	Compulsory land acquisition (expropriation of properties for public project). Demolition of structures such as houses, buildings, shops	• Impacts avoided by engineering route (alternative) away from built-up areas • Works to avoid interference with existing activities. • Adoption of a reduced right-of-way • Design changes (e.g. underground) to minimise impacts on properties and • Compensation of owners of affected properties on the basis of current market value
Impact on Cultural Heritage Damage could affect the historic, scientific, social, and amenity values; aesthetic impacts on cultural monuments and archaeological sites	Damage caused by construction related works such as quarries and borrow sites, and unregulated access to cultural heritage sites	• Construction should avoid alignment through known cultural sites • Cultural sites uncovered during construction works should lead to possible realignment of infrastructure. • Excavation, erosion control, restoration of structural elements, rerouting and siting

		• Salvage excavation and relocating artefacts from a site. • Dialogue between GRDA and NMMB is required to avoid damage to cultural sites • Marking and fencing important cultural sites during the construction period
Waste Generation	Excavation spoil and construction waste Inappropriate Construction camp siting and handling of sewage and garbage Spills from construction equipment operation/servicing	• Disposal of construction related waste materials at designated waste dump site • Waste minimization measures, through re-use • Waste management plan to be incorporated in railway planning
Utility Disruptions	Construction activities and the probable need to realign utility supply lines	• Advance public notices • Collaboration with utility providers • Provision of alternative supplies where applicable e.g. water supply by tankers to affected communities • Restoration of utility lines and other structures damaged during the construction
Public Safety and Health	Exposure to dust and emission from construction equipment Exposure to high and continuous noise level and vibration from construction activities Lack of warning signs and safeguards Influx of migrant workers and introduction of diseases such as STDs, HIV/AIDS	• Regular servicing of construction equipment • Use of equipment with low operating noise levels • Restricting construction work to daytime • Introduction of speed control devices for vehicles at crossings • Public awareness campaigns (provision of sign posts) • Provision of diversions where possible during construction period • Open ditches and other potential hazards properly marked with visible reflective tapes
Occupational Health and Safety	Accidents e.g. from operation of construction equipment	• Training of workers in safe equipment use • Provision of personal protective equipment and clothing • Enforcement of the use of such equipment • Frequent maintenance of equipment • Safety rules for workers and their enforcement • Emergency procedures and training

APPENDIX 3A

Common and Significant E&S Impacts of Railway Infrastructure Projects - Ranked

	Environmental / Social Parameters	Common					Average	Rank	Significant					Average	Rank
		GRDA ₁	GRDA ₂	EPA	GRCL	MoT			GRDA ₁	GRDA ₂	EPA	GRCL	MoT		
1	Dust	3	2	3	3	3	2.8	H	3	3	3	3	3	3.0	H
2	Noise and Vibration	3	3	3	3	2	2.8	H	3	1	3	3	3	2.6	H
3	Level crossing accidents	2	3	3	3	3	2.8	H	1	1	3	2	3	2.0	M
4	Public safety/accident	1	1	3	2	2	1.8	M	1	1	3	2	2	1.8	M
5	Compensation issues	3	2	3	1	3	2.4	M	3	2	3	1	3	2.4	M
6	Induced development	3	0	1	2		1.5	M	3	0	1	2		1.5	M
7	Cultural concerns	2	2	2	2	0	1.6	M	1	1	2	2	0	1.2	L
8	Archaeological losses	1	2	1	1	2	1.4	L	1	1	1		2	0.8	L
9	Utility lines (e.g. water) relocation	1	3	1	3	3	2.2	M	1	2	1	3	3	2.0	M
10	Risk of HIV/AIDS spread	3	2	1	0	3	1.8	M	2	1	1	0	3	1.4	L
11	Wildlife concerns	3	2	2	1	3	2.2	M	3	1	2	1	3	2.0	M
12	Forestry concerns (access through)	3	3	2	2	3	2.6	H	3	2	2	2	3	2.4	M
13	Habitat disruption/fragmentation	1	3	1	3	3	2.2	M	1	1	2	3	3	2.0	M
14	Water contamination	1	2	1	1	3	1.6	M	1	1	1	0	3	1.2	L
15	Stream diversion / blocking	3	2	1	1	3	2.0	M	2	1	1	0	3	1.4	L
16	Flooding	1	0		2	1	0.8	L		0		2	1	0.75	L
17	Inadequate drains along rail tracks	1	2	1	3	2	1.8	M	1	0	1	3	3	1.6	M
18	Run off	3	2	0	3	2	2.0	M	3	1		3	2	2.25	M
19	Pits / trenches near railway tracks	0	2	1	3	3	1.8	M	0	0	2	3	3	1.6	M
20	Construction waste generation	2	3	2	3	3	2.6	H	2	1		3	3	2.25	M
21	Top soil removal within corridor	3	3	1	3	3	2.6	H	3	2	3	3	3	2.8	H
22	Tree/vegetation removal in corridor	3	3	2	3	3	2.8	H	3	2		3	3	2.75	H
23	Blasting	1	2	1	0	3	1.4	L	1	1		0	3	1.25	L
24	Tunnelling	0	2	1	0	3	1.2	L	0	1		0	3	1.0	L

APPENDIX 3B

Common and Significant Environmental and Social Impacts Associated with Railway Operations – Ranked

	Environmental / Social Parameters	Common					Average	Rank	Significant					Average	Rank
		GRDA ₁	GRDA ₂	EPA	GRCL	MoT			GRDA ₁	GRDA ₂	EPA	GRCL	MoT		
1	Dust	2	1		3	3	2.25	M	3	1		3	3	2.50	H
2	Noise and Vibration	3	3		3	2	2.75	H	3	3		3	3	3.00	H
3	Level crossing traffic and accidents	2	2		3	3	2.50	H	2	2		3	2	2.25	M
4	Public safety/accident risk	3	1		2	1	1.75	M	2	1		2	2	1.75	M
5	Train maintenance	3	2		3	0	2.00	M	3	2		3	1	2.25	M
6	Track maintenance	3	2		3	3	2.75	H	3	2		3	2	2.50	H
7	Induced development	3	2				2.50	H	3	2				2.50	H
8	Train breakdown	2	1		2	0	1.25	L	1	1		2	2	1.50	M
9	Train derailment/skidding	2	2		3	2	2.25	M	2	2		3		2.33	M
10	Littering from trains	2	1		3	0	1.50	M	3	2		3	0	2.00	M
11	Oil spills and oil waste generation	2	2		3	2	2.25	M	3	2		3	1	2.25	M
12	Waste generation at stations	3	2		3	2	2.50	H	3	2		3	1	2.25	M
13	Concerns to wildlife (e.g. Reserve)	2	1		1	3	1.75	M	3	1		1	3	2.00	M
14	Water contamination	1	0		1	3	1.25	L	1	1		1	3	1.50	M
15	Flooding	0	2		2	0	1.00	L	0	1		2	1	1.00	L
16	Inadequate drains along railway tracks	3	2		3	2	2.50	H	3	1		3	2	2.25	M
17	Pits / trenches near railway tracks	0	0		2	3	1.25	L	0	0		2	3	1.25	L

Note: H is High; M is Moderate; and L is Low

APPENDIX 4

Environmentally Sensitive Areas – Schedule 5 of LI 1652

- All areas declared by law as national parks, watershed reserves, wildlife reserves and sanctuaries including sacred groves,
- Areas with potential tourist value,
- Areas which constitute the habitat of any endangered or threatened species of indigenous wildlife (flora and fauna),
- Areas of unique historic, archaeological or scientific interests,
- Areas which are traditionally occupied by cultural communities,
- Areas prone to natural disasters (geological hazards, floods, rainstorms, earthquakes, landslides or volcanic activities).
- Areas prone to bushfires.
- Hilly areas with critical slopes.
- Areas classified as prime agricultural lands.
- Recharge areas of aquifers.
- Water bodies characterized by one or any combination of the following conditions:
 - water tapped for domestic purposes;
 - water within controlled and/or protected areas;
 - Water that supports wildlife and fishery activities.
- Mangrove areas characterized by one or any combination of the following conditions:
 - areas with primary pristine and dense growth;
 - areas adjoining the mouths of major river systems;
 - areas near or adjacent to traditional fishing grounds;
 - areas that act as natural buffers against shore erosion, strong winds or storm floods

APPENDIX 5

Ghana Railway Master Plan (RMP)

Environmental and Social Management Framework



ENVIRONMENTAL PROTECTION AGENCY
DEVELOPMENT AUTHORITY

GHANA RAILWAY

INITIAL ASSESSMENT/REGISTRATION FORM [For RMP Projects]

(Completed in Duplicate)

Project Name:

Location (Region, District,
etc):

Address for Correspondence

Contact Person _____ **Position** _____

Phone No. _____ **Fax No.** _____

E-mail _____

Contact _____

Contact Address of Environmental Protection Agency Offices

	Office/ Region	Address (P O Box)	Telephone		Office/ Region	Address (P O Box)	T
1	Head Office	M326, Accra	03020664697/8 0289673961/2	7	Ashanti	M1945, Kumasi, Suame	0322
2	Greater Accra	M326, Accra	0208140851	8	Central	870, Cape Coast	0332
3	Brong Ahafo	1505, Sunyani	0352027480/81	9	Eastern	725, Koforidua	0342
4	Tarkwa, EPA	1, Tarkwa	036220786	10	Northern	620, Tamale	0372
5	Upper West	179, Wa	03920 22479	11	Upper East	80, Bolgatanga	0382
6	Tema EPA	301, Tema	0303310009/312012	12	Volta	513, Ho	0362
				13	Western	304, Sekondi-Takoradi	0314

1.0 Description of Project

1.1 Type of project

.....

1.2 Nature of Project

.....

1.3 Scope of Project [Size/scale, area covered, type of raw materials (quantities and sources), types of equipment, implements, machinery, etc.]

.....

.....

.....

1.4 Waste Generation

i. Types: Solid ☐ Liquid ☐ Gaseous ☐ Other ☐

.....

ii. Quantity:

.....

iii Means/Place of Disposal:

.....

2.0 Proposed Site/Route for Project

2.1 Location [attach Site Plan or Map (if available)]

i. Location or Area (and nearest Town(s)):

.....

ii. Land take (total area for project and related activities):

.....

2.2 Existing Land Use of the Area/Route for the Project:**2.3 Site Description [Attach photographs and sketches showing distances]**

- i. Distance from nearest water body and/or other sensitive areas/sites (socially and environmentally)

2.4 Land Cover and Topography

- i Land cover of the Site/Route consists (completely, partly, or noticeably) of

- ii Elevation and topography is mainly

Flat	☐	Valley	☐	Slope	☐	Undulating	☐
Hill	☐	Mountain	☐	Depression	☐	Others	

3.0 Infrastructure

- i. The project would be developed in/on:

Undeveloped site ☐ Partly developed site ☐ Existing Facility ☐ Other (spe

- ii. The project would involve excavation Yes ☐ No ☐

- iii. Estimated depth of the excavations, etc):

- vi. Are any of the following 'Lines' located within, across or along the Right of Way of the proposed site/route?

Water Supply ☐ Power ☐ Telecommunication ☐ Petroleum Pipeline ☐ Road ☐

4.0 Environmental and Social Impacts**4.1 Air Quality** - Would the proposed project:

- i. Emit during construction/operation

Dust ☐ Smoke ☐ Volatile Organic Compounds (VOCs) ☐ Radia

- ii. Expose workers or the public to substantial emissions? Yes ☐ No ☐

- iii. Result in cumulatively increased emissions in the area? Yes ☐ No ☐

- vi. Create objectionable odour affecting people? Yes ☐ No ☐

4.2 Biological Resources - Would the proposed project:

- i. Have adverse effect on any reserved area (wildlife or forest)? Yes ☐ No

- ii. Have adverse effect on wetland areas through removal, filling, hydrological interruption or other means? Yes ☐ No

- iii. Interfere substantially with the movement of any wildlife species? Yes ☐ No

- vi. Be located within 100m from an Environmentally Sensitive Area such as wetland, water bodies, mangrove, etc? Yes ☐ No

4.3 Cultural Resources - Would the proposed project:

- i. Disturb any sacred area, shrine or cemetery? Yes ☐

- ii. Cause substantial adverse effect on any archeological or historic site? Yes ☐

iii. Alter the existing visual character of the area and surroundings?	Yes ☐	No ☐

4.4 Water Quality and Hydrology - Would the proposed project:

i. Generate and discharge during construction/operation:

Liquid waste ☐	Liquid with oily substance ☐
Liquid with human or animal waste ☐	Liquid with chemical substance ☐
Liquid with pH outside 6-9 range ☐	Liquid with odour/smell ☐

ii. Lead to changes in the drainage pattern of the area, resulting in erosion or siltation? Yes ☐

iii. Lead to increase in surface run-off, which could result in flooding on or off-site? Yes ☐

iv. Increase runoff, which could exceed the capacity of existing drainage? Yes ☐

4.5 Noise Nuisance - Would the proposed Project:

i. Generate noise in excess of established permissible noise level (60-75dB)? Yes ☐

ii. Expose persons to excessive vibration and noise? Yes ☐

4.6 Spent Lubricants and Waste Chemicals

i. Would the proposed Project generate spent lubricants (oil and grease)? Yes ☐

No ☐

ii. Would the proposed Project generate waste chemical? Yes ☐

No ☐

ii. If yes, estimate quantities per month
.....

4.7 Other Environmental and Social Impacts.....
.....
.....
.....
.....

5.0 Management of (Environmental and Social) Impacts

5.1 Air Quality.....
.....
.....

5.2 Biological Resources.....
.....
.....

5.3 Cultural Resources.....
.....
.....

5.4 Water Quality and Hydrology.....

.....

5.5 Noise

 .

5.6 Spent

Lubricants.....

5.7 Any

Other.....

DECLARATION

I, ... hereby declare that the information provided on this form is true to the best of my knowledge and shall provide any additional information that shall come to my notice in the course of processing this application.

.....

Signature

Date

Use the space below for any additional information

APPENDIX 6

GRDA Needs Assessment - Results

A1. Institution/Department (Name)... **Ghana Railway Development Authority**
 A2. Respondent's Name (optional)..... Position... **Project Director**
 A3. Respondent's Qualification ... **MSc Civil Engineering**
 A4. Respondent's Unit/Section... **Planning, Development and Research**
 A5. Unit/Section Responsible for EA/EM... **Planning, Development and Research**

General Knowledge of EA Instruments

B1. Are you conversant with the Environmental Assessment (EA) legislation, procedures applicable to the transport sector?

	EA Instruments	Are you aware of this?	Have you used it in the past	Purpose for use (Comments)
1	EPA Act, 1994 (Act 490)	Yes ☒ No ☐	Yes ☐ No ☒	
2	EA Regulations, 1999 (LI 1652)	Yes ☒ No ☐	Yes ☐ No ☒	
3	Ghana EIA Procedures	Yes ☒ No ☐	Yes ☐ No ☒	

B2. List any other relevant legislation/requirement/information source important to the railway sector (on environment and social issues)

Transport Sector Environmental Assessment Guidelines for the Aviation, Rail and Road Transport Sub-sectors.

EA / EM Functions and Capacity Needs

C1. Which of the following EA / EM activities or functions are performed by your Department/ Organisation?

	Tick	EA & EM Activities	Comments
1	☐	Planning phase activities	
2	☒	Design/engineering	Through consultants
3	☐	Proposal preparation for EA consultants	
4	☒	Providing Guidance to EA consultant & for the EA work	
5	☒	Registering Railway projects with EPA	
6	☒	Screening of Railway Sector projects	
7	☐	Preparing Scoping with TOR for EIA studies	
8	☐	Submission/review of Scoping Report	
9	☐	Organising Public Consultation and Public Hearing	
10	☒	Handling Compensation issues	
11	☐	Submitting EA report for review and approval	
12	☐	Payment of fees and permit collection	
13	☒	Taking custody of EA and related reports	
14	☒	Ensuring implementation of mitigations, etc	
15	☒	Implementing mitigations measures	
16	☒	Proposal/TOR preparation for construction contracts/contractors	
17	☒	Railway infrastructure construction supervision	
18	☒	Monitoring of implementation of Railway projects	
19	☒	Monitoring of Railway operations	
20	☐	Please specify any other	

C2. Which of the above activities are you personally engaged in? (state the numbers representing the activities)
 2, 4, 18, 17, 16, 6 and 14

C3. Rank adequacy of existing capacity to perform EA functions

	Capacity to perform EA functions	Rank with "5" as highest					If ranking is below capacity building req
		1	2	3	4	5	
1	Rate your capacity to adequately handle your functions			☒			Need to engage requ
2	Rate the ability of relevant officials in your institution to perform EA functions			☒			Need to train current

3	Rate the ability of officials of other relevant institutions to performing their required EA functions				✓		
4	Rate the ability of private sector experts (consultants) offering EA services to handle EA					✓	

4. Please state number of staff in the institution with EA / EM capacity

	Staff Capacity	Formal Training	On the Job Learning	Comments
1	Number of staff with EA/EM capacity		2	
2	Number needed (considered adequate) to handle EA/EM in the institution	4		In the process of staff

Railway Infrastructure/Services and related EAs

D1. What are the main classes or types of Rail Transport interventions or projects or infrastructure or services that require investments or that are undertaken by the MoT and the GRDA?

Rail freight and passenger services including intercity and sub-urban services. Rail infrastructure rehabilitation and reconstruction/construction.

D2. Have you been involved in a railway sector project? Yes ☒ No ☐

D3. If Yes state how many Four (4)

D4. What was/were your role(s)? Director and Supervisor

D5. Please specify the category of Railway projects and the corresponding level of EA they are subjected to. Very minimal level of EA

Railway Projects and Institutional Roles

E1. Which institutions did you work with on the Railway project(s)?

Ghana Highway Authority and Architectural and Engineering Services limited.

E2. Which institutions tend to be more relevant to the railway sector (on environmental and social issues)?

Ghana Highway Authority.

E3. Do any of the following institutions play any part in the EA of a railway sector project?

	Institution	Response		Institution	Response
1	Ministry of Transportation	Yes ☒ No ☐	8	Wildlife Division	Yes ☐ No ☒
2	Ghana Highway Authority	Yes ☒ No ☐	9	Forest Services Division	Yes ☒ No ☐
3	Department of Urban Roads	Yes ☐ No ☒	10	Land Valuation Board	Yes ☒ No ☐
4	Feeder Roads Department	Yes ☐ No ☒	11	Utility Service Providers	Yes ☒ No ☐
5	Environmental Protection Agency	Yes ☒ No ☐	12	Metropolitan/Municipal / District Assemblies	Yes ☒ No ☐
6	Water Resources Commission	Yes ☐ No ☒	13	Traditional Authorities	Yes ☒ No ☐
7	Forestry Commission	Yes ☒ No ☐			Yes ☒ No ☐

E4. List any (other) departments/organisations that must be included in or omitted from the 13 listed above in the institutional arrangements under the ESMF. Those in charge of Cultural Heritage site, Geological Survey Department

APPENDIX 7

Consultation with GRDA

Main Respondent: Mr Sadique Abubakarr

	Issues	Discussions
1	GRDA as the Owner of the Railway Sector Infrastructure (will) have certain cut out responsibilities. What are (will be) the key responsibilities of GRDA in managing the Railway Sector?	GRDA's responsibilities include: - Promote the development of railway and railway services - Hold, administer and improve the railway assets and - Promote the development and management of suburban railways by - a) Setting and enforcing safety and security standards for construction and operation of railways b) Granting licences, concessions and leases which are necessary for the operation of railways and railway services. c) Regulate and monitor the activities of licensees, concessionaires and operators of railways d) Initiate, conduct, promote and encourage studies necessary for the growth and development of railways etc.
2	GRDA will therefore be responsible to ensure EIAs are carried out for future Rail infrastructure development / rehabilitation, etc?	Yes
3	GRDA therefore needs some in-house EA capacity to lead in the process and also to monitor Environmental and Social (E&S) Safeguard Measures?	Yes
4	How will GRDA be expected to regulate Railway Operations (and the Operating Companies) to ensure compliance with required E&S Safeguards?	The GRDA law requires the establishment of a Railway Safety and Security Inspection Division of GRDA which shall be responsible for enforcing the provisions of the Act and regulations thereof including functions related to safety and protection of passengers and goods carried by railway.
5	The Operating Companies will own the Rolling Stock. What does this mean in terms of environmental commitments?	It means the Operating Companies will acquire the necessary Coaches, Vehicles, and Locomotives that they need to (or will) operate with. It pre-supposes that they will have associated environmental responsibilities.
6	GRDA is the Owner of the Infrastructure, but the Operating Companies will be using the facilities. Who will be responsible for the various maintenance activities and who will be held accountable - environmentally?	Agreements between the Operating companies and GRDA will be worked out who should be held accountable. In most cases it will be the operating companies.
7	Maintenance of the Rolling Stock?	The Operating Companies
8	Would each Operating Company have its separate/individual Maintenance Facilities/Workshops?	Difficult to say It could be worth outsourcing these type of responsibilities to special Railway Infrastructure Maintenance Companies (RIMC), where all operators can rely on for services. The alternative is that the predominant carrier or the biggest fleet company may provide services to be required by the smaller companies within each domain of operation. Carriers may move across domains and may also rely on the services of the domain. Meaning there will always be some company(ies) which can be held responsible.
9	Maintenance of the Train Stations?	Railway Infrastructure Maintenance Companies or the predominant carrier license holder in that particular area.
10	Maintenance of the Rail Tracks?	Railway Infrastructure Maintenance Companies or the predominant carrier license holder in that particular area.

11	Recruitment and Maintenance of Security Guards?	Railway Infrastructure Maintenance Companies or the predominant carrier licensed for that particular area.	
12	Maintaining Maintenance Facilities / Workshop Facilities for use by Operating Companies?	Railway Infrastructure Maintenance Companies or the predominant carrier licensed for that particular area.	
13	Maintenance of Running Sheds?	Railway Infrastructure Maintenance Companies (RLMC) or the predominant carrier licensed for that particular area.	
14	What are (will be) the main sources and types of waste and who should manage them?	• Toilet/sanitary facilities in the Coaches – Operating Companies • Toilet/sanitary facilities in the Stations – RLMC/Operating Companies • Oil waste (engine oil, spent lubricants, etc) – RLMC/Operating Companies • Bauxite haulage slurry materials discharged onto tracks, which react with ballast to form hard solid on tracks) – Operating Companies (if they will be responsible for the maintenance of the tracks –it is a track maintenance issue) • Emissions from wagons – Operating Companies	
15	What conditions should inform Grade Separation at Road/Rail Crossings?	• The type of Road (Highway, Urban or Feeder) • Location of road – busy area or urban, remote or rural, etc • Traffic volumes – high or low • Feeder roads would usually have level crossing • Operating speed of trains	
16	What are some of the common abuses of Railway reservations/Right of Way?	• Dumping of waste along the RoW (especially in depressions) • Drains constructed by Road Sector Agencies end up discharging onto the RoW of Railway lines • Encroachment for various purposes e.g. scrap recycling, squatters in temporary structures (the resulting unplanned development has no proper access roads and no drainage systems including solid waste disposal outlets)	
17	How can such problems (these abuses) be addressed?	The relevant institutions must do their duties, e.g. the Assemblies must enforce planning regulations to check unauthorized location of structures, designate waste disposal sites and be seen to enforce their by-laws. They must not allow indiscriminate dumping. The Road Sector Agencies should ensure their contractors do the right thing in road-drain construction.	
18	What about encroachment? How can Railway reservation or RoW be protected against say encroachment?	It will be expensive to provide complete fencing. At least some limited fencing in critical sections can be done. The local Authorities must enforce by-laws on constructions of all structures	
19	For what, for instance would make you consider any section of the reservation critical and therefore qualify to be fenced?	For instance, where livestock (say goats, sheep and cattle) commonly cross the rail tracks. This can result in train accident. But most importantly in the cities where the rail tracks are used as access routes as well as where squatters are likely to settle.	
20	What is likely to happen to the existing old facilities, machinery, equipment and buildings, e.g. the old rusted coaches lined up there, the 1903 old rail tracks, this 1907 office structures?	• Some will be scrapped, e.g. the old coaches, which may be difficult to find parts to rehabilitate, and also the outdated pieces of machinery and maintenance equipment. • The old rail tracks will be scrapped – they are good steel just like the old coaches and can be sold. • Others may require extensive rehabilitation, e.g. the buildings	

APPENDIX 8

Consultation with Ghana Railway Company Limited

Main Respondents:

William Ackeen (Chief Civil Engineer) – 0244 478 619

Benjamin Amofah (Ag Deputy Managing Director (E)) – 0244 469 160 benamofah@gmail.com

Joseph Sankah (Ag Deputy Managing Director (Admin/Opt)) – 0244 235 335 joesankah@yahoo.com

Samuel K Mensah (Deputy Pebs/Admin) – 0209 417 670 appmens@hotmail.com

Mike Dzimah (Chief Mechanical/Electrical Engineer) – 0244 701278 macdzimah@yahoo.com

	Issues	Discussions
1	GRDA as the Owner of the Railway Sector Infrastructure (will) have certain cut out responsibilities. What are (will be) the key responsibilities of GRDA in managing the Railway Sector?	As the Owner, GRDA's responsibilities may include: • Development of the Rail Tracks and other basic Railway Infra • Engaging suitable Railway Operating Companies to operate th • Establishing Standards: • Facility standards – e.g. Gauges, Coaches • Operating standards – e.g. Speed limits (say depending on cargo (hazardous nature of cargo, sensitivity of the corridor • Environmental standards – e.g. Emissions standards • Regulating Railway Operations (the Operating Companies)
2	GRDA will therefore be responsible to ensure EIAs are carried out for future Rail infrastructure development / rehabilitation, etc?	Yes
3	GRDA therefore needs some in-house EA capacity to lead in the process and also to monitor Environmental and Social (E&S) Safeguard Measures?	Yes
4	How will GRDA be expected to regulate Railway Operations (and the Operating Companies) to ensure compliance with required E&S Safeguards?	The GRDA law requires the establishment of an Infrastructure Division of GRDA which can be responsible for the planning and monitoring functions of the GRDA
5	The Operating Companies will own the Rolling Stock. What does this mean in terms of environmental commitments?	It means the Operating Companies will acquire the Rolling Stock (Coaches, Vehicles, Wagons and Locomotives that will be used to (or will) operate with. It pre-supposes that the Operating Companies will assume all associated environmental responsibilities
6	GRDA is the Owner of the Infrastructure, but the Operating Companies will be using the facilities. Who will be responsible for the various maintenance activities and who will be held accountable - environmentally?	This is a difficult one. That is not clarified in the GRDA Law. We need to identify the specific areas requiring maintenance and make the best proposition on who take up the responsibility
7	Maintenance of the Rolling Stock?	The Operating Companies
8	Would each Operating Company have its separate/individual Maintenance Facilities/Workshops?	Difficult to say It could worth outsourcing these type of responsibilities to a special Railway Infrastructure Maintenance Company (RIMC), where all operators can rely on for service
9	Maintenance of the Train Stations?	Railway Infrastructure Maintenance Companies
10	Maintenance of the Rail Tracks?	Railway Infrastructure Maintenance Companies
11	Recruitment and Maintenance of Security Guards?	Railway Infrastructure Maintenance Companies
12	Maintaining Maintenance Facilities / Workshop Facilities for use by Operating Companies?	Railway Infrastructure Maintenance Companies
13	Maintenance of Running Sheds?	Railway Infrastructure Maintenance Companies

14	What are (will be) the main sources and types of waste and who should manage them?	• Toilet/sanitary facilities in the Coaches – Operating Companies • Toilet/sanitary facilities in the Stations – RLMC • Oil waste (engine oil, spent lubricants, etc) - RLMC • Bauxite haulage slurry materials discharged onto tracks, which react with ballast to form hard solid on tracks) – Operating Companies • Emissions from wagons – Operating Companies	
15	What conditions should inform Grade Separation at Road/Rail Crossings?	• The type of Road (Highway, Urban or Feeder) • Location of road – busy area or urban, remote or rural, etc • Traffic volumes – high or low • Feeder roads would usually have level crossing	
16	What are some of the common abuses of Railway reservations/RoW?	• Dumping of waste along the RoW (especially in depressions) • Drains constructed by Road Sector Agencies end up discharging onto the RoW • Encroachment for various purposes e.g. scrap recycling	
17	How can such problems (these abuses) be addressed?	The relevant institutions must do their duties, e.g. the Assemblies must designate waste disposal sites and be seen to enforce their by-laws. They must not allow indiscriminate dumping. The Road Sector Agencies should ensure their contractors to do the right thing in road-drain construction.	
18	What about encroachment? How can the reservation or RoW be protected against say encroachment?	It will be expensive to provide complete fencing. At least some limited fencing in critical sections can be done.	
19	What for instance would make you consider any section of the reservation critical and therefore qualify to be fenced?	For instance, where livestock (say goats, sheep and cattle) commonly cross the rail tracks. This can result in train accident.	
20	What is likely to happen to the existing old facilities, machinery, equipment and buildings, e.g. the old rusted coaches lined up there, the 1903 old rail tracks, this 1907 office structures?	• Some will be scrapped, e.g. the old coaches, which may be difficult to find parts to rehabilitate, and also the outdated pieces of machinery and maintenance equipment.. • The old rail tracks will be scrapped – they are good steel just like the old coaches and can be sold. • Others may require extensive rehabilitation, e.g. the buildings	

APPENDIX 9

Consultation with Environmental Protection Agency

Main Respondents:

Samuel Anku (Director Head Office, Accra)	0208158027
Ebenezer Appah-Sampong (Director, Head Office, Accra)	0277163050
Audrey Quarcoo (Deputy Director & Head of EAA Department)	0242728940
Irene Heathcote (Accra East Regional Director, Tema)	0274112112
Yaw Sarfo-Afriyie (Regional Director, Western Region)	0244639012
Shine Fiagome (Principal Programme Officer, Western Region)	0244185270

	Discussion Issues	Responses
1	Apart from the 24 common and significant environmental and social impacts associated with railway infrastructure development and the 17 impacts associated with railway transport operations which you have ranked, what others impacts would you consider relevant for inclusion	The questionnaire covers all relevant issues. Additions could however, include: - Emissions from trains during operations (depending on the type of system adopted) - Terminal management of mainly waste - Induced commercial activities in Terminals
2	What issues do you consider very significant as far as ESMFs are concern?	The fact that the individual projects under the Railway Master Plan will themselves be subjected to specific assessment. In this respect the development of a very good specific screening criteria for use by GRDA, and enhancing the capacity of the GRDA to own and implement the ESMF effectively
3	The screening criteria for the RMP projects and the RMP-specific EA Registration Form (Initial Assessment or Screening Form) will be soon drafted for EPA's consideration and acceptance	We look forward to receiving and reviewing them for inputs
4	Are there any other observation	Opportunity to look at intra-city light rail as an option, distinct from the inter-city ones
5	Any other piece of advice and guidance from EPA to make the exercise move rather fast	SEA of transport policy has useful information on the railway sector

APPENDIX 10

Consultations with the Ministry of Transport (Planning Department)

Respondent's Name (optional) Mr Twumasi-Ankrah Selby
Respondent's Position Chief Planning Officer
Contact: 0243244885; ta5selby@yahoo.com

	Discussion Issues	Responses
1	What is the main role of the Ministry of Transport in Railway sector?	The Ministry has the policy making role, among others for the Railway Sector. The basic policy framework to revamp the sector are initiated and supervised by the MoT.
2	What other functions does the Ministry play in overseeing the effective operation of the sector?	MoT performs M&E functions of the sector. The Ministry will also be involved in the licensing of operators to run the permanent right of way
3	Will the organogram of MoT show respective positions for Railway Sector oversight roles e.g. policy and planning as well as M&E?	Yes. A copy of the Organizational Chart will be made available

APPENDIX 11

A. Consultation with Ghana Highway Authority

Main Respondent:

Respondent's Name (optional) Rita Ohene Sarfoh (0244858609)
Respondent's Position Chief Engineer
Respondent's Unit/Section. Road Safety and Environment Division
Unit/Section Responsible for EA/EM Environmental Management Unit

	Issues	Responses
1	Cases of railway lines crossing roads at same (grade) level occur. How common is this?	Common
2	What is the type and nature of problems encountered in such cases?	Build roads to accommodate the existing lines, Rail – Road conflicts
3	Cases of railway lines crossing roads at different (grade) levels occur? How common is this?	Rarely
4	Why is that the case? What kind of benefits or otherwise could there be for that case?	Usually within the Urban sections. Grade separation avoid train-vehicular conflicts
5	What are the procedures to follow in ensuring mutually agreed and compatible road-railway line crossing development?	Develop a comprehensive integrated transport plan that addresses all the various modes of transports
6	If no procedures currently exist, what procedures must be developed and followed? <i>(Please refer to the proposed draft on the next page with any comments)</i>	Consult with the GHA and other road agencies
7	Which Unit in the Organization is (should be) responsible and who is (should be) the contact person for such cases?	Survey and Design as well as Environmental Unit of the Road Safety and Environment Division

B. . Consultation with Department of Urban Roads

Main Respondents:

Odartey Lanquaye (Deputy Director) 0544749322 olanquaye@gmail.com

Eric Amoako (Head Environmental Management Unit) 0244965949 ericamoako.2001@yahoo.com

Ferdinand Yali (Environmental Management Unit) 0269612891 kofyali@yahoo.com

Agreeable Procedures to ensure smooth construction of Road-Rail Line Crossings

	Responsibility of GRDA		Responsibility of GHADA/DUR
1	Prepare and submit: 1. plan of development and layout of the proposed railway line for development, 2. scope of the potential road-rail conflict, 3. proposed initial measures to address the potential conflict, and 4. timeframe of implementation		Receive and acknowledges submission from GRDA and sets date for joint assessment meeting Review the layout and plan of development, as well as proposed scope of work and implementation timeframe
2	Meet with GHADA/DUR for joint sessions (including inspection if necessary) to finalize assessment of plan of development, scope of work and implementation timeframe		Meet with GRDA for joint sessions (including inspection if necessary) to finalize assessment of plan of development, scope of work and implementation timeframe
3	GHADA/DUR submits an implementation budget		Prepare implementation budget for GRDA
4	Sign a memorandum of understanding with GHADA/DUR for implementation of the 'conflict section		GHADA/DUR and GRDA sign a memorandum of understanding for implementation
5	Provide the required budget for implementation		GHADA/DUR receives funds for implementation and contracts the work out
6	Joint Site meeting to review progress of implementation, etc		Joint site meeting and consultations

C. Department of Feeder Roads

Main Respondent:

Mr Eric Duncan William (Deputy Director) 0244955725.....edunwil@yahoo.com

Feeder roads occur often in rural areas where vehicular traffic tends to be rather low on the roads. Railway crossings are not considered a major problem for feeder roads. It is enough for a flagman to alert and stop vehicles when the train is passing. Therefore no rigid procedures as such as required. However, the Director must be notified, so that the DFR Regional Engineers can also be informed to supervise construction of crossings.

APPENDIX 12

Consultation with Wildlife Division of the Forestry Commission

Main Respondent: C C Amankwah

0244 262 467 ccamankwah@yahoo.com

	Discussion Issues	Responses
1	Are there any existing Railway lines passing through any Wildlife Reserve?	No. Not as far as I know.
2	Does the Wildlife Division (WD) have any reservation allowing Railway line development through Reserve?	Yes, serious reservation. It must not happen
3	Why that? Is transport access not necessary to promote eco-tourism?	Railway lines constructed through reserves will be detrimental to reserves and its wildlife resource. There could be train accidents by wild animals crossing. The animals would be killed by train habitats, breeding and feeding ranges, etc could be fragmented by other negative effects like noise and vibration.
4	So what is the position of the WD on rail infrastructure through its reserves?	'No go' area. Must be avoided at all cost
5	What about Railway lines passing close to reserves?	Relevant measures must be put in place, in consultation with the Wildlife Division, to ensure the safety of animals and also of train passengers. Measures could include providing high fencing along the section of RoW, and special measures to prevent wild animals skirting outside the reserve. Workers would also be prohibited from hunting during construction.

Consultation with Forest Services Division of the Forestry Commission

Respondent: Mr Raphael Yeboah (Executive Director of FSD) 0243 148 445

	Discussion Issues	Responses
1	Are there any existing Railway lines passing through forests?	I should think so, especially in the Nkwaw area and other parts of the Western and Ashanti Regions)
2	Does the Forest Services Division (FSD) have any reservation allowing Railway line development through Forest Reserves?	The existing Railway lines date far back, most of them were established before current reserves were established by law. Any new rail line development through a reserve will need FSD's approval.
3	So it means it is possible for rail tracks to pass through forest reserves. Isn't it	Yes, but with conditions. This could be similar to the routing of the River Authority's high tension pylons through reserves.
4	The existing practice with electricity lines could apply to railway lines also.	Yes. The FSD should be contacted with the required information and evidence of other alternatives duly considered.
5	Are there any other measures to consider?	The RoW for instance, would be reduced to half the standard requirement, to minimize impacts, and trees along the RoW removed for safety of falling across the track.
6	Who will be the contact person or Unit in FSD	Mr Boadu (Director of Operations) - 0244 421 333

APPENDIX 13

A. Consultation with Ghana Water Company (Ghana Urban Water Limited)

Main Respondent: Peter De-Veer
 Position: Regional Distribution Manager
 Contact: 02444 256 591 – peter.de-veer@ghanawater.info

	Discussion Issues	Responses
1	Are there any cases where utility lines or provision have to be relocated due to planned railway infrastructure project?	Yes, a case at Shangri-La, but not common with railway, but with roads
2	What is the nature of problems encountered in such cases?	Major transmission line could be affected, which could be very expensive to fix/relocate. Distribution mains (not that expensive). Services line (relative to manage)
3	What are the procedures to follow in ensuring compatible or sustainable development?	Pre-project knowledge/information as mitigation measure, about 3 months in advance. Assessment of budget required for execution of changes with existing plans. Make future plans available to GWCL to mitigate their own plan
4	If no procedures currently exist, what procedures must be followed?	On region by region basis - Submit layout plan of the line matched with the layout to determine the conflict points for existing and proposed. Budget for relocation. GRDA makes funds available for relocation of the pipes
5	Which unit in the organization is responsible and who is the contact person for such cases?	Chief Manager/District Manager

B. Consultation with Electricity Company of Ghana

Main Respondent: Sam Adjidjonu
 Position: Divisional Manager (Rural Projects)
 Contacts: 0208 135611 sadjidjonu@yahoo.com; sadjidjonu@ecggh.com

	Discussion Issues	Responses
1	Are there any cases where utility lines or provision of services have to be relocated due to planned railway infrastructure development?	Yes
2	How frequent are such cases?	2 cases around Tema Harbour
3	What is the nature of problems encountered in such cases?	Cost borne by GRDA. ECG estimates the cost
4	What are the procedures to follow in ensuring compatible or sustainable development?	GRDA notifies ECG at address provided, with project plan and planned schedule of development ECG acknowledges receipt and ECG does an assessment
5	If no procedures currently exist, what procedures must be followed?	ECG approach with the plan and time duration. Given access and prepare cost estimates. Submit costs to GRDA, and once paid ECG awards contract. Pro-activeness - well in advance in order to save time
6	Which unit in ECG is responsible and who is the contact person?	Divisional Manager - Rural Projects Directorate: Network Projects, ECG Head Office, Box 521, Accra

APPENDIX 14

Consultation with Telecommunication Organizations/Companies

A. Ghana Telecommunications Company Limited (VODAFONE)

Institution/Department: **Ghana Telecommunications Company Limited / Technology**
 Respondent's Name: **Tony Assan**
 Respondent's Position: **Head of Networks**
 Respondent's Unit/Section: **Networks-Technology**
 Unit/Section Responsible for EA/EM: **External Affairs / Technology**

	Discussion Issues	Responses
1	Are there cases where Telecom lines or facilities or services have been interfered with or relocated due to railway infrastructure development?	Yes, so the Railway Authority must inform Vodafone of the scope of works. Based on the information provided Vodafone can determine potential impact i.e. whether to relocate or install new cables.
2	Where has this occurred in recent times?	The Tema Harbour area, in August 2012. Also Graphic Road, Accra.
3	What is the nature of problems encountered in such cases?	Tema Harbour: The overhead cables across the rail track needed to be raised above the rail track. An additional pole was planted to raise the cables. Graphic Road: There was the need to relocate cables to avoid obstruction during reconstruction of the intermodal bridge and along the rail line.
4	What are the procedures to follow in ensuring compatible (or sustainable) development (i.e. for both the Telecom Company and Railway Authority)?	Normally, a letter from the Authority or its appointed representative, informing Vodafone in writing, of planned works that are likely to impact our existing network. Vodafone will undertake a survey which will be based on the defined scope to the infrastructure that already exists and whether there is the need for relocation. Going forward, it is Vodafone's view that the installation of underground cable infrastructure is considered as part of any railway re/development. Because Vodafone has the most comprehensive network in the country, the company adopted a Dial before you Dig Policy following international best practice. We encourage organization or individuals from the public or private sectors to contact Vodafone prior to any redevelopment.
5	If no procedures currently exist, what procedures must be followed?	Procedures are already in place as highlighted above. It is important that stakeholders are properly apprised of future development at the earliest opportunity to enable greater synchronization of plans. This should result in more sustainable outcomes. Communication is key.
6	Which Unit in the Organization is responsible and who is the contact person for such cases?	Vodafone Ghana Technology Function Headed by Patricia Obo-Nai. Contact number is 0202002023

B. Millicom Ghana Limited (Tigo)

Institution/Department: **Millicom Ghana Limited**
 Respondent's Name: **James Ampoful 02777551571**
 Respondent's Position: **Planning Department (FIBER Section)**
 Respondent's Unit/Section: **Planning Department (FIBER Section)**
 Unit/Section Responsible for EA/EM: **Technical Planning Dept**

	Discussion Issues	Responses

1	Are there cases where Telecommunication lines or facilities or services have to be interfered with or relocated due to railway infrastructure development?	Yes	
2	Where has this occurred in recent times?	Graphic Road near OCADECO	
3	What is the nature of problems encountered in such cases?	Transboring under the rail way lines	
4	What are the procedures to follow in ensuring compatible (or sustainable) development (i.e. for both the Telecom Company and Railway Authority)?	We always contact the company involved to see how best it can done	
5	If no procedures currently exist, what procedures must be followed?	Engagement with the Chamber is key to align all Mobile Operators with plans going forward	
6	Which Unit in the Organization is responsible and who is the contact person for such cases?	Technical Department Larry Arthur Telephone Ag. Chief Technical Officer	

C. Procedure for smooth relocation and alignment of Telecommunication Lines and Fibre Deployment in relation to Railway Infrastructure Development

	Responsibility of GRDA	Responsibility of the Ghana Chamber of Telecommunications (GCT) or Vodafone
	GRDA will be responsible to perform the following	Telecom Companies represented by GCT will be responsible for the following:
1	Submit development plans for future rail tracks (once available) to the Ghana Chamber of Telecommunications (for information and planning of its members); Telecom Chamber should be notified prior to the commencement of any Railway re/development Planning. Clear prior notification time should be indicated. E.g. "The GRDC shall notify the members of GCT at least 6 months prior to any Railway Development"	Receive/acknowledge receipt of the Development Plans for future rail tracks
2	Submit a Detailed Layout Plan for proposed development, indicating scope of impact on existing network, implementation plan with timeframe (once feasibility is complete)	Receive/acknowledge receipt of Detailed Layout Plans from GRDA and date for joint assessment meeting Review the Layout Plan, and survey scope of impact on existing network as well as proposed scope of work and implementation timeframe
3	Engage the relevant GCT members in joint sessions (including inspection if necessary) to synchronize plans, finalize assessment (if for instance there is need for relocation or new cables, etc), scope of work, plan of development and implementation timeframe;	Meet with GRDA for joint sessions (including inspection if necessary) to synchronize plans, finalize assessment (if for instance there is need for relocation or new cables, etc), scope of work, plan of development and implementation timeframe
4	A memorandum of understanding with GCT member is signed for implementation of the agreed works	GCT member and GRDA sign a memorandum of understanding for implementation of the agreed works
5	Provide the required budget for implementation and would underwrite the total cost of any relocation/re alignment of telecommunication infrastructure	GRDA provide the required budget for implementation Telcos will bear the supplementary cost of any new/additional infrastructure that they request to be incorporated into any rail re-development
6	Hold and coordinate regular site meetings to ensure aligned implementation.	Additional Comments: Guidelines seem to have an emphasis on existing infrastructure rather than future deployment. As with the road projects, there is clearly some merit in considering deployment as part of any new railway re-development. Thus, the focus need not be solely on 'relocation and alignment of telephone lines.' A process map that captures these agreed procedures may also be helpful Contact details of GRDA will be useful

APPENDIX 15A

Questionnaire for Ranking E&S Impacts of Railway Infrastructure Projects

The table below contains a list of Environmental and Social issues associated with railway infrastructure development

Which of these issues would you rank as a **common** and as a **significant** occurrence, arising from railway construction/rehabilitation projects (**with 3 as Common or Significant, 2 Average, 1 Low, and 0 Not Applicable**)?

Please Tick as appropriate

Which of these would you expect to be considered in the ESMF?

Common E&S Issues potentially associated with Railway Infrastructure Development

	Environmental/Social Parameters	Common				Include in ESMF	Significant				In in
		0	1	2	3		0	1	2	3	
1	Dust										
2	Noise and vibration										
3	Level crossing traffic and obstruction										
4	Public safety/accident risk										
5	Compensation issues										
6	Induced development										
7	Cultural concerns										
8	Archaeological losses										
9	Utility lines (e.g. water, power) relocation										
10	Risk of HIV/AIDS spread										
11	Wildlife concerns (e.g. access near)										
12	Forestry concerns (e.g. access through)										
13	Habitat disruption/fragmentation										
14	Water contamination										
15	Stream diversion / blocking										
16	Flooding										
17	Inadequate drains along railway tracks										
18	Run off disruption										
19	Pits / trenches near railway tracks										
20	Construction waste generation										
21	Top soil removal within corridor										
22	Tree/vegetation removal within corridor										
23	Blasting										
24	Tunnelling										
25	Please add any others										

APPENDIX 15B

Environmental and Social (E&S) Areas of Interest for Railway Operations

The Table below contains a list of Environmental and Social issues associated with railway operations.

Which of these issues would you rank as a **common** and as a **significant** occurrence, arising from Railway operations (**with 3 as Common or Significant, 2 as Average, 1 as Low, and 0 as Not Applicable**)?

Please Tick as appropriate

Which of these would you expect to be considered in the ESMF?

List of Common E&S Issues potentially associated with Railway Operations

	Environmental/Social Parameters	Common				Include in ESMF	Significant				Inc in ESMF
		0	1	2	3		0	1	2	3	
1	Dust										
2	Noise and vibration										
3	Level crossing traffic and accidents										
4	Public safety/accident risk										
5	Train maintenance										
6	Track maintenance										
7	Induced development										
8	Train breakdown										
9	Train derailment/skidding										
10	Littering from trains										
11	Oil spills and oil waste generation										
12	waste generation at Stations										
13	Concerns to wildlife (e.g. Reserve)										
14	Water contamination										
15	Flooding										
16	Inadequate drains along railway tracks										
17	Pits / trenches near railway tracks										
18	Please add any others										

APPENDIX 16

Questionnaire

Institutional Needs Assessment for ESMF Implementation

Background

Environmental Assessment (EA) has been an important environmental prevention, planning and management tool in Ghana since the 1980s, in ensuring sound and sustainable investments and developments. The EPA Act 490 (1994) and the EA Regulations, LI 1652 (1999) are the main legal basis for EA application in Ghana. The Ghana EA system provides for both the planning phase (environmental assessment), and the implementation (construction and operation) phase (environmental management) of development actions, investments, etc. An additional feature of Ghana's EA system is the all-inclusive definition of "environment", which covers the natural and social environment (including cultural resources), and also institutional, etc.

The EA Regulations give the general framework and procedures for carrying out EA and Environmental Management (EM) of activities of all sectors (e.g. Transportation (Railway), etc). The decision by the Ministry of Transport (MoT) to prepare an ESMF is to move away from the generalized EA framework, and to adapt a Railway Sector-specific EA system. The advantages will be numerous. The ESMF will provide a platform of standard principles and processes for the railway sub-sector programs and activities agreeable to all parties – MoT and the implementing Authority, the EPA, and other stakeholders – eliminating the need to always re-negotiate, and to screen on project by project basis, etc. The ESMF will represent a statement of policy, and provide the guiding principles, institutional arrangements and administrative procedures as the environmental and social safeguards instrument of reference, in the implementation of Railway sector projects.

The purpose of this questionnaire is to explore:

- EA capacity or awareness within the relevant institutions generally;
- The existing capacity and/or availability to facilitate the application of or compliance with the ESMF;
- Capacity in the private sector to provide competent services under the ESMF; and
- Opportunities for enhanced institutional collaboration and elicit input on the scope of the ESMF.

The responses provided to the questionnaire will be treated confidential and used only for the above purpose

General Information

- A1. Institution/Department (Name).....
 A2. Respondent's Name (optional)..... Position.....
 A3. Respondent's Qualification
 A4. Respondent's Unit/Section.....
 A5. Unit/Section Responsible for EA/EM.....

General Knowledge of EA Instruments

B1. Are you conversant with the Environmental Assessment (EA) legislation, procedures applicable to the transport sector?

	EA Instruments	Are you aware of this?	Have you used it in the past	Purpose for using
1	EPA Act, 1994 (Act 490)	Yes ☐ No ☐	Yes ☐ No ☐	
2	EA Regulations, 1999 (LI 1652)	Yes ☐ No ☐	Yes ☐ No ☐	
3	Ghana EIA Procedures	Yes ☐ No ☐	Yes ☐ No ☐	

B2. List any other relevant legislation/requirement important to the Railway Sector (on environment and social issues)

EA / EM Functions and Capacity Needs

C1. Which of the following EA / EM activities or functions are performed by your Department/ Organisation?

	Tick	EA & EM Activities	Comments
1	☐	Planning phase activities	
2	☐	Design/engineering	
3	☐	Proposal preparation for EA consultants	
4	☐	Providing Guidance to EA consultant & for the EA work	
5	☐	Registering Railway projects with EPA	
6	☐	Screening of Railway Sector projects	
7	☐	Preparing Scoping with TOR for EIA	
8	☐	Submission/review of Scoping Report	

9	☐	Organising Public Consultation and Public Hearing	
10	☐	Handling Compensation issues	
11	☐	Submitting EA reports to EPA for review and approval	
12	☐	Payment of fees and collection of environmental permit	
13	☐	Taking custody of EA and related reports	
14	☐	Ensuring implementation of mitigations, etc	
15	☐	Implementing mitigation measures	
16	☐	Proposal/TOR preparation for construction contracts	
17	☐	Railway infrastructure construction supervision	
18	☐	Monitoring of implementation of Railway projects	
19	☐	Monitoring of Railway operations	
20	☐	Please specify any other	

C2. Which of the above activities are you personally engaged in? (state the numbers representing the activities).....

C3. Rank adequacy of existing capacity to perform EA functions

	Capacity to perform EA functions	Rank with "5" as highest					If ranking is below "4" capacity building req
		1	2	3	4	5	
1	Rate your capacity to adequately handle your functions						
2	Rate the ability of relevant officials in your institution to perform EA functions						
3	Rate the ability of officials of other relevant institutions to performing their required EA functions						
4	Rate the ability of private sector experts (consultants) offering EA services to handle EA						

C4. Please state number of staff in the institution with EA / EM capacity

	Staff Capacity	Formal Training	On the Job Learning	Comments
1	Number of staff with EA/EM capacity			
2	Number needed (considered adequate) to handle EA/EM in the institution			

Railway Infrastructure/Services and related EAs

D1. What are the main classes or types of Rail Transport interventions or projects or infrastructure or services that require investments or that are undertaken by the MoT and the GRDA?

.....

D2. Have you been involved in a Railway sector project? Yes ☐ No ☐

D3. If Yes state how many

D4. What was/were your

role(s)?.....

D5. Please specify the category of Railway projects and the corresponding level of EA they are subjected to.

Railway Projects and Institutional Roles

E1. Which institutions did you work with on the Railway project(s)?

.....

E2. Which institutions tend to be more relevant to the railway sector (on environmental and social issues)?.....

E3. Do any of the following institutions play any part in the EA of a Railway sector project?

Institution	Response	Institution	Response
1 Ministry of Transport	Yes ☐ No ☐	8 Wildlife Division	Yes ☐ No ☐
2 GRDA	Yes ☐ No ☐	9 Forest Services Division	Yes ☐ No ☐
3 Department of Urban Roads	Yes ☐ No ☐	10 Land Valuation Division	Yes ☐ No ☐
4 Department of Feeder Roads	Yes ☐ No ☐	11 Utility Service Providers	Yes ☐ No ☐
5 Environmental Protection Agency	Yes ☐ No ☐	12 MMDAs	Yes ☐ No ☐
6 Water Resources Commission	Yes ☐ No ☐	13 Ghana Railway Company Ltd	Yes ☐ No ☐
7 Forestry Commission	Yes ☐ No ☐	14 Ghana Highway Authority	Yes ☐ No ☐

E4. List any (other) departments/organisations that must be included in or omitted from the 13 listed above in the institutional arrangements under the ESMF

.....

APPENDIX 17A

Consultation Outline – GRDA and GRCL

	Issues for Discussion	Responses
1	GRDA as the Owner of the Railway Sector Infrastructure (will) have certain cut out responsibilities. What are (will be) the key responsibilities of GRDA in managing the Railway Sector?	
2	GRDA will therefore be responsible to ensure EIAs are carried out for future Rail infrastructure development / rehabilitation, etc?	
3	GRDA therefore needs some in-house EA capacity to lead in the process and also to monitor Environmental and Social (E&S) Safeguard Measures?	
4	How will GRDA be expected to regulate Railway Operations (and the Operating Companies) to ensure compliance with required E&S Safeguards?	
5	The Operating Companies will own the Rolling Stock. What does this mean in terms of environmental commitments?	
6	GRDA is the Owner of the Infrastructure, but the Operating Companies will be using the facilities. Who will be responsible for the various maintenance activities and who will be held accountable - environmentally?	
7	Maintenance of the Rolling Stock?	
8	Would each Operating Company have its separate/individual Maintenance Facilities/Workshops?	
9	Maintenance of the Train Stations?	
10	Maintenance of the Rail Tracks?	
11	Recruitment and Maintenance of Security Guards?	
12	Maintaining Maintenance Facilities / Workshop Facilities for use by Operating Companies?	
13	Maintenance of Running Sheds?	
14	What are (will be) the main sources and types of waste and who should manage them?	
15	What conditions should inform Grade Separation at Road/Rail Crossings?	
16	What are some of the common abuses of Railway reservations/Right of Way?	
17	How can such problems (these abuses) be addressed?	
18	What about encroachment? How can Railway reservation or RoW be protected against say encroachment?	
19	What for instance would make you consider any section of the reservation critical and therefore qualify to be fenced?	
20	What is likely to happen to the existing old facilities, machinery, equipment and buildings, e.g. the old rusted coaches lined up there, the 1903 old rail tracks, this 1907 office structures?	

APPENDIX 17B

Consultation with Road Sector Agencies

(Ghana Highway Authority (GHA), Department of Urban Roads (DUR) & Department of Feeder Roads (DFR))

This questionnaire is to explore measures that ensure smooth and agreeable procedures for the construction of Road-Railway Line crossings

Institution (Name).....

Respondent's Name (optional).....

Respondent's Position

Respondent's Unit/Section.....

1. Cases of railway lines crossing roads at same (grade) level occur. How common is this?
 a. Very Common b. Common c. Occasional d. Rarely

2. What is the type and nature of problems encountered in such cases?

Cases of railway lines crossing roads at different (grade) levels occur? How common is this?

- a. Very Common b. Common c. Occasional d. Rarely

3. Why is that the case? What kind of benefits or otherwise could there be for that case?

4. What are the procedures to follow in ensuring mutually agreed and compatible road-railway line crossing development?

5. If no procedures currently exist, what procedures must be developed and followed?
 (Please refer to the proposed draft on the next page with any comments)

6. Which Unit in the Organization is (should be) responsible and who is (should be) the contact person for such cases?

Proposed Draft

Ghana Railway Development Authority's responsibility

1. Prepare and submit:
 - a. plan of development and layout of the proposed railway line for development,
 - b. scope of the potential road-rail conflict,
 - c. proposed initial measures to address the potential conflict, and
 - d. timeframe of implementation
2. Meet with GHA/DUR/DFR for joint sessions (including inspection if necessary) to finalize assessment of plan of development, scope of work and implementation timeframe;
3. GHA/DUR/DFR submit an implementation budget;
4. Sign a memorandum of understanding with GHA/DUR/DFR for implementation of the 'conflict section'; and
5. Provide the required budget for implementation.

Responsibility of Road Sector Agency

1. Receive and acknowledges submission from GRDA and sets date for joint assessment meeting;
2. Review the layout and plan of development, as well as proposed scope of work and implementation timeframe;
3. Meet with GRDA for joint sessions (including inspection if necessary) to finalize assessment of plan of development, scope of work and implementation timeframe;
4. Prepare implementation budget for GRDA;
5. GHA/DUR/DFR and GRDA sign a memorandum of understanding for implementation of the 'conflict section';
6. GRDA provide the required budget for implementation

APPENDIX 17C

Consultation with Forest Service Division of the Forestry Commission

The purpose of this questionnaire is to explore:

- Opportunities for enhanced institutional collaboration with the GRDA and elicit input on the scope of the ESMF; and
- Measures to ensure safe and compatible rail track development and Railway services **through or near Forest Reserves.**

General Information

Respondent's Name (optional).....

Respondent's Position

Respondent's Unit/Section.....

Unit/Section Responsible for EA/EM.....

1. Is there any existing railway line(s) passing through or near Forest or Wildlife Reserve?

- b. Yes b. No

If Yes, please indicate where these occur

.....

.....

2. What is the nature of problems encountered in such cases?

.....

.....

.....

3. Are there cases where railway lines can go through or pass near Wildlife or Forest Reserve?

- a. Yes b. No

Please explain your answer

4. What are the procedures to follow in ensuring compatible or sustainable railway infrastructure development through or near reserves?

.....

.....

.....

5. If no procedures currently exist, what procedures must be followed?

6. Which Unit in the Organization is responsible and who is the contact person for such cases?

APPENDIX 17D

Consultation Outline – GWCL and ECG

The purpose of this questionnaire is to explore:

- Opportunities for enhanced institutional collaboration with the GRDA and elicit input on the scope of the ESMF; and
- Measures to ensure smooth relocation and alignment of rail track development in relation to existing water pipelines and electricity lines.

General Information

Respondent's Name (*optional*).....

Respondent's Position

Respondent's

Unit/Section.....

Unit/Section Responsible for

EA/EM.....

1. Are there cases where utility lines or provision or services have to be relocated due to planned railway infrastructure development?

a. Yes

b. No

Please explain your answer

.....

2. What is the nature of problems encountered in such cases?

.....

3. What are the procedures to follow in ensuring compatible or sustainable development?

.....

4. If no procedures currently exist, what procedures must be followed?

.....

5. Which Unit in the Organization is responsible and who is the contact person for such cases?

.....

APPENDIX 17E

Consultation with Ghana Chamber of Telecommunications and its Members

The purpose of this questionnaire is to explore:

- Opportunities for enhanced institutional collaboration with the GRDA and elicit input on the scope of the ESMF; and
- Measures to ensure smooth relocation and alignment of Telecommunication Lines/Services in relation to Railway infrastructure development.

General Information

Respondent's Name (*optional*).....
 Respondent's Position
 Respondent's Unit/Section.....
 Unit/Section Responsible for EA/EM.....

1. Are there cases where Telecommunication lines or facilities or services have to be interfered with or relocated due to (planned) railway infrastructure development?

.....

2. Where has this occurred in recent times?

.....

3. What is the nature of problems encountered in such cases?

.....

4. What are the procedures to follow in ensuring compatible (or sustainable) development (i.e. for both the Telecom Company and Railway Authority)?

.....

5. If no procedures currently exist, what procedures must be followed? (*please refer to draft proposal below*)

.....

6. Which Unit in the Organization is responsible and who is the contact person for such cases?

.....

APPENDIX 17F

Consultation with Bulk Oil Storage and Transportation (BOST)

The purpose of this questionnaire is to explore:

- Opportunities for enhanced institutional collaboration with the GRDA and elicit input on the scope of the ESMF; and
- Measures to ensure smooth relocation and alignment of rail track development in relation to existing BOST pipelines.

General Information

Respondent's Name (optional).....

Respondent's Position

Respondent's

Unit/Section.....

Unit/Section Responsible for

EA/EM.....

- 1 Are there cases where planned railway infrastructure development (say construction of a new Rail Track) could interfere with BOST pipeline or depot or facilities?
- a. Yes b. No

- 2 Are there cases where planned construction of BOST pipelines or depots or facilities could be obstructed by an existing Railway Infrastructure (say an existing Rail Track) or Railway Reservation/Right of Way?
- Yes b. No

- 3 Have any of the above scenarios arisen? Where and when?

.....

....

- 4 Would any of the above cases require relocation or realignment of their existing lines or infrastructure to make way for the development of other's infrastructure? Explain

.....

....

- 5 If relocation is a possibility, what procedures should be followed in ensuring smooth relocation and development?

.....

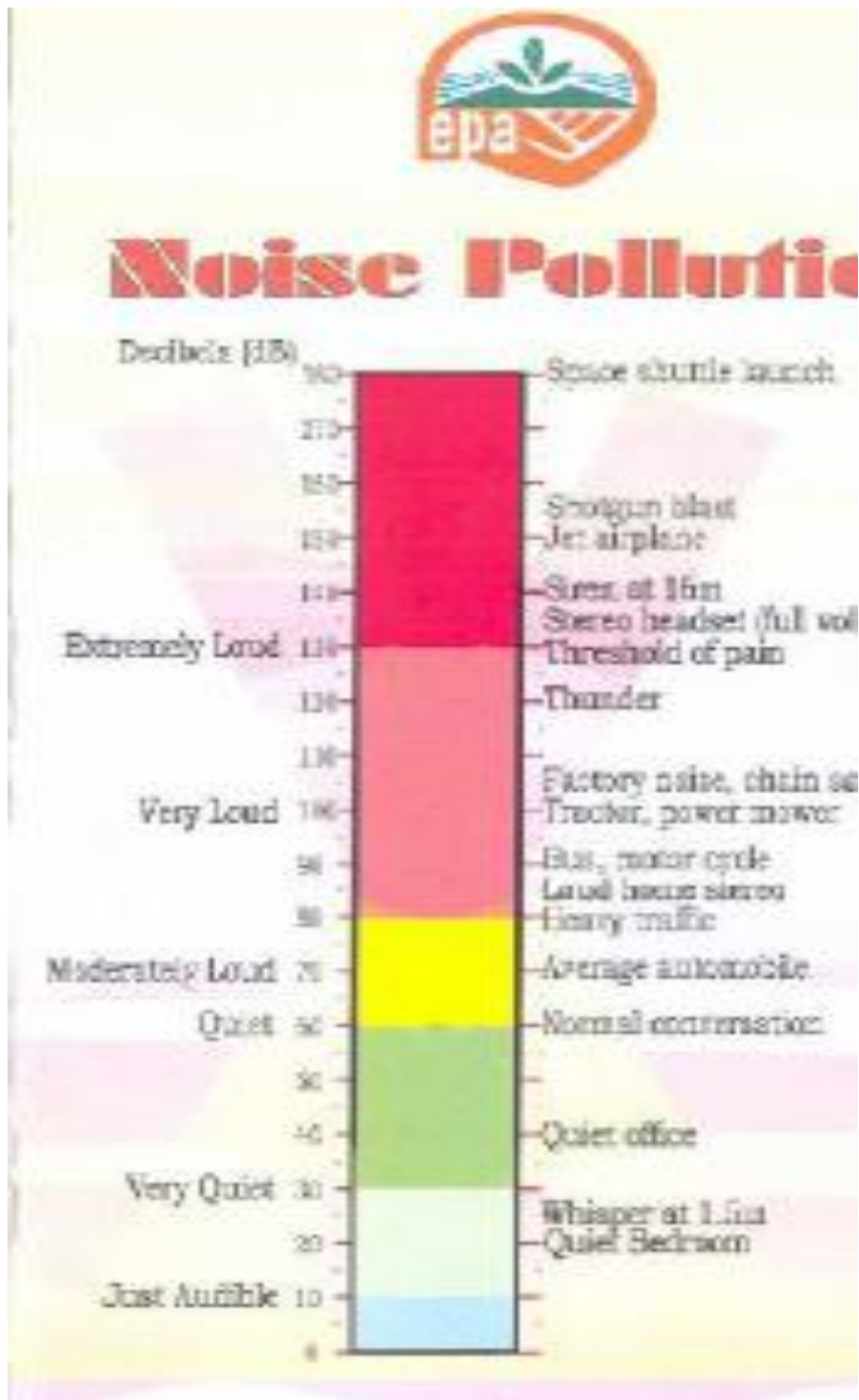
....

- 6 Which Unit in your Organization would be responsible and who would the contact person for such cases?

.....

.....

APPENDIX 18



APPENDIX 19A

REVIEW COMMENTS ON SUBMITTED DRAFT ESMF



Tel: (0302) 664697 / 664698,
662465 / 667524
Fax: 233 (0302) 662690

Email: support@epaghana.org

Our Ref: CI: 2269/01/02

Environmental Protection Agency

P. O. Box M 326
Ministries Post Office
Accra, Ghana

December 21, 2011

The Ag. Chief Executive
Ghana Railway Development Authority
Ministries Post Office, PMB 54 Accra-Ghana
Tema

**RE: SUBMISSION OF DRAFT ENVIRONMENTAL AND SOCIAL MANAGEMENT
FRAMEWORK (ESMF) FOR THE GHANA RAILWAY MASTER PLAN**

We refer to the draft ESMF report on the above proposal submitted to the Agency, in accordance with the Environmental Assessment Regulations 1999, (LI 1652).

The report has been duly reviewed and the attached areas/issues have been identified for consideration and inclusion in the final ESMF.

You are therefore required to finalize the report taking into account the attached issues and submit (3) hard copies and (1) electronic copy of the ESMF.

Do not hesitate to consult with the Agency for any further guidance and clarification you may require.

Yours faithfully,

Audrey Quarcoo (Mrs)
PPO/EAA Dept.
For: Ag. Executive Director

CC: The Consultant, Centre for Environment and Health Research & Training

APPENDIX 19B**REVIEW COMMENTS ON SUBMITTED DRAFT ESMF - DETAILS**

GHANA RAILWAY MASTER PLAN Environmental & Social Management Framework

1.0 REVIEW COMMENTS

• **Executive Summary**

The purpose of the Environmental and Social Management Framework (ESMF) should also indicate that it would be used for providing guidance for projects under the Railway Master Plan (RMP), including construction, re-construction, rehabilitation, decommissioning, scrapping, realignment, installations, etc of the railway network and infrastructure in Ghana.

• **Key Policy, Legal and Institutional Framework under executive summary**

Others policy and legal frameworks should include the following:

- Forestry Commission Act
- Water Resources Commission Act
- Lands Act
- Ghana Shared Growth and Development Agenda

• **1.4 Purpose and Objective of the ESMF**

In addition to the stated objectives the ESMF is also the tool for mainstreaming environmentally sound principles and approaches into the design and implementation of the RMP

• **1.5 Methodology for the ESMF Process**

The ESMF assessment process and preparation also involved visits to selected sites which must be indicated under the methodology

The main reference documents reviewed should include:

- Water Resources Commission Act
- Lands related legal instruments
- Forestry related legal instruments

• **2.1.1 Ghana's Environmental Policy**

A new National Environmental Policy has been formulated which builds on the previous one. The policy aims at managing the environment to sustain society at large. This vision is based on an integrated and holistic management system for the environment in Ghana. It is aimed at sustainable development. The policy seeks to unite Ghanaians in working toward a society where all residents of the country have access to sufficient and wholesome food, clean air and water, decent housing and other necessities of life. That will further enable them to live in a fulfilling spiritual, cultural and physical harmony with their natural surroundings.

This new paradigm of sustainable development based on integrated and coordinated environmental management will ensure:

- citizens' quality of life and their living and working environments;

- equal access to land and other natural resources;
- more efficient use of social, cultural and natural resources;
- public participation and environmental governance.

- **2.4 National Strategic Development Goals**

The GPRS 1 & 2 are relevant for the project however, the emphasis should rather be on the Ghana Shared Growth and Development Agenda

There were no references to the Environmental Quality Guidelines on noise and air quality

- **General Physical And Socio-Economic Baseline**

Environmentally Sensitive Areas

The proposed Master Plan has identified various areas or routes for intervention. Is it possible to superimpose this map on the Ghana map to link them to environmentally sensitive locations such as Mole National Park, Forest Reserves, Major Rivers etc. This would guide the proponent in the selection of routes. Alternatively sensitive sites along the routes earmarked for railway development can be identified. This does not apply to existing rail networks.

- **Screening Criteria**

The screening criteria should consider criteria for relocation of Project Affected Persons

- **Impact Identification and Mitigation**

Can the impact identification and mitigation be structured along construction/rehabilitation and operational phases?

- **7.9 Waste Generation and Disposal Principles**

This section should also consider the development of waste management plans for major railway terminals. This should include an institutional system for managing waste

- **Environmental Monitoring**

Development of the environmental monitoring system or capacity is also essential to enable the authority continuously develop an environmentally friendly railway system. Areas for monitoring include noise and vibration, air quality, ROW, waste management at terminals, public safety, accidents etc.

You may consider creating a summary table that would capture, the activities, impacts and mitigation principles, institutional roles for implementing mitigation principles.. This can also be part of the executive summary.

Appendix 20A

CONSULTATION OUTCOME WITH NATIONAL COMMUNICATIONS AUTHORITY



NATIONAL COMMUNICATIONS AUTHORITY (NCA), GHANA

NCA/MISC/VOL.16/02

27TH FEBRUARY, 2019

The Chief Executive Officer
Ghana Railway Development Authority
P. O Box PMB 54
Roman Ridge Residential Area
Accra-Ghana

Attn.: Mr. Richard D. Dombo



Dear Sir,

RE: REVIEW OF THE RAILWAY MASTER PLAN OF GHANA

The National Communications Authority (NCA) acknowledges receipt of your letter dated 14th February, 2019 and numbered GRDA/GL/19/020 on the above-mentioned subject.

The NCA considers the Railway Transport sector as a very important user of radio frequency in Ghana. In line with International Telecommunications Union (ITU) Spectrum Allocations, the NCA will make spectrum available in the existing Bands assigned for Railway Communications to facilitate any spectrum-related technology in the Railway Plan of Ghana. These Bands include 140-150 MHz, 330 – 360 MHz, 410 – 420 MHz and 450 – 460MHz.

Further, **World Radiocommunication Conference-2019 (WRC-19) Agenda Item 1.11** considers studies to facilitate global or regional harmonized Frequency Bands for the implementation of Railway Radiocommunication Systems between Train and Trackside (RSTT), within existing Mobile Service Allocations. Four main categories of RSTT applications are considered, which are:

- Train Radio (for voice dispatching, signalling and traffic management with the aim of safe train operation).
- Train Positioning Information (gathering train positioning information relevant to train operations).
- Train Remote (data communication between locomotive and ground, to control the engine).
- Train Surveillance (capture and transmission of video of the public and trackside areas, etc.).

The NCA entreats Ghana Railway Development Authority (GRDA) to consider inculcating the aforementioned applications in the Master Plan. Additional Spectrum allocations emanating from WRC-19 to facilitate these applications will be made available for Railway Development in Ghana.

We encourage GRDA to follow the activities of ITU-R, Study Group 5, Working Party (WP) 5A. WP 5A is responsible for studies on **WRC-19 Agenda Item 1.11**, which considers

NCA Tower, No. 6 Airport City
P. O. Box CT 1568, Cantonments, Accra
Website: www.nca.org.gh

Tel: +233 (0) 302 771 701 / 776 621, (0) 501 451 522/3
Fax: +233 (0) 302 763 449
Email: enquiry@nca.org.gh, info@nca.org.gh

efficient communications in Railway Systems, for further information. The next meetings of WP 5A is scheduled from 29th April to 9th May, 2019 in Geneva, Switzerland. You may visit the website below for further information on the activities of WP 5A:

<https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5a/Pages/default.aspx#>

Please accept the assurances of our highest esteem.

Yours faithfully,


PRINCE OFOSU SEFAH
AG. DEPUTY DIRECTOR GENERAL
(OPERATIONS)
FOR: DIRECTOR GENERAL
"no/ma/p/000"

① CFC
FYI please

~~25/2/19~~ 25/2/19
cc: Resident Engineer
Team Engineers
for your information
and necessary
action please.

cc: Deputy CEO (Operations)
Director, R&A

Appendix 20B

CONSULTATION OUTCOME WITH MINISTRY OF ENVIRONMENT, SCIENCE AND TECHNOLOGY

MINISTRY OF ENVIRONMENT, SCIENCE, TECHNOLOGY & INNOVATION

Our Ref: CS.8.7

Tel: 0302 - 666 049

Fax: 0302 - 688 913/ 688 663

E-mail: info@mesti.gov.gh

Website: www.mesti.gov.gh



Republic of Ghana

Post Office Box M232

Ministries, Accra

Ghana

March 1, 2019

RE: REVIEW OF THE RAILWAY MASTER PLAN OF GHANA-LIST OF STAKEHOLDERS OF PRELIMINARY CONSULTATION.

I refer to your letter No. GRDA/GL/19/020 dated 14th February, 2019 on the above subject matter.

The Ministry studied the attached Railway Master Plan and would like to submit the following inputs:

- Ensure/establish linkage between the Railway Master Plan and the Spatial Development Framework as well as Planning and Zoning Standards in accordance with the Land Use and Spatial Planning Act, Act 925.2016.
- In accordance with the countries Environmental Laws, undertake Environmental and Social Safeguards of the Railway Master Plan.
- Develop a detailed Strategic Environmental Assessment (SEA) and Environmental and Social Management Framework as part of the Railway Master Plan. Incorporate the need to undertake Environment Impact Assessment and Environmental and Social Management Plan for proposed projects.

The above will among others address the following;

- Dust Emissions and Emissions of poisonous gas from tracks (Air pollution) into the atmosphere
- Noise pollution during infrastructure works
- Worker safety, that is minimizing accidents
- Habitat protection (Biodiversity issues)
- Management of impacts on water and other natural resources
- Technological impact
- Human Settlement issues
- Soil erosion.

Counting on your usual cooperation.

**LEVINA OWUSU (MRS)
AG.CHIEF DIRECTOR
FOR MINISTER**

**RICHARD D. DOMBO
CHIEF EXECUTIVE OFFICER
GHANA RAILWAY DEVELOPMENT AUTHORITY**

Appendix 20C

CONSULTATION OUTCOME WITH VODAFONE



1st March 2019

RICHARD D. DOMBO
THE CHIEF EXECUTIVE OFFICER
GHANA RAILWAY DEVELOPMENT AUTHORITY
ACCRA

Our ref: EA/RGA/01032019/01

Dear Sir,

RE: REVIEW OF THE RAILWAY MASTER PLAN OF GHANA – LIST OF STAKEHOLDERS FOR PRELIMINARY CONSULTATION

We refer to your letter dated 14th February 2019 on the above subject.

We welcome the opportunity to provide inputs to the development of the Railway Master Plan. We recognise that it is an integral part of the agenda of government to expand on the transformational needs of this country. Vodafone has extensive underground fibre infrastructure along most of the existing rail routes and will be happy to share details of the fibre layout to ensure minimal service interruption and damage during the redevelopment process.

Vodafone fibre infrastructure can be located along the present rail routes listed below:

a. Tema Metro area	q. Kumasi (Tanoso) to Offinso	Techiman via
b. Tema – Akosombo	r. Techiman Township	
c. Tema – Prampram area	s. Sunyani – Techiman	
d. Akosombo – Ho	t. Techiman – Kintampo	
e. Koforidua Township	u. Kintampo – Buipe	
f. Koforidua – Tafo	v. Buipe – Tamale	
g. Accra / Achimota – Nsawam area	w. Tamale – Walewale	
h. Sekondi – Takoradi	x. Walewale - Bolgatanga	
i. Takoradi Metro	y. Bolgatanga – Navorongo	
j. Takoradi – Agona Nkwanta	z. Navorongo – Paga	
k. Tarkwa Township	aa. Sunyani – Wenchi	
l. Dunkwa Township	bb. Wenchi – Bamboi	
m. Obuasi Township	cc. Bamboi – Sawla	
n. Nkawkaw Township	dd. Sawla – Wa	
o. Ejisu – Kumasi		
p. Kumasi Metro		

Vodafone will also be pleased to see the redevelopment of the Master Plan to include the new routes listed below. There are commercially viable paths for us, hence the need for extension of telecommunication infrastructure.

- a. Keta – Aflao
- b. Ho – Aflao
- c. Takoradi – Half Asini
- d. Cape Coast - Obuasi

Furthermore, we believe that the network rail expansion will deliver enormous economic value to the communities included in the Master Plan. In line with this, we will be interested in seeing:

- (i) the creation of telecom ducts along all routes being redeveloped to facilitate easier expansion of fibre network and services
- (ii) railway stations built to accommodate deployment of Wi-Fi and other telecom solutions from service providers and,

Ghana Telecommunications Company Limited
c2 General Headquarters, Vodafone Ghana South Liberation Link,
Manet Tower A, Airport City, Accra-Ghana
T + 233 (302) 919 935, www.vodafone.com.gh

(iii) train coaches, which can accommodate Wi-Fi services.

Finally, Vodafone is happy to participate in further workshops where we can contribute to design specifications and other appropriate requirements.

We look forward to future engagements to improve the rail network sector in the country.

Yours sincerely,



Gayheart Mensah
Director, External Affairs.

C2 General

Appendix 20D

CONSULTATION WITH EPA

Date: April 18, 2019
Time: 10:00 to 11:00am
Mr Kwabena Badu-Yeboah
Director/Head: Environmental Assessment & Audit Dept
Tel: 050 130 1399

Requirement for updating ESMF for the Railway Master Plan

The ESMF for the Railway Master Plan was submitted in 2013, but since implementation did not start and the ESMF is about 6 years old, some significant conditions might have changed requiring an update of the 2013 ESMF, in order to make it current, acceptable and the environmental permit renewed. Changes could include the following:

- Some significant baseline condition change might have happened within existing railway corridors or need to account for new corridors to acquire, e.g. with the two main additional / branch lines (Takoradi to Elubo, and Sekondi to Shama), among others now introduced;
- New policies and legal frameworks might have occasioned, e.g. the new Hazardous and Electronic Waste Control and Management Act (Act 917) and Regulations in place;
- The current strong push for and role of private sector involvement in the railway development, making the Public Private Partnership Policy now applicable;
- Other changes in the legal framework applicable include –
 - The Local Governance Act, 2016 (Act 936); and
 - Land Use and Spatial Planning Act, 2016 (Act 925).
- Institutional changes occurred, for instance, it's no longer the Ministry of Transportation in charge over railways, but now specific Ministry of Railways Development;

Handling of old Asbestos roofing Sheet on decommissioned Railway Buildings

The subject of Asbestos roofing sheets decommissioning is a major source of concern. This was however, dealt with in the Western Railway Line ESIA. The key areas of concern included:

- Occupational hazards relating to the removal process of the sheets;
- Packaging of the sheets for transfer to landfill sites;
- Availability of appropriate waste landfill for burial of the materials;
- Risk to the public who might consider the salvaged Asbestos sheets as treasured material for their use.

This will be one of the most significant adverse impacts, both occupational and public, that must be fully addressed to provide guidance in the updated ESMF. This was not addressed in the 2013 ESMF.

New Right of Way Acquisition

With the two additional branch lines from Takoradi to Elubo, and Sekondi to Shama, among others, would require compensation payment to landowners and for property and crops affected. Currently the EPA is working to resolve compensation issues related to the Tema-Mpakadan Railway line construction. Compensation issues are very critical and the ESMF must emphasize the requirement for Resettlement Action Plan (RAP) preparation. This is significant also for the fact that private sector involvement might fall on IFC sources for financing, where RAP will be a mandatory requirement.

ANNEX 2. RAILWAY MARKET SURVEY

Ghana Railway Development Authority



Railway Market Social Survey

April 2019

 Centre for Environment &
Health Research & Training
www.centreforenvironment.com
Box SK482, Sakumono Estates Tel: +233 -303403275 / -243223864
6 Osiehour Plaza, Sakumono Estate Junction



EXECUTIVE SUMMARY

Introduction

The Government of Ghana has developed a Railway Master Plan to rehabilitate, expand and modernise the railway system and improve the provision of rail transport services. A railway market research in the form of a social survey was undertaken to provide important information which will help to identify and analyse the needs of the market, the market size and the competition, the level of interest of private citizens/users on the development of the railway network in Ghana and the “willingness to pay” (i.e. the most a user will spend for the service).

Methodology

A quantitative market survey was undertaken on railway services in 8 towns in Ghana; Tema, Accra, Nsawam, Kumasi, Sunyani, Sekondi-Takoradi, Tamale and Paga. These are towns selected for having the service currently operational, previously operational and never have been operational. The purpose was for the survey help identify and analyse needs of the market, the market size, competition and level of interest of users or patrons.

Summary of Results and Discussion

Reliable results were obtained indicated by the male to female ratio which was exactly that of the current 2019 reported ratio. Further analysis showed a good potential for patronage of the service albeit some level of unwillingness of patrons to pay comparable fares as other transport services. Trains ranked favourably to private car in terms of its use as a primary means of transportation, saving travel time, safety, comfortability and flexibility.

Recommendations and Conclusion

It was recommended public education and some significant level of sophistication of the railway services is needed to boost patronage. However, the survey was found to be limiting; that a mixed methodology would have further elicited information from the perspectives and experiences especially from current users and perhaps previous patrons to enrich the information and data gleaned from the survey. This was evident in respondents agreeing to all that was suggested for the development and improvement of the railway service without opportunity for inputs from the respondents.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	cccxc
TABLE OF CONTENTS.....	cccxc
LIST OF FIGURES.....	cccxcii
LIST OF TABLES	cccxcii
LIST OF PLATES.....	cccxcii
1.0 INTRODUCTION AND METHODOLOGY	394
1.1 Introduction	394
1.2 Methodology.....	394
1.2.1 Sample Size	394
1.2.2 Data Collection Tools.....	395
1.2.3 Data Analysis	395
1.2.4 Researcher Orientation	395
1.2.5 Pilot Study.....	395
2.0 SUMMARY OF RESULTS AND DISCUSSION	397
2.1 Biodata	397
2.1.1 Gender	397
2.1.2 Age.....	398
2.1.3 Educational Background	399
2.1.4 Occupation.....	400
2.2 Patronage of Rail Service	400
2.2.1 Means of Transport	401
2.2.2 Rail Use	402
2.3 Advantages of Various Means of Transport.....	403
2.3.1 Travel Cost.....	403
2.3.2 Travel Time	403
2.3.3 Safety	404
2.3.4 Comfort.....	404
2.3.5 Flexibility.....	405
2.4 Railway Development	405
2.5 Railway Improvement	407
2.6 Cost/Payments	410
3.0 RECOMMENDATIONS AND CONCLUSION	413
REFERENCES.....	414
APPENDICES	415

LIST OF FIGURES

Figure 2.1	Gender Distribution of Respondents by Towns	397
Figure 2.2	General Gender Distribution of Respondents	398
Figure 2.3	Age Distribution of Respondents	399
Figure 2.4	Distribution of Educational Background	399
Figure 2.5	Occupation of Respondents	400
Figure 2.6	Patronage of Rail Service	400
Figure 2.7	Means of Transport.....	402
Figure 2.8	Frequency and Purpose of Rail Use	402
Figure 2.9	Travel Cost as an Advantage.....	403
Figure 2.10	Travel Time as an Advantage	404
Figure 2.11	Safety as an Advantage.....	404
Figure 2.12	Comfort as an Advantage	405
Figure 2.13	Flexibility as an Advantage.....	405
Figure 2.14	Effects of New Railway Infrastructure	407
Figure 2.15	Means to Improve Rail Services	409
Figure 2.16	Willingness to Pay.....	411

LIST OF TABLES

Table 1.1	Sample Size.....	395

LIST OF PLATES

Plate 2. 1	Passengers on Board Train in Sekondi-Takoradi	401
Plate 2. 2	Rail Use	403
Plate 2. 3	Cleanliness on Board Trains and at Train Station	407

CHAPTER ONE

Introduction and Methodology

❖ Introduction

❖ Methodology

1. INTRODUCTION AND METHODOLOGY

1.1 Introduction

The Government of Ghana has developed a Railway Master Plan to rehabilitate, expand and modernise the railway system and improve the provision of rail transport services. The master plan will specifically deliver the following, among others:

- Rehabilitation plans for the existing railway network and infrastructure;
- Work-plans to up-grade and thereafter in sequential phases, construct new lines;
- Construction of new standard gauge lines covering the whole country (for both existing and new line);
- Construction of new standard gauge sub-urban lines in the regional capitals;
- Financial plan for investment on the existing and proposed network and rolling stock, which would include infrastructural interventions on the network and at the stations, the application of new technologies and the purchase and maintenance of rolling stock;
- Transport policies capable of ensuring the transfer of traffic from road to rail;
- Intermodal links with other priority projects and increasing the rail transport capacity of goods and passengers; and
- Specifications for railway infrastructure including – track, signal and telecommunication, buildings (including stations, workshops and other structures).

A railway market research in the form of a social survey was undertaken to provide important information which will help to identify and analyse the needs of the market, the market size and the competition, the level of interest of private citizens/users on the development of the railway network in Ghana and the “willingness to pay” (i.e. the most a user will spend for the service).

1.2 Methodology

The survey was conducted in 8 cities/towns in Ghana namely: Accra, Tema, Nsawam, Sekondi-Takoradi, Kumasi, Sunyani, Tamale and Paga. These towns/cities were grouped as follows:

- Where the railway services currently are operational (Tema, Accra and Sekondi-Takoradi);
- Where the railway infrastructure exists but not currently operational (Nsawam and Kumasi); and
- Where the infrastructure is non-existent and therefore never been operational (Paga and Tamale).

Three groups of respondents were purposively targeted; those who currently use the service, those who have ever used the service and potential users.

1.2.1 Sample Size

The sample size of each of the town is presented in Table 1.1 below. The respondents were chosen based on the proximity to railway infrastructure (about 500m radius from railway infrastructure). Where railway infrastructure is non-existent and therefore never been operational (Paga and Tamale), the survey was conducted in the central business area.

Table 1.1 Sample Size

Town	Sample Size	Town	Sample Size
Accra	100	Nsawam	50
Tema	50	Sekondi-Takoradi	50
Kumasi	100	Tamale	50
Sunyani	50	Paga	50

1.2.2 Data Collection Tools

A closed-ended, pre-coded questionnaire was used to conduct the survey. The questionnaires covered biodata, patronage, advantages of the various means of transport, rail improvement, rail development and cost/payment of rail services. This was loaded onto the Akvo Flow software installed on an android tablet/phone device. The data captured process on the Akvo Flow software entails the following details:

- Enumerator ID capture – Each field assessor had a unique ID which was used to trace data captured to the assessor;
- Mandatory capture of geo coordinates; and
- Auto capture of the date and time of each interview.

Completed surveys were sent electronically to a central cloud point for collation and analysis.

1.2.3 Data Analysis

Coded data from the household survey following entry into the Akvo Flow Software was imported into excel and the SPSS statistical software. The data was cleaned and checked for data inconsistencies at the end of each field day and upon conclusion of data entry. Further data analysis was done in SPSS version 21.0. Univariate analysis was performed to produce frequency tables and data summary statistics. Graphs were generated using Excel.

1.2.4 Researcher Orientation

A 1-day orientation was held to provide training for the field teams. During training, each interviewer pre-tested at least four questionnaires. The orientation covered the following:

- Consenting of subjects; and
- Questionnaire administration.

1.2.5 Pilot Study

A pilot study was conducted a day after the orientation in Tema township. Upon information gathered from the pilot study, changes were made to the initial questionnaire to accommodate issues such as segregation of coaches; banning of noise-generating activities on the train; and notification of delays. The employment categories were also modified to get a better representation of respondents.

CHAPTER TWO

Summary of Results and Discussion

- ❖ **Biodata**
- ❖ **Patronage**
- ❖ **Advantages of Various Means of Transport**
- ❖ **Railway Development**
- ❖ **Railway Improvement**
- ❖ **Cost/Payments of Rail Services**

2. SUMMARY OF RESULTS AND DISCUSSION

The results of the market survey are presented in graphs and discussed under six main sub-headings as follows:

- Biodata;
- Patronage;
- Advantages of various means of transport;
- Railway development;
- Railway improvement; and
- Cost/Payments of rail services.

However, details relating to responses to individual questions are presented in tables in Appendix 5.

2.1 Biodata

The biodata of the respondents collected includes:

- Gender;
- Age;
- Educational background; and
- Occupation.

2.1.1 Gender

Generally, except for Tema, Paga, and Tamale, all the other towns showed higher percentage of males sampled with Sunyani and Sekondi-Takoradi showing equal proportions of males and females. In the other cosmopolitan cities where the railways service is either presently operating or had ever operated in the past, again except for Tema, the others (Kumasi, Nsawam and Accra) had more males sampled. Tema therefore presents a unique picture worthy of notice (Figure 2.1).

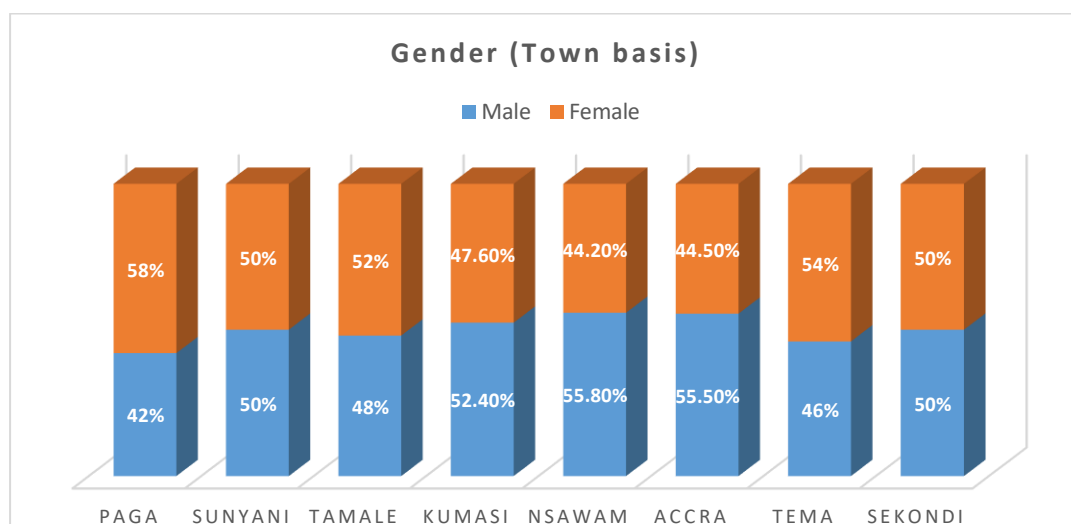


Figure 2.1 Gender Distribution of Respondents by Towns

The overall gender sampled gives the exact male to female ratio of 50.9 to 49.1 of Ghana's 2019 population as indicated by the United Nations Department of Economics and Social Affairs: Population

Affairs 2019. This therefore suggests the survey was in conformity with the basic scientific principles and techniques which imply all deductions appropriately derived from this survey are accurate and could be relied on (Figure 2.2).

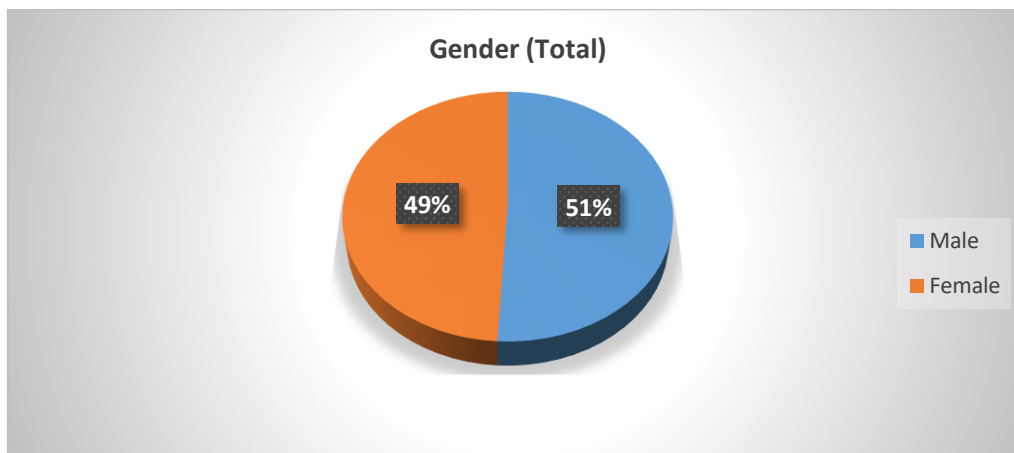


Figure 2.2 General Gender Distribution of Respondents

2.1.2 Age

The overwhelming 80% of persons between the ages of 26-64 can be said to be the active working population who patronise the various means of transportation available and therefore were captured in the survey. The age distribution of respondents is presented in Figure 2.3 below.

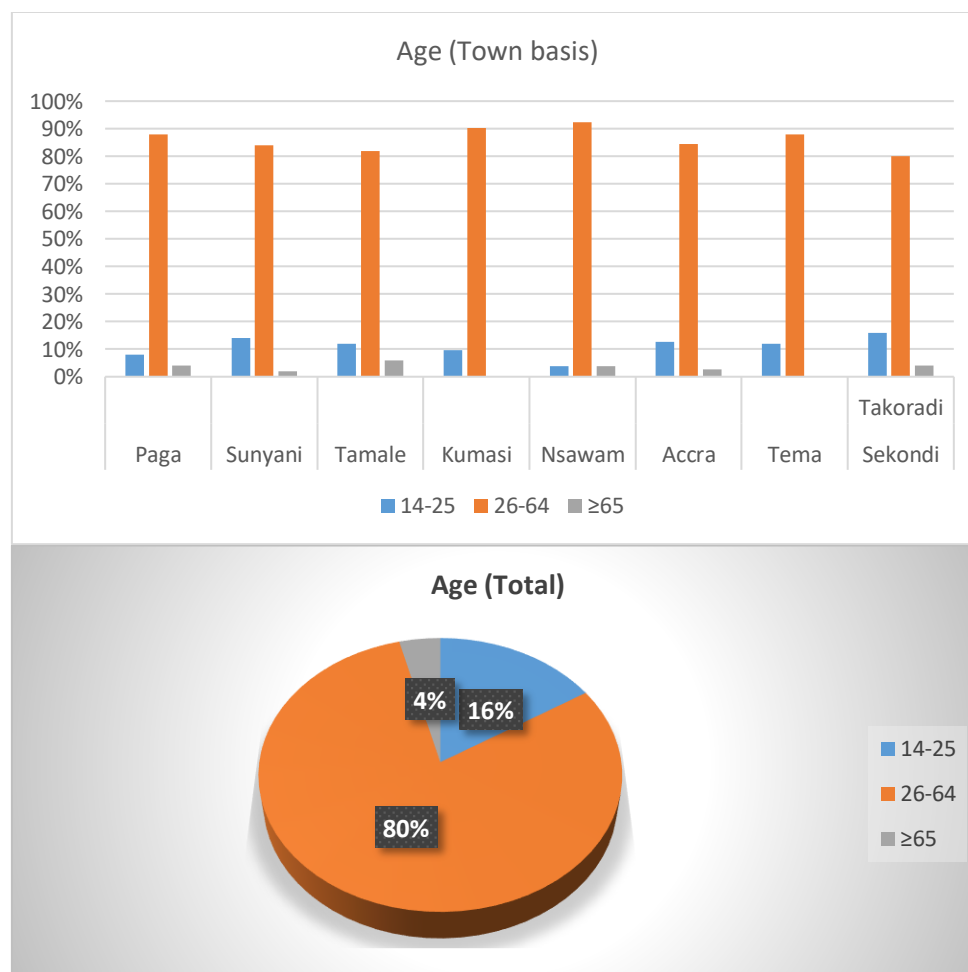
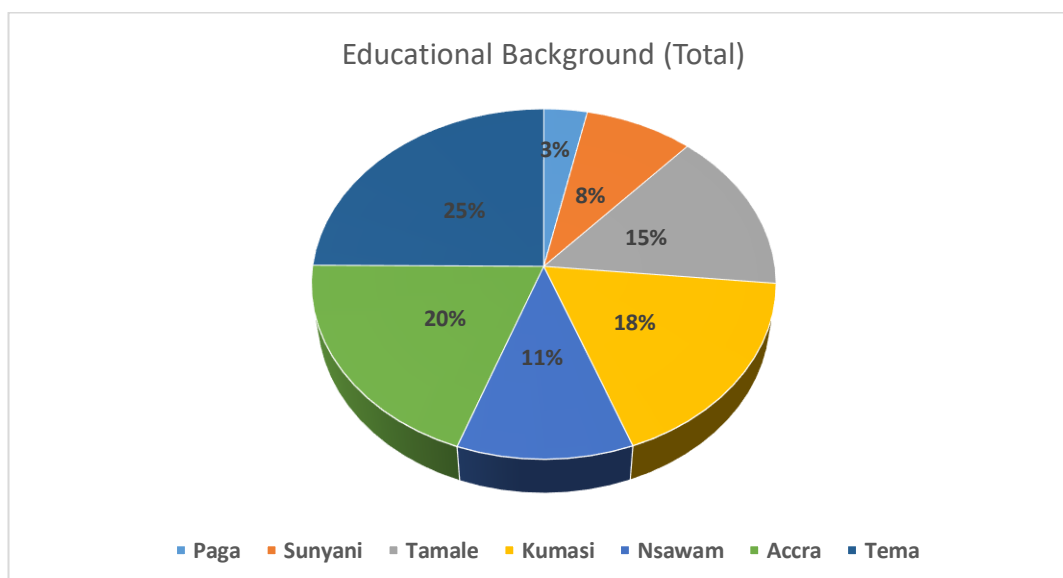
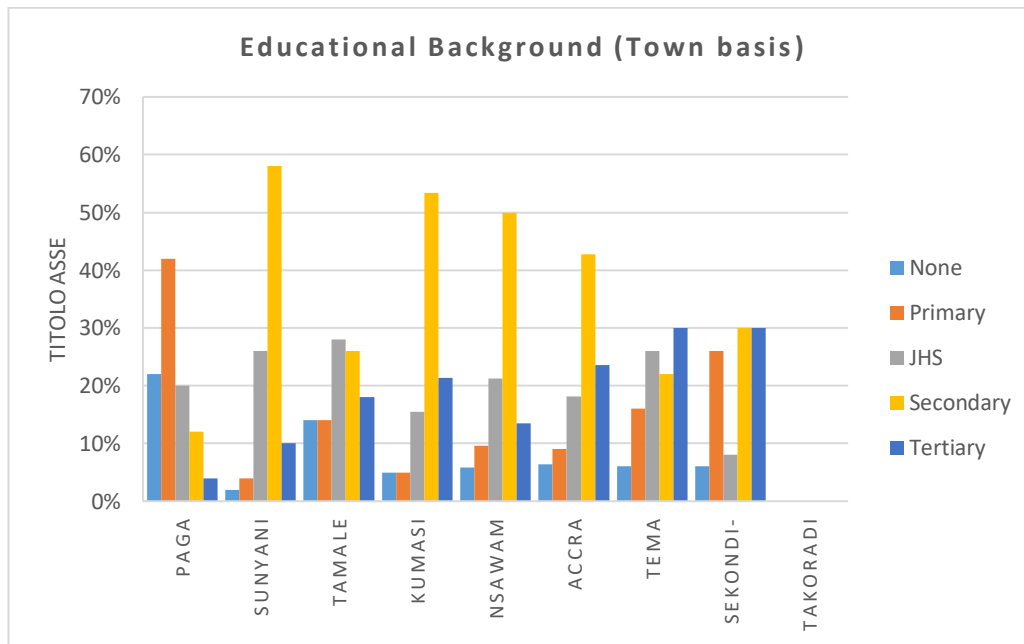


Figure 2.3 Age Distribution of Respondents**2.1.3 Educational Background**

The educational level of most persons sampled in 4 out of the 8 towns was secondary (SHS), with JHS being second in most of the towns (Figure 2.4). It is however significant to note that Tema, being one of four cosmopolitan towns, deviates in a way similar to what was observed in terms of gender above; the most persons sampled had tertiary education. This presents an interesting feature as the percentage of tertiary educated persons of 30% being the highest is same for another port city, Sekondi-Takoradi. These two cities are not only port cities but also industrial cities, with Sekondi-Takoradi fast becoming the hub of Ghana's oil industry. This perhaps accounts for the highly qualified persons sampled in these port and industrial cities.

**Figure 2.4 Distribution of Educational Background**

2.1.4 Occupation

A greater percentage of the respondents are engaged in business, which was expected as the survey was conducted primarily in markets. Unpredictably, formal workers came second to business men/women, as current train users were more of formal workers. Of the 4% of students, the most were current Sekondi-Takoradi train users, as the rail services were favourable to them with reduced tariffs (Figure 2.5).

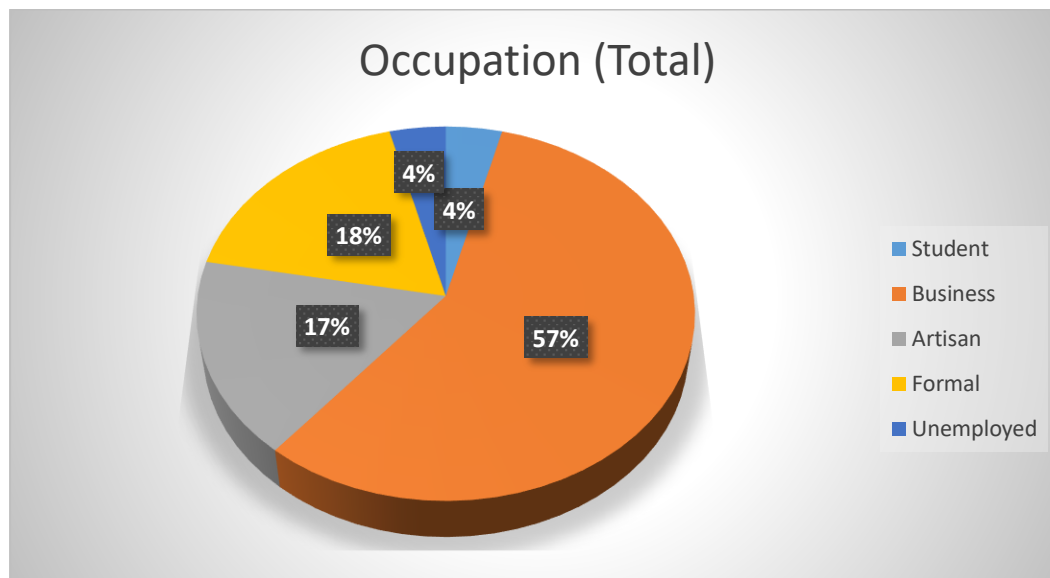


Figure 2.5 Occupation of Respondents

2.2 Patronage of Rail Service

The observed results are really predictable as only 3 locations currently have the service operational and therefore providing the opportunity of patronage at 15%. The service was however more extensively operational in the past in all the targeted towns except for Tamale, Sunyani and Paga. This therefore reflects in a higher percentage of those who ever used the service in the past accounting for over twice (about 34%) than those currently using it. Three of the 8 towns sampled do not have any railway infrastructure and therefore the likelihood of non-patronage ever which reflects in majority of respondents of over 50% (Figure 2.6). Plate 2.1 shows images of people patronising the rail services in Sekondi-Takoradi.

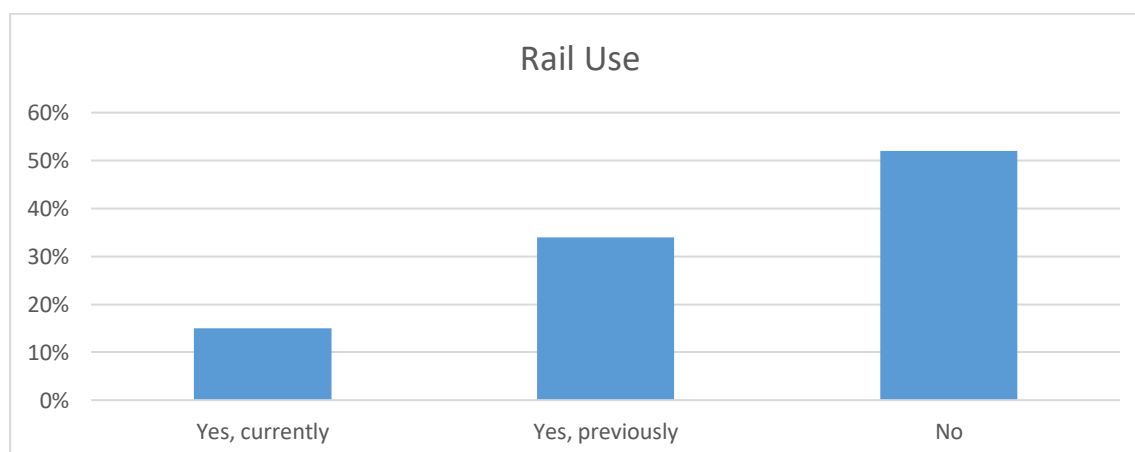


Figure 2.6 Patronage of Rail Service



Plate 2.1 *Passengers on Board Train in Sekondi-Takoradi*

2.2.1 Means of Transport

Except for walking or bike use and the impressive comparable percentage of patronage of trains to private car as primary means of transport at about 7% and 9% respectively, the observed trend is predictable. Trotro and bus undoubtedly are the primary means of intra and inter city transportation respectively for majority of Ghanaians recording the highest percentage of approximately 43%. The observed second highest of about 22% for walking or bike use could be due to the two towns of Tamale and Paga where use of bike is common and obvious as a primary means of transportation. With the vast area covered by both towns coupled with less means of transportation as compared to the other towns surveyed, walking possibly is a primary means of transportation.

The train expectedly being the least means of primary transportation is due to its limited current services (currently operational in only 3 of the 8 towns sampled). However, it being that significantly close to the use of private car as a primary means of transportation, its limited operations notwithstanding, underscores its potential. It would seem to suggest that it has the potential to compare favourably with private cars if the service is expanded and made attractive in terms of cost, comfort, safety among other desirable attributes associated with the use of private cars.

Taxi which now could encompass Uber services being the most preferred as secondary means of transportation is expected especially for private car users for intra city use due to its comfort and time saving attributes. The inconveniences and discomfort usually associated with trotro/bus could be tolerated even by car users for occasional intra city use as a second means of transportation. Though not deduced from the survey, anecdotal observations would support the fact that for inter-city travels car users patronise buses and coaches which in addition to occasional use of trotro would justify their ranking as the second preferred use as second means of transportation (Figure 2.7).

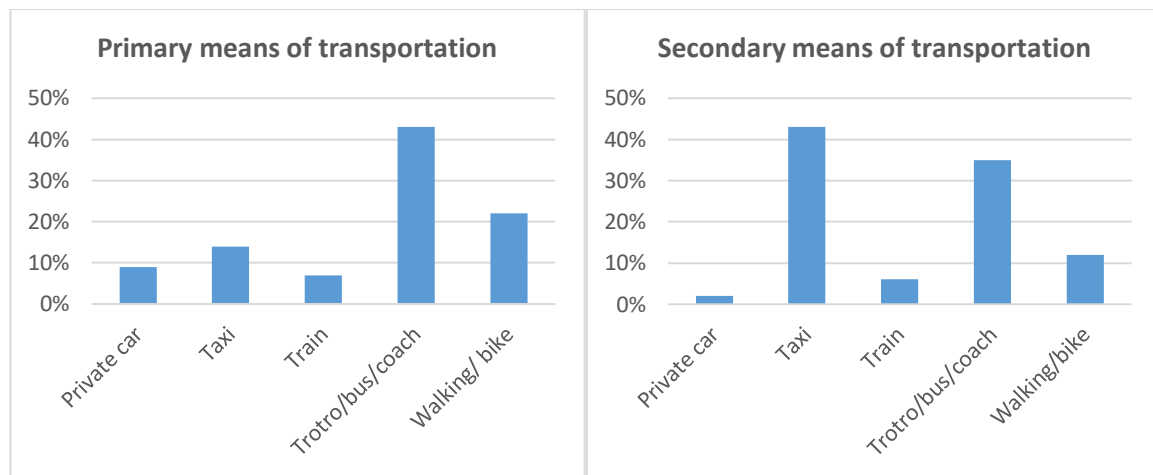


Figure 2.7 Means of Transport

2.2.2 Rail Use

Results on the purpose and frequency of rail use reflects responses due to the survey questionnaire and purposive sampling of passengers currently using the service in the three functioning locations of Tema, Accra and Sekondi-Takoradi. Thus passenger use is dominant as indicated in the graph with daily use being the highest for the frequency of usage perhaps for work or business purposes.

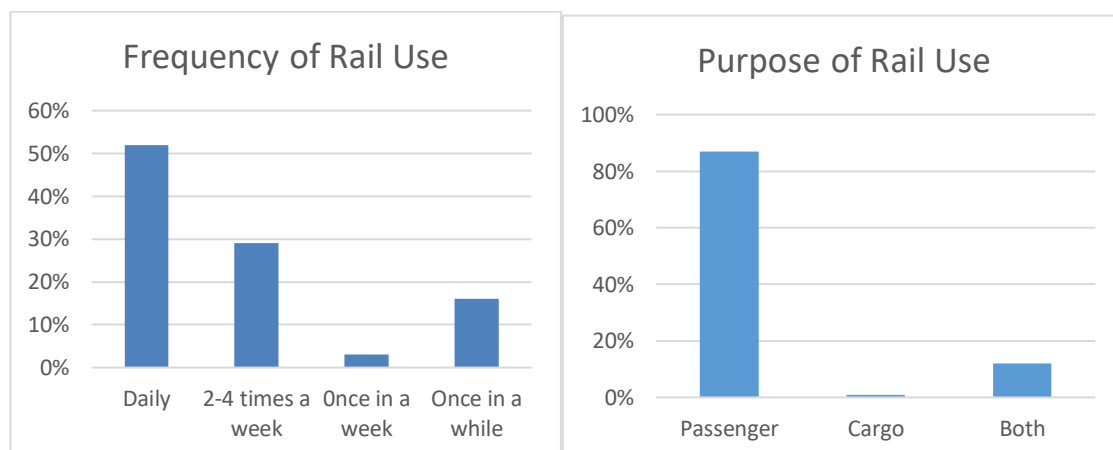


Figure 2.8 Frequency and Purpose of Rail Use

The main purpose for rail use was as passengers (97%, 76.5% and 80% respectively). Majority of rail passengers in Accra (60%) and Sekondi-Takoradi (52%) used the rail service daily while 30% and 36% used the service 2 to 4 times a week respectively. On the contrary, more (41.2%) of the rail users in Tema patronized the service once in a while, compared to 35.3% using the service daily (Figure 2.8). Plate 2.2 illustrates the different rail uses by a cargo passenger and regular passengers.



a. Passengers about to board train



b. Train passenger with cargo

Plate 2.2**Rail Use**

2.3 Advantages of Various Means of Transport

The advantages of the various means of transport included:

- Travel cost;
- Travel time;
- Safety;
- Comfort; and
- Flexibility.

2.3.1 Travel Cost

In terms of travel costs, trotro (about 70%) and train (about 50%) are generally seen as being cheaper, while about 51% and 40% disagreed to taxi and private car being cost effective means of transport respectively. Although a relatively lower percentage neither agreed nor disagreed to the cost effectiveness of the various means of transport (10% or less), about 20% were unsure of trains. This is due to the fact that many people had never boarded a train before, and/or had no knowledge of the general costs of train rides.

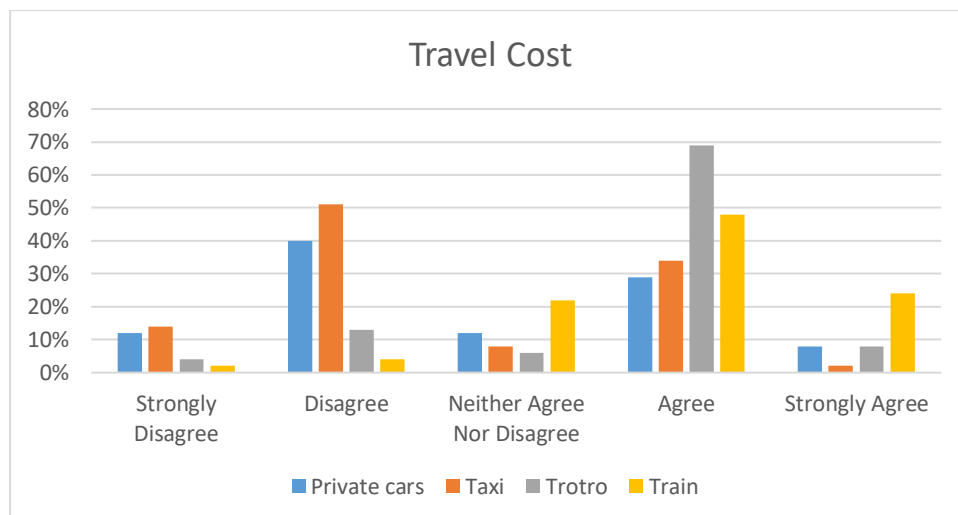


Figure 2.9 *Travel Cost as an Advantage*

2.3.2 Travel Time

Private car and taxi are favoured for reducing travel time, while many respondents disagreed to trotro reducing travel time. However, train is unexpectedly seen to be good in saving travel time especially

for those who strongly agree. This could be due to the experiences of passengers currently using the limited railway services sampled. Thus from these results, an efficient railway system has a strong potential to be patronised by persons desiring quick means of transportation

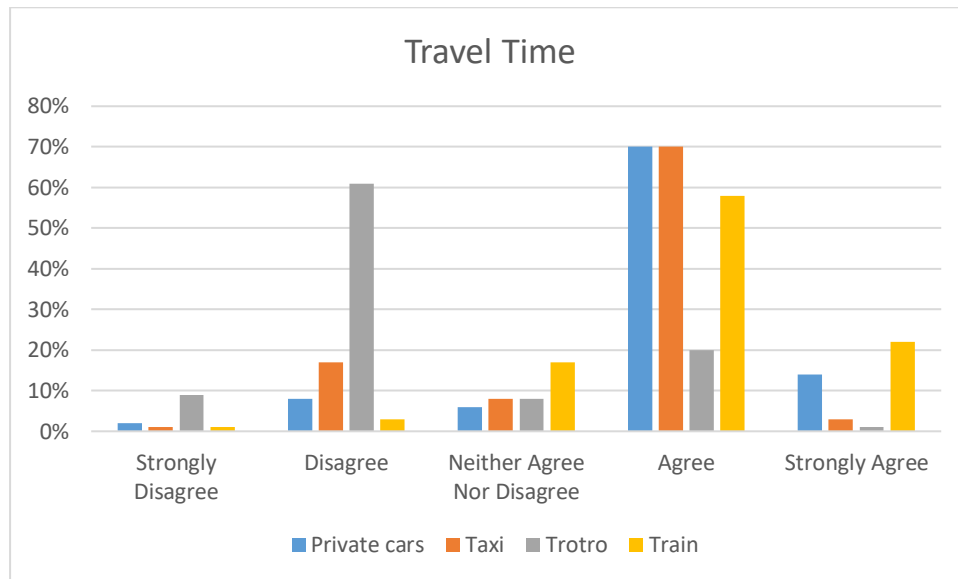


Figure 2.10 Travel Time as an Advantage

2.3.3 Safety

Safety follows the same trend as for travel time with train coming second to private car and first for those who strongly agree to safety of trains as compared even to private car. Again, trotro was not perceived to be a safe means of transport, with about 50% disagreeing. Many of the respondents believed that none of the means of transport were safe because they can be involved in accidents at any time. Again a reason for the development of a railway service as it seems to have a favourable potential for its patronage.

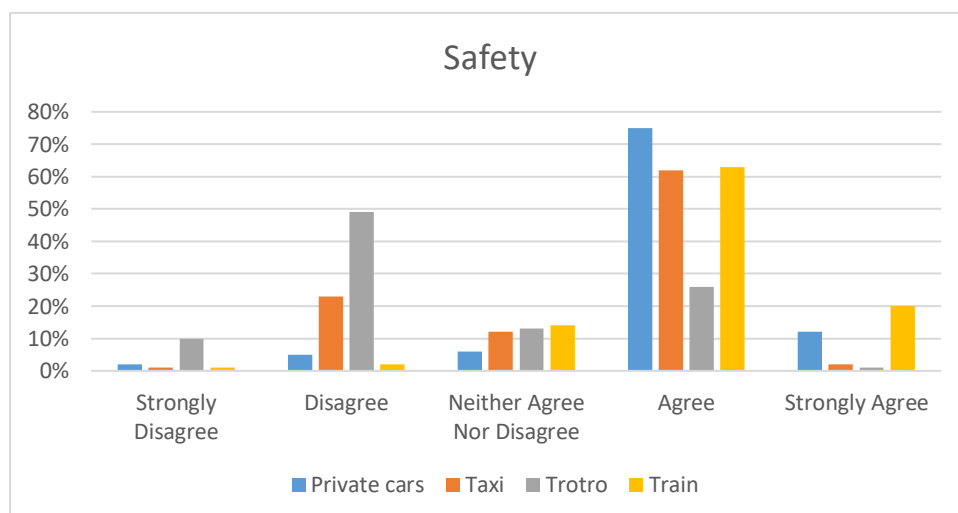


Figure 2.11 Safety as an Advantage

2.3.4 Comfort

Although the most agreed comfortable means of transportation was private car, the train also ranks favourably in terms of its comfortability to trotro, especially for those who strongly agree, coming second to private car.

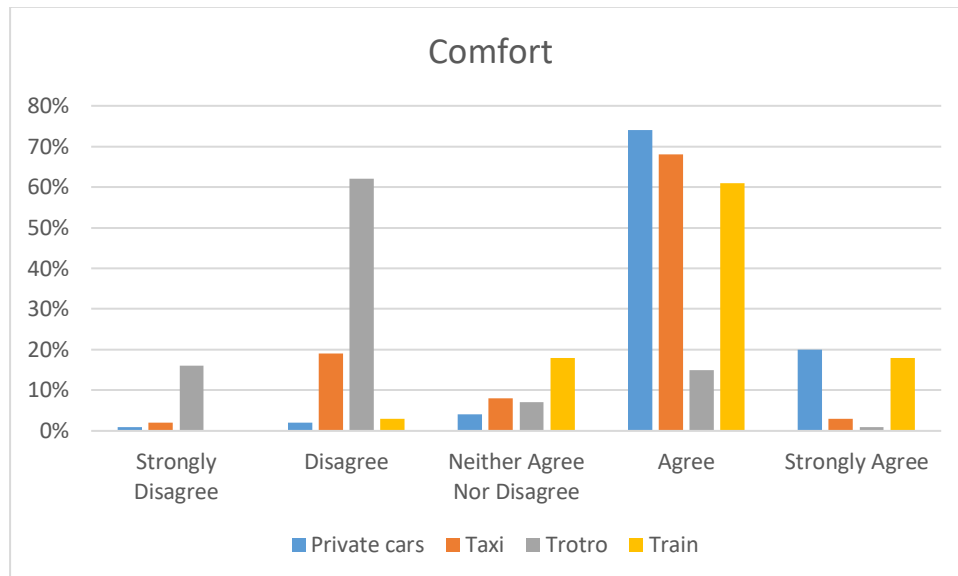


Figure 2.12 *Comfort as an Advantage*

2.3.5 Flexibility

Flexibility also follows in a similar trend as for safety, travel time etc., except that it is perceived as being more flexible than trotro which is debatable from an anecdotal perceptive. Perhaps ‘flexibility’ as a word may not have been explicit in meaning to respondents relating to what it was supposed to connote.

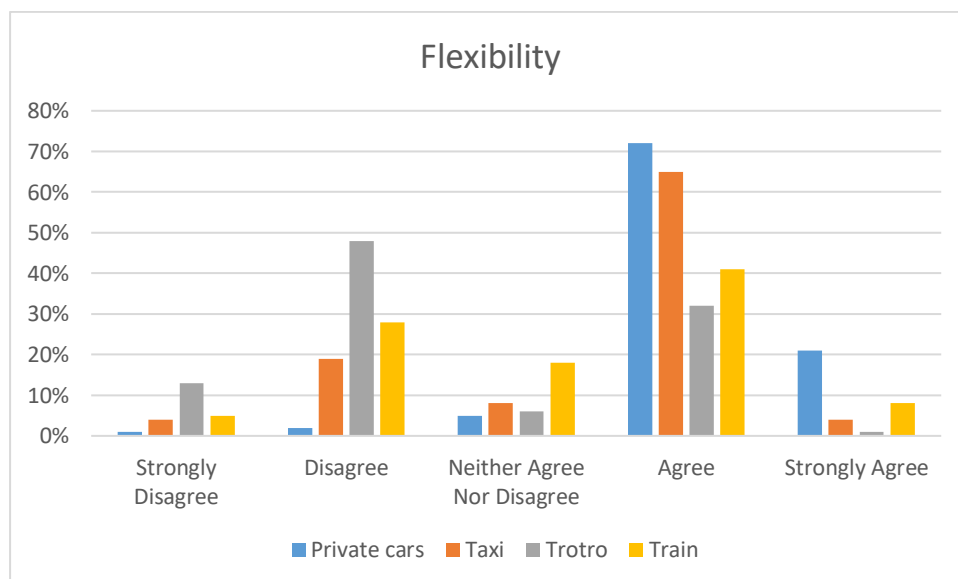
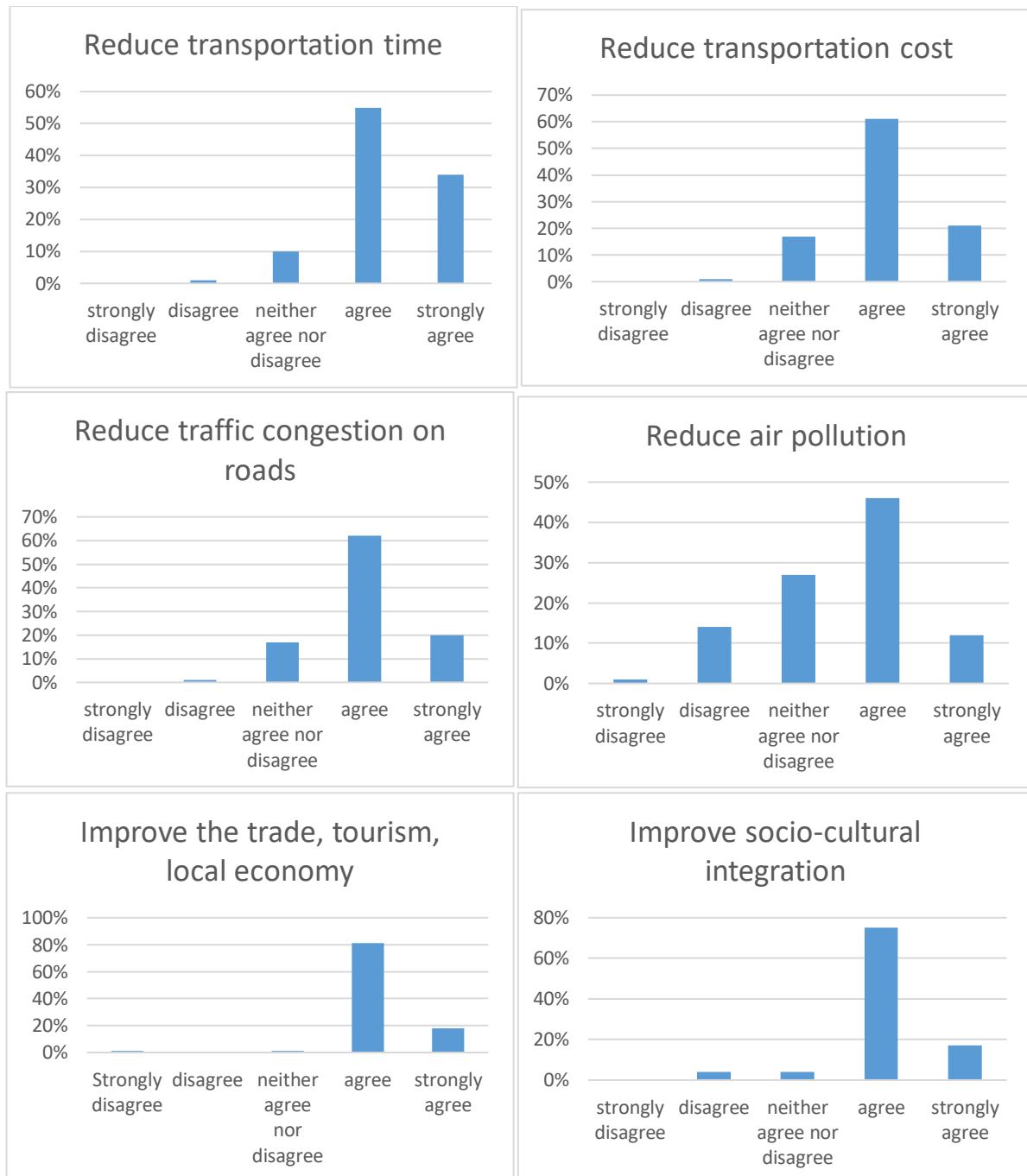


Figure 2.13 *Flexibility as an Advantage*

2.4 Railway Development

Respondents in towns with no railway infrastructure (Sunyani, Tamale and Paga) were generally in agreement with all that was proposed as benefits associated with development of a railway service in terms of reduction; in time of transportation, cost of transportation, traffic congestion on roads, air pollution including improvement in; trade, tourism, local economy, socio-cultural integration, quality of community life, employment opportunities and that railway development could damage properties if no compensation is given. Although a few neither agreed nor disagreed because they had no knowledge

of the train system, many were very welcoming and positive on the prospects of new railway infrastructure in their area. However, over 75% of respondents acknowledged the fact that a new infrastructure could lead to the damage of people's properties. The details have been presented in Figure 2.14.



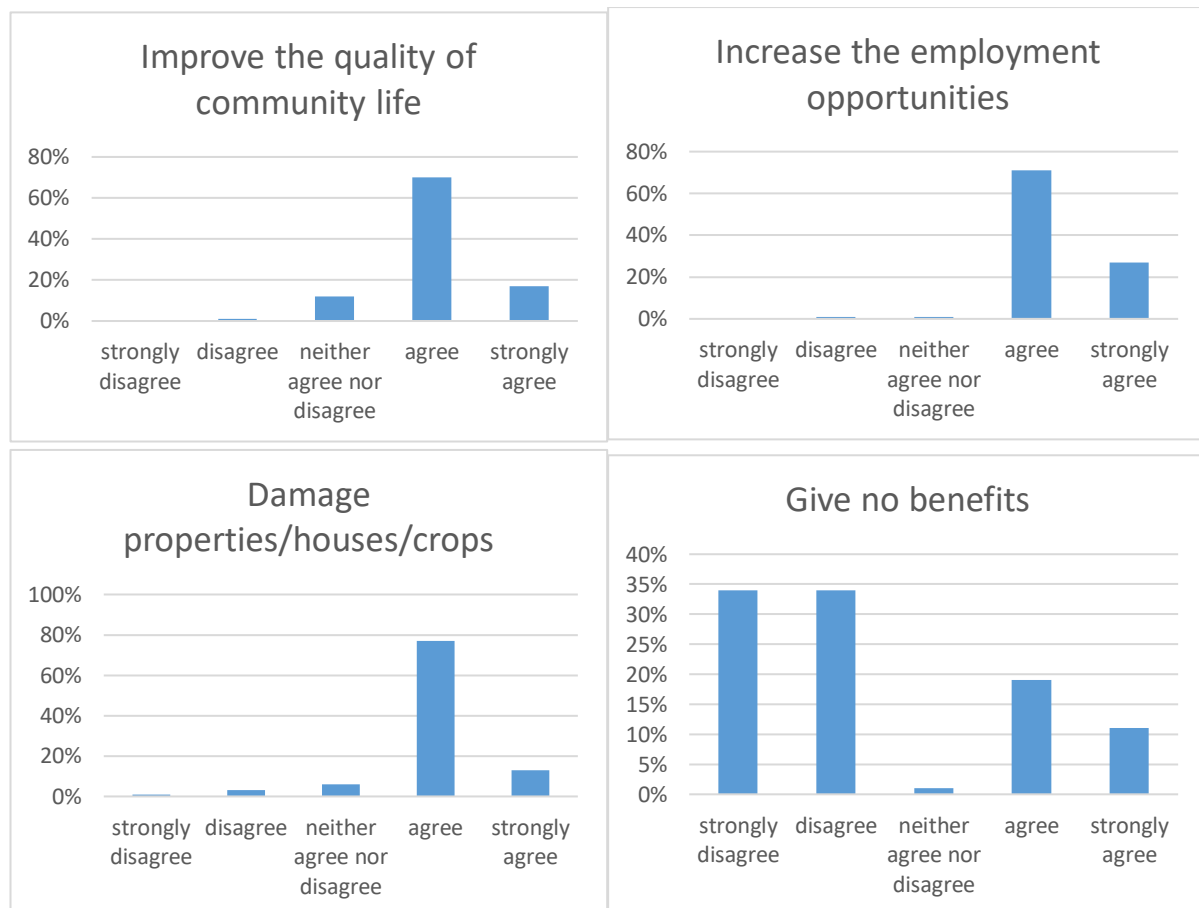


Figure 2.14 Effects of New Railway Infrastructure

2.5 Railway Improvement

Respondents in areas where the rail service is currently (Accra, Tema and Sekondi-Takoradi) and where it was previously (Kumasi and Nsawam) gave their perceptions on how the rail services can be improved. As with railway development, respondents were in agreement with all that was suggested for the improvement of the service; frequency of the trains, travel time, punctuality/reliability, personal security, cleanliness/good maintenance, reliable real time information, connections with other modes of public transport, banning noise making and the segregation of coaches. Plate 2.3 shows cleanliness as a means to railway improvement.



a. Notice on Keeping the Train Clean



b. A Clean Train Station

Plate 2.3

Cleanliness on Board Trains and at Train Station

However, some were sceptical on the banning of noise-generating activities such as preaching and selling on board, hence almost 20% disagreed. Mostly, the market women wanted to have a chance to make some extra income by selling their goods on board. Others thought people preaching on board a long journey train ride was not a bad idea, as long as they did not distract the train driver. However, the majority agreed to the banning of such activities on board as they wanted peace and quiet on their journeys. Train delay was also a concern that almost all current train users; on means of notification about delays, respondents preferred text messages to the others suggested. All responses are as shown in the graphs in Figure 2.15.



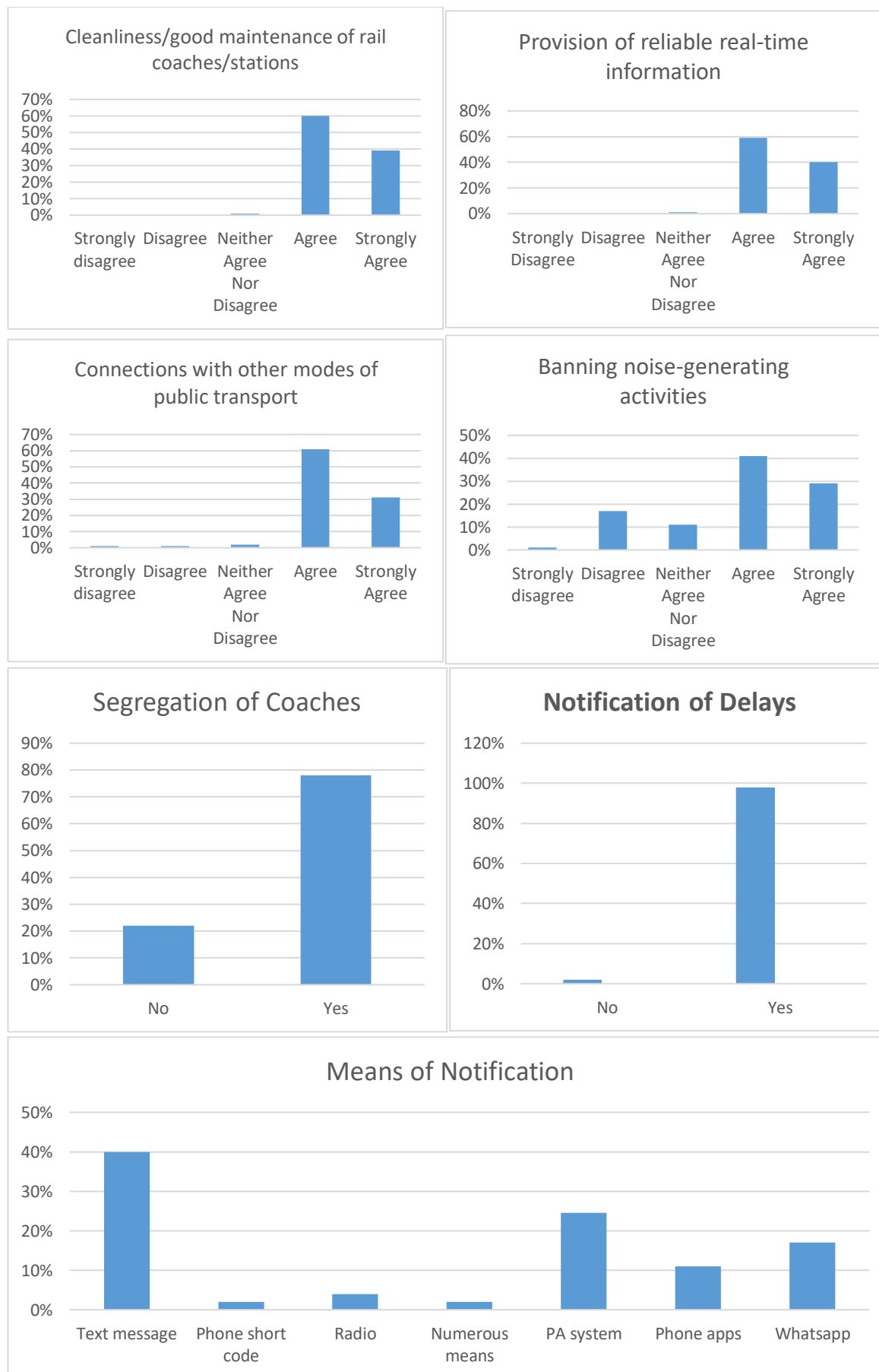


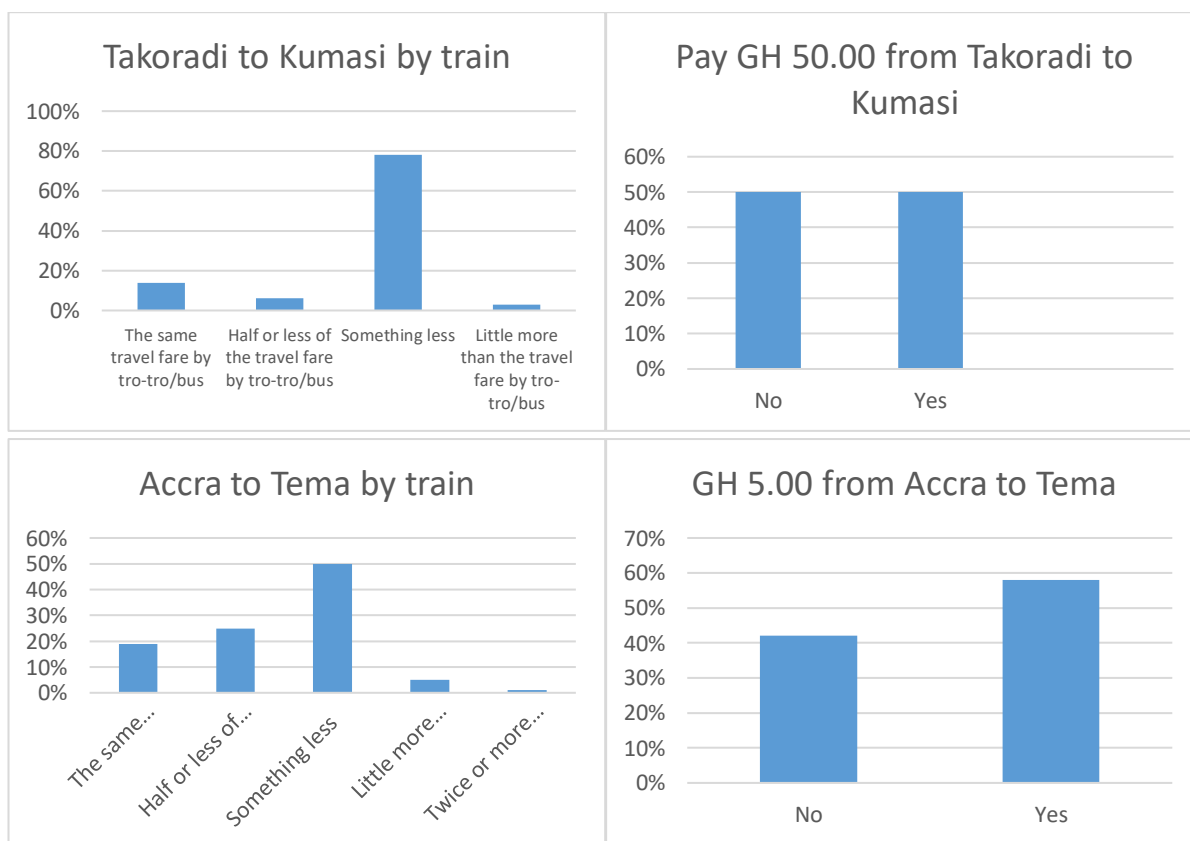
Figure 2.15 Means to Improve Rail Services

2.6 Cost/Payments

In comparison to trotro/bus, the trend is to pay ‘something less’. These responses may have been influenced by the cost of travelling by bus which generally is moderately high for the average income earner. This expectation of paying something less to travel on a train is very significant if the percentage of those who specifically said ‘half or less’ of the cost of trotro/bus is added to those who said ‘something less’. Thus it is expected costs of travelling by train should be significantly less than that of trotro/bus. Current rail users in Tema and Accra pay GH¢3 per trip, while users and students in Sekondi-Takoradi pay GH¢2 and GH¢1 per trip respectively.

However, when specific costs were put on the travel distance, except for the cost of GH¢100 for Kumasi to Paga where 8% more respondents said ‘No’ than those who said ‘Yes’, the other scenarios were either equally divided or were willing to travel at that cost. This is illustrated by the graphs in Figure 2.16.

The above responses clearly suggest unwillingness to pay more for any travel on train compared to trotro/bus but when enticed by a clean air-conditioned train, they seem to waver and a significant few are willing to pay to patronise the service. It also goes to suggest a preconceived negative notion of a train not being as comfortable as other means of transportation and therefore not deserving of high fares.



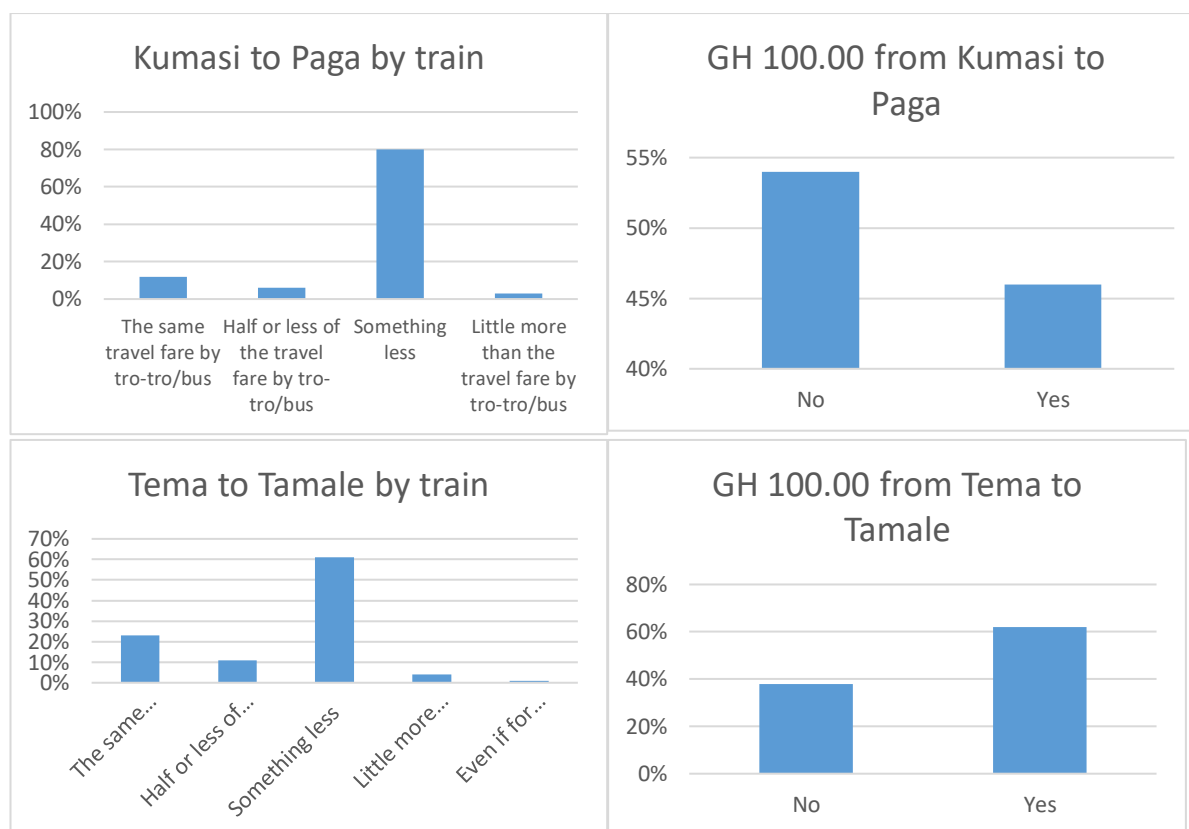


Figure 2.16 Willingness to Pay

CHAPTER THREE

Recommendations and Conclusion

3. RECOMMENDATIONS AND CONCLUSION

The survey presents reliable data that can be used to guide the development of the railway service in Ghana. The focus of the survey was based on passenger use and information gathered would suggest a good potential for patronage as indicated in the following:

- The train ranked significantly close to private car as a primary means of transportation;
- Train unexpectedly seen to be good in saving travel time. An efficient railway system has a strong potential to be patronised by persons desiring quick means of transportation;
- Safety follows the same trend as for travel time with train coming second to private car;
- The train also ranks favourably in terms of its comfortability and flexibility; and
- Formal workers possibly with tertiary level education were recorded as current patrons.

However, there seems to be a preconceived negative notion of a train for which reason not deserving of fares as for the other means of transportation. This possibly could have been due to information gleaned from past users and or those who have never used the service. Respondents only considered paying higher fares when a different picture of a clean train with air-condition was painted. This therefore means public education and some level of sophistication of the railway service will be needed to promote patronage of the service.

The survey was limiting in the use of only quantitative instruments which did not provide opportunity for respondents especially those currently patronizing the service to volunteer other information from their perspectives and experience. This is a missed opportunity considering the tertiary educational levels of respondents in Accra, Tema and Sekondi-Takoradi. Information on preferred time of travel (day or night) for instance especially for inter-city travels was missed as may have been other vital information from the perspectives of users and potential patrons.

REFERENCES

Ghana Railway Master Plan, 2013

Ghana Railway Master Plan Environmental and Social Framework, 2013

United Nations Department of Economics and Social Affairs: Population Affairs, 2019

APPENDICES

- ❖ Appendix 1.0 Letter of Authorization from GRDA
- ❖ Appendix 2.0 Introduction Letter
- ❖ Appendix 3.0 Market Survey Plan
- ❖ Appendix 4.0 Questionnaire
- ❖ Appendix 5.0 Detailed Tables of Results
- ❖ Appendix 6.0 Field Pictures

Appendix 1.0 Letter of Authorization from GRDA**GHANA RAILWAY DEVELOPMENT AUTHORITY**

Our Ref: **GRDA/GL/18/078**
Your Ref:
Date: **8TH AUGUST, 2018**

TO WHOM IT MAY CONCERN

The Ghana Railway Development Authority (GRDA) has authorized Team Engineering SpA of Italy to undertake preliminary investigations for a review of the Railway Master Plan (RMP) of Ghana.

The Authority seeks your co-operation and assistance to enable Team Engineering SpA as well as their Partners undertake this assignment of national importance.

The assignment will be carried out from August 2018 to April 2019.

Thank you for your co-operation.

RICHARD D. DOMBO
AG. CHIEF EXECUTIVE OFFICER

CC: Hon. Minister, MoRD
Deputy Hon Ministers – I & II, MoRD
Chief Director, MoRD
Board Chairman, GRDA
Deputy Chief Executive Officer (Ops)
Deputy Chief Executive Officer (GS)

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www.grda.gov.gh

Appendix 2.0 Introduction Letter

379 00 MP R FN 0

416 - 459



LM/md/379.18/062/19
21st March, 2019

Dear Sir/Madam,

REVIEW OF THE RAILWAY MASTER PLAN OF GHANA
To Whom It May Concern

We make reference to GRDA letter Ref GRDA/GL/18/078 dated 8th August, 2018 (attached). As part of our review of the Railway Master Plan, our Sub-Consultant, Centre for Environment and Health Research and Training (CEHRT), will be undertaking surveys across the country and aboard some train services.

In accordance with the referenced letter, we ask for your co-operation to enable CEHRT to undertake this assignment of national importance.

Yours faithfully,

A handwritten signature in blue ink, appearing to read 'Marenzi'.

For Ing. Luigi MARENZI
(Executive Director)

TEAM Engineering S.p.A. – Via C. Manassei, 38 – 00151 Roma – tel.: +39 06 5343 520/ 5343 588
fax: +39 06 5343 561 - e-mail: teameng@teamgroup.it – Web: www.teamgroup.it – ftp.teamgroup.eu
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P. IVA 01156681007 – Sede legale: Largo della Primavera, 40 00171 Roma



Appendix 3.0 Market Survey Plan

Date	Location	Respondents
22/03/19	Tema, Accra	Current train users
25/03/19	Tema, Accra	Current train users
26/03/19 (AM)	Accra	Previous and potential train users
26/03/19 (PM)	Nsawam	Previous and potential train users
27/03/19	Sunyani	Previous and potential train users
28/03/19 – 29/03/19	Kumasi	Previous and potential train users
28/03/19 (Team 2)	Paga	Previous and potential train users
29/03/19 (Team 2)	Tamale	Previous and potential train users
01/04/19	Tema	Previous and potential train users
03/04/19 – 04/04/19	Sekondi Takoradi	Current, previous and potential train users

Appendix 4.0 Questionnaire

Public Involvement – Survey Questionnaire

Location

Select the town	Indicate the location (i.e. bus terminal, taxi station, etc.) and address
Accra	
Nsawam	
Tema	
Sekondi - Takoradi	
Kumasi	
Tamale	
Paga	
Sunyani	

Bio data

Gender	Male	Female

Age	14-25	26-64	Over 65

Education	None	Primary/Middle	JHS	Secondary/Vocational	Tertiary

Occupation	Student	Business	Artisan	Formal	Unemployed

1. Have you ever used the rail service?		Yes, currently	Yes, previously	NO
If Yes, for what purpose do you use the rail service?				
1.1. Passenger				
1.2. Cargo				
1.3. Both				
1.4.				
If Yes, how often do you use it?				
1.5. Daily				
1.6. 2-4 times a week				
1.7. Once in a week				
1.8. Once in a while				
If Yes, what is the average cost per trip?				
GHS 1	GHS 2	GHS 3	GHS 4	GHS 5
				More than GHS 5
If Yes, would you prefer segregation of the coaches into classes (first, business, economy, etc.) with enhanced services?				
1.9. Yes				
1.10. No				
If Yes, in the event of train delays would you want to notified?				

1.11. Yes	
1.12. No	
If Yes , how would you want to be notified?	
1.13. Text message	
1.14. Whatsapp	
1.15. Phone apps	
1.16. Emails	
1.17. Phone short code	
1.18. Radio	
1.19. Other	
2. Your Primary means of transportation for work/school is	
2.1. Walking/bike	
2.2. Private car	
2.3. Taxi	
2.4. Tro tro/bus/coach	
2.5. Train	
2.6. other	
3. Your Secondary means of transportation for work/school is	
3.1. Walking/bike	
3.2. Private car	
3.3. Taxi	
3.4. Tro tro/bus/coach	
3.5. Train	
3.6. other	

Please rate the extent to which you agree/disagree with the following: 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
4. The advantages of " Private car" are					
4.1. Travel costs	1	2	3	4	5
4.2. Travel time	1	2	3	4	5
4.3. Safety	1	2	3	4	5
4.4. Comfort	1	2	3	4	5
4.5. Flexibility	1	2	3	4	5
4.6. other	1	2	3	4	5

5. The advantages of "Taxi " are					
5.1. Travel costs	1	2	3	4	5
5.2. Travel time	1	2	3	4	5
5.3. Safety	1	2	3	4	5
5.4. Comfort	1	2	3	4	5
5.5. Flexibility	1	2	3	4	5
5.6. other	1	2	3	4	5
6. The advantages of "Tro tro/bus/coach" are					
6.1. Travel costs	1	2	3	4	5
6.2. Travel time	1	2	3	4	5
6.3. Safety	1	2	3	4	5
6.4. Comfort	1	2	3	4	5
6.5. Flexibility	1	2	3	4	5
6.6. other	1	2	3	4	5
7. The advantages of "railway" are					
7.1. Travel costs	1	2	3	4	5
7.2. Travel time	1	2	3	4	5
7.3. Safety	1	2	3	4	5
7.4. Comfort	1	2	3	4	5
7.5. Flexibility	1	2	3	4	5
7.6. other	1	2	3	4	5
(Note: Only, if respondent is in areas affected by railway service)					
8. How could the present railway service be improved?					
8.1. Frequency of the trains	1	2	3	4	5
8.2. Travel time	1	2	3	4	5
8.3. Punctuality/reliability of the services	1	2	3	4	5
8.4. Safety on board/in stations and on platforms	1	2	3	4	5
8.5. Cleanliness/good maintenance of rail coaches/stations	1	2	3	4	5
8.6. Speed of the trains	1	2	3	4	5
8.7. Connections with other modes of public transport	1	2	3	4	5
8.8. Tariff reductions for frequent users, seniors, students, etc ...	1	2	3	4	5
9. Would you be interested in a new railway infrastructure development in your area?	YES	NO	I DON'T KNON		
10. A new railway infrastructure development in your area, could:					
10.1. Reduce the time of transportation	1	2	3	4	5
10.2. Reduce the cost of transportation	1	2	3	4	5

10.3. Reduce the traffic congestion on roads, accidents and risks	1	2	3	4	5
10.4. Reduce air pollution	1	2	3	4	5
10.5. Improve the trade, tourism, local economy	1	2	3	4	5
10.6. Increase the employment opportunities	1	2	3	4	5
10.7. Improve socio-cultural integration	1	2	3	4	5
10.8. Improve the quality of community life	1	2	3	4	5
10.9. Damage properties/houses/crops (if no adequate compensation will be foreseen)	1	2	3	4	5
10.10. Give no benefits	1	2	3	4	5
11. How much is the following important for a good rail service:					
11.1. Frequency of the trains	1	2	3	4	5
11.2. Travel time					
11.3. Punctuality/reliability of the services	1	2	3	4	5
11.4. Personal security on board/in stations and on platforms	1	2	3	4	5
11.5. Cleanliness/good maintenance of rail coaches/stations	1	2	3	4	5
11.6. Provision of reliable real-time information (about timetable, next stations regularity of service, etc.)	1	2	3	4	5
11.7. Connections with other modes of public transport	1	2	3	4	5
11.8. Banning noise-generation activities (selling, preaching, singing, etc.)	1	2	3	4	5

12. How much would you pay to travel from Takoradi to Kumasi by train?		
12.1. Half or less of the travel fare by tro-tro/bus		
12.2. Something less		
12.3. The same travel fare by tro-tro/bus		
12.4. Little more than the travel fare by tro-tro/bus		
12.5. Twice or more the travel fare by tro-tro/bus		
12.6. Even if for free, I would never travel by train		
13. Would you pay GH¢50.00 per passenger to travel from Takoradi to Kumasi with clean, efficient and air-conditioned trains?	YES	NO
14. How much would you pay to travel from Accra to Tema by train?		
14.1. Half or less of the travel fare by tro-tro/bus		
14.2. Something less		
14.3. The same travel fare by tro-tro/bus		
14.4. Little more than the travel fare by tro-tro/bus		
14.5. Twice or more the travel fare by tro-tro/bus		

14.6. Even if for free, I would never travel by train		
15. Would you pay GH¢ 5.00 per passenger to travel from Accra to Tema with clean, efficient and air-conditioned trains?	YES	NO
16. How much would you pay to travel from Kumasi to Paga by train?		
16.1. Half or less of the travel fare by tro-tro/bus		
16.2. Something less		
16.3. The same travel fare by tro-tro/bus		
16.4. Little more than the travel fare by tro-tro/bus		
16.5. Twice or more the travel fare by tro-tro/bus		
16.6. Even if for free, I would never travel by train		
17. Would you pay GH¢100.00 per passenger to travel from Kumasi to Paga with clean, efficient and air-conditioned trains?	YES	NO
18. How much would you pay to travel from Tema to Tamale by train?		
18.1. Half or less of the travel fare by tro-tro/bus		
18.2. Something less		
18.3. The same travel fare by tro-tro/bus		
18.4. Little more than the travel fare by tro-tro/bus		
18.5. Twice or more the travel fare by tro-tro/bus		
18.6. Even if for free, I would never travel by train		
19. Would you pay GH¢100.00 per passenger to travel from Tema to Tamale with clean, efficient and air-conditioned trains?	YES	NO

Appendix 5.0 Detailed Tables of Results

Occupation

	Artisans	Business	Formal	Students	Unemployed	Total
Paga	11(22%)	23(46%)	7 (14%)	3(6%)	6(12%)	50(100%)
Sunyani	6(12%)	38(76%)	4(8%)	1(2%)	1(2%)	50(100%)
Tamale	13(26%)	17(34%)	11(22%)	4(8%)	5(10%)	50(100%)
Kumasi	13(13%)	71(69%)	16(15%)	3(3%)	0(0%)	103(100%)
Nsawam	9(17%)	40(77%)	1(2%)	1(2%)	1(2%)	52(100%)
Accra	24 (21.8)	59 (53.6)	19 (17.3)	2 (1.8)	6 (5.5)	110 (100.0)
Tema	9 (18.0)	22 (44.0)	18 (36.0)	0 (0.0)	1 (2.0)	50 (100.0)
Sekondi-Takoradi	3 (6.0)	24 (48.0)	17 (34.0)	5 (10.0)	1 (2.0)	50 (100.0)

Ever used the railway service?

	Yes, Currently	Yes, Previously	No	Total
Paga	0 (0.0)	5(10%)	45(90%)	100(100%)
Sunyani	0 (0.0)	12(24%)	38(76%)	100(100%)
Tamale	0 (0.0)	8(16%)	42(16%)	100(100%)
Kumasi	0 (0.0)	46(45%)	57(55%)	103(100%)
Nsawam	0 (0.0)	37(71%)	15(29%)	52(100%)
Accra	33 (30.0)	42 (38.2)	35 (31.8)	110 (100.0)
Tema	17 (34.0)	11 (22.0)	22 (44.0)	50 (100.0)
Sekondi-Takoradi	25 (50.0)	12 (24.0)	13 (26.0)	50 (100.0)

Primary Means of transportation

	Private	Taxi	Train	Trotro/bus/coach	Walking/bike	Total
Paga	5(10%)	3(6%)	0(0%)	0(0%)	42(84%)	50(100%)
Sunyani	2 (4%)	9(18%)	0(0%)	28 (56%)	11(22%)	50(100%)
Tamale	5(10%)	4(8%)	0(0%)	0(0%)	41(82%)	50(100%)
Kumasi	15(15%)	24(23%)	1(1%)	54(52%)	9(9%)	103(100%)
Nsawam	1(1%)	12(23%)	0(0%)	28(55%)	11(21%)	52(100%)

Secondary Means of transportation

	Private	Taxi	Train	Trotro/bus/coach	Walking/bike	Total
Paga	0(0%)	23(46%)	0(0%)	0(0%)	27(56%)	50(100%)
Sunyani	1(2%)	30(60%)	0(0%)	14(28%)	5(10%)	50(100%)
Tamale	0(0%)	21(42%)	0(0%)	0(0%)	29(58%)	50(100%)
Kumasi	1(1%)	43(42%)	0(0%)	56(54%)	3(3%)	103(100%)
Nsawam	1(1%)	25(48%)	0(0%)	16(32%)	10(19%)	52(100%)

Private Car – Cost Effective

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0(0%)	10(20%)	1(2%)	25(50%)	14(28%)	50(100%)
Sunyani	1(2%)	18(36%)	6(12%)	23(46%)	2(4%)	50(100%)
Tamale	0(0%)	3(6%)	1(2%)	25(50%)	21(42%)	50(100%)
Kumasi	14(14%)	49(48%)	20(19%)	20(19%)	0(0%)	103(100%)
Nsawam	0(0%)	11(21%)	3(6%)	38(73%)	0(0%)	52(100%)
Accra	16 (14.5)	22 (20.0)	10 (9.1)	48 (43.6)	14 (12.7)	110 (100.0)
Tema	0 (0.0)	19 (38.0)	6 (12.0)	18 (36.0)	7 (14.0)	50 (100.0)

Sekondi-Takoradi	9 (18.0)	18 (36.0)	8 (16.0)	14 (28.0)	1 (2.0)	50 (100.0)

Private Car – Travel Time

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	8(16%)	40(80%)	0(0%)	2(4%)	0(0%)	50(100%)
Sunyani	1(2%)	42(84%)	4(8%)	1(2%)	2(4%)	50(100%)
Tamale	19(38%)	29(48%)	1(2%)	1(2%)	0(0%)	50(100%)
Kumasi	15(14%)	79(77%)	5(5%)	4(4%)	0(0%)	103(100%)
Nsawam	2(4%)	34(65%)	5(10%)	11(21%)	0(0%)	52(100%)
Accra	15 (13.6)	61 (55.5)	7 (6.4)	19 (17.3)	8 (7.3)	110 (100.0)
Tema	2 (4.0)	42 (84.0)	1 (2.0)	5 (10.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	10 (20.0)	31 (62.0)	9 (18.0)	0 (0.0)	0 (0.0)	50 (100.0)

Private Car – Safety

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	1(2%)	45(90%)	1(2%)	3(6%)	0(0%)	50(100%)
Sunyani	2(4%)	42(84%)	3(6%)	2(4%)	1(2%)	50(100%)
Tamale						50(100%)
Kumasi	79(76%)	14(14%)	5(5%)	5(5%)	0(0%)	103(100%)
Nsawam	0(0%)	45(86%)	4(8%)	3(6%)	0(0%)	52(100%)
Accra	10 (9.1)	71 (64.5)	10 (9.1)	12 (10.9)	7 (6.4)	110 (100.0)
Tema	6 (12.0)	40 (80.0)	3 (6.0)	1 (2.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	11 (22.0)	35 (70.0)	4 (8.0)	0 (0.0)	0 (0.0)	50 (100.0)

Private Car – Comfortability

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	21(42%)	29(58%)	0(0%)	0(0%)	0(0%)	50(100%)
Sunyani	4(8%)	42(84%)	3(6%)	0(0%)	1(2%)	50(100%)
Tamale	18(36%)	32(64%)	0(0%)	0(0%)	0(0%)	50(100%)
Kumasi	14(14%)	84(81%)	4(4%)	1(1%)	0(0%)	103(100%)
Nsawam	2(4%)	44(85%)	5(10%)	1(1%)	0(0%)	52(100%)
Accra	17 (15.5)	80 (72.7)	4 (3.6)	6 (5.5)	3 (2.7)	110 (100.0)
Tema	12 (24.0)	36 (72.0)	1 (2.0)	1 (2.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	14 (28.0)	33 (66.0)	3 (6.0)	0 (0.0)	0 (0.0)	50 (100.0)

Private Car – Flexibility

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total

Paga	28(56%)	20(40%)	0(0%)	2(4%)	0(0%)	50(100%)
Sunyani	1(2%)	45(90%)	2(4%)	0	2(4%)	50(100%)
Tamale	17(34%)	30(60%)	1(2%)	2(4%)	0	50(100%)
Kumasi	13(13%)	87(84%)	3(3%)	0(0%)	0(0%)	103(100%)
Nsawam	0(0%)	47(90%)	5(10%)	0(0%)	0(0%)	52(100%)
Accra	19 (17.3)	76 (69.1)	7 (6.4)	5 (4.5)	3 (2.7)	110 (100.0)
Tema	12 (24.0)	35 (70.0)	2 (4.0)	1 (2.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	18 (36.0)	28 (56.0)	3 (6.0)	1 (2.0)	0 (0.0)	50 (100.0)

Taxi– Cost Effective

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	16(32%)	0	34(64%)	0	50(100%)
Sunyani	1(2%)	19(38%)	2(4%)	25(50%)	3(6%)	50(100%)
Tamale	0	29(58%)	2(4%)	18(36%)	1(2%)	50(100%)
Kumasi	3(3%)	44(43%)	19(18%)	37(36%)	0(0%)	103(100%)
Nsawam	1(2%)	9(17%)	7(14%)	35(67%)	0(0%)	52(100%)
Accra	4 (3.6)	19 (17.3)	6 (5.5)	65 (59.1)	16 (14.5)	110 (100.0)
Tema	1 (2.0)	13 (26.0)	2 (4.0)	34 (68.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	3 (6.0)	29 (58.1)	1 (2.0)	16 (32.0)	1 (2.0)	50 (100.0)

Taxi– Travel Time

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	41(82%)	3(6%)	6(12%)	0	50(100%)
Sunyani	1(2%)	40(80%)	2(4%)	5(10%)	2(4%)	50(100%)
Tamale	0	29(58%)	7(14%)	12(24%)	2(4%)	50(100%)
Kumasi	4(4%)	88(85%)	4(4%)	7(7%)	0(0%)	103(100%)
Nsawam	0(0%)	35(67%)	5(10%)	12(23%)	0(0%)	52(100%)
Accra	8 (7.3)	58 (52.7)	13 (11.8)	29 (26.4)	2 (1.8)	110 (100.0)
Tema	1 (2.0)	29 (58.0)	7 (14.0)	13 (26.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	1 (2.0)	43 (86.0)	2 (4.0)	4 (8.0)	0 (0.0)	50 (100.0)

Taxi– Safety

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	36(72%)	10(20%)	4(8%)	0	50(100%)
Sunyani	0	21(42%)	8(16%)	19(38%)	2(4%)	50(100%)
Tamale	0	34(68%)	2(4%)	14(28%)	0(0%)	50(100%)
Kumasi	2(2%)	56(54%)	11(11%)	34(33%)	0(0%)	103(100%)
Nsawam	0(0%)	38(73%)	6(12%)	8(15%)	0(0%)	52(100%)
Accra	6 (5.5)	68 (61.8)	8 (7.3)	25 (22.7)	3 (2.7)	110 (100.0)
Tema	2 (4.0)	27 (54.0)	10 (20.0)	11 (22.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	2 (4.0)	41 (82.0)	7 (14.0)	0 (0.0)	0 (0.0)	50 (100.0)

Taxi– Comfortability

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0(0%)	20(40%)	8(16%)	20(40%)	2(4%)	50(100%)
Sunyani	1(2%)	36(72%)	7(14%)	5(10%)	1(2%)	50(100%)
Tamale	0(0%)	14(28%)	6(12%)	27(54%)	3(6%)	50(100%)
Kumasi	4(4%)	88(85%)	4(4%)	7(7%)	0(0%)	103(100%)
Nsawam	0(0%)	47(90%)	2(4%)	3(6%)	0(0%)	52(100%)
Accra	6 (5.5)	75 (68.2)	8 (7.3)	20 (18.2)	1 (0.9)	110 (100.0)
Tema	1 (2.0)	33 (66.0)	6 (12.0)	9 (18.0)	1 (2.0)	50 (100.0)
Sekondi-Takoradi	1 (2.0)	41 (82.0)	2 (4.0)	6 (12.0)	0 (0.0)	50 (100.0)

Taxi– Flexibility

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	9(18%)	1 (2%)	26(52%)	14(28%)	50(100%)
Sunyani	1(2%)	41(82%)	6(12%)	2(4%)	0	50(100%)
Tamale	0	16(32%)	4(8%)	28(56%)	2(4%)	50(100%)
Kumasi	4(4%)	97(94%)	2(2%)	0(0%)	0(0%)	103(100%)
Nsawam	3(6%)	32(61%)	12(23%)	5(10%)	0(0%)	52(100%)
Accra	9 (8.2)	75 (68.2)	13 (11.8)	13 (11.8)	0 (0.0)	110 (100.0)
Tema	2 (4.0)	29 (58.0)	4 (8.0)	13 (26.0)	2 (4.0)	50 (100.0)
Sekondi-Takoradi	1 (2.0)	36 (72.0)	1 (2.0)	12 (24.0)	0 (0.0)	50 (100.0)

Trotro/bus/coach – Cost Effective

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	1(2%)	42(84%)	3(6%)	3(6%)	1(2%)	50(100%)
Sunyani	2(4%)	37(74%)	4(8%)	3(6%)	2(4%)	50(100%)
Tamale	2(4%)	27(54%)	9(18%)	9(18%)	2(4%)	50(100%)
Kumasi	7(7%)	73(71%)	5(5%)	15(14%)	3(3%)	103(100%)
Nsawam	0(0%)	43(83%)	1(2%)	8(15%)	0(0%)	52(100%)
Accra	6 (5.5)	66 (60.0)	7 (6.4)	16 (14.5)	6 (5.5)	110 (100.0)
Tema	7 (14.0)	32 (64.0)	2 (4.0)	8 (16.0)	1 (2.0)	50 (100.0)
Sekondi-Takoradi	6 (12.0)	36 (72.0)	1 (2.0)	6 (12.0)	1 (2.0)	50 (100.0)

Trotro/bus/coach – Travel Time

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0(0%)	10(20%)	10(20%)	29(58%)	10(20%)	50(100%)
Sunyani	0(0%)	14(28%)	6(12%)	26(52%)	4(8%)	50(100%)
Tamale	0(0%)	4(8%)	9(18%)	35(70%)	2(4%)	50(100%)
Kumasi	0(0%)	23(22%)	6(6%)	68(66%)	6(6%)	103(100%)
Nsawam	1(2%)	11(21%)	1(2%)	38(73%)	1(2%)	52(100%)
Accra	15 (13.6)	4 (3.6)	3 (2.7)	67 (60.9)	21 (19.1)	110 (100.0)

Tema	0 (0.0)	10 (20.0)	5 (10.0)	29 (58.0)	6 (12.0)	50 (100.0)
Sekondi-Takoradi	1 (2.0)	15 (30.0)	4 (8.0)	23 (46.0)	7 (14.0)	50 (100.0)

Trotro/bus/coach – Safety

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0(0%)	7	7	30	6	50(100%)
Sunyani	0(0%)	24	11	9	6	50(100%)
Tamale	0(0%)	10	5	35	0	50(100%)
Kumasi	2(2%)	48(47%)	10(10%)	37(35%)	6(6%)	103(100%)
Nsawam	1(2%)	9(17%)	13(25%)	27(52%)	2(4%)	52(100%)
Accra	3 (2.7)	16 (14.5)	7 (6.4)	60 (54.4)	24 (21.8)	110 (100.0)
Tema	1 (2.0)	8 (16.0)	7 (14.0)	30 (60.0)	4 (8.0)	50 (100.0)
Sekondi-Takoradi	0 (0.0)	13 (26.0)	8 (16.0)	24 (48.0)	5 (10.0)	50 (100.0)

Trotro/bus/coach – Comfort

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0(0%)	8(16%)	0(0%)	33(66%)	9(18%)	50(100%)
Sunyani	0(0%)	16(32%)	7(14%)	23(46%)	4(8%)	50(100%)
Tamale	0(0%)	3(6%)	1(2%)	37(74%)	9(18%)	50(100%)
Kumasi	2(2%)	17(17%)	12(12%)	65(62%)	7(7%)	103(100%)
Nsawam	0(0%)	5(10%)	3(5%)	42(81%)	2(4%)	52(100%)
Accra	1 (0.9)	11 (10.0)	4 (3.6)	60 (54.5)	34 (30.9)	110 (100.0)
Tema	1 (2.0)	5 (10.0)	3 (6.0)	28 (28.0)	11 (22.0)	50 (100.0)
Sekondi-Takoradi	0 (0.0)	10 (20.0)	5 (10.0)	31 (62.0)	4 (8.0)	50 (100.0)

Trotro/bus/coach – Flexibility

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0(0%)	6(12%)	0(0%)	22(44%)	22(44%)	50(100%)
Sunyani	1(2%)	22(44%)	7(14%)	17(34%)	3(6%)	50(100%)
Tamale	0(0%)	7(14%)	2(4%)	32(64%)	9(18%)	50(100%)
Kumasi	0(0%)	40(39%)	7(7%)	50(48%)	6(6%)	103(100%)
Nsawam	1(2%)	16(31%)	3(6%)	32(61%)	0(0%)	52(100%)
Accra	3 (2.7)	31 (28.2)	8 (7.3)	54 (49.1)	14 (12.7)	110 (100.0)
Tema	2 (4.0)	21 (42.0)	6 (12.0)	14 (28.0)	7 (14.0)	50 (100.0)
Sekondi-Takoradi	0 (0.0)	22 (44.0)	1 (2.0)	23 (46.0)	4 (8.0)	50 (100.0)

Railway – Cost effective

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	8(16%)	36(72%)	6(12%)	0(0%)	0(0%)	50(100%)
Sunyani	8(16%)	13(26%)	23(46%)	3(6%)	3(6%)	50(100%)
Tamale	6(12%)	17(34%)	25(50%)	2(4%)	0(0%)	50(100%)

Kumasi	22(21%)	43(42%)	31(30%)	5(5%)	2(2%)	103(100%)
Nsawam	12(23%)	35(67%)	4(8%)	0(0%)	1(2%)	52(100%)
Accra	21 (19.1)	60 (54.5)	15 (13.6)	10 (9.1)	4 (3.6)	110 (100.0)
Tema	20 (40.0)	20 (40.0)	7 (14.0)	1 (2.0)	2 (4.0)	50 (100.0)
Sekondi-Takoradi	27 (54.0)	21 (42.0)	2 (4.0)	0 (0.0)	0 (0.0)	50 (100.0)

Railway – Travel Time

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	7(14%)	33(66%)	10(20%)	0(0%)	0(0%)	50(100%)
Sunyani	12(24%)	27(54%)	10(20%)	1(2%)	0(0%)	50(100%)
Tamale	6(12%)	21(42%)	23(46%)	0(0%)	0(0%)	50(100%)
Kumasi	23(22%)	51(50%)	24(23%)	5(5%)	0(0%)	103(100%)
Nsawam	4(7%)	44(85%)	1(2%)	2(4%)	1(2%)	52(100%)
Accra	25 (22.7)	70 (63.6)	12 (10.9)	1 (0.9)	2 (1.8)	110 (100.0)
Tema	13 (26.0)	26 (52.0)	5 (10.0)	5 (10.0)	1 (2.0)	50 (100.0)
Sekondi-Takoradi	27 (54.0)	23 (46.0)	0 (0.0)	0 (0.0)	0 (0.0)	50 (100.0)

Railway - Safety

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	2(4%)	42(84%)	4(8%)	2(4%)	0(0%)	50(100%)
Sunyani	15(30%)	25(50%)	8(16%)	1(2%)	1(2%)	50(100%)
Tamale	6(12%)	29(58%)	14(28%)	1(4%)	0(0%)	50(100%)
Kumasi	20(19%)	58(57%)	21(20%)	4(4%)	0(0%)	103(100%)
Nsawam	7(13%)	41(79%)	4(8%)	0(0%)	0(0%)	52(100%)
Accra	18 (16.4)	73 (66.4)	14 (12.7)	3 (2.7)	2 (1.8)	110 (100.0)
Tema	16 (32.0)	28 (56.0)	5 (10.0)	0 (0.0)	1 (2.0)	50 (100.0)
Sekondi-Takoradi	20 (40.0)	29 (58.0)	1 (2.0)	0 (0.0)	0 (0.0)	50 (100.0)

Railway – Comfort

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	9(18%)	29(58%)	11(22%)	1(2%)	0(0%)	50(100%)
Sunyani	11(22%)	28(56%)	10(20%)	1(2%)	0(0%)	50(100%)
Tamale	4(8%)	29(58%)	17(34%)	0(0%)	0(0%)	50(100%)
Kumasi	20(19%)	51(50%)	29(28%)	3(3%)	0(0%)	103(100%)
Nsawam	6(12%)	36(69%)	8(15%)	2(4%)	0(0%)	52(100%)
Accra	12 (10.9)	81 (73.6)	11 (10.0)	5 (4.5)	1 (0.9)	110 (100.0)
Tema	11 (22.0)	31 (62.0)	6 (12.0)	2 (4.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	24 (48.0)	26 (52.0)	0 (0.0)	0 (0.0)	0 (0.0)	50 (100.0)

Railway– Flexibility

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	1(2%)	3(6%)	7(14%)	27(54%)	12(24%)	50(100%)
Sunyani	6(12%)	31(62%)	11(22%)	2(4%)	0(0%)	50(100%)
Tamale	1(2%)	14(28%)	18(36%)	17(34%)	0(0%)	50(100%)
Kumasi	14(14%)	58(56%)	26(25%)	5(5%)	0(0%)	103(100%)
Nsawam	0(0%)	25(48%)	4(8%)	23(44%)	0(0%)	52(100%)
Accra	9 (8.2)	41 (37.3)	18 (16.4)	36 (32.7)	6 (5.5)	110 (100.0)
Tema	2 (4.0)	21 (42.0)	5 (10.0)	20 (40.0)	2 (4.0)	50 (100.0)
Sekondi-Takoradi	12 (24.0)	16 (32.0)	3 (6.0)	16 (32.0)	3 (6.0)	50 (100.0)

Railway Infrastructure Reducing time of Transportation

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	4	32	12	2	0(0%)	50(100%)
Sunyani	29	20	1	0(0%)	0(0%)	50(100%)
Tamale	3	32	15	0(0%)	0(0%)	50(100%)
Kumasi	47(46%)	55(53%)	1(1%)	0(0%)	0(0%)	103(100%)
Nsawam	16(31%)	22(42%)	1(2%)	0(0%)	0(0%)	52(100%)

Railway Infrastructure Reducing Cost of Transportation

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	45	4	1	0(0%)	50(100%)
Sunyani	30	20	0	0(0%)	0(0%)	50(100%)
Tamale	2	26	22	0(0%)	0(0%)	50(100%)
Kumasi						103(100%)
Nsawam						52(100%)

Railway Infrastructure Reducing Congestion on Roads

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	28	21	1	0(0%)	50(100%)
Sunyani	29	21	0	0(0%)	0(0%)	50(100%)
Tamale	1	44	5	0(0%)	0(0%)	50(100%)
Kumasi						103(100%)
Nsawam						52(100%)

Railway Infrastructure Reducing Air Pollution

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	16	21	12	1	50(100%)
Sunyani	18	29	2	1	0	50(100%)
Tamale	0	24	17	8	1	50(100%)

Railway Infrastructure Could Improve Trade and Tourism

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	1	49	0	0	0	50(100%)
Sunyani	26	23	0	0	1	50(100%)
Tamale	0	44	1	0	0	50(100%)
Kumasi						103(100%)
Nsawam						52(100%)

Railway Infrastructure Could Improve Socio-Cultural Integration

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	1	46	2	2	0	50(100%)
Sunyani	25	22	2	1	1	50(100%)
Tamale	0	45	2	3	0	50(100%)
Kumasi						103(100%)
Nsawam						52(100%)

Railway Infrastructure Could Improve Quality of Life

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	0	44	6	0	0(0%)	50(100%)
Sunyani	26	18	5	1	0(0%)	50(100%)
Tamale	0	43	7	0	0(0%)	50(100%)
Kumasi						103(100%)
Nsawam						52(100%)

Railway Infrastructure Could Provide Employment Opportunities

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	13	34	2	1	0(0%)	50(100%)
Sunyani	26	24	0	0	0(0%)	50(100%)
Tamale	2	48	0	0	0(0%)	50(100%)
Kumasi						103(100%)
Sunyani						52(100%)

Railway Infrastructure Could Damage Properties

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Paga	1	48	1	0	0	50(100%)
Sunyani	19	19	8	3	1	50(100%)
Tamale	0	49	0	1	0	50(100%)
Kumasi						103(100%)
Nsawam						52(100%)

Frequency of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	15 (45.5)	14 (42.4)	1 (3.0)	2 (6.1)	1 (3.0)	33 (100.0)
Tema	8 (47.1)	6 (35.3)	1 (5.9)	2 (11.8)	0 (0.0)	17 (100.0)
Sekondi-Takoradi	6 (24.0)	12 (48.0)	0 (0.0)	7 (28.0)	0 (0.0)	25 (100.0)

Travel Time/Speed of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	9 (27.3)	15 (45.5)	6 (18.2)	3 (9.1)	0 (0.0)	33 (100.0)
Tema	7 (41.2)	5 (29.4)	3 (17.6)	2 (11.8)	0 (0.0)	17 (100.0)
Sekondi-Takoradi	3 (12.0)	21 (84.0)	1 (4.0)	0 (0.0)	0 (0.0)	25 (100.0)

Punctuality/Reliability of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	18 (54.5)	15 (45.5)	0 (0.0)	0 (0.0)	0 (0.0)	33 (100.0)
Tema	8 (47.1)	9 (52.9)	0 (0.0)	0 (0.0)	0 (0.0)	17 (100.0)
Sekondi-Takoradi	2 (8.0)	22 (88.0)	0 (0.0)	1 (4.0)	0 (0.0)	25 (100.0)

Safety of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	13 (39.4)	17 (51.5)	3 (9.1)	0 (0.0)	0 (0.0)	33 (100.0)
Tema	7 (41.2)	9 (52.9)	0 (0.0)	1 (5.9)	0 (0.0)	17 (100.0)
Sekondi-Takoradi	2 (8.0)	22 (88.0)	0 (0.0)	1 (4.0)	0 (0.0)	25 (100.0)

Cleanliness of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	14 (42.4)	18 (54.5)	0 (0.0)	1 (3.0)	0 (0.0)	33 (100.0)
Tema	9 (52.9)	8 (47.1)	0 (0.0)	0 (0.0)	0 (0.0)	17 (100.0)
Sekondi-Takoradi	1 (4.0)	22 (88.0)	1 (4.0)	1 (4.0)	0 (0.0)	25 (100.0)

Connections of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	15 (45.5)	15 (45.5)	3 (9.1)	0 (0.0)	0 (0.0)	33 (100.0)
Tema	7 (41.2)	9 (52.9)	0 (0.0)	0 (0.0)	1 (5.9)	17 (100.0)
Sekondi-Takoradi	3 (12.0)	22 (88.0)	0 (0.0)	0 (0.0)	0 (0.0)	25 (100.0)

Tariff Reductions of Trains Improve Service

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	14 (42.4)	15 (45.5)	1 (3.0)	3 (9.1)	0 (0.0)	33 (100.0)
Tema	7 (41.2)	9 (52.9)	0 (0.0)	0 (0.0)	1 (5.9)	17 (100.0)
Sekondi-Takoradi	5 (20.0)	20 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)	25 (100.0)

Frequency of Trains Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	43 (39.1)	63 (57.3)	2 (1.8)	1 (0.9)	1 (0.9)	110 (100.0)
Tema	18 (36.0)	29 (58.0)	0 (0.0)	3 (6.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	13 (26.0)	33 (66.0)	1 (2.0)	3 (6.0)	0 (0.0)	50 (100.0)

Travel Time of Trains Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	30 (27.3)	73 (66.4)	4 (3.6)	2 (1.8)	1 (0.9)	110 (100.0)
Tema	19 (38.0)	31 (62.0)	0 (0.0)	0 (0.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	13 (26.0)	36 (72.0)	1 (2.0)	0 (0.0)	0 (0.0)	50 (100.0)

Punctuality of Trains Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	38 (34.5)	58 (52.7)	3 (2.7)	0 (0.0)	1 (0.9)	110 (100.0)
Tema	19 (38.0)	31 (62.0)	0 (0.0)	0 (0.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	11 (22.0)	38 (76.0)	1 (2.0)	0 (0.0)	0 (0.0)	50 (100.0)

Personal Security of Trains Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	33 (30.0)	74 (67.3)	1 (0.9)	1 (0.9)	1 (0.9)	110 (100.0)
Tema	18 (36.0)	31 (62.0)	1 (2.0)	0 (0.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	13 (26.0)	36 (72.0)	1 (2.0)	0 (0.0)	0 (0.0)	50 (100.0)

Cleanliness of Trains Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	51 (46.4)	57 (51.8)	0 (0.0)	0 (0.0)	2 (1.8)	110 (100.0)
Tema	19 (38.9)	30 (60.0)	1 (2.0)	0 (0.0)	0 (0.0)	50 (100.0)

Sekondi-Takoradi	14 (28.0)	35 (70.0)	0 (0.0)	1 (2.0)	0 (0.0)	50 (100.0)

Real-time Information of Trains Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	49 (44.5)	58 (52.7)	2 (1.8)	0 (0.0)	1 (0.9)	110 (100.0)
Tema	17 (34.0)	33 (66.0)	0 (0.0)	0 (0.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	12 (24.0)	38 (76.0)	0 (0.0)	0 (0.0)	0 (0.0)	50 (100.0)

Connection with Other Modes Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	29 (26.4)	72 (65.5)	5 (4.5)	1 (0.9)	3 (2.7)	110 (100.0)
Tema	18 (36.0)	30 (60.0)	1 (2.0)	1 (2.0)	0 (0.0)	50 (100.0)
Sekondi-Takoradi	12 (24.0)	36 (72.0)	1 (2.0)	1 (2.0)	0 (0.0)	50 (100.0)

Banning Noise-generating Activities Important

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree	Total
Accra	40 (36.4)	44 (40.0)	14 (12.7)	8 (7.3)	4 (3.6)	110 (100.0)
Tema	13 (26.0)	23 (46.0)	4 (8.0)	9 (18.0)	1 (2.0)	50 (100.0)
Sekondi-Takoradi	12 (24.0)	25 (50.0)	5 (10.0)	8 (16.0)	0 (0.0)	50 (100.0)

Pay from Accra to Tema

	Half or less of trotro travel fare	Little more	Something less	Same	Twice or more	Total
Accra	33 (30.0)	6 (5.5)	41 (37.3)	29 (26.4)	1 (0.9)	110 (100.0)
Tema	11 (22.0)	3 (6.0)	32 (64.0)	3 (6.0)	1 (2.0)	50 (100.0)

Pay GHS 50 per Passenger from Accra to Tema

	Yes	No	Total
Accra	62 (56.4)	48 (43.6)	110 (100.0)
Tema	31 (62.0)	19 (38.0)	50 (100.0)

Pay from Takoradi to Kumasi

	Half or less of trotro travel fare	Little more	Something less	Same	Total
Sekondi-Takoradi	4 (8.0)	1 (2.0)	37 (74.0)	8 (16.0)	50 (100.0)

Pay GHS 50 per Passenger from Takoradi to Kumasi

	Yes	No	Total
Sekondi-Takoradi	35 (70.0)	15 (30.0)	50 (100.0)

Segregation of Coaches

	Yes	No	Total
Accra	16 (80.0)	4 (20.0)	20 (100.0)
Tema	8 (88.9)	1 (11.1)	9 (100.0)
Sekondi-Takoradi	18 (72.0)	7 (28.0)	25 (100.0)

Notification of Train Delays

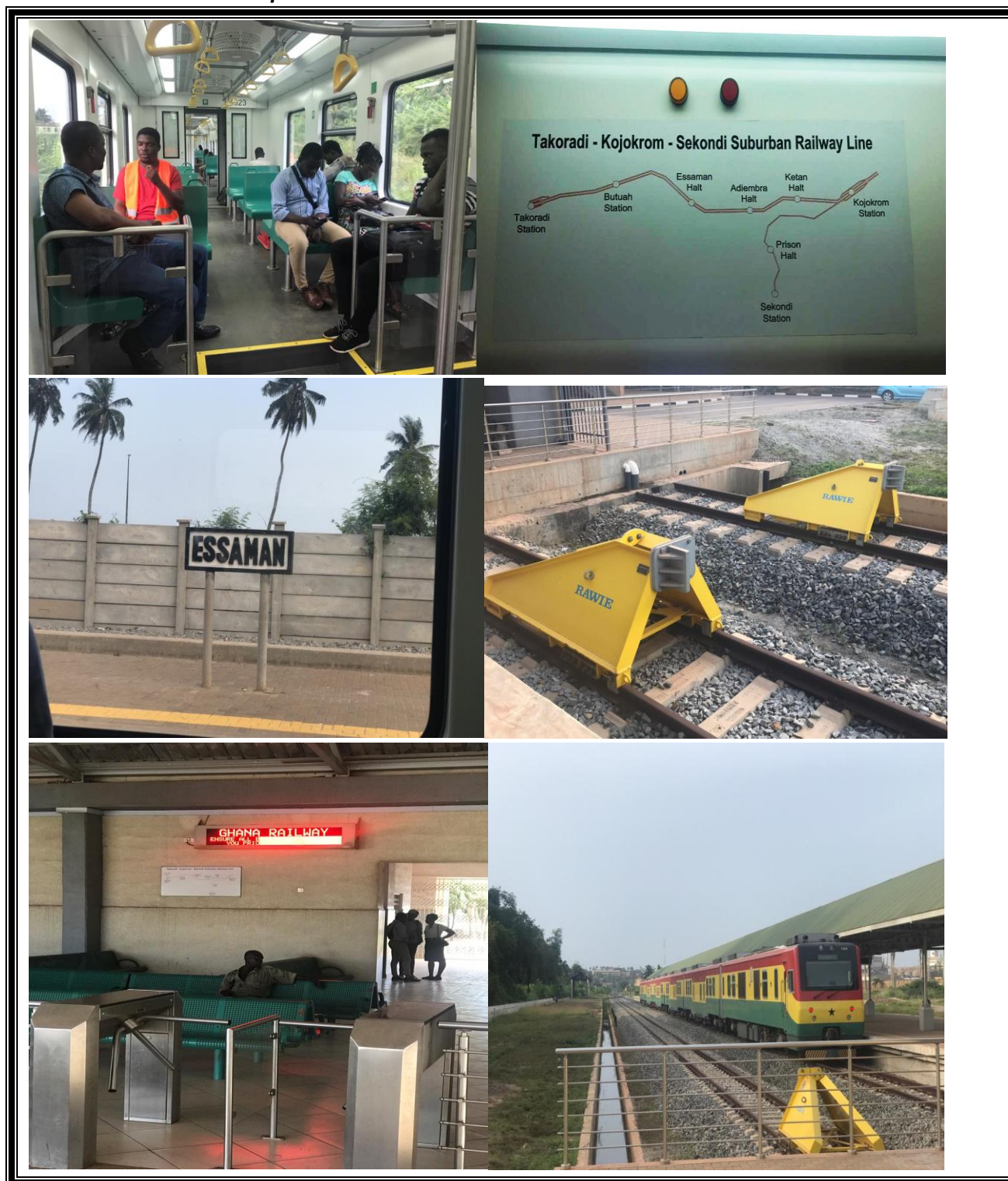
	Yes	No	Total
Accra	20 (100.0)	0 (0.0)	20 (100.0)
Tema	9 (100.0)	0 (0.0)	9 (100.0)
Sekondi-Takoradi	24 (96.0)	1 (4.0)	25 (100.0)

Means of Notification of Delay

	Phone apps	Phone short code	Radio	Text message	WhatsApp	PA system	Total
Accra	3 (15.0)	0 (0.0)	1 (5.0)	4 (20.0)	5 (25.0)	7 (35.0)	20 (100.0)
Tema	2 (22.2)	0 (0.0)	0 (0.0)	6 (66.7)	0 (0.0)	1 (11.1)	9 (100.0)
Sekondi-Takoradi	1 (4.0)	1 (4.0)	1 (4.0)	11 (44.0)	4 (16.0)	6 (24.0)	25 (100.0)

Appendix 6.0 Field Pictures

Sekondi-Takoradi Rail Infrastructure



Old Rail Infrastructure in Kumasi



Accra-Tema Rail Infrastructure



ANNEX 3. MAIN PPP RAILWAY PROJECTS IN AFRICA

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Ethiopia - Djibouti	a) EDR (Operations) b) JV CREC and CCECC (Construction)	2017		Addis Ababa (Ethiopia) Port of Doraleh (Djibouti)	759	G	20.000.000 (Designed transport capacity)	130.000 (Designed transport capacity)

CONCESSION / CONSTRUCTION CONTENTS
a) Concession/Construction: - construction: JV CREC (China Railway Group Limited) and CCECC (China Civil Engineering Construction Corporation) - concession: Ethio-Djibouti Railway (EDR) b) Activities Construction: rolling stock had been purchased by Ethiopian Railways Corporation (ERC). All the rolling stock has been transferred to the Ethio-Djibouti Standard Gauge Railway Share Company (EDR) which operates the railway as a share kind contribution by ERC Actual costs of the Addis Ababa–Djibouti Railway were around 4,5b\$. This is approximately 30% more than originally planned Concession: initially (up to 2023) operations on the new railway will be undertaken jointly by the China Railway Group Limited (CREC) and the China Civil Engineering Construction Corporation (CCECC), then it will managed by EDR c) Shareholders - EDR - 25% Djiboutian government - 75% Ethiopian government b) Construction JV CREC (China Railway Group Limited) and CCECC (China Civil Engineering Construction Corporation)

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) The initial operations made by the construction company will prevent issue due to management discontinuity in the first running; b) An important investment (even non totally sufficient) has been provided and funded 70 percent by the Export-Import Bank of China and 30 percent by the Ethiopian government c) Africa's first standard-gauge electrified railroad

ISSUES (EXPERIENCED / POTENTIAL)
a) In order to reduce the investment (cheap railway line first), the railway line was built without access roads, trunk lines, spur lines, branch lines, storage facilities, goods handling facilities or dry ports. Furthermore most railway stations are far outside the city centers and even outside the towns and cities they are intended to serve b) The construction of the railway line was an EPC/Turnkey project. However, the accompanying infrastructure was neglected, and the railway was not ready to go into commercial operation at its commissioning c) Many mistakes in project planning and execution produced losses for around 1 B\$. This is approximately 30% more than originally d) the loans given by China is very high so such development project needs to be profitable in a medium term

ADDITIONAL INFO
https://ethiodjiboutirailway.com/en/

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Kenia - Uganda	RVR (Rift Valley Railway)	2006	25 (ended in 2017)	Mombasa - Nairobi Nairobi - Nanyuki Nairobi - Kitale	2.541	R	1.335.000	0

CONCESSION / CONSTRUCTION CONTENTS
a) Concession: Kenia and Uganda Railways jointly own the railway infrastructure and facilities on the concessioned line from Mombasa in Kenya to Kampala in Uganda. b) Activities: the concessionaire operates the rolling stock and maintains the infrastructure. In reality the concessionaire also invests in infrastructure improvements and expansion. In 2017 Kenya and Uganda Governments terminated the 25-year contract signed with the Rift Valley Railways (RVR). The termination order was put into effect following RVR's failure to meet the set operating targets and agreements- The operations of the railway in Kenya reverted to the Kenya Railways Corporation. Uganda Railways will resume operations, as before the concession was awarded c) Shareholders (March 2010) - Africa Railways of Egypt (subsidy of citadel capital) (51%), - Trans-Century Limited of Kenya (34%), - Bomi Holdings of Uganda (15%)

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) A strong partnership with America Latina Logistica has been built up to benefit from their experiences in managing and operating rail infrastructure and services. This partnership has allowed RVR to develop new markets by finding innovative solutions to transport bulky goods.

ISSUES (EXPERIENCED / POTENTIAL)
a) At the beginning of the project was not made an adequate assessment of the infrastructure and the existing rolling stock . This was recognised after the concession was awarded changing the original business plan. It is possible that suitable technical assistance at this stage could have isolated the factors for developing a good contract and could have circumvented some of the problems b) Considering the before point the investment and financial structure was not adequate to the needs of the project and even the later investment of 287 m\$ made in 2010 was not enough c) Insufficient due diligence was carried out on the financial capabilities of the original shareholders

ADDITIONAL INFO
http://krc.co.ke/

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Kenya	a) CBRC (Construction) b) CBRC (Concession)	2017	10	Mombasa - Nairobi	485	G	14.000.000 (by end 2019)	1.400.000 (2018)

CONCESSION / CONSTRUCTION CONTENTS								
a) concession - Construction: China Road and Bridge Corporation (CBRC) - Concession: China Road and Bridge Corporation (CBRC) b) Activities A new standard gauge line is under construction from Mombasa to Nairobi parallel to the existing metre gauge line. Financing is a commercial loan from Exim Bank of China. Contract includes construction and procurement of rolling stock Construction of 472km Mombasa – Nairobi standard-gauge railway (SGR) is due to be completed in March 2017 by China Railway and Bridge Corporation Concession: CRBC has a 10-year concession to operate the line, to allow test running to begin in preparation for the start of train operation. The Chinese will be in charge of the new railway line for some time, while Kenyans are being trained to take over. The line will initially carry diesel cars while electrification is possible in future. c) Shareholders								

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)								
a) The railway is the Kenya's biggest infrastructure project and it is also a part of a strategic plan for China to deepen its economic links in Africa b) The project cost \$3.2bn and the Export-Import Bank of China reportedly funded 90 percent of the total c) It took three-and-a-half years to build, using Chinese track-laying technology and there were light different with the initial forecast d) The line is supposed to eventually connect land-locked South Sudan, eastern Democratic Republic of Congo, Rwanda, Burundi and Ethiopia to the Indian Ocean e) Cuts the journey-time from Mombasa to Nairobi to four-and-a-half hours, compared to nine hours by bus or 12 hours on the previous railway								

ISSUES (EXPERIENCED / POTENTIAL)								
a) Given the investment of 3,2 b\$ the break-even point supposed by 2020 seems to optimistic including the increase of traffic b) Many of the employees working for the SGR are Kenyans. However, as of July 2018, Chinese workers still occupy most of the critical positions, including dispatcher and locomotive drive								

ADDITIONAL INFO								
http://krc.co.ke/								

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Zambia	RSZ	2003	30 (ended in 2012)	Railway systems of Zambia	1.200	R	0	0

CONCESSION / CONSTRUCTION CONTENTS
a) concession: was awarded in 2003 to RSZ (Railway System Zambia), It was cancelled in 2012 by the government because of the deterioration of infrastructure by the concessionaire and because the concessionaire decreased significantly the performance and quality of rail services. b) activities Operations maintenance of national railways. The concessionaire made a provision of US\$40 million for the rehabilitation of Zambia Railways Unclear contract language and the lack of a rail regulator with the clear powers of sanctions for breaking the terms of the contract contributed to the poor performance of the concessionaire. The concession was structured to perform on net/tkm basis. Transnet (first three years)/Spoornet have been involved in the beginning. When the concessionaire realized that the agreement is not working he started to renegotiate. However the railway transport was cancelled to a certain degree as the losses were increasing. Trading became the more important business and finally was the core business of the concessionaire. Shareholders:

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) in order to improve operation after concession failure, the Industrial Development Corporation (IDC) Board has approved an investment of 850 m\$ into rail infrastructure and rolling stock for Zambia Railways Limited (ZRL) b) to increase profits and make the company sustainable ZRL has been transforming from an ordinary rail company to a total logistics provider

ISSUES (EXPERIENCED / POTENTIAL)
a) The concession not only deteriorated rail assets and the government had to stop this development and to cancel the concession to avoid further downgrading of railways. The mining companies changed to road due to the poor performance of the railways b) Unclear contract language and the lack of a rail regulator with the clear powers of sanctions for breaking the terms of the contract contributed to the poor performance of the concessionaire. c) Not planned additional additional costs for securing and subsidising passenger train operations

ADDITIONAL INFO

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Morocco	ONCF(public corporation)			a) Atlantic railway corridor: Tanger – Casablanca (TGL) b) Maghrebi (E – O) railway corridor: Nador – Casablanca (TGL) c) Casablanca - Marrakech	2.295	R = current railway G = Casablanca - Marrakech	30.000.000	38.000.000

CONCESSION / CONSTRUCTION CONTENTS
a) Concession: ONCF is currently a public corporation, benefiting from the Établissement Public Industriel etCommercial (EPIC) status. It is member of the UIC and UACF. b) Activities: ONCF missions are as followed : - Operate national railways - Carry studies, construction and operation of new railway lines - Operate all mission-related enterprises Budget efforts in infrastructure development and maintenance were significant, growing from \$ 857m for 2002-2005 to \$ 2.2b for 2005-2009, allowing doubling tracks on high traffic sections (Casablanca – Fès, Casablanca-Kenitra, Casablanca-El Jadida et Fès-Sidi-Kacem), and participating to upgrades in ageing signalization system. c) Shareholders

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) Morocco's approach to reforming railways has differed substantially from other African countries. Instead of switching to a concession system by a PPP Morocco reformed of its state-owned monopoly ONCF towards a market-oriented strategy, b) Unlike other situations, Morocco's: railways was not so in bad condition managers and staff were technically competent; government put financial resources to rescue ONCF from crisis, and to develop activities c) ONCF invested around 630 m\$ in projects to modernize the network and operations currently generate enough revenues to sustain rehabilitation and maintenance of existing tracks and rolling stock. d) In Morocco started the first HSR in Africa Tangier-Casablanca e) Road transport is not perceived as competitive with freight activities, but rather as complementary

ISSUES (EXPERIENCED / POTENTIAL)
a) The investment for HSR (Tangier - Casablanca) of 1,2 b\$ could not be have an adequate return and profitability

ADDITIONAL INFO
https://www.oncf.ma/

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Senegal - Mali	Transrail	2003	25 (ended in 2015)	Dakar-Bamako	1287 km a) 642 Mali b) 644 Senegal	R	250.000	2.600.000

CONCESSION / CONSTRUCTION CONTENTS
a) Concession: awarded in 2003 to Transrail a Franco-Canadian management consortium b) Activities A vertically-integrated concession that allocates full responsibility for infrastructure and rolling stock to the concessionaire. The Concessionaire supports all the operations, maintenance, renewal and building costs of the track. Concessionaire investment in rail infrastructure above a certain threshold requires the approval of the Concession Authority. The Concessionaire bought the rolling stock that it wanted from the state companies and was free to buy additional vehicles. All acquisitions were financed by the concessionaire except and is responsible for maintenance and operations. The concessionaire was obliged to take equal shares of staff from the previous national railway companies of Mali and Senegal. In the case of PSO, operation and maintenance costs of rolling stock should be reimbursed by the public authority. Nevertheless international passenger services were discontinued because of safety concerns. Despite Transrail's obligation to maintain a passenger service, they concentrated on the transport of goods. Many stations have been closed and the numbers of connections reduced, creating difficulties for isolated communities. Apart from the petit train de banlieue, twice-daily service between Dakar and Thiès, passenger services have been suspended since the 2009 accident c) Shareholders Transrail was bought in 2007 by the Belgian company Vecturis

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) Governments in Senegal and Mali are studying a new institutional framework for railways. Separation of infrastructure (governments) and operations (private) is widely accepted, but many government officials still believe that fees will be enough to repay debt and fund maintenance, although this is not practical. b) It is extremely important that new institutional arrangements are based on sound business models and that governments are fully aware of the costs that would be associated with owning, regulating and managing their railway network. c) Mali and Senegal have signed agreements worth US\$2.73bn with the state-owned China Railway Construction Corporation (CRCC) for the upgrade of the 1,228-km Dakar-Bamako railway line. d) The project has been structured as two separate agreements: - 1.24 b\$ deal between CRCC and Senegal—funded by a 30-year loan from China with a 2% interest rate; - 1.49b\$ agreement between CRCC and Mali, for which financing is also likely to come from a Chinese institution

ISSUES (EXPERIENCED / POTENTIAL)
a) The initial financial package associated in 2003 with the concession (65 m\$) greatly underestimated the funding needs required to upgrade the infrastructure so operations could be performed to acceptable standards binational concession with two sovereign authorities adds complexity to what it is usual in these cases, as it involves different jurisdictions, customs, tax and social security regimes. b) binational concession with two sovereign authorities adds complexity to what it is usual in these cases, as it involves different jurisdictions, customs, tax and social security regimes; c) Transrail shareholding has been notoriously unstable and most stakeholders can show little—if any- track record in the railways industry. d) On December 7th 2015 the governments of Mali and Senegal unilaterally ended the contract, suggesting some form of compensation payment will need to be made to concessionaire to avoid lengthy arbitration procedures e) Current situation in 2019: the Dakar-Bamako train is definitely not running at the moment, and hasn't done for some years. All passenger service has stopped completely except for Kayes-Bamako, and shows no sign whatsoever of resuming anytime soon.

ADDITIONAL INFO
0

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Tanzania	TRL	2007	25 (ended in 2010)	North and East of Tanzania	2.720	R	270.000	290.000

CONCESSION / CONSTRUCTION CONTENTS
a) Concession: Tanzania Railway limited (TRL) is a rail operator providing Freight and Passenger service. From 2007 to 2010 TRL was under a concession. From 2010 TRL come back as state company in 2018 has been established TRC the new state owned concessioarie c) Activities: The concession imply maintenance of railways and investement on new . However there were disputes over funding and the condition of inherited assets. In 2009 RITES threatened to pull out 25 locomotives and 23 coaches it had imported from India on lease, saying it had not been paid. Furthermore delays is the payment of wages led to industrial action, resulting in the government having to pay a large part of the arrears to defuse the situation. In 2010 Rites withdrew and the contract was cancelled , leaving TRL as a wholly state-owned company In 2018 a new Tanzania Railways Corp (TRC) has been established to bring together railway infrastructure and operations, following a decade of vertical separation. The staff and assets of state-owned infrastructure company Reli Assets Holding Co have been merged with those of operating concessionaire Tanzania Railways Ltd to form the new corporation, along with their related debts. C) Shareholders : initial concession (2007-2010) - Government of Tanzania 51% - RITES (an indian company): 49% from 2010 100% Government of Tanzania

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) in the new concession based to TRC the Company organisational structure has been modified to establish a department of business development, which will oversee the transformation of prevoius TRL from operational to business oriented, and from loss making to a commercially successful and profitable company. b) Cost centres and business units will be established in order to introduce or enhance performance based evaluation and reward for the various departments

ISSUES (EXPERIENCED / POTENTIAL)
a) The failure of the Tanzanian concession was due to a number of factors, the main one being the lack of clear understanding on both sides (that is, the concessionaire and the government) of the expectations of the other. b) There was no assessment of the condition of the infrastructure before the concession was awarded. c) The government promised staff a salary increase when the concessionaire came in, this was not agreed with the concessionaire who refused to pay. The government then paid the increase themselves. d) In an effort to increase revenue, the concessionaire raised the rail tariffs to a level where it was 70% more expensive to transport by rail than by road. Transport times were not reduced, it still took much longer to transport by rail. e) The concession to RITES Ltd of India was cancelled in 2010 and the Government and resumed control

ADDITIONAL INFO

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Tanzania-Zambia	a) TAZARA (Tanzania Zambia railway authority) jointly and equally owned by governments of Tanzania and Zambia and has never been put into a concession agreement	1975		Dar es Salaam (Tanzania) - New Kapiri Mposhi (Zambia)	1860 (Tazara)	R	4.900.000	1.650.000

CONCESSION / CONSTRUCTION CONTENTS	
a) Concession	TAZARA (Tanzania Zambia railway authority) jointly and equally owned by governments of Tanzania and Zambia and has never been put into a concession agreement
b) Activities	In the latest year both services (freight and passenger) declined due to the ageing of the installations and the lack of maintenance, the railway has begun to decline also on the financial front, the situation is critical. In 2016 China announced it will rehabilitate the Tanzania-Zambia Railway, opening thus new development perspectives for the entire region. China will inject m\$ 376 in the rehabilitation of the 1,860 km of the Tanzania-Zambia Railway (Tazara) which connects the port of Dar es Salaam to the Zambian city of Kapiri-Mposh In latest 2019 to The government of China has made another announcement plans to offer approximately US \$1.2bn to the Tanzania Zambia Railway Authority (TAZARA) for the rehabilitation of the railway line shared by the two states (Tanzania and Zambia).
c) Shareholders	- Government of Tanzania (50%) - Government of Zambia (50%)

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)	
a)	the new project include not only to rehabilitate the railway but also to expand the railway, with the construction of links and junctions with the original path towards the new Tanzanian harbour of Bagamoyo, towards Malawi, Katanga, Rwanda and Burundi
b)	as first part of the project In 2016, the company set in motion an ambitious programme to rehabilitate 400 wagons by 2018. In 2017 they have refurbished 315 wagons of various types and capacities in our workshops

ISSUES (EXPERIENCED / POTENTIAL)	

ADDITIONAL INFO	
	https://www.tazara.co.tz/

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
France	LISEA	2017	50	Tours - Bordeaux	300	G	0	0

CONCESSION / CONSTRUCTION CONTENTS
a) Concession: Lisea awarded a concession contract that includes financing, design, construction, operation, and maintenance of the project for 50 years. LISEA has employed joint venture COSEA to deliver the design and construction. MESEA, a 70:30 joint venture between Vinci and SYSTRA, will be responsible for the maintenance of the new line. b) Activities: The HSR project is 302 km long, with 38 km of connecting line to the conventional rail network. It represents a total investment of €7.8 billion and is the biggest public-private partnership (PPP) contract ever signed in France's rail sector as well as one of the world's largest infrastructure projects launched over the last decade. The concession provides for the financing, design, construction, operation and maintenance of the new line with a projected construction period of 6 years The design-build contract has been awarded to COSEA, a consortium led by VINCI Construction. Other players include Eurovia, BEC, NGE, TSO, Ineo, Inexia, Arcadis, and Egis Rail. LISEA will be remunerated in the form of traffic-related fees paid by users operating trains capable of travelling on the new line. Traffic risk rests with LISEA. c) Shareholders - Vinci Concessions(Vinci SA subsidiary) (33.4%= - Caisse des dépôts et consignations (25.4%) - Meridiam (22.0%) - Ardian (19.2%)

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) The HSR project is 302 km long, with 38 km of connecting line to the conventional rail network. It represents a total investment of €7.8 billion and is the biggest public-private partnership (PPP) contract ever signed in France's rail sector as well as one of the world's largest infrastructure projects launched over the last decade. b) The concession provides for the financing, design, construction, operation and maintenance of the new line with a projected construction period of 6 years c) The concession contract includes financing, design, construction, operation, and maintenance of the project for 50 years. The design-build contract has been awarded to COSEA, a consortium led by VINCI Construction. Other players include Eurovia, BEC, NGE, TSO, Ineo, Inexia, Arcadis, and Egis Rail.

ISSUES (EXPERIENCED / POTENTIAL)
a) An innovative procurement model target to integrate building with operation optimizing the total cost for the 50 Y period concession b) Concession length: A longer than usual concession period of 50 years was agreed in order to provide better value for money financing. c) Traffic risk: Patronage risk is borne by the concessionaire to achieve a better risk and reward package. d) The project apply some innovative instruments and machinery for infrastructure and rolling stock maintenance.

ADDITIONAL INFO
0

GENERAL DATA								
Countries	Concession/ Construction Company	Start Y	Duration	Route Railway Concession/ Construction	Route Railway network length	Type of Investment: R = Rehabilitate G = Green field	Freight (tonnes)	Passengers
Netherlands	HSL Zuid	2009	30	Amsterdam area - Belgian borders	125	G	0	24.000.000

CONCESSION / CONSTRUCTION CONTENTS
a) Concession The Government of the Netherlands awarded the country's largest ever public-private partnership (PPP) contract to the consortium Infrasppeed until 2030; it is responsible for design, construction, financing and maintenance b) Activities: The Dutch Transport Ministry was the client and financier of all civil works (including tunnels, bridges and elevated sections) throughout the project, and retains ownership of the line. Construction of the railway civil works was divided into several contracts, each worth about EUR 400 million, awarded to different contracting consortia. A key feature of the project was the separation of the construction works package from track and signalling to achieve a better risk allocation. As part of the development of HSL Zuid, The State of the Netherlands (Dutch State) procured a Public-Private Partnership (PPP) for the railway infrastructure, including the track system, the traction power supply system, the signalling system, noise barriers, communication systems and ancillary equipment such as tunnel technical installations (the HSL infrastructure). c) Shareholders: Infrasppeed consists of Fluor Daniel, BAM/NBM, Siemens, Innisfree and Charterhouse Project Equity Investment. The banking consortium is led by Bayerische Hypo- und Vereinsbank, ING, KBC, KfW, Dexia Public Finance Bank and Rabobank

POSITIVE FACTORS (EXPERIENCED / POTENTIAL)
a) The 10% involvement of Dutch flag carrier airline KLM (now part of Air France) in partnership with Nederlandse Spoorwegen (NS) as service operators HSA, operating as NS Hispeed, is illustrative of integration of the project with other transport modes, as is the building of extensive car parking near the stations involved.

ISSUES (EXPERIENCED / POTENTIAL)
a) The HSL started operation in 2009, after a four year delay. The track was finished in 2007. b) However because of problems with the trains ordered and the security system, it was not possible to start operations earlier. c) In deciding the definite route, there was a conflict between the Dutch and Belgium/Flemish government about the best route to cross the border and enter Antwerp

ADDITIONAL INFO
a) http://www.infrasite.nl b) https://www.ns.nl

ANNEX 4. PREVIOUS PROPOSAL FOR THE RAILWAY DEVELOPMENT IN GHANA (DRAFT FINAL REPORT - REF: 379-00-MP-R-DF-1 DATED JULY 2019): EXECUTIVE SUMMARY.

1. Introduction

This Annex 4 presents the Executive Summary of the Draft Final Report (Ref. 379-00-MP-R-DF-0).

The Draft Final Report (Ref. 379-00-MP-R-DF-0) has been submitted on 19th July 2019 and was presented officially on 8th August 2019 to the Ministry of Railways Development and the Ghana Railway Development Authority, in the presence of: Hon. Minister Joe Ghartey (Minister for Railways Development), Richard Diedong Dombo (CEO of GRDA), Siisi Essuman Ocran (Acting Chief Director of MoRD), Lord Laud Quansah (Director of GRDA), Kwabena Bomsu (Civil Engineer MoRD), Seth Owus Marfo (P.A of the Hon. Minister), Godwin Kobla Gadikor (Director PPMA MoRD), Christabel Naa Kowah Quaye (Senior Private Secretary - MoRD).

The Draft Final Report contained the outcomes of the Cost-Benefit Analysis for the development of the National Railway Network proposed in five different phases (2022-2045) and carried out on the basis of the traffic forecasts, collected in the first Data Analysis Report (Ref. 379-00-MP-R-DA-0) submitted on 17th April 2019 with the letter LM/md/397.18/079/19.

2. Investment Plan for the new railway system

The Proposed Expansion of the National Railway Network runs along several corridors in a north-south and east-west direction and, besides linking the main cities, also connects both existing and potential mineral deposits with the two important Ports in the Country (Takoradi and Tema).

The New Railway Network is comprised mainly of three north-south routes (Ghana-Burkina Faso, Central Spine and Western Expansion), a coastal line running in an east-west direction (Trans-ECOWAS Corridor) and three Transversal connections.

The expansion of the National Railway Network will be carried out with the **construction of new Standard Gauge lines** to ensure a more complete transportation service for the whole Country.

The development of the New Railway Network will be implemented in successive phases, identified on the basis of the priorities for the traffic demand and considering, simultaneously, the strategic importance of each railway link for the development of the Country.

The study is based on the assumption that the expansion will be developed by **2045** in **five (5) Phases of intervention** and preceded by an **initial scenario (Phase 0)** which will be completed by the year **2022**, when the standard gauge railway lines (Tema-Akosombo and Takoradi-Tarkwa), currently under construction, will be in operation.

Phases 1, 2, 3, 4 and 5 are forecasted to enter the infrastructure scenario in the year 2027 (Ph. 1-2), 2032, 2037 and 2045 respectively. To respect such timing, it is necessary that a structured and co-ordinated political, financial and industrial effort be put into place, so as to give consistency and continuity to the development of the railway infrastructure, particularly concentrated in the 15 years immediately after completion of Phase 0. Moreover, there is also the opportunity for the Country to achieve the same goals even more rapidly, should the scenario conditions be even more optimistic, as

➤ **Phase 1** includes the completion of the construction of the **SG Western Railway Line and its branch (273 km)**, and the construction of the **SG Eastern Railway Line (304 km)**, both are always considered among the priority interventions to be implemented for the development of the economy of the Country.



Schematic Map of Proposed New Rail Network

- **Phase 2** introduces the entry in operation of the second section of the **Ghana - Burkina Faso Interconnectivity Project (690 km)**, of which the first section Tema-Akosombo-Mpakadan (97 km) is already under construction.

Both Phase 1 and Phase 2 will be in operation starting from 2027, given the importance of having these connections for the Country as soon as possible.

- Once the north-south connection has been guaranteed with the completion of Ghana-Burkina Faso corridor, **Phase 3 - the TransECOWAS rail (557 km)** will put in place the west-east connection and the integration of Ghana within the ECOWAS region. The TransECOWAS railway line is considered to be in operation by 2037.
- **Phase 4 - Central Spine** -, assumed to be in operation by 2037, will reinforce the north-south connection, linking Kumasi to the Ghana- Burkina Rail through Tamale (**383 km**).
- Finally, **Phase 5** is forecasted to be in operation by 2045, with the **Western Expansion** Awaso-Techiman-Sawla-Hamile (**656 km**) and the **Transversal Expansion (383 km)**, including the three following sections: Fufulsu-Sawla, Techiman-Atebubu-Kwadwokuro, Nyinahin-Kumasi.

The following Table summarizes the studied phases for the expansion of the New National Railway Network.

PHASES	Length approx. (km)	Operational starting from
PHASE 0	163	2022
Western Line (Takoradi-Tarkwa)	66	
Ghana-Burkina Faso Lot. 1 (Tema-Akosombo-Mpakadan)	97	
PHASE 1	577	2027
Western Line (Tarkwa-Kumasi/Dunkwa-Awaso)	273	
Tarkwa-Kumasi	200	
Dunkwa-Awaso	73	
Eastern Line (Accra-Kumasi)	304	
PHASE 2	690	2027
Ghana-Burkina Faso Lot. 2 (Mpakadan-Nkwanta-Yendi-Tamale-Paga)	690	
Mpakadan-Nkwanta-Yendi	376	
Paga-Tamale-Yendi	314	
PHASE 3	557	2032
TransEcowas (Aflao-Accra-Takoradi-Elubo)	557	
Aflao-Tema-Accra	185	
Accra-Takoradi	212	
Takoradi - Elubo	160	
PHASE 4	383	2037
Central Spine (Kumasi-Tamale)	383	
PHASE 5	1039	2045
Western Expansion (Awaso-Techiman-Sawla-Hamile)	656	
Awaso-Techiman	220	
Techiman-Sawla	223	
Sawla-Hamile	213	
Transversal Expansions	383	
(Transversal 1) Fufulsu-Sawl	126	
(Transversal 2) Techiman-Atebubu-Kwadwokuro	199	
(Transversal 3) Nyinahin-Kumasi	58	
TOTAL	3,409	2022-2045

Proposed phases for the expansion of the National Railway Network

3. Results of the Traffic Demand Forecasting

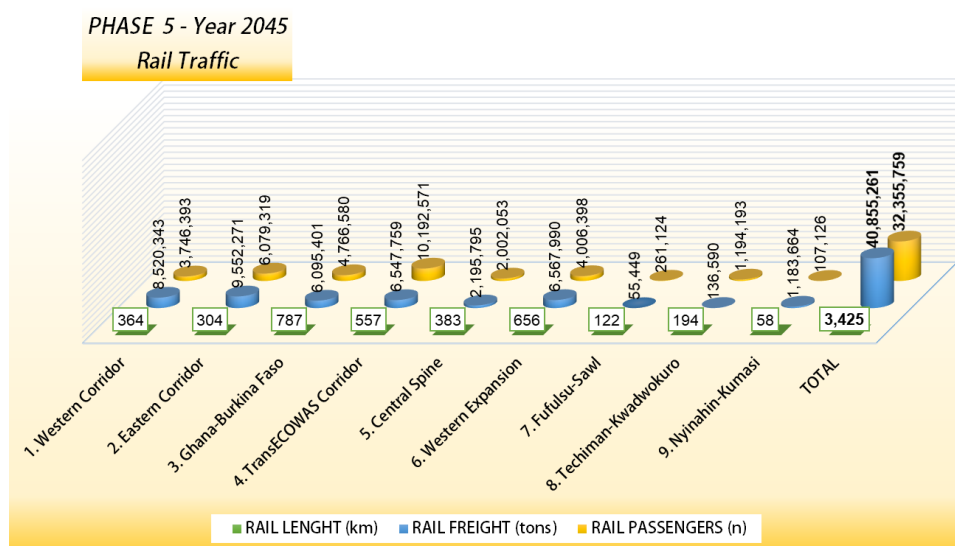
The Traffic Demand Forecasting was carried out for the five (5) different scenarios.

Despite the “conservative” approach followed, **the result of the traffic forecasts shows significant traffic flows** both on the road network and on the railway network. In the long-term scenario (year 2045) the rail traffic demand on some corridors (mainly on Western and Eastern) will be represented by **high volumes** that are comparable to the existing volumes of some main European rail lines. This is a consequence of both demographic development and economic development.

The outcomes of the traffic study indicate that the new railway network, once in operation in 2045, will be able to absorb 40.8 million tons of freight (45.97% of the national freight traffic) and 32.3 million passengers (17.21% of the overall passenger traffic).

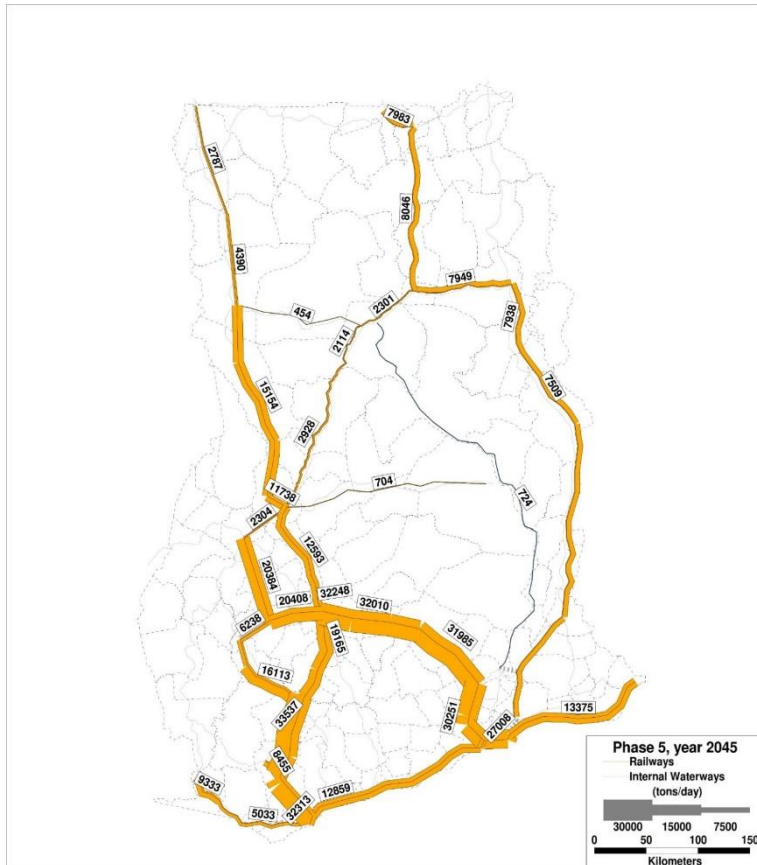
PHASE 5 (Year 2045)	ROAD			RAIL			TOTAL (Rail+Road)	
	LENGHT (km)	FREIGHT (tons)	PASSENGERS (n)	LENGHT (km)	FREIGHT (tons)	PASSENGERS (n)	FREIGHT (tons)	PASSENGERS (n)
1. Western Corridor	489	10,929,591	33,451,680	364	8,520,343	3,746,393	19,449,933	37,198,073
2. Eastern Corridor	376	11,713,417	39,239,109	304	9,552,271	6,079,319	21,265,688	45,318,428
3. Ghana-Burkina Faso	757	8,612,493	15,604,164	787	6,095,401	4,766,580	14,707,894	20,370,744
4. TransECOWAS Corridor	396	8,877,791	45,565,953	557	6,547,759	10,192,571	15,425,550	55,758,525
5. Central Spine	378	1,875,587	8,562,779	383	2,195,795	2,002,053	4,071,382	10,564,832
6. Western Expansion	662	5,589,182	12,751,331	656	6,567,990	4,006,398	12,157,171	16,757,729
7. Fufulsu-Sawl	146	124,692	255,641	122	55,449	261,124	180,141	516,765
8. Techiman-Kwadwokuro	0	0	0	194	136,590	1,194,193	136,590	1,194,193
9. Nyinahin-Kumasi	78	301,780	264,545	58	1,183,664	107,126	1,485,444	371,671
TOTAL	3,283	48,024,532	155,695,201	3,425	40,855,261	32,355,759	88,879,794	188,050,960

Road and Rail traffic of the Phase 5 - Year 2045



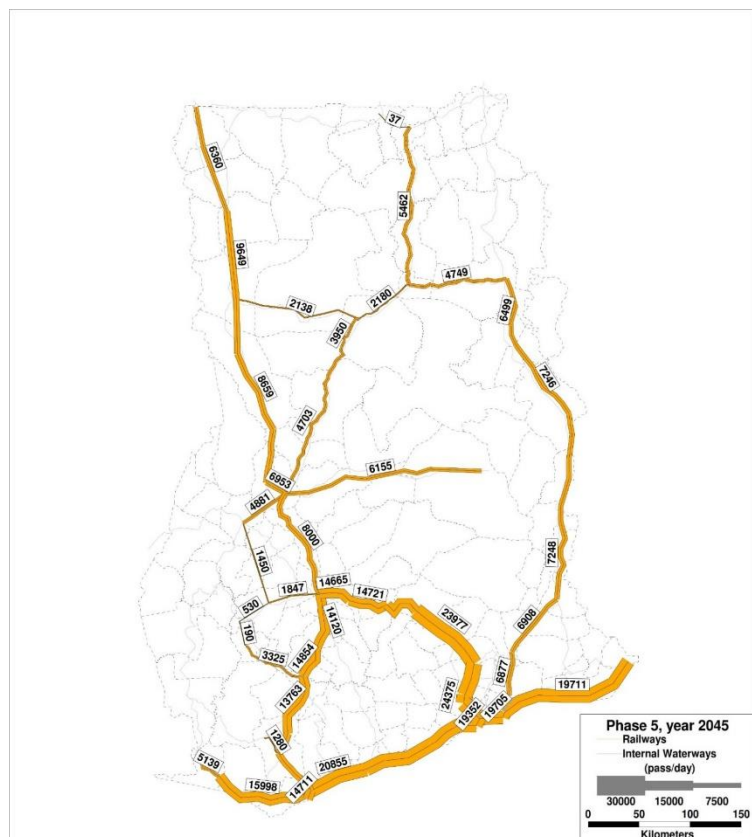
Rail Traffic of the Phase 5 - Year 2045

The next figures contain the rail traffic flow-diagrams for the freight and passenger transport demand at year 2045, when all the foreseen Phases of the National Railway Master Plan will be implemented.



Freight traffic flows assigned for the Phase 5 at year 2045 (Railway Network)

Passenger traffic flows assigned for the Phase 5 at year 2045 (Railway Network)



4. Main technical characteristics

The development of the interventions has been spread over a period of 23 years. The interventions, foreseen by the Ghana Railway Master Plan, concern the construction of **3,409 km** of new standard gauge railway lines.

Physical characteristics and main constraints, which directly affect the technical aspects of the rail line and consequently the costs of the infrastructure, have been analysed for every rail corridor of the future National Railway System. Starting from this analysis, the performance and Design Criteria for the New Standard Gauge Lines are proposed, as follows:

- Minimum planimetric curve radii of 1500m on the flat and 1200m in hilly terrain:
- 5‰ maximum gradients on the flat, 10‰ in hilly terrain and exceptionally 15‰; maximum axle load 25 ton;
- Permanent way on ballast with 60kg/m rails, elastic fastenings and prestressed concrete sleepers (those for the rehabilitation of narrow gauge with a length of 2.60m, predisposed for the successive transformation to standard gauge).
- Maximum speed for passenger trains: 120 and 160km/h respectively for local and express trains.
- Maximum speed for freight trains: 80 and 100 km/h, for light commercial loads and heavy mine transport.
- For the stations: Adoption of European railway standards (in line with UIC recommendations) for the stops, secondary and main stations, in regard to the dimensions and equipment of the spaces dedicated to passengers (concourse, waiting rooms, toilets), to commercial premises and operational service premises (ticket office, technical installations' premises, premises for personnel). For the comfort of passengers, cantilevered roofs will be foreseen along the boarding and disembarking platforms and pedestrian under and overpasses, equipped also with elevators for access to the train platforms (where applicable).
- For signalling and telecommunications: the proposed long distance Telecommunication system is based on Synchronous Digital Hierarchy (SDH) technologies. The installation is foreseen with optic fibre cables along each railway line and the installation of signal regenerators in each station. The network is completed with the DMR (Digital Mobile Radio) radio communication system, with a frequency band dedicated for use on the railway network, reserved for land-train service communication and for personnel in service along the line.

The proposed Signaling System for the new Ghana Railway System is based on the European Railway Traffic Management System (ERTMS) Level 1 initially, to be upgraded to ERTMS Level 2 in a subsequent phase. The Level 1 equipment will to be integrated with additional outdoor equipment: track circuits, axle counters and level crossing installations.

- Train operations: In terms of transport capacity, it has been assumed:
 - the standard freight train is composed of 30 wagons and one (or two) locomotives, depending on the line gradient and expected maximum speed, with a total mass of around 1,500 tons, with a maximum load of 25tons/axle and maximum speed of 80-100km/h and commercial speed of 60-70km/h

- the standard passenger train is composed of 12 coaches and one locomotive. In terms of maximum transport capacity, such a train is suitable for 1,200 passengers and maximum speed of 120-160km/h and commercial speed of 80-100km/h.

The Rolling Stock for the foreseen operations on each line of the railway network has been calculated in accordance with the Traffic Demand Forecasting.

At the 2050 horizon, the fleet results as having the following total composition

- ✓ Locomotives: N° 162
- ✓ Freight wagons: N° 2,175
- ✓ Passenger coaches: N° 1,080

5. Economic Analysis

This study has been carried out according to a classical Cost-Benefit Analysis (CBA) to evaluate the economic feasibility of the foreseen investments, comparing them with the return that they will have in respect of the social benefits they produce.

The Economic Analysis is based on the comparison of the following two cases:

- The first case, called “**without Project**” is considered the normal evolution of the existing situation;
- The second case, called “**with Project**” takes into consideration the construction of new railway lines according to the plan.

The case “without Project” is represented by the **Phase 0**, which incorporates the “do nothing” scenario. New Scenarios (“with Project”), are represented by **Phases 1-2-3-4-5**, which are considered on a stand-alone basis according to an incremental approach versus Phase 0. Therefore, each Phase has been assessed on the basis of their specific capital expenditure, operating costs and benefits.

The analysis is conducted for a period of 30 years starting from the beginning of operations of the railway lines in Phase 1.

The analysis has a discontinuous characteristic, because the flow of costs and benefits may be produced at different times. For this reason, a discount rate must be used to take into account the depreciation of the currency. The Social Discount Rate in the analysis has been assumed to be 8%.

The **costs** used in the Economic Analysis, in the various phases of the Master Plan were:

- The investment over the years for the cost of the **infrastructure**, the financial value of which is approximately US\$ 18,462 million, that has been reduced with a corrective factor of 0.8 to approximately US\$13,574 million (deducting taxes, duties and excise) to obtain the **economic value**.
- The investment over the years for the cost of **rolling stock** to be purchased, the financial value of which is approximately US\$1,379 million, has been reduced with a corrective factor of 0.91 to approximately US\$1,254 million (deducting taxes, duties and excise) to obtain the **economic value**;
- The operating **costs (VOC)** per vehicle/km, as an average cost of the various categories and types of vehicles that travel on roads under various conditions.
- The cost of maintenance and operations of the infrastructures and the lines.

- The cost of maintenance and operations of the trains (ROC), both freight and passenger. The cost per ton-km has also been calculated for heavy and standard trains and the cost per passenger-km on the basis of international experience and taking into account the local conditions.

The **benefits** that have been evaluated and quantified in the Economic Analysis in the various phases of the project are as follows:

- A **saving in transport costs** for passengers due to the lower cost of transportation by rail and for the financial operators in the various business sectors;
- A **saving on road maintenance** due to the reduced traffic and less damage as a consequence of the fewer heavy vehicles in circulation;
- A **saving due to the fewer road accidents** that will occur as a consequence of the reduced road traffic.

The CBA demonstrates a positive economic return of the Master Plan's whole of life costs; the table below summarises the performance indicators' results

Economic performance indicators	Value	Unit
Economic Net Present Value	6,078	M US\$
Economic Internal Rate of Return	14.2%	%
Economic Benefits to Cost Ratio	1.7	ratio
Payback Period	18	years

Economic performance indicators

6. Financial Analysis

The Financial Analysis examines the financial investments of the total of the 5 Phases of the new Railway Master Plan (18,461 M US\$ for the infrastructure and 1,378 MUS\$ for the rolling stock), operating expenses and the operative revenues, according to the priority programme derived from the Economic Analysis

The Financial Analysis is conducted over a long period (**2022 – 2059**), thus providing the scenario with a 30 years analysis starting from the first phases to be implemented (Phase1&2) and 15 years from the last phase starting in 2045.

Infrastructure and rolling stock investment expenses are supposed to be covered by the public sector through a repartition of the 20% direct investment and 80% loan, with a term of 15 years.

The outcomes of the Financial Analysis of all interventions are reported in the table below:

Financial performance indicators	Value	Unit
Financial Net Present Value	- 5,041	M US\$
Financial Internal Rate of Return	2.3%	%

Financial performance indicators.

The operating profit from operations (before deduction of financial interests) is positive from the 6th year of the analysed scenario. However, railways are very capital intensive projects with huge upfront disbursements: this means a great burden of financial interests to be paid, which offsets the same profitability from operations. In the Master Plan financial projection exercise carried out, this trend only inverts starting from the 16th year onwards, when profit (before tax computation) is generated.

The calculated financial F-IRR and the specific cost profile of railway operations induces the opportunity for conceiving some form of subsidy in order to render railway projects attractive also to private investors.

ⁱ The Unsettled Matter of Discounting the Future, by James Broughel and the Mercatus Center at George Mason University, 2018

ⁱⁱⁱ Annex III to the Implementing Regulation on application form and CBA methodology

ⁱⁱⁱ “Social Discount Rate”, Joice Valentimy and Jose Mauricio Pradoz (2008)

^{iv} “The Economic Footprint of Railway Transport in Europe”, commissioned by Community of European Railway and Infrastructure Companies (CER), 2014; “Future Employment in Transport: analysis of Labour and Supply demand”, commissioned by European Commission, 2014

^v For example, in many cases, although rail services and infrastructure are separate entities and have different budgets (minimum requirement required by EU law) they are owned by a single publicly owned company (as a sort of “holding company”). This is the case of Germany, Italy, etc. .

^{vi} The source of information for these prices were the official web page of “Intercity STC Coaches Ltd” (<https://stc.gov.gh/fares/>) and the online ticketing portal <https://portal.myticketgh.com/bus/tickets>

^{vii} See also <https://www.ezv.admin.ch/ezv/en/home/information-companies/transport--travel-documents--road-taxes/heavy-vehicle-charges--performance-related-and-lump-sum-/lump-sum-heavy-vehicle-charge--psva--for-foreign-vehicles.html#-1769454327>