1.0. EXECUTIVE SUMMARY

1.1. Introduction

China Railway Eryuan Engineering Group Co., Ltd (CREEC) will conduct Feasibility Study (FS) for traction power supply system for high speed railway project. The railway will lengthy from Muse to Mandalay. The total length of the main railway line is 409.960 km. According to the Environmental Conservation Law, 2012 and Environmental Impact Assessment Procedure, 2015, CREEC will have to conduct Environmental Impact Assessment not only for the proposed railway alignment but also for the railway power supply system. So, this EIA is as an integral part of the Muse-Mandalay Railway Alignment Project. Ever Green Tech Environmental Services and Training Co., Ltd. was appointed to conduct Environmental Impact Assessment (EIA) for the proposed project. Ever Green Tech Environmental Services and Training Co., Ltd (EGT) submitted the Scoping Report on 29 November 2019 as an Initial Environmental Impact Assessment Report with Letter No-SAMAKA-2019 (CREEC) 875. On 20 February 2020, Environmental Conservation Department amended in accordance with Letter No-EIA-1/7(435/2020) and EGT resubmitted the Revised Scoping Report on 23 July 2020 with Letter No-SAMAKA-2020 (CREEC) 987. The Environmental Conservation Department approved the Scoping Report on 10, December, 2020 with Letter No- EIA-2/2 (3035/2020). The Environmental Impact Assessment Report was submitted on 15 June 2021 with Letter No SAMAKA-2021 (CREEC) 032 by Ever Green Tech Environmental Services and Training Co., Ltd and the Environmental Conservation Department amended in accordance with Letter No- EIA 2/9/ RT(EIA) (36/2022) on 11 January, 2022.

1.2. Summary of Introduction

1.2.1. Brief of Project Proponent

The followings are the brief of project proponent for the FS of Muse-Mandalay railway project.

Project Developer	
Project Developer	Myanma Railways (MR) under the Ministry of Transport and Communications (MOTC)

Type of Project	Power Stations and Transmission Lines along Muse-Mandalay Railway
Project Location	Muse-Mandalay Railway starts from Muse port of entry at the north, goes south to Mandalay
Contact Person	1.U Myo Win (General Manager) Upper Myanmar Administration (MR) Upper Myanmar Administration Department, Mandalay Station, Mandalay, Myanmar Tel：+95-2-35172 Fax：+95-2-35829 E-mail：myowingmupper@gmail.com
	2.U Phyo Htet Kyaw [Assistant General Manager (Planning)] Planning and Administration Department, (MR) Nay Pyi Taw Station Compound, Nay Pyi Taw, Myanmar Tel：+95-6777164(office)/+95-9-43124800(mobile) Fax：+95-67-77164

1.2.2. Brief of EIA Team

Below is the background information on Ever Green Tech Environmental Services and Training Co., Ltd., (Third party) who will conduct the EIA.

Ever Green Tech Environmental Services & Training Co., Ltd.	
Company Name	Ever Green Tech Environmental Services and Training Co., Ltd.
Company Registration Number	3344/2015-2016 (Ygn)
Transition Consultant Registration Number	0047

Contact Address	1/9, Baho Road, 16th Quarter, Hlaing Township, Yangon.
Telephone Number	09-5099230, 09-5099232
E-mail	green.evergreentech@gmail.com
Contact person	Dr. Kyaw Swar Tint Ph.D. (Mining) Principal Environmental and Social Consultant 09-797111000 11kyawswar@gmail.com

1.2.3. Selected Consultants for Conducting EIA

The following are the selected consultants for conducting EIA for power supply system of railway project.

	No	Name	Degree	Responsibility	Area of Expertise
Our Consultants	1	Dr. Kyaw Swar Tint	Ph.D. (Mining)	Principal Consultant	(a) Air Pollution Control (b) Noise and Vibration (c) Socio-Economy (d) Environmental Management and Monitoring
	2	Mr. Min Aung	M.Sc. (Chemistry)	Key Consultant	(a) Water Pollution Control (b) Modelling of Water Quality (c) Meteorology, Modeling for Air Quality (d) Soil and Ground Water Pollution Control
	3	Dr. Thein Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Risk Assessment and Hazard Management (b) Facilitation of Meeting (c) Occupational Safety and Health
	4	Dr. Myo Min Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Evaluation of Alternatives (b) Resources Utilization and Management (c) Waste Management
	5	Dr. Sao	Ph.D.	Consultant	Remote Sensing and GIS

		Hone Pha	(Electronics)		
	6	Ms. Nandar Nwe	M.S. in EIA/EMS (YTU), Dip; in Applied Psychology (YU)	Consultant	Social Impact Assessment (Household Survey)
	7	Ms. Thazin Htwe	M.S. in EIA/EMS (YTU), Dip; in Applied Psychology (YU)	Consultant	Social Impact Assessment (Public Consultation and Stakeholder Engagement)
	8	Mr. Yaw Ma Nar	B.Sc. (Forestry); Dip in EIA/EMS	Field Coordinator	Baseline Study (Traffic)
	9	Mr. Moe Pyi Kyaw	B.Sc. (Forestry)	Surveyor	Baseline Study (Water and Soil Quality)
	10	Dr. Wyne Nwe Nwe Oo	Ph.D. (Biotech)	Consultant	Species Identification
	11	Dr. Nyunt Lwin	Ph.D. (Zoology)	Consultant	Fauna Diversity
	12	Dr. Nyo Nyo Lwin	Ph.D. (Botany)	Freeland Consultant	Flora Diversity
	13	Dr. Khon Aung	M.B.B.S. (Ygn)	Consultant	Health Impact Assessment
	14	Dr. Ohm Thaik	Ph.D. (Mining)	Consultant	Geotechnical (Slope Stability)
	15	Dr. Tin Aung Myint	Ph.D. (Geology)	Consultant	Geology
	16	Dr. Win Swe	Ph.D. (Geography)	Consultant	Hydrology and Political Science
	17	Ms. May Thet Zaw	M.E. (Civil)	Consultant	Constructional Related Impact Assessment
	18	Ms. Nay Chi Win Maung	M.E. (Civil)	Consultant	Risk Assessment
	19	U Aung Naing Tun	L.L.B; MBA	Consultant	Legal Requirements
Foreign Consultant	20	Mr. Cheng Liang shuang	M.Sc. (Conservation of Soil & Water)	Consultant	Water resources and high speed railway design

Selected Consultants for Report Writing

Selected consultants for EIA Report Writing are shown in the following table.

No.	Name	Degree	Responsibility	Report Writing
1	Dr. Kyaw Swar Tint	Ph.D. (Mining)	Key Consultant	(a) Noise and Vibration Assessment (b) Environmental Management and Monitoring (c) Overall Review
2	Mr. Min Aung	M.Sc. (Chemistry)	Key Consultant	(a) Impact Assessment and Mitigation Measures for Surface Water Environment (b) Impact Assessment and Mitigation Measures for Soil Quality
3	Dr. Thein Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Risk Assessment and Hazard Management (b) Occupational Safety and Health
4	Dr. Myo Min Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Alternatives Analysis (b) Resources Utilization and Management
5	Dr. Sao Hone Pha	Ph.D. (Electronics)	Consultant	(a) GIS Study for Land Use Land Cover
6	Ms. Nandar Nwe	M.S. in EIA/EMS (YTU),	Consultant	(a) Social Impact Assessment (Household Survey and Analysis)
7	Ms. Thazin Htwe	M.S. in EIA/EMS (YTU), Dip; in Applied Psychology (YU)	Consultant	(a) Social Impact Assessment (Stakeholder Engagement and Public Consultation Meetings)
8	Mr. Yaw Ma Nar	B.Sc. (Forestry); Dip in EIA/EMS	Field Coordinator	(a) Environmental Baseline Study Baseline Study (Traffic and Secondary Data Collection)
9	Mr. Moe Pyi Kyaw	B.Sc. (Forestry)	Surveyor	(a) Baseline Study (Surface Water and Soil Quality)
10	Dr. Wyne Nwe New Oo	Ph.D. (Biotech)	Consultant	(a) Biodiversity Impact Assessment and Management
11	Dr. Nyunt Lwin	Ph.D. (Zoology)	Consultant	(a) Species Identification and Evaluation (Fauna Diversity)
12	Dr. Nyo Nyo Lwin	Ph.D. (Botany)	Freelance Consultant	(a) Species Identification and Evaluation (Flora Diversity)
13	Mg Hein Moe Lwin	MSc. (Zoology)	Consultant	(a) Impact Evaluation on Eco System
14	Dr. Ni Ni Aye	M.B.B.S. (Ygn); MSc (Public Health)	Consultant	(a) Health Impact Assessment
15	Dr. Ohm Theik	Ph.D. (Mining)	Consultant	(a) Analysis for Slope Stability (b) Alternative Analysis
16	Dr. Tin Aung Myint	Ph.D. (Geology)	Consultant	(a) Earthquake Assessment, (b) Mineral Resources and Engineering Geology
17	Dr. Win Swe	Ph.D. (Geography)	Consultant	(a) Hydrology and Ground Water (b) Methodology for SIA Study
18	Ms. Nay Chi Win Maung	M.E. (Civil)	Consultant	(a) Constructional Related Impact Assessment (b) Railway Construction Method
19	U Aung Naing Tun	L.L.B; MBA	Consultant	(a) Laws and Regulations
20	Mr. Cheng Liang shuang	M.Sc. (Conservation of Soil & Water)	Consultant	(a) Water Resources and High-Speed Railway Design

1.2.4. Objectives of A Study

The EIA report will contain:

(a) the present status of air, noise, water, land, biological, socio-economic and health components of the environment;

(b) identification and evaluation of positive and negative impacts due to the development of the project;

(c) proposed pollution control measures, environmental management plan (EMP) to be adopted for mitigation of adverse impacts;

(d) measures for the improvement of the community around the area, and

(e) Post-project environmental quality monitoring programme.

1.2.5. Scope of the EIA Study

This EIA study for the proposed railway power supply system will cover FS for the following:

(1) Traction substations; and

(2) Transmission line along the railway.

But the EIA study will not cover the main power generation sources for required electrical power for the power supply system.

1.3. Summary of Legal Requirements

1.3.1. Laws and Regulations Related to the Proposed Project

Myanmar has promulgated several laws and regulations concerning protection of the environment. The following table describes laws and regulations which are directly or indirectly associated with the proposed railway power supply system.

Table. Laws and Regulations Related to Workmen' Right, Occupational Safety and Health

Laws and Regulations	Year
The Labor Organization Rules (No.1,7 to 11)	2012
Labor Disputes Resolution Law	2012
Employment and Skill Development Law	2013
The Leave and Holiday Act	1951
Minimum Wages Law	2013
Payment of Wages Act	2016
The Social Security Law	2012

Workmen's Compensation Act	2005
Prevention and Control of Communicable Diseases Law	1995
The Control of Smoking and Consumption of Tobacco Product Law	2016
The Prevention of Hazard from Chemical and Related Substances Rule	2013
Occupational Safety and Health Law (Pyidangsu Hluttaw Law No.8)	2018
Workmen's Compensation Act	1923
Law Relating to Overseas Employment	1999
The Prevention of Hazard from Chemical and Related Substances Law	2013

Table. Laws and Regulations Related to Cultural and Heritage

Laws and Regulations	Year
The Protection of Rights of Natural Race Law	2015
Protection and Preservation of Cultural Heritage Regions Law	2019
The Protection and Preservation of Antique Objects Law	2015
The Protection and Preservation of Ancient Monuments Law	2015
Rules for the Protection of the Rights of ethnic nationalities	2019

Table. Laws and Regulations Related to Natural Environment

Laws and Regulations	Year
Forest Law	2018
The Conservation of Biodiversity and Protected Areas Law	2018
Conservation of Water Resources and River Laws	2016
Conservation of Water Resources and River Rules	2013
Mandalay Region Freshwater Fisheries Law	2012
Shan State Freshwater Fisheries Law	2014

Table. Laws and Regulations Related to Communities' Development, Health and Safety

Laws and Regulations	Year
Union of Myanmar Public Health Law	1972
Village Regional Development Law	2019
Law of Protecting of Farmer Rights and Enhancement of their Benefits	2013
Second amendment of the law on the development of border area and national races	2015
Public Health Law	1972

Table. Laws and Regulations Related to Transportation and Communication

Laws and Regulations	Year
Railway Transportation Service Law	2016
The Highways Law	2015
Road Law	2000
Vehicle Safety and Motor Vehicle Management Law	2020
Motor Vehicle Rules	1987

Table. Laws and Regulations Related to Land Acquisition

Laws and Regulations	Year
Vacant, Fallow, Virgin Land Management Law	2018
Land Acquisition, Resettlement and Rehabilitation Law	2019
Farm Land Law	2012
National Land Use Policy	2016
Shan State Development Law	2013
Mandalay Region Development Organizations Law	2014
The Upper Myanmar Land and Revenue Regulation	1889
The Land Acquisition Act	1894

Table. Laws and Regulations Related to Power Supply

Laws and Regulations	Year
Law Amending the Electronic Transactions Law	2021
Telecommunication Law	2013
The Electricity Law	2014
The Electricity Rule	2015

Table. Other Relative Laws and Regulations for the Proposed Project

Laws and Regulations	Year
Natural Disaster Management Law (Law No.21)	2013
Constitution of the Republic of the Union of Myanmar	2008
Law on Standardization (Law No.28)	2014
Environmental Conservation Law	2012
Environmental Conservation Rules	2014
EIA Procedures	2015
National Environmental Quality (Emission) Guidelines	2015
Law Amending the Factories Act (Pyidaungsu Hluttaw Law No.12/2016)	1951
Private Industrial Enterprise Law	1990
Myanmar Fire Force Law	2015
The Myanmar Insurance Law	1993
Myanmar Petroleum and Petroleum Products Law	2017
The Petroleum Rules	1937
The Export and Import Law	2012
The Industrial Explosive Materials Law	2018
The Explosive Substance Act	1908
The Myanmar Engineering Council Law	2013
Myanmar Fire Bridge Law	2015
Patent Law	2019
Myanmar Investment Law	2016
Myanmar Investment Rules	2017
The Law Relating to Aquaculture	1989
The Ethnic Rights Protection Laws	2015

1.3.2. Summary of International Agreements and Conventions

In addition to the domestic laws listed above, Myanmar is also a signatory to the following international conventions, and these may have relevance to the proposed survey activities.

Table 1.1. International Agreements and Conventions Relevant to the Proposed Project

International Agreements and Conventions	Status
Vienna Convention for the Protection of the Ozone Layer, 1985	1998
Montreal Protocol on Substances that Deplete the Ozone Layer, 1989	1993
Basel Convention, 1989	2015
United Nations Framework Convention on Climate Change (UNFCCC), New York, 1992 and Kyoto Protocol 1997	1995 and 2005
Convention on Biological Diversity, Rio de Janeiro, 1992	1994
Asia Least Cost Greenhouse Gas Abatement Strategy (1998 ALGAS)	1998
United Nations Agenda 21	1997
Relevant ILO Conventions in force in Myanmar • C1 Hours of Work • C14 Weekly Rest • C17 Workmen's Compensation (Accidents) • C19 Equality of Treatment (Accident Compensation) • C26 Minimum Wage Fixing Machinery • C29 Forced Labour Convention • C42 Workmen's Compensation (Occupational Diseases) Revised 1934 • C52 Holidays with Pay	

1.3.3. Summary of National Environmental Quality (Emissions) Guideline for Electrical Power Transmission and Distribution

This guideline applies to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. Power transmission and distribution does not typically give rise to significant effluents or air emissions. Where potentially contaminated water runoff or dust exists, site operations should comply with the following effluent guideline and the general air quality guideline.

(a) Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/l	30
Chemical oxygen demand	mg/l	125
Oil and grease	mg/l	10
pH	S.U.[a]	6-9
Total coliform bacteria	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

[a] ***Standard Unit***

(b) Electromagnetic Field

Additionally, exposure limits for general public exposure to electric and magnetic fields should comply with International Commission on Non-ionized Radiation Protection guidelines for limiting general public exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 Gigahertz).

Frequency	Electric Field (V/ma)	Magnetic Field ((µT[b])
50 Hz[c]	5000	100
60 Hz	4150	83

[a] **Volts per meter;** [b] **Micro tesla;** [c] **Hertz**

(c) Noise level set in NEQG

In NEQG, the noise level is set as shown in the following table.

Receptor	One Hour LAeq	
	Daytime (7:00-22:00) (10:00-22:00 for public holidays)	Night Time (22:00-7:00) (22:00-10:00 for public holidays)
Residential, institutional,	55	45
Industrial, commercial	70	70

Source: NEQG (December 2015)

1.4. Summary of Project Description

1.4.1.Main Components and Functions

The external power supply mainly provides power energy for the railway power supply system. Each traction substation supplies power for the electric locomotive by introducing two-circuit independent & reliable 132kV or 230kV power supplies from the local power system and then converting voltage to 27.5kV by a traction transformer. Meanwhile, a step-down transformer is used to ensure 11kV power output so as to power all power consumption points such as station, work area, yard, and substation.

The interface between external power supply works and traction power supply system works is the high-voltage incoming pole in the traction substation. The works in incoming pole is traction power supply system works (below red dotted line in the figure below); and the external power supply supporting works is 132kV or 230kV transmission line from local substation of state power network to traction substation (between the blue and red dotted lines in the figure below). Some areas may suffer insufficient power supply. At this time, it is necessary to consider the new local 230kV substation and networking 230kV transmission line.

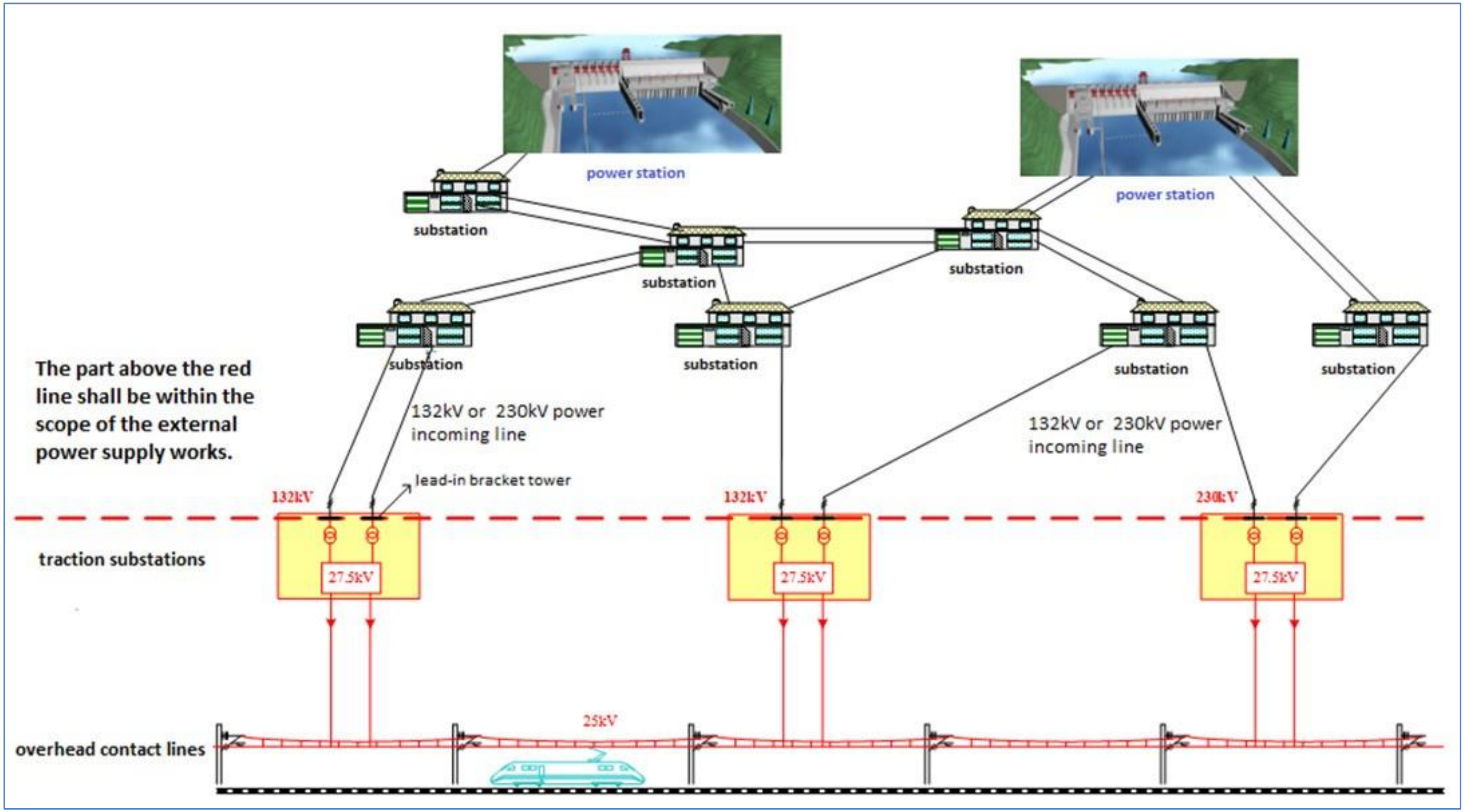


Figure - Schematic Diagram of Interface between External Power Supply and Traction Power Supply System

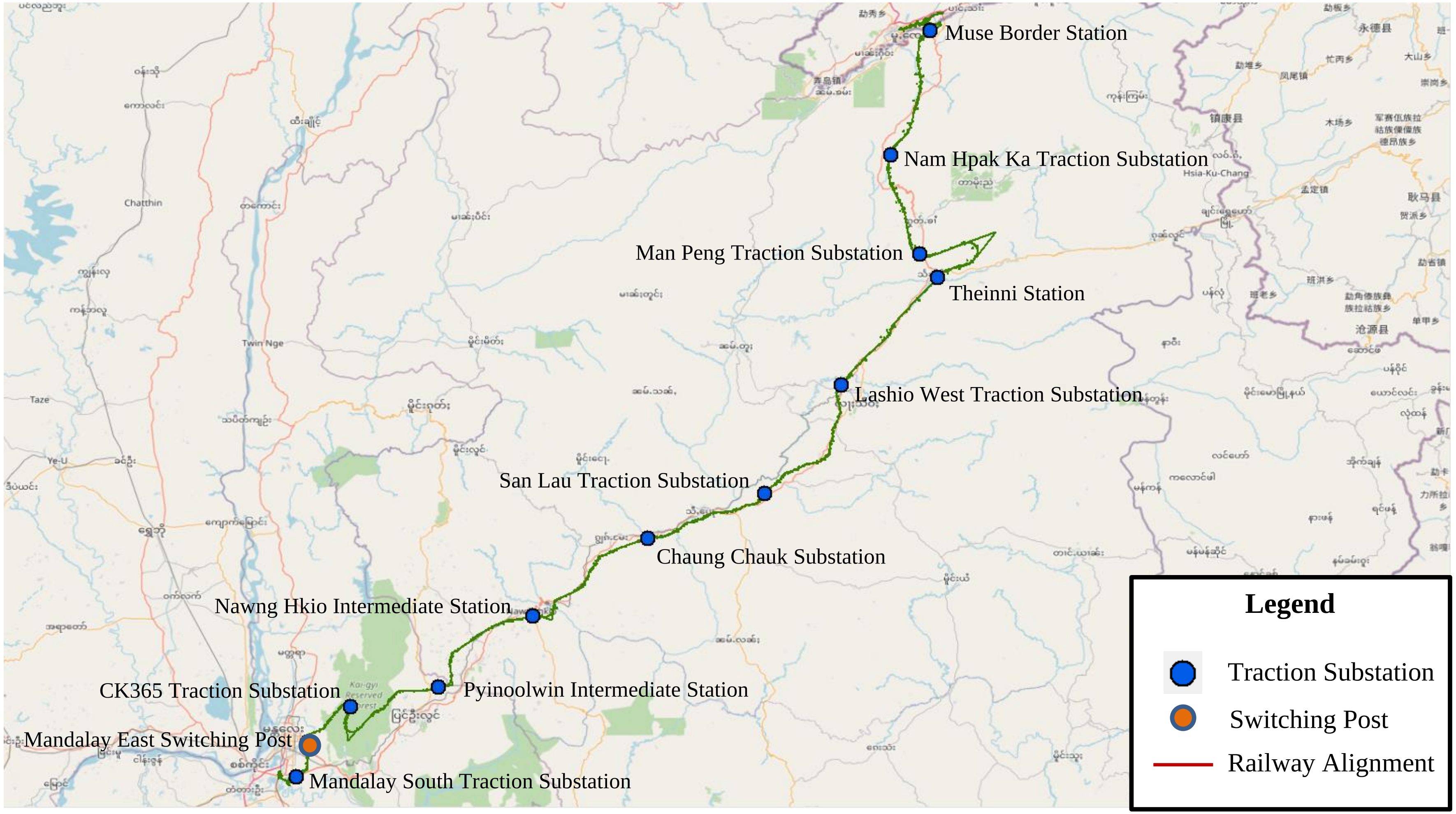


Figure - Traction Substations and Switching Post along the Railway in GIS Map

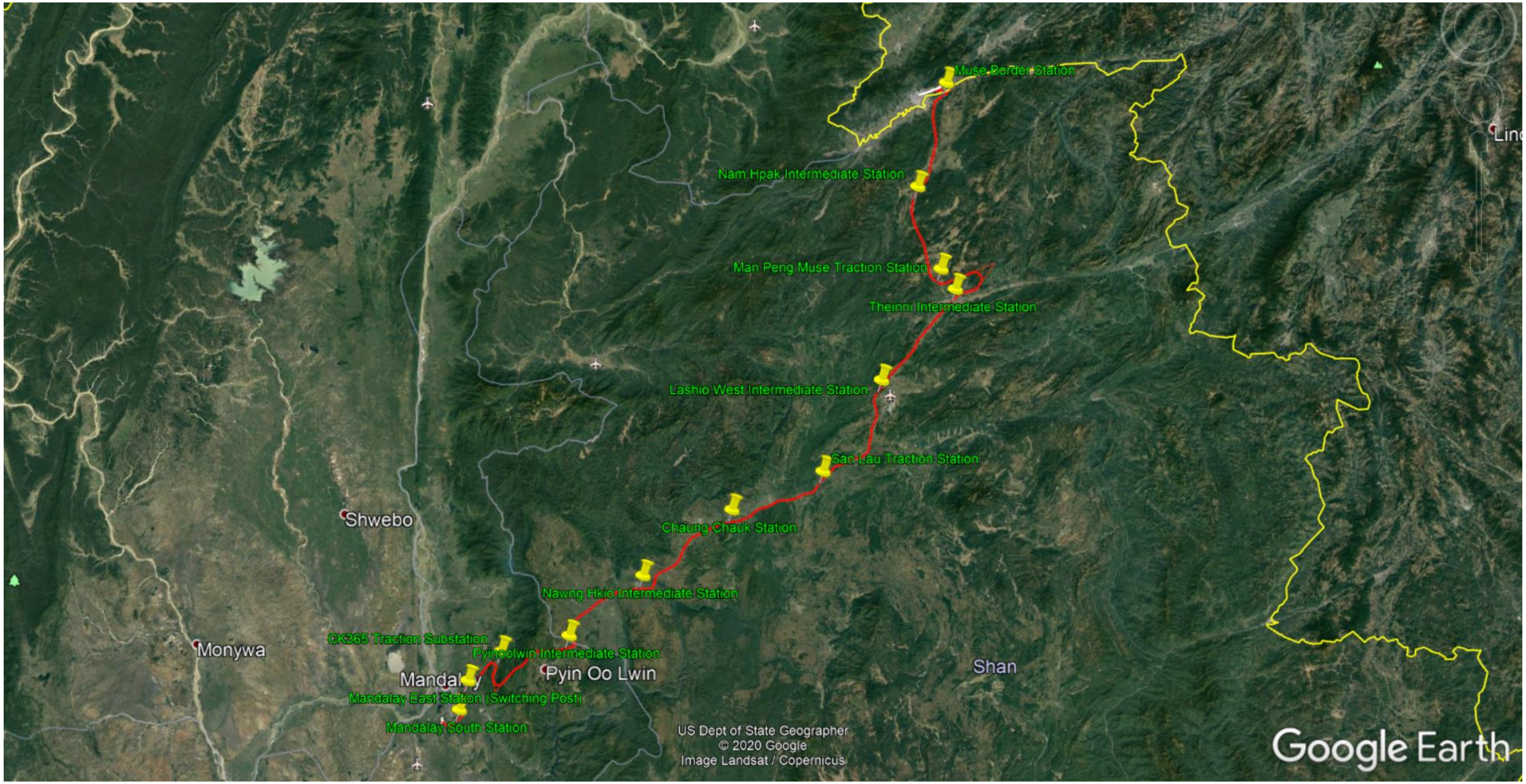


Figure - Traction Substations and Switching Post along the Railway in Google Earth

1.4.2. Work Schedule for Construction and Operation Phases

All of the railway related works such as power supply system, bridges and culverts, tunnels and alignment will accomplish at the same time of 5 years construction period. According to the distribution of key works and the works determining the construction period, combined with the topographic and geological conditions along the line and track-laying scheme, the total construction is arranged as 5 years in line with the construction organization design progress of the similar projects under construction.

Construction preparation will be around 6 months and communication, electric power supply & traction power supply and other auxiliary works: starting in June of the fifth year and completing in September of the fifth year.

Joint commissioning: 3 months. The line will be officially opened and operated at the end of the fifth year.

Implementation Schedule for Railway Power Supply System

Phase	Item	Duration
Pre-construction Phase	All traction Substation	2 months
Construction Phase	Civil works for traction substation with related to transmission line framework	22 months
	Installation of required electrical materials at every station, and electric power supply and traction power supply	4 months
Operation/ Ongoing Site Maintenance	All traction substation	50 years or more than
Decommissioning Phase	All traction substation	1 year

1.4.3. Summary of Project Activities

The following figure shows the construction of traction substation

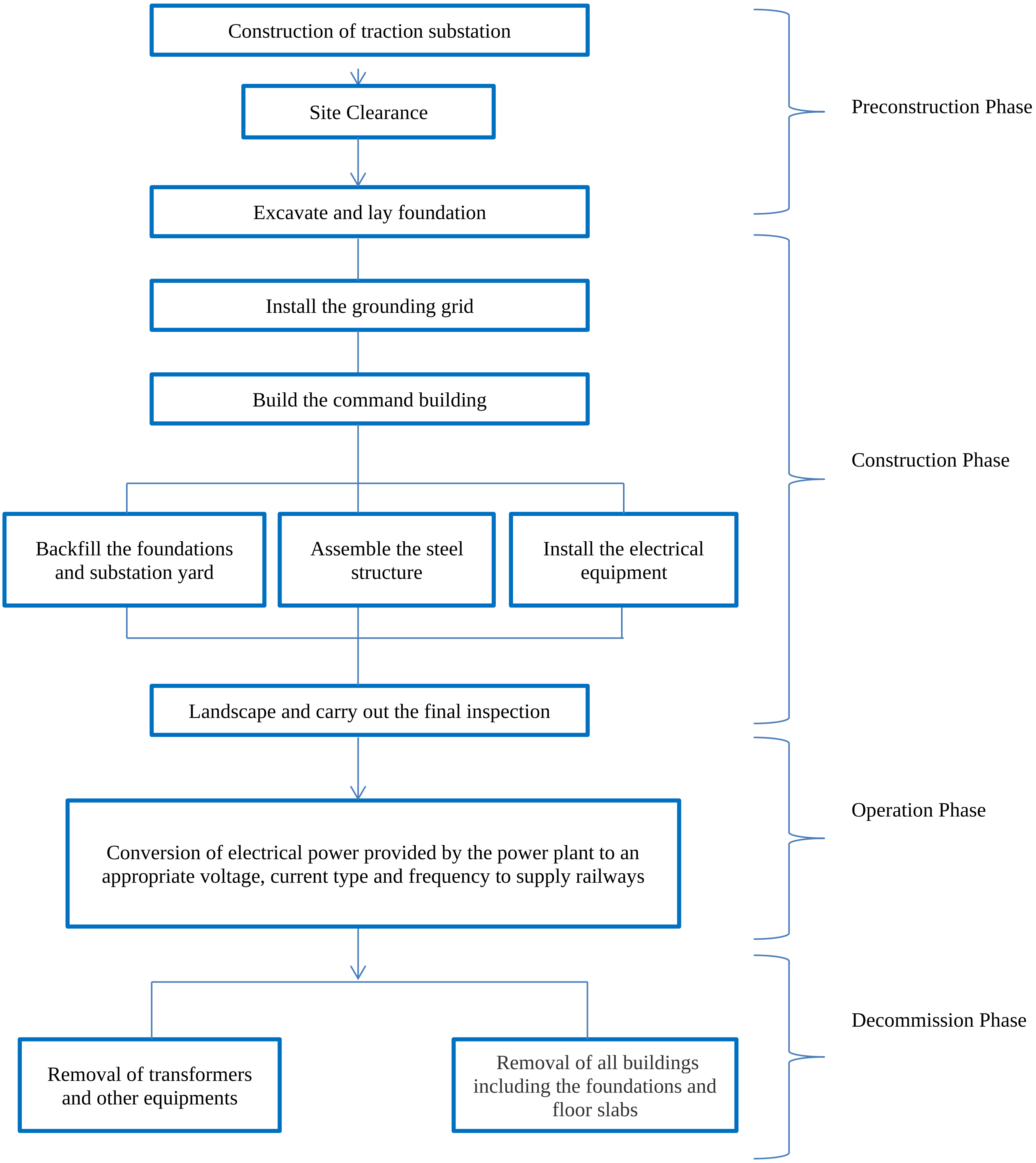


Figure - Process Flow Chart for Construction of Traction Substation

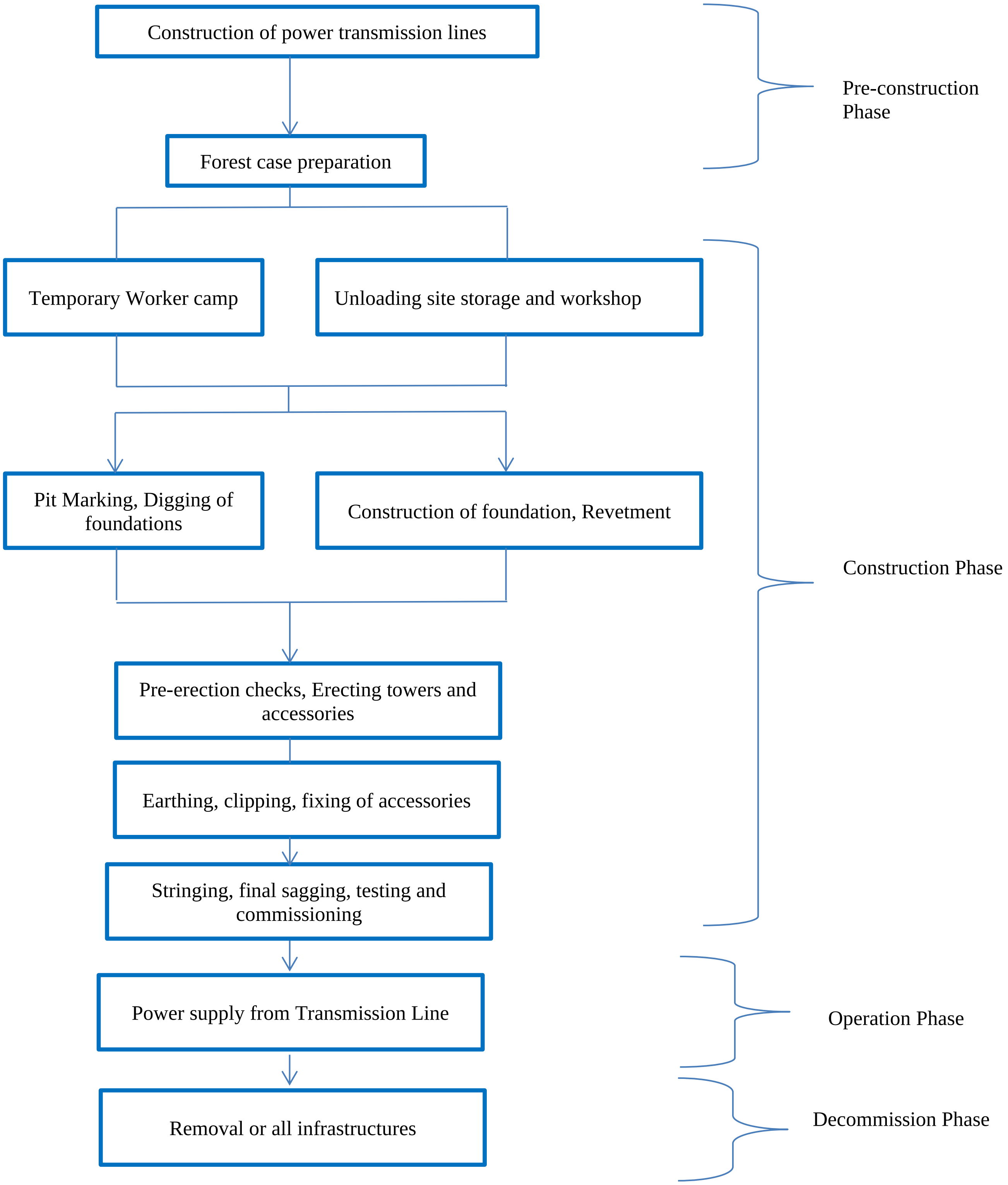


Figure - Process Flow Chart for Construction of Transmission Lines

1.4.4. Summary for Alternative Analysis

The alternative analysis for railway power supply system for Mandalay-Muse Railway was conducted into the following points (a) "no project" alternative and (b) alternative analysis for main power supply source.

(a) The "No Action" Alternative

In Myanmar, transportation is still difficult due to the lack of alternative ways expect for road way in many region. High speed rail way system will be beneficial for improvement of transportation system in Myanmar. So, "no-project" option represents a lost opportunity for Myanmar and cannot be accepted in the present condition.

(b) Process Alternative

Alternative analysis for process (main power supply source) will be focused on the use of electricity from local source, electricity from self-generator and electricity from other source (solar). According to the alternative analysis, in areas where local power supply is pressured, self-contained power supply should be used. For self-contained power supply, solar energy should be used where land use is available and otherwise, combustion engines such as generators should be used.

(c) Location Alternative (Alignment Alternative)

Alignment alternative for railway power transmission line will be the same as alternative analysis for railway alignment and detailed consideration for alternative analysis for railway alignment will be described in EIA report for railway alignment.

1.5. Summary of Description of the Surrounding Environment

The followings are the summary for the surrounding environment.

1.5.1. Air Quality and Noise Level

Air quality along the railway stations where the traction substations will be constructed are good according to the baseline study due to the less industrial development and less transportation traffic in rural areas.

Location of Ambient Air Quality Sampling

No.	Sample Name	Coordinates		Remarks
		Latitude(N)	Longitude(E)	
1	AS0	21°51'11.93"N,	96° 4'17.38"E	Myitnge Railway Station
2	AS-1	21°52'48.75"N,	96°13'34.70"E	Ohn Chaw Tar Zone
3	AS-2	22° 2'13.97"N,	96°27'57.83"E	Pyin Oo lwin Railway Station
4	AS-3	22° 3'30.29"N,	96°29'51.88"E	Pyin Oo Lwin Industrial Zone
5	AS-4	22°21'4.94"N,	96°54'50.62"E	Naung Peng Rail way station
6	AS-5	22°37'5.20"N,	97°17'40.17"E	Hsipaw Railway Station
7	AS-6	22°58'22.88"N,	97°43'50.33"E	Lashio Railway Station

Summary of Air Quality Results

In comparison with the WHO air Quality Standards, the result of the air quality in this area are lower than its guideline values except for the concentrations of CO and $PM_{2.5}$. Most of the sampling points are beside the road and residential areas so it is assumed that the major sources of CO and $PM_{2.5}$ is from the vehicle emissions from the vehicles, roads and smokes from the residential area. The locations of the results are mostly in human comfort area which is within the village and the results have stated that the maximum peak velocity (Vmax) in the location of 4 places is less than its given standard of 5mm/s (long term).

Measurement location for Noise Level

No.	**Place**	**Coordinates**	
		Latitude(N)	Longitude(E)
1	Myit Nge Railway Station	21°51'11.93"N,	96° 4'17.38"E
2	Ohn Chaw Tar Zone	21°52'48.75"N,	96°13'34.70"E
3	Pyin Oo Lwin Railway Station	22° 2'13.97"N,	96°27'57.83"E
4	Pyin Oo Lwin Industrial Zone	22° 3'30.29"N,	96°29'51.88"E
5	Naung Peng Railway Station	22°21'4.94"N,	96°54'50.62"E
6	Hsipaw Railway Station	22°37'5.20"N,	97°17'40.17"E
7	Lashio Railway Station	22°58'22.88"N,	97°43'50.33"E

No.	Place	Coordinates	
		Latitude(N)	Longitude(E)
1	Pyin Oo Lwin - Oak Pho Village (Monastery)	N 22° 04’ 15.87”	E 096° 23’ 58.30”
2	Naung Cho - Shwe Pyi Nyunt Village	N 22° 18’ 16.29”	E 096° 50’ 02.16”
3	Goke Hteik	N 22° 20’ 08.94”	E 096° 51’ 53.42”
4	Hsipaw (near Baw Gyo Pagoda)	N 22° 34’ 59.78”	E 097° 13’ 59.62”
5	Beyond Hsipaw (San Laung)	N 22° 40’ 33.66’	E 97° 30’ 17.4”
6	L ashio	N 22° 59’ 05.41”	E 097° 42’ 23.09”
7	Hseni	N 23° 18’ 23.97”	E 097° 58’ 28.30”
8	Nam Hpat Kar	N 23° 41’ 21.89”	E 097° 49’ 02.76”
9	Muse	N 24° 00’ 03.10”	E 097° 56’ 25.90”

Summary of Noise Quality Results

The noise level in Myitnge Railway Station, Ohn Chaw Tar Zone, Pyin Oo Lwin Railway Station, Naung Peng Rail way, Hsipaw Railway Station, Lashio Railway Station, Goke Hteik, Hsipaw (near Baw Gyo Pagoda), Lashio, and Hseni exceed the NEQG standards which is 55dB during day time and 45dB during night time in residential/institutional area. In Pyin Oo Lwin-Oak Pho Village (Monastery), Naung Cho – Shwe Pyi Nyunt and Muse do not exceed the NEQG Standards which is 55dB during day time and 45dB during night time in residential/institutional area. In Pyin Oo Lwin Industrial Zone Public Area, the result of noise level is below its NEQG standard for industrial area which is 70dB during the day and night. For Goke Hteik,and Beyond Hsipaw (San Laung), the results are below during the night but in day time, it exceeds the NEQG standard of 55dB.

1.5.2. Water Quality

Water quality in all rivers and streams along the railway alignment are acceptable as domestic water due to water quality testing results.

Locations of Water Samples for Dry Season and Wet Season

no.	Name (Dry Season)	Coordinates		Name (Wet Season)	Coordinates	
		Latitude	Longitude		Latitude	Longitude
1	Shweli River (Muse)	24.01721°	97.90384°	Namkhon Monastery (Muse)	24.00058°	97.940547

2	Nant Paung Stream (Muse)	23.85798°	97.97741°	Nam Paw Stream (Muse)	23.85798°	97.97741°
3	NantKhaing Stream (Kutkai)	23.57058°	97.81950°	Natural Spring Near Nam Paw Stream (Muse)	23.800891°	97.920002°
4	Namtu Stream (Thenni)	23.28817°	97.95394°	Nam Khaing Stream (Kutkai)	23.57058°	97.81950°
5	Pan Phet Stream (Thenni)	23.13200°	97.84320°	Namtu Stream (Theinni)	23.28817°	97.95394°
6	A-T Stream (Lashio)	22.99409°	97.76455°	Pan Phet Stream (Theinni)	23.13200°	97.84320°
7	Sint In Stream (Lashio)	22.70178°	97.53847°	Nant Lam Stream (Hsipaw)	22.61445°	97.39456°
8	Kho Lone Stream (Hsipaw)	22.61445°	97.39456°	Dokehtawady River (Hsipaw)	22.60728°	97.30748°
9	Dokehtawady River (Hsipaw)	22.60728°	97.30748°	Kyin Thi Stream (Hsipaw)	22.56428°	97.20963°
10	Kyin Thi Stream (Kyauk Me)	22.56428°	97.20963°	Goke Twin stream (Naung Cho)	22.35489°	96.83371°
11	Goke Twin Stream (Naung Cho)	22.35489°	96.83371°	Wel Laung Stream (Pyin Oo Lwin)	22.082172°	96.580458°
12	Yae Ni Stream (Pathein Gyi)	21.99596°	96.12399°	Nartaungkya Stream (Pathein Gyi)	21.880704°	96.226655°
13	SeDaw Gyi Stream (Pathein Gyi)	21.91917°	96.18635°	Sedaw Gyi Cannal	21.91917°	96.18635°
14	Myaung Ma Gyi Stream (Amarapura)	21.85159°	96.12443°	Dokehtawady(Myit Nge River)	21.83646°	96.07781°
15	Myaing Gyi Stream (Min Village)	21.84470°	96.10187°			
16	Dokehtawady River (Myit Nge)	21.83646°	96.07781°			

Summary of Water Quality Results for Dry season and Wet Season

In comparison with National Drinking Water Quality Standard, Myanmar (2014), the water quality result for the dry season exceed the maximum permissible limit of 15 TUN and the turbidity of the water is 35 NTU which is higher than its limit of 5 NTU. The presence of iron in the river is also high which is 1.95mg/l exceeding its limit of 1mg/l. In wet season, the water quality results in all these 14 water bodies during wet season do not exceed its maximum permissible limit except for the turbidity. The results have shown that the turbidity in all 14 water surfaces have exceeded the maximum limit of 5 NTU because of the wet season, rain causes to increase the turbidity of water.

1.5.3. Soil Quality

Soil samples are collected along the railway line and all of the sample were tested in Department of Agricultural, Yangon. According to the testing results, all of the samples are suitable for agricultural purposes.

Location of Soil Samples for Dry Season and Wet Season

no.	Name (Dry Season)	Coordinates		Name (Wet Season)	Coordinates	
		Latitude	Longitude			
1	Phat Man Soil (I)	23.84672°	97.96399°	Phat Man Soil (II)	23.800891°	97.9200002°
2	Lower Nam Phat Loon Soil (I)	23.57058°	97.81950°	Lower Nam Phat Loon Soil (II)	23.569606°	97.819422°
3	Theinni Soil(I)	23.28817°	97.95394°	Theinni Soil(II)	23.288344°	97.954061°
4	Hang Lu Soil(I)	23.13200°	97.84320°	Hang Lu Soil(II)	23.119017°	97.836422°
5	Pang Huauk Soil	22.61445°	97.37921°	Pang Huauk Soil(II)	22.611375°	97.378211°
6	Hsipaw Soil (I)	22.60728°	97.30748°	Hsipaw Soil (II)	22.621989°	97.334172°
7	Kyin Thi Soil(I)	22.56428°	97.20963°	Kyin Thi Soil(II)	22.564178°	97.209489°
8	Goke Twin Soil	22.35489°	96.83371°	Goke Twin Soil(II)	22.354586°	96.833431°
9	Sedaw Gyi Soil	21.91917°	96.18635°	Sedaw Gyi Soil(II)	21.872109°	96.182244°
10	Myit Nge Soil	21.83646°	96.07781°	Myit Nge Soil(II)	21.819177°	96.106333°

Summary of Soil Quality Results for Dry Season and Wet Season

For the dry season, the present of nutrient in Hang Lu, Myit Nge, Pang Hsauk, Phat Man and Lower Nam Phat Loon is in medium range which is an adequate level for most crops. The other 5 soil samples are low in nitrogen so plants are stunted as plants cannot make proteins, amino acids and even its very DNA. For the wet season, the total amount of nitrogen in Phat Man, Myit Nge, Sedaw Gyi Canal and Hsipaw is in medium range which is an adequate level for most crops. The other 6 soil samples are low in nitrogen so plants are stunted as plants cannot make proteins, amino acids and even its very DNA.

1.5.4. Vibration Level

Vibration levels were measured at points along the proposed Muse-Mandalay Railway. The measurements are taken in places which are Pyin Oo Lwin-Oak Pho Village (Monastery), Naung Cho- Shwe Pyi Nyunt Village, Goke Hteik, Hsipaw (near Baw Gyo Pagoda), Beyond Hsipaw (San Laung), Lashio, Hseni, Nam Hpat Kar and Muse. All of the vibration levels are within the acceptable level.

Measurement locations for Vibration

No.	Coordinates		Remarks
	Latitude(N)	Longitude(E)	
1	N 22° 04’ 15.87”	E 096° 23’ 58.30”	Pyin Oo Lwin - Oak Pho Village (Monastery)
2	N 22° 18’ 16.29”	E 096° 50’ 02.16”	Naung Cho - Shwe Pyi Nyunt Village
3	N 22° 20’ 08.94”	E 096° 51’ 53.42”	Goke Hteik
4	N 22° 34’ 59.78”	E 097° 13’ 59.62”	Hsipaw (near Baw Gyo Pagoda)
5	N 22° 40’ 33.66’	E 97° 30’ 17.4”	Beyond Hsipaw
6	N 22° 59’ 05.41”	E 097° 42’ 23.09”	Lashio
7	N 23° 18’ 23.97”	E 097° 58’ 28.30”	Hseni
8	N 23° 41’ 21.89”	E 097° 49’ 02.76”	Nam Hpat Kar
9	N 24° 00’ 03.10”	E 097° 56’ 25.90”	Muse

Summary of Vibration Results

The locations of the results are mostly in human confort area which is within the village and the results have stated that the maximum peak velocity (V_{max}) in the location of 4 places is less than its given standard of 5mm/s (long term). Since the project is still ongoing and will take much time to take up to operation stage, the results of the vibration are less than its limit so there is no disturbance to the surrounding locals.

1.5.5. Mining Areas

There wiilbe Mohochuane Mine (Pb,Zn), Bawdwin Mine (Pb, Zn), Sintaung (Coal), Nanma (Coal), Yadanatheingi (Pb, Zn), Naungthakaw (Fe), Pauktaw (Fe), Inya (Fe), Kyadwinye Iron

Mine (Fe), Aniskan (Ba) and Phayauntaung (Au) Mine arond the Muse-Mandalay Railway line. However, all of the mining areas are far from the impact zone of the railway tunnels.

1.5.6. Military Areas

There are military areas in Nam Hpak Ka, Lashio, Pyin Oo Lwin and other places along the route.

1.5.7. Topography

Being a mountainous region in Shan State, topography natural event is too much. So, most of the railway component part will be over bridges and under tunnel.

1.5.8. Geology

There will be fold, fault, earthquake zone and active faults along the Muse-Mandalay Railway line.

1.5.9. Mineral Deposits

According to the existing geological records and possible structural trends, there would be lead-zinc-silver, antimony, gold that could be expected in it. Coal and phosphorous deposits might also be found as well. Some deposits are a little far from the proposed railway line. Why mentioned here is that mineral deposits are trending approximately N-S direction and those could be probably found during construction of the line such as tunneling, bridge, station and railway line etc.,. For example, although Phayaung taung gold is far from the construction, gold occurrences are sporadically found along the western margin of Shan scarp, trending N-S direction. For Yadanatheingi lead-zinc-silver deposit, similar deposits and occurrences could be estimated in Pyin Oo Lwin, Naungcho and Kyaume as regional structural trending passing in these areas. Similarly, deposits at Bawdwin mine and Mohochaung mine, they might also be extended more or less into Hsipaw, Lasho, Kutkai and Nam Hpatkar areas.

1.5.10. Hydrology

The Muse-Mandalay railway line serially crosses several rivers such as the Shweli River, Nan Paw River, Nam Hkai River, Nam Tu River, Nam Yao River, Nam Ma River and Nam Tu/Myitnge River or Dok Ta Waddy River. Drainage system includes dendritic drainage pattern, trellis drainage pattern, parallel drainage pattern and rectangular drainage pattern observed along the line and dendritic drainage pattern is the most prominent. In limestone area, because of karst nature, there is also internal drainage pattern developed.

1.5.11. Dams and Hydropower

There are also several dams especially constructed on Myitnge river and Shweli river for hydropower demand and cultivation purposes. On Nam Tu-Myitnge river, Yeywa Dam has completed. Namtu Dam and upper Yeywa dam are still under construction and Middle Yeywa dam and Deedoke dam are planned to be constructed. On Shwe Li river Shwe Li I hydropower project is already finished and Shwe Li II and III is also under construction. There are many natural lakes, ponds, waterfalls, springs and small reservoirs found around or along the line and local people get used to them for agricultural and domestic utilization in the area.

1.5.12. Occurrence and Distribution of Groundwater

Groundwater along the line occurs as four types; 1. Pore-water in loosely cemented soil and younger rock, 2. Bedrock fissure water in clastic and crystalline rocks, 3. Karst water in carbonate rocks and 4. geothermal water from the earth.
The major aquifers of Myanmar range from Precambrian to Recent age and vary from coastal and north-south trending tectonically controlled basins. The major groundwater recharge is from monsoonal rainfall, which extends from June to September, ranges up to 3050 mm in the deltaic area, 3810 mm in the north, ~2000 mm in the eastern mountainous region, and only 760 mm in the central dry zone. The largest aquifer is the Irrawaddy river basin, which like the IGBM basin is the most prolific aquifer, however, much of the aquifers of the basin have been identified to have groundwater enriched with As. The other aquifers are in the Thanlwin, the Chindwin, and the Sittaung rivers.

1.5.13. Geotechnical Characteristics

The geotechnical characteristics along the Muse-Mandalay Railway are:

i. Karst
ii. Landslide and Talus
iii. Unstable Rocks and Rock-Fall
iv. Bedding
v. Seismic Liquefaction

vi. Soft Soil and Mollisol
vii. Expansive Soil
viii. Expansive Rock
ix. High Ground Stress

1.5.14. Socio-economic

The proposed line mostly passes through mostly in Shan State and partly in Mandalay Regions. These two regions have different socio-economic conditions. Mandalay region is urban area and the living standard is relatively high. But the socio-economic conditions in Shan State where the railway alignment will pass is dominated by agriculture and underdeveloped.

1.5.15. Existing Biodiversity

Through the field survey, it was observed that biodiversity was rich in the project area. Sample collection was conducted in the field with scientific and systematically. Study area was divided into two parts, Part I (plain area, Armarapura and Patheingyi) and Part II (hill area, Pyin Oo Lwin to Muse). Study sites were allocated into six study sites in Part I and thirty eight points for flora and forty nine study sites in Part II. A total of (64) plant species and (89) fauna species were recorded in Part I and (80) plant species and (112) fauna species in Part II. The habit of identified plant species consists of seven different types, including tree, shrub, herb, climber, bamboo and parasitic shrub. according to IUCN red list, in study. For fauna species according to IUCN Red List, *Javanicus* (VU), *cucullate* (NT, EN), *Psittacula finschii*), *Ichthypphaga ichthyaetus* (NT), *Macaca leonine* and *Pardofelis marmorata* (VU), *Cyclemys oldhamii* (NT), *Melanochelus trijuga* (NT), *Indotestudo elongate* (EN) should be protected.

1.5.16. Cultural and Heritage

The nearest cultural relics will be Gokhteik Bridge and Baw Kyo Pagoda with the distance of 980 m and 1079.05 m away horizontally respectively from the proposed alignment.

1.6. Summary of Environmental Impacts and Mitigation Measures

The following table shows the summary of environmental impacts and mitigation measures for all environmental and social impacts during construction and operation phases related to the proposed project.

Table 1.2. Summary of Potential Environmental and Social Impacts and Mitigation Measures

Item	Expected Environmental and Social Impacts and Sources of Impacts	Receptors	Mitigation Measures
Pre-Construction Phase			
Impacts on air environment	Fugitive dust generation Fugitive dust generation due to dozers and trucks for site clearing and ground levelling	Local residents in nearest villages, Local residents near along the hauling road, Flora diversity along the hauling road	- Water will be sprayed at construction site by using handheld spray. - Wheels of vehicles will be cleaned and goods carried will be covered while delivering.
	Vehicular emissions Vehicular emissions from the operation of vehicles and machineries	Ambient Air Quality	- In loading and unloading time and idle time will be planned to reduce during working hours - Avoid local traffic time - Machineries, vehic-les and generator with good engine conditions and use low sulphur content fuel will be used. - Machineries, vehicles and generator will be maintained regularly.
	Increase in noise Noise from heavy machineries and vehicles	Local residents nearby	- Working at night wll be limited and the operation of noisy equipment and machineries will be avoided at night if it is necessary to make operation at night - Construction activities reasonably will be arranged, especially at night - Regular maintenance of machineries will be carried out.
Impacts on surface water environment	Liquid wastes Temporary water pollution due to earth working activities Sedimentation of surface drainage networks Improper handling of fuel oil and lubricants	Surface water quality	- Proper drains to prevent run off from the site to enter any water body will be provided. - Wastewater from entering the nearest water bodies will be prevented. - Any leakage of oil and lubricant from vehicles and machineries use will be avoided.
	Solid wastes Unsuitable soil materials from site clearing activities Domestic solid wastes	Surface water quality	- Reduce, reuse and recycle of domestic wastes will be done. - Unnecessary earthworks will be limited. - Over-excavation will be prevented.

			- Working in a small area at a point of time will be carried out
Impacts on soil environment	Domestic wastes from pre-construction workers Biomass site clearing and tree cutting Earth soil from earth cutting activities	Soil contamination and ground water quality	- Wastes will be disposed according to the rules and regulations of MCDC - Solid waste management plan will be provided. - Handling of diesel and lubricants will be taken with special care to avoid leakage.
Impacts on biodiversity environment	Impacts on flora diversity Tree cutting alongside the railway and for the construction of stations	Flora diversity	- Cutting of road side plants and fence plants will be avoided.
	Impacts on fauna diversity The destruction of the vegetation cover along the strip of land May occur destroyed that individuals of some plant species are present in this strip The destruction and loss of the habitats along the land strip along the power line	Fauna diversity	- Sound proof measurement will be constructed surrounding a construction site as needed - Borrow pit will be away from fauna diversity abundance area
Impact on human environment	***Impacts on socio-economic environment*** (a)Positive socio-economic impact Temporary employment opportunities(approximately 15 workers) for local people during about 6 months	Local people	- Policy to use local people as much as possible will be carried out.
	(b) Negative socio-economic impact (i) Visual Impacts Visual pollutants like waste from site clearance and from the tree cutting alongside of railway	Local community	- Efficient and timely removal of all demolition and construction waste as per requirement will be done.
	(b) Negative socio-economic impact (i)Land acquisition and involuntary resettlement Land use and involuntary resettlement will	Local residents near the railway line	- Agricultural land, historical places, archeological places, forest area and ecologically sensitive area will be avoided as much as possible, fair compensation for land use as per compensation program in RAP - Overhead bridge will be used as much as

	affect socio-economic situation of local people Resettlement or/and relocation of buildings and other assets, involving some changes Loss of income opportunity of some PAPs due to resettlement and shop owners, vendors or farmers to be affected by construction works		possible - Compensation for affected structures and standing crops and assistance of livelihood restoration as per RAP will be made.
	(ii) Visual Impacts Visual pollutants like waste from site clearance and from the tree cutting alongside of railway	Local community	- Soil materials generated from site clearing activities will be disposed of systematically to avoid impact on visual amenity of receptors
	Impact on Indigenous and Ethnic People Related to Culture Exchange Indigenous or ethnic minority people will be affected from associated society.	Indigenous and Ethnic People	- Local cultural elements will be integrated into the hotel environment using local products, decorations, and even architecture. - A display corner or an exhibition will be created on traditional craftsmanship and sell local handicrafts. - The hiring of local staff and tour operators especially in major travel destinations will be encouraged. - Awareness-raising activities for local communities will be hosted and training to local business will be offered
Construction Phase			
Impact on air environment	Fugitive dust generation Dust emission from on-site vehicles and construction activities Particulate matter from transportation of construction materials and demolition waste, and traffic movement on unpaved road	Local residents in nearest villages, Local residents near along the hauling road	- Use covers or control equipment on material handling sources will be done. - Properly enclosing the site through use of appropriate hoarding and screening will be carried out. -Excavated soils and demolition wastes with impervious sheeting will be covered. - Water as a dust suppressant as needed will be sprayed. - Transportation of vehicles will be avoided to reduce dust generation

	Gaseous emissions Gaseous emissions from the operation of generator, concrete mixer and vehicles	Ambient Air Quality	- Construction vehicles and machinery will be used systematically to minimize emissions of fuel fumes - Machineries, vehicles and generator with good engine conditions and low sulphur content fuel will be used.
	Increased in Noise Level Noise generation from earth moving and excavation equipment, generators, concrete mixer Minimize vehicle movement and save money by reused on site to fill in low lying areas cut material from an embankment	Local residents in nearest villages	-Vehicle speeds will be reduced around sensitive receptors such as dwellings and schools - Choosing site for concrete-mixing, batching plants and similar activities at least 500m away from sensitive areas will be done. - Noisy activities will be scheduled. - Operation of heavy machinery will be limited at night - Choosing inherently quiet equipment with mufflers will be done. - Warning signs will be installed in areas of high noise levels - Equipment speed will be kept as low as possible
Impacts on surface water environment	Construction debris Waste materials such as pallets, packing crates, steel structures off-cuts and waste concretes Drainage and seepage from construction waste dumping site Unsuitable soil material from preparation of foundation	Surface water quality	- The time of exposure of any waste and erodible land exposed to stormwater runoff will be minimized. - Land clearing activities will be minimized to those of required work areas - Sediment controls will be used, with special care taken during the rainy season - Paving roads wherever possible will be carried out.
	Impacts on surface water environment The removal of riverine woodland will be inevitable in order to create the ROW Downstream areas normally affected by sediment loads from upside areas During rainy season, erosion may occur in weak soil	Surface water quality	- Chemical and oils storage areas will be placed on a hard concrete base to protect from rain and severe weather. - Zinc-based coating paint will be used instead of lead-based coating - Prefabricated septic tanks will be installed on site which discharge to a subsurface soak away

	Effluent Discharges (i) Increase the suspended matter of the water body when entering into the water body (ii) the accidental spillage of fuels and hydraulic fluids from construction plant Hazardous Waste Surface water pollution due to the spillage of lead-based paint used for transmission lines coating process		to avoid soil contamination and smell. - Contingency plans for control of spills of oil and other hazardous substances - Waste disposal site will be placed systematically -Waste contamination issues for power lines and stations will be carried out.
	Oil and grease Leakage of fuel oil from transportation of construction materials Lubricants and grease from machineries	Surface water quality	- Work areas will be restored as soon as possible once any construction is complete. - Construction works will be avoided during the rainy season. - Leakage of oil and lubricant from vehicles and machineries used in construction phase will be avoided.
	Domestic wastes from construction workers Domestic waste generation from construction workforce Improper waste disposal from establishment of labor camps	Surface water quality	- Waste water channels from the site will be connected to septic tank -Bare areas will be replanted after the construction state - Compact soil as soon as building foundations will be formed to prevent erosion, especially during the wet season
	Impact on Watershed – due to cutting of trees	Surface water quality	- Tunnel will be constructed close to the forest area. - limit tree cuttings
Impacts on soil and ground water environment	Impact on soil and ground water quality Accidental spills of fuel oil and lubricants due to improper handling or storage of equipment Wastewater from repair shops and washing places Construction debris and domestic wastes	Soil contamination	-Generated materials for reclamation purposes will be used whenever applicable on site -Construction wastes through careful planning will be minimized - All chemical wastes will be labeled and stored in corrosion and resistant containers -Collection sites and schedule will be identified for the removal of construction wastes to

	from construction workers Soil contamination and ground water pollution from improper disposal of solid wastes Seepage from waste dump site		minimize odor and pest infestation - Sedimentation pond will be carried out with suitable drainage system around the dumping sites
	Impacts on Soil Quality due to Hazardous Wastes Oil-based paints are consisted of VOC, so these paint cans can be hazardous to the environment if they are not properly disposed. The lead-based paints for the steel structure for the construction of the stations	Soil contamination	- Water-based paint will be substituted for oil-based paints; - oil-based paint or residuals down the drain will never be discharged. - Disposal of hazardous wastes will be made according to the rules and regulations of CDC
Impacts on biodiversity environment	Impact on flora diversity Clearing away trees and natural vegetation	Flora diversity	- The appropriate number, spacing, and location of crossing structures based on species-specific information will be determined and constructed. - Structures for obstructions will be monitored such as detritus or silt blockages, that impede movement -Human activity near crossing structures, with use of measures such as fencing and signage will be managed.
	Impact on fauna diversity Hazards to the habitats of birds and butterflies due to clearing away trees Disturbance to the aril and wild animals due to noise from construction activities	Fauna diversity	- The WDNR guidelines for preventing the spread of exotic invasive plant species and diseases will be followed such as oak wilt - Working at night will be avoided. - Sound proof measurement will be taken at biodiversity sensitive areas
Impacts on human environment	Positive socio-economic impact Job Creation Nearly 500 employment opportunities for local people	Local residents	- Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible - The developer will encourage construction sub-contractor to use local labor force as part of tender requirement

	Skill development for local people Local people hired by the proposed project would remain in communities with skills acquired during project construction	Local residents	- Training programs will be implemented prior to and during the construct- ion phase
	Potential to growth of local economy and business There will be benefit for local economy if the required food and consumer goods for construction workers are bought from nearest villages	Local residents	- Any food and consumer goods that can be bought in nearest villages will be preferred as first priority - The project developer will encourage construction contractors and sub-contractors to stimulate the emergence of local small business as part of tender requirement
	Negative socio-economic impacts Traffic congestion Road traffic congestion in surrounding area during construction period	Local residents	- Construction hauling will be arranged reasonably, especially during local traffic time. - Alternative road will be used that will not pressure on public road.
	Blockage of drainage Blockage of drainage system, natural spring and village road due to land filling Increase potential to flood in nearest agricultural lands	Local people	- Alternative water way will be prepared -Drainage facilities will be utilized to discharge the harvested water
	Agricultural Lands Soil material from construction site can also enter agricultural lands close to power lines	Local community near the proposed project	-Construction through sensitive farmland will be avoided or minimized. - Overhead bridges will be used where feasible - Transmission structures with longer spans to clear fields will be used - Exclusion fencing will be installed to keep livestock away from construction activities
	Public road damage The transportation of workers and construction materials can damage the damage to the public road	Local community	- The roads will be repaired as soon as possible if the public roads are damaged by the construction activities - Public roads will be used as per resistance of roads if unavoidable
	Impacts Influx of more worker and	Local community near the proposed	- Local construction workers will be appointed

	population Increase temporary pressure on existing infrastructure and services including health care, food, shelter, water, transport and recreational facilities	project	- Own health care facilities will be supported to workers
	Conflicts between communities Conflict between non-Shan communities and Shan ethnic A higher frequency of incidents of name-calling, spitting, hostile attitudes, damage to property and racially motivated violence against them	Local community near the railway line	-Local people will be used as much as possible -Night out for foreign workers will be limited. - The use of foreign workers will be limited. - When making an agreement contract with contractors and subcontractors, it will include the fact that they have to use local workers as much as possible.
	i) Livelihood and economic activity Disruption of livelihood and economic activities of business located along the route Impact on people whose livelihood is linked with existing modes of transportation	Local people alongside	- Loss of business (temporary or permanent), loss of livelihood, loss of wages will be paid according to the RAP. - Provision of compensation to the Project Affected Parties (PAPs) using the compensation will be carried out. - Continual liaising with the PAPs will be undertaken to decide on the site-specific mitigation measures. - Consultation with people whose livelihood depend on modes of transportation that may be affected by the project. They will be included in the development of the traffic management plan.
	Impacts Socio-economic impact people whose livelihood is linked with existing modes of transportation	Local people alongside	- Result in a material effect through diminishing the quality of life as replacement will be made in locality or be compensated
Impacts of utility consumption	Water consumption Impact on local water usage due to the water used for construction process and for domestic workers	Local community	- Water will be taken from surface water sources or underground sources where the sources are available - Residents' opinion will be considered and make agreements or contracts with the head of the village if spring water or underground water

			are the water sources of villages - Awareness campaign to disseminate knowledge on strategies and technologies that will be used for water conservation
	Fuel consumption The different forms of energy are used for different purposes in the construction process. Electricity cannot be directly used from existing power lines since the construction process takes place where there is no electricity and generators will be mainly used as the source of energy	Local community	-Construction machines will be used efficiently. - Workers will be trained to gain the knowledge of energy conservation. -The efficient site management will be learned to the workers.
	The effect of transmission Line on Local services electrical induction onto a piece of a structure that is insulated from the ground by assembly on wooden blocks		- Tower locations will be realigned to avoid the sewer line - Leakage of coolants and insulants will be avoided.
	Anticipated Impacts on Archaeology and Cultural Heritage No impact on Cultural and Religious sites because during design stage extra care was taken to ensure that religious structures/public property were avoided		- Programs for archaeological works will be designed to identify, characterize and record buried archaeological remains -The archaeological site that will be pointed out by heritage advisors, and an archaeological evaluation will be avoided.
	Visual Impacts Visual intrusions arise from the inevitable presence of construction equipment, materials, transport vehicles, and piles of soil and debris as a result of clearing, site work, and heavy equipment and vehicles on the road	Local community near the project area	- The construction area of the site will be fenced - Roads providing access to the site will be maintained free of dust and mud - All remaining construction materials will be removed from the site after the construction
	Community Health Impact (i) Increase infection of air-borne disease	Construction workers and local community	- Medical check for workers will be carried out who are susceptible infection of air-borne diseases

	- Air-borne diseases such as tuberculosis, influenza and meningitis can spread easily due to an influx of construction workers from other places		
	(ii) Fugitive dust emissions - Dust emissions due to on-site heavy-duty off-road vehicles, other light-duty vehicles	Construction workers and local community	- Wetting of roads by water spraying will be carried out. - Vehicle speeds will be restricted. - Wheel or body washing
	(iii) Increase infection of water borne diseases - Cholera and diarrhea will increase if there will be no proper sanitation practices at the construction site	Construction workers and local community	- Proper sanitation system will be provided for construction workers - Construction debris will be disposed at suitable location that does not impact on local nearest rivers - All areas of fuel storage will be banned to prevent hydrocarbon pollution of surface water
	(iv) Increase infection from mosquito - Stagnant pools of water will cause bleeding zone for mosquitoes and infections from mosquitoes	Construction workers and local community	- Construction time will be avoided in rainy seasons as much as possible - Proper temporary or permanent drainage system will be compensated
	(v) Increase risk of sexually transmitted infections - The influx of new migrant workers, living away from their families lead to an increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia	Construction workers and local community	- Information and education about safe sex and implement HIV control program will be provided
	(vi) Health impact related to increase in noise level - Noise from construction machineries and pilling operation will produce high noise level	Construction workers and local community	-Speed limits for trucks will be reduced in the project area to reduce noise level - Working at night will be avoided.
	(vii) Impacts due to stringing activities - Stringing activity around the wires and other electrical units can be a potential	Construction workers	- An Emergency Prevention and Response Plan (EPRP) will be developed according to Angolan requirements and international industry standards and best practices

	hazard if proper planning is not followed		- Personnel will be trained on how to respond to unplanned events
Operation Phase			
Impact on air environment	Impacts on air environment due to gaseous emissions Gaseous emissions from the production of required electrical power by auxiliary generator during power outage	Ambient air	- Generator with good engine condition will be used. - Regular maintenance of generator will be carried out. - Low noise traction substation transformer will be used.
	Impact of Noise – Noise and vibration due to the travelling of high- speed trains	Local residents near the proposed project	- Sound proof measurements will be taken near the public area
Impact on surface water environment	- Wastewater used by workers during operation phase - Paint residue for maintenance of power supply stations	Surface water quality	- Treatment of waste water will be used by installation of oil-water separator - Workers will be trained on appropriate handling of oil and lubricants and paint residues
Impact on soil and ground water environment	Leakage of oil and grease from the train maintenance	Local residents near the railway line	-Zinc-based paint will be used instead of lead-based paint - Leakage of oil or paint will be controlled and avoided.
Impact on biodiversity environment	(a) Flora Diversity - Some plants can suffer leaf damage if the electric field is high enough, which causes the tips of the leaves to dry out and can reduce growth	Flora and fauna diversity	- The use of passive shield wires will be installed near transmission lines that generate opposing cancellation fields from electromagnetic induction - Teleology will be successfully applied in both residential and commercial environments to mitigate magnetic fields from overhead transmission and distribution lines, and tmderground residential distribution (URD)

			lines
	(b) Fauna Diversity - Transmission lines have an effect on wildlife that include long-term changes to habitat, impacts on herpetofauna, avian (bird and bat) strikes, noise effects, electric and magnetic fields, and electrocution	Flora and fauna diversity	- Low noise equipment will be used. - The activities will be avoided at night -Barricades or fences will be used to prevent wildlife from access to the transmission lines
Impact on human environment	Positive socio-economic impact Improvement in livelihood and economic The direct employment opportunities would be increased for the local people.	Local community	- Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible - Sub-contractor will encourage to use local labor force as part of tender requirement.
	(ii) Benefits to national economy - There can be income from usage of electricity from local power supply system	National government	- Electricity will be used systematically - Electricity bills will be audited yearly with professionals
	Negative socio-economic impacts (i) Impact due to electricity consumption - Power supply points of the whole line will be mainly distributed in station, yard, substation and the tunnel in the sections where lighting and ventilation are required	Local community	-The source of electricity that does not pressure on local use in the current and future will be used. - Alternative source of energy will be used such as solar power where land use will available or self-generator where there has high pressure on local electrical use
	(ii) Social tension The nearby villages do not get electricity all the time while the railway lighting is always on during the night	Local community	- Distributing electricity will be considered also for local people before starting the project if possible. -Local people will be supported by supplying solar system
	Visual Impact Visual impact due to the construction of the new power station building and run of way for transmission lines	Local community for the proposed project	- The design will be local designs suitable with surrounding beautiful Shan State - Hard landscaping and planting will be introduced to help integrate the building into its environment
Impacts of Utility Consumption	Electricity is used to provide the adequate lighting and safety signboards	Local community	-Good housekeeping measures such as turning off equipment and lights when not in use will

			be implemented. - LED lights and/or lower wattage lamps will be used. - Alternative source will be used like solar system
Community Health Impacts	Noise Noise can be generated from the use of axillary generator during power outage	Local community	- Low noise power transformers will be used. - Sound proof generator will be used.
	Gaseous Emission Gaseous emission due to the production of required electrical power by axillary generator during power outage	Local community	-generator with good engines will be used. - Generators will be maintained regularly.
	Electromagnetic Fields (EMF) - The local people within this distance can be affected due to EMF - The health of local people can be disturbed according to their distance from the source	Local community	- Metals such as copper or brass will be used as electromagnetic shielding - For electrocution and electromagnetic wave, warning signs indicating high voltage area will be used. - The workers will be followed the National EQEG guidelines for preventing exposure to human beings
	Electrocution Cause fatal impact on people when they come in contact with the lines due to high voltage of power lines	Local community	- Warning signs indicating high voltage area will be used. - Barricades or fences will be used to restrict access to high voltage area
	Chemical Hazards - The typical chemicals found in substations include dielectric fluid, transformer oil, capacitor oil, sulphur hexafluoride and sulphuric acid	Local community	- Hazardous chemicals and materials will be handled and stored properly - People from the hazardous chemical substances will be isolated.
Decommissioning Phase			
Impacts on air environment	Dust generation Dust emission from the truck vehicles and other heavy/light-duty vehicles	Local residents along the railway line	- Water will be sprayed on sites during destruction activities - Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes

	Noise Noise pollution from removal of buildings and infrastructures	Local residents along the railway line	-All exhaust systems will be maintained good working orders - Equipment will be maintained regularly.
Impact on surface water environment	- Increased sedimentation of water courses - Piling steel structures on the site for a long time without moving to dumping sites or to places to do recycling	Nearest rivers and water bodies	- Wastes will be disposed properly according to the requirements - The wastes will be recycled by giving to recyclists and secondary users can use them
Impacts on soil and ground water environment	Contamination of soil and groundwater occur as a result of accidents and/or improper handling of lubricants, oils, and transformer oils (PCBs)	Soil contamination	-Hazardous wastes and solid wastes will be disposed of according to the rules and regulations of CDCs - Removal of electrical equipment will be carried out carefully.
Impacts on socio-economic environment	**Loss of jobs for local people and revenues for the government** Loss of jobs and indirect employment depending on the operation of proposed and of associated services for tourism as well as loss of revenues for the government	Local people	- Extensive and comprehensive warning to employees to allow them to source alternative livelihood will be taken early - A plan to reuse the proposed project to other partner company to retain the revenue for the government will be prepared.
	Visual Impact Visual impacts on communities in the vicinity area due to the waste generated from decommissioning activities and piling of wastes on the site	Local people	-All the structures will be demolished including transmission towers and transmission lines affecting the visual amenities - Wastes will be disposed of properly.

1.7. Summary of Cumulative Impacts

Table - Summary of Cumulative Impacts

Phase	Item	Cumulative Impacts	Mitigation Measure
Pre-construction Phase	Loss of Habitat	Leads to extreme temperature swings that are harmful to plants and animals from removing trees	• Clearing of vegetation should be kept to a minimum • Keeping the width and length of earthworks to a minimum • Wetland habitats identified should be retained within the development footprint in its current state. • Replantation
	Deforestation	Greater amount of greenhouse gases to be released into the atmosphere	• Protect natural carbon sinks that could be endangered by the project, such as peat soils, woodlands, wetland areas and etc. • Clearing of vegetation should be kept to a minimum • Avoid unnecessary idling of construction vehicles • Construction machineries and vehicles will be maintained properly.
Construction Phase	Water Scarcity	More water scarcity problems in Northern Shan Region and Pyin Oo Lwin	1. Sustainable water management 2. Reclaimed water 3. Awareness & Education 4. Construction period should be started in the late rainy season in order to be able to store rainwater in storage tanks throughout the whole rainy season.
Operation phase	Alternation in land use pattern	Impact on the agriculture in that area	Compensate/Buy the firm land whose owner wants to sell with reasonable price
	Visual Impact	The cumulative impact of the proposed structures and other infrastructure and link roads will be particularly significant with the farmland and the urban edge along the road will contribute to the increasing urbanization of that area	The location and color of storage tanks should be selected with consideration of architecture view.
	Water Scarcity	Increase in population can lead to water scarcity problems currently faced by the local people.	1. Sustainable water management 2. Reclaimed water 3. Awareness & Education 4. Construction period should be started in the late rainy season in order to be able to store rainwater in storage tanks throughout the whole rainy season.
	Increase in Human Trafficking	Since the transportation becomes easy, the increase in human trafficking rate could also occur.	The corporation with human trafficking team in every trip to Mandalay to Muse Permanent Immigration Inspection Team should be made.
	Increase in Trade off Drugs	Since the transportation becomes easy and the profits of trade off drugs are high, the rate of trading off drugs would increase especially in Shan State.	- Trading off the chemicals and drugs used to manufacture drugs into Shan State should be restricted. - The government should redouble its drug control and anti-corruption efforts

1.8. Summary of Environmental Management and Monitoring Plan

1.8.1. Overall Budget for Environmental Management and Monitoring

The overall budget for environmental management and monitoring will be as follow:

Table – Overall Budget of Environmental Management

No,	Phases	Estimated Cost/Year	Total Budget
1.	Pre-construction Phase	2,150,000 kyats	2,150,000 kyats
2.	Construction Phase	12,650,000 kyats	20,570,000kyats
3.	Operation Phase	6,180,000kyats	24,810,000 kyats
4.	Decommissioning Phase	2,180,000 kyats	2,180,000 kyats

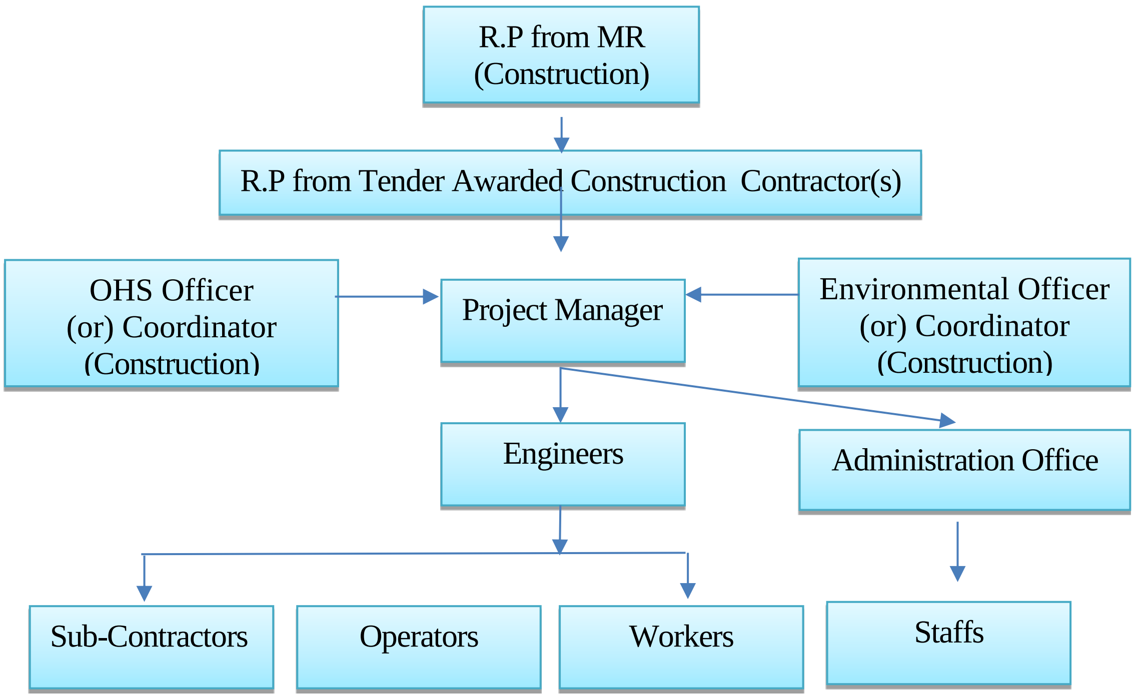
Table – Overall Budget of Environmental Monitoring

No,	Phases	Estimated Cost/Year	Total Budget
1.	Pre-construction Phase	2,040,000	2,040,000kyats
2.	Construction Phase	2,737,000kyats	8,211,000 kyats
3.	Operation Phase	6,972,000 kyats	348,120,000kyats
4.	Decommissioning Phase	-	-

1.8.2. Responsible Organization

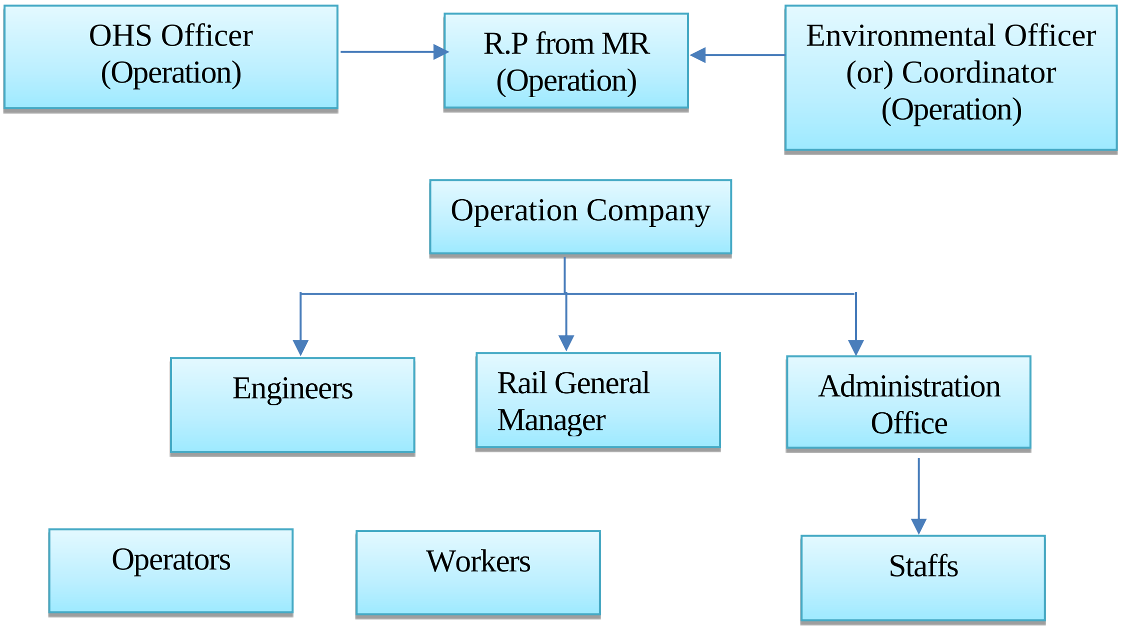
The responsible organization will be as follow:

(a) For Pre-Construction and Construction Phase



Construction Contractor(s) Environmental Management Team

(b) For Operation Phase



R.P – Representative Person

Operation Environmental Management Team

Corporate Social Responsibility (CSR) Fund

The company's policies for local socio-economic development are shown in the following table.

No.	Description	Company's Policy
1.	Local Community Development Policy	Appoint local people with relevant skills as much as possible and at least 50% of local people will be appointed during operation phase.
2.	Corporate Social Responsibility (CSR) Policy	Contribute at least 2 percent of the annual net profit after tax as CSR fund

1.9. Summary of Public Consultation and Disclosure

Public consultation will be made by household survey, focus group discussion and public consultation meetings. In fulfillment of the public consultation for the project, at least 19 public meetings for the whole project including six stakeholder meetings for scoping reports in total will be held so far.

(a) Household Survey and Focus Group Discussion

For household survey, 87 villages along the railway were conducted to evaluate primary socio-economic conditions of the project area and to understand the mood, perceptions and extent of preparedness of the people towards the proposed project. To get the accurate data, primary data collection will be conducted by social specialist, social consultants, local authorities and local people. During household survey, the most important positive outcomes from the project expected by the local people and most of their concerns about proposed project are as follow:

- The damage of agricultural land, forest area, historical places and archeological sites;
- Compensation to land use if they don't have permit to land right;
- the blockage of streams and natural springs; and
- worry to damage on the hill-side cultivation.

(b) Public Consultation Meetings (PCMs)

In public consultation meeting that was organized with participation of local stakeholders, parliament members, NGO and mass media, etc. are attended and asked questions that they want to know. The followings are the summary of key public concerns through the public consultation process.

Summary of Public Conservation Meeting for EIA

Ever Green Tech and MR hold 19 PCMs in 9 townships along the MMR both for scoping and EIA reports.

No.	Meeting	Location	Date	No of Participants
PCMs for Scoping				
1	Public Meeting for Scoping Proposal	Zaytawon Monastery, Myit Nge (Mandalay)	(25.6.2019)	Local Authorities = 20 NGOs = 12 Local People = 180
2	Public Meeting for Scoping Proposal	Township Hall, Naung Cho	(26.6.2019)	Local Authorities = 15 NGOs = 12 Local People = 120
3	Public Meeting for Scoping Proposal	Meeting Hall (GAO), Kyauk Me	(27.6.2019)	Local Authorities = 20 NGOs = 12 Local People = 115
4	Public Meeting for Scoping Proposal	Meeting Hall (GAO), Lashio	(29.6.2019)	Local Authorities = 33 NGOs = 10

				Local People = 110
5	Public Meeting for Scoping Proposal	Township Hall, Thein Ni	(1.7.2019)	Local Authorities = 12 NGOs = 6 Local People = 102
6	Public Meeting for Scoping Proposal	City Hall, Muse	(2.7.2019)	Local Authorities = 22 NGOs = 4 Local People = 60
PCMs for EIA				
1	Public Meeting for EIA Stage	Pyin Oo Lwin (City Hall)	(31.8.2019)	Local Authorities = 22 NGOs = 10 Local People = 125
2	Public Meeting for EIA Stage	Mandalay (Pathein Gyi) (Township Hall)	(17.8.2019)	Local Authorities = 16 NGOs = 13 Local People = 150
3	Public Meeting for EIA Stage	Hsipaw (Township Hall)	(7.9.2019)	Local Authorities = 20 NGOs = 12 Local People = 180
4	Public Meeting for EIA Stage	Kuitkai (Meeting Hall, GAO)	(22.10.2019)	Local Authorities = 20 NGOs = 8 Local People = 180
5	Public Meeting for EIA Stage	Mandalay (Pathein Gyi) (Township Hall)	(10.10.2019)	Local Authorities = 15 NGOs = 10 Local People = 60
6	Public Meeting for EIA Stage	Pyin Oo Lwin (City Hall)	(11.10.2019)	Local Authorities = 16 NGOs = 12 Local People = 90
7	Public Meeting for EIA Stage	Naung Cho (Township Hall)	(1.9.2019)	Local Authorities = 18 NGOs = 9 Local People = 200
8	Public Meeting for EIA Stage	Hsipaw (Township Hall)	(21.10.2019)	Local Authorities = 22 NGOs = 10 Local People = 110
9	Public Meeting for EIA Stage	Theinni (Township Hall)	(25.10.2019)	Local Authorities = 12 NGOs = 6 Local People = 102
10	Public Meeting for EIA Stage	Lashio (Meeting Hall, GAO)	(8.9.2019)	Local Authorities = 22 NGOs = 10 Local People = 200
11	Public Meeting for EIA Stage	Muse (City Hall)	(24.10.2019)	Local Authorities = 22 NGOs = 10 Local People = 85

12	Public Meeting for EIA Stage	Kyauk Me (City Hall)	(6.9.2019)	Local Authorities = 16
				NGOs = 13
				Local People = 180
13	Public Meeting for EIA Stage	Kuitkai (NantphatKha) (Church)	(23.10.2019)	Local Authorities = 14
				NGOs = 6
				Local People = 100

(c) Summary of Public Concerns through Public Consultation Process

The followings are the summary of key findings from public consultation process.

(a) Less damage to agricultural land, forest area and histological places;
(b) Not to damage to uncover natural resources; (keep away alignment from natural resources existing area);
(c) Proper compensation to land use with or without ground gram;
(d) Declare the width of the railway line and land use of other facilities openly;
(e) Limit tree cutting outside of the project area;
(f) Less damage to wildlife along the railway line;
(g) Control foreign and migrant workers;
(h) Policy to prevent the settlement of migrant workers near the project sites;
(i) Policy to ensure job opportunities to local people;
(j) Tender system for every project implementation works;
(k) Not to separate the agricultural lands by the railway;
(l) Not to increase in traffic during construction phase;
(m) Road damage during transportation of construction materials;
(n) Create job opportunities for local people at Muse-Mandalay Railway road where the economic conditions can be reduced due to the development of railway line;
(o) Not to produce the electricity for railway in Myanmar;
(p) Not to use the require electricity for new railway in local source.

(d) Summary of Public Disclosure Process

Draft EIA report will be made publicity on MR website and all comment and response will be accompanied in the final EIA report. The final EIA report will be upload and disclose in MR website.

1.10. Summary of Grievance Redress Committee (GRC)

Responsible Person for GRM

Name	U Phyo Htet Kyaw
Position	Assistant General Manager (Planning)

Address	Nay Pyi Taw Station Compound, Nay Pyi Taw, Myanmar
Contact Number	Tel : +95-6777164(office)/+95-9-43124800(mobile) Fax : +95-67-77164

Township, district and state level committees for the grievance redress mechanism

No	Committee Member	Member Role
Township Level Redress Committee (TRC)		
	A person elected from citizen	Chairperson
	A person elected from experts	Member
	A person elected from CSOs	Member
	Deputy admin officer – township level (General Administrative Department)	Member
	Township level officer	Member
District Level Redress Committee (DRC)		
	A person elected from citizen	Chairperson
	A person elected from experts	Member
	A person elected from CSOs	Member
	Deputy admin officer – district level (General Administrative Department)	Member
	District level officer	Member
State Level Redress Committee (SRC)		
	The president appointed mayor as a minister	Chairperson
	In Yangon, there are four districts and each district can elect one representative	4 Members
	Appointed from government	4 Members

1.10. Conclusion

According to the impact assessment for the feasibility study for the railway power supply system, the most possible impacts will be land use, increase in traffic, soil contamination and noise during construction phase and the use of electrical power and EMF during operation phase. The most possible socio-economic impacts will be impact on agricultural lands, increase in traffic, and impacts due to population influx and pressure on electricity consumption. According to the nature of the environmental and social impacts for railway power supply system, the impact due to construction phase will be more than operation and decommissioning phase. As for conclusion, all of the environmental and social impacts can be mitigated to proper mitigation measures to acceptable level described in this report. According to the nature of the environmental and social impacts for railway construction, the impact due to construction phase will have high impact than operation phase. So, MR will pay high attention for construction phase. For the land use, it will be prepared as RAP report as supplementary report.

2.0. INTRODUCTION

2.1. Project Background

On October 22nd, 2018, Myanma Railways, the Ministry of Transport and Communications of the Republic of the Union of Myanmar and China Railway Eryuan Engineering Group Co. Limited, China Railway Group Limited, the People's Republic of China signed the Memorandum of Understanding (MOU) on Feasibility Study for Muse-Mandalay Railway Project in Nay Pyi Taw, the capital of Myanmar. Subsequently, a Coordination Committee, a Joint Working Group and a Technical Working Group were established. From December 5th to 12th, 2018, the Ministry of Transport and Communications of Myanmar conducted a joint survey with CREEC on the Muse-Mandalay Railway, and held a post-survey summary meeting to confirm the route, main station location, and main technical standards of the railway. Muse-Mandalay Railway starts from Muse port of entry at the north, goes south to Mandalay, the second largest city in Myanmar, and connects important cities, towns such as Muse port of entry, Lashio etc with Myanmar central region. Main line totals 409.960km. Muse-Mandalay Railway connects with China's railway network at the north, and links up with Myanmar existing meter-gauge railway by a break of gauge at Mandalay. Through the exiting meter-gauge railway, it can reach Naypyitaw, Yangon and another Myanmar southeast region as well as northwest region with Myitkyina as the example. So, it is necessary to conduct EIA for the power stations according to the Environmental Impact Assessment Procedure, 2015 in Myanmar.

2.2. Brief of the Project Proponent

The followings are the brief of project proponent for the FS of Muse-Mandalay railway project.

Project Developer	
Project Developer	Myanma Railways (MR) under the Ministry of Transport and Communications (MOTC)

<table>
<tr><td>Type of Project</td><td>Power Stations and Transmission Lines along
Muse-Mandalay Railway</td></tr>
<tr><td>Project Location</td><td>Muse-Mandalay Railway starts from Muse port of entry at the north, goes south to Mandalay</td></tr>
<tr><td rowspan="2">Contact Person</td><td>1.U Myo Win (General Manager)
Upper Myanmar Administration (MR)
Upper Myanmar Administration Department,
Mandalay Station,
Mandalay, Myanmar
Tel : +95-2-35172
Fax : +95-2-35829
E-mail : myowingmupper@gmail.com</td></tr>
<tr><td>2.U Phyo Htet Kyaw [Assistant GeneralManager (Planning)]
Planning and Administration Department, (MR)
Nay Pyi Taw Station Compound,
Nay Pyi Taw, Myanmar
Tel : +95-6777164(office)/
+95-9-43124800(mobile)
Fax : +95-67-77164</td></tr>
</table>

2.3. Brief of the EIA Service Provider

Below is the background information on Ever Green Tech Environmental Services and Training Co., Ltd., (Third party) who will conduct the EIA.

<table>
<tr><th colspan="2">Ever Green Tech Environmental Services & Training Co., Ltd.</th></tr>
<tr><td>Company Name</td><td>Ever Green Tech
Environmental Services and Training Co., Ltd.</td></tr>
<tr><td>Company Registration No.</td><td>3344/2015-2016 (Ygn)</td></tr>
<tr><td>Transitional Third Party Registration No.</td><td>0047</td></tr>
</table>

Contact Address	1/9, Baho Road, 16th Quarter, Hlaing Township, Yangon.
Telephone Number	09-5099230, 09-5099232
E-mail	green.evergreentech@gmail.com; md@everrgreentechmyanmar.com.mm
Contact person	Dr. Kyaw Swar Tint Ph.D. (Mining) Principal Environmental and Social Consultant 09-797111000 11kyawswar@gmail.com

2.4. Selected Consultants for Conducting EIA

The following are the selected consultants for conducting EIA for power supply system of railway project.

	No.	Name	Degree	Responsibility	Area of Expertise
Our Consultants	1	Dr. Kyaw Swar Tint	Ph.D. (Mining)	Principal Consultant	(a) Air Pollution Control (b) Noise and Vibration (c) Socio-Economy (d) Environmental Management and Monitoring
	2	Mr. Min Aung	M.Sc. (Chemistry)	Key Consultant	(a) Water Pollution Control (b) Modelling of Water Quality (c) Meteorology, Modeling for Air Quality (d) Soil and Ground Water Pollution Control
	3	Dr. Thein Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Risk Assessment and Hazard Management (b) Facilitation of Meeting (c) Occupational Safety and Health
	4	Dr. Myo Min Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Evaluation of Alternatives (b) Resources Utilization and Management (c) Waste Management
	5	Dr. Sao Hone Pha	Ph.D. (Electronics)	Consultant	Remote Sensing and GIS

	6	Ms. Nandar Nwe	M.S. in EIA/EMS (YTU), Dip; in Applied Psychology (YU)	Consultant	Social Impact Assessment (Household Survey)
	7	Ms. Thazin Htwe	M.S. in EIA/EMS (YTU), Dip; in Applied Psychology (YU)	Consultant	Social Impact Assessment (Public Consultation and Stakeholder Engagement)
	8	Mr. Yaw Ma Nar	B.Sc. (Forestry); Dip in EIA/EMS	Field Coordinator	Baseline Study (Traffic)
	9	Mr. Moe Pyi Kyaw	B.Sc. (Forestry)	Surveyor	Baseline Study (Water and Soil Quality)
	10	Dr. Wyne Nwe Nwe Oo	Ph.D. (Boitech)	Consultant	Species Identification
	11	Dr. Nyunt Lwin	Ph.D. (Zoology)	Consultant	Fauna Diversity
	12	Dr. Nyo Nyo Lwin	Ph.D. (Botany)	Freeland Consultant	Flora Diversity
	13	Dr. Khon Aung	M.B.B.S. (Ygn)	Consultant	Health Impact Assessment
	14	Dr. Ohm Thaik	Ph.D. (Mining)	Consultant	Geotechnical (Slope Stability)
	15	Dr. Tin Aung Myint	Ph.D. (Geology)	Consultant	Geology
	16	Dr. Win Swe	Ph.D. (Geography)	Consultant	Hydrology and Political Science
	17	Ms. May Thet Zaw	M.E. (Civil)	Consultant	Constructional Related Impact Assessment
	18	Ms. Nay Chi Win Maung	M.E. (Civil)	Consultant	Risk Assessment
	19	U Aung Naing Tun	L.L.B; MBA	Consultant	Legal Requirements
Foreign Consultant	20	Mr. Cheng Liang shuang	M.Sc. (Conservation of Soil & Water)	Consultant	Water resources and high speed railway design

2.5. The Need of EIA

Although the proposed project is FS stage, EIA is required for the proposed railway alignment project in accordance with this Environmental Conservation Law (2012) and Environmental Impact Assessment Procedure, 2015. Moreover, the proposed project will also include the construction, operation and maintenance of traction substations and transmission line for power supply system for high speed electric trains, and so separate EIA is required for this railway power supply system. The Environmental Conservation Department under Ministry of Natural Resources and Environmental Conservation is the lead authority for this EIA process and the development needs to be authorized by this department in accordance with this Environmental Conservation Law (2012).

2.6. Purpose and Objectives of the EIA Study

The Environmental Conservation Department under Ministry of Natural Resources and Environmental Conservation is the lead authority for this EIA process and the development needs to be authorized by this Department in accordance with this Environmental Conservation Law (2012). The environmental impacts associated with the proposed project require investigation in compliance with the EIA (Environmental Impact Assessment) procedures (2015). The main purpose of an EIA is to provide the relevant authorities with sufficient information on the proposed activities to allow them to make an informed decision on whether or not the EIA should be authorised. This EIA will be conducted according to Environmental Impact Assessment Procedures, 2015. The objectives of an EIA are to:

- Ensure that social and environmental considerations are explicitly addressed and incorporated into the development decision-making process;
- Anticipate and avoid, minimize or offset significantly adverse biophysical, social and other relevant impacts of proposed developments;
- Protect the productivity and capacity of natural systems and the ecological processes which maintain their functions; and
- Promote development that is sustainable and that optimizes resource use and management opportunities.

An EIA functions as a planning tool which helps determine the social, economic and Environmental impacts of a proposed project through Public Participation (PP) and independent specialist assessment. Through the EIA, potential negative and positive impacts are identified and recommendations are made for reducing or avoiding negative impacts, and enhancing positive impacts.

The findings of an EIA are transferred into clear and measurable objectives that must be achieved during construction, operation and decommissioning of a proposed project. These objectives, and plans for achieving them, are captured in an Environmental Management Plan (EMP). The EMP is a public document and typically becomes a component of the project financing terms and conditions should the project go ahead.

The basic guiding principles of the EIA are:

- To inform decision-makers and result in appropriate levels of Environmental protection and community well-being;
- To provide timely information and outputs which assist with design and engineering modifications that reduce negative impacts;
- To identify any significant Environmental effects and key issues (i.e. the matters that must be taken into account when making decisions) and apply the necessary mitigation measures;
- To provide opportunities to inform and involve Interested and Affected Parties (I&APs), incorporating their inputs and concerns explicitly into the documentation and decision-making;
- To allow opportunities for participation by the authorities involved;
- To ensure that the EIA team has implemented appropriate methodologies and experts from the relevant disciplines, and to ensure the team has assessed potential interrelationships between the biophysical, social and economic issues; and
- To provide, as far as possible, an objective, rigorous and balanced assessment of the issues.

2.7. About the EIA and EMP Report

EIA is a formal process used to predict how the proposed project will affect natural resources such as water, air, land, socio-economic and wildlife. It is desirable to ensure that the development options under consideration are sustainable. It also aims to make recommendations for the mitigation of the potential negative impacts and enhancement of the positive ones.

EMP is a site-specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental impacts arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures the project

implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle.
The EIA and EMP reports will contain:

(a) the present status of air, noise, water, land, biological, socio-economic and health components of the environment;
(b) identification and evaluation of positive and negative impacts due to the development of the project;
(c) proposed pollution control measures, environmental management plan (EMP) to be adopted for mitigation of adverse impacts;
(d) measures for the improvement of the community around the area, and
(e) post-project environmental quality monitoring programme.

In making impact assessment, Green Tech ESIA Team mostly referred to the pollution limits set by Myanmar National Emission Guidelines, USEPA, OSHA and WHO.

2.8. Scope of the EIA Study

This EIA study for the proposed railway power supply system will cover FS for the following:

(1) traction sub stations; and
(2) transmission line along the railway.

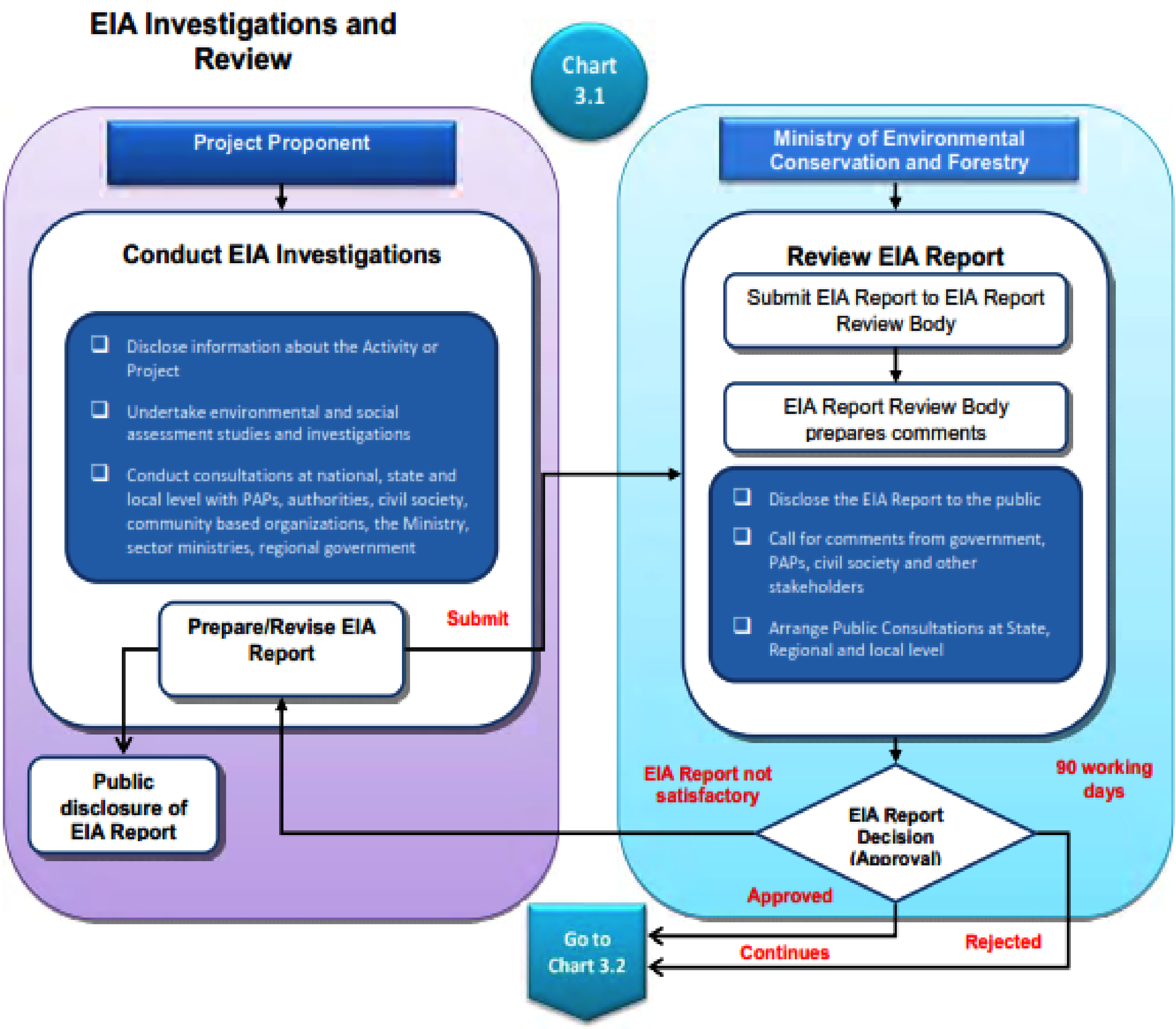
But the EIA study will not cover the main power generation sources and main power transmission line for traction substations.

3.0. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This chapter sets out the relevant legal and policy context in Myanmar and documents the environmental and social standards with which the proposed project has to comply with, as well as the international standards that the project will follow.

3.1. National Requirements

The EIA has been undertaken in accordance with the Myanmar Environmental Impact Assessment Procedure which was promulgated on December 29th, 2015, and provides legislation for environmental and social governance of economic development in Myanmar, under the Environmental Conservation Law 2012 and Environmental Conservation Rules 2014 of the National Environmental Policy for Myanmar 1994. An overview of the process (from the Myanmar EIA Procedure, 2015) is shown in Figure 3.1.



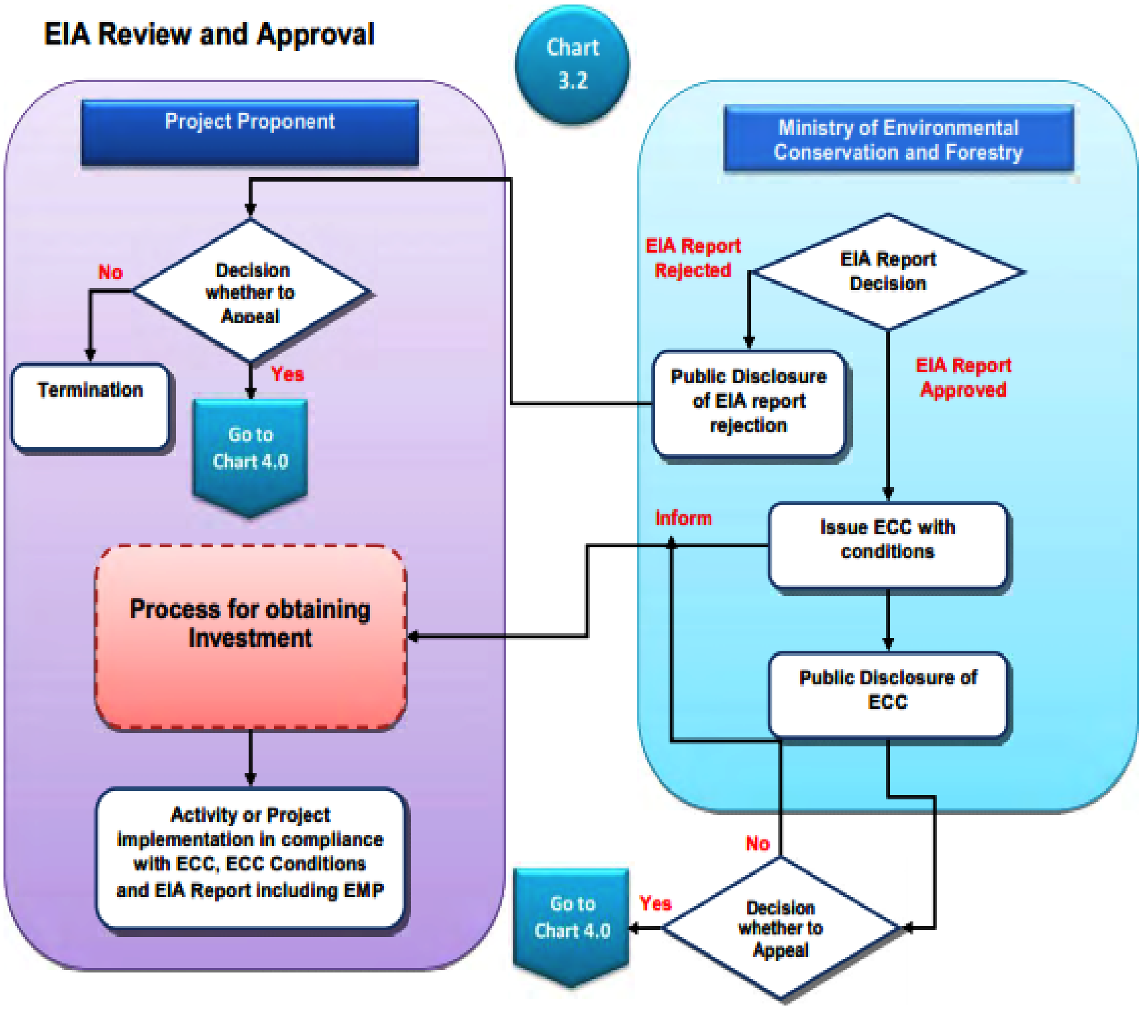


Figure 3.1. EIA Review and Approval Process

3.2. Laws and Regulations Related to the Proposed Project

Myanmar has promulgated several laws and regulations concerning protection of the environment. The following table describes laws and regulations which are directly or indirectly associated with the proposed project.

Table 3.1. Laws and Regulations Related to Workmens' Right, Occupational Safety and Health

Law name and section	Legal Commitments
The Labor Organization Rules (No, 1, 7 to 11), 2012	
Section 18	The project proponent has to comply for dismiss of worker with section 18 of the Labor Organization Law.
Section 19	The project proponent has to comply for dispute between employer and worker with section 19 of the Labor Organization Law.
Section 20	The project proponent has to comply for dispute between employer and worker with section 20 of the Labor Organization Law.

Section 21	The project proponent has to comply for dispute between employer and worker with section 21 of the Labor Organization Law
Section 22	The project proponent has to comply with section 22 of the Labor Organization Law.
Labor Disputes Resolution Law, 2012	
Section 38	The project proponent has to comply with section 38 of Labor Dispute Resolution Law.
Section 38 a	The project proponent has to comply with section 38a of Labor Dispute Resolution Law.
Section 39	The project proponent has to comply with section 39 of Labor Dispute Resolution Law.
Section 40	The project proponent has to comply with section 40 of the Labor Dispute Resolution Law.
Section 43	The project proponent has to comply with or abide by any of the terms of the agreement entered into before the mediation body in connection with the dispute.
Section 51	The project proponent has to comply with section 51 of Labor Dispute Resolution Law.
Employment and Skill Development Law,2013	
Section 5	The project proponent has to employ according to section 5 of Employment and Skill Development Law.
Section 14	The project proponent has to carry out training programmes in accord with the work requirement in line with the policy of the skill development team to develop the skill relating to the employment for the workers who are proposed to appoint and working at present.
Section 30 (a & b)	The project proponent has to pay money not less below 0.5% of salary, total wages paid to the level of worker supervisor and the workers below such level in such work monthly without fail as the contribution to the fund.The project proponent has to ensure that put in money paid has to not be deducted from the wage or salary of the workers.
The Leave and Holiday Act, 1951 (Law Amended July, 2014)	
Section 3	The project proponent has to comply for the holiday of worker according to section 3 of 1951 Leave and Holidays Act.
Section 5	The project proponent has to comply in related to leave of worker according to section 3 of 1951 Leave and Holidays Act.
Section 14	The project proponent has to comply with section 14 of 1951 Leave and Holidays Act.
Section 16	The project proponent has to comply with section 16 of 1951 Leave and Holidays Act.
Minimum Wages Law, 2013	
Section 12	The project proponent has to pay wage according to section 12 of Minimum Wages Law.
Section 13	The project proponent has to carry out with section 13 of Minimum Wages Law.
Payment of Wages Act, 2016	
Section 3	The project proponent has to pay the wages according to section 3 of Payment of Wages Act.
Section 4	The project proponent has to pay the wages according to section 4 of Payment of Wages Act.
Section 5	The project proponent has to difficulty to pay the wages according to Section 4 sub-section (c) because of significant happenings, including natural disaster, the employer must report to the Department with solid evidence that wages will be paid at the mentioned day upon the workers' agreement.
Section 7	The project proponent has to comply according to section 7 of Payment of Wages Act.
Section 8	The project proponent has to comply according to section 8 of Payment of Wages Act.
Section 10	The project proponent has to comply according to section 10 of Payment of Wages Act.
Section 14	The project proponent has to allow the presiding overtime rate for an employee carries as set by the Law of Payment of Wages Act
The Social Security Law, 2012	
Section 11a	The project proponent has to comply in accordance with section 11 of the Social Security Law, 2012.
Section 15	The project proponent has to pay Social Security Fund described in section 15 of the Social Security Law, 2012.
Section 18	The project proponent has to deduct contributions to be paid by worker from his wages together with contribution to be paid by him and pay to the social security fund.
Section 48	The project proponent has to comply with section 48 of the Social Security Law, 2012.

Section 75	The project proponent has to prepare and keep records described in section 75 of the Social Security Law, 2012 and lists correctly and submit to the relevant township social security office in accord with the stipulations. The project proponent has to inform the relevant township social security office if the matters described in section 75b arise and submit records of work and lists if requested by inspectorate or official assigned by the Social Security Head Office and various levels of Regional Social Security Office under this Law.
Workmen's Compensation Act, 2005	
Section 3	The project proponent has to liable to pay compensation in accordance with section 3 of the Workmen's Compensation Act if personal injury is caused to a workman by accident arising out of and in the course of his employment
Prevention and Control of Communicable Diseases Law, 1995	
Section 3	The project proponent has to follow the Ministry of Health to prevent the spread of infectious diseases.
Section 4	The project proponent has to comply with the provisions of Article 3 of the Ministry of Health and the Department of Health regarding the prevention and control of communicable diseases.
Section 11	The project proponent has to allow the health officer according to section 11 of Infectious Disease Prevention and Control Law for the prevention of spread of infection diseases.
The Control of Smoking and Consumption of Tobacco Product Law, 2016	
Section 9	The project proponent has to carry out the task according to section 9 of the Control of Smoking and Consumption of Tobacco Product Law.
The Prevention of Hazard from Chemical and Related Substances Rules, 2013	
Section 15	The project proponent has to carry out inspection and training according to section 15 of Prevention of Hazard from Chemical and Related Substances Law.
Section 16	The project proponent has to comply Section 16 of Prevention of Hazard from Chemical and Related Substances Law.
Section 17	The project proponent has to put the insurance in accordance with the prescriptive stipulations to be able to pay the compensation, if the impact and damage is occurred on the Human Being and Animals or the environment in respect of the chemical and related substances businesses.
Section 22	The project proponent has to abide the regulations consisted in the registration certificate furthermore shall also abide the order and instructions issued occasionally by the Central Supervisory Board.
Section 27	The project proponent has to control and decrease the hazard of the chemical and related substance according to section 27 of Prevention of Hazard from Chemical and Related Substances Law.
Section 30	The project proponent has to comply according to Section 30 of Prevention of Hazard from Chemical and Related Substances Law.
Occupational Safety and Health Law (Pyidangsu Hluttaw Law No.8), 2019	
Section 12	(A) The project proponent has to appoint the person in charge of occupational safety and health to closely monitor the safety and health of the workers according to the type of work. (B) The project proponent has to form occupational safety and health committee, consisting of workers' representatives, in accordance with the provisions of the Ministry.
Section 14	The project proponent has to follow Rules and regulations issued under this law.
Section 16	The project proponent has to allow the inspection officers for inspection of safety and health conditions of the workplaces.
Section 17	The project proponent has to allow inspectors for conducting the actions described in section 17 of Occupational Safety and Health Law.
Section 18	The project proponent has to report the inspection officers any injuries to the workplace for reasons described in section 18 of Occupational Safety and Health Law
Section 26	The project proponent has to perform the tasks described in section 26 of Occupational Safety and Health Law.
Section 27	The project proponent does not have to dismiss or demote an employee for the reason described in section 27 of Occupational Safety and Health Law.

Section 34	The project proponent has to be responsible for occupational injury, dangerous event, in case of serious work injury and if an employee suffers from a specified occupational disease.
Section 36	The project proponent has to follow the inspecting officer for any work-related injuries, dangerous events, occupational diseases, workplace poisoning
Workmen's Compensation Act, 1923	
Section 3	The project proponent has to liable to pay compensation in accordance with section 3 of Workmen's Compensation Act if personal injury is caused to a workman by accident arising out of and in the course of his employment.
Law Relating to Overseas Employment, 1999	
Section 19	Project proponent has to comply with decision of the Minister for Labour described in section 19 of Law Relating to Overseas Employment
The Prevention of Hazard from Chemical and Related Substances Law, 2013	
Section 15	The project proponent has to carry out inspection and training according to section 15 of Prevention of Hazard from Chemical and Related Substances Law.
Section 16	The project proponent has to comply Section 16 of Prevention of Hazard from Chemical and Related Substances Law.
Section 17	The project proponent has to put the insurance in accordance with the prescriptive stipulations to be able to pay the compensation, if the impact and damage is occurred on the Human Being and Animals or the environment in respect of the chemical and related substances businesses.
Section 22	The project proponent has to abide the regulations consisted in the registration certificate furthermore shall also abide the order and instructions issued occasionally by the Central Supervisory Board.
Section 27	The project proponent has to control and decrease the hazard of the chemical and related substance according to section 27 of Prevention of Hazard from Chemical and Related Substances Law.
Section 30	The project proponent has to comply according to Section 30 of Prevention of Hazard from Chemical and Related Substances Law.

Table 3.2- Laws and Regulations Related to Cultural and Heritage

Law name and section	Legal Commitments
The Protection of Rights of Natural Race Law, 2015	
Section 5	The project proponent has to completely be informed, coordinated and performed with the relevant local ethnic groups in the case of development works, major projects, businesses and extraction of natural resources will be implemented within the area of ethnic groups.
Protection and Preservation of Cultural Heritage Regions Laws, 2019	
Section 21	The project proponent has to comply with the Regional Conservation Committee in accordance with the stipulations, to obtain the prior approval that there is no harm to the cultural heritage area.
The Protection and Preservation of Antique Objects Law, 2015	
Section 12	The project proponent who finds the object which has no owner or custodian has to inform the relevant Ward or Village-Tract Administrator if he knows or it seems reasonable to assume that the said object is an antique object.
The Protection and Preservation of Ancient Monuments Law, 2015	
Section 12	The project proponent has to promptly inform the relevant Ward or Village-Tract Administrative Office when he finds an ancient monument.
Section 15	The project proponent has to apply to get prior permission to the Department when the project is within the specified area of an ancient monument.
Section 20	The project proponent does not have to carry out discarding chemical substance and rubbish which can affect an ancient monument and the environment within the specified area of an ancient monument or of a listed ancient monument without a written prior permission.

Rules for the Protection of the Rights of ethnic nationalities, 2019	
Section 20	The project proponent has to comply with section 20 of rules for the protection of the rights of ethnic nationalities.
Section 21	The project proponent has to comply with section 21 of rules for the protection of the rights of ethnic nationalities

Table 3.3- Laws and Regulations Related to Natural Environment

Law name and section	Legal Commitments
Forest Law, 2018	
Section 12	The project proponent has to get approval of the Ministry to carry out any development work or economic scheme within forest land or forest covered land.
The Conservation of Biodiversity and Protected Areas Law, 2018	
Section 19	The project proponent has to follow the Ministry of Forest Department according to section 19 of the Conservation of Biodiversity and Protected Areas Law.
Section 35	The project proponent has to comply with section 35 of the Conservation of Biodiversity and Protected Areas Law.
Section 39	The project proponent has to comply with the punishment according to the section 39 of the Conservation of Biodiversity and Protected Areas Law.
Conservation of Water Resources and Rivers Law, 2016	
Section 47	The project proponent has to get the opinion from the Department by stating the location of work, scope of work and the period of operation.
Section 48	The project proponent has to comply with the department according to section 48 of Conservation of Water Resources and Rivers Law.
Section 49	The project proponent has to pay the service fee prescribed by the Ministry for measurement printing and field inspection and river water use fee prescribed by the Ministry on the use of river water for other activities and river maintenance fee.
Conservation of Water Resources and Rivers Rules, 2013	
Section 47	The project proponent has to get the opinion from the Department by stating the location of work, scope of work and the period of operation.
Section 48	The project proponent has to comply with the department according to section 48 of Conservation of Water Resources and Rivers Law.
Section 49	The project proponent has to pay the service fee prescribed by the Ministry for measurement printing and field inspection and river water use fee prescribed by the Ministry on the use of river water for other activities and river maintenance fee.
Mandalay Region Freshwater Fisheries Law, 2012	
Section 38	The project proponent has responsible for the damage or pollute the water.
Shan State Freshwater Fisheries Law, 2014	
Section 39	The project proponent has to comply with any restrictions or prohibitions according to the section 39 of Shan State Freshwater Fisheries Law.
Section 40	The project proponent has not to change the volume or flow of the water according to section 40 of Shan State Freshwater Fisheries Law.

Table 3.4- Laws and Regulations Related to Transportation and Communication

Law name and section	Description
Railway Transportation Service Law, 2016	
Section 14 (B)	The project proponent has to submit the relevant particulars of the land to be acquired in accordance with the existing laws and procedures relating to the land acquisition if the land acquisition is required for the railway in the project
Section 16	The project proponent has to comply according to the Section 16 of the Railway Transport Service Law.
Section 24 (B)	The project proponent has to comply according to the Section 16 of the Railway Transport Service Law.

Section 28	The project proponent has to carry out the work described in section 18 of the Railway Transport Service Law with the approval of the Central Supervisory Board in respect of construction, maintenance of railways and infrastructure in connection with the railway transport service for the interests of the public.
Section 29	The project proponent has to send a notice to the land user or occupant for objection to any work, if any, by stating purpose and reason before carrying out the works mentioned in section 28, state the nature and volume of work exactly in the notice, give a copy of notice sent to the Central Supervisory Board.
Section 32	The project proponent has to enter upon any land adjoining the railway boundary to prevent accidents and repair the damage with the approval of the Central Supervisory Board in case of landslide and other accidents, and in recognition of potential accidents in cuttings, embankments and other works under its supervision. The project proponent has to have the right to enter upon the land and repair the damage without prior approval of the Central Supervisory Board if the damage requires emergency repair. Such action has to be reported to the Central Supervisory Board within 24 hours to obtain the approval, by mentioning the occurrence or the nature of potential accident and works to be carried out.
Section 34	The project proponent has to comply according to section 34 of the Railway Transport Service Law for carrying out the work in its section 32.
Section 36	The project proponent has to carry out as described in section 36 of the Railway Transport Service Law in respect of causing danger or inconvenience to the land users and occupants due to alteration of land and watercourses caused by the construction of the railway and receiving the compensation by the land users and occupants.
Section 39	The proponent has to comply according to section 39 of Railway Transport Service Law.
The Highways Law (Law No. 24), 2015	
Section 7	The project proponent has to get approval for the construction of billboard for constructing something by crossing the highways and construction within the boundaries of the highway.
Section 23	The project proponent has to permission from the Ministry in advance for power line connection.
Road Law, 2000	
Section 4	The project proponent has to carry out land confiscation and removal of buildings in accordance with existing laws for the construction and expansion of roads.
Vehicle Safety and Motor Vehicle Management Law, 2020	
Section 9	The project proponent has to follow the Ministry for determining and restricting the areas where motor vehicles used in the country are allowed to travel.
Section 12	The project proponent has to follow the Ministry in relation to the initial registration of motor vehicles.
Section 14	The project proponent has to set the speed for the safe movement of vehicles traveling on public roads.
Section 18	The project proponent has to maintain the vehicle and repair in accordance with the standards prescribed by the Department in order to drive safely.
Section 81	The project proponent has to carry out the loading or transporting of dangerous goods in the motor vehicle in accordance with the stipulations.
Motor Vehicle Rules, 1987	
Section 143	The project proponent has to follow the notification letter of the Ministry of Transport for determining the speed as required by road conditions.
Section 145	The project proponent has to follow section 145 of Motor Vehicle Rules.
Section 160	The project proponent has to follow in related with the use of horn according to section 160 of Motor Vehicle Rules.
Section 165	The project proponent has to comply during transportation of goods according to section 165 of Motor Vehicle Rules
Section 167	The project proponent has to comply for the vehicle malfunction according to section 167 of Motor Vehicle Rules.
Section 168	The project proponent has to comply for fueling of vehicle according to section 168 of Motor Vehicle Rules.
Section 169	The project proponent has to comply with the weight limit for crossing the bridge.

Table 3.5- Laws and Regulations Related to Communities' Development, Health and Safety

Law name and section	Description
Union of Myanmar Public Health Law, 1972	
Section 3	The project proponent has to allow the government to improve the health of the working population and advising on the health issues described in section 3 of 1972 Union of Myanmar Public Health Law to protect the health of the working population.
Section 5	The project proponent has to follow the organizations formed under this law to inspect and instruct the project at any time.
Village Regional Development Law, 2019	
Section 11	Project proponent has to comply with the right of rural people in accordance with section 11 of Village Regional Development Law.
Law of Protecting of Farmer Rights and Enhancement of their Benefits, 2013	
Section 9 (d, e)	Project proponent has to comply with section 9(d, e) of Law of protection of farmer rights and enhancement of their benefits for the unfair land acquisition
Second amendment of the law on the development of border areas and national races, 2015	
Section 4	Project proponent has to comply with section 4 of second amendment of the law on the development of border areas and national races in relating to altitude of the national race.
Public Health Law, 1972	
It is concerned with protection of people's health by controlling the quality and cleanliness of food, drugs, environmental sanitation, epidemic diseases and regulation of private clinics.	

Table 3.6- Laws and Regulations Related to Land Acquisition

Law name and section	Description
Vacant, Fallow, Virgin Land Management Law , 2018	
Section 10	The project proponent has to comply with the Central Committee according to section 10 of Vacant, Fallow, Virgin Land Management Law.
Section 19	The project proponent has to follow the Central Committee if ancient cultural heritage and resources in fallow and virgin lands arise
Land Acquisition, Resettlement and Rehabilitation Law , 2019	
Section 39	Project proponent has to comply with section 39 of Land Acquisition, Resettlement and Rehabilitation Law in association with compensation for land acquisition.
Section 41	Project proponent has to comply with section 41 of Land Acquisition, Resettlement and Rehabilitation Law for the complains of affected persons.
Section 42	Project proponent has to follow section 42 of Land Acquisition, Resettlement and Rehabilitation Law for the submission a petition to the relevant court in associated with complains of affected persons.
Section 46	Project proponent has to comply with resettlement or rehabilitation procedures in accordance with section 46 of Land Acquisition, Resettlement and Rehabilitation Law.
Section 54 (b, c)	Project proponent has to comply with central committee in accordance with section 54 of Land Acquisition, Resettlement and Rehabilitation Law for the acquisition of temporary land use.
Section 58	Project proponent has to compensate in accordance with section 58 of Land Acquisition, Resettlement and Rehabilitation Law for the damage of land used for temporary.
Farm Land Law, 2012	
Section 30	The project proponent has to comply related to the use of farmland according to section 30 of Farmland Law.
National Land Use Policy, 2016	
Part (V)	Project proponent has to comply with procedures related to land acquisition, relocation, compensation, rehabilitation and restitution of National Land Use Policy for land acquisition for project development.

Shan State Development Law, 2013	
Section 17	The project proponent has to follow the Township Committee according to section 17 of Shan State Development Law.
Section 22	The project proponent has to pay for tax according to section 22 of Shan State Development Law.
Section 69	The project proponent has to get the permission of the township committee to dispose if environmentally harmful substances on the road or in a place not designated for disposal.
Section 70	The project proponent has to get water from the public water supply business of the Department of Development Affairs with complying with the regulations
Mandalay Region Development Organizations Law, 2014	
Section 26	The project proponent has to follow the Ministry according to section 26 of Mandalay Region Development Organizations Law.
Section 39	The project proponent has to allow for inspection of the wells and ponds within the development area according to section 39 of Mandalay Region Development Organizations Law.
Section 40	The project proponent has to follow the committee according to section 40 of Mandalay Region Development Organizations Law.
Section 78	The project proponent has responsible for not to pollute air, not to damage the environment and not to do anything that could cause water pollution and not to dump into streams, ponds and drains streams.
Section 80	The project proponent has to get the permission of the township committee for disposal according to section 80 of Mandalay Region Development Organizations Law.
The Upper Myanmar Land and Revenue Regulation	
Section 27	The project proponent has to be liable to the payment of land-revenue to the Government according to section 27 of the Upper Myanmar Land and Revenue Regulation.
The Land Acquisition Act	
Section 4	The project proponent has to publish a notification and has to cause public notice of the substance of such notification to be given at convenient places in the said locality.
Section 5	The project proponent has to pay at the time of such entry or tender payment for all necessary damage to be done, and, in case of dispute as to the sufficiency of the amount so paid or tendered, he shall at once refer the dispute to the decision of the Collector or other chief revenue-officer of the district, and such decision shall be final.
Section 5A	The project proponent has to give the objector an opportunity of being heard either in person or by pleader and shall, after hearing all such objections and after making such further inquiry, if any, as he thinks necessary, submit the case for the decision of the President of the Union. The project proponent has complied the decision of the President of the Union on the objections.

Table 3.7- Laws and Regulations Related to Power Supply

Law name and section	Description
Law Amending the Electronic Transactions Law	
Section 16	The project proponent has to shall apply to the certification authority to obtain the certificate in accordance with the stipulations.
Section 17	The Project proponent has to inform by any suitable arrangement without delay.
Section 18	The project proponent has to be liable for the consequences of the loss and damage.
Telecommunication Law,2013	
Section 32	The Project proponent has to follow the conditions on matters relating to access and interconnection of the Network Services to Network Facilities according to rule of Department.
The Electricity Law, 2014	
Section 18	The project proponent has to carry out electric power generation and distribution businesses only if the electrical safety certificate is received from the Chief Inspector.
Section 19	The project proponent has to apply to the authorized person to issue the permit in accord with the stipulations if he desires to carry out the business contained in the permit jointly with other entities, transfer the business to other entities and sell, mortgage, lease, exchange and give the whole or part of the business contained in the permit.

Section 20	The project proponent has to abide by the rules, regulations, bye-laws, notifications, orders, directives and procedures issued by the Ministry in carrying out the electrical business contained in the permit.
Section 22	The project proponent has to be liable for causing any damage or loss due to the negligence by him to any person or entity.
Section 24	The project proponent has to compensate in accord with the method prescribed by the Ministry for the value of damage or loss if damages or losses arise to any other electric power user or any electrical business due to negligence of any electric power user.
Section 26	The project proponent has to abide according to section 26 of the Electrical Law.
Section 27	The project proponent has to report to the Chief Inspector and in-charge of the relevant department as soon as possible in the event of electricity hazard occurs in respect of generation, transmission, distribution and utilization of electric power.
Section 33	The project proponent has to comply with section 33 of the Electricity Law.
Section 68	The project proponent has to compensate according to the section 68 of the Electricity Law if a person is injured, or disabled or killed by the electric shock or outbreak of fire due to negligence or default of the permit holder or the person designated by him.
The Electricity Rule, 2015	
Section 12	The project Proponent has to follow the rule of not transfer electricity licence to any other person without the approval in writing of the Minister.
Section 21	The Project Proponent has to follow the rule of after conclusion with the office, prescribe renewable energy targets.

Table 3.8- Other Relative Laws and Regulations for Proposed Project

Law name and section	Description
Natural Disaster Management Law (Law No. 21), 2013	
Section 9 (a)	The project proponent has to follow the National Committee in the case of natural disaster and implementing natural disaster management.
Constitution of the Republic of the Union of Myanmar, 2008	
Section 24	Project proponent has to comply with section 24 of Constitution of the Republic of the Union of Myanmar in association with the chance of workers.
Section 45	Project proponent understand and accepts section 45 of Constitution of the Republic of the Union of Myanmar in association with conservation of natural environment.
Section 349	Project proponent understand section 349 of Constitution of the Republic of the Union of Myanmar in association with development of project.
Section 359	Project proponent understand and accept section 359 of Constitution of the Republic of the Union of Myanmar in association with forced to work.
Section 24	Project proponent has to comply with section 24 of Constitution of the Republic of the Union of Myanmar in association with the chance of workers.
Law on Standardization (Law No. 28), 2014	
Section 9	The Project proponent has to apply to the Department in accord with the stipulations to obtain the accreditation certificate.
Section 14	The Project proponent has to apply to the Department in accord with the stipulations if desirous to extend the term of the accreditation certificate.
Section 16	The Project proponent has to register at the Department after obtaining the approval of the Council on the standardization mark for each category of quality recommendation for which it may issue.
Section 17	The Project proponent has to apply to the organization which have obtained the accreditation certificate from the department for quality recommendation.
Environmental Conservation Law, 2012	
Section 7	The project proponent has to manage according to the Section 7.
Section 14	The project proponent has to carry out treating of emitting substances which cause pollution in the environment in accord with stipulated environmental quality standards.
Section 15	The project proponent has to install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution.

Section 24	The project proponent has to follow the Ministry terms and condition relating to environmental conservation.
Section 29	The project proponent has to follow the rules, notifications, orders, directives and procedures issued under this Law.
Environmental Conservation Rules, 2014	
Rule 69	The project proponent has to follow the rule of not to pollute the environment, not to cause damage to the ecosystem.
EIA Procedures, 2015	
Article 102 to 110	The project proponent has to report the monitoring included in EIA procedure article 102 to 110.
Article 113	The project proponent has to comply with the determination of Ministry if environmental obligations are not being complied by project proponent.
Article 115	The project proponent has to cost all the inspection and monitoring of project according to article 115 of EIA Procedure.
Article 117	The project proponent has to follow the Ministry program described in Article 117 of EIA procedure.
National Environmental Quality (Emission) Guidelines, 2015	
Section 2.1.9	The project proponent has to comply with the National Environmental Quality (Emission) Guidelines.
Law Amending the Factories Act 1951 (Pyidaungsu Hluttaw Law No. 12/2016)	
Section 19	Project proponent has to comply with section 19 of Law Amending the Factories Act 1951 in relating to hearing and the safety of workers.
Private Industrial Enterprise Law, 1990	
Section 13	The project proponent has to follow the duties described in section 13 of Private Industrial Enterprise Law, 1990.
Myanmar Fire Force Law, 2015	
Section 25	The project proponent has to comply according to law no. 25 of Myanmar Fire Force Law by forming the reserve fire brigade and providing fire safety equipment.
The Myanmar Insurance Law, 1993	
Section 15	The project proponent has to follow compulsory Third Party Liability Insurance with the Myanmar Insurance.
Section 16	The project proponent has to comply with section 16 of the Myanmar Insurance Law.
Myanmar Petroleum and Petroleum Products Law,2017	
Section 9	The project proponent has to comply with the Ministry of Transport and Communications relating with any petroleum.
Section 10	The project proponent has to follow the rule of Ministry of Natural Resources and Environmental Conservation according to section 10 of the Petroleum and Petroleum Product Law.
Section 11	The project proponent has to express the warning sign of danger by stamping, embossing, painting, printing or any other means on all receptacles containing any dangerous petroleum and petroleum product.
Section 31	The project proponent has to comply according to section 31 of the Petroleum and Petroleum Product Law.
Section 33	The project proponent has not to fail to report immediately to the nearest authority concerned and provide information relating to any accident if an explosion or fire occurs due to any petroleum and petroleum product business activities, or it is likely to cause fire at or near to the place where petroleum and petroleum product is stored.
The Petroleum Rules, 1937	
Section 63	The project proponent has to comply according to section 63 of the Petroleum Rules, 1937.
Section 66	The project proponent has to responsible that petroleum not be transported on any public vehicle which is carrying passengers.
Section 72	The project proponent has to responsible to carry out the provisions of these rules according to section 72 of the Petroleum Rules, 1937.
Section 80	The project proponent has to comply according to section 80 of the Petroleum Rules, 1937.

Section 92	The project proponent has to be responsible for all operations within an installation or storage shed to be conducted under the supervision of an experienced responsible agent or supervisor.
Section 93	The project proponent has to comply according to section 93 of the Petroleum Rules, 1937.
The Export and Import Law, 2012	
Section 7	The project proponent has to comply with section 7 of the Export and Import Law.
The Industrial Explosive Materials Law, 2018	
Section 6 (c)	The project proponent has to comply with section 6(c) of the Industrial Explosive Materials Law.
Section 7 (c)	The project proponent has to comply with section 7(c) of the Industrial Explosive Materials Law for the procurement, provision, storage and distribution of explosives of explosive.
Section 11 (b)	The project proponent has to allow the Chief Inspector according to section 11 (b) of the Industrial Explosive Materials Law.
Section 13	The project proponent has to apply to renew the licence, 30 days before expiration to the Chief Inspector in accordance with the stipulations if he wishes to continue to store industrial explosive materials.
Section 14 (b)	The project proponent has to comply according to section 14 (b) of the Industrial Explosive Materials Law.
Section 15	The project proponent has to comply according to section 15 of the Industrial Explosive Materials Law.
Section 16	The project proponent has to take necessary preventive measures in accordance with the specifications to avoid harm in transport, manufacture, use or possession of industrial explosive materials.
Section 18	The project proponent has not to refuse inspection of the Chief Inspector or an inspector.
Section 19	The project proponent has to comply with section 19 of the Industrial Explosive Materials Law.
Section 20	The project proponent has to comply with section 20 of the Industrial Explosive Materials Law.
Section 21	The project proponent has to license according to section 21 of the Industrial Explosive Materials Law.
The Explosive Substance Act, 1908	
Section 3	The project proponent has to responsible for the punishment according to section 3 of the Explosive Substances Act.
Section 4	The project proponent has to comply with section 4 of the Explosive Substances Act.
Section 5	The project proponent has to comply with the section 5 of the Explosive Substances Act.
The Myanmar Engineering Council Law, 2013	
Section 34	The project proponent has to comply according to the section 34 of Myanmar Engineering Council Law.
Section 37	The project proponent has to follow the section 37 of Myanmar Engineering Council Law.
Myanmar Fire Bridge Law, 2015	
Section 25	The project proponent has not to fail to form the Reserve Fire Brigade and not fail to provide fire safety equipment.
Patent Law, 2019	
Section 17	Project proponent has to comply with section 17 of Patent Law when an invention is made under the employment contract between the employer and employee.
Myanmar Investment Law, 2016	
Section 50	The project proponent has to invest according to the section 50 of Myanmar Investment Law.
Section 51	The project proponent has to comply with section 51 of Myanmar Investment Law.
Section 65	The project proponent has to comply with section 65 of Myanmar Investment Law.
Section 73	The project proponent has the type of insurance specified in the rules in any insurance business authorized to conduct insurance business in the State.
Myanmar Investment Rules, 2017	
Section 202	The project proponent has to abide by all the terms and conditions set forth in the permit and other applicable laws when conducting the investment business.

Section 203	The project proponent has to contact the relevant government department according to section 203 of Myanmar Investment Rules
Section 206	The project proponent has to submitted to the Commission Office for approval if foreign consultant expert is hired.
Section 212	The project proponent has to insure the relevant type of insurance according to Section 212 of Myanmar Investment Rules.
The Law Relating to Aquaculture, 1989	
Section 29	The project proponent has not to obstruct navigation and flow of water or pollute the water within the fisheries waters.
The Ethnic Rights Protection Law, 2015	
Section 5	The project proponent has to completely inform, coordinate and perform with the relevant local ethnic groups in the case of development works, major projects, businesses and extraction of natural resources.

3.3. International Agreements and Conventions

In addition to the domestic laws listed above, Myanmar is also a signatory to the following international conventions, and these may have relevance to the proposed survey activities. Refer to the following Table.

Table 3.9- International Agreements and Conventions Relevant to the Proposed Project

International Agreements and Conventions	Status	Purposes
Vienna Convention for the Protection of the Ozone Layer, 1985	1998	Aims at the protection of the ozone layer, including requirements for limiting the production and use of ozone depleting substances.
Montreal Protocol on Substances that Deplete the Ozone Layer, 1989	1993	Aims at the protection of the ozone layer, including requirements for limiting the production and use of ozone depleting substances.
Basel Convention, 1989	2015	The Convention regulates the transboundary movements of hazardous wastes and provides obligations to its parties to ensure that such wastes are managed and disposed of in an environmentally sound manner.
United Nations Framework Convention on Climate Change (UNFCCC), New York, 1992 and Kyoto Protocol 1997	1995 and 2005	Provide a framework for intergovernmental efforts to tackle climate change. Recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.
Convention on Biological Diversity, Rio de Janeiro, 1992	1994	Aims to promote national policies for the conservation of wild flora, fauna and habitat that needs to be included in planning policies. The three main goals are: (1) the conservation of the biological diversity; (2) the

		sustainable use of its components; (3) fair and equitable sharing of the benefits.
Asia Least Cost Greenhouse Gas Abatement Strategy (1998 ALGAS)	1998	Develop national and regional capacity for preparation of GHG inventories. Assist in identifying GHG abatement options and preparation of a portfolio of abatement projects for each country.
United Nations Agenda 21	1997	Building on the National Environment Policy of Myanmar, takes into account principles contained in the Global Agenda 21. Myanmar Agenda 21 also aims at strengthening and promoting systematic environmental management in the country.
Relevant ILO Conventions in force in Myanmar • C1 Hours of Work • C14 Weekly Rest • C17 Workmen's Compensation (Accidents) • C19 Equality of Treatment (Accident Compensation) • C26 Minimum Wage Fixing Machinery • C29 Forced Labour Convention • C42 Workmen's Compensation (Occupational Diseases) Revised 1934 • C52 Holidays with Pay		Sets out legal instruments drawn up by the ILO's constituents (governments, employers and workers) and setting out basic principles and rights for workers.

3.4. National and International Guidelines for Proposed Project

EIA assessment was undertaken in accordance with Myanmar's National Environmental Quality (Emission) (NEQ) Guidelines which were promulgated on December 29th, 2015 and provide the basis for regulation and control of various environmental parameters, including noise, air emissions, and effluent discharges. Moreover, beside the national guidelines and international guidelines and standards are referred to the impact assessment as follow:

(a) World Health Organization Guidelines (WHO);

(b) National Ambient Air Quality Standard (NAAQS), USEPA;

(c) IFC Guidelines for Waste Management Facilities, 2007;

(d) IFC Guidelines for Water and Sanitation, 2007; and

(e) IFC Guidelines for Occupational, Health and Safety, 2007,

3.4.1. National Environmental Quality Guidelines for Electrical Power Transmission and Distribution

This guideline applies to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. Power transmission and distribution does not typically give rise to significant effluents or air emissions. Where potentially contaminated water runoff or dust exists, site operations should comply with the following effluent guideline and the general air quality guideline.

(a) Water Quality

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/l	30
Chemical oxygen demand	mg/l	125
Oil and grease	mg/l	10
pH	S.U.[a]	6-9
Total coliform bacteria	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

[a] ***Standard Unit***

Table 3.10- Proposed National Drinking Water Quality Standard, Myanmar (2014)

Parameter	Unit	Maximum Permissible Limit
TCU (True Color Unit)	Pt.Co	20
Turbidity (NTU-Nephelometric Turbidity Unit)	NTU	5
Total Dissolved Solvents (TDS)	mg/l	1000
Chloride	mg/l	250
Total Hardness (as $CaCO_3$)	mg/l	500
Iron	mg/l	1
pH	mg/l	6.5-8.5
Sulphate	mg/l	400
Calcium	mg/l	200
Magnesium	mg/l	150
Electrical Conductivity	µs/cm	1500

(b) Noise level set in NEQG

According to the NEQG that has been prescribed by Ministry of Environmental Conservation and Forestry on 29th December, 2015, under Chapter 1 (General Provision), Section 1, sub-section 1.3 mentioned the following requirement for noise levels;

Noise prevention and mitigation measures should be taken by all projects where predicted or measured noise impacts from a project facility or operation exceed the applicable noise level guideline at the most sensitive point of reception. Noise impacts should not exceed the levels shown below, or result in a maximum increase in background levels of three decibels at the nearest receptor location off-site.

In NEQG, the noise level is set as shown in Table below and noise prevention and mitigation measures should be taken by all projects where the predicted or measured noise impacts from a project facility or operation exceed the applicable noise level guideline at the most sensitive point of reception. Noise impact should not exceed the levels shown below, or result in a maximum increase in background levels of three decibels at the nearest offsite receptor location.

Table - Noise Level set in NEQG

Receptor	One Hour L_{Aeq}	
	Daytime (7:00-22:00) (10:00-22:00 for public holidays)	Night Time (22:00-7:00) (22:00-10:00 for public holidays)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: NEQG (December 2015)

It is noted that NEQG does not mention a guideline value to be specified for railway noise and so it is necessary to use this guideline for noise.

3.4.2. International Environmental Quality Guidelines for Proposed Project

(a) Air Quality

General guideline values for air emissions are described in WHO and NAAQS and the project shall apply theses guideline values for air quality parameters such as SO_2, NO_2, particulate matters (PM_{10} and $PM_{2.5}$).

Table 3.11 - World Health Organization Guidelines (WHO)

Pollutants	Averaging Period	WHO 2021 Air Quality Guideline		
PM 2.5 (µg/m³)	Annual	5		
	24-hour	15		
PM10 (µg/m³)	Annual	15		
	24-hour	45		
O3 (µg/m³)	Peak Season	60		
	8-hour	100		
NO2 (µg/m³)	Annual	10	0.005ppm	5ppb
	24-hour	25	0.013ppm	13ppb
	1-hour	200	0.106ppm	106ppb
SO2 (µg/m³)	24-hour	40	0.015ppm	
	10-minute	500	0.191ppm	
CO (mg/ m³)	24-hour	4		
	8-hour	10	8.729ppm	
	1-hour	35		
	15-minute	100		

µg = microgram
[a] = 99th percentile (i.e. 3-4 exceedance days per year)
[b] = Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.
Note: Annual and peak season is long-term exposure, while 24 hour and 8 hour is short-term exposure.

OSHA has established a Permissible Exposure Limit (PEL) for CO2 of 5,000 parts per million (ppm) (0.5% CO2 in air) averaged over an 8-hour work day (time-weighted average orTWA.)

Normal CO2 Levels

The effects of CO2 on adults at good health can be summarized to:

normal outdoor level: 350 - 450 ppm

acceptable levels: < 600 ppm

complaints of stuffiness and odors: 600 - 1000 ppm

ASHRAE and OSHA standards: 1000 ppm

general drowsiness: 1000 - 2500 ppm

adverse health effects may be expected: 2500 - 5000 ppm

maximum allowed concentration within a 8 hour working period: 5000 - 10000 ppm

maximum allowed concentration within a 15 minute working period: 30000 ppm

Table 3.12 - National Ambient Air Quality Standard (NAAQS), USEPA;

Pollutants	Averaging Period	Guideline Value ($\mu g/m^3$, ppm, ppb)
Carbon Monoxide	1-hour 8-hours	9 ppm 35 ppm
Nitrogen dioxide	1-hour 1-year	100 ppb 53 ppb
Ozone	8-hour daily maximum	0.070 ppm
Particulate matter PM_{10}[a]	24-hours	150 $\mu g/m^3$
Particulate matter $PM_{2.5}$[b]	1-year 24-hour	15 $\mu g/m^3$ 35 $\mu g/m^3$
Sulfur dioxide	1-hour 3-hours	75 ppb 0.5 ppm

(b) Electromagnetic Field

Additionally, exposure limits for general public exposure to electric and magnetic fields should comply with International Commission on Non-ionized Radiation Protection guidelines for limiting general public exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 Gigahertz).

Frequency	Electric Field (V/ma)	Magnetic Field ((μT^b)
50 Hz[c]	5000	100
60 Hz	4150	83

[a] Volts per meter; [b] Micro tesla; [c] Hertz

IFC Guidelines for Waste Management Facilities

Section 1.0 Industry-Specific Impacts and Management

Section 2.0 Performance Indicators and Industry Benchmarks

IFC Guidelines for Water and Sanitation

Section 1.0 Industry-Specific Impacts and Management

Section 2.0 Performance Indicators and Industry Benchmarks

IFC General EHS Guideline

Section 2.0 Occupational Health and Safety

3.6. Penalties and other Administrative Punishment

The developer must know the penalties and other administrative punishment granted as EIA Procedures in Myanmar as follow:

No	Non-Compliance	Penalties	Specific Administrative Punishment of the Ministry
1.	Failure or delay in timely submission of reports within Period prescribed by Ministry	100 to 500 US$ or equivalent Myanmar Kyat + 10-25 US$/ day unit cured or equivalent Myanmar Kyat	-Issue Enforcement Notice
2.	Obstruction or interference with an official in the course of their duties	250 to 5,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice -Criminal prosecution
3.	Failure to provide information to the Ministry or any representative	1,000 to 5,000 US$ or equivalent Myanmar Kyat	-Suspension of Approval of EMP, EMP-CP, EMP-OP in whole or in part
4.	Failure to provide information to the Ministry Inspector or any representative when requested in regard to inspection and monitoring	250 to 5,000 US$ or equivalent Myanmar Kyat	- Issue Enforcement Notice
5.	Undertaking or allowing any preparatory or other construction works without the prior approval by the Ministry of a reserved EMP or EMP-CP	1,000 to 5,000 US$ or equivalent Myanmar Kyat +50 to 500 US$/ day until cured or equivalent Myanmar Kyat	-Criminal prosecution
6.	Operating/implementing without a permit, or approval by the Ministry of an EMP or EMP-Op	1,000 to 5,000 US$ or equivalent Myanmar Kyat +50 to 500 US$/ day unit cured or equivalent Myanmar Kyat	- Criminal prosecution
7.	Non-compliance with an Enforcement Notice or Suspension Notice issued by the Ministry	2,000 to 10,000 US$ or equivalent Myanmar Kyat +100-500 US$/day unit cured or equivalent Myanmar Kyat	-Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
8.	Failure to notify to the Ministry of any knowledge of any event of an imminent of Environmental damage	1,000 to 5,000 US$ or equivalent Myanmar Kyat	- Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
9.	Failure to take reasonable steps to prevent an imminent thread of damage to the Environment, social, human health, livelihoods, or property, where application based on the EMP, EMP-CP or EMP-OP	2,500 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
10.	Non-compliance with conditions in 'the ECC and allowable Emission Limit Values	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice

			- Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
11.	Failure to take pay compensation amounts required in respected in respect of social impacts	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
12.	Failure to fully restore social conditions upon resettlement	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part

Notes:

1. All penalty amounts set forth in this Annex are denominated in United States Dollars (US$) and are subject to annual inflation adjustment.
2. Abbreviations are as follows;

EMP-CP = Environmental Management Plan – Construction Phase
EMP-OP = Environmental Management Plan –Operational Phase

3.7. Project's Environmental, Social and Health Policies

The main policy and commitment of project developer can be identified in the following points:

1. the protection of public safety, the health and safety of the workforce and the local communities
2. the protection and promotion of human rights, the economic and social development of local communities;
3. the protection of the environment and the conservation of biodiversity and ecosystems;
4. the continuous improvement of the quality of the processes, services and products of our activities and operations;
5. the compliance with Myanmar laws, regulations and industrial standards regarding the environment, health, safety and hygiene at work in all of our operations
6. visible and active leadership that promotes HSE excellence, which engages and motivates employees and contractors alike to succeed
7. setting objectives and targets for measuring and improving HSE performance in line with Company activities and strategic objectives
8. manage HSE in order to achieve our objective of incident free operations
9. implementing sustainable development principles in our activities

10. seek and achieve continuous improvement in our processes, consistent with our strategic objectives and priorities, by adopting the most advanced systems for environmental protection and energy efficiency
11. creating a culture in which employees, Contractors and Visitors share these commitments and understand that working safely is a condition of employment.

3.7.1. Sustainability Policy

Project developer's sustainability model is "To operate in a sustainable manner means to create value for stakeholders, and to use resources so that the needs of future generations will not be compromised, respecting people, the environment and the society as a whole." the developer adheres to a sustainability policy, which is composed of the following principles:

12. *Stakeholder relations* – "Engaging stakeholders and involving them in company's business are both prerequisites for sustainability and for the construction of reciprocal value."
13. *Human Rights* – "The respect of Human Rights represents the basis for an inclusive growth of societies, of the territories and, consequently, of the companies that work there."
14. *Relations with communities and contribution to local development* – "Dialogue, the respect of local communities, the evaluation of impacts are all preconditions for an effective cooperation, targeted at creating territorial value."

Climate strategy – "To satisfy the world's energy demand, by containing, at the same time, emissions of gases that have an impact on climatic change, is one of the greatest challenges of modern society."

3.8. Statement of Commitments

The followings are the commitments of the project developer and environmental assessment practitioner.

3.8.1 Commitments of Project Developer

The project developer will have to comply with the followings:

a) Comply with the commitments of the environmental and socio-economic development revealed in the Environmental Impact Assessment report.

b) Acknowledge and comply the laws, regulations and guidelines associated with the project, included in the report.

c) Comply and proceed the alternative methods, mitigation measures and monitoring plans included in the report for the reduction of the negative environmental impacts; and take responsibility for the environmental impacts due to non-compliance of the commitment.

d) This environmental impact assessment is accurate and complete.

e) Give priorities for the occupational health and safety of the workers.

f) Utilize the exact amount of fund as stated in proposed expenditure for cooperate social responsibility funds.

g) Take responsibility for all of the works and absence of the contractors, sub-contractors, officers and representatives of the company in operating the processes.

h) Take responsibility to support after discussion for the impacted people to ensure for their stable livelihood not lower than before the project; and resettlement and rehabilitate the impacted local people, government organizations and other related people and organizations.

i) Take responsibility to compensate, support, resettle and rehabilitate the effected people to ensure for their stable livelihood not lower than before the project after discussion with the relevant local authorities, related organizations and local people.

List of Commitments of Project Developer during each phase of project

Phase	Commitments of Project Developer
Pre-Construction Phase	• Take responsibility to compensate, support, resettle and rehabilitate the effected people to ensure for their stable livelihood not lower than before the project after discussion with the relevant local authorities, related organizations and local people. • Take responsibility to support after discussion for the impacted people to ensure for their stable livelihood not lower than before the project; and resettlement and rehabilitate the impacted local people, government organizations and other related people and organizations.

Construction Phase	• It is promised that the materials required for the proposed project will be obtained from organizations with environmental compliance. • It is promised to get the attitude of the locals if the water to be used during the construction phase for the proposed project has to be taken from a local water source. • It is promised that compensation will be made with the land owner if the top soil to be used during the construction phase for the proposed project has to be taken from nearby land. • Take responsibility for all of the works and absence of the contractors, sub-contractors, officers and representatives of the company in operating the processes. • Give priorities for the occupational health and safety of the workers. • At least 50% of local people will be used as worker required for the construction phase. • All the required resources are obtained by tendering and local resources are prioritized to be used. • The detailed baseline study for 11 traction substations and 1 switching post was not able to carry out during feasibility stage since the proposed location of traction substations can be changed so only when implementing stage is reached, the detailed baseline study will be carried out again at each stations along with EMP-Construction Phase.
Operation Phase	• Take responsibility for the shortage of groundwater to the affected area (the nearest villages) by digging the new deep wells, tube well and supporting water requirement to those areas if they suffer the shortage of groundwater. • Take responsibility for all of the works and absence of the contractors, sub-contractors, officers and representatives of the company in operating the processes. • Utilize the exact amount of fund as stated in proposed expenditure for cooperate social responsibility funds. • Give priorities for the occupational health and safety of the workers.

(Signature)

Name -

Occupation -

3.8.2. Commitments of the Environmental Assessment Practitioner

The EIA report was written by Ever Green Tech Environmental Services and Training Co., and EIAs in this report were designed by the following criteria;

(a) The designed EIA complied with the National Constitution, Environmental Conservation Law, EIA Procedures, and National Environmental Quality Guideline.

(b) This EIA also complied with the existing or future Labor laws, Occupational Health and Safety Laws, Rules and Procedures.

(c) These environmental impact protection procedures are designed of incident avoiding, mitigation and replacing for the project proponent who commits to follow the environmental impact protection procedure.

(d) This environmental management report is systematically designed not only for environmental impact protection procedures and occupational safety and health but also emergency management planning and social welfare programs.

(e) All facts including in this report are systematically surveyed without bias. As a third party, we commit and take full responsibility for all facts in this report.

(Signature)

Name -

Occupation -

4. PROJECT DESCRIPTION AND ALTERNATIVE SELECTION

4.1 Project Background

As part of the governments national transport strategy Ministry of Transport and Communication (MOTC) intends to improve transport capacities of the Country by constructing the Railway between Muse to Mandalay. On October 22, 2018, Myanma Railways (MR) and China Railway Eryuan Engineering Group Co., Ltd (CREEC) signed and entered into the Memorandum of Understanding on Feasibility Study (FS) for Muse-Mandalay Railway Project. According to this MOC, CREEC will conduct FS for Muse-Mandalay Railway alignment. As part of the MOU in order to meet regulatory requirements of the ECD, CREEC will conduct the Environmental Impact Assessment (EIA) for the Project. The line starts from Muse Port in the north and ends at Mandalay, the second largest city, in the south, connecting important towns like Muse, Lashio, Kyaukme, Pyin Oo Lwin and the central area. The total length of the main line is 409.960km.

As there will also include 11 traction substations and transmission lines along the proposed railway line, a separate EIAis needed for the proposed railway power supply system as integral part of the Muse-Mandalay Railway Project.

4.2. Project Location, Overview Map and Site Layout Maps

4.2.1 Alignment Plan for Power Transmission Line

As the railway line is Muse to Mandalay, the power line will also parallel to the railway alignment. The total length of the power transmission line will be more than 400km.

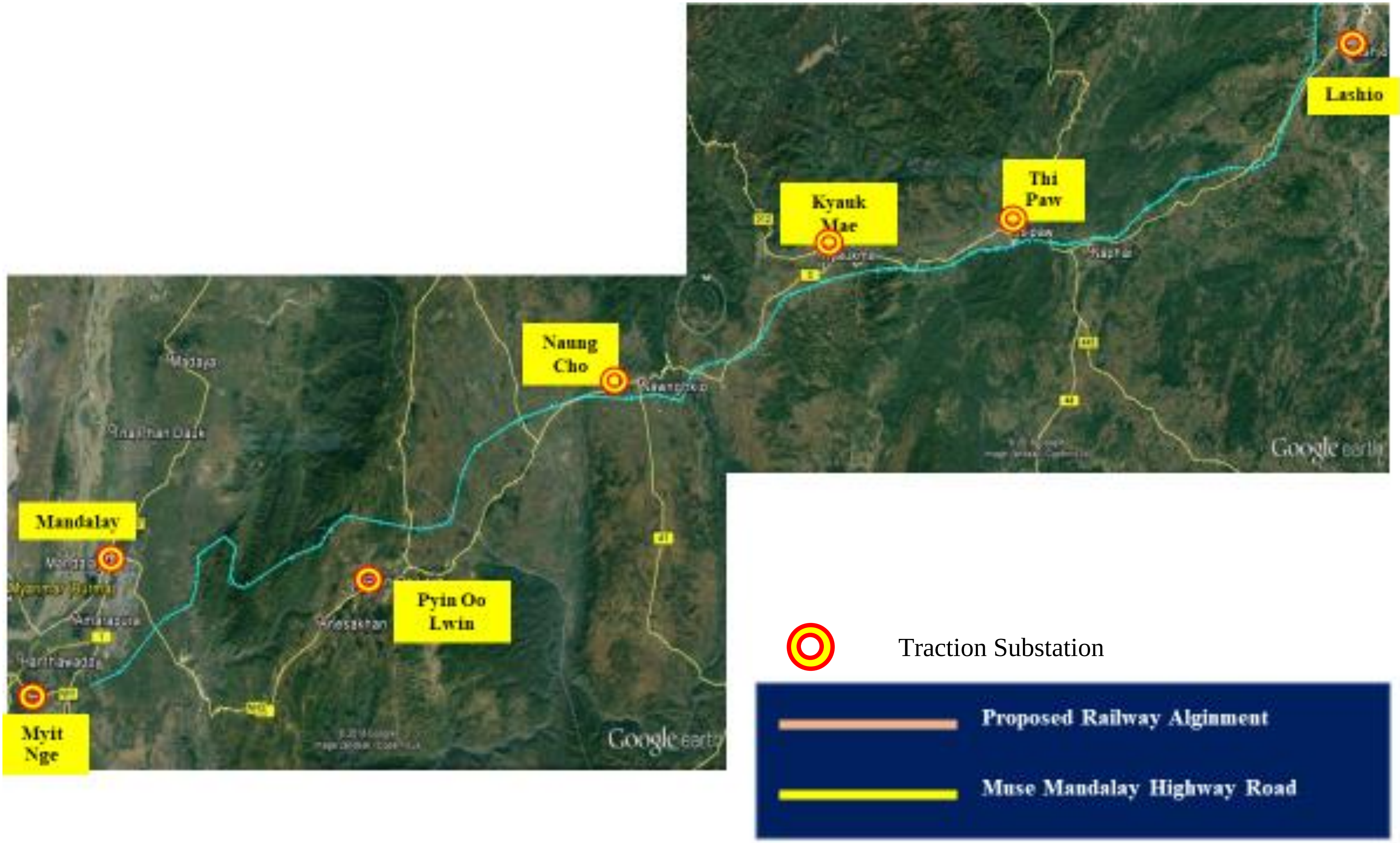


Figure 4.1 Muse-Mandalay Railway Alignment and Power Transmission Line in Google Earth (Mandalay to Lashio)

Figure 4.2 Muse-Mandalay Railway Alignment and Power Transmission Line in Google Map (Lashio to Muse)

4.3 Land Use, Project Development and Implementation Time Schedules

4.3.1 Land Use

The main line length of Muse-Mandalay Railway is 409.960km, with 124 new bridges (69.309km in total length), 60 new tunnels (152.160km in total length). The total length of bridge and tunnel is 221.469km, accounting for 54.02% of the main line length. There are 36 stations along the whole line. The meter-gauge railway link from Mandalay South to Myitnge is 4.170 km long, without bridge and tunnel works, and Myitnge Station is to be renovated. The land use for main line of Muse-Mandalay Railway is 37,320,512m^2, including 25,951,997m^2 permanent land use and 11,368,515m^2 temporary land use. Land use for the meter-gauge connecting line from Mandalay South to Myitnge is 292,909m^2, including 189,699m^2 permanent land use and 103,210m^2 temporary land use. The land use along the line consists of permanent new land use and temporary land use, land use quantities and specifications are detailed in the table below.

Land use item		Land use quantity (m^2)			Land use specifications (m^2/km)		
		New land use	Temporary land use	Sub-total	New land use	Temporary land use	Sub-total
Total for main line from Muse to Mandalay South	Section subgrade	9,262,532	2,793,158	12,055,690	68,025	20,513	88,538
	Including land use for other disciplines	25,951,997	11,368,515	37,320,512	63,304	27,731	91,035
Total for Muse-Mandalay South	Section subgrade	9,425,986	2,893,158	12,319,144	67,168	20,616	87,784
	Including land use for other disciplines	26,141,696	11,471,725	37,613,421	63,124	27,701	90,825

Source: Feasibility Study Report for MMR (CREEC)

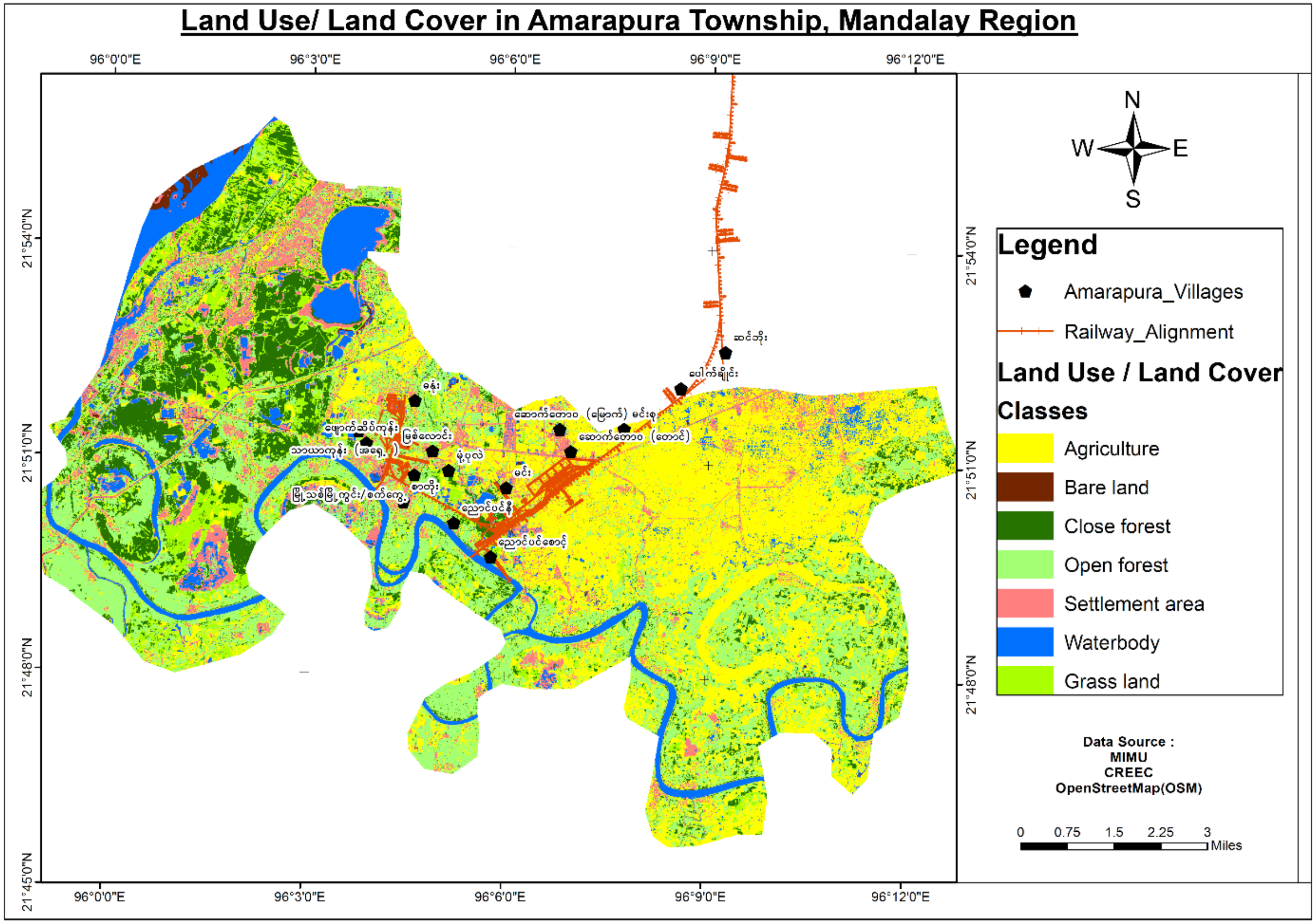


Figure 4.3- Land Use Map of Amarapura Township (Source: EIA Team, 2019)

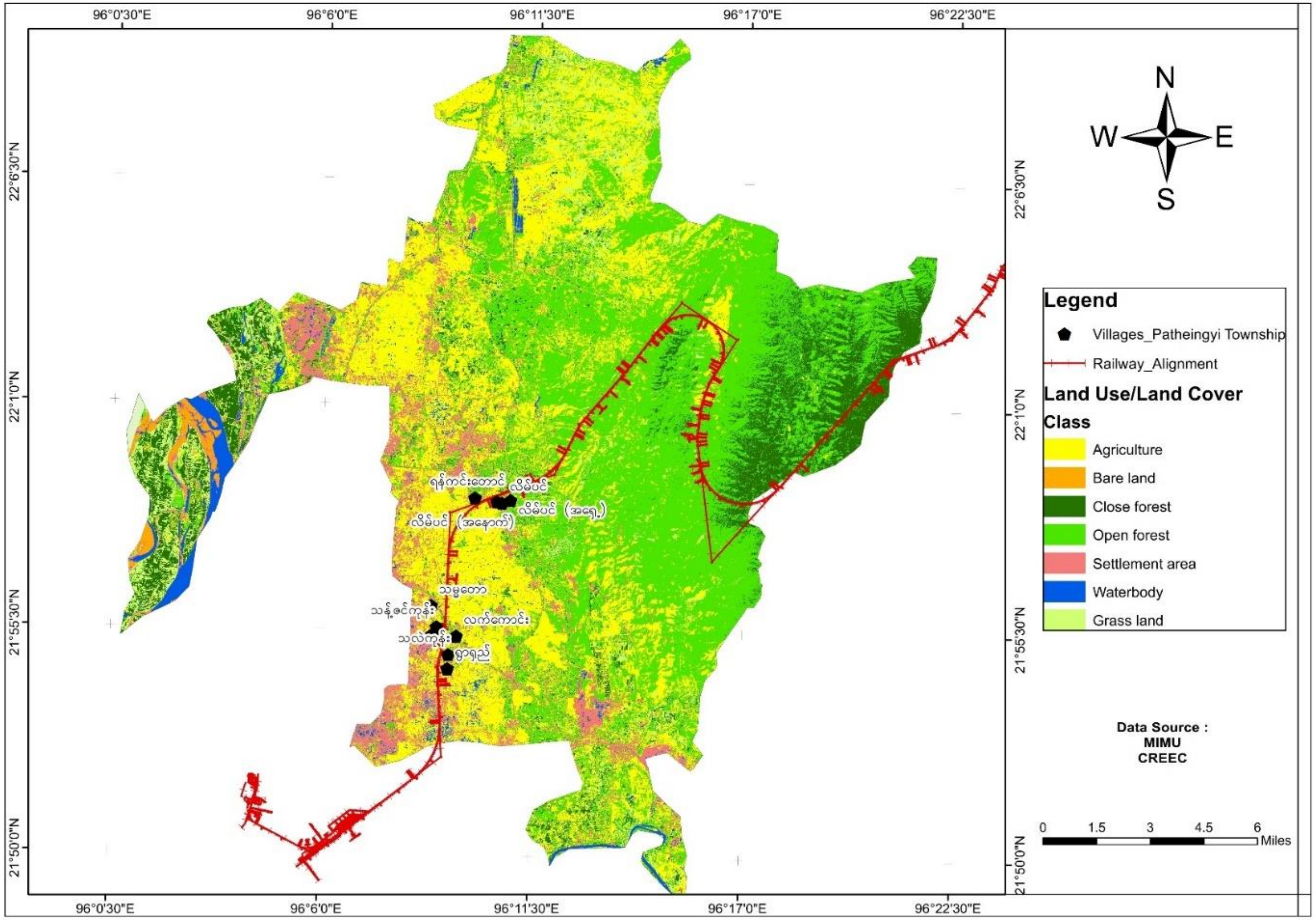


Figure 4.4. Land Use Map of Patheingyi Township (Source: EIA Team, 2019)

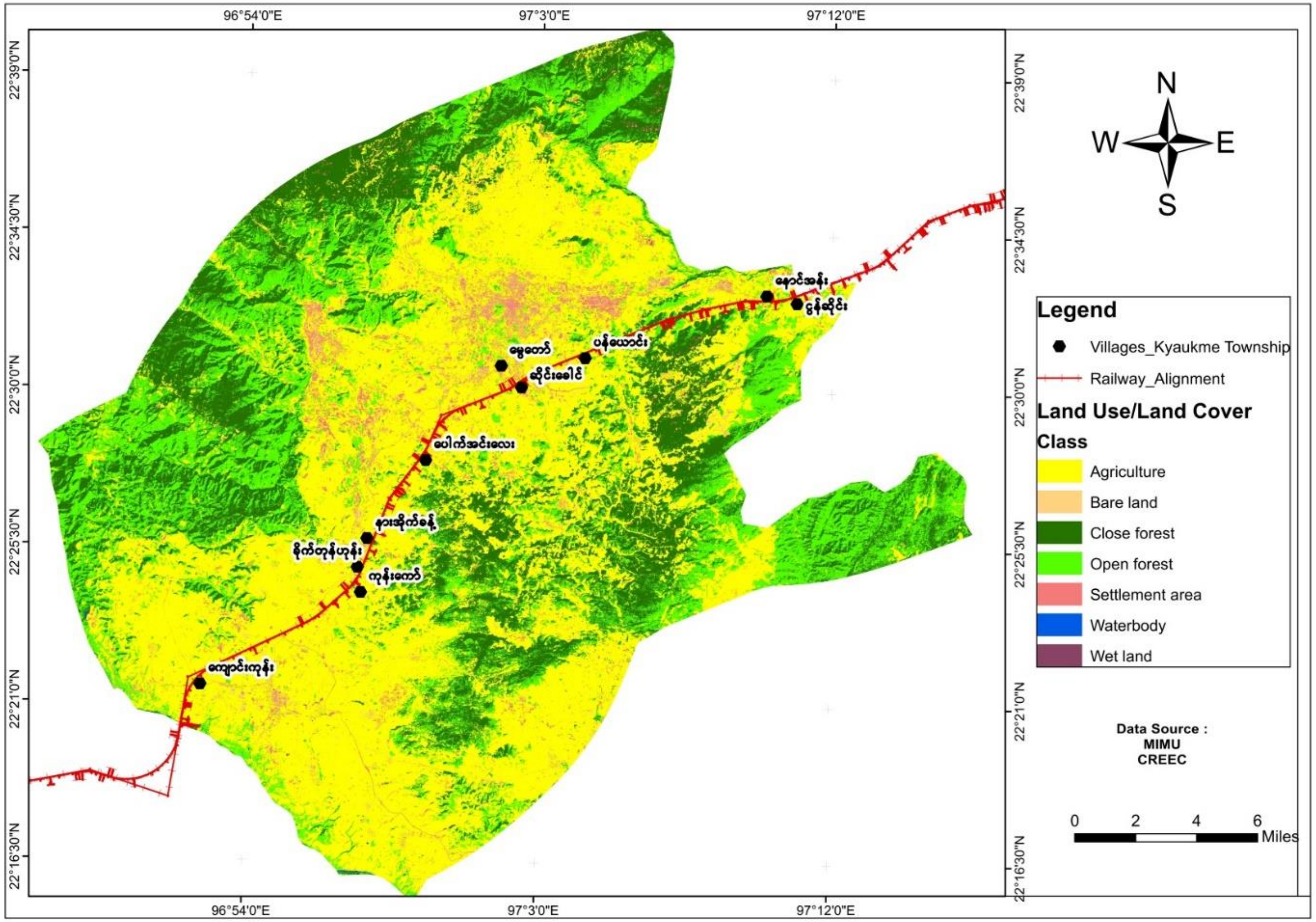


Figure 4.5- Land Use Map of Kyaukme Township (Source: EIA Team, 2019)

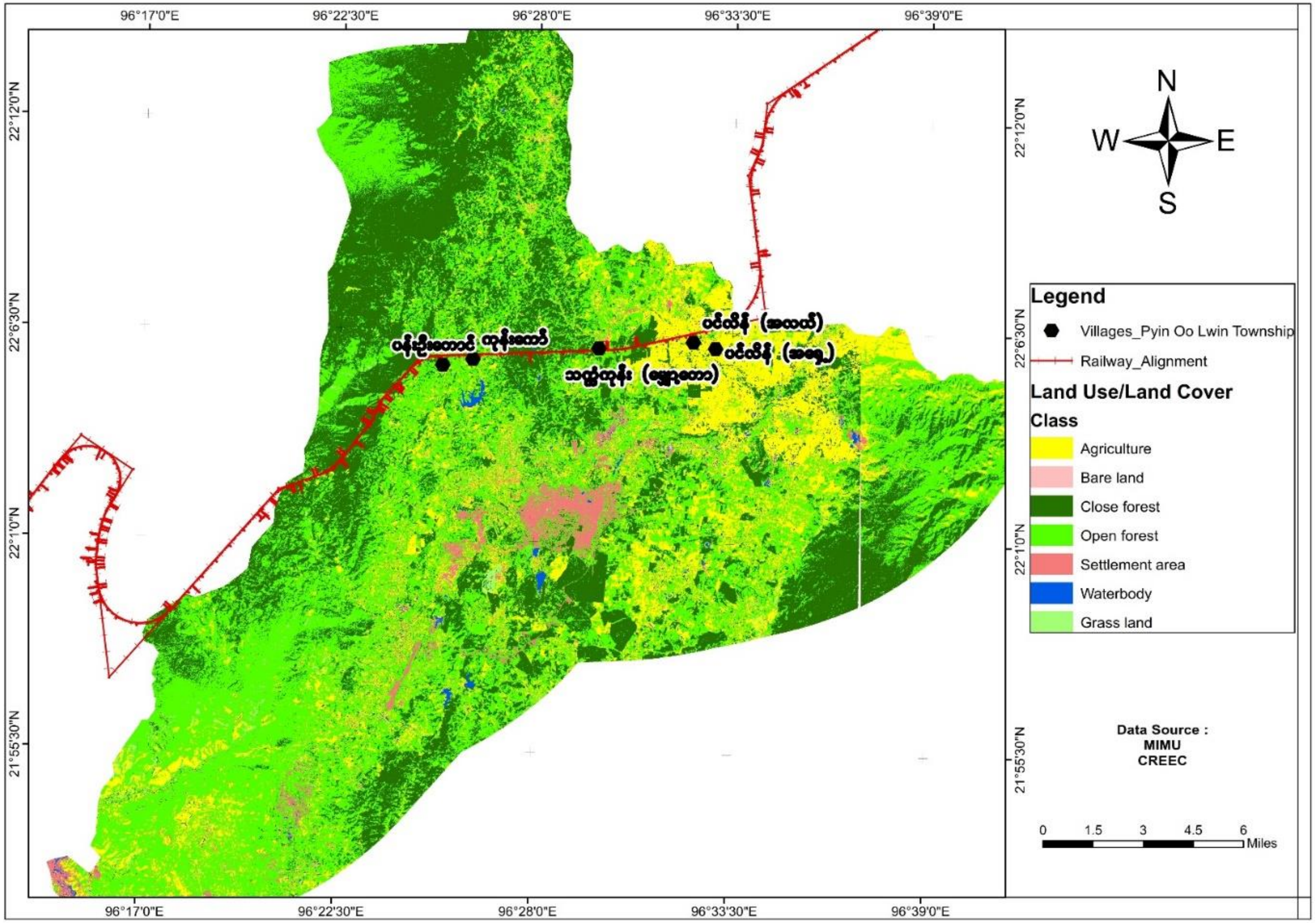


Figure 4.6 - Land Use Map of Pyin-Oo-Lwin Township (Source: EIA Team, 2019)

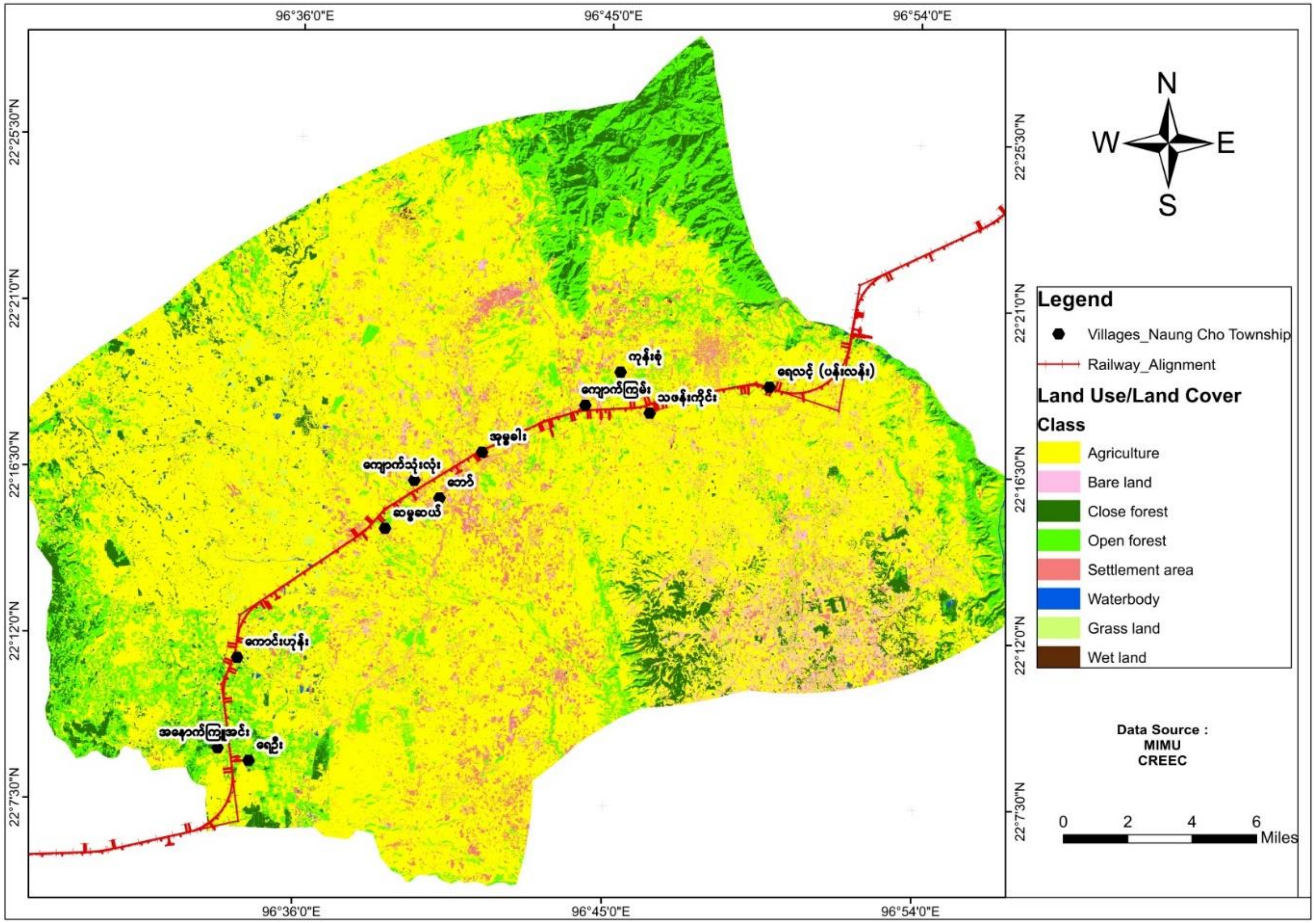


Figure 4.7- Land Use Map of Naung Cho Township (Source: EIA Team, 2019)

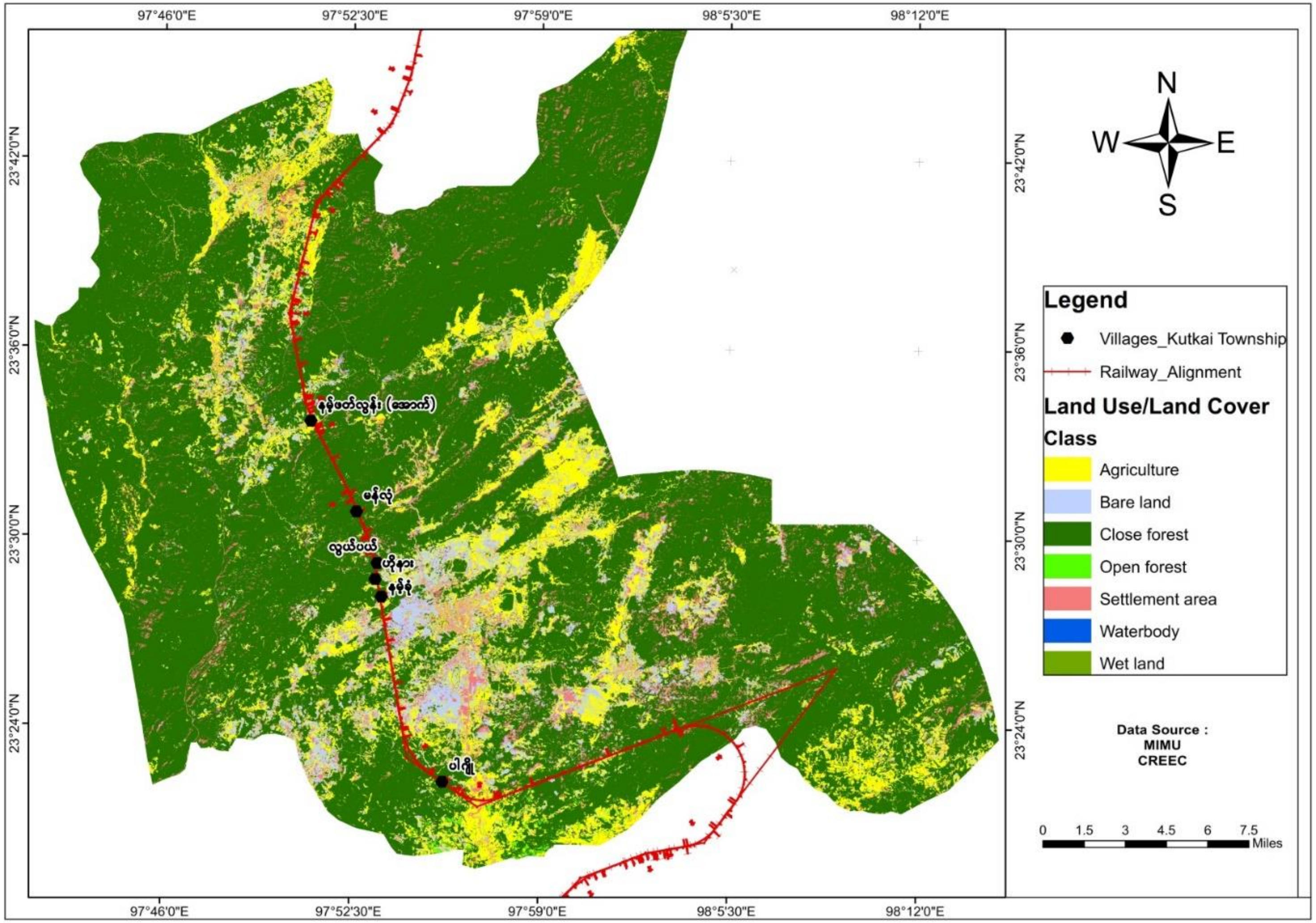


Figure 4.8 - Land Use Map of Kutkai Township (Source: EIA Team, 2019)

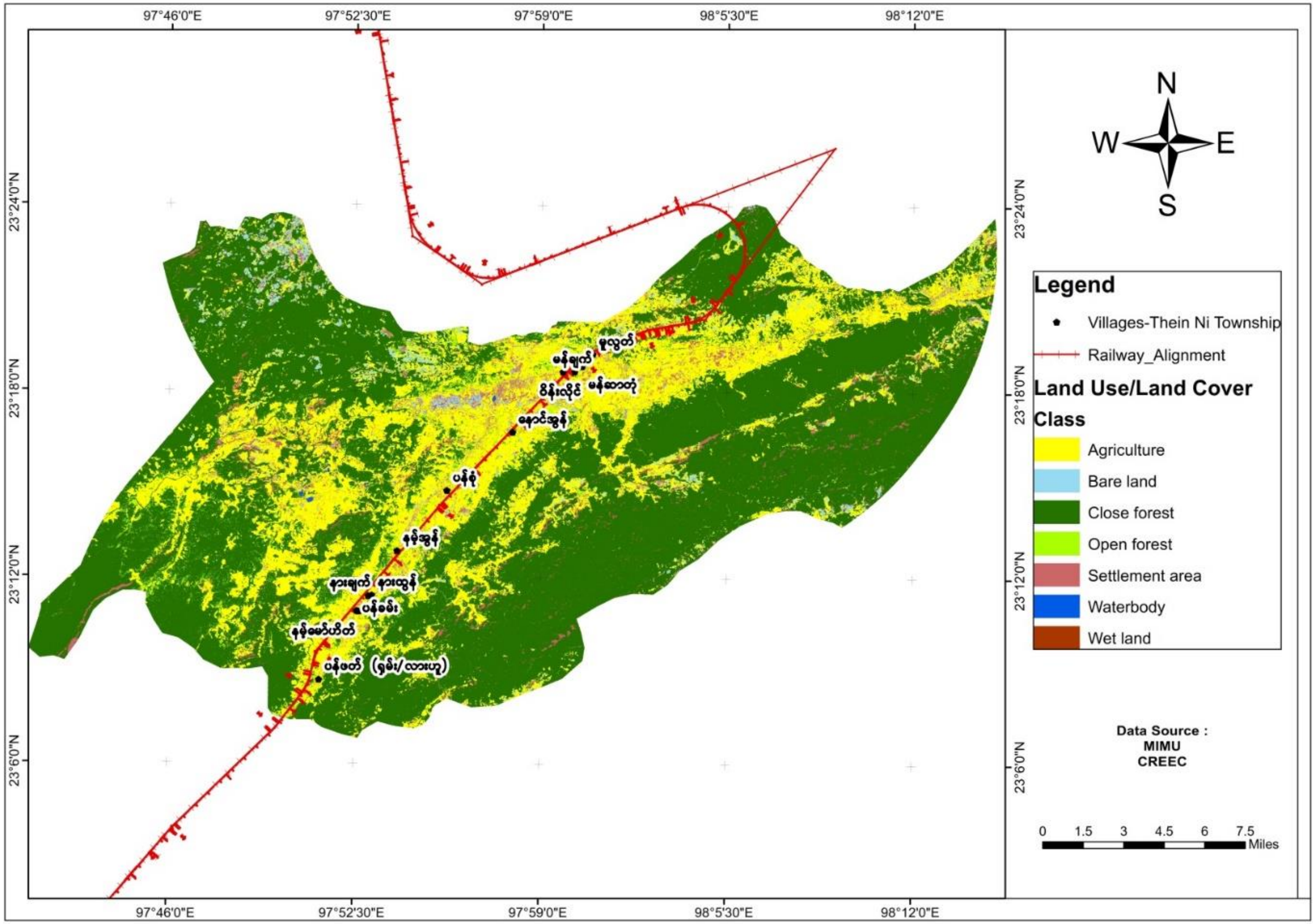


Figure 4.9 - Land Use Map of Thein Ni Township (Source: EIA Team, 2019)

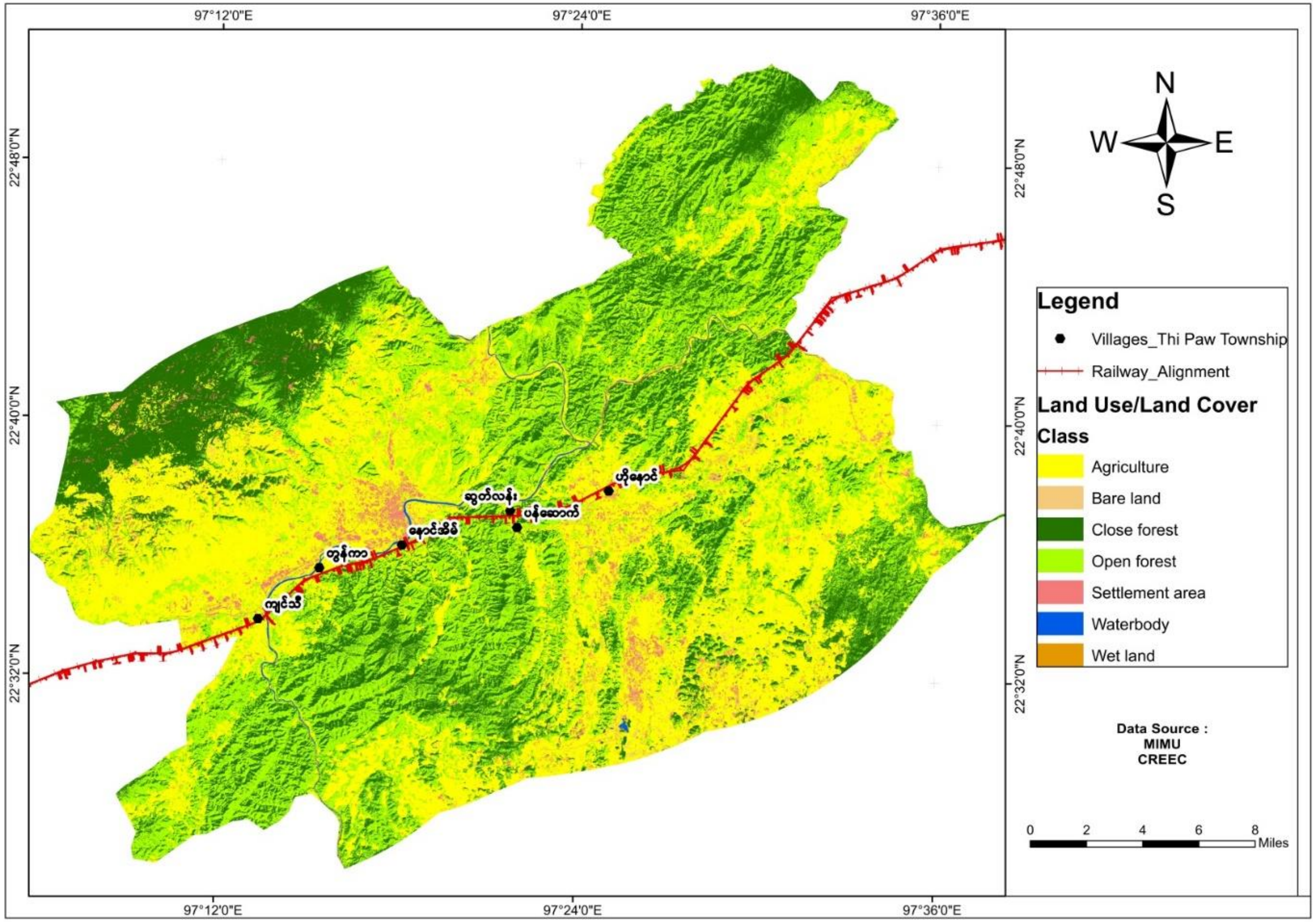


Figure 4.10- Land Use Map of Thi Paw Township (Source: EIA Team, 2019)

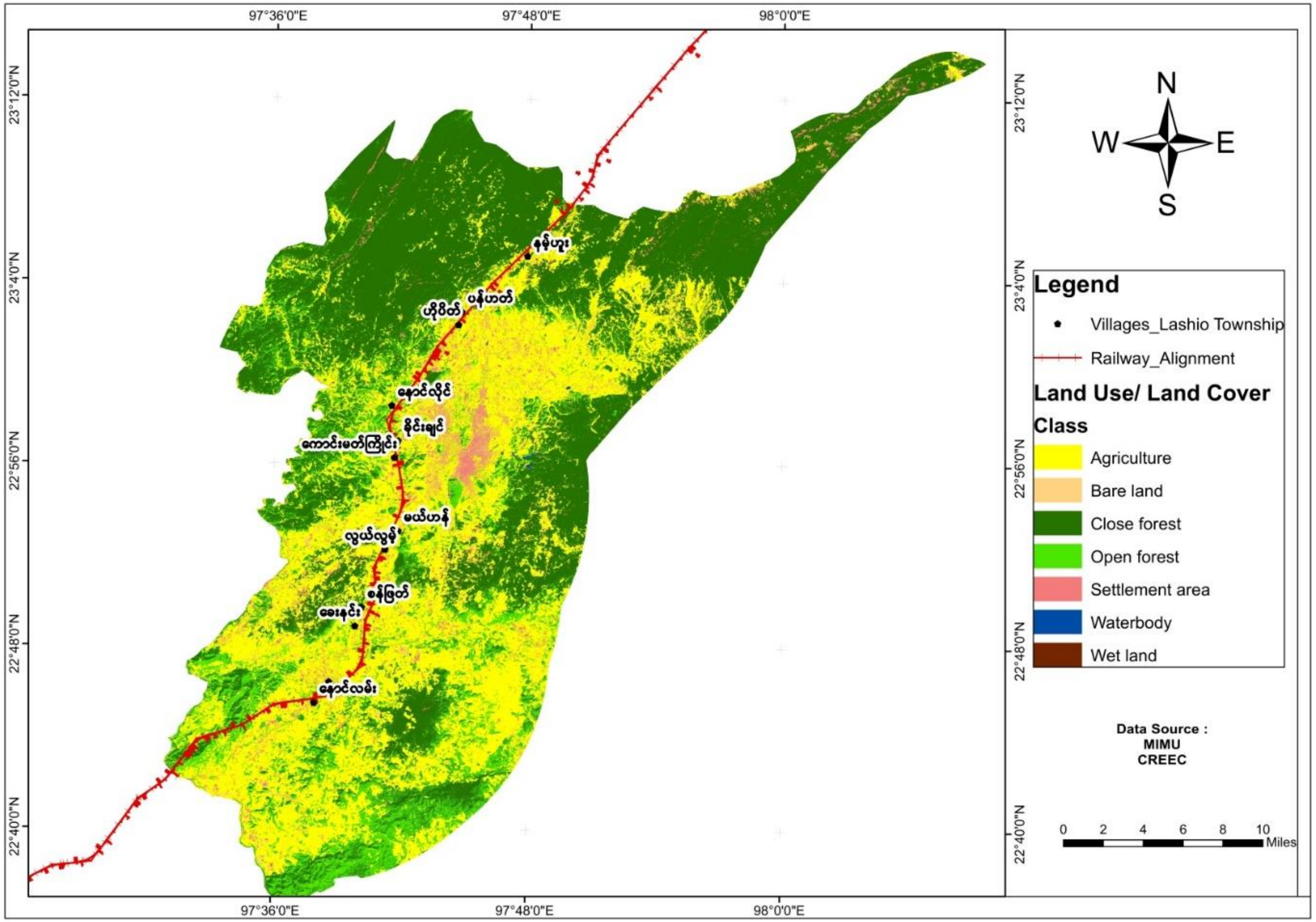


Figure 4.11- Land Use Map of Lashio Township (Source: EIA Team, 2019)

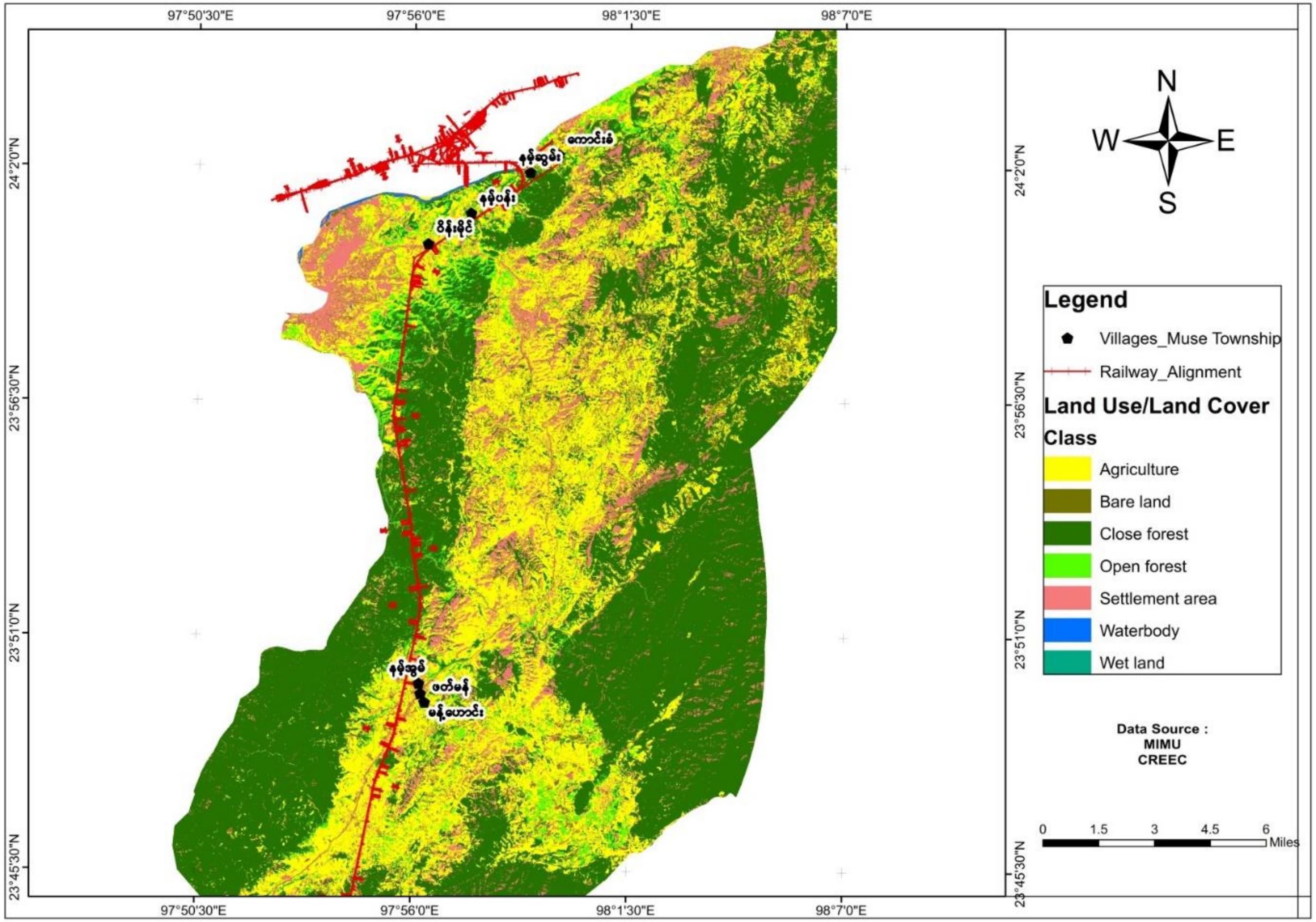
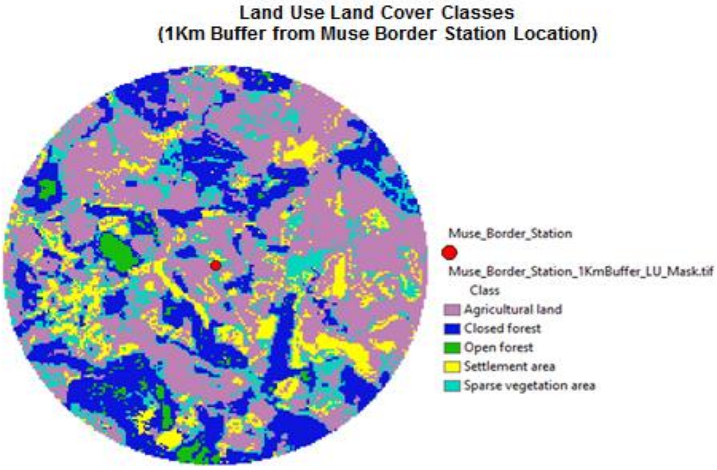
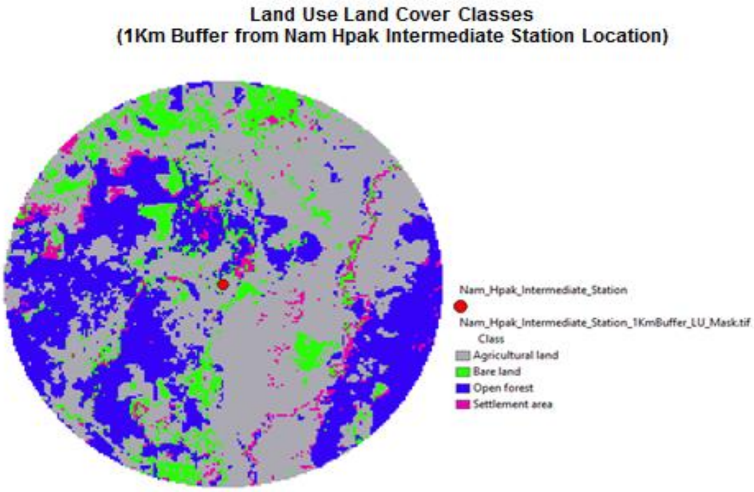
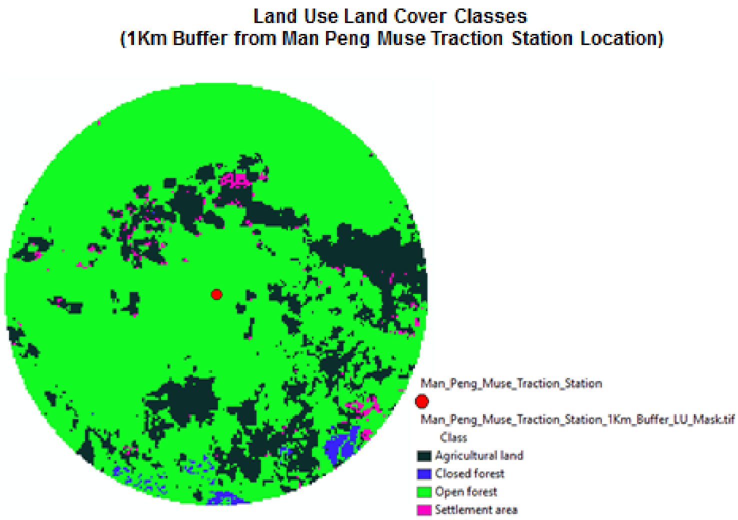


Figure 4.12- Land Use Map of Muse Township (Source: EIA Team, 2019)

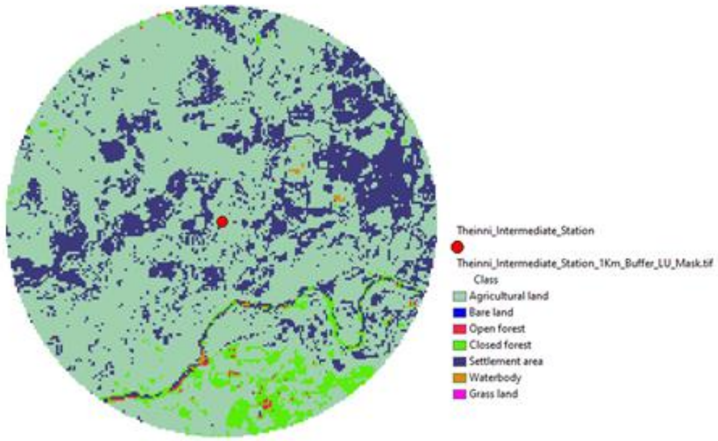
As the project is during the state of feasibility study, the railway alignment can change according to the need of the project. The project affected persons and land compensation are described in RAP. According to the GIS study, the land use classes within AOI of 1km around traction substations including switching post are as follow:



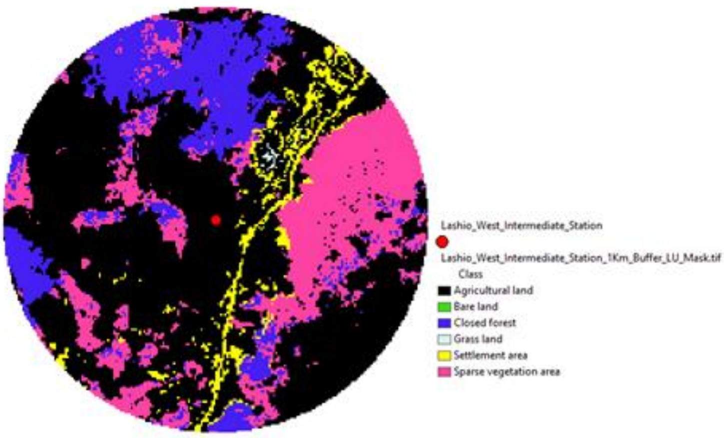




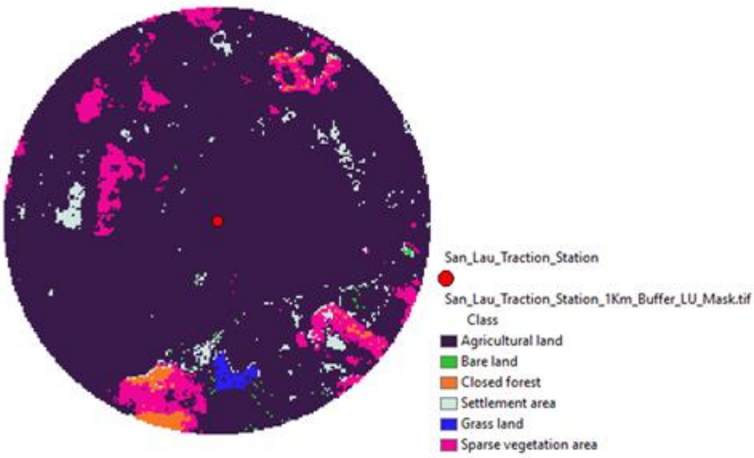
Land Use Land Cover Classes
(1Km Buffer from Theinni Intermediate Station Location)



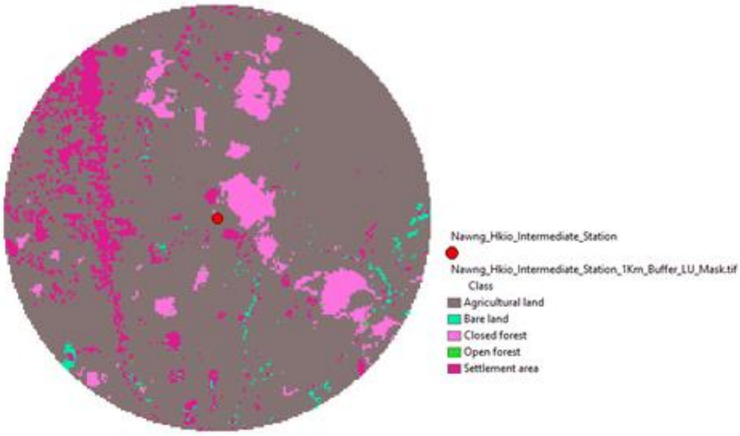
Land Use Land Cover Classes
(1Km Buffer from Lashio West Intermediate Station Location)



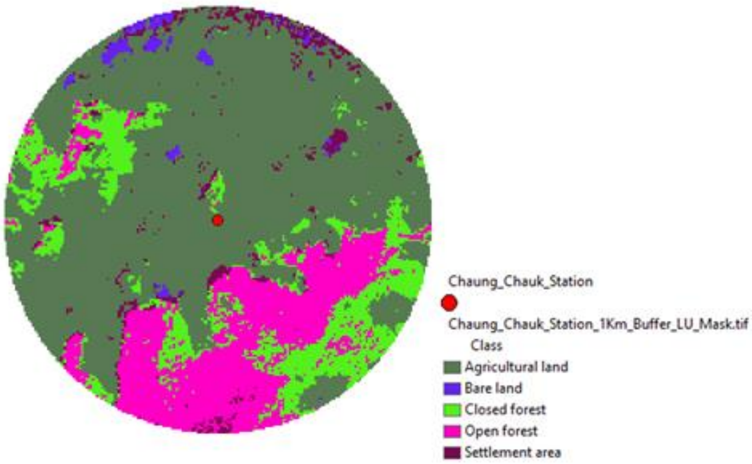
Land Use Land Cover Classes
(1Km Buffer from San Lau Traction Station Location)



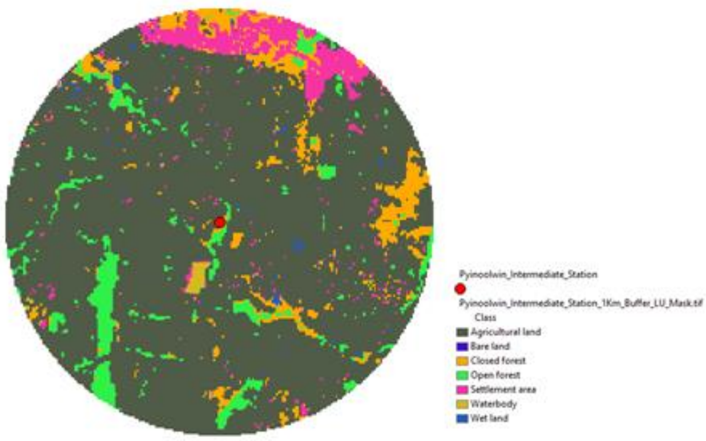
Land Use Land Cover Classes
(1Km Buffer from Nawng Hkio Intermediate Station Location)



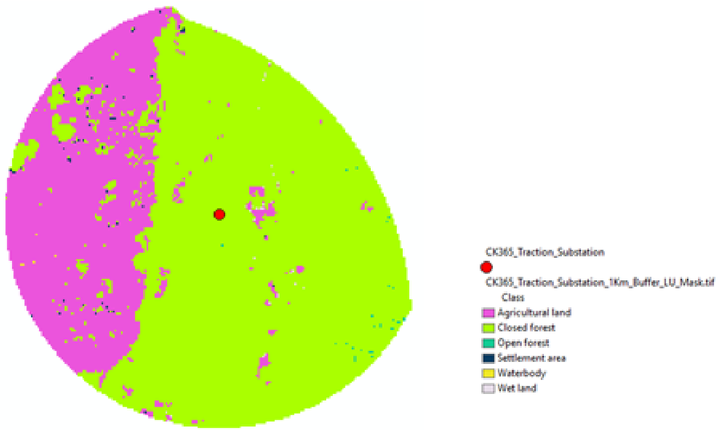
Land Use Land Cover Classes
(1Km Buffer from Chaung Chauk Station Location)



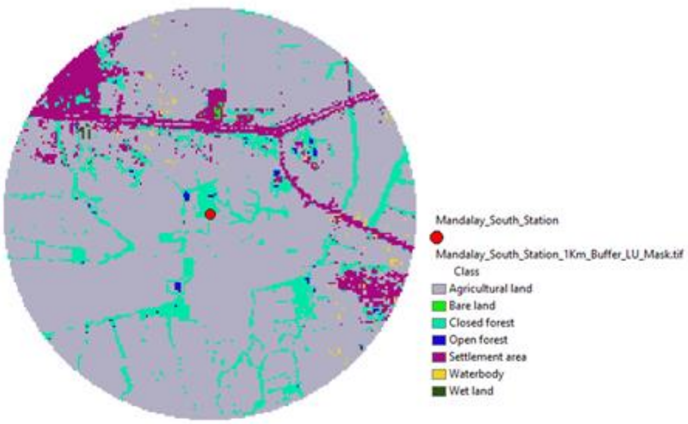
Land Use Land Cover Classes
(1Km Buffer from Pyinoolwin Intermediate Station Location)



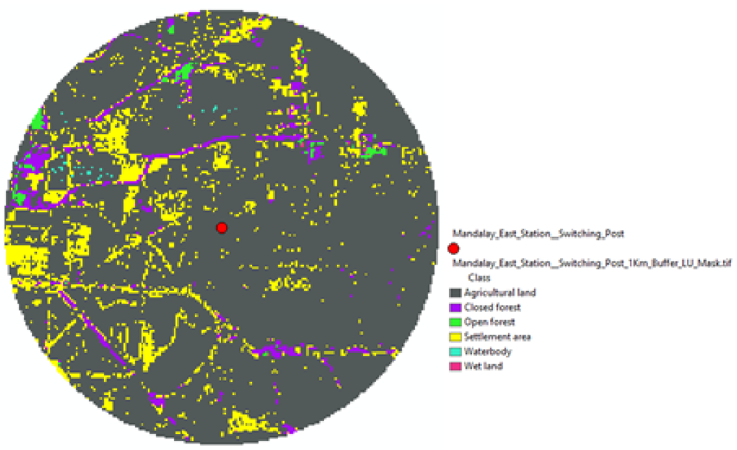
Land Use Land Cover Classes
(1Km Buffer from CK365 Traction Substation Location)



Land Use Land Cover Classes
(1Km Buffer from Mandalay South Station Location)



Land Use Land Cover Classes
(1Km Buffer from Mandalay East Station _Switching Post Station Location)



4.3.2. Overview of Railway Power Supply System

The external power supply mainly provides power energy for the railway power supply system. Each traction substation supplies power for the electric locomotive by introducing two-circuit independent & reliable 132kV or 230kV power supplies from the local power system and then converting voltage to 27.5kV by a traction transformer. Meanwhile, a step-down transformer is used to ensure 11kV power output so as to power all power consumption points such as station, work area, yard, and substation.

The interface between external power supply works and traction power supply system works is the high-voltage incoming pole in the traction substation. The works in incoming pole is traction power supply system works (below red dotted line in the figure below); and the external power supply supporting works is 132kV or 230kV transmission line from local substation of state power network to traction substation (between the blue and red dotted lines in the figure below). Some areas may suffer insufficient power supply. At this time, it is necessary to consider the new local 230kV substation and networking 230kV transmission line. There will not be included the construction of transmission line and substation between the power source and traction transformer for the proposed project. The schematic diagram of the engineering interface boundary is shown in Fig. 4.3.

System Access Voltage Level

The determination of grid voltage level is related to the power supply mode, power supply load, power supply distance and other factors. The voltage level of the user's power supply facilities connected to the power network is related to the user's power quality, one-time investment and far-future operation costs. The voltage level to be chosen shall be determined upon technical and economic comparison based on nearby power networks, capacity of the user's electrical equipment, load character and near-future development plan, rather than the capacity only. For this line, relevant factors shall be comprehensively considered, and two voltage levels of 132kV and 230kV are adopted to adapt to different situations.

Table 4-1 Selection of Supply Capability and Supply Voltage of Power System

Rated voltage (kV)	Transmitted power (MVA)	Delivery distance (km)
132	10 ~ 50	50 ~ 150
230	100 ~ 150	100 ~ 300

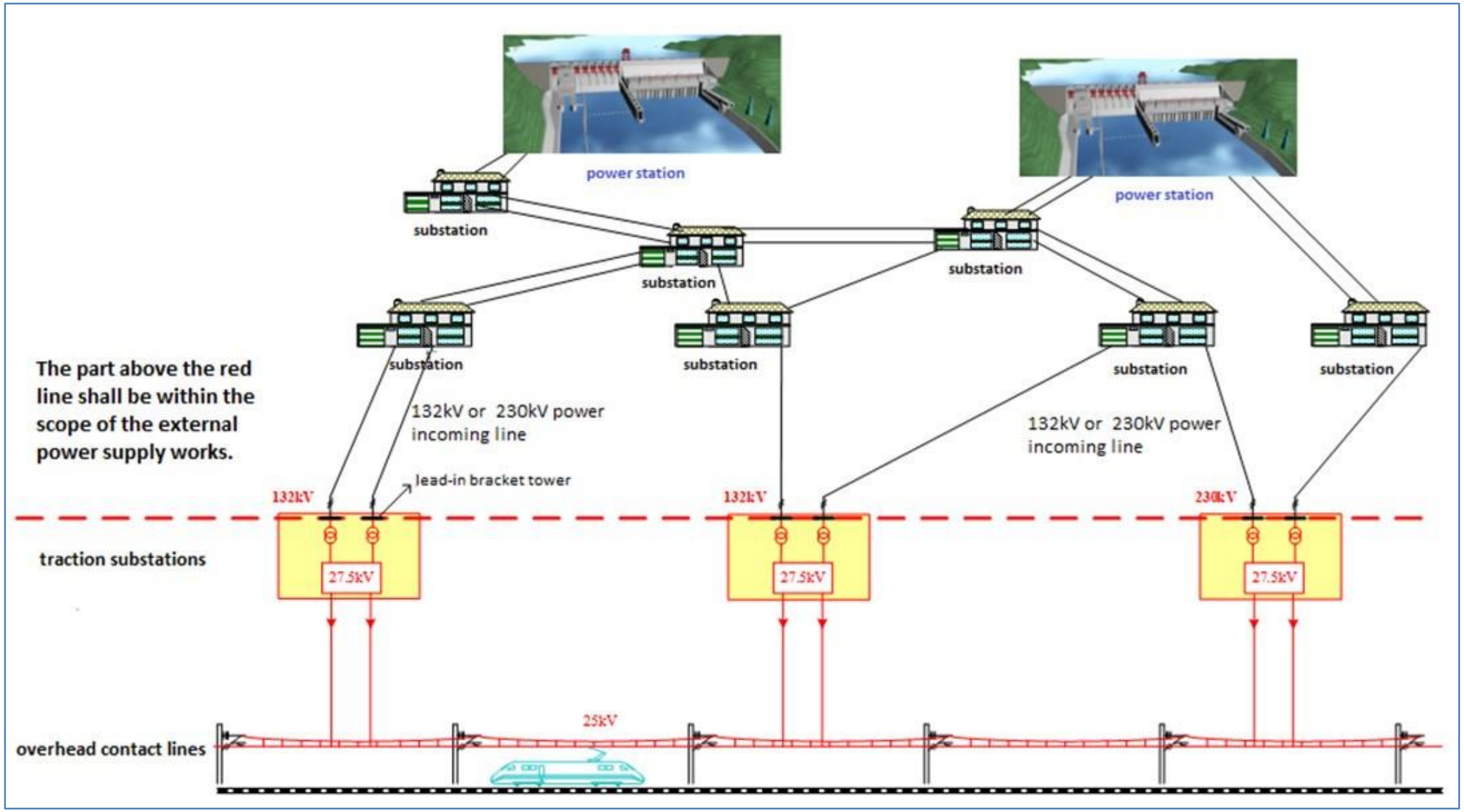


Fig. 4.13- Schematic diagram of interface between external power supply and traction power supply system

4.3.3. Work Schedule and Workforce for Construction and Operation Phases

All of the railway related works such as power supply system, bridges and culverts, tunnels and alignment will accomplish at the same time of 5 years construction period. According to the distribution of key works and the works determining the construction period, combined with the topographic and geological conditions along the line and track-laying scheme, the total construction is arranged as 5 years in line with the construction organization design progress of the similar projects under construction.

Estimated startup time of the project is 2023 in the near future. Construction preparation will be around 6 months and communication, electric power supply & traction power supply and other auxiliary works: starting in June of the fifth year and completing in September of the fifth year. Joint commissioning: 3 months. The line will be officially opened and operated at the end of the fifth year.

Implementation Schedule for Railway Power Supply System

Phase	Item	Duration
Pre-construction Phase	All traction Substation	2 months
Construction Phase	Civil works for traction substation with related to transmission line framework	22 months
	Installation of required electrical materials at every station, and electric power supply and traction power supply	4 months
Operation/ Ongoing Site Maintenance	All traction substation	50 years or more than
Decommissioning Phase	All traction substation	1 year

Detail Construction Implementation Schedule

The following table shows the time schedule for project activities of the construction stage

No	Project Activities	Estimated Project Duration (days)	Estimated Start Date
1	Site Clearance	60	Jun-2023
2	Excavate and Lay Foundation	60	Jun-2023
3	Temporary worker camp	60	Jun-2023
4	Unloading site storage and workshop	60	Jun-2023
5	Install the grounding grid	120	Aug-23
6	Building the common building	300	Dec-23

7	Backfill the foundation and station yard	60	Oct-24
8	Assemble the steel structure	180	Dec-24
9	Pit marking, Digging of foundations	90	Aug-23
10	Construction of foundation, Revetment	300	Nov-23
11	Pre-erecting checks, Erecting towers and accessories	270	Sep-24
12	Install the electrical equipment	120	Jun-27
13	Landscape and carry out the final inspection	90	Oct-27
14	Earthing, Clipping, Fixing of accessories	120	Jun-27
15	Stringling, Final sagging, testing and commissioning	90	Oct-27

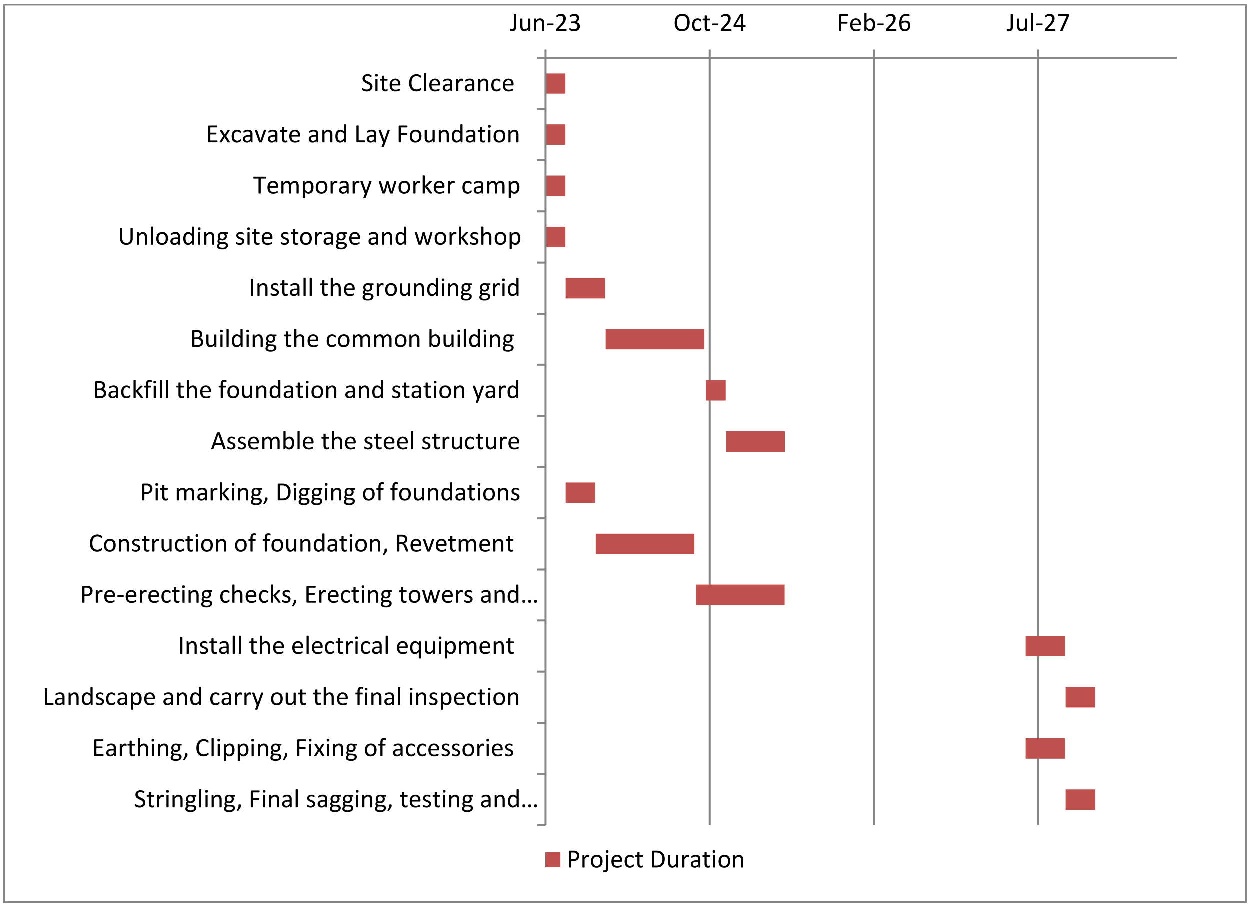


Figure – Detail Construction Implementation Schedule

Required Workforce for Construction and Operation Phase

(a) Construction Period

During construction phase, all civil works for traction substation and switching post with related to transmission line framework can be divided into 6 construction sites. Each site can be consisted of the construction of two traction substations. Estimated number of workers for each unit of civil works is 41 numbers. For construction phase, the project will use engineers, skillful workers and general workers as follow:

No.	Types of Workers	Quantity	Remarks
1.	Administration	2	For each construction site
2.	environmental and safety engineer	1	For each construction site
3.	civil engineer	1	For each construction site
4.	electrical engineer	1	For each construction site
5.	Skillful Workers	10	For each construction site
6.	Machine Operator	6	For each construction site
7.	General Workers	20	For each construction site
	Total	41	For each construction site

The work force condition may change depending on the workforce requirement of the construction site condition and the worker readiness from the project developer. At least 50% of local people will be used as worker required for the construction phase.

(b) Operation Period

For operation and maintenance for each substation, the workforces required are as follows:

No.	Types of Workers	Quantity
1.	senior electrical engineer	1
2.	assistant electrical engineers	2
3.	skillful workers	4

4.3.4. Project Organization

The project will be carried out by the Myanama Railways (MR), Minstry of Transport and Communications (MOTC) of the Republic of the Unioin of Myanmar. However, the construction of the project will be done by the CREEC under the supervision of MR and MOTC. The organization chart for the construction phase of the proposed railway bridges and culverts is described as follows. The professionals and work crews have not been selected for the project during FS stage.

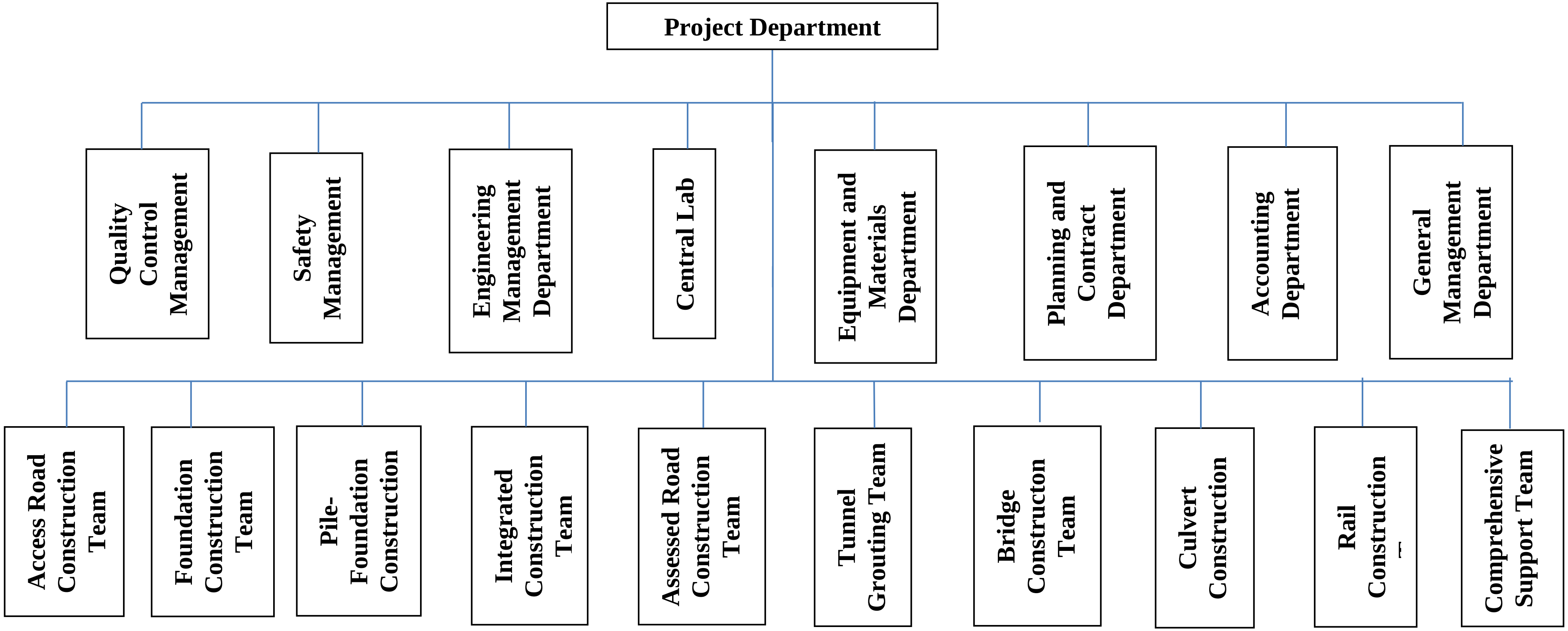


Fig 4.14-Organization Chart

4.4. Description of the Process

The following phases will be considered in conducting of EIA for the proposed project.

(i) Pre-construction Phase

Pre-construction activities will involve removal of select vegetation, if any, and the grading and excavation of soils for the installation of structural foundations for power stations, transmission line, and electricity supplies system.

(ii) Construction Phase

Construction activities will include installation of grounding grid, construction of temporary worker camps, access road construction, construction of command building, stringing activities and installation of electrical equipment, etc. The assembly of transformers, circuit breakers, CCTVs, circuit switchers, capacitors, and disconnect switches must be closely watched and tested to ensure proper assembly. This is especially true for transformers since their future trouble-free operation is very dependent on proper handling during assembly.

(iii) Operation Phase

Operational and maintenance activities associated with the railway power supply system include the maintenance and clearing of transmission line, maintenance and painting of substations and transformers. It will also include filling of transformer fluid.

(iv) Decommissioning Phase

This will include demolition, decommissioning and destruction of power station and power line activities. In addition to steel structures, the control building will be disassembled and removed from the site. Fencing around the substation will be broken down and removed. The gravel or aggregate surface at the substation will loaded onto trucks and removed for sale and reuse. Foundations would be exposed using backhoes, bulldozers, and other heavy earth moving equipment.

4.4.1. Traction Substation Construction Methods

The construction procedures for traction substation for railway power supply system will be as follow:

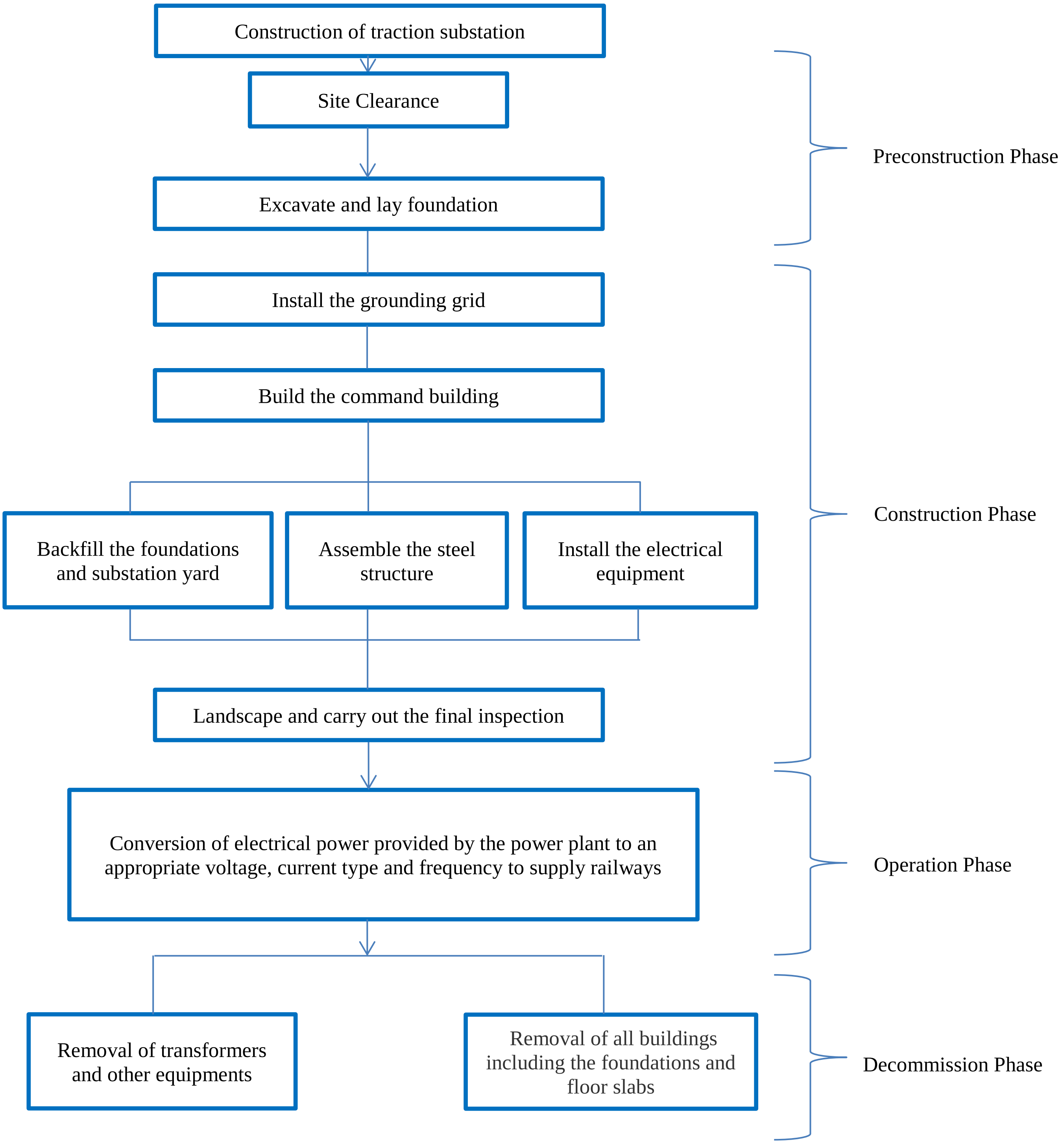


Figure 4.15 -Process Flow Chart for Construction of Traction Substation

1. Site clearance

The process of site clearance is generally undertaken as part of enable works, carried out to prepare a site for construction. The **activity** of tree-cutting is done in this stage.

2. Excavate and lay foundation

At this step, workers excavate the site, build the formwork, install the reinforcements and pour the concrete.

3. Install the grounding grid

The grounding grid is installed to ensure the safety of people and the equipment. Buried underground, the grid redirects the fault current.

4. Build the command building

The command building houses the control and protection equipment. Most substations are automated and remotely controlled. Only the largest substations have permanent technical staff on site since most are maintained by mobile teams.

5. Backfill the foundations and substation yard

Once the foundations have been laid, we backfill them and level the yard with granular material (sand, gravel, rock, etc.) that is adapted to the site.

6. Assemble the steel structures

Once the concrete is set, steel structures are assembled to support the electrical equipment.

7. Install the electrical equipment

Once the framework is built, we install the equipment on the foundations and steel structures. Each piece of equipment is then connected to the control room, which is under construction. We permanently fence off the new installations to ensure everyone’s safety. The equipment will be tested before the installations are connected to the power grid. Finally, we commission the substation and ensure that the electricity is flowing.

8. Landscape and carry out the final inspection

The project ends with landscaping; we plant trees, create mounds of earth and do more work if necessary.

We do earthwork, demobilize the site and carry out the final inspection to wrap up the project. Only the operating equipment is left at the substation.

9. Conversion of electrical power

The substation converts electric power from the form provided by the electrical power industry for public utility service to an appropriate voltage, current type and frequency to supply railways.

10. Removal of transformers and other equipment

The decommissioning typically includes the removal of all infrastructures if it is no longer required, or has reached end-of-life conditions.

11. Removal of all buildings including the foundations and floor slabs

In addition to steel structures, the control building will be disassembled and removed from the site. Fencing around the substation will be broken down and removed. The gravel or aggregate surface at the substation will loaded onto trucks and removed for sale and reuse. Foundations would be exposed using backhoes, bulldozers, and other heavy earth moving equipment.

4.4.2. Construction Methods for Power Transmission Lines

The construction procedures for power transmission line along the railway alignment will be as follow:

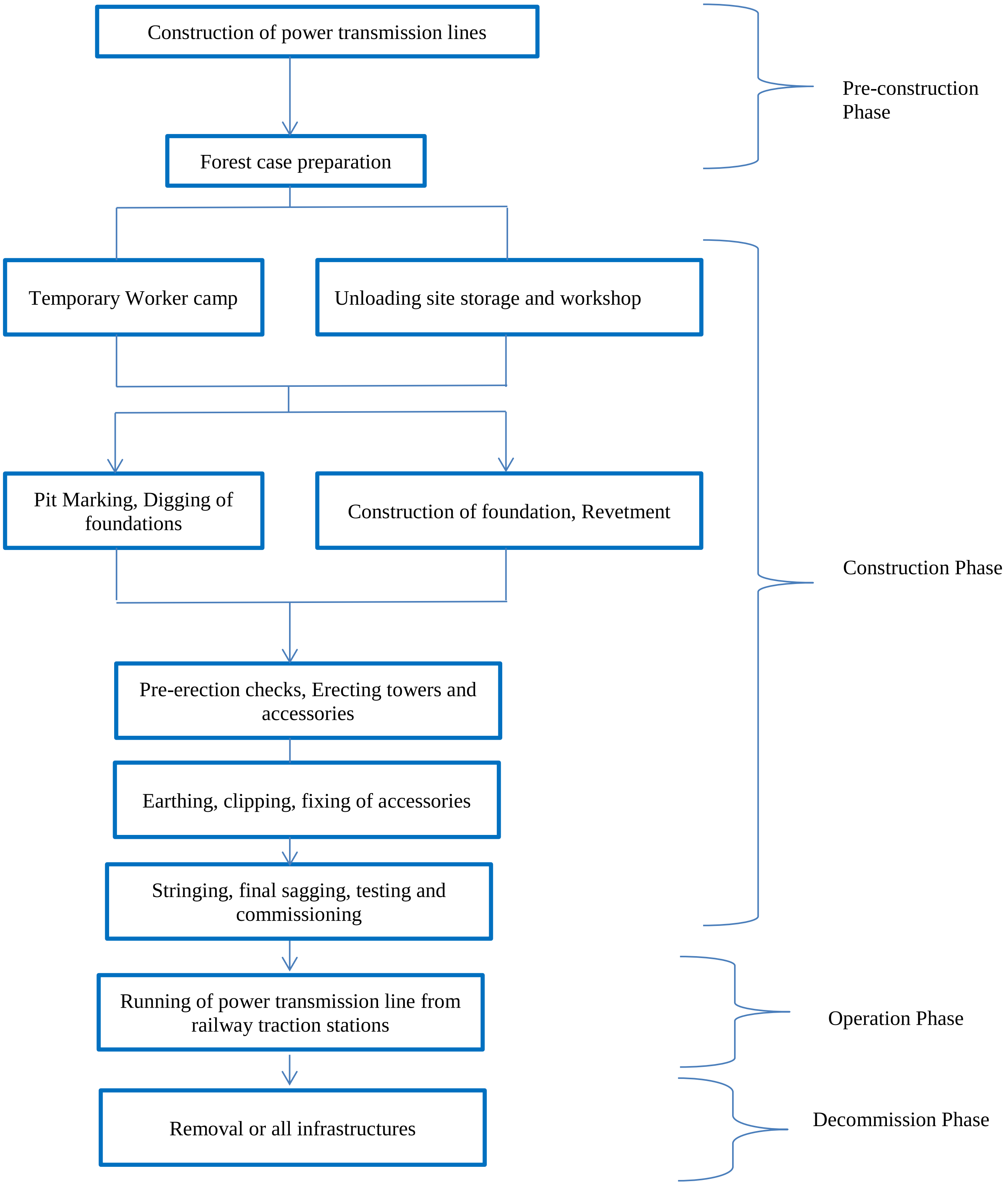


Figure 4.16 - Process Flow Chart for Construction of Transmission Lines

1. Forest case preparation

Enumeration of trees to be cut, lopped/trimmed in the Right of Way clearance according to girth, height, type of tree.

2. Temporary worker camps

Temporary worker camps are set up en-route the transmission line.

3. Unloading of material at site, storage and workshop

The tower erection sites are normally very remote where mechanized equipment is not readily available or are not accessible (e.g. in hilly regions). Storage and workshop areas are established in an area accessible easily by trucks, motorized equipment, have power availability and storage area. Mostly a small mechanized boom crane is available; otherwise it is manually unloaded using chain and pulleys blocks.

4. Pit marking, digging of foundation

After the location marking has been done, the marking of the pits for excavation for the foundation is done. Each pit and foundation is specific to the type of tower to be erected at that location. Angle of deviation for each tower must be compared with the profile sheet. Pits must be free from excess soil after excavation. Clearing of any trees etc. near the foundations is required.

5. Construction of foundation, revetment

Bending steel rods, tying with steel wires and mixing concrete for the foundation is done manually. This is followed by pouring in concrete prepared using a manual mixing machine. This steel-concrete structure is known as Reinforced Cement Concrete (RCC). The concrete is casted manually into the foundations and footing prepared manually using ply-boards and/or wood casts made as per design.

6. Pre-erection checks and Erecting towers, arms, Erection, Tightening and Punching

Checking of all tower locations with respect to design type, the wind load, the conductor weight, the type of accessories, the angle of wire and determine the tower erection methodology for sag and tensioning. Cutting of trees and vegetation for the right of way. The Lattice structure tower parts are moved/loaded manually up to the erection point and then lifted manually/using chain pulleys to the top. There is no high boom crane available in remote areas to help lift the towers parts to the top.

7. Earthing, clipping and fixing of accessories (installation of OPGW (Optical Ground Wire)

Double earthing of each tower is done using manual labor to ensure proper protection of the entire system from faults and accidents. All accessories are erected manually using small pulley and tensioner followed by erection of disk insulators. Earth wire or OPGW is usually strung first on the top arms of the tower followed by accessories on the lower arms, followed by stringing of power conductor.

8. Stringing and final sagging and tensioning of earth-wire and power conductor, Testing and Commissioning

The paying out/stringing of power conductor is done manually using aerial rollers/ pullers, tensioners winches etc. to provide the correct sag prescribed for the wire.

9. Running of power transmission line from railway traction stations

Each traction substation supplies power for the electric locomotive by introducing two-circuit independent & reliable 132kV or 230kV power supplies from the local power system and then reducing converting voltage to 132/27.5kV or 230/27.5kV by a traction transformer.

10. Removal of all infrastructures during decommissioning phase at the end of life

All of the infrastructures will be disassembled and removed from the site. Foundations would be exposed using backhoes, bulldozers, and other heavy earth moving equipment.

4.4.3. Railway Traction Load Demand

(i) Load characteristics

The external power supply mainly provides power energy for the railway power supply system. Each traction substation supplies power for the electric locomotive by introducing two-circuit independent & reliable 132kV or 230kV power supplies from the local power system and then reducing converting voltage to 132/27.5kV or 230/27.5kV by a traction transformer. Single-phase power frequency 25kV AC asymmetric power supply mode is adopted. Meanwhile, a step-down transformer is used to ensure 11kV three-phase power output so as to power all power consumption points such as station, work area, yard, and substation.

(ii) Distribution of railways substations and power load demands

A total of eleven new traction substations and nine 11kV new distribution substations shall be built for the whole line in an integrated manner.

Table 4.2- Locations of Traction Substation and Distribution Substation

No.	Traction Substation	Installed Capacity (MVA)	11kV Distribution Substation	Installed Capacity (MVA)	Description
1	Muse	2×(12.5+20)	Muse	2×4	Combined construction of traction and distribution substations
2	Nam Hpak Ka	2×(20+20)	Nam Hpak Ka	2×4	Combined construction with new Nam Hpak Ka Central Substation for external power supply
3	Man peng	2×(16+25)	-	-	Traction substation
4	Theinni	2×(16+16)	Theinni	2×4	Combined construction of traction and distribution substations
5	Lashio West	2×(20+20)	Lashio West	2×4	Combined construction with new Lashio West Central Substation for external power supply
6	San lau	2×(20+20)	San lau	2×4	Combined construction of traction and distribution substations
7	Chaung Chauk	2×(20+25)	Chaung Chauk	2×4	Combined construction with new Chaung Chauk Central Substation for external power supply
8	Nawng Hkio	2×(20+20)	Nawng Hkio	2×4	Combined construction of traction and distribution substations
9	Pyinoolwin	2×(20+25)	Pyinoolwin	2×4	Combined construction with new Pyinoolwin Central Substation for external power supply
10	CK365	2×(20+12.5)	-	-	Traction substation
11	Mandalay South	2×(12.5+20)	Mandalay South	2×8	Combined construction of traction and distribution substations

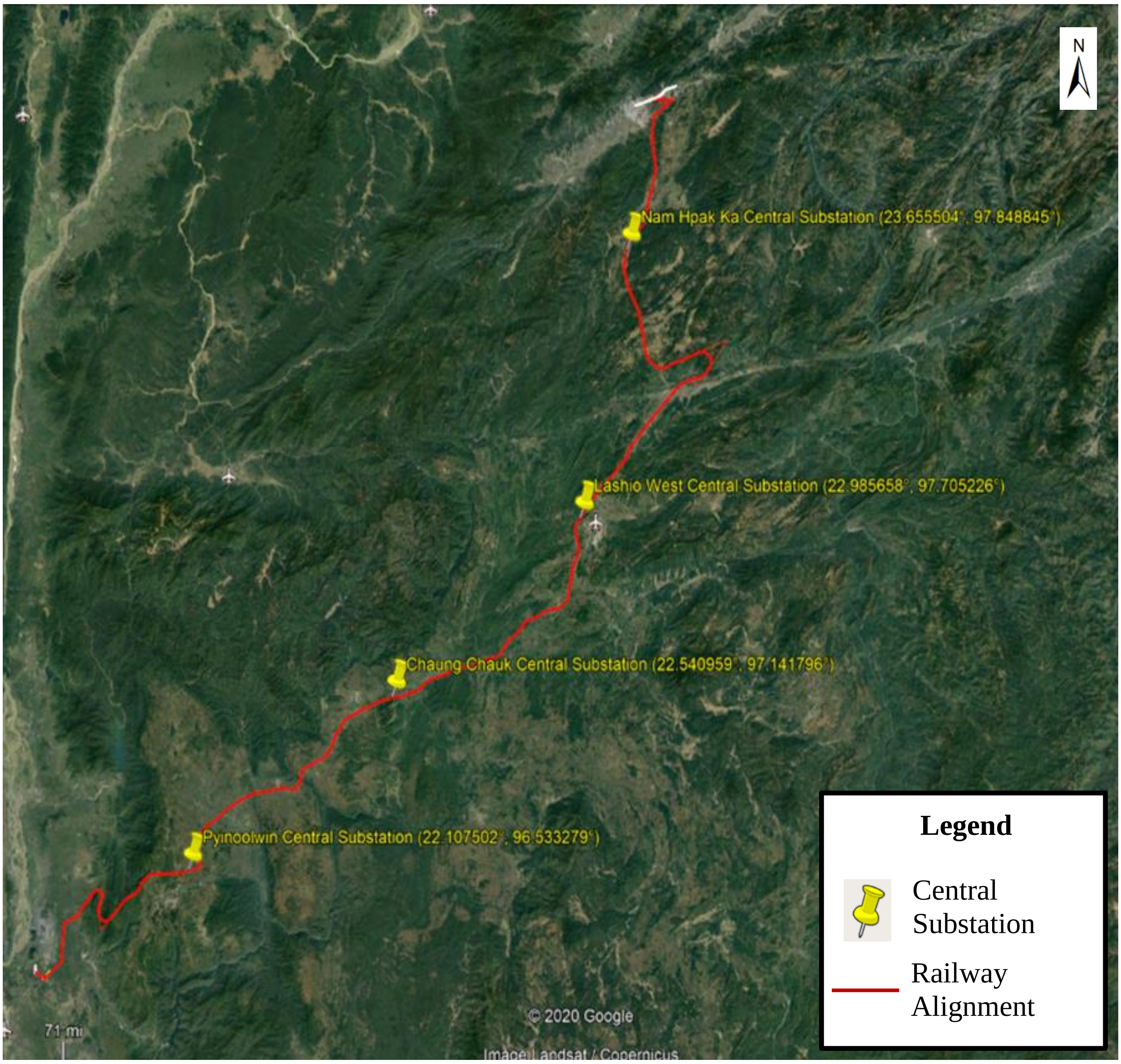


Figure 4.17 – Location of Central Substations in Google Map

4.4.4 Power Distribution along the Railway

From the geographical connection diagram of existing power networks in Myanmar, the proposed Muse-Mandalay Railway passes through Shan State and Mandalay Division. The power station, 230/132kV substation and transmission line in these two regions are shown in Tables 7-9. Among them, there are a large hydropower station Shweli with an installed capacity of 600MW in Shan State and a large hydropower station YEYWA with an installed capacity of 790MW and UPPER YEYWA Hydropower Station (under construction) with an installed capacity of 280MW in Mandalay. Shwesaryan–ManSan-Shweli double-circuit 230kV transmission line is in parallel with nearby main power network laid along the railway. The distribution of external power network for the railway in this section shows obvious characteristics of “weak in the north and strong in the south”. With Pyinoolwin as the boundary, there is a larger gap existed between “the strong and the weak”. The power supply of hydro-power stations along the line is comparatively abundant, but the power network of them is weak. Even so, by reinforcing and constructing supporting power network, the requirement of power supply for this railway can be met accordingly.

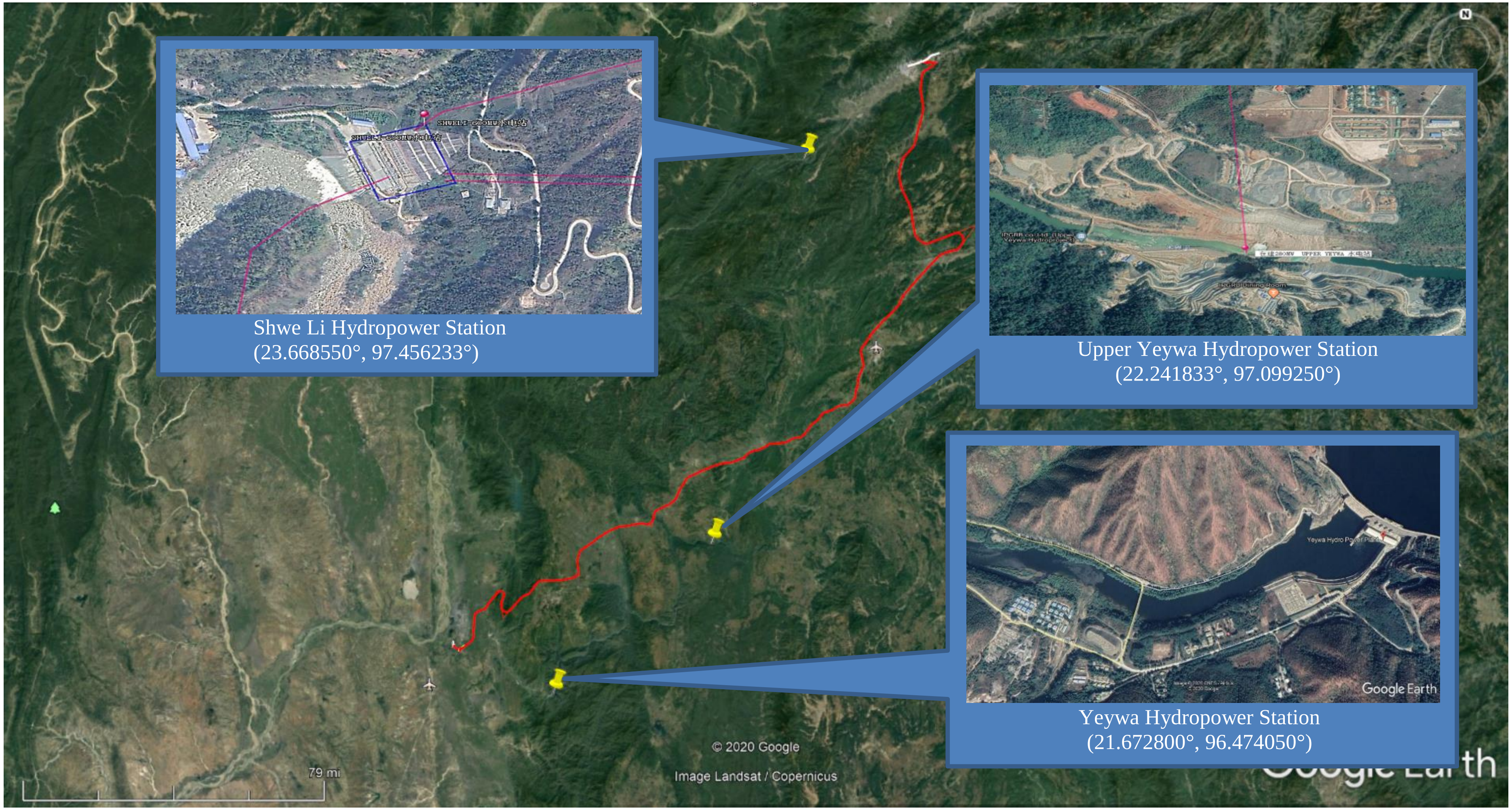


Figure – Hydropower Stations along the Proposed Railway

Table 4-3 Statistics on Power Stations in Shan State and Mandalay Division

S/N	Power station	Installed capacity (MW)	Location	Location
1	Shweli Hydropower Station	600	23°40'6.78" N, 97°27'22.44"E	Shan State
2	Zawgyi No. (1) Hydropower Station	18	21°34'30.03"N, 96°52'21.31"E	Shan State
3	Zawgyi No. (2) Hydropower Station	12	21°34'10.06"N, 96°52'11.82"E	Shan State
4	KengTawng Hydropower Station	54	20°35'9.41"N, 98°17'36"E	Shan State
5	MyoGyi Hydropower Station	30	21°27'54.36"N, 96°22'51.24"E	Shan State
6	Tigyit Thermal Power Station	120	20°25'54.85"N, 96°42'9.02"E	Shan State
7	Kinda Hydropower Station	56	21°9'49.72"N, 96°19'22.62"E	Mandalay Division
8	Sedawgyi Hydropower Station	25	22°20'52.22"N, 96°19'22.32"E	Mandalay Division
9	Yeywa Hydropower Station	790	21°40'22.02"N, 96°28'26.59"E	Mandalay Division
10	Kyaukse Thermal Power Station	102	21°40'3.39"N, 96°9'10.22"E	Mandalay Division
11	Myingyan Thermal Power Station	95	21°23'22.66"N, 95°22'31.89"E	Mandalay Division

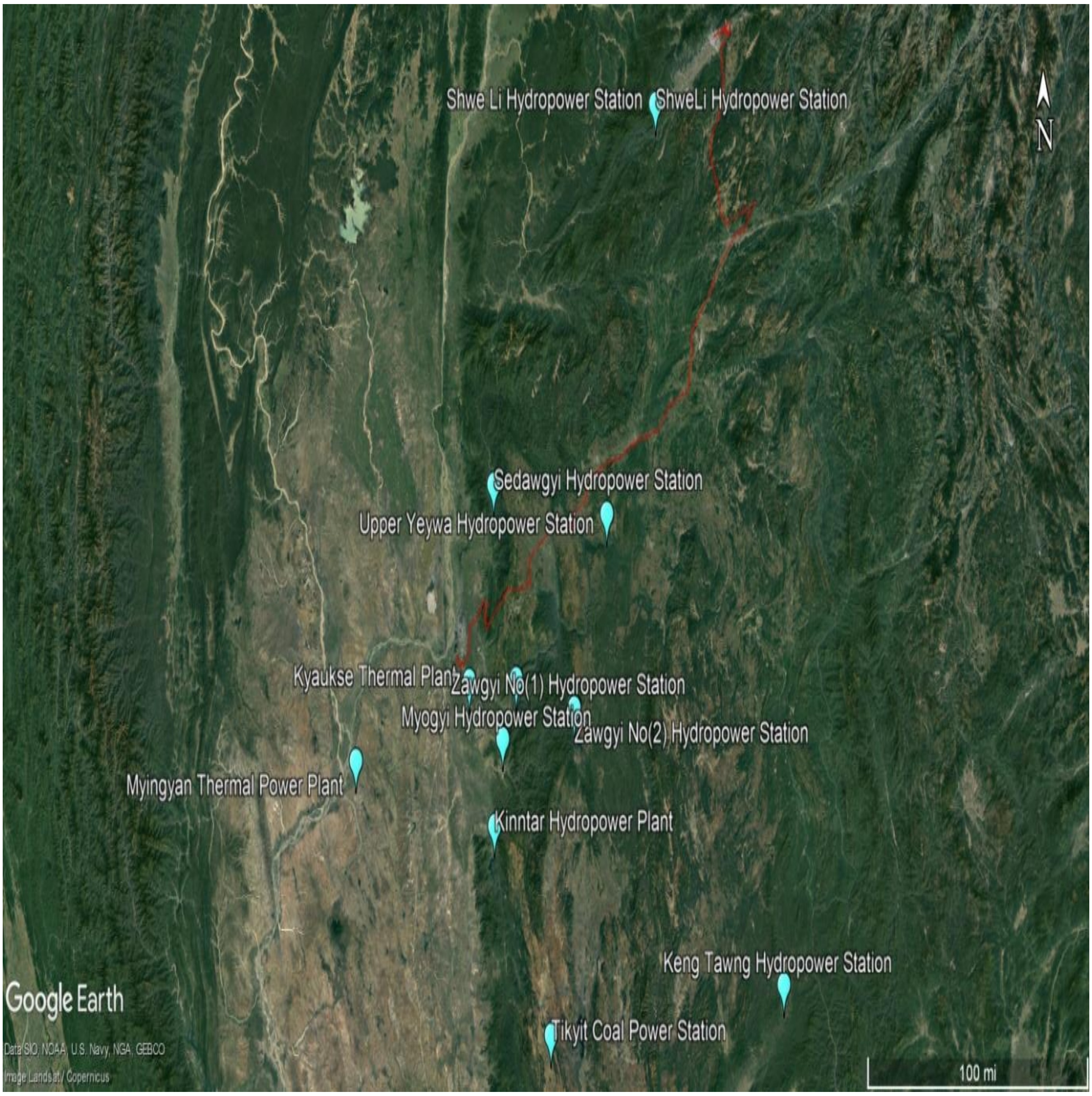


Figure 4.18 – Location of Power Stations for the Proposed Project

Table 4-4 Statistics on 132/230kV substations in Shan State and Mandalay Division

S/N	Substation	Voltage grade (kV)	Installed capacity	Regio
1	Mansan	230/66/11	60	Shan State
2	Kala w	132/66	80	Shan State
		132/33/11	50	Shan State
3	Nansan	132/66/11	60	Shan State
4	Taunggyi	132/66/11	50	Shan State
		132/66/11	50	Shan State
5	Myingyan	230/33/11	85	Mandalay Division

	(Steel Mill)	230/33/11	85	Mandalay Division
		230/11	85	Mandalay Division
6	Myaukpyin	230/33/11	100	Mandalay Division
		230/33/11	100	Mandalay Division
		230/33/11	100	Mandalay Division
7	Shwesaryan	230/132/11	100	Mandalay Division
		230/33/11	60	Mandalay Division
8	Thapyawa	230/33/11	60	Mandalay Division
		230/33/11	60	Mandalay Division
9	Thazi	230/132/11	100	Mandalay Division
		230/132/11	100	Mandalay Division
		132/33/11	30	Mandalay Division
		132/33/11	30	Mandalay Division
10	Beli n	230/132/11	100	Mandalay Division
		132/33/11	30	Mandalay Division
		132/33/11	30	Mandalay Division
11	Tagondine	132/33	80	Mandalay Division
		132/33/11	30	Mandalay Division
		132/11	50	Mandalay Division
12	Myingyan	132/66/11	45	Mandalay Division
		132/66/11	45	Mandalay Division
13	Yinmarbin	132/33	15	Mandalay Division
14	Yatanabon	132/33/11	18	Mandalay Division
15	Yepaungsone	132/33/11	60	Mandalay Division
16	Lattpanhla	132/33/11	20	Mandalay Division
		132/66/11	60	Mandalay Division
17	Ingone	132/33/11	60	Mandalay Division
18	Anesakhan	132/33/11	60	Mandalay Division
19	Aungpinlae	132/33/11	30	Mandalay Division
		132/11	31.5	Mandalay Division
20	Taungdawkwin	132/33/11	50	Mandalay Division
		132/33/11	50	Mandalay Division
		132/33/11	50	Mandalay Division

Table 4-5 Statistics on 132/230kV Transmission Lines in Shan State and Mandalay Division

S/N	Transmission line	Voltage grade	Conductor model MCM	Distance (km)	Region
1	230 kV Shweli - Mansan	230kV	605	95.9	Shan State
2	230 kV Mansan - Shwesaryan	230kV	605	194.1	Shan State
3	132 kV Ba Lu Chaung (2) - Tigit	132kV	397.5	134.9	Shan State
4	132 kV Tigit - Kalaw	132kV	397.5	28.1	Shan State
5	132 kV Kyaungtaung - Nansan	132kV	397.5	118.9	Shan State
6	132 kVNansan - Pinpet	132kV	397.5	69.4	Shan State
7	132 kV Kalaw – Pinpet (1)	132kV	397.5	64.4	Shan State
8	132 kV Pinpet – Kalaw (2)	132kV	397.5	64.1	Shan State
9	230 kV Myingyan (Steelmill) - Thapyaywa	230kV	605	53.46	Mandalay Division
10	230 kV Thazi - Thapyaywa	230kV	605	15.65	Mandalay Division
11	230 kV Yeywa - Thapyaywa	230kV	795	69.75	Mandalay Division
12	230 kV Belin - Thapyaywa	230kV	795	54.65	Mandalay Division
13	230 kV Shwesaryan - Belin	230kV	795	17.14	Mandalay Division
14	230 kV Yeywa - Belin	230kV	795	24.33	Mandalay Division
15	230 kV Shwesaryan - Myaukpyin	230kV	605	16.26	Mandalay Division
16	132 kV Kalaw - Yepaungsone	132kV	397.5	23.69	Mandalay Division
17	132 kV Yepaungsone - Thazi	132kV	397.5	21.49	Mandalay Division
18	132 kV Thazi - Belin	132kV	336.4	62.88	Mandalay Division
19	132 kV Belin - Tagondine	132kV	336.4	22.21	Mandalay Division
20	132 kV Shwesaryan - Yadanarpon	132kV	397.5	11.37	Mandalay Division
21	132 kV Yadanarpon – PyinOoLwin	132kV	397.5	9.64	Mandalay Division
22	132 kV Tagondine - Shwesaryan	132kV	397.5	11.66	Mandalay Division
23	132 kV Kinda - Thazi	132kV	300 sqmm	45.40	Mandalay Division
24	132 kV Sedawgyi - Aungpinlae	132kV	336.4	30.20	Mandalay Division
25	132 kV Aungpinlae - Tagondine	132kV	336.4	6.55	Mandalay Division
26	132 kV Sedawgyi - Kyaukphahtoe	132kV	397.5	131.63	Mandalay Division
27	132 kV Kinda - Ingone	132kV	336.4	29.16	Mandalay Division
28	132 kV Ingone - Belin	132kV	336.4	12.68	Mandalay Division
29	132 kV Belin - Aungpinlae	132kV	336.4	24.75	Mandalay Division
30	132 kV Thazi - Myingyan	132kV	397.5	65.20	Mandalay Division

31	132 kV Ingone - Taungdawkwin	132kV	397.5	6.60	Mandalay Division
32	132 kV Myingyan – Sunlun	132kV	605	3.05	Mandalay Division
33	132 kV Yepaungsone - Yinmarpin	132kV	397.5	0.57	Mandalay Division

4.4.5. Power Supply Scheme

Basic Data for Traction Power Supply Calculation

Basic data of external power system

In line with the external power supply along the line, and after estimated calculation, the system short-circuit capacity of the 132kV voltage level is calculated as 400MVA, and the system short circuit-capacity of the 230kV voltage level is calculated as 800MVA.

4.4.6. Traction Power Supply Mode

(a) Traction power supply system

Traction power supply system is a complete system which receives power from the external power system, which converts 132kV (or 230kV) three-phase AC power into single-phase AC power through traction transformers, provides required power to the electric locomotive through the OCS (overhead contact system), and completes full functions such as traction power distribution, transmission, etc. The detailed traction power supply schemes are shown in the table below.

Table 4-6 Supply scheme for External Power Supply for Railway

Traction substation		Mandalay South	CK3 65	Pyinoolwin	Nawng Hkio
External power supply scheme	Circuit I	Shwesaryan 230kV Substation	Aukpyinmy 230kV Substation	Pyinoolwin Central Substation	Pyinoolwin Central Substation
	Circuit II	Shwesaryan 230kV Substation	Aungpinlae 132kV Substation	Pyinoolwin Central Substation	CHaung Chauk Central Substation
External power reinforcement works		-	-	New Pyinoolwin 230/132/11kV, 230/27.5kV Central Substations; one 230kV incoming line connected from existing Shwesaryan –Mansan 230kV transmission line in T shape, the other one 230kV incoming line to YEYWA Hydropower Station	
Traction substation		CHaung Chauk	San lau	Lashio West	Theinni
External power supply scheme	Circuit I	CHaung Chauk Central Substation	CHaung Chauk Central Substation	Lashio West Central Substation	Lashio West Central Substation

	Circuit II	CHaung Chauk Central	Lashio West Central	Lashio West Central	New 132kV double-circuit external
External power reinforcement works		New CHaung Chauk 230/132/11kV, 230/27.5kV Central Substations; one 230kV incoming line conncted from existing Shwesaryan –Mansan 230kV transmission line in T shape, the other one 230kV incoming line to UPPER		New Lashio West 230/132/11kV, 230/27.5kV Central Substations; new 230kV double-circuit line connected from existing Mansan230kV Substation to Lashio West Central Substation	
Traction substation		Man peng	Nam Hpak Ka	Muse	
External power supply scheme	Circuit I	Nam Hpak Ka Central Substation	Nam Hpak Ka Central Substation	Nam Hpak Ka Central Substation	
	Circuit II	New 132kV double-circuit external power line from Theinni Traction Substation to Man peng Traction	Nam Hpak Ka Central Substation	Nam Hpak Ka Central Substation	
External power reinforcement works		New Nam Hpak Ka 230/132/11kV, 230/27.5kV Central Substations; new 230kV double-circuit line connected from 230kV side of existing SHWELI (600MW) Hydropower Station to			

4.4.7. Required Power and Annual Electricity Consumption

The power and electricity consumption required by the railway is listed as follows.

Table 4.7. Table of Required Power and Electricity Consumption

Design year	Country	Traction substation	Annual electricity consumption (10^4kW•h)		Required power (10^4 kW)			
			each substation	total	Annual average		Annual	
					each substa-tion	total	each substa-tion	total
2035	Myanmar	Muse	2603.3	49149.3	0.297	5.611	0.521	9.848
		Nam hpak ka	4723.7		0.539		0.945	
		Man Peng	5235.3		0.598		1.047	
		Theinni	3650.7		0.417		0.730	
		Lashio West	51		0.589		1.031	
		San lau	5485.2		0.626		1.097	
		Chaung Chauk	5583.1		0.637		1.117	
		Nawng hkio	5231.3		0.597		1.046	
		Pyinoolwin	5453.6		0.623		1.091	
		CK365	4359.5		0.498		0.872	
		Mandalay South	1667.6		0.190		0.334	

2045	Myanmar	M u	3702.8	70005.8	0.423	7.992	0.741	14.001
		Nam hpak ka	6746.6		0.770		1.349	
		Man Peng	7245.6		0.827		1.449	
		Theinni	4990.5		0.570		0.998	
		Lashio West	7429.3		0.848		1.486	
		San lau	7757.7		0.886		1.552	
		Chaung Chauk	78		0.896		1.570	
		Nawng hkio	73 74		0.842		1.475	
		Pyinoolwin	7709.1		0.880		1.542	
		CK365	6927.2		0.791		1.354	
		Mandalay South	22 72		0.259		0.454	

Note: In the table, the average annual load utilization is 8760 hours, and the maximum load utilization is 5000 hours.

4.4.8. Traction Substation, Switching Post and Traction Power Supply Dispatching

4.4.8.1. Traction Power Supply Facilities

(a) Site selection of traction substations and switching posts

(1) Principle of site selection

(i) Facilitate the inlet and outlet of overhead lines and reduce the amount of earthwork;

(ii) Avoid areas with high fill and large number of buildings to be demolished;

(iii) Suitable geological conditions and foundation bearing capacity to facilitate the providing of assess roads to posts;

(iv) Close to stations or villages in order to facilitate operation, maintenance and living supplies as much as possible;

(v) Try not to occupy or occupy less farmland, and pay attention to coordination with the surrounding environment;

(vi) The elevation of the traction substation site should be above the 100-year flood level and 0.5 m above the water logging level; the elevation of the switching post site should be above the 50-year flood level and 0.5 m above the water logging level.

4.4.8.2. General Layout and Production Building Layout

(a) Traction substation which are jointly built

The four new 230kV traction substations are to be built, including Nam Hpak Ka, Lashio West, Chaung Chauk and Pyinoolwin, and to be jointly built with the local 230/132/11kV center substations, with shared yard and common external power supply line. But, the layout of production buildings for the four substations and the local ones are set up separately. Except for its traction transformer which adopts the outdoor low-type arrangement, the rest of the 230kV distribution equipment of traction substation adopts the outdoor middle-type arrangement. The indoor part of 27.5kV distribution equipment adopts overhead outgoing line GIS insulated switchgear with double-row arrangement. The outdoor part is arranged in medium-sized arrangement. The indoor grid spacing of 27.5kV substation self-use transformer and 11kV substation self-use transformer is arranged. The traction substation adopts mesh spacing arrangement, which is equipped with high voltage chamber, inspection room, main control room, communication machinery room, substation self-power transformer room, on-duty house and auxiliary house, etc.

(b) The remaining traction substation

Except for its traction transformer adopts the outdoor low-type arrangement, the rest of the 132 (230) kV distribution equipment of each new traction substation adopts the outdoor middle-type arrangement. The indoor part of 27.5kV distribution equipment adopts overhead outgoing line GIS insulated switchgear double-row arrangement. The outdoor part is arranged in middle-type arrangement. The indoor grid spacing of 27.5kV substation self-use transformer and 11kV substation self-use transformer is arranged. The traction substation adopts mesh spacing arrangement, which is equipped with high voltage chamber, inspection room, main control room, communication machinery room, substation self-power transformer room, on-duty house and auxiliary house, etc.

(c) Switching post

The box-type structure is used in the new switching post, which is designed based on the no-man on duty and guard design. The incoming & outgoing line disconnecting switch and surge arrester of switching post is arranged in outdoor middle-type arrangement. An integrated automation system is set up in the switching post, which is incorporated into the traction power supply dispatching system.

(d) Structure type

(i) The φ 350mm equal-diameter steel pipe column and steel truss beam are used in the incoming line structure of traction substation and the gate structure above traction transformer; and the height of pillar is 10m, and the transverse beam is composite beam of lattice steel pipe with a span of 12m; flange connections are used between pillars and foundations, between pillars and beams.

(ii) The 27.5kV gate-structure terminal of traction substation adopts φ 350mm equal-diameter steel pipe column and steel truss beam. The height of the pillar is 7.3m and the length of the transverse beam is 9m.

(iii) The 27.5kV feeder terminal structure and angle pole structure column adopts φ 350mm equal-diameter steel pipe column, and the height of pillar is 7.3m.

(iv) The support of outdoor distribution equipment adopts φ 300mm equal-diameter steel pipe column, and the pillar height adopts 2.5m or 3m respectively according to the type of equipment.

(e) OCS switch monitoring stations are set up in each newly opened station of the line in the initial stage, which is generally built in conjunction with the signal building and incorporated into the remote control system of traction power supply of the whole line.

(f) Muse to Mandalay Railway is included in the traction power supply dispatching console of Muse ~ Mandalay South newly set in the proposed Mandalay South power dispatching center post for the dispatching and management.

Fig. 4.19 - Vertical view of traction substation

Fig. 4.20 - HV incoming side of traction substation

Fig. 4.21- Main control room of traction substation

4.4.8.3. Traction Power Supply Dispatching and Remote-Control System

(a) Location selection for traction power supply dispatching center and dividing of dispatching zone

One Mandalay South traction power supply dispatching center is to be built.

Muse-Mandalay traction power supply dispatching console is to be built =, which is responsible for the dispatching and command of all traction power facilities on this line, with conditions for future expansion reserved.

(b) OCS suspension type

The OCS suspension type adopts completely compensated simple overhead contact line.

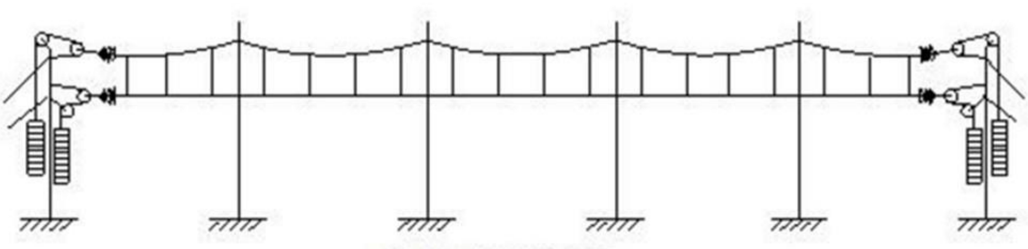


Fig. 4.22 - Completely compensated simple overhead contact line

4.4.8.4. Selection Principles of Mast, Supporting Assembly, Foundation and Insulator

Mast

The cantilever pole of the sectional subgrade is made of ring-shaped equal-diameter prestressing concrete pillars, the rigid cross-span pole and cross-beam of stations and multi-track bridges are made of steel tubes, the lattice straight-leg bridge steel column is used for the cantilever pole of the bridge, and the hot-dip galvanizing is used for all steel columns and rigid cross-beams for corrosion resistance.

Figure. Hard cross-span of station

Supporting assembly

The cantilever pole adopts top cantilever tube and slanted cantilever tube and increases cantilever brace. The transition mast of overlap and the turnout mast are assembled in a double cantilever form and the cantilever brace is added. The steady arm adopts aluminum alloy and is provided with a wind-proof.

The station and the multi-parallel track section adopt portal structure; the same portal structure is used when constructing the canopy column.

On the multi-track bridges, the OCS is suspended by portal structure; on the single and double-track bridges, the OCS passes through the cantilever pole suspension. The newly-built main line section adopts the T-beam bridge, and the OCS mast foundation adopts the bolt embedded on the hood of the bridge pier.

Foundation

The annular equal-diameter prestressed concrete poles adopt drilling foundation. The subgrade section of the anchor backstay under the OCS and the Additive wire adopts the drilling foundation; the portal structure steel pole uses the foundation pit to excavate the cast-in-place C30 concrete foundation; The steel pole on the pier (abutment) adopts the embedded foundation anchor method. The foundation in the tunnel is in the form of a preformed conduit.

Insulator

The OCS design is carried out as the non-polluted area for the whole line. The composite insulator is used in the tunnel, the anchorage under the contact wire, messenger wire and above the OCS. The rest adopts porcelain insulators; the bending strength of the rod insulator is not less than 12kN. The tensile strength of the composite insulator on OCS is not less than 120kN; return conductor, power supply line and other additional wires outside the tunnel of the adopt suspended porcelain insulators.

The insulator leakage distance is not less than 1400mm.

Dropper

Adjustable overall current-carrying dropper will be used throughout the line.

OCS components and other equipment

OCS components use standardized general-purpose products; OCS fittings adopt high-strength, anti-corrosion performance and relatively simple processing structure and material. It can adapt to the high tension of the high-speed OCS and is accompanied by the long-term low-frequency vibration working condition. The fitting ensures operation safety and reduces maintenance workload;

Fasteners adopt locknut when bolts, nuts, thread or other types are connected.

4.4.8.5. Type of OCS Suspension at Platform Shelter, Bridges, Tunnels, and Overpass Building

On Bridges

OCS Suspension is mounted at bridges by completely compensated simple overhead contact line.

In tunnels

Drop tubes are erected in tunnels for OCS suspension, and the supporting device is insulated rotating top cantilever. The OCS suspension base is fixed in the reserved trench.

Figure - Drop tube suspension for double-track tunnel

At over-line structures

New over-line structures shall have a clearance height no less than 7500mm. At places of over-line structures, how the OCS cross over these structures depends on clearance height and structure types. At places like tunnel entrance/exit, over-line bridge, and where across power lines, messenger wire, additive wire, power supply wire shall be equipped with preformed armor rods.

At platform canopy

OCS mast is not allowed to be erected on the main platform. Where there is canopy on the platform, OCS will be built along with canopy mast in an integrated manner. Where there is no canopy, OCS masts are erected outside the platform as far as practicable.

4.4.9. Electric Power

4.4.9.1. Power Supply Situation near Project Area

(a) Power supply situation of external electric network

The transmission voltage level of Myanmar State Grid is divided into 500 kV, 230 kV, 132 kV and 66 kV, and the distribution voltage level is divided into 33 kV, 11 kV and 6.6 kV. There exist two power plants near Muse-Mandalay railway, among them, SHWELI power plant with a capacity of 600MW and SEDAWGYI power plant with a capacity of 25MW. There are also three 230kV substations, namely MANSAN, SHWESARYAN and MYAUKPYIN, and four 132kV substations including PYINOOLWIN, YADANARPON, INDUSTRIAL, AUNGPIN, etc. Power grid is unevenly distributed along the route. For example, Muse-Pyinoolwin segment has no access to 132kV power grid. Only one existing substation-MANSAN 230kV substation is located 30km west of Lashio, connecting to SHWELI 600MW power station in the north, and to SHWESARYAN 230kV substation 20km south of Mandalay in the southwest. For Pyinoolwin-Mandalay segment, the power grid is more accessible, forming a 132kV power supply network, along which there are five 132kV substations and two 230 kV substations.

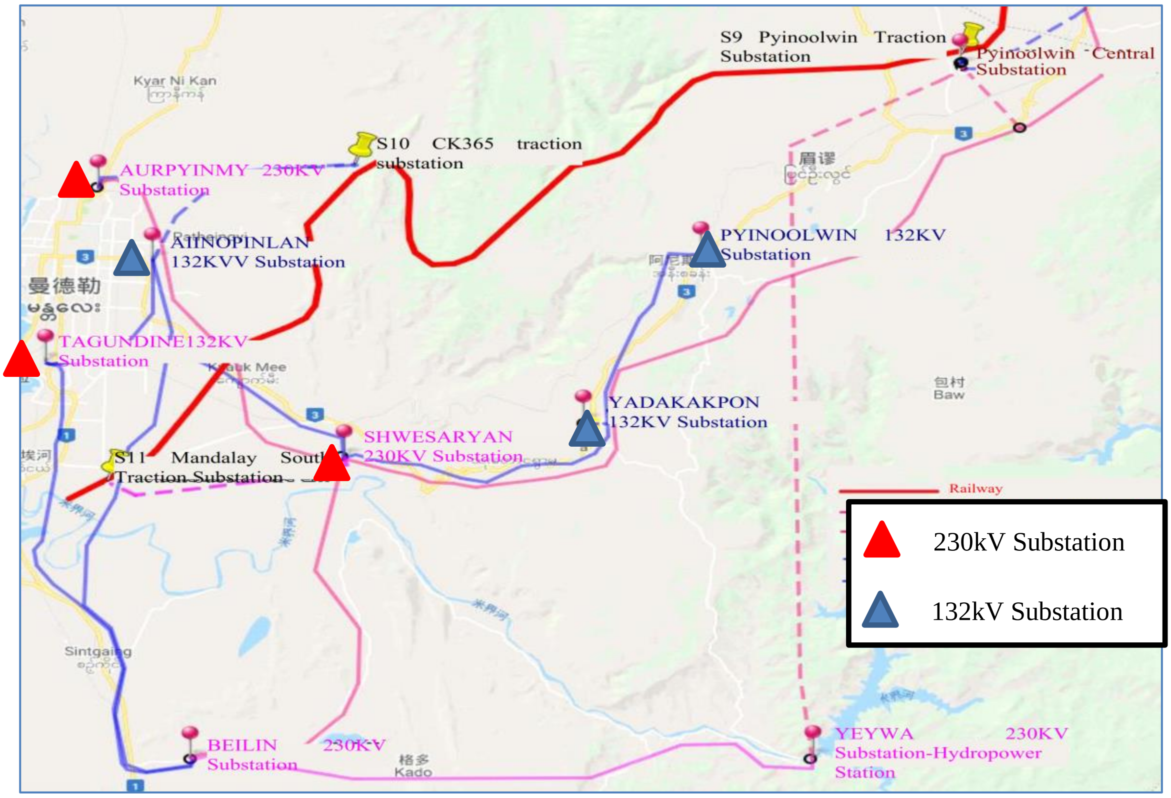


Figure 4.23 - Schematic diagram of power supply for Mandalay

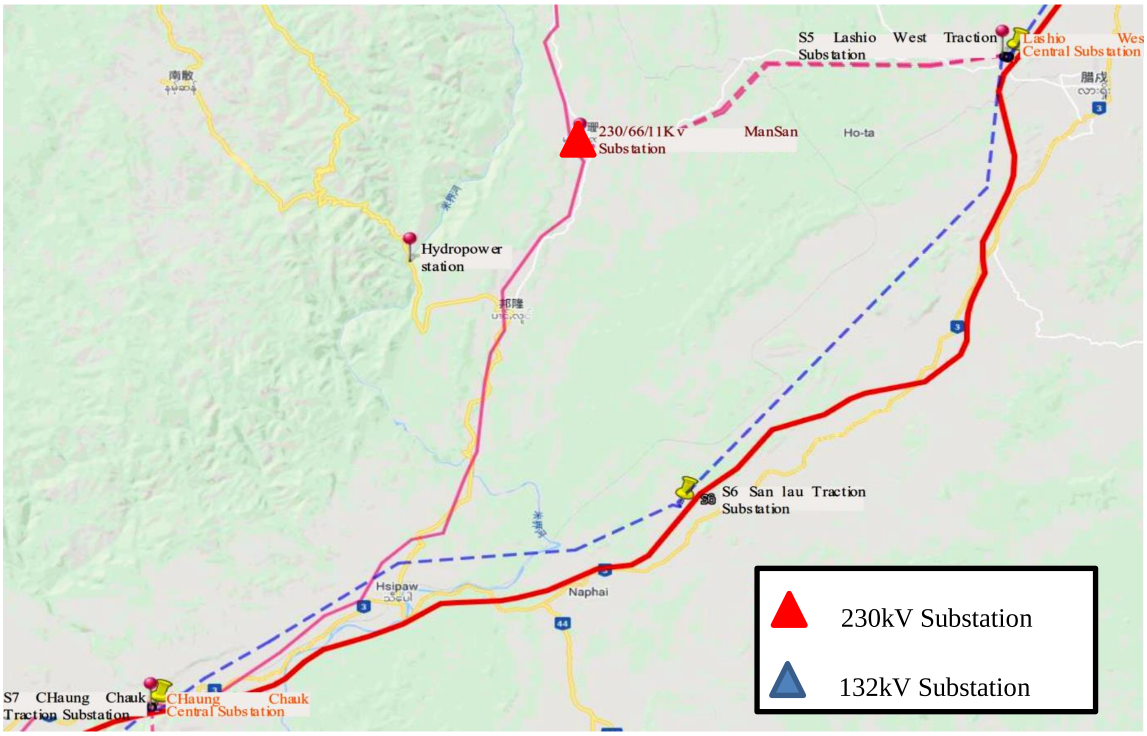


Figure 4.24 - Schematic diagram of power supply between Chaung Chauk and Lashio West Central Substations

(b) Power source and power supply equipment of electrified railway

The proposed railway is electrified, and the local power distribution network construction is under construction. Eleven traction substations along Muse-Mandalay railway are scheduled to be built for the near future, as detailed in the table below.

Table 4.8 - List of the proposed traction substations

Traction substation location	Traction substation power source
Muse traction substation	132kV
Nam Hpak Ka traction substation	230kV
Man peng traction substation	132kV
Theinni traction substation	132kV
Lashio West traction substation	230kV
San lau traction substation	132kV
Chaung Chauk traction substation	230kV
Nawng Hkio traction substation	132kV
Pyinoolwin traction substation	230kV
CK365+000traction substation	132kV
Mandalay South traction substation	230kV

4.4.9.2. Electrical Load

(a) Load distribution and load level

(1) Distribution of power load

Power supply points of the whole line will be mainly distributed in station, yard, substation and the tunnel in the sections where lighting and ventilation are required. Load will be for communication, signaling, information and infrared axle temperature detection devices, locomotive maintenance and water supply and drainage equipment, air conditioning, ventilation and indoor and outdoor lighting, etc in the stations along the line.

(2) Load level

According to the importance of electric load for railway operation in this project and the requirement of allowable blackout time for each load, the electric load is classified as follows: First class load will be for communication, signaling, operation dispatching system and real-time information equipment in station closely related to railway operation and management; operation power supply for substations of electric power and electrification; emergency lighting for tunnel and station; automatic fire alarm system equipment and disaster prevention and safety monitoring system equipment; automatic fare collection system; firefighting equipment in station building, etc.; disaster prevention and rescue equipment in emergency rescue station . Second class load will be station lighting, OCS switch, maintenance equipment in the comprehensive working area, water supply and drainage and sewage treatment equipment, ventilation equipment for tunnel operation, disaster prevention and rescue equipment (tunnel refuge and emergency exit), ordinary elevator and escalator, and special air conditioners for the main equipment of communication and signaling, etc. Third class load will be advertising lighting, air conditioning refrigeration and water system equipment, electric heating equipment and other lighting, power and electric equipment that do not belong to the first class and the second class loads.

(b) Load estimation

Based on the equipment type, load capacity and power requirements provided by the relevant disciplines and the load level specified in the specifications, incorporating the data of bridge length, tunnel length, buildings, station and yard, etc., the load will be estimated. The table for main electrical load for typical stations along the line is as follows.

Table 4.9 - Main electrical load at typical stations of the whole line

Typical station	Water supply section	Comprehensive maintenance	Infrared for axle temperature	Signaling	Communi-cation	Information application	Indoor and outdoor lighting	Other power	Total
Intermediate station	78	204	5	20	10	35	105	210	667
Passing station	22	0	0	20	7	5	43	180	277
Intermediate station (freight yard)	78	284	5	20	10	35	158	282	872

General Layout for Transmission Line

Conductor and Earth Wire

(1) Conductor

Steel-cored aluminium stranded wires are recommended for conductor of overhead lines in this project. The conductor has a safety factor of 2.5, a design safety factor of 2.25 at suspension points, and an annual average running tension of 25%.

(2) Earth Wire

Double earth wire erection method is recommended for design where aluminium conductors are arranged at one side of two earth wires and OPGW optical cables are arranged on the other side.

The design safety factor of the earth wire shall not be smaller than that of the conductor, and the distance between the conductor of the central span and the earth wire shall meet the following requirement:

$$\mathbf{S \geq 0.012L+1}$$

Where,

S = Distance between the conductor and the earth wire (m)

L = Span (m)

Calculation conditions: temperature+25°C, no wind.

The recommended design safety factor is 3.0.

The double-circuit power transmission line of the project is provided with an iron tower with double earth wires, where aluminium conductors are arranged at one side and OPGW optical cables are arranged on the other side. The iron tower with the single earth wires and OPGW optical cables are used for single-loop power transmission lines.

To prevent breeze vibration from damaging the conductor and earth wire, dampers are recommended for anti-vibration protection for the conductors and the earth wires in this project.

(3) Insulation Coordination

Insulation coordination is designed for this project according to the upper limit of Class II polluted zone and the creep age distance is 2.5 cm/kV.

According to the insulation materials, insulators used for power transmission and distribution lines can be mainly divided into three types, namely, porcelain insulator, glass insulator and composite insulator. Although composite insulators have light weight, good pollution-proof performance and strong resistance to external forces, their performance deteriorates greatly for far-future operation in high altitude areas with high UV. Their insulator strings are light and are not applicable for preventing wind age yaw flashover. Generally, composite insulators should be used with caution. Therefore, composite insulators are not recommended for this project. Although toughened glass insulators have good mechanical and electrical performance and self-shattering, and is easy for maintenance and difficult to deteriorate, their high self-explosion rate increases the potential safety hazard of the lines, and are not recommended for this project. Porcelain insulators have advantages of easy manufacturing, low cost and good electrical insulation and mechanical properties.

The safety factors of the mechanical strength for insulators used in this project shall meet the requirements shown in the following table.

Table 4.10 – Safety Factors of the Mechanical Strength for Insulators

Item	Maximum service load	Sustained load	Wire failure	Disconnection	Checking calculation
Safety coefficient	2.7	4.0	1.8	1.5	1.5

(4) Lightning Protection and Grounding

Under the conditions of no wind and ice at 15°C, the distance between the conductor of the central span and the earth wire shall meet the requirements of $S \geq 0.012 L+1$. All iron towers along the line are grounded by foundation. Each iron tower is laid with an artificial earthing device which uses a shallow-buried horizontal radiation earthing body. The earthing body is made of 10 ϕ10 galvanized round steel, and the lead-down wire is made of ϕ12 galvanized round steel. All the four tower legs of the iron towers connect with the earthing body. The horizontal earthing device is shown in the following figure.

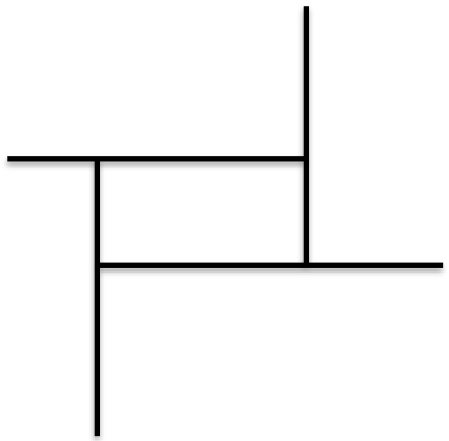


Figure 4.25 – Schematic Diagram of Laying a Horizontal Earthing Device

If the soil resistivity of some sections along the line is relatively high, it is difficult for the earthing resistance to meet the standard requirements if a common earthing arrangement is used. In this case, comprehensive resistance reduction measures can be taken, such as extending horizontal earth wire, adding resistance reducing agent, and **using** resistance reducing module to reduce tower earthing resistance to meet related requirements.

The value of the unearthed power frequency earthing resistance for towers with earth wires along the line shall not be greater than the value specified in the following table.

Table 4.11 – Unearthed Power Frequency Earthing Resistance for Poles with Earth Wires

Soil sensitivity (Ω·m)	≤ 100	100 to 500	500 to 1000	1000 to 2000	>2000
Power frequency earthing resistance (Ω)	10	15	20	25	30*

Note: * If the soil resistivity exceeds 2,000 Ω•m and it is difficult for the earthing resistance to drop to 30 Ω, six to eight radial earthing bodies or continuously extending bodies with a total length not exceeding 500m can be used without affecting the earthing resistance.

(5) Insulator Strings and Fitting

The safety factor of the fitting strength shall meet the following requirements:

- The safety factor is not smaller than 2.5 under maximum service load.
- The safety factor is not smaller than 1.5 in cases of wire fault, disconnection and checking calculation.

The suspension insulator strings and jumper strings of the general section in this project use single-link connection. For important cross spans, the suspension insulator strings use double-link connection and double wire clamps. Tension insulator strings use single-link connection for incoming and outgoing spans of the substation and other tension insulator strings use double-link connection.

(6) Conductor Transportation

For the overhead transmission lines in this project, the length of the lines in each section does not exceed 100km, requiring no transportation.

Table 4.12 – Engineering Quantities of Transmission Line Projects

Project Item	Unit	Qty.
Single-circuit 132kV transmission line	km	325.2
Double-circuit 132kV transmission line	km	63.7

Single-circuit 230kV transmission line	km	114.6
Double-circuit 230kV transmission line	km	100.9

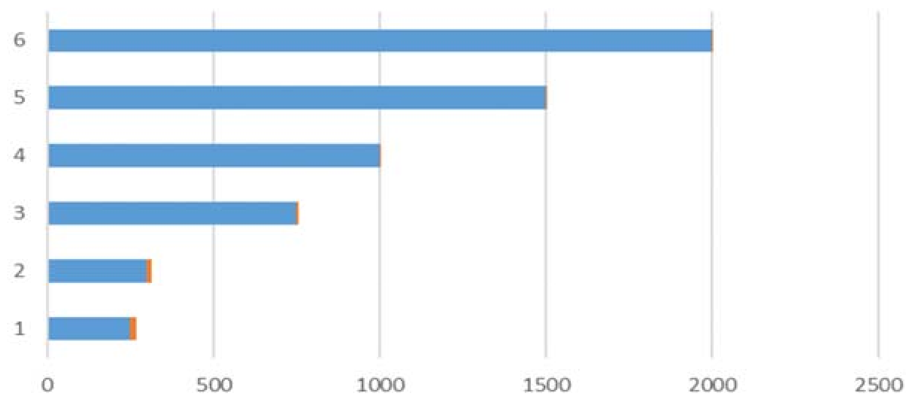
4.4.10. Waste Generation and Discharge

Activity	Waste Generation
Pre-construction Phase	
Site Clearing	Dust Generation
	Gaseous Emission from Construction Equipment
	Spillage of Fuel oil and Lubricants
	Domestic wastes from worker camp
Construction Phase	
Construction Activities	Dust Generation
	Gaseous Emission from Construction Equipment
	Spillage of oils, lubricants and paint
	Construction Debris
	Seepages from construction waste dump site
	Domestic wastes from worker camp
Operation and Maintenance Phase	
Maintenance Activities	Spillage of oil and grease through maintenance activities
	Paint residue for maintenance of station

Estimation Volume of Waste Generation

The volume of spillage of oils, lubricants and paint, construction debris and seepage from construction waste dump site is under controlled.

Dust Generation Volume Estimation



	1	2	3	4	5	6
Mixing Height (m)	250	300	750	1000	1500	2000
Dust Concentration,C (mg/m3)	17.07	14.23	5.69	4.23	2.85	2.13

Gaseous Emission

Emission Estimation Result (ton/yr)

Total Emission Estimation Result (ton/yr)						
VOC tons/yr	CO tons/yr	NOx tons/yr	PM-10 tons/yr	PM-2.5 tons/yr	SO2 tons/yr	CO2 tons/yr
2.599	10.034	22.811	2.005	1.952	2.931	2125.647

Average daily wastewater flow from worker

Project Phase	Total Number of Worker (each unit of work)	Daily Wastewater Flow (gal/person/day)	Daily Wastewater Flow (gal/ /day)
Pre-construction and Construction	41	50	2050
Operation and Maintenance	7	50	350

Storage and Handling of Hazardous Materials

Zinc based Painting

Handling

Keep away from food, drink and animal feeding stuffs. Handle all packages and containers carefully to minimize spills. Keep container tightly sealed when not in use. Avoid the formation of mists. Do not handle until all safety precautions have been read and understood. Do not handle broken packages without protective equipment.

Storage

It is stored away from incompatible materials. Keep only in the original container. Keep container tightly closed, in a cool, well ventilated place. Keep containers upright. Protect containers from damage. Bund storage facilities to prevent soil and water pollution in the event of spillage. The storage area floor should be leak-tight, jointless and not absorbent.

Quantity

For 100 square feet, 1.38 gal of paint is required.

Waste Disposal Measure during Construction Phase

Construction waste generated by construction shall be recycled and utilized as much as possible. Waste that cannot be utilized shall be transported to designated places or properly disposed. Random stacking and placing are strictly prohibited. Temporary garbage stacking points such as dustbins and garbage bins shall be set up reasonably at construction sites and construction camps, and rain-proof facilities shall be set up to avoid soil, water and ecological environment pollution caused by surface runoff from rain-washed garbage. Household garbage shall be collected and disposed altogether cannot be dumped at free will.

Waste Disposal during Operation and Maintenance

Domestic sewage is to be discharged into septic reservoir, and oily sewage in the tum around depot is settled in oil separation sedimentation reservoir and goes through air flotation and then both of them flow into the integrated MBR sewage treatment equipment. After treatment, they will be reused or discharged nearby. The oil-containing scum in the oil separation reservoir is got out manually and transported outside on a regular basis, and handed over to the local sanitation department for centralized treatment.

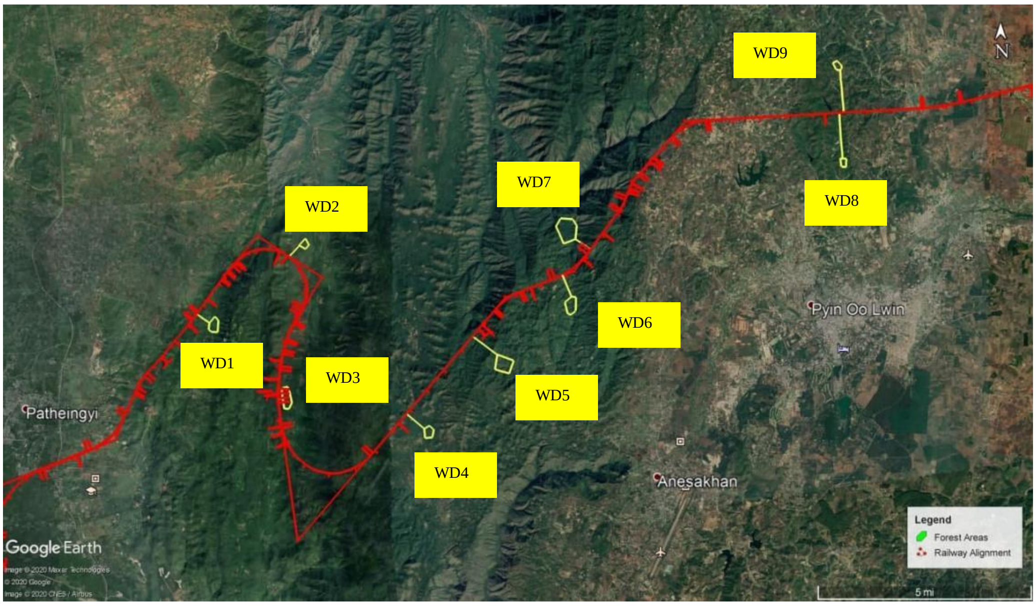
Waste Discharge from Construction Camp

The construction personnel have relatively simple lives, thus their sewage discharges are relatively less with simple pollution behavior, mainly including fecal sewage, kitchen sewage, bath wastewater and other domestic sewage. The waste disposal areas will be determined in the construction stage. The following guidelines are considered for waste disposal for labor camp.

- The distance of pit toilet should be at least 100m away from surface water bodies used for drinking water.
- Sewage should be discharged so it does not enter the catchment of drinking water supplies/intakes., into a stream or into the ocean at any point where it may cause a health risk to camp personnel or nearby communities.
- All drains should be kept covered.

Spoil Ground and Borrow Area

A total of 47 waste sites are selected for the subgrade to meet the problems of project waste dumping and insufficient filler or long transport distance. The spoil ground should not be placed on the unfavorable geological and unstable slopes. The retaining wall should be set at the lock of the spoil ground; the borrow area and spoil ground should be taken for the uniform greening of grass seeds, to prevent soil erosion and protect the environment. Borrow area and spoil ground should avoid occupation of farmland; it is strictly forbidden to abandon the ballast into rivers, reservoirs, bridges, culverts and villages. The waste dumping sites along the railway alignment for the waste management plan are shown in the following figures.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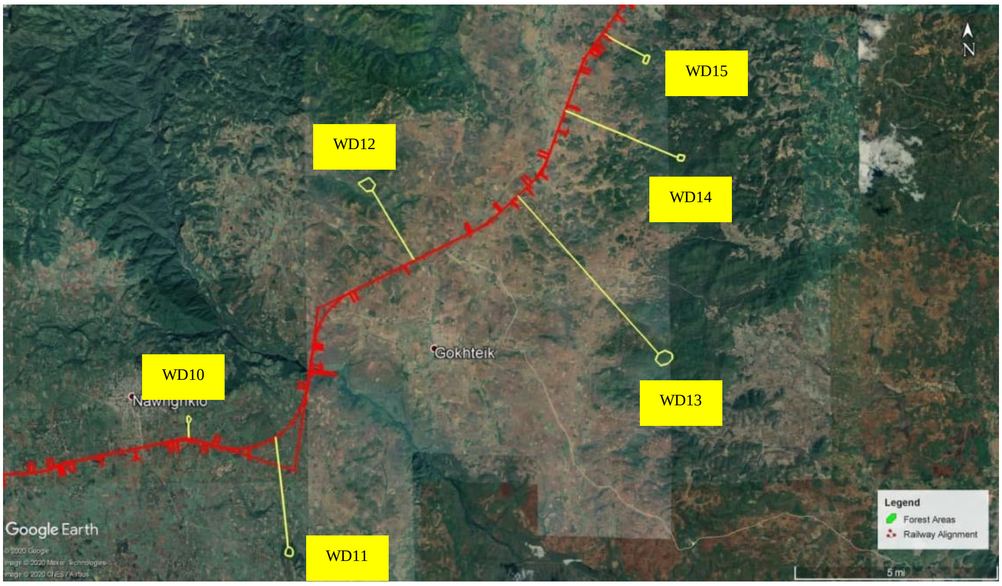
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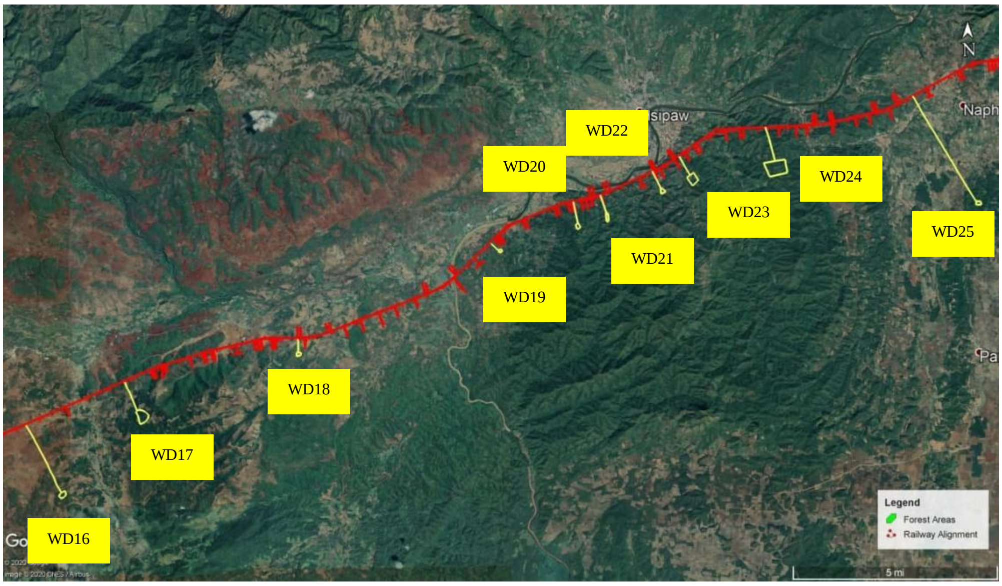
WD22
WD20
WD24
WD23
WD25
WD21
WD19
WD18
WD17
WD16
Legend
Forest Areas
Railway Alignment
5 mi
N


WD28
WD27
WD26
Nawngmawn
Naphai
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Forest Areas
Railway Alignment
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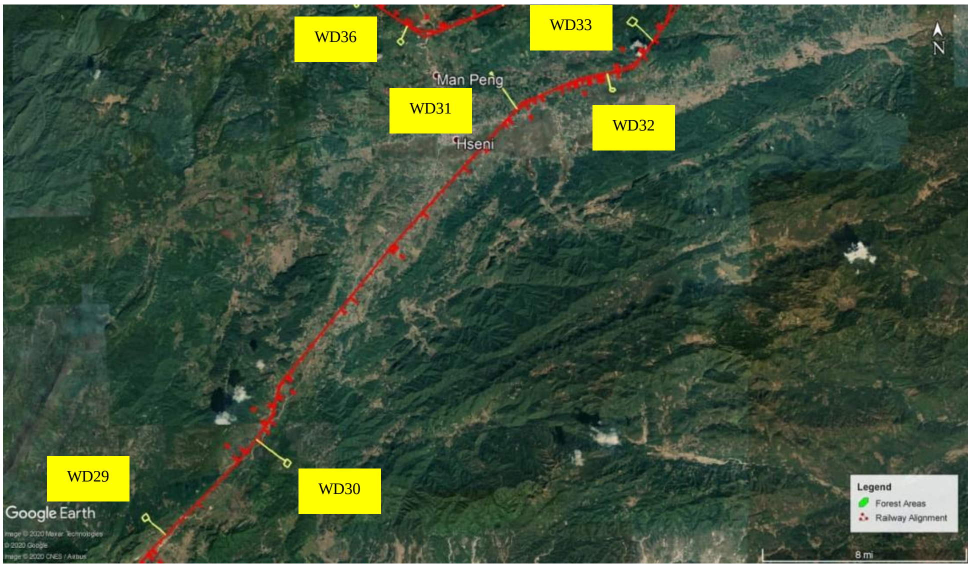
WD36
WD33
Man Peng
WD31
WD32
Hseni
WD29
WD30
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Forest Areas
Railway Alignment
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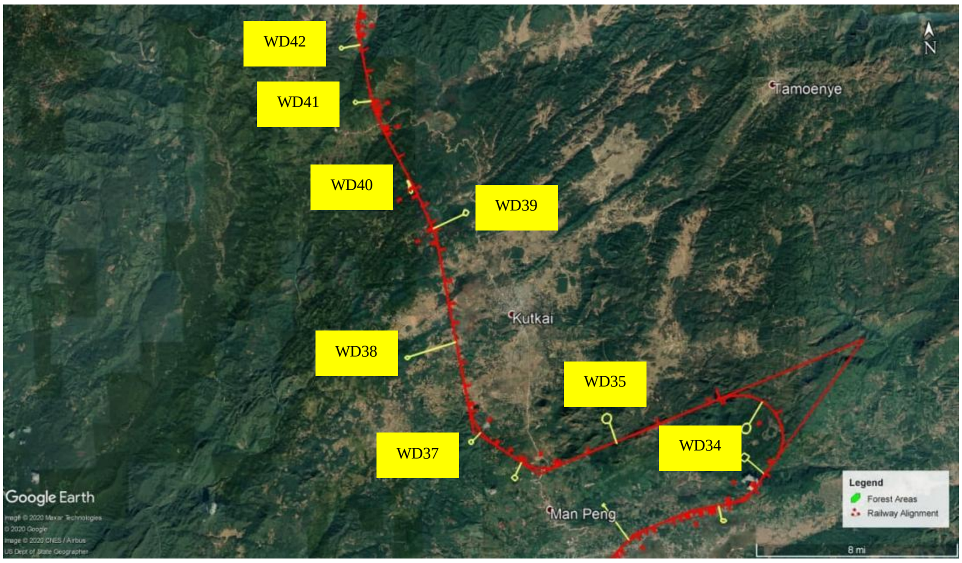
WD42
WD41
Tamoenye
WD40
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Kutkai
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Man Peng
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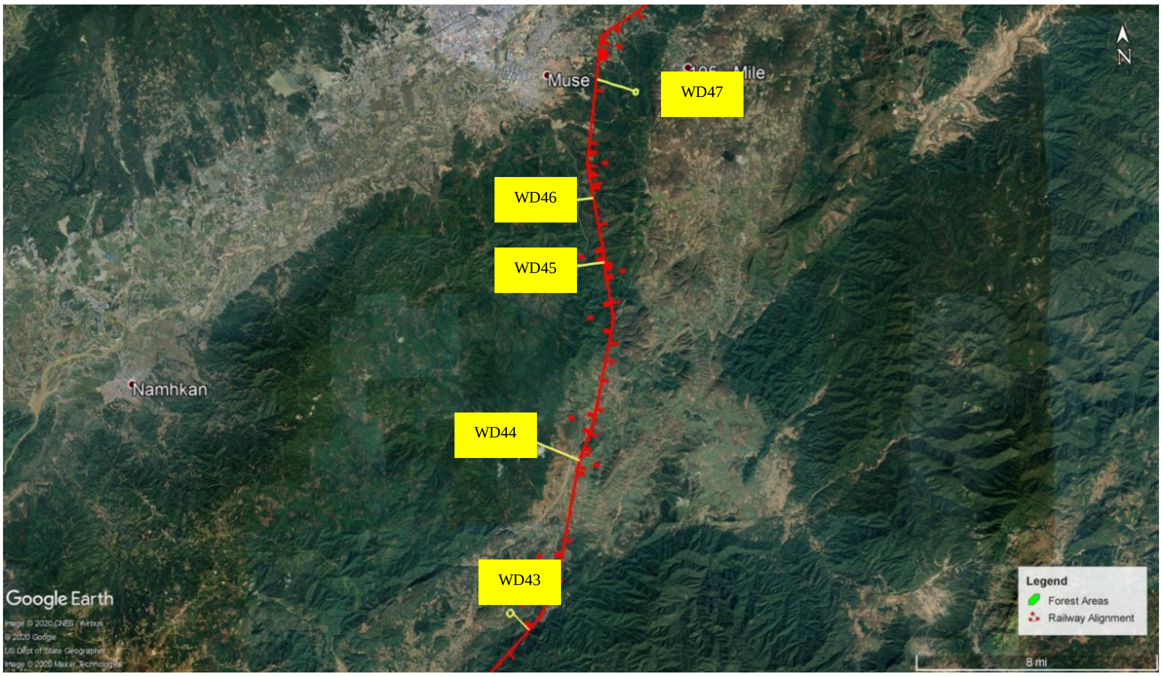


Figure 4.26 – Proposed waste dumping sites along the railway alignment

Table 4.13– The Locations and Capacity of Proposed Waste Dump Areas

Proposed Waste Dump Area			Name of Tunnel	Area of dump area (m^2)	Distance from Alignment (m)	Surrounding Environment (within 1km radius)
ID	Coordinate					
	Latitude	Longitude				
WD-1	22° 1'44.51"N	96°14'20.99"E	Taung Kyun 2, 3 Tunnels & Tok Hka Taung Tunnels	178,800	646.89	Forest Area Monastery(0.95km)
WD-2	22° 3'23.68"N	96°16'21.39"E	Taung Kyun 1 Tunnel	77,236	574.70	Forest Area
WD-3	22° 0'14.34"N	96°15'56.05"E	Sakangyi 1 & 2 Tunnels	227,209	173.22	Forest Area
WD-4	21°59'31.60"N	96°19'8.06"E	Sakangyi 1 Tunnel	127,860	914.25	Forest Area Cropland (0.21km)
WD-5	22° 0'54.56"N	96°20'48.49"E	Sakangyi 1 Tunnel, Sin Byu In 3 Tunnel	328,268	1,162.62	Forest Area
WD-6	22° 4'56.30"N	96°28'13.66"E	Pyinoolwin Tunnel	62,071	892.14	Forest Area Cropland (0.47km)
WD-7	22° 2'5.45"N	96°22'16.21"E	Pyinoolwin Tunnel	213,713	762.55	Forest Area
WD-8	22° 3'37.43"N	96°22'12.03"E	Sin Byu In 1 & 2 Tunnels Pyinoolwin Tunnel	551,353	1,654	Forest Area
WD-9	22° 6'53.70"N	96°28'6.03"E	Pyinoolwin Tunnel	71,366	1,532.68	Forest Area

WD-10	22°19'23.13"N	96°49'18.64"E	Ko San 2 Tunnel	31,067	560.46	Vacant Land Cropland (0.16 km) Nearest Local Residence (0.38 km)
WD-11	22°16'36.81"N	96°51'36.35"E	Ko San 1 Tunnel	79,869	4,292.30	Vacant Land Cropland (0.38 km) Monastery (0.22 km)
WD-12	22°24'17.81"N	96°53'27.99"E	Kyaung Gone Tunnel	206,667	3,160.35	Forest Area Cropland (0.57km
WD-13	22°20'35.78"N	97° 0'8.43"E	Kyaung Gone Tunnel & Myin Gwin Tunnel	258,047	8,234.56	Vacant Land
WD-14	22°24'46.77"N	97° 0'34.28"E	Myin Gwin Tunnel	52,098	4,767.70	Vacant Land
WD-15	22°26'50.84"N	96°59'49.06"E	Man Loi 1, 2, 3 & Long Wai Tunnels	57,118	1,849.24	Vacant Land Cropland (0.45 km)
WD-16	22°31'3.03"N	97° 6'34.64"E	Kyaukme & Chaung Chauk Tunnels	160,794	3,060.14	Forest Area Cropland (0.84 km)
WD-17	22°29'26.17"N	97° 4'42.71"E	Kyaukme Tunnel	46,783	1,216.50	Forest Area Cropland (0.26 km)
WD-18	22°32'19.05"N	97°10'4.77"E	Kyang Yin 1 & 2 Tunnels	20,657	593.90	Vacant Land Cropland (0.34 km) Nearest Local Residence (0.76 km)
WD-19	22°34'27.88"N	97°14'45.20"E	Baw Gyo 2 Tunnel	12,876	473.38	Forest Area Farmland (0.68 km)
WD-20	22°34'58.61"N	97°16'33.19"E	Baw Gyo 1 & Nalin 2 Tunnels	26,950	845.84	Forest Area
WD-21	22°35'9.38"N	97°17'13.94"E	Nalin 1 Tunnel	30,899	737.19	Forest Area
WD-22	22°35'41.86"N	97°18'31.30"E	Teng Sam 2	26,970	744.05	Forest Area Farm Land (0.35km) Nearest Local Residence (0.82 km)
WD-23	22°35'56.46"N	97°19'13.43"E	Teng Sam 1 & Hsipaw	116,576	858.15	Forest Area Monastery (0.7 km)
WD-24	22°36'9.01"N	97°21'8.91"E	Hsipaw, Hsup Lang, Pang Hsauk 2, 1 & Kong Tha 2 Tunnels	433,763	1,404.22	Forest Area
WD-25	22°35'20.74"N	97°25'46.53"E	Kong Tha 1	27,069	4,875.25	Forest Area Cropland (0.61 km)
WD-26	22°42'3.44"N	97°30'6.19"E	Kong Mon	69,250	613.43	Forest Area Cropland (0.82 km)
WD-27	22°43'21.58"N	97°31'46.72"E	Nam Um & Sint Eng 2	40,054	254.15	Forest Area Cropland (0.37 km) Stream (0.66 km)
WD-28	22°44'54.68"N	97°34'39.69"E	Sint Eng 1	74,285	361.22	Forest Area Cropland (0.9 km)
WD-29	23° 5'8.68"N	97°46'8.72"E	Hang Lu	129,096	1.477.89	Vacant Land

WD-30	23° 6'55.23"N	97°51'27.52"E	Hang Lu	136,470	2,405.28	Vacant Land
WD-31	97°51'27.52"E	97°59'21.80"E	Laban Pa	20,272	2,763.98	Vacant Land Cropland (0.56 km)
WD-32	23°19'38.12"N	98° 3'55.84"E	Nawng Yen 3 & 2	60,087	965.09	Vacant Land Cropland (0.4 km) Nearest Local Residence (0.76 km)
WD-33	23°21'53.49"N	98° 4'39.70"E	Nawng Yen 2 & 1	230,834	1,586.95	Forest Area Nearest Local Residence (0.91 km)
WD-34	23°22'54.10"N	98° 4'43.24"E	Nawng Yen 1 & Man Peng 2	282,422	1,674.56	Forest Area Nearest Local Residence (0.89 km)
WD-35	23°23'21.95"N	97°59'28.18"E	Man Peng 2 & 1	278,026	1,498.39	Forest Area Cropland (0.38 km)
WD-36	23°21'20.37"N	97°55'59.96"E	Man Peng 1	90,647	921.66	Vacant Land Cropland (0.3 km)
WD-37	23°22'37.28"N	97°54'22.62"E	Kutkai 3	59,748	719.29	Forest Area
WD-38	23°25'33.51"N	97°52'2.54"E	Kutkai 2	44,590	3,135.47	Forest Area Cropland (0.55 km)
WD-39	23°30'31.06"N	97°54'19.24"E	Kutkai 1, Peng Nin 3 & 2	92,740	2,149.45	Forest Area Lashio-Muse Road (0.89 km) Nearest Local Residence (0.76 km)
WD-40	23°31'28.18"N	97°52'14.49"E	Pang Nin 2 & 1	124,261	89.41	Forest Area Nearest Local Residence (0.9 km)
WD-41	23°34'25.20"N	97°50'13.87"E	Nam Hpak Ka 2	44,636	925.05	Forest Area Cropland (0.43 km) Stream (0.83 km)
WD-42	23°36'18.69"N	97°49'43.54"E	Nam Hpak Ka 2 & 1	41,660	1,132.07	Forest Area Cropland (0.91 km)
WD-43	23°43'14.72"N	97°52'49.96"E	Na Hpai	100,314	1,200.62	Vacant Land Cropland (0.44 km)
WD-44	23°48'20.42"N	97°53'12.50"E	Pang Hkam 2	73,880	3,364.99	Forest Area
WD-45	23°53'8.60"N	97°54'21.58"E	Pang Hkam 2 & 1	159,443	2,498.14	Forest Area
WD-46	23°55'3.39"N	97°54'22.02"E	Pang Hkam 1, Muse 4, 3 & 2	190,667	1,960.45	Forest Area
WD-47	23°58'11.90"N	97°57'3.12"E	Muse 2 & 1	56,607	2,061.70	Vacant Land Cropland (0.4 km)

4.4.11. Water Usage and Discharge for Muse-Mandalay Proposed Project

Production sewage and domestic sewage discharged from water discharge points of various stations along the line will be processed as per relevant sewage treatment processes which are determined according to the requirements of the sewage composition, discharge volume and requirements of the receiving water body near the outlet, and should only be discharged after qualified. The treatment technique should be unified to provide convenience for operation and maintenance.

Name of water station	Domestic water consumption	Sewage discharge	Water source	Wastewater treatment
Man Hawng	$19m^3/d$	$8m^3/d$	Underground water	integrated MBR (Membrane Bio-Reactor) sewage treatment device
Nam Hpak Ka	$62m^3/d$	$56m^3/d$	Underground water	integrated MBR sewage treatment device
Kutkai	$26m^3/d$	$16m^3/d$	Underground water	integrated MBR sewage treatment device
Man peng	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Nawng yen	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Theinni	$34m^3/d$	$22m^3/d$	Underground water	integrated MBR sewage treatment device
Hang lu	$13m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Lashio West	$140m^3/d$	$98m^3/d$	Municipal water	integrated MBR sewage treatment device
Mehan	$24m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Nam un	$16m^3/d$	$9m^3/d$	Underground water	integrated MBR sewage treatment device
Sam lou	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Hsipaw	$62m^3/d$	$38m^3/d$	Underground water	integrated MBR sewage treatment device
Chaung Chauk	$26m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Kyaukme	$70m^3/d$	$49m^3/d$	Underground water	integrated MBR sewage treatment device
Myin Gwin	$29m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Nawng Hkio	$53m^3/d$	$30m^3/d$	Underground water	integrated MBR sewage treatment device
Gan gaw	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Pyinoolwin	$110m^3/d$	$81m^3/d$	Underground water	integrated MBR sewage treatment device
Sin byu in	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Taung Kyun	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device
Tok hka taung	$9m^3/d$	$8m^3/d$	Underground water	integrated MBR sewage treatment device

4.4.12. Temporary Engineering

The temporary engineering includes yards for pre-casting, construction camp and construction road.

4.4.12.1. Temporary material yard and Construction Camp

The construction yard of the project is mainly located at the portal of tunnel, both ends of the bridge and the working points of each concentrated subgrade section. Some construction camps are arranged in combination with the beam yard, track-laying base, sleeper precast yard, concrete mixing station, filling centralized mixing station and other temporary works and some construction camps are solved by renting local houses. The specific location and number of construction camps will be determined in the construction stage.

For new freight yards, the required area of facilities such as storage yard and warehouse shall be calculated by area method in accordance with the description of goods, loaded/unloaded at freight yards and the volume of various goods arrived and shipped; besides, the freight yards shall be designed in the light of concrete circumstances and the topography and urban planning.

- Cargo warehouse

  In general, a warehouse with a span of 12m, 15m or 18m is adopted according to the designed rows for stockpiling goods and the topographical and geological conditions. A larger span shall be selected in case of large traffic capacity and mechanical uploading/unloading. Large spaces such as cargo warehouses and maintenance factory buildings are preferably constructed of reinforced concrete bents or steel structures.

- Storage yard

  Its length is generally an integral multiple of 14m and its width may be selected from the range of 4.0m – 16.0m depending on the specific conditions.

Temporary material yard is to be provided in Shwe Li East, China, Lashio and Mandalay Myanmar. The proposed locations for the construction of labor camps and storage areas are shown in the following figure and table.

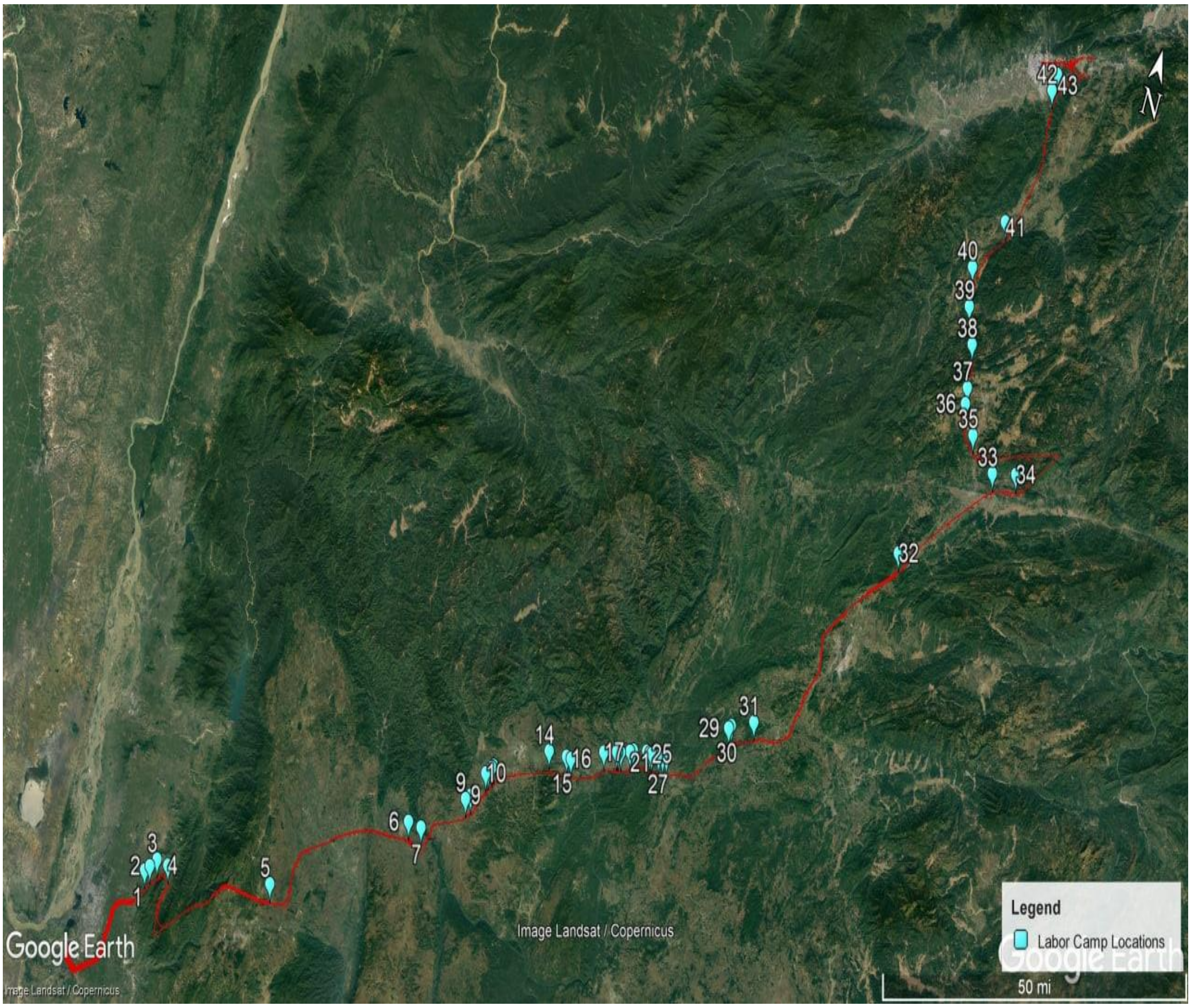


Figure 4.27 – Locations of Labor Camps and Storage Areas for the proposed project

Table 4.14 – Locations of Labor Camps and Storage area along the proposed project area

Labor Camps	Coordinates	
	Latitude	Longitude
LC 1	22° 1'4.62"N	96°13'7.01"E
LC 2	22° 1'44.85"N	96°13'43.40"E
LC 3	22° 2'44.33"N	96°14'32.10"E
LC 4	22° 2'45.00"N	96°16'20.47"E
LC 5	22° 6'22.18"N	96°31'47.77"E
LC 6	22°18'57.28"N	96°49'21.06"E
LC 7	22°19'2.94"N	96°51'21.38"E
LC 8	22°23'52.45"N	96°56'40.72"E
LC 9	22°24'25.91"N	96°57'16.61"E
LC 10	22°27'12.82"N	96°58'38.49"E
LC 11	22°27'30.16"N	96°58'54.72"E
LC 12	22°28'0.90"N	96°59'18.50"E
LC 13	22°28'16.31"N	96°59'30.48"E

LC 14	22°32'20.01"N	97° 6'55.03"E
LC 15	22°32'40.52"N	97° 9'36.26"E
LC 16	22°32'41.29"N	97°10'19.14"E
LC 17	22°34'53.78"N	97°14'48.26"E
LC 18	22°35'32.77"N	97°16'36.42"E
LC 19	22°35'35.14"N	97°16'48.85"E
LC 20	22°35'42.00"N	97°17'14.45"E
LC 21	22°36'14.07"N	97°18'31.71"E
LC 22	22°36'30.17"N	97°18'59.33"E
LC 23	22°37'3.79"N	97°20'55.79"E
LC 24	22°37'3.58"N	97°21'26.75"E
LC 25	22°37'3.61"N	97°21'44.66"E
LC 26	22°37'11.53"N	97°22'48.90"E
LC 27	22°37'18.93"N	97°23'26.01"E
LC 28	22°37'29.52"N	97°23'57.75"E
LC 29	22°43'11.29"N	97°31'52.19"E
LC 30	22°43'32.54"N	97°32'9.08"E
LC 31	22°44'57.35"N	97°35'16.26"E
LC 32	23° 7'23.81"N	97°49'58.61"E
LC 33	23°19'15.60"N	98° 0'43.41"E
LC 34	23°20'17.71"N	98° 4'13.56"E
LC 35	23°21'46.88"N	97°56'26.98"E
LC 36	23°24'15.92"N	97°54'12.95"E
LC 37	23°25'49.23"N	97°53'55.34"E
LC 38	23°30'1.60"N	97°53'2.82"E
LC 39	23°33'22.78"N	97°51'17.17"E
LC 40	23°37'9.68"N	97°50'21.02"E
LC 41	23°42'52.31"N	97°53'30.28"E
LC 42	23°57'22.69"N	97°55'39.08"E
LC 43	23°59'7.02"N	97°55'53.26"E

4.4.12.2. Health and Sanitation Facilities

Sanitary and toilet facilities are constructed of materials that are easily cleanable. Sanitary facilities are cleaned frequently and kept in working condition. It is designed to provide workers with adequate privacy, including ceiling to floor partitions and lockable doors. An adequate number of toilets are provided to workers in which standard range from 1unit to 15 persons to 1unit per 6persons.

Ventilated Improved Pit Latrine (VIP)

The Ventilated Improved Pit (VIP) latrine is designed to reduce odors and flies to surrounding environment. It comprises of a pit, a cover slab, a superstructure and a well-fixed vent pipe with fly trap/ screen. The principle of operation is that a continuous flow of air comes in through the superstructure and enters the pit through the hole. This airflow will go down into the pit displacing (pushing up) the hot smelly air upward through the vent pipe . A darkened interior is maintained causing insects entering the pit to be attracted towards the light at the top of the vent pipe and trapped by the fly screen.

Construction design of Ventilated Improved Pit Latrine (VIP)

Each ventilation pipe should be vertical, sticking out above the latrine's roof by at least 0.5m. The hole where the vent pipe comes through thr roof should be made water tight to avoid leaks. To ensure a better anchorage of the plastic vent pipe at the bottom, a clamp can be connected at the level where it will be mortared in the slab.

The separation in individual pit compartments by solid walls going from the bottom until the top of the pit is needed to avoid cross-ventilation of the air movement between the different defecation holes, which would hamper the VIP ventilation principles. This means as well that every single compartment of the VIP latrine should have its own ventilation pipe.

When PVC pipes are used as a vent pipe, their diameter should ideally be 150mm and at least 110mm. Having a dark colored vent pipe at the outside of the superstructure and oriented towards the sun might allow a better ventilation of the latrine during wind still days, but complicate the construction.

The fly screen on the top of the vent pipe must be stainliess stell, aluminium or PBVC coated fiberglass, because the gasses escaping from the latrine are very corrosive to mild metal. If really nothing else is available, painted metal mesh is the last option.

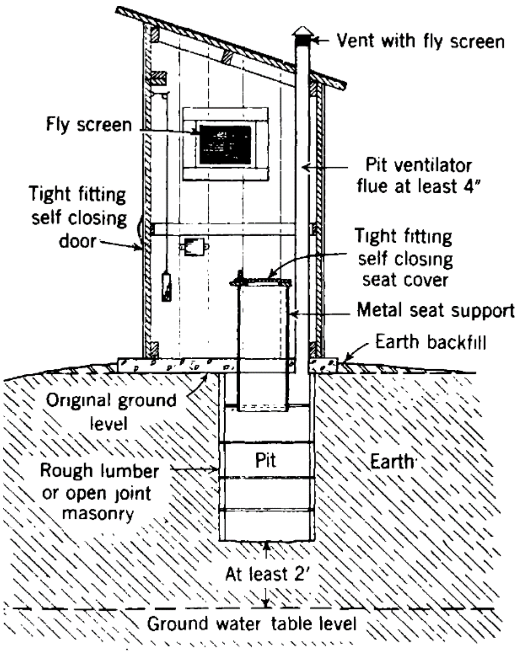


Figure- Example of Ventilation Improved Pit Latrine

4.4.12.3. Access Road Construction

The construction road is a permanent or temporary vehicle transport passageway for railway construction. It also takes into consideration the maintenance of equipment, emergency rescue or local needs after the operation of the railway.

Design Principles

1) The construction road should be designed according to the distribution of key projects and traffic condition along the line, combined with material supply plan, transportation equipment conditions and local road development plan. When the construction road is used as the railway operation and maintenance passageway, as the road to the station (substation) or is included into the local road development planning, it should be designed in accordance with the principle of combination of permanent and temporary usage.
2) The construction road should be designed according to the traffic volume and topographic conditions, referring to the relevant highway design specifications. Access road on soft soil foundation should meet the requirements of deformation and stability.
3) Pavement standards can be selected according to topographic conditions, climatic conditions, traffic volume and local material sources

Classification

Based on the traffic function, it can be divided into trunk road and link line. The trunk road is the main road for construction transportation, and generally serves for multiple construction site; the link line is the secondary road for construction transportation, which is connected with the trunk road, and generally leads to a single or two earthwork sites, bridges, tunnel work zones, station buildings, earth and stone borrowing and spoil yards, sand and stone yards, traction substations, communication base stations, temporary stations and longitudinal transport roads within the construction site.

Usage

Construction roads can be divided into temporary construction roads or construction roads to be used both temporarily and permanently based on its usage.

(1) Temporary construction road

Survey and construction access roads (transportation of large-scale equipment, bridge paving and erection, material and slag transfer, etc.) are temporary used for railway construction.

(2) Construction roads to be used both temporarily and permanently reserved due to disaster prevention and rescue, operation and maintenance or local requirements, are used in the early stage for railway survey, design and construction, and in the later stage for railway disaster prevention and rescue, operation and maintenance or as local roads.

Technical standard

The main technical standards for construction roads are shown in the following table.

Table – Main technical standards for construction roads

Item		Truck road		Link road	
Designed speed (km/h)		40	30	30	20
Subgrade width (m)	Single-lane	/	4.5	4.5	4.5
	Double-lane	8.5	7.5	7.5	6.5
Pavement width (m)	Single-lane	/	3.5	3.5	3.5
	Double-lane	7	6.5	6.5	6
Minimum curve radius (m)		60	30	30	18
Maximum vertical grades (%)		7	8	8	9

The project is to build 824 km of construction road, 2km of construction access bridge, 16 km of access road for beam transport.

The construction trunk roads of this project are connected with local roads, which improve the local road network and improve the road capacity. The construction link lines can connect with the local villages, farmland and other places to meet local residents' travel or crop transportation needs.

Access Road for Operation and Maintenance

Design Principles

1) When the railway is located near the existing road, the existing road along the line is used as the access road for operation and maintenance. If the existing road standard does not meet the requirements, reconstruction and expansion should be carried out.
2) Areas far away from existing roads but near the stations should utilize the roads to station and substations as the access road for operation and maintenance.

3) In-section areas far away from the existing roads should utilize the construction road as the access road for operation and maintenance. When there is no construction road, it is necessary to build a new road as the access road for operation and maintenance.

Technical standards

The operation and maintenance passageway of this project is designed following the standard of collector road, and in combination with the topographic conditions of the construction site, different design speeds are adopted. For section with small topographic fluctuation and flat terrain, the design speed is 30 km/h and for difficult areas, the speed limit is 20 km/h. the main technical indicators are listed in following table.

Table – Main Technical Standards

S/N	Design speed		30 km/h	20 km/h
1	Minimum radius of curve (m)	General value	65	30
		Limit value	30	15
2	Minimum length of transition curve (m)		25	20
3	Minimum radius without super-elevation (m)	Crown ≤2%	350	150
		Crown >2%	450	200
4	General minimum radius of convex vertical curve (m)	General value	400	200
		Limit value	250	100
5	General minimum radius of concave vertical curve (m)	General value	400	200
		Limit value	250	100
6	Length of vertical curve (m)	General value	60	50
		Minimum value	25	20
7	Maximum vertical grades (%)		16	16

The project newly builds 297.943km of access road for operation and maintenance, including 12.38km of road to station and substation, 275.4km of construction road and 10.163km reconstructed road.

4.4.13. Material, Plant and Equipment

The materials used in proposed project are described below.

Name	Unit	QTY
(I) New traction substation (middle-type + overhead outgoing line GIS)	**Nr.**	**11**
230kV AH incoming line supporting-structure installation H=10m Lp=16m	set	10
230kV H intermediate supporting-structure installation H=10m Lp=16m	set	22

230kV Π terminal supporting-structure installation H=10m Lp=16m	set	22
132kV AH incoming line supporting-structure installation H=10m Lp=16m	set	20
132kV H intermediate supporting structure installation H=10m Lp=16m	set	20
132kV Π terminal supporting-structure installation H=10m Lp=16m	set	16
132kV standard traction substation (2 incoming 4 outgoing) supporting-structure installation	Nr.	4
Traction substation with through power (3 incoming 4 outgoing) supporting-structure installation	Nr.	3
Supporting-structure installation for 230kV traction substation to be jointly built with local substation	Nr.	4
Supporting-structure installation for traction substation of junction station (2 incoming 10 outgoing)	Nr.	2
Foundation treatment	Nr.	11
Substation equipment and supporting-structure foundation pouring	Nr.	11
230/27.5kV traction transformer installation	set	10
132/27.5kV traction transformer installation	set	12
230/11kV power transformer installation	set	2
132/11kV power transformer installation	set	12
230kV circuit breaker installation	set	12
132kV circuit breaker installation	set	22
230kV voltage instrument transformer installation	Nr.	30
132kV voltage instrument transformer installation	Nr.	45
230kV current instrument transformer installation	Nr.	36
132kV current instrument transformer installation	Nr.	90
230kV disconnecting switch mounted on the pillar (three-pole)	set	26
132kV disconnecting switch mounted on the pillar (three-pole)	set	58
230kV surge arrester installation	one/set	30
132kV surge arrester installation	one/set	42
27.5kV surge arrester installation	two/set	74
Disconnecting switch mounted on the post (27.5kV single pole)	set	30
Installation of indoor bipolar load switch (27.5kV)	set	11
Installation of indoor tripole load switch (11kV)	set	11
27.5kV anti-lightning ring and surge arrester installation	set	30
Lightning rod installation	set	44
Installation of protective mesh/fence self-use transformer room in substation	Increase/decrease one interval	22
Installation of self-use transformer in three-phase substation (27.5kV and 11kV)	set	14
Installation of 27.5kV overhead outgoing line GIS circuit breaker cabinet	set	104
Installation of 27.5kV bus isolation overhead outgoing line GIS cabinet	set	22

Installation of 27.5kV disconnecting switch overhead outgoing line GIS cabinet	set	11
Installation of 27.5kV voltage instrument transformer and arrest overhead outing line GIS cabinet	set	44
Cable laying direct-supply substation	Nr.	11
Equipment number, brand making, direct-supply substation	Nr.	11
Equipment painting and direct-supply substation	Nr.	11
Pre-electrification test and direct-supply substation	Nr.	11
Commissioning of three-phase transformer system 40000KA	Nr.	22
Commissioning of three-phase transformer system 6300KA (power transformer)	Nr.	14
Commissioning of self-use voltage transformer system in substation three-phase 80kVA	set	22
Commissioning of incoming line system 230kV	set	8
Commissioning of incoming line system 132kV	set	16
Commissioning of feeder line system 27.5kV	set	30
Commissioning of differential protection device for traction transformer	set	22
Commissioning of feeder distance protection device	set	30
Commissioning of battery and DC Device	set	11
Commissioning of auto-reclosing device for transmission line	set	11
Commissioning of integrated automation device	set	11
Commissioning of automatic switching device for standby power supply	set	11
Commissioning of switching device of accident lighting	set	11
On-line monitoring system for oil chromatography	set	36
Commissioning of electroscope	set	72
Commissioning of earthing network	set	11
Commissioning of independent earthing pole	Nr.	11
Installation and commissioning of equipment in high voltage room	Set	11
Commissioning of auxiliary safety monitoring system	station	11
Indoor and outdoor lighting system for traction substation	set	11
Commissioning of interface between microcomputer monitoring disk and remote control communication in the controlled stations	set	11
Commissioning of main body of controlled substation	set	11
Single commissioning of secondary equipment in RTU substation of controlled stations	set	11
Testing of fault recognizing function for controlled station	set	11
Joint commissioning of systems in controlled stations	set	11
(II) Switching Post	**Nr.**	**1**
Installation of 27.5kV box-type switching post	set	1
Installation of disconnecting switch mounted on pillar	set	4
Anti-lightning ring and surge arrester installation	set	4
Cable laying	Nr.	1
Outdoor lighting of for the whole substation	Nr.	1
Installation and commissioning of earthing network	Nr.	1
Testing and commissioning of the whole substation	Nr.	1
Installation and commissioning of safety monitoring system	set	1

(III) OCS isolation switch monitoring	**set**	**50**
Installation of master monitoring station	set	50
Digging and masonry of optical (electrical) cable channel underground 600 x 300 (mm)	hm	842
Insulated and flame-retardant cable bracket	Nr.	57200
Control cable laying 500V 2.5mm^2 7 core	hm	2496
Control cable laying 500V 4mm^2 7 Core	hm	2496
Joint commissioning of systems in controlled stations	station	50
(IV) Traction power supply dispatching center	**Nr.**	**1**
Core switch three-layer Gigabit Ethernet switch	set	2
Dispatch switch three-layer Gigabit Ethernet switch	set	2
Acquisition switch three-layer Gigabit Ethernet switch	set	2
Data server 64-bit RISC frame CPU, UNIX server	set	2
Disk arrays not less than 10TB	set	1
Application server 64-bit RISC frame CPU, UNIX server	set	2
Communication server 64-bit RISC frame CPU, UNIX server	set	2
Repeat application server WINDOWS server	set	1
Dispatch workstation WIN graphics workstation	set	12
Human-machine interface equipment 24” LCD	set	24
Scheduling printer color laser printer	set	1
Maintenance workstation WIN graphics workstation	set	1
Human-machine interface equipment 24” LCD	set	2
Maintenance of printer color laser printer	set	1
Channel interface device configured based on actual interface type	set	2
Satellite clock	set	1
UPS (Containing Battery Cabinet) 40KA	set	1
Low-voltage power distribution panel of distribution cabinet	set	1
Dispatching workbench	set	6
Maintenance workbench	set	1
Server cabinet standard 19” cabinet (including KVM)	set	4
Network cabinet standard 19” cabinet	set	2
Installation of accessories, various cables, etc	set	1
System support software UNIX and WIN operating system and media	set	1
System platform software (support system extension, multi-line access)	set	1
System application software	set	1
Repeating terminal	set	1
Traction power supply maintenance management information system (workshop level)	set	1
Safety monitoring system	set	1

4.4.14. Source and Supply of Materials

Source and Supply of Main Materials (excluding local material)

Muse to Hsipaw Section: OSC column, reinforced concrete sleeper, other materials and other equipment will be firstly transported by the operation train to Shwe Li check point and then to Muse track-laying base and transported to the construction site by work train. **Mandalay to Hsipaw section:** OSC column, reinforced concrete sleeper, other materials and equipment will be first transported by operation train to port of Myanmar, and then shipped to Yangon port of Myanmar, and then transported by meter-gauge railway to Mandalay track-laying base, and to construction site by work train. For steel, wood, cement, etc., material yard along the line will be taken as the starting point, and it will be directly transported to construction site by truck.

Table of Main Engineering Quantities

Item Unit		Unit	Quantities
Electricity	Electric power line	Km	1019.8
	HV overhead line	Km	133.3
	HV truck cable line	Km	356.1
	HV station and yard cable line	Km	124
	Low voltage cable line	Km	406.4
	OCS	Km	713

Source and Supply of Local Material

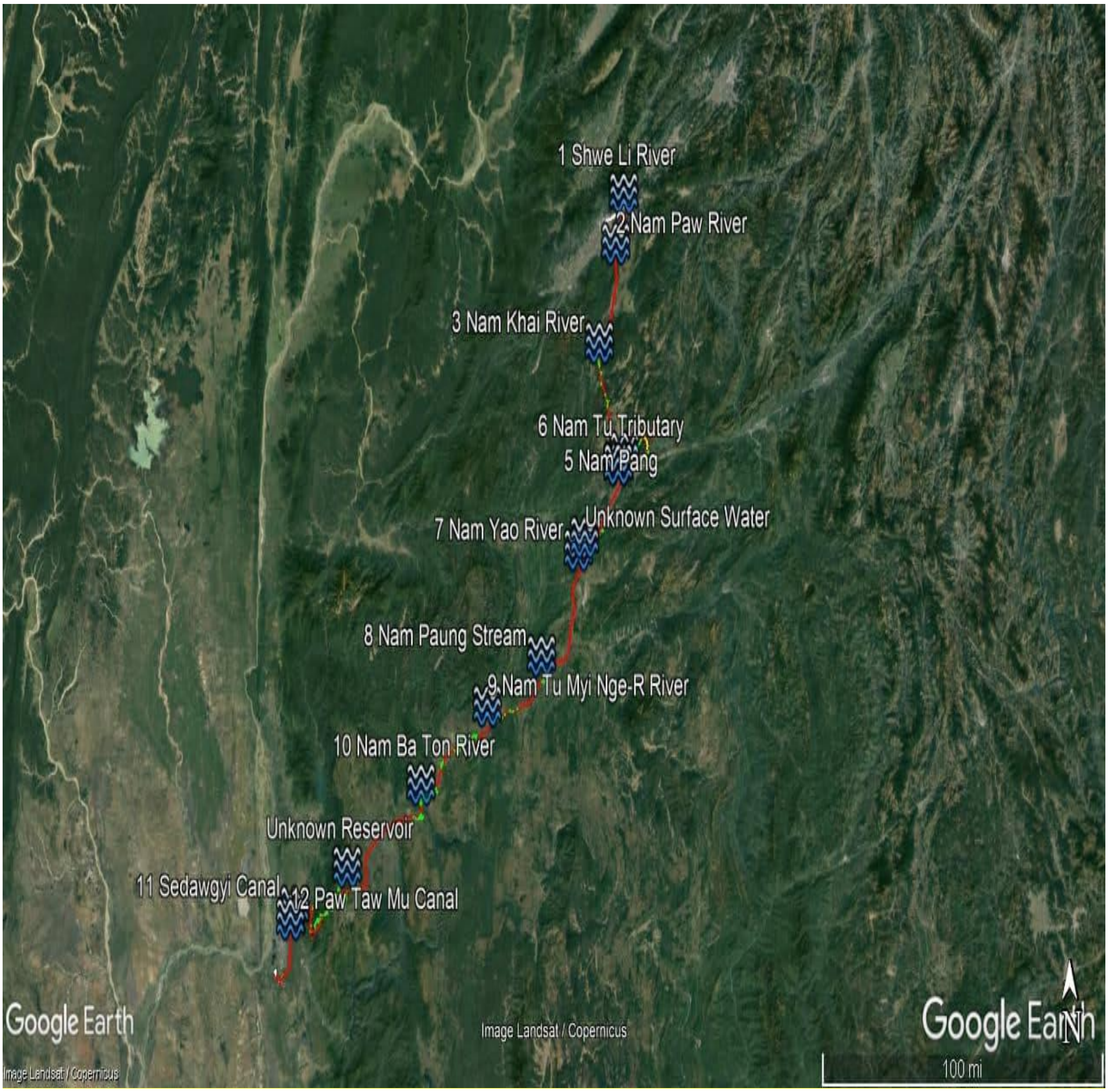
Other local construction materials, such as sand and gravel, etc.: supplied by the local source in line with the requirements of construction materials, and transported by truck to the batching plant and construction site. Muse to Mandalay section crosses the area with wide distribution of limestone and dolomite, where the coarse aggregate source is rich and quarries are distributed uniformly. In addition, stone for construction may also be supplied partly with spoil from cutting and tunnel construction after processing; natural fine aggregate is scarce, the natural medium and coarse sand available is mainly distributed in the Ayeyarwady, the Myitnge River and the Shwe Li River. For other sections, machine-made sand may be considered. There are brick factories along the line, for the convenience of adopting bricks for construction.

Transportation of raw materials to the construction site for transmission line and traction substation

Raw materials	Transportation		Route
Sand and chipping	Truck		From nearby local areas of Mandalay
Cement, wood and etc	Truck		Material yard along the line to construction site
Concrete, steel, other materials and equipment	Muse-Hsipaw section	Operation train	From Shwe Li check point to Muse track-laying base
		Work train	From Muse track-laying base to construction site
	Mandalay to Hsipaw section	Operation train	First transported to port of Myanmar and then shipped to Yangon port of Myanmar
		Meter-gauge railway	From Yangon port of Myanmar to Mandalay track-laying base
		Work train	From Mandalay track-laying base to construction site

Source of construction water supply

Construction water can be used from surface water and groundwater from drilling well. The water system along the route is mainly the Ayeyarwady River and its tributaries. The route passes through larger rivers, including the Shwe Li River, and rivers within the territory of Myanmar like the Nan Paw River, the Nam Hkai River, the Nam Tu River, the Nam Yao River, the Nam Tu miy Nge-R River, the Nam Ma River and Nam ban ton River. The Shwe Li River and Nam Tu River are the first tributaries of Ayeyarwady River; the Nam Paw River, Nam Hkai River, Nam Yao River, Nam Ma River and Nam ban ton River belong to the tributaries of Nam Tu River.



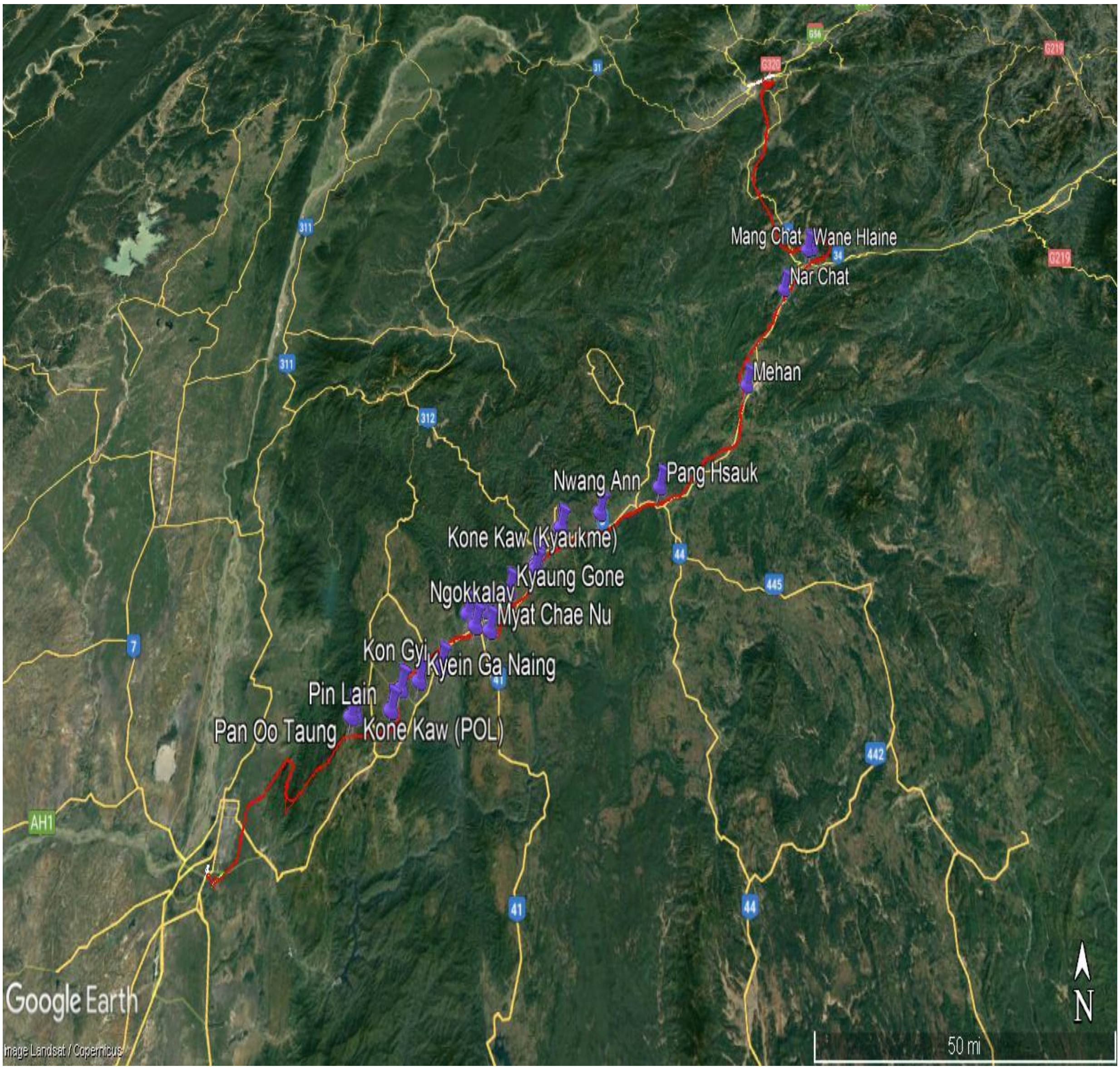
Distribution of surface water along the line for the proposed project

This project mainly passes through Shan Plateau in northern mountain area of Myanmar, and goes through Pyinoolwin and then into the Ayeyarwady river basin in Mandalay plain.

Groundwater along the line

There are three types of groundwater along the line, which are pore water in Quaternary looserock, bedrock fissure water and karst water.

Along the Muse-Mandalay railways, the living water supply in rural areas is mainly from the extraction of shallow groundwater. Most of the villages along the railway line used natural spring water as drinking and domestic water.



Distribution of spring water along the line for the proposed project

Surface Water Along the Line			
1	Shwe Li River	24° 1'59.05"N	97°58'38.79"E
2	Nam Paw River	23°53'19.20"N	97°55'58.85"E
3	Nam Khai River	23°36'16.25"N	97°50'28.11"E
4	Nam Tu River	23°17'23.32"N	97°58'36.34"E
5	Nam Pang River	23°15'25.20"N	97°56'35.27"E
6	Nam Tu Tributary	23°15'19.24"N	97°56'30.12"E
	Unknown Surface Water	23° 2'49.35"N	97°45'31.03"E
7	Nam Yao River	23° 0'41.44"N	97°43'21.90"E
8	Nam Paung Stream	22°42'29.25"N	97°31'18.07"E
9	Nam Tu Myi Nge-R River	22°33'54.42"N	97°13'39.32"E
10	Nam Ba Ton River	22°20'23.58"N	96°52'4.14"E
	Unknown Reservior	22° 5'59.70"N	96°27'58.56"E
11	Sedawgyi Canal	21°58'52.01"N	96°10'42.55"E
12	Paw Taw Mu Canal	21°56'41.01"N	96° 9'16.36"E

Spring Water Along the Line			
1	Mang Chat	23°18'47.90"N	98° 0'29.87"E
2	Wane Hlaine	23°18'33.08"N	97°59'19.40"E
3	Nar Chat	23°10'54.72"N	97°52'38.25"E
4	Mehan	22°53'2.12"N	97°41'41.83"E
5	Pang Hsauk	22°36'41.58"N	97°22'2.37"E
6	Nwang Ann	22°32'47.50"N	97° 9'59.99"E
7	Pang Ywang	22°30'30.26"N	97° 2'23.07"E
8	Mway Taw	22°30'11.58"N	97° 2'0.69"E
9	Na Ai Hkant	22°25'33.28"N	96°57'39.93"E
10	Khite Tone Home	22°24'52.11"N	96°57'28.76"E
11	Kone Kaw (Kyauk Me)	22°24'19.07"N	96°57'28.68"E
12	Kyaung Gone	22°21'29.64"N	96°52'39.07"E
13	Taung Quarter	22°19'0.81"N	96°48'13.51"E
14	Myat Chae Nu	22°16'17.74"N	96°49'16.48"E
15	Ngokkalay	22°16'51.78"N	96°46'31.84"E
16	Lone Yone	22°18'29.95"N	96°45'3.53"E
17	Kon Gyi	22°11'48.96"N	96°40'43.48"E
18	Kyein Ga Naing	22° 9'58.94"N	96°36'56.57"E
19	Anauk Kyu Inn	22° 8'53.60"N	96°33'48.65"E
20	Pin Lain	22° 6'18.84"N	96°32'21.46"E
21	Kone Kaw (POL)	22° 5'43.54"N	96°26'9.36"E
22	Pan Oo Taung	22° 5'31.96"N	96°25'25.38"E

Construction Power Supply

According to the railway alignment scheme and the relevant data, such as the load demand and distribution of each construction supply point, the connection scheme of external power supply for traction power supply, etc., combined with the distribution of the power supply point of external electricity grid, totally 9 centralized substation and distribution facilities (construction substation and switching yard) are provided in the construction power supply scheme of the project.

Muse to Hsipaw section, Muse, Kutkai, Theinni, Lashio and Hsipaw 66kV substations of local power grid are distributed along the line, and HV power supply of the substation is connected from 230kV substation 66kV outgoing line respectively with high power supply reliability; Chaung Chauk to Pyinoolwin section, the power grid is weak without 66kV and above substation, combined with the external power supply scheme, the external power incoming line of Chaung Chauk and Pyinoolwin 230kV center substations will be constructed firstly for the external power grid project of the section, and centralized substation facilities will be set up for construction power supply, Pyinoolwin to Mandalay section, the external power 132kV incoming line to SS10CK365 traction substation will be constructed firstly for the external power grid project of the section, and construction power supply will be connected from the line, and the specific scheme are shown in the following.

(1) Muse 4# tunnel outlet 33kV construction switching yard (CK19+000)

A 33kV construction temporary switching yard will be set up near the outlet of Muse 4# tunnel. A 33kV power supply line will be connected from the existing Muse 66kV substation. Power supply line will be temporary, and the calculated load will be 4172kW. A 33kV feeder will be used for the power supply of the outlet of Muse 4# tunnel, and another 33kV line will be used for the power supply of the inlet of Pang hkam1# tunnel.

(2) Kutkai 1# super major bridge 33kV construction switching yard (CK72+500)

A 33kV construction temporary switching yard will be set up near Kutkai1# super major bridge. A 33kV power supply line will be connected from the existing Kutkai 66kV substation. Power supply line will be temporary, and the calculated load will be 8062kW. A 33kV feeder will be used for the power supply of the outlet of Kutkai1# tunnel, and another 33kV line will be used for the power supply of Kutkai1# super major bridge.

(3) Theinni super major bridge 33kV construction switching yard (CK117+100)

A 33kV construction temporary switching yard will be set up near Theinni super major bridge. A 33kV power supply line will be connected from the existing Theinni 66kV substation. Power supply line will be temporary, and the calculated load will be 6430kW. A 33kV feeder will be used for the power supply of the outlet of Laban pa tunnel, and another 33kV line will be used for the power supply of Theinni super major bridge.

(4) Kening 2# super major bridge 33kV construction switching yard (CK137+100)

A 33kV construction temporary switching yard will be set up near Kening2# super major bridge. A 33kV power supply line will be connected from the existing Hispaw 66kV substation. Power supply line will be temporary, and the calculated load will be 6148kW. A 33kV feeder will be used for the power supply of Keing No.1 medium bridge, and another 33kV line will be used for the power supply of Kening2# super major bridge.

(5) Hsuplang major bridge 33kV construction substation (CK198+040)

A 33kV construction temporary substation will be set up near Hsuplang major bridge. A 33kV power supply line will be connected from the existing Hispaw 66kV substation. Power supply line will be temporary, and the calculated load will be 3650kW. A 33kV feeder will be used for the power supply of the outlet of Pang Sawk1# tunnel, and another 11kV line will be used for the power supply of Hsuplang major bridge.

(6) Chaung Chauk tunnel outlet 33kV construction substation (CK225+800)

A 33kV construction temporary substation will be set up near the outlet of Chaung Chauk tunnel. For external power grid combining permanent and temporary works, 1 230/33kV construction substation will be set up at 230kV center substation. A 33kV power line will be connected. Power supply line will be temporary, and the calculated load will be 5804kW. One 11kV feeder will be used for the power supply of the outlet of Chaung Chauk tunnel, and another 33kV line will be used for the power supply of Loi law major bridge.

(7) Kon San No.2 tunnel outlet 132kV construction substation (CK282+800)

A 132kV construction temporary substation will be set up near the outlet of Kon San No.2 tunnel. For external power grid combining permanent and temporary works, a 132kV line (the 132kV line is connected from 230/132/33kV construction substation at the inlet of Pyinoolwin tunnel) will be connected from NwangHkio 132kV line. Power supply line will be temporary, and the calculated load will be 7336kW. A 33kV feeder will be used for the power supply of the outlet of Kon San No.2 tunnel, and another 11kV line will be used for the power supply of Nawng Hkio super major bridge.

(8) Pyinoolwin tunnel inlet 230kV construction substation (CK323+650)

A 33kV construction temporary substation will be set up near the inlet of Pyinoolwin tunnel. For external power grid combining permanent and temporary works, 230/132/33kV construction substation will be set up at Pyinoolwin 230kV center substation. A 33kV power supply line will be connected. Power supply line will be temporary, and the calculated load will be 8664kW. Because there is no large power load at small mileage end, only a 33kV feeder at large mileage end will be used for the power supply of Pyinolwin tunnel inlet.

(9) TaungKyun 1# tunnel outlet 132kV construction substation (CK365+100)

A 132kV construction temporary substation will be set up near the outlet of TaungKyun No.1 tunnel. For the external power supply, it is proposed to build 1 132kV line in SS10CK365 traction substation firstly. 132/33kV substation will be set up nearby for construction power supply. Power supply line will be temporary, and the calculated load will be 10802kW. A 33kV feeder will be used for the power supply of the outlet of TaungKyun No.1 tunnel, and another 33kV line will be used for the power supply of TaungKyun No.5 super major bridge.

4.5 Description of the Selected Alternatives

4.5.1. Analysis of Alternatives

Alternative analysis has been considered as an integral part of EIA process, which involves examination of alternative ways of achieving the objectives of the proposed project. The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the unwanted impacts. Alternative analysis is also a form of mitigation measures.

The alternative analysis for power supply system of Mandalay-Muse Railway was conducted into the following points (a) "no project" alternative, (b) Process Alternative and (c) alternative analysis for site selection. In each subcomponent many options were considered and these options were weighed from all considerations such as cost, environment, and ease of implementation.

4.5.1.1 The "No Action" Alternative

The no project alternative or no action alternative will be considered as with or without the proposed project as follow:

Without project

If this project is not implemented, no construction costs, resettlement and environmental impact will occur. However, the backward productivity and inconvenient traffic environment along the route will hinder the economic development of Mandalay, Shan State and even Myanmar, making the people along the route still living in poverty and unable to promote social progress. This alternative avoids the implementation of Muse-Mandalay Railway. In no project scenario case, there will be no impact on natural environment and local communities. But there will be positive impacts on residents' life quality in "Project Scenario" case. So, it is necessary to consider from environmental and social perspectives.

(a) From an Environmental Perspective

Although the development of the proposed project will have more or less environmental impacts, the levels of acceptability will be decided in conjunction with threshold criteria as shown in the following table.

Table 4.15 - Threshold Criteria to Determine the Acceptability of Environmental Impacts

Level of Acceptability	*Threshold Criteria for Potential Impacts*
Unacceptable	Exceeds legal or regulatory standard, e.g. water quality standard. Increases level of risk to public health. Extinction of biological species, loss of genetic diversity, rare or endangered species, critical habitat.
Normally Unacceptable	Conflict with policies or land-use plans. Loss of populations of commercial biological species. Large scale loss of productive capacity of renewable resources.
May be Acceptable with Mitigation	Avoidance of spread of biological disease, pests, feral animals or weeds. Some loss of threatened habitat.
Normally Acceptable	Some loss of populations and habitats of non-threatened species. Modification of landscape without downgrading special aesthetic values. Emissions demonstrably less than the carrying capacity of the receiving environment.

Source: Modified from Sippe (1999)

The "No Action" alternative will be considered according to the above table for the environmental perspective.

All of the project's related environmental impacts can be mitigated to allowable levels with proper mitigation measures and so the proposed project can be considered as may be acceptable with mitigation. The "No Action" alternative is not a feasible alternative, as it would lead to loss of significant foreign direct investment as well as significant employment opportunities – direct employment opportunities are currently estimated at 500 (on average) during the 5 years of construction and 1200 (on average) during operations for at least 30 years. The location of the traction substation shall be as harmonious as possible with the surrounding environment. To reduce electromagnetic pollution, try to stay away from residential areas as much as possible. Except that the traction transformer and mutual inductor are oil-immersed type, the remaining electrical equipment and operating units are oil-free equipment. The oil-collecting well is provided in the oil-immersed equipment to prevent the transformer oil from polluting the environment. Use low noise equipment to reduce noise pollution. In the spare places in each station, flowers and low shrubs are properly planted to protect the environment, under the premise of ensuring normal power supply and satisfying the touch potential & step potential. The traction transformer adopts low-loss transformer and the other transformer adopts energy-saving products. The secondary equipment adopts microcomputer integrated automation device with integrated control, protection, measurement and signaling. It can be operated in dark screen, and the lighting uses high-efficiency energy-saving light source. So, the proposed railway power supply system can be considered as may be acceptable with mitigation from environmental perspective.

(b) From a Socio-economic Perspective

Constructing Muse-Mandalay Railway can improve traffic conditions, lower transport costs and promote personnel exchanges which will add vitality into the national economy, and improve people's livelihood and boost social development & stability.

A "no-project" option will mean that the status quo remains and all the social impacts related to the existence of the projects are not envisaged. This implies that if the project were not to proceed, none of the positive or negative impacts identified in this study will materialize. A no-project option will see all the anticipated project benefits not realized. The foregone benefits of this option will include loss of foreign capital investment, loss of transportation development in the regions, loss of employment opportunities for local people, loss of infrastructure development, loss of increased business opportunities for local services, loss of skill development and improved services and of community development potential among other benefits of the project. Moreover, the change to get electricity power to local community by mean of the power transmission line to railway traction substation. So, the no option alternative is not suitable for the proposed project from a socio-economic perspective.

4.5.1.2. Process Alternative (Alternative Analysis for Power Source)

Distribution station generally utilizes two types of power sources: from local power grid, and from self-generated power source. The technical, economic comparison of the two power supply solutions is as follows.

(a) Consideration Power Source from Local Power Grid

In Myanmar, there are great possibilities for developing hydro-electricity. Available installed capacity in terms of Myanmar's national hydropower resources is approximately 60 million kilowatts and economically available installed capacity is approximately 40 million kilowatts. The areas suitable for large hydropower stations construction are mainly concentrated in the Kachin State, Karen State, upper reaches of the Ayeyarwady River in Shan

State and the Salween River Basin and available for building more than 15 Megawatt-level hydropower stations. Myanmar is rich in hydropower resources, but at present, utilization rate is extremely low, with wide development prospect and huge potential consumer market. According to statistics from the Ministry of Electricity and Energy in 2018, the total installed capacity of power stations all over Myanmar is 5,409MW. About 60% of electricity in Myanmar is hydro-power, with 36% generated by natural gas, and 2% generated by coal and diesel.

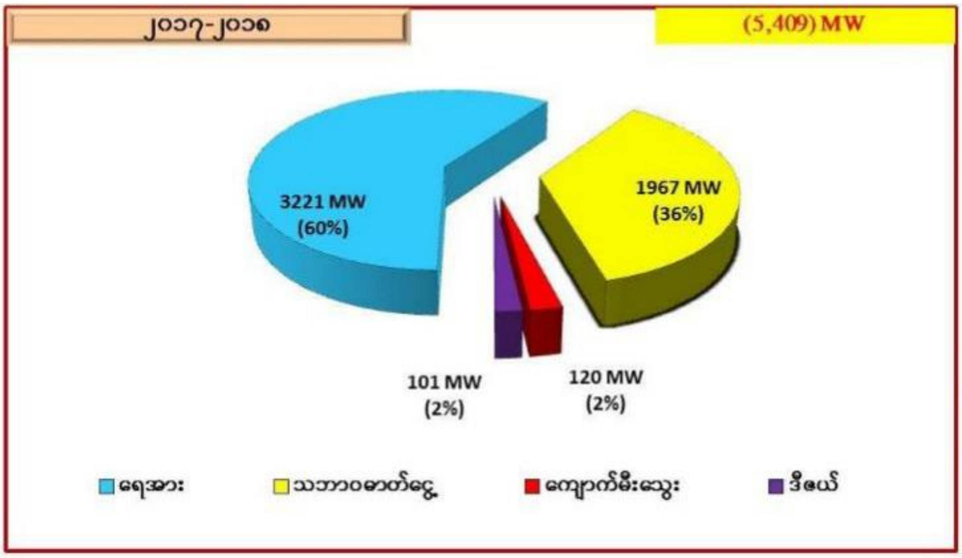


Fig. - Percentage of power supply in Myanmar

In 2014, Myanmar developed the National Electricity Master Plan. According to the Plan, the total installed capacity in Myanmar will reach 28,784MW by 2030, including 4,986MW (17.32%) for natural gas generation and 2,760MW (9.58%)for thermal power.

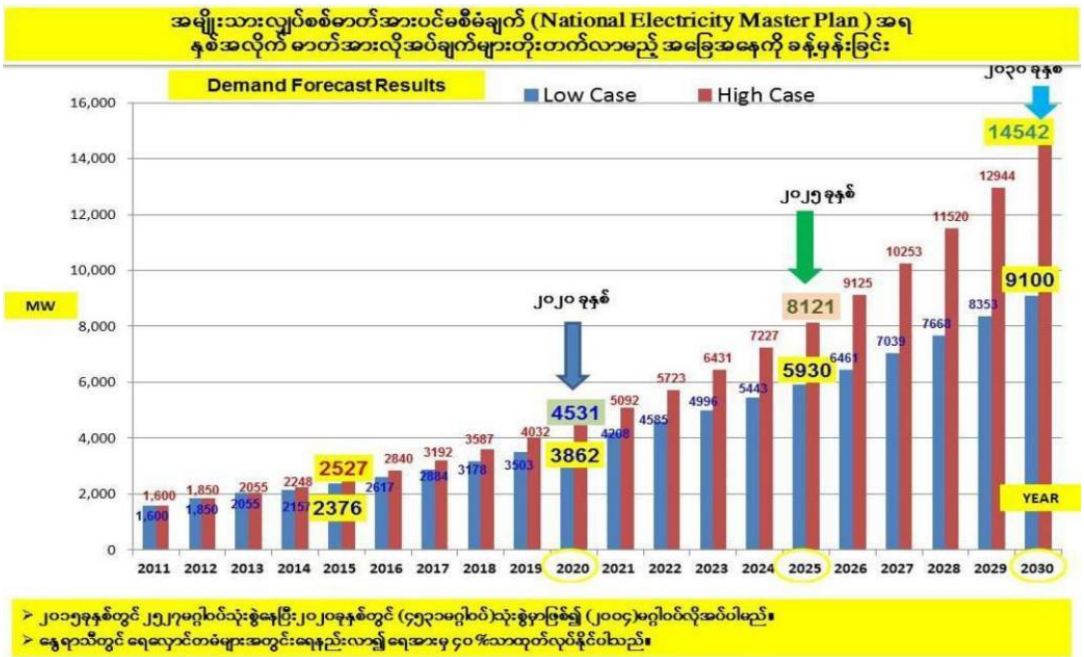


Fig. - Myanmar's power load prediction

The largest power station in operation in Myanmar is located 52km southeast of Mandalay. The Yeywa Hydropower Station over the Myitnge River has an installed capacity of 790,000kW. The hydropower stations under construction include: Middle Yeywa Hydropower Station, Upper Yeywa Hydropower Station, Middle Paunglaung Hydropower Station, Kyaiktaung Hydropower Station, Shweli River (III)Hydropower Station, etc. The power supply in Rangoon, the largest city in Myanmar, is mainly guaranteed by natural power stations. The largest gas power station is Alone Gas Power Station in southern Rangoon, and has an installed capacity of 275,000kW. The installed capacity of power stations put into operation in Myanmar are listed as follows: (above 100,000kW)

Table - Installed capacity of power stations put into operation in Myanmar (above 100,000kW)

S/N	Hydropower station	Capacity
1	Yeywa Hydropower Station	790,000kW
2	Shweli River (I)Hydropower Station	600,000kW
3	Paunglaung Hydropower Station	289,000kW
4	Alone Gas Power Station	275,000kW
5	Dapein River (I)Hydropower Station	240,000kW
6	Baluchaung Gas Power Station	208,000kW
7	Buluqiao (II)Hydropower Station	168,000kW
8	Thaketa Gas Power Station	145,000kW
9	Upper Paunglaung Hydropower Station	140,000kW
10	Laima Gas Power Station	122,000kW
11	Thandwe Hydropower Station	120,000kW
12	Daoyeka	120,000kW
13	Tikyit Coal-fired Power Station	120,000kW
14	Chipwi Nge Hydropower Station	99,000kW

In terms of power network, Myanmar's transmission voltage classes are divided into 500kV, 230kV, 132kV and 66kV, and the distribution voltage classes are divided into 33kV, 11kV and 6.6kV. Among them, 500kV power network belongs to works under construction; thirty-eight 230kV substations have a total installed capacity of 5,520MVA and a total transmission line length of 4,580km; forty-two 132kV substations have a total installed capacity of 1,734.5MVA and a total transmission line length of 2,193km; forty-two 66kV substations have a total installed capacity of 4,040MVA and a total transmission line length of 10,442km.

First, main state power network (mainly 230 kV) was built in the surrounding around the two load centers in Rangoon and Mandalay but not directly connected to the neighboring state grid.

Second, majority of remote areas far from main state power network are powered by small hydropower stations in an isolated manner.

Third, a small amount of electricity is purchased from neighboring countries in the border area.

Fourth, refined oil products are used to generate electricity to address power demands. The Shweli River (I)Hydropower Station and Dapein River (I)Hydropower Station in Myanmar are connected to the power network in Yunnan, China. The Government is actively promoting power development, and continues to build large power stations, power networks as well as large power transmission channels with neighboring countries. The existing and planned Myanmar state grids are shown in the following figures.

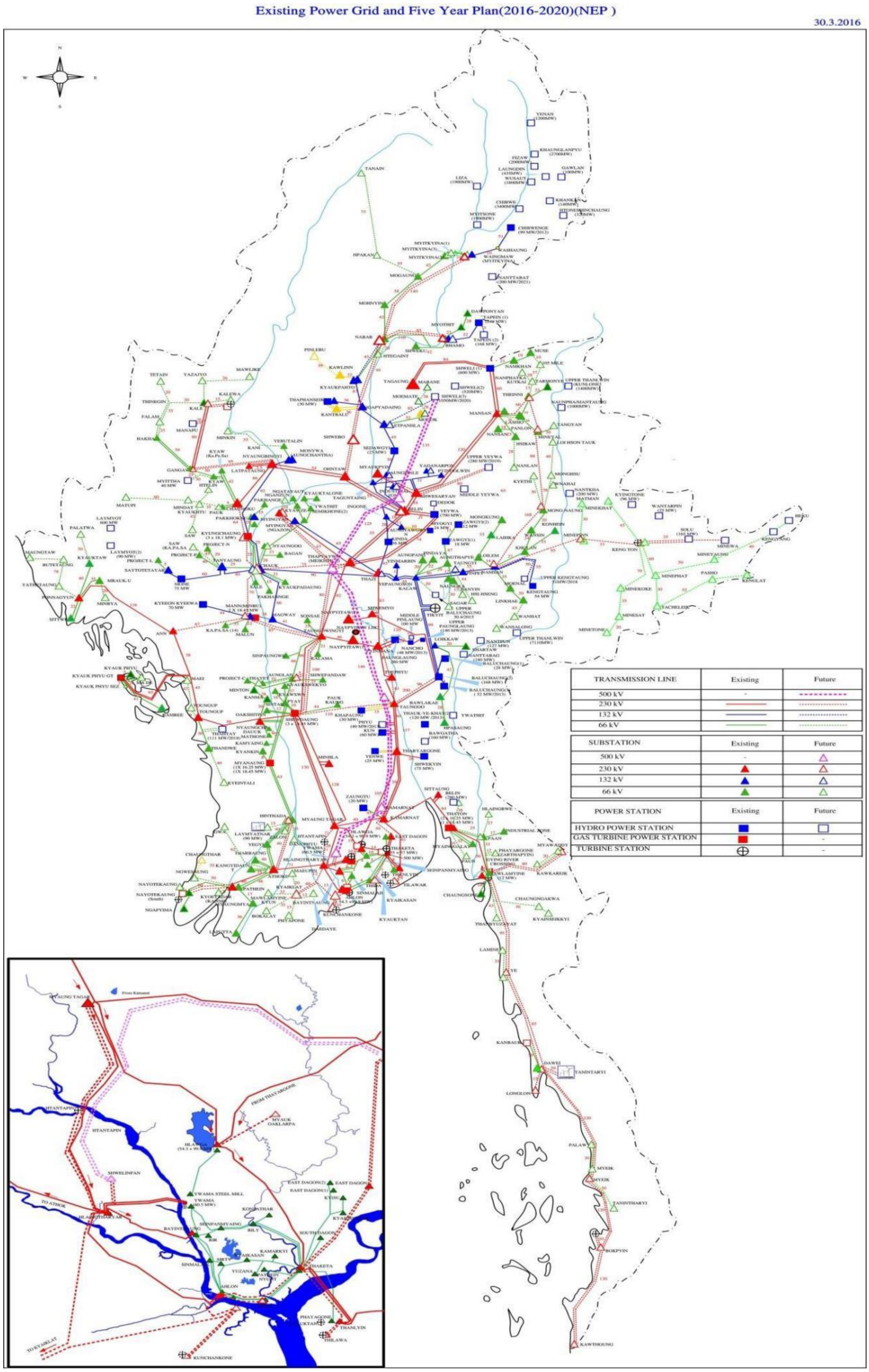


Fig. Wiring diagram of existing state grid in Myanmar

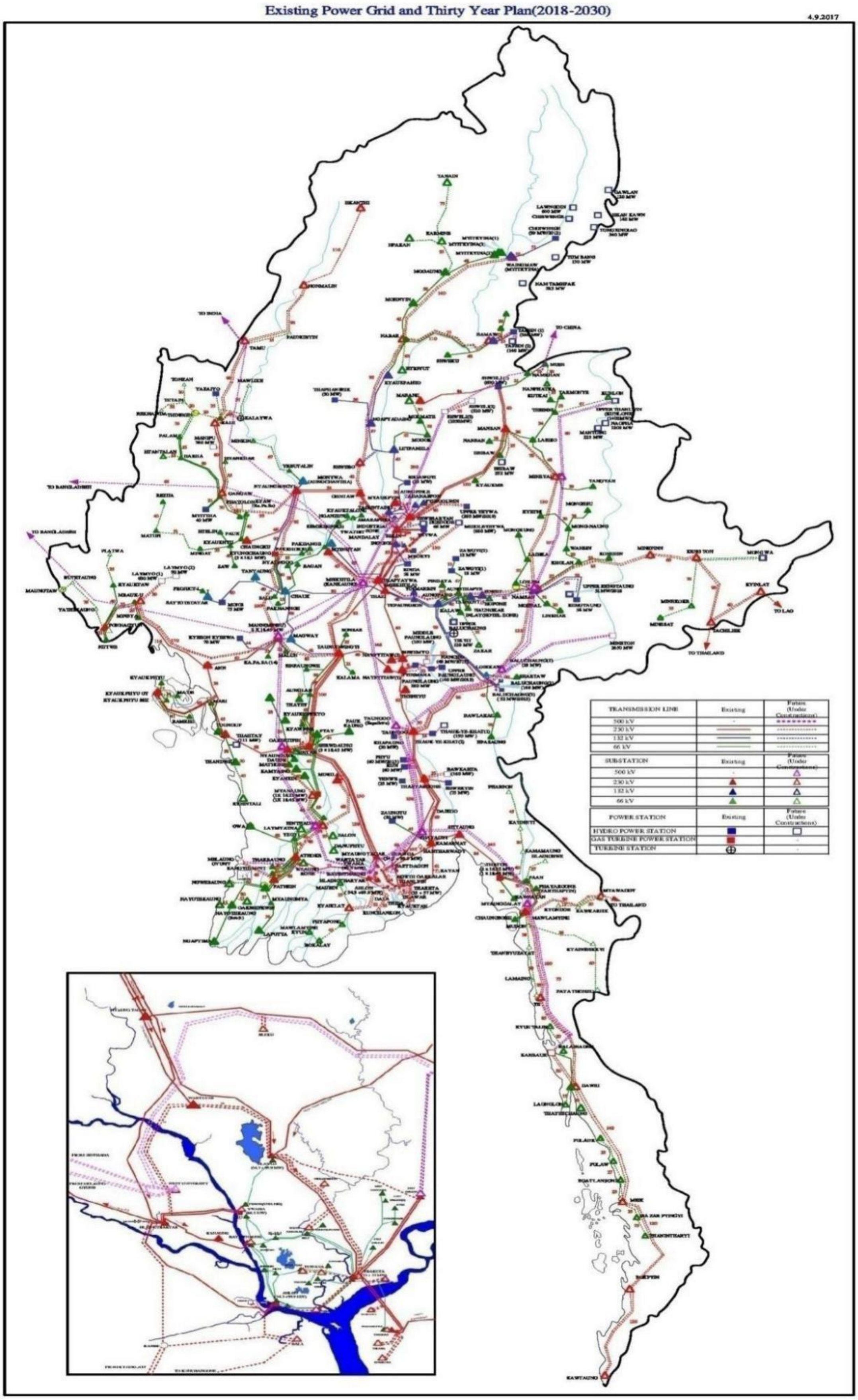


Fig. Wiring diagram of planned state grid in Myanmar

Although there will have a lot of electrical power source in Myanmar, there will still have no electrical power and no surplus electrical power as shown in the following figures.

Current Electricity Supply in Shan State (North)
Location Map

(a) Area - 28111.9 sq-mil
(b) No. of Household - 445983
(c) No.of Electrified Household - 138789
(d) No. of District - 6
(e) No. of Townships - 21
(f) No .of Sub Townships - 10
(g) No. of Town - 19
(h) District Engineer Office - 6
(i) Township Engineer Office - 13
(j) Town Engineer Office - 2
(k) Township Manager Office - 14
(l) Town Manager Office - 10

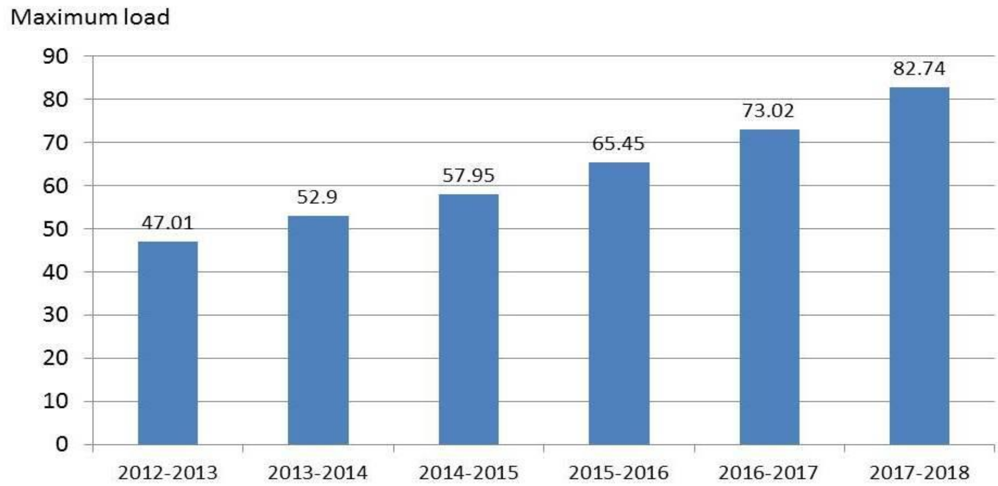
Electrified Towns/Villages in Shan State (North)

Sr.No.	Name of District	No. of Town								No. of Village							
		List	Electrified						Un-electrified	List	Electrified						Un-electrified
			Power System	Other							Power System	Other					
				Disel	Solar	Small hp	Neighbour	Power System + Other Total				Disel	Solar	Small hp	Neighbour	Power System + Other Total	
1	Lashio	4	4	-	-	-	-	4	-	1516	205	1	137	9	-	352	1164
2	Kyuak me	10	7	3	-	-	-	10	-	1667	231	11	356	86	-	684	983
3	Muse	7	6	-	-	-	1	7	-	959	69	2	110	42	162	385	574
4	Kunlon	1	-	-	-	-	1	1	-	173	-	-	35	-	32	67	106
5	Hopan	3	-	1	-	1	1	3	-	648	-	-	66	8	5	79	569
6	Lauk Kai	4	-	2	-	-	2	4	-	278	-	-	15	50	122	187	91
	Total	29	17	6	-	1	5	29	-	5241	505	14	719	195	321	1754	3487

List of Electrified Households from Power System in Shan State (North)

Sr.No.	Name of District	No. of Household	No. of Electrified Household	No. of Un-electrified Household	Electrified %
1	Lashio	125181	53474	71707	42.72%
2	Kyuakme	163679	49790	113889	30.42%
3	Muse	86255	35525	50730	41.19%
4	Kunlon	10392	-	10392	0%
5	Hopan	35630	-	35630	0%
6	Lauk Kai	24846	-	24846	0%
	Total	445983	138789	307194	31.12%

Annually Increased Peak Load in Shan State (North)



Townships/Villages to be electrified in Shan State (North) after completion of the projects in financial year 2018 - 2019

Sr.No.	Name of District	No. of Town								No. of Village							
			Electrified								Electrified						
		List	Power System	Other					Un-electrified	List	Power System	Other					Un-electrified
				Disel	Solar	Small hp	Neighbour	Power System + Other Total				Disel	Solar	Small hp	Neighbour	Power System + Other Total	
1	Lashio	4	4	-	-	-	-	4	-	1516	242	1	137	9	-	389	1127
2	Kyuakme	10	7	3	-	-	-	10	-	1667	285	11	356	86	-	738	929
3	Muse	7	6	-	-	-	1	7	-	959	75	2	110	42	162	391	568
4	Kunlon	1	-	-	-	-	1	1	-	173	-	-	35	-	32	67	106
5	Hopan	3	-	1	-	1	1	3	-	648	-	-	66	8	5	79	569
6	Lauk Kai	4	-	2	-	-	2	4	-	278	-	-	15	50	122	187	91
	Total	29	17	6	-	1	5	29	-	5241	602	14	719	195	321	1851	3390

Households to be electrified in Shan State (North) after completion of the projects in financial year 2018 - 2019

Sr.No.	No.of District	No.of Household	No.of Electrified Household	No.of Un-electrified Household	Electrified Household %
1	Lashio	125181	55864	69317	44.63%
2	Kyuakme	163679	52184	111495	31.88%
3	Muse	86255	35663	50592	41.35%
4	Kunlon	10392	-	10392	0%
5	Hopan	35630	-	35630	0%
6	Lauk Kai	24846	-	24846	0%
Total		445983	143711	302272	32.22%

Annually Increased Peak Load Condition of five years (from financial year 2017-2018 to 2021-2022)in Shan State (North)

Sr.No	Name of District	Supplied LOAD (MW)									
		2017-2018		2018-2019		2019-2020		2020-2021		2021-2022	
		Max;	Min;	Max;	Min;	Max;	Min;	Max;	Min;	Max;	Min;
1	Lashio	35.15	13.5	44.5	15.5	48.5	17	50.5	18	51	20
2	Kyuakme	20.25	6	23.5	7	27.5	8	30.5	10	33.8	12
3	Muse	24.34	7	27.5	9	30.5	10	32.5	12	34.7	14
4	Kunlon	-	-	-	-	-	-	1	0.5	1.5	0.75
5	Hopan	-	-	-	-	-	-	1	0.5	1.5	0.75
6	Lauk Kai	-	-	-	-	-	-	8	5	10	6
Total		82.74	26.5	95.5	31.5	106.5	35	123.5	46	132.5	53.5

Current Electricity Supply in Mandalay Region (10/2019)

(a) Area – 11926.12 sq-mile

(b) Household – 1323191 No

(c) Electrified Household – 879363 No

(d) District – 7 No

(e) Township – 28 No

(f) Town – 6 No

(g) Township Manager Office – 34 office

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Electrified Towns /Villages in Mandalay Region (10/2019)

Sr. No	District	No. of Town					No. of Village				
		List	Electrified			Un-electrified	List	Electrified			Un-electrified
			Power System	Other	Total			Power System	Other	Total	
1	Mandalay	7	7	-	7	-	310	292	18	310	0
2	Pyin Oo Lwin	6	6	-	6	-	725	421	100	521	204
3	Kyaukse	6	6	-	6	-	775	613	162	775	0
4	Meiktila	4	4	-	4	-	1094	558	260	818	276
5	Myingyan	4	4	-	4	-	773	513	121	634	139
6	Nyaung -U	4	4	-	4	-	559	228	90	318	241
7	Yamething	3	3	-	3	-	563	269	103	372	191
	Total	34	34	-	34	-	4799	2894	854	3748	1051

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List of Districts of Electrified Households from Power System in Mandalay Region (10/2019)

Sr. No	District	Household	Electrified Household	Un-electrified Household	Electrified Household %
1	Mandalay	324477	322991	1486	99.54%
2	Pyin Oo Lwin	214948	126119	88829	58.67%
3	Kyaukse	169988	104330	65658	61.38%
4	Meiktila	200227	111477	88750	55.68%
5	Myingyan	180995	102165	78830	56.45%
6	Nyaung-U	116434	62056	54378	53.30%
7	Yamething	116122	50225	65897	43.25%
Total		1323191	879363	443828	66.46%

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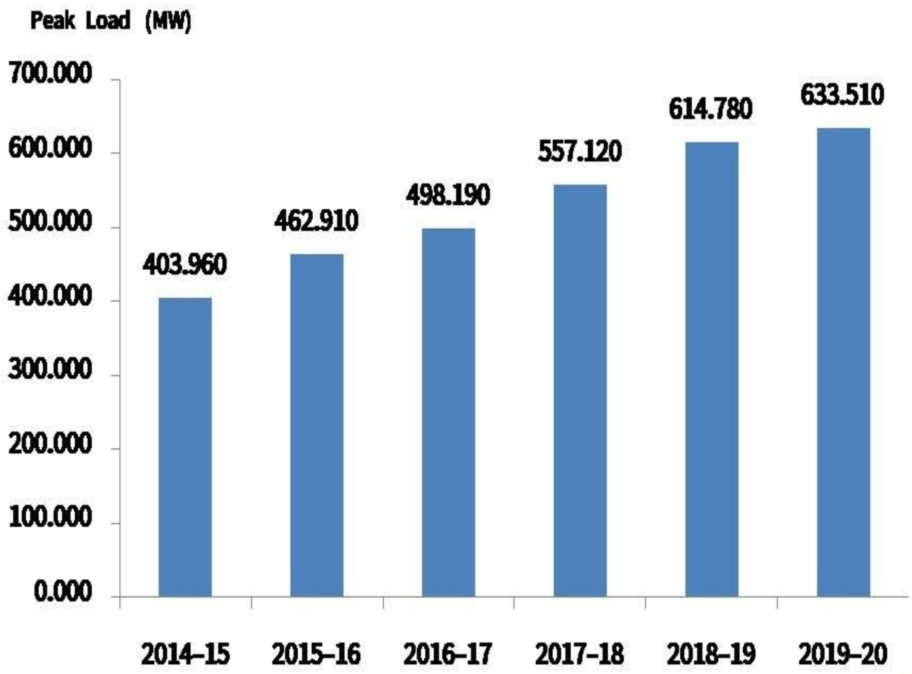
Annually Increased Peak Load Condition in Mandalay Region (10/2019)



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(b) Consideration Power Source from Self-contained Power Supply

Self-generated power sources will be Self-contained power supply (take diesel generator, as an example and another source from neighbor countries for traction substations near border line) and Self-contained Power Supply (Solar System).

(c) Comparison and Selection of Alternative for Power Supply Source

Table - Comparison and selection of external power supply for distribution station

Description	Environmental Perspective	Social Perspective	Technical and Economic Perspective
Local power grid power supply	Will analyze based on land use, traffic and impact on biodiversity	Will analyze based on whether there is no pressure on local power supply system or not	Will analyze based on availability and technical issues
Self-contained power supply (take diesel generator as an example)	Will analyze based on environmental impact due to gaseous emission	Will analyze based on impact on agricultural land and pressure on local electricity use	Will analyze based on availability of and technical and economic issues

Table - Comparison and Selection of the Preferred Alternatives

Description	Environmental Perspective	Technical Perspective	Economic Perspective	Social Perspective
Local power grid power supply	- In grid operations, changes of climatic effect may be caused by energy losses during electricity transmission. - In the planning of new transmission line routes from local grid to proposed project,	The power line distance from grid to proposed project should be suitable distance to avoid power energy loss. To give required power for proposed	The rate of electrical power consumption for commercial use is 180 kyats per unit in maximum. The power line distance from grid to proposed	Pressure on Local Power Supply

	the most significant permanent change on nature will be the line clearing becomes treeless and Impacts on fauna is habitat changes. - Grid interconnection process can result in permanent land conversion, land degradation, and the exclusion of traditional land uses in and around the transmission right-of-way.	project, it is required an efficient power energy supply source (substations, power plants) without pressure on local electric utilities. Grid supply has strong point by power fluctuations that is mostly stable.	project should be suitable distance to avoid higher cost of interconnection	
Self-contained power supply (take diesel generator, as an example and another source from neighbor countries for traction substations near border line)	- Gaseous emission which negatively impact air quality, and contribute significantly to carbon emissions will be major impact by self-generator because operation will be carried out 24 hours for electric trains. - Secondary impact will be noise effects. Diesel generators generate 88db of noise, while generators running on petrol or gas can go above 95db, according to. Farooq Alam, senior research officer for air quality at the Environment Protection Department.	For traction substations and auxiliary power supply, it is needed to choose proper generator with respects to required voltage to avoid power overload.	The rate of electrical power consumption by self-contained power is 450 kyats per unit in average.	Impact on Community's Health due to gaseous emissions
Self-contained Power Supply	- There will be no greenhouse gas emissions and	- Heat energy from the sun can only be	The cost is very high.	Land acquisition due to large area

(Solar System)	reduces some types of air pollution. - Affect to biodiversity environment due to large amount of land use areas needed	received during the day time, except cloudy season.		needed to install solar panels

According to this table, power supply using from local grid and self-contained both effect on environment respectively. The impact event that needs to be carefully beware is that construction of transmission lines from grid to traction substations because this impact will affect on biodiversity directly. Thus, we need to avoid protected areas and follow land restrictions. But the negative effect of self-generator is more obvious than grid because air pollution especially CO2 emission from one litre of diesel fuel is 2.68 kg and emits 46.5 metric tons of CO2 annually and noise effect impacts 24 hours to nearby for non-stop operation of generator. Moreover economically, local power grid is the proper option for proposed project with compared the rate of electricity consumption. Solar energy system can be used in environmentally sensitive areas. But solar energy is of high cost and it requires a large amount of land areas which can have impact on both biodiversity environment and human environment. From Mandalay to Pyin Oo Lwin railway line segment, it is found out that there is enough power supply source by national grid without effecting local utility but from Pyin Oo Lwin to Muse segment, it is observed that there are few supply source by grid. In summary, areas where there will have high pressure on local electrical power supply system, self-contained power supply should be used. For self-contained power supply, solar energy should be used where land use is available and otherwise, combustion engines such as diesel or natural gas generators should be used.

4.5.1.3. Alignment Alternative

Generally, alignment alternative for railway power transmission line will be the same as alternative analysis for railway alignment. Alternative analysis for railway alignment will be described in EIA report (Railway Alignment).

4.5.1.4. Distribution Scheme Alternative

The distribution scheme of power supply facilities shall be comprehensively considered in combination with the alignment scheme, the distribution of power system along the line and the power supply scheme of the adjacent lines, on the premise of ensuring the safe, reliable and balanced power supply of the entire traction power supply system. The environmental and social impacts are nearly the same for both schemes.

The technical and economic indicators comparison of main items of the above-mentioned power supply schemes are listed as follows.

The following two traction power supply schemes were compared.

Scheme I (recommended one): Direct feeding system with return conductor; 11 new traction substations at Muse, Nam hpak ka, Man Peng, Theinni, Lashio West, San lau, Chaung Chauk, Nawng hkio, Pyinoolwin, CK365 and Mandalay South and1 new switching post at Mandalay East will be constructed.

Scheme II (compared one): Direct feeding system with return conductor;11 new traction substations at Muse, Nam hpak ka, Nawng yen, Hang lu, NaUng, Hispaw, Kyaukme, Nawng hkio, Pyinoolwin, CK365 and Mandalay South and1 new switching post at Mandalay East will be constructed.

Table – Technical and economic indicators comparison of power supply schemes

Item \ Power supply scheme		Scheme 1 (recommended one)	Scheme 2 (compared one)
Traction power supply mode		Direct feeding system with return conductor	Direct feeding system with return conductor
New traction substations (set)	Station	10	10
	Reserved station	0	0
	section	1	1
New switching post (set)		1	1
Total installed capacity of traction transformer (MVA)		806	791
Total cost estimate of the Chapter (1,000 USD)		42,028.33	42,029.16
Main advantage		The power supply capacity is strong, and most of the traction substations are located at stations. The setting conditions are relatively good, close to the town, which is conducive to operation management. The distance of the feeding sections of traction substations is average, and the voltage level at the end of the feeding sections is relatively high. It can better connect with external grid.	The power supply capacity is strong. Most of the traction substations are located at stations, and the setting conditions are relatively good.

Main disadvantage	One traction substation is provided in the section.	One traction substation is provided in the block section. The voltage level at the end of the feeding sections of multiple traction substations is low, and the reinforcing feeder shall be provided for the OCS in a number of block sections. The connection conditions with external grid is poor.

Table – Matrix Table for Selection of Preferred Alternatives

	Local power grid power supply				Self-contained power supply (Generators)				Self-contained power supply (Solar system)			
	Environmental Perspective	Technical Perspective	Economic Perspective	Social Perspective	Environmental Perspective	Technical Perspective	Economic Perspective	Social Perspective	Environmental Perspective	Technical Perspective	Economic Perspective	Social Perspective
Mandalay South Traction Substation	√	√	√		√			√				
CK 365 traction substation	√	√	√		√			√				
Mandalay East switching post	√	√	√		√			√				
Pyinoolwin Traction Substation	√	√	√		√			√				
Nawng hkio traction substation	√			√	√	√		√	√		√	√
Chaung Chauk	√	√	√	√	√			√	√		√	√

traction substation												
San Lau traction substation	√	√	√	√	√	√		√	√		√	√
Lashio West traction substation	√	√	√	√	√	√		√	√		√	√
Theinni traction substation	√			√	√	√		√	√		√	√
Man Peng traction substation	√			√	√	√		√	√		√	√
Nam Hpak Ka traction substation	√	√	√	√	√			√	√		√	√
Muse border traction substation	√		√	√	√	√		√	√		√	√

In accordance with the comprehensive comparison, Scheme I will have better combination with the railway plan and profile and facilitate operation management. Therefore, Scheme I is recommended in the study.

5.0. DESCRIPTION OF THE SURROUNDING ENVIRONMENT

5.1. Setting the Study Limits

As the railway line is Muse to Mandalay, the power line will also parallel to the railway alignment. The total length of the power transmission line will be more than 400km.
The AOI for the railway power supply system will be considered based on the key potential impacts and project locations for traction substations and transmission lines, and most public concerns as follow:

(a) Consideration AOI by significance of key potential impacts;
(b) Consideratin by AOI by sensitive of project location; and
(c) Consideration by AOI by most public concerns.

After considering all of the above three attentions for AOI, all of the EIA studies (hydrology, biodiversity, cultural and heritage, social, noise & vibration, land use) will be assessed 500m beside the centre line of the railway alignment for transmission line, 1km around the railway traction substations including one switching post.

5.1.1. Considerations of AOI by Key Potential Impacts

AOI will be considered by accessing key potential impacts as follow:

Table 5.1 – Key Potential Environmental Impacts of Power Transmission Line

		Project Actions/Activities	**Soil Quality**	**Soil Erosion**	**Top Soil**	**Surface water Quality**	**Surface water flow patterns**	**Sediments deposition**	**Groundwater quality**	**Hydrogeological flow patterns**	**Air quality**	**Noise and Vibrations**	**Landscape**	**Flora**	**Fauna**	**Habitats**	**Protected and designated sites**	**Cultural Heritage**
Pre –Construction and Construction Phase	1.	Clearance of existing land, vegetation and building	√	√	√	√	√	√	-	√	√	√	√	√	√	√	√	√
	2.	Temporary sites used for construction works (material storage and equipment maintenance camps, concrete batching plants, crushing plants) and housing of construction workers	√	-	√	√	-	-	-	-	√	√	√	√	√	√	-	-
	3.	Above ground construction, earthworks, cut and fill or excavations, and building of transmission line	√	-	-	-	-	-	-	√	√	√	√	√	√	√	√	√
	4.	Sewage and domestic waste from workers' dormitory and seepage water from unsuitable soil particles dumping site and waste disposal site	√	-	-	√	-	-	-	-	-	-	-	-	-	-	-	-
	5.	Haulage roads	√	√	√	√	√	√	-	√	√	√	√	√	√	√	-	-
	6.	Construction traffic and machinery movement	-	-	-	-	-	-	-	-	√	√	-	√	√	√	-	-
	7.	Rise in the number of migrant workers	√	-	-	√	√	√	√	√	-	-	√	√	√	√	√	√
Operational Phase	1.	Noise from traction substations	-	-	-	-	-	-	-	-	-	√	-	-	√	-	-	-
	2.	EMF	-	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-
	3.	Maintenance of power stations and transmission line (machine repair and paint work)	√	-	-	√	-	-	-	-	-	-	-	-	-	-	-	-
	4.	Presence of permanent ways for traction substations	-	-	-	-	-	-	-	-	√	√	√	√	√	-	-	-
	5.	Electric shock and fire hazard	√	-	√	√	-	-	-	√	√	-	√	√	√	√	√	√

Table 5.2 – Key Potential Socio-economic Impacts

		Project Actions/ Activities	Land and Property	Community Health and Safety	Community tensions	Disruption of utilities	Economy	Employment	Education and training	Workforce related impacts	Communities "Quality of Life"
Pre-Construction and Construction Phase	1.	Above ground construction, earthworks, cut and fill or excavations, and building of liner at structures and stations, transmission lines	√	-	√	-	√	√	-	√	-
	2.	Temporary sites used for construction works (material storage and equipment maintenance camps) and housing of construction workers	√	-	√	√	-	-	-	-	-
	3.	Haulage roads	√	√	√	-	√	-	-	-	√
	4.	Construction traffic and machinery movement	-	√	√	-	-	-	-	√	-
	5.	Solid and liquid	√	√	√	-	-	-	-	-	
	6.	Blockage of village roads	-	-	√	-	√	-	-	√	-
	7.	Blockage of natural drainage system	-	√	√	√	√	-	-	-	√
Opreation Phase	1.	Noise and EMF	-	√	√	-	-	-	-	-	-
	2.	Conflict with local people due to the use of foreigners and migrant workers	√	√	√	√	√	√	-	-	√
	3.	Pressure on existing health care services, food accessible and security services	-	√	√	√	√	√	-	-	√
	4.	Presence of permanent ways for traction substations	-	√	√	-	-	√	√	√	-
	5.	Fire Hazard and electrical Hazard	√	√	√	-	√	-	-	-	√

According to the above consideration, the most possible environmental impacts will be impact on impact on surface water environment (blockage of natural drainage system and changes in hydrology regime), impact on soil environment (impact on agricultural land nearby) due to waste dumping site and effluent water, impact on biodiversity environment (noise, cutting of trees and hunting of animals), and impact on socio-economic environment (impacts related to migrant workers, noise, land acquisition and pressure on utilities use, blockage of drainage system and village road) and effect from electromagnetic field during operation.

5.1.2. Consideration of AOI

For railway power supply system, AOI will have to consider for (i) traction substations, (ii) access road to traction substations and (iii) power transmission line as follow:

Table 5.3 – Considerations of AOI for Traction Substations

Types of Impacts	Duration	Potential Impacts	Affected Receptors	Baseline Study	Considerations of AOI for
Environmental Impacts	During construction phase	Land use	- Impact on agricultural land, residential and forest areas	Baseline soil quality will be good due to less industrialization in rural area. Sensitive for land acquisition and some people do not have land right although they use the land for long time ago.	The land use for largest traction substation will be (85m×70m).
		Biodiversity	- Direct impact on flora diversity due to cutting of trees will be within 6000m^2 beside the substations - Indirect impact on fauna diversity due to constructio noise especially for generator - Indirect impact on flora and fauna diversity due to cutting of trees and killing of animals by migrant workers	Nature Reserve, National Park, Protected Area, National Park and ASEAN Heritage Park, Wildlife Sanctuary, Bird Sanctuary, Wildlife Park, Mountain Park, Wildlife Sanctuary and ASEAN Heritage Park, Elephant Range and Wildlife Sanctuary) are not included along Muse-Mandalay. But the CK 365 traction substation and San Lau Traction substation will cross the following reserved forest (such as Taung Kyun and Extended Taung Kyun forest and Nam Ma forest).	Impact on flora and fauna diversities for both direct and indirect impacts during construction phase due to the all of the tree cutting and hunting activities will be within 500m beside the traction substations.
	During operation phase	Noise	- Local residents - Fauna diversity	Ambient air quality and noise level are good according to the baseline study.	The noise level of substation will be approximately 73dB(A) from 15m away and all of the noise level will be less than 55dB(A) in day time and 45dB(A) in night time (National Emission Quality Guidelines) at the boundary of AOI (1000m).
		EMF	Nearest local residents and fauna diversity	Ambient air quality and noise level are good according to the baseline study.	Safe distance of EMF for 230KV traction station is 40 m (USBR,1980).

So, the AOI for 1km radius from the traction substation will be covered for the proposed traction substation project.

Table 5.4 – Consideration of AOI for Access Road to Traction Substations

Types of Impacts	Duration	Potential Impacts	Affected Receptors	Baseline Study	Considerations of AOI
Environ-mental Impacts	During constructi on phase	Land use	- Impact on agricultural land and forest area	Baseline soil quality will be good due to less industrialization in rural area. Sensitive for land acquisition and some people do not have land right although they use the land for long time ago.	The effect of land use of access road to railway station will be within 80ft beside the access road.
		Biodiversity	- Direct impact on flora diversity due to cutting of tree for railway station - Indirect impact on fauna diversity due to constructio noise - Indirect impact on flora and fauna diversity due to cutting of trees and killing of animals by migrant workers	Nature Reserve, National Park, Protected Area, National Park and ASEAN Heritage Park, Wildlife Sanctuary, Bird Sanctuary, Wildlife Park, Mountain Park, Wildlife Sanctuary and ASEAN Heritage Park, Elephant Range and Wildlife Sanctuary) are not included along Muse-Mandalay.	All access road will be 80ft wide and all activities for cutting the trees and hunting will be expected withing 1000ft beside the road.
	During operation phase	Dust	- Local residents - Flora diversity beside the road	Ambient air quality and noise level are good according to the baseline study.	All of the access road will be nylon concrete road and less impact on local resident and flora diversity and impact zone will be within 500m beside the road.

So, AOI for 500m beside the railway road will be covered for access road to traction substation.

Table 5.5 – Consideration of AOI for Transmission Lines

Types of Impacts	Duration	Potential Impacts	Affected Receptors	Baseline Study	Considerations of AOI
Environ-mental Impacts	During constructi on phase	Land use	- Impact on agricultural land and forest area	Baseline soil quality will be good due to less industrialization in rural area. Sensitive for land acquisition and some people do not have land right although they use the land for long time ago.	The effect of land use of transmission line will be within 100m.
		Biodiversity	- Direct impact on flora diversity due to cutting of tree for transmission line - Indirect impact on fauna diversity due to constructio noise - Indirect impact on flora and fauna diversities due to cutting of trees and killing of animals by migrant workers	Nature Reserve, National Park, Protected Area, National Park and ASEAN Heritage Park, Wildlife Sanctuary, Bird Sanctuary, Wildlife Park, Mountain Park, Wildlife Sanctuary and ASEAN Heritage Park, Elephant Range and Wildlife Sanctuary) are not included along Muse-Mandalay. But the transmission line will pass though the following forests such as Taung Kyun and Extended Taung Kyun forest, Taung Pyo and Extended Taung Pyo, Nwang Hkio forest, Goketwin forest, Namma Forest, Tain Lone, Pang Hsauk forest, Bone Mon forest, Loi Sam Sitt forest, Kaung Lang forest and Nam Palon forest.	Impact on flora and fauna diversities for both direct and indirect impacts during construction phase due to the all of the tree cutting and hunting activities will be within 1000ft beside the transmission line.
	During operation phase	EMF	Local residents and fauna diversity	There are a lot of natural drainage system and water spring along the railway alignment.	EMF for safe distance of 25KV traction station is 30 m (USBR,1980).
		Biodiversity (Fauna)	EMF	Most of the local residents near the alignment are villagers and very few number are dense populated area.	EMF radiation for all living things will be the same and can consider 30m is safe distance.
		Biodiversity (Flora)	EMF	The existing nosie quality is good and below the NEQ due to less industrilization in rural area.	No impact on flora diversity due to the low voltage transmission line.

So, AOI as 1km radius for traction substations, 500m beside the access road and 500m beside the transmission line will be covered for railway power supply system.

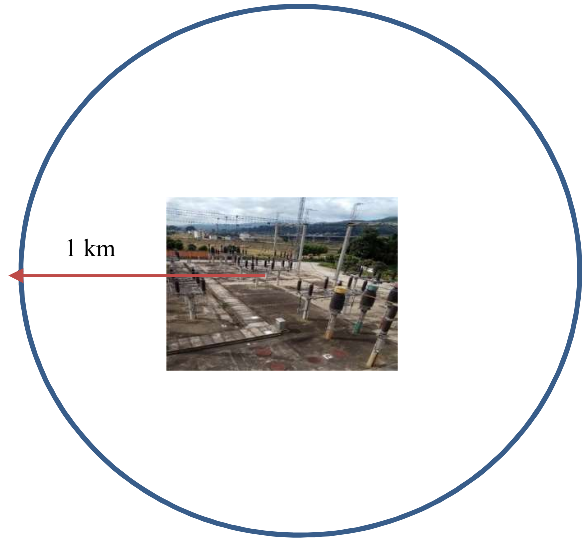


Figure 5.1 - AOI for Railway Traction Substation

Figure 5.2 - AOI for transm ission line

5.2. Methodology and Objectives for Environmental Baseline Study

Environmental baseline study was conduct by the following methodology and objectives. During feasibility stage, detailed baseline study for the 11 traction and 1 switching post was not able to conduct since the location of the traction substations may change along the line. Therefore, when the project is implemented, detailed baseline study for 11 traction substations, 1 switching post and transmission line will be carried out along with EMP-Construction Phase.

5.2.1. Methodology and Objectives for Ambient Air Quality

Objectives

Ambient air quality monitoring collects and measures samples of ambient air pollutants to evaluate the status of the atmosphere as compared to clean air standards and historical information. Monitoring helps in assessing the level of pollution in relation to ambient air quality standards. Standards are a regulatory measure to set the target for pollution reduction and achieve clean air.

Methodologies

Ambient Air Quatity monitoring will be conducted by Haz-Scanner EPAS by the following methodologies.

Figure 5.3 - Haz-Scanner EPAS for Ambient Air Quality Monitoring

Monitoring Parameters

The parameters for ambient air quality monitoring will be SO_2, NO_2, CO_2, CO, H_2S, O_3, $PM_{2.5}$ and PM_{10}.

Sampling Rate and Sensors

Determination and analysis of ambient air qualities were conducted by using Haz-Scanner Environmental Perimeter Air Station (EPAS).

Sampling rate of air quality will be recorded automatically every one minute for important gases (Sulfur dioxide, Nitrogen dioxide, Carbon dioxide, Carbon monoxide, Hydrogen sulfide, Particulate matter, Hydrogen sulfide and Ozone) to describe ambient air quality. Sampling pump was adjusted to 2 liter/min. Different analysis methods will be integrated in the instrument, such as particulates 90° Infrared Light Scattering for particulate matters (PM_{10}, $PM_{2.5}$), electrochemical sensors for toxic gases (SO_2, NO_2, CO, H_2S), NDIR (optional sensor) for (CO_2) and Gas Sensing Semiconductor- GSS technology (optional sensor) for O_3.

Table - Important Gases for Ambient Air Quality

No.	Parameters	Analysis Methods
1.	Sulfur dioxide (SO_2)	Electrochemical sensors
2.	Nitrogen dioxide (NO_2)	Electrochemical sensors
3.	Carbon Dioxide (CO_2)	NDIR (optional sensor)
4.	Carbon monoxide (CO)	Electrochemical sensors
5.	Hydrogen Sulfide (H_2S)	Electrochemical sensors
6.	Particulate matter 2.5 ($PM_{2.5}$)	Infrared Light Scattering
7.	Particulate matter 10 (PM_{10})	Infrared Light Scattering
8.	Ozone (O_3)	Gas Sensing Semiconductor- GSS technology (optional sensor)

5.2.2. Methodology and Objectives for Existing Noise Level

Objectives

As the construction and operation of railway power supply will impact on existing noise level, existing noise level will have to monitor as baseline study.

Methodology

The approach will be based on SANS 10328:2008, 'Methods for Environmental noise impact assessments' as well as the IFC PS and Equator Principles. The technical guidelines will be based on good engineering practice, SANS 10103:2008, 'The measurement and rating of Environmental noise with respect to annoyance and to speech communication' and the IFC EHS Guidelines for noise.

Scope of Work

Proposed project along railway network generally rural and agricultural nature of the existing environment, noise levels can be predicted to be low. So, measure the present ambient noise levels will be done along the proposed railway project.

Noise Level Monitoring Equipment

To monitor the existing noise level, the team will use TES-1353H Integrating Sound Level Meter which is applicable with IEC61672-1: 2003, IEC60651: 1979, ANSI S1.4: 1983 and IEC60804: 1985 standards. Existing noise level will be monitored in both day time (07:00 to 22:00) and night time (22:00 to 07:00).

Figure 5.4- TES 1353H Integrating Sound Level Meter

Noise Quality Monitoring Results

The results for noise level monitoring will be calculated by using Panel V8.01 Software as follow:

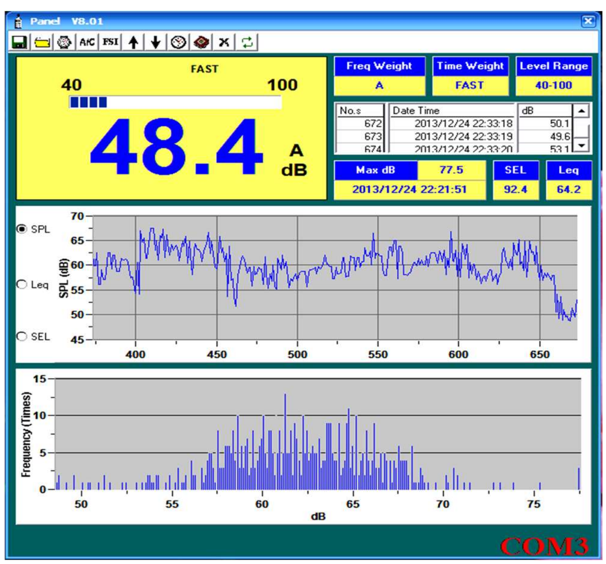


Figure 5.5 - Integrating Sound Level Software (Panel V8.01)

Noise Level Monitoring Standard

Noise level monitoring results will be compared with Myanmar Emission Guidelines, 2015 for residential, institutional and educational areas as follow:

Table - Noise Level Monitoring Standard

Receptor	One Hour LAeq (dBA)[a]	
	Day time (07:00-22:00) (10:00-22:00 for Public holidays)	Night time (22:00-07:00) (2200-10:00 for Public holidays)
Residential, Institutional, Educational	55	45

Source: Myanmar Emission Guidelines (2015)

5.2.3. Methodology and Objectives for Existing Vibration Level

Objectives

Vibration impact assessment will be made to monitor the existing vibration level and to predict the vibration level of railway on bridge when the rail travel during operation phase.

Methodology

Existing vibration level will monitor by using g vibration level by ground blast vibration meter (Vibro Series) and prediction of vibration level at nearest local residents within 1km radius of the proposed bridge project.

Figure 5.6 - Vibro Vibration Meter

Analysis Method

The ground vibration can be measured at a remote point and displacement, particle velocity, particle acceleration and frequency can be measured. The measuring equipment should be capable of providing a direct reading of the maximum instantaneous peak particle velocity, which is the vector sum of the three orthogonal ground vibration components detected by the geophone.

Ground vibration should be measured with tri-axial transducers, and the measurement equipment should have a maximum absolute error of 15% over a frequency range of 5 Hz (lower cut-off frequency) to 250 Hz. The dynamic range of the equipment should be sufficient for the vibration levels to be measured.

The instrument should have these three components: tri-axial transducer, processor and recorder. They should be interconnected with cables. The recorder should give a printed recording of the date, the time, and the resultant peak particle velocity as measured by the transducer.

5.2.4. Methodology and Objectives for Existing Soil Quality

Objective

The objectives of the soil quality assessment for will be as follow:

- To assess the current physical and chemical status of the greenfield area targeted for the development;
- To determine the pre-development land capability of the soil cover to be affected by the proposed project; and
- To assess the expected impacts posed on the soil resource by the proposed development.

Methodologies

The entire area comprises greenfields. In terms of the legislation it is proposed to conduct a soil investigation based on the Soil Classification System for SA, 1991. Such an assessment will include a physical investigation of the soil cover to be disturbed by the tunneling. The scope of work entails the following:

- Conduct a desktop study as a prerequisite prior to a field visit;
- Conduct a field visit during which a physical assessment of the soil covering the areas to be disturbed will take place;
- Compile soil, land use and land capability maps for the assessed area; and
- Compile a report on the findings and results of the assessed area.

Desktop Study

A desktop study will be conducted to gain a general understanding of the soil resource covering the area in question. Existing broad scale maps will be obtained and reviewed to address the input requirements for the EIA report.

In-field Soil Assessment

In preparation for a field visit soil survey locations will be generated to optimise coverage of the expected soil types. Actual field mapping and classification will be supported by soil profiling to serve as a platform for detail level mapping. During soil mapping, the extent of ecologically sensitive areas, such as wetlands, will be identified and delineated on the basis of soil types. The following attributes listed recorded at each location point:

- Soil form and depth;
- Estimated soil texture and structure;
- Content of coarse fragments;
- Underlying material;
- Current land use; and
- Land capability.

Sampling of Representative Areas

Chemical balance in the soil profile may be subjected to disturbance during the planned development and post-activity restoration. In order to obtain fertility status of the soil resource prior to commencement of any development activities, a sampling program is recommended in conjunction with the soil mapping exercise.

The sampling of major delineated units is good practice. A maximum of 4 sample locations are deemed sufficient to exhibit the required soil properties and chemical status. The following analysis package is proposed and will be submitted to the laboratory of the Department of Agricultural:

- Particle size distribution on selected samples (3-fraction testing);
- pH (water);
- Exchangeable cations Na, K, Ca, Mg (Saturated paste method);
- Phosphorus (Bray1 method);
- Organic carbon content on selected topsoil samples (Walkley Black method); and
- Electrical conductivity (indication of salt presence).

Testing of Soil Quality

All of the soil samples will be tested in National Laboratory under the Myanma Research and Innovation Department.

5.2.5. Methodology and Objectives for Existing Biodiversity Situation

Objectives

- Undertaking the collection of baseline environmental data;
- Characterisation of the baseline Environment;
- Identification, and assessment of key adverse impacts that may result from the activities of the project;
- Identification, assessment and recommendations of appropriate and practical mitigation measures to remove or minimize the adverse impacts identified; and
- Providing specialist ecological input into the Environmental and Social Management Plan (ESMP).

Methodology

This section considers the effects that the proposed project might have on biological, nature conservation resources including habitats, species, and individual sites of nature conservation value. It addresses effects at all stages of the project cycle, including site clearance and construction, operation, and decommissioning.

Desk Based Research

Data on statutory designated sites within 5 km of the proposed project boundary, non-statutory designated sites within 2 km, and protected species within 2 km were requested or gathered from the existing records. Publications mainly consulted included: National Biodiversity Strategy and Action Plan 2011 and National Biodiversity Strategy and Action Plan 2015-2020.

Study Area and Biodiversity Opportunity Areas

Muse-Mandalay Railway starts from Muse port of entry at the north, goes south to Mandalay, the second largest city in Myanmar, and connects cities, towns such as Muse port of entry, Lashio, Pyin Oo Lwin and so on. Biodiversity Opportunity Areas are areas identified as being particularly beneficial for implementing conservation measures.

Proposed Method of Assessment

The assessment will address habitats, plant and animal species and sites of special importance for any of these. It will address these receptors in their scientific, ecosystem functioning, and nature conservation aspects only. It will not address them in respect of their contribution to agriculture or the landscape, nor in their socio-economic aspects. These matters will be addressed in the appropriate chapter.

- ✓ London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London, 1990 (Date Ratified: 1993)
- ✓ United Nations Framework Convention on Climate Change (UNFCCC), New York, 1992 (Date Ratified: 1994)
- ✓ Convention on Biological Diversity, Rio de Janeiro, 1992 (Date Ratified: 1994)
- ✓ Stockholm Convention on Persistent Organic Pollutants (POPs), 2001 (Date Ratified: 2004 (Accession))

Desk-based Studies

- ✓ Records will also be requested from governmental and non-governmental natural history and conservation groups that are likely to be consulted as part of the ecological assessment process.
- ✓ An air-photo assessment of border networks in an 2-5 km buffer around the proposed project site will be conducted.
- ✓ A further search for published literature and reports of previous surveys relevant to the survey area will be conducted.

Field Surveys

A number of habitat and species surveys have been and will be undertaken and he following additional field surveys will be required:

- ✓ initial surveys of areas for which access was not available in May 2019 (follow-on surveys that arise from the findings);
- ✓ scientifically botanical surveys
- ✓ scientifically fauna surveys
- ✓ scientifically bat surveys

Interview Survey for Flora and Fauna

In addition to the field observation, secondary data will also surveyed by interviewing local residents and through literature review. In the interview survey, the surveyor visited the residents in and around the survey area and asked about the name of plants and animals existing in and around the area.

Data Analysis of Plant species

Samples of some species were not directly identified in field. After field trip, plant identification will be conducted based on available literatures such as key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994), Backer *et. al.*(1963), Kress *et. al.* (2003), Gardner *et al.* (2000), Caton *et al.* etc., and verification will be also conducted by recorded field photographs and some useful internet websites. Finally, the threatened levels of plant species of the survey area will be chacked and mentioned in accordance with "The IUCN Red List of Threatened Species, 2018"

Data Analysis of Fauna Species

- ✓ **Bird Species:** The recorded species will be then identified using reference books.
- ✓ **Mammal Species:** All data recorded in the survey area will be entered into the field data sheet. Information on some species will obtained from interviews with the local people.

Consultation

The following groups having a statutory role in the EIA process will be consulted:

- ✓ the local authority Planning and Biodiversity officer
- ✓ Environment Agency and
- ✓ Non-Governmental Organization

In addition, a wide range of non-statutory natural history and nature conservation groups will be consulted.

Procedure Impact Assessment

In order to assess the likely significant environmental impacts, potential Impacts of the Proposed Project will be preliminary identified based on the project description and overall environmental conditions. The impacts of flora and fauna will be classified as A to D in accordance with the following criteria, assuming no specific measures toward the impacts are taken:

1) A-: Significant negative impact A+: Significant positive impact
2) B-: Some negative impact B+: Some positive impact
3) C: Impacts are not clear, need more investigation
4) D: No impact or impacts are negligible, no further study required

5.2.6. Methodology and Objectives for Surface Water (Hydrology) Conditions

Objectives

The surface water study will focus on the characterisation of the baseline hydrology at the project site and assess the potential impacts on surface water due to project development. The following tasks are proposed:

- Compilation of a baseline report to characterise the existing hydrology and water quality of the area;
- Development of floodlines for the area; and
- Development of a stormwater management plan for the site.

Scope of Work

The scope of work for the surface water assessment is provided below.

Site Visits

Two site visits are proposed. The first visit will be a reconnaissance visit to understand the situation in site. The further two visits are to set up the baseline monitoring program and take field measurements.

Hydrology Study

It aims at assessing sensitivity of the baseline hydrological environment and the potential impacts of the proposed development upon it and proposes mitigation measures in order to ensure that the potential adverse impacts of the proposed project development on the hydrological environment will be slight and neutral. The potential impacts on the surface water environment from the proposed project development, in the absence of suitable mitigation measures, are considered to be as follows:

- Direct impacts of the project construction on the hydrological environment for example contamination of surface water (if encountered in excavations) from the spillage/leakage of fuels from vehicles and fuel/ waste storage areas.
- Direct impacts from excavated areas (overburden) where vegetation has been removed through release of silt laden surface water runoff into local watercourses due to soil erosion and increased volumes of surface water runoff.
- Direct impacts of project operation on the hydrology for example, surface water contamination from minor leakage of oil from train (locomotive) or filling point used at the stations.

Water Quality Testing

All of the surface and ground water quality will be tested in Water Quality Testing Laboratory under the Department of Occupational Health.

Significance Criteria

Relevant documentation gathered from diverse sources categorize impact into five (5) categories to aid in assessing the potential impacts of the proposed development on the hydrological environment in terms of how significant an impact may be on the overall environment as follows:-

***Imperceptible Impact*:** An impact capable of measurement but without noticeable consequences.

Slight Impact: An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.

***Moderate*:** An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.

Significant Impact: An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

***Profound Impact*:** An impact which obliterates sensitive characteristics.

5.2.7. Methodology and Objectives for Existing Visual Condition

As power station construction will cause some visual impact and the followings are the methodologies for visual impact study.

Objectives

The objectives of the Visual Impact Assessment (VIA) will be to:

- Assess the baseline conditions of the visual context within which the proposed project will take place;
- Determine what visual receptor groups may potentially be affected by the project;
- Establish what visual impacts may potentially arise as a result of the project and determine their social significance; and
- Investigate possible methods with which the potential impacts may be mitigated.

Methodologies

The specific scope of works is briefly described below:

- The VIA will assess the value of the study area as a visual resource, as a function of its perceived aesthetic value, and will assess the magnitude and significance of the potential visual impact of the proposed activities;
- A Visual Resources Analysis will be carried out, which will identify elements that are considered to be of visual significance. Conversely elements that detract from the visual quality of the landscape will also be identified;
- A Visual Receptor Analysis will be done which will identify receptors that may be negatively impacted upon by the proposed activity. This will include adjacent landowners as well as significant commuting routes and areas where large groups of people may congregate;
- The VIA will also explore potential visual mitigation strategies and implementation measures that need to be considered during construction and implementation, operations and possible closure of the proposed project.

5.2.8. Methodology and Objectives for Waste and Utilities Consumption

Objectives of the Waste and Utilities Assessment

The objectives of the Waste and Utilities Assessment will be to:

- Identification, and assessment of key adverse impacts that may result from the consumption of waste and utilities;
- Determine what natural resources may potentially be affected by the project;
- Investigate possible methods with which the potential impacts may be mitigated.

- Identification, assessment and recommendations of appropriate and practical mitigation measures to remove or minimize the adverse impacts identified; and
- Providing specialist waste and utilities management to input into the Environmental and Social Management Plan (ESMP).

Scope of Work

The specific scope of works is briefly described below:

- Identification of site specific water use, electricity use and waste management activities including monitoring and control activities relating to the development in operational mode;
- Formulation of a set of strategies and actionable objectives for the sustainable water use or waste management approach for the current development. This will lead to a range of management measures to meet the set goals and objectives.

5.2.9. Cultural and Heritage

Objectives

The preparation of cultural and heritage impact accessment involves the listing of

- Classified or listed monuments and sites together with their protective perimeter, and the perimeters of Areas of Protection of Architectural, Urban and Landscape Heritage,
- Known Archaeological areas and areas of high archaeological potential.
- Declaration file that contains the description of works, the surface area used as a basis for calculating the preventive archaeology fees and impacts on the subsurface.

Methodology

In fact, there are possible necessaries to do cultural heritage assessment as follows;

1. Baseline data for the existing cultural heritage sites
2. The potential impacts on the cultural heritage sites and landscape
3. Making cultural map
4. Writing the strong mitigation and monitoring plans to reduce the negative impacts

5.2.10. Methodology and Objectives for Ground and Geology and Geotechnical Conditions

Objectives

One inch topographic map of the Myanmar Survey Department, Landsat satellite image was used as a base map in the field. The lithologic characters, dip and strike of the beds of various stratigraphic units were studied and plotted on the base map. Tape and compass traverse method and surveying are used in the field.

Literature surveying concerning about the geology of the northern Shan State along the Muse-Mandalay railway line was done and applied in the field. Stratigraphic studies and samplings were carried out with the GPS locations in the area. These samples were examined using a polarizing microscope, for the petrographic studies and mineralogical investigations. Major and minor elements of sixty rock samples, forty ore samples were analyzed using X-ray fluorescence (WDXRF) and Atomic Absorption Spectrometer (A.A.S).

Methodology

Ground and Geology Assessment

Ground and geological impact assessment will include:

(1) Geological characteristics;
(2) Tectonic setting;
(3) General geology and engineering geology;
(4) Geological hazard;
(5) Neotectonic movement characteristics;
(6) Flood and fault;
(7) Earthquake and active fault; and
(8) Mineral deposite.

Geotechnical Assessment

Geotechnical assessment will include krast, land slide and talus, unstable rock and rock fall, bedding, seismic liquification, soft soil, high ground stress, ground motion parameter zonization.

5.3. Public Administration and Planning

As the project will be in FS stage, the detailed data for the project construction and operation phase have not been identified. Generally, the construction of the project will be also be conducted by CREEC and/or tender winning company after the international tendering process. The operation of the Muse-Mandalay Railway will be conducted by MR and tender winning company.

5.4.Environmental Baseline Quality

5.4.1. Air Quality

Emission of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of the project. These activities can be point sources, fugitive sources, and mobile sources and by process such as Transportation, vehicles Movements, combustion, materials storage, or other specific processed. projects will prevent or minimize impacts by ensuring that emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standard, and emission do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards.

Survey Item

As the railway construction and operation will have no significant impact on air quality, and the main impact on air quality will be gaseous and particulate matter (PM) emission during construction phase. So, the parameters for air quality survey were SO_2, NO_2, CO_2, CO, $PM_{2.5}$, and PM_{10}, Temperature, Relative Humidity, Wind Speed and Wind Direction, and Noise.

Methology for Selection of Air Quality Monitoring Stations

Except for the area in Mandalay Division, the area in Shan State where the alignment passess are mostly in remote area which is partially controlled by EAOs and so difficult to made monitoring in that areas during crisis period of EAOs and Myanmar Military between 2019 to 2020. So it was unable to carry out ari quality monitoring in nearsest places close to alignment and ambient air quality monitoring were conducted near the intersection point of railway and road way. Therefore, the survey for ambient air monitoring was carried out on chosen parts of NH3 highway (Muse to Mandalay) which is closest to the railway line. Moreover, the selected monitoring point is near location of batching plant (focal place of construction site) and residential areas. Since the pollutants will be generated mainly from batching plant and site during construction stage, there will be impact on air environment due to operation of concrete batching plant and construction activities. Moreover, during impact assessment of operation phase, there is less impact on air environment as the project will use electric-train so air sampling points will not be needed for further monitoring. So, air quality monitoring near batching plant (focal place of construction site) during construction phase will be enough for ambient air quality. The air quality survey was carried out in 18 locations. AS-1, AS-2, and AS-7were located near railway station project area. If needed, air quality monitoring will be made along the railway as in EMP-OP. The details of the location of air quality survey points are presented in figure below during May 2019.

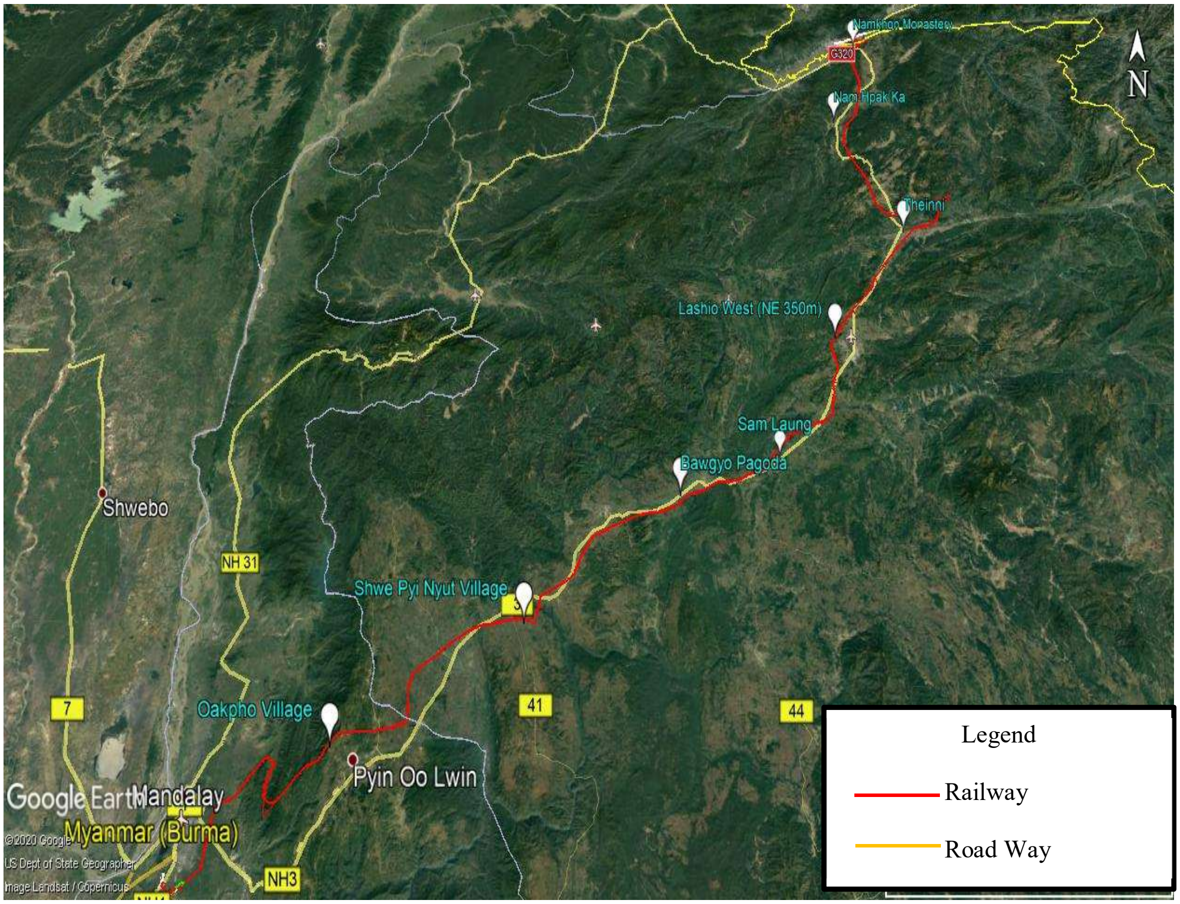
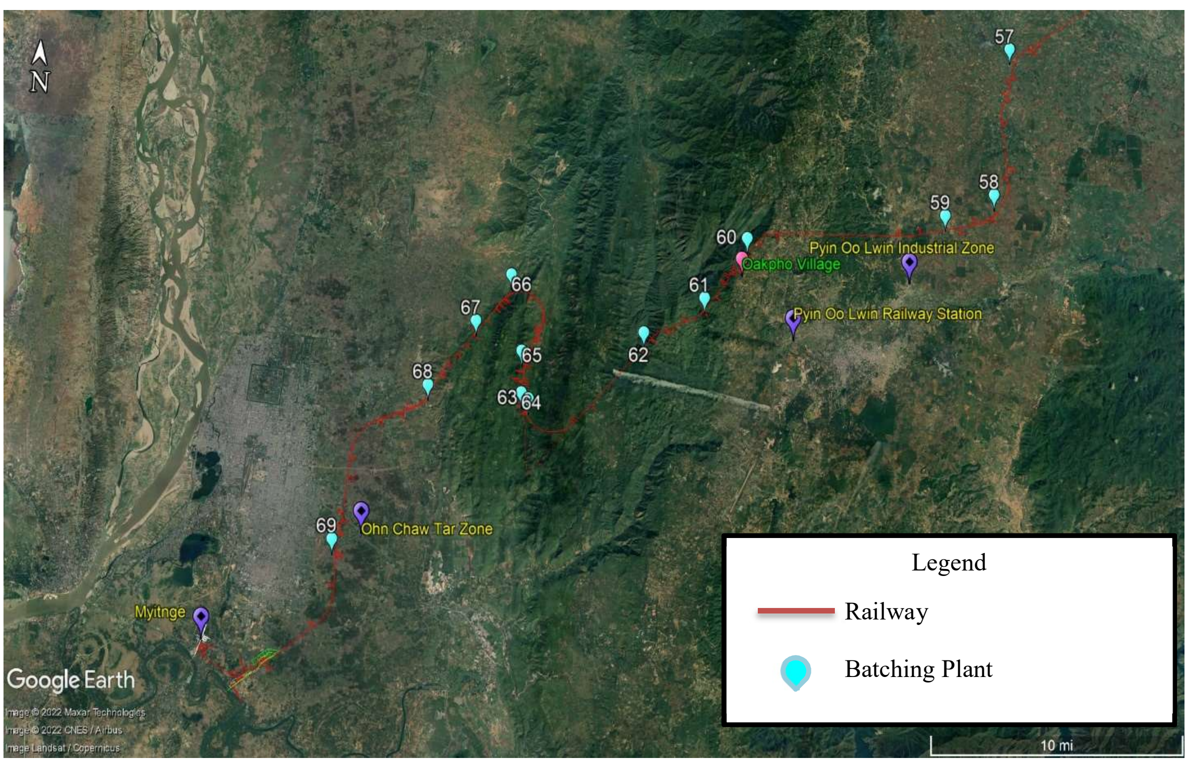


Figure - Locations of Railway and Road Way in Google Map



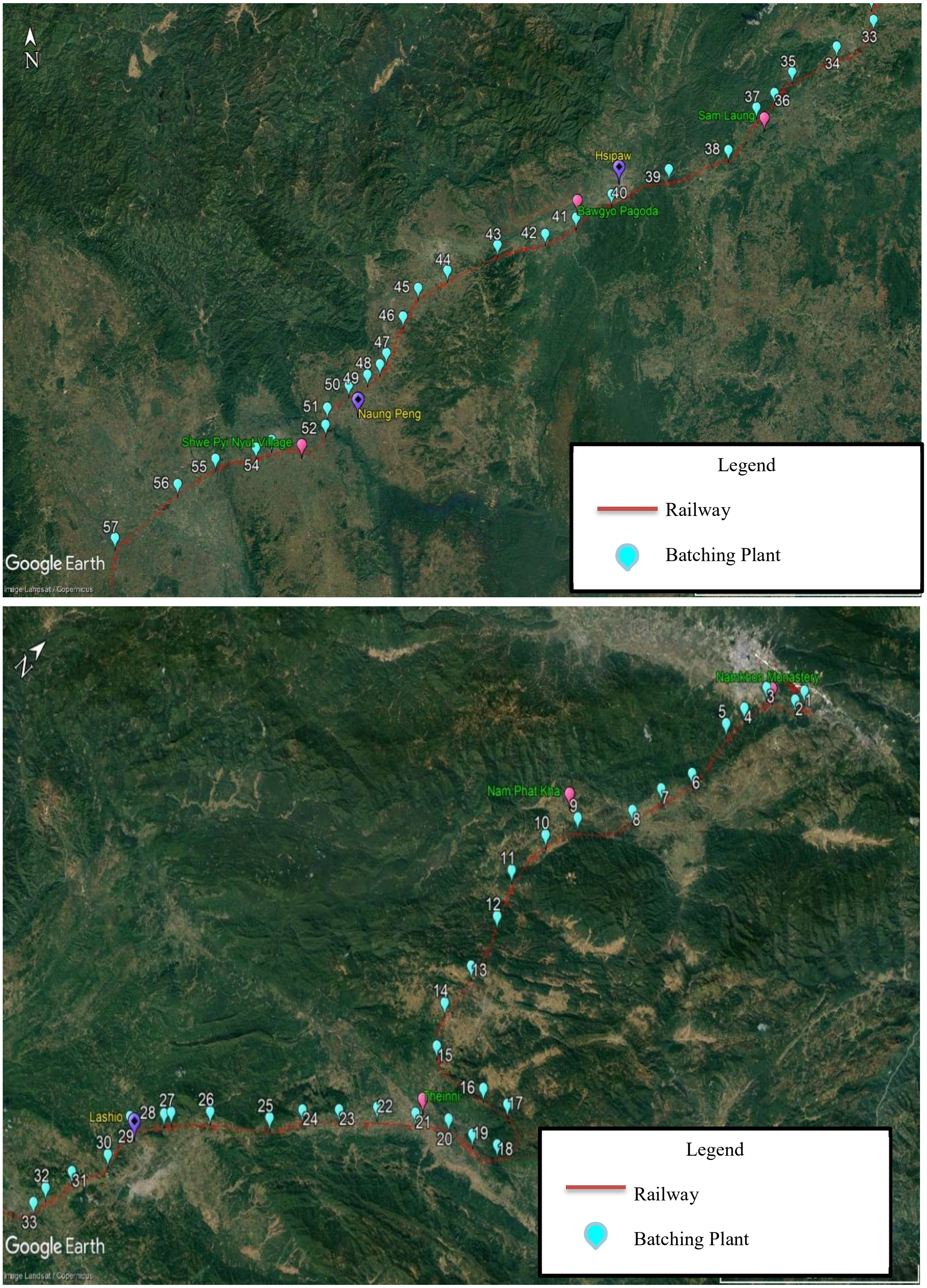


Figure 5.7 – Location of Air Sampling Points along the alignment line

Table 5.6 - Location of Ambient Air Quality Sampling of the Muse-Mandalay Railway Project for Dry Season

Sr. No	Sample Name	Coordinates		Remarks
		Latitude(N)	Longitude(E)	
1	AS0	21° 51'11.93"N,	96° 4'17.38"E	Myitnge Railway Station
2	AS-1	21° 52'48.75"N,	96° 13'34.70"E	Ohn Chaw Tar Zone
3	AS-2	22° 2'13.97"N,	96° 27'57.83"E	Pyin Oo lwin Railway Station
4	AS-3	22° 3'30.29"N,	96° 29'51.88"E	Pyin Oo Lwin Industrial Zone Public Area
5	AS-4	22° 21'4.94"N,	96° 54'50.62"E	Naung Peng Rail way station
6	AS-5	22° 37'5.20"N,	97° 17'40.17"E	Hsipaw Railway Station
7	AS-6	22° 58'22.88"N,	97° 43'50.33"E	Lashio Railway Station

Survey Methodology

Sampling and analysis of ambient air quality were conducted by referring to the recommendation of the United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner Environmental Perimeter Air Station (EPAS) was used to collect ambient air quality. Sampling rate or air quality data were measured automatically every one minute and directly read and recorded onsite for measured parameters (SO_2, NO_2, CO_2, CO, H_2S, O_3, CH_4, PM_{10}, $PM_{2.5}$), as shown in Table. Sampling pump was operated at 2 L/min. Different analysis methods are integrated in the instrument, such as Particulates 90° Infrared Light Scattering for particulate matters (PM_{10}, $PM_{2.5}$), electrochemical sensors for toxic gases (SO_2, NO_2, CO, H_2S), NDIR (optional sensor) for (CO_2, CH_4) and Gas Sensing Semiconductor- GSS technology (optional sensor) for O_3.

Sampling and Analysis Method for Air Quality

No.	Parameter	Analysis Method
1	Sulfur dioxide (SO2)	On site reading
2	Nitrogen dioxide (NO2)	On site reading
3	Carbon Dioxide (CO2)	On site reading
4	Carbon monoxide (CO)	On site reading
5	Hydrogen Sulfide (H2S)	On site reading
6	Particulate matter 2.5 (PM2.5)	On site reading
7	Particulate matter 10 (PM10)	On site reading
8	Methane (CH4)	On site reading
9	Hydrogen Sulfide (H2S)	On site reading
10	Solar Radiation	On site reading
11	Wind Direction	On site reading
12	Wind Speed	On site reading
13	Temperature	On site reading
14	Relative Humidity	On site reading
15	Ordor	On site reading
16	Noise and Vibration	On site reading

Figure 5.8 - Sampling Location Point One, AS0, 21°51'11.93"N, 96° 4'17.38"E Myitnge Railway Station

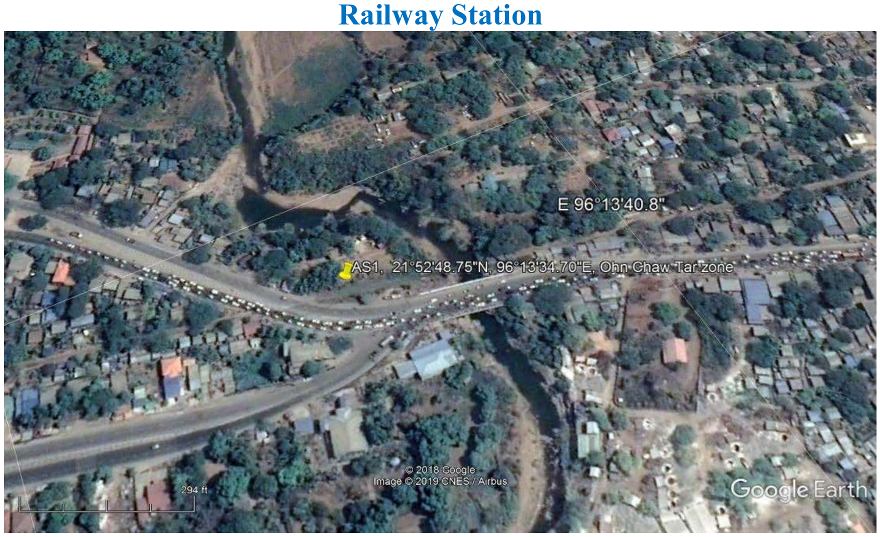


Figure 5.9 - Air Sampling Location Two, AS1, 21°52'48.75"N, 96°13'34.70"E Ohn Chaw Tar Zone

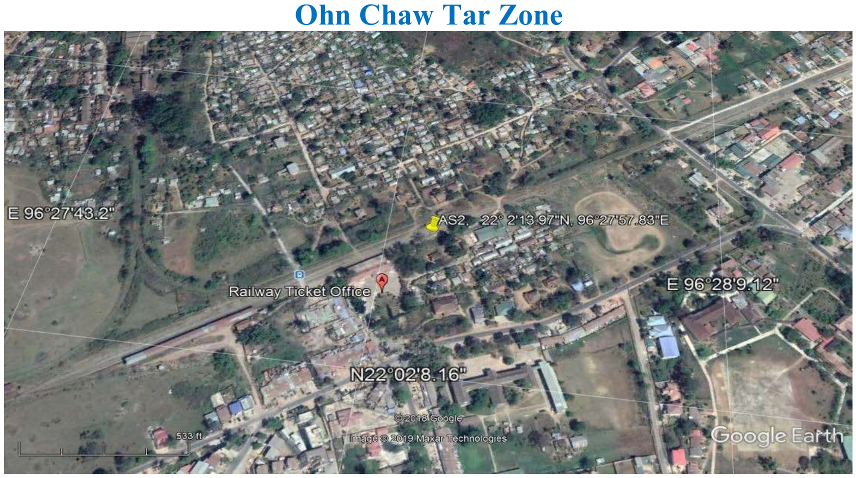


Figure 5.10 - Air Sampling Location Point Three, AS2, 22° 2'13.97"N, 96°27'57.83"E Pyin Oo lwin Railway Station

Figure 5.11- Air Smapling Location Four, AS3, 22° 3'30.29"N, 96°29'51.88"E Pyin Oo Lwin Industrial Zone Public Area

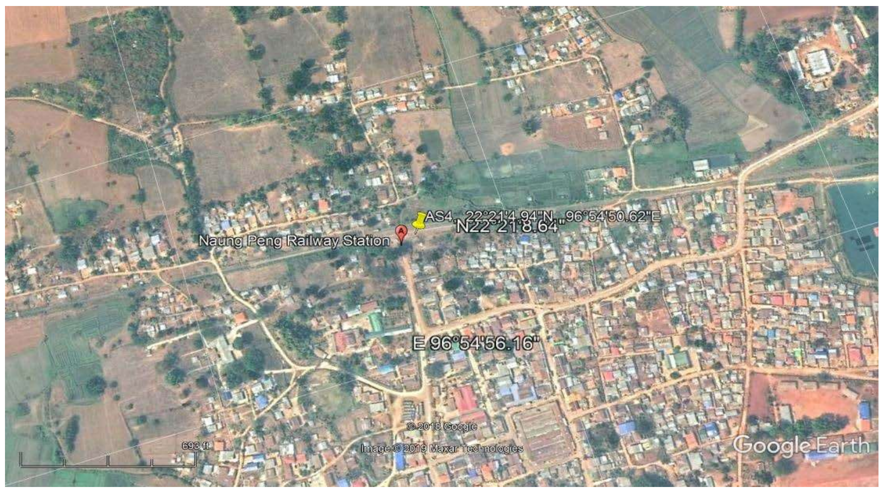


Figure 5.12-Air Smapling Location Five, AS4, 22°21'4.94"N, 96°54'50.62"E Naung Peng Rail way station

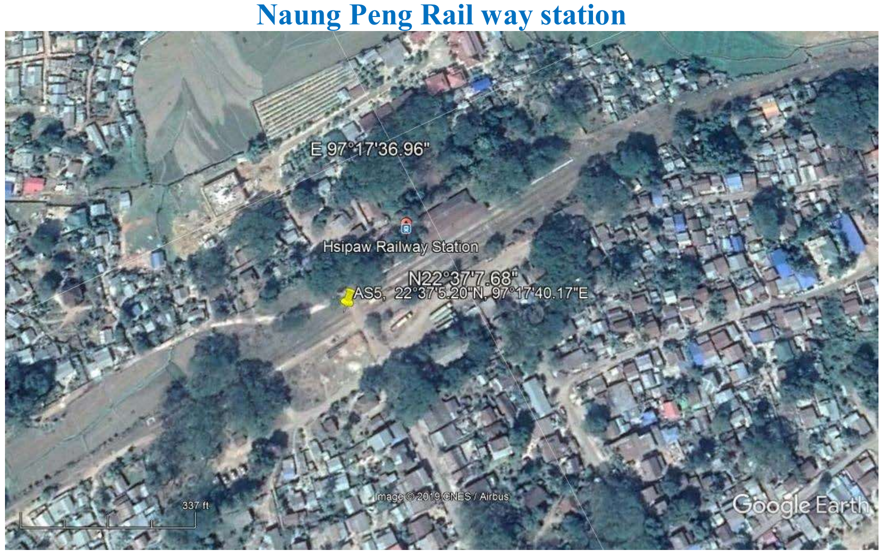


Figure 5.13 - Air Sampling Location Point Six, AS5, 22°37'5.20"N, 97°17'40.17"E Hsipaw Railway Station

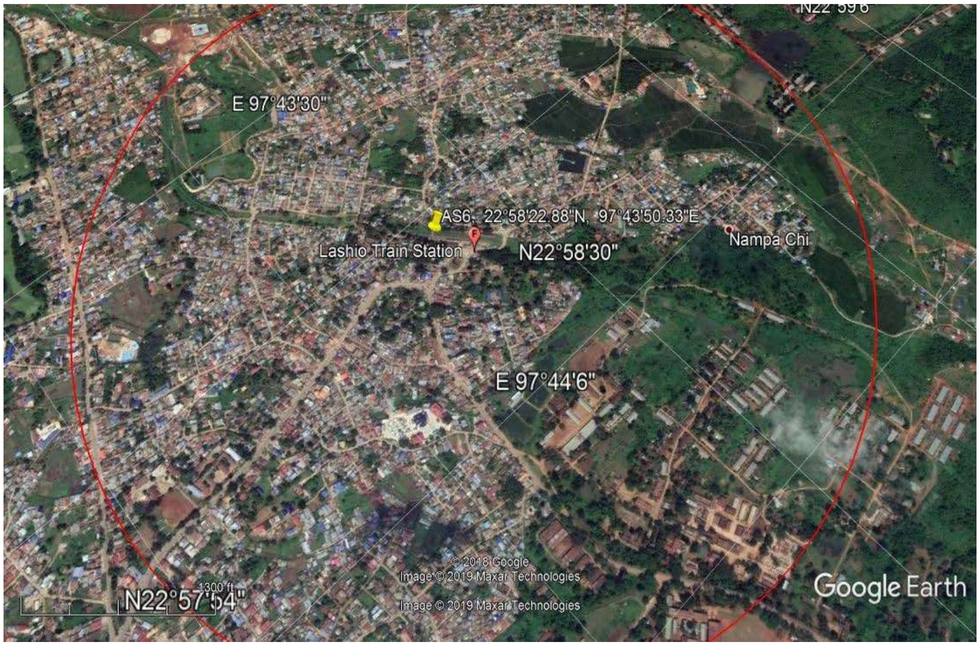


Figure 5.15 - Air Sampling Location Point Seven, AS6, 22°58'22.88"N, 97°43'50.33"E Lashio Railway Station

Table 5.7 - General Conditions of Ambient at the Time of Sampling on Points

Sr.	Latitude(N)	Longitude(E)	Air Temp	WBT	Dew Point	Humidity
1	21° 51'11.93"N,	96° 4'17.38"E	31.6°	33.2°	30.6°	74.6%
2	21°52'48.75"N,	96°13'34.70"E	40°	28.8°	27°	51.1%
3	22° 2'13.97"N,	96°27'57.83"E	36°	28.3°	26.7°	55.5%
4	22° 3'30.29"N,	96°29'51.88"E	34°	28.2°	28.1°	66.2%
5	22°21'4.94"N,	96°54'50.62"E	34°	28.2°	26.7°	70.9%
6	22°37'5.20"N,	97°17'40.17"E	33°	27.2°	27.5°	64.3%
7	22°58'22.88"N,	97°43'50.33"E	33.11°	27.7°	26.6°	61.5%

Table 5.8 - Assessment of Ambient Air Quality in the Project

Sr.	Locations		Air Temp	WBT	Dew Point	Humidity	CO2 (ppm)
1	21°51'11.93"N,	96° 4'17.38"E	Low	Low	Low	Medium	Low
2	21° 52'48.75"N,	96° 13'34.70"E	Low	Low	Low	Medium	Low
3	22° 2'13.97"N,	96° 27'57.83"E	Low	Low	Low	Medium	Low
4	22° 3'30.29"N,	96° 29'51.88"E	Low	Low	Low	Medium	Low
5	22° 21'4.94"N,	96° 54'50.62"E	Low	Low	Low	Medium	Low
6	22° 37'5.20"N,	97° 17'40.17"E	Low	Low	Low	Medium	Low
7	22° 58'22.88"N,	97° 43'50.33"E	Low	Low	Low	Medium	Low

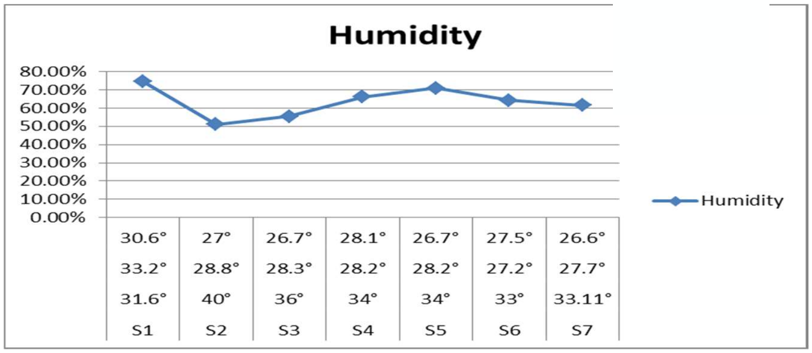


Figure - Humidity

Table 5.9 - Wind Speed and Air Direction

Sr. No	Sample Name	Coordinates		Remark
		Latitude(N)	Longitude(E)	
1	AS0	21° 51'11.93"N,	96° 4'17.38"E	AS0, Myitnge Railway Station
2	AS-1	21° 52'48.75"N,	96° 13'34.70"E	Ohn Chaw Tar Zone
3	AS-2	22° 2'13.97"N,	96° 27'57.83"E	Pyin Oo lwin Railway Station
4	AS-3	22° 3'30.29"N,	96° 29'51.88"E	Pyin Oo Lwin Industrial Zone Public
5	AS-4	22° 21'4.94"N,	96° 54'50.62"E	Naung Peng Rail way station
6	AS-5	22° 37'5.20"N,	97° 17'40.17"E	Hsipaw Railway Station
7	AS-6	22° 58'22.88"N,	97° 43'50.33"E	Lashio Railway Station

Wind speed and wind direction of proposed Muse Mandalay Railway Project site had been measured by using EPAS

Table - Wind Speed and Air Direction of AS1

Date	Time	WDir, Deg.	WSpM,mps	Date	Time	WDir, Deg.	WSpM,mps
19-5-2019	11:46:01	292	4.8	19-5-2019	12:54:01	264	8.7
19-5-2019	11:50:01	298	3.4	19-5-2019	12:55:01	257	6
19-5-2019	12:00:01	176	2.3	19-5-2019	12:56:01	249	6.3
19-5-2019	12:10:01	134	0.8	19-5-2019	12:57:01	265	6.6
19-5-2019	12:20:01	22	0	19-5-2019	12:58:01	242	5.4
19-5-2019	12:30:01	284	0	19-5-2019	12:59:01	252	5.8
19-5-2019	12:40:01	225	7.4	19-5-2019	13:00:01	231	6.6
19-5-2019	12:50:01	253	4.8	19-5-2019	13:01:01	254	8.1
19-5-2019	12:51:01	240	5.3	19-5-2019	13:04:01	236	9.6
19-5-2019	12:52:01	248	7	19-5-2019	13:05:01	233	10.5
19-5-2019	12:53:01	260	8.2	19-5-2019	13:07:01	240	8.3

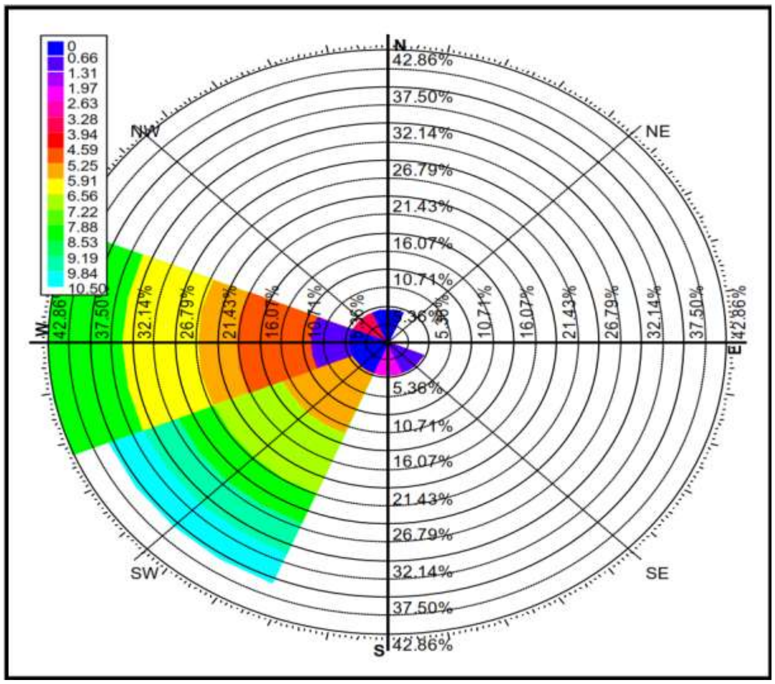


Figure - Wind Rose Diagram at AS1 at Myitnge Railway Station

Table - Wind Speed and Air Direction of AS2

	Sample Name	Coordinates		Rema			
		Latitude(N)	Longitude(E)	Sensitive Areas			
	AS-2	21° 52'48.75"N,	96° 13'34.70"E	Ohn Chaw Tar Zone			
Date	Time	WDir, Deg.	WSpM,mps	Date	Time	WDir, Deg.	WSpM,mps
19-5-2019	14:40:01	161	1	19-5-2019	15:21:01	148	0
19-5-2019	14:45:01	166	1	19-5-2019	15:24:01	170	0.2
19-5-2019	14:50:01	178	0.4	19-5-2019	15:27:01	193	0.2
19-5-2019	14:55:01	147	2	19-5-2019	15:30:01	151	0
19-5-2019	15:00:01	160	0.7	19-5-2019	15:33:01	208	0.3
19-5-2019	15:05:01	154	0.2	19-5-2019	15:34:01	179	3.2
19-5-2019	15:10:01	132	0.1	19-5-2019	15:36:01	280	0.8
19-5-2019	15:11:01	157	0.6	19-5-2019			
19-5-2019	15:12:01	131	0.2	19-5-2019			
19-5-2019	15:15:01	149	0.5	19-5-2019			
19-5-2019	15:18:01	149	0	19-5-2019			

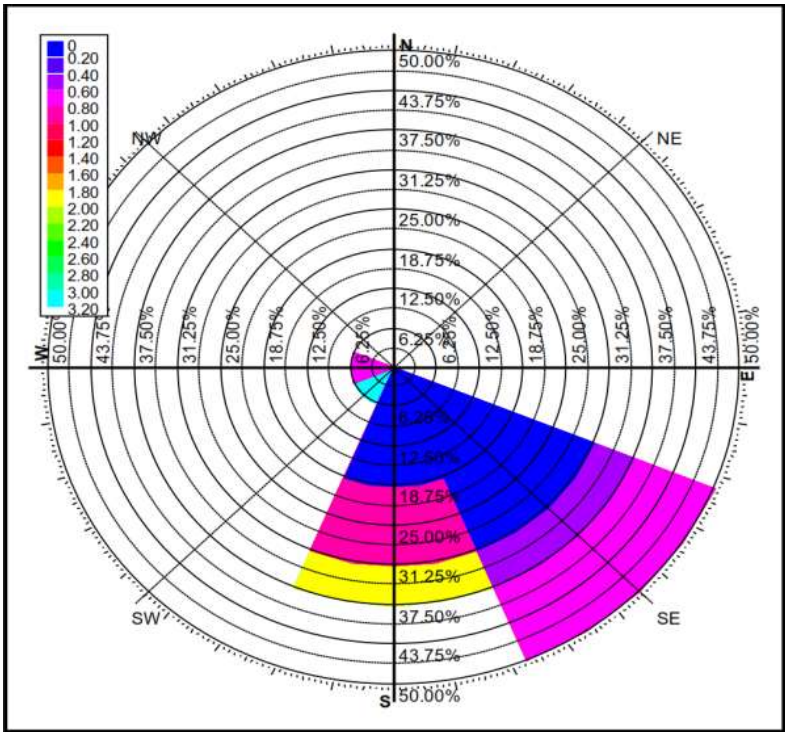


Figure - Wind Rose Diagram at AS2

Table - Wind Speed and Air Direction of AS3

	AS-3	22° 3'30.29"N,	96° 29'51.88"E	Pyin Oo Lwin Industrial Zone Public Area	
Date	Sample point	Time	Wind Speed (km/h)	Wind Direction (degree)	Wind Direction (cardinal point)
20.5.2019	Air Sample 3	8: 00 AM	1.6	312°	NW
		9: 00 AM	3.1	328°	NNW
		10: 00 AM	2.2	310°	NW
		11: 00 AM	6.2	66°	SSW
		12: 00 PM	4.2	56°	ESE
		13: 00 PM	2.1	129°	SE
		14: 00 PM	6.1	160°	SSE
		15: 00 PM	4.2	201°	SSW

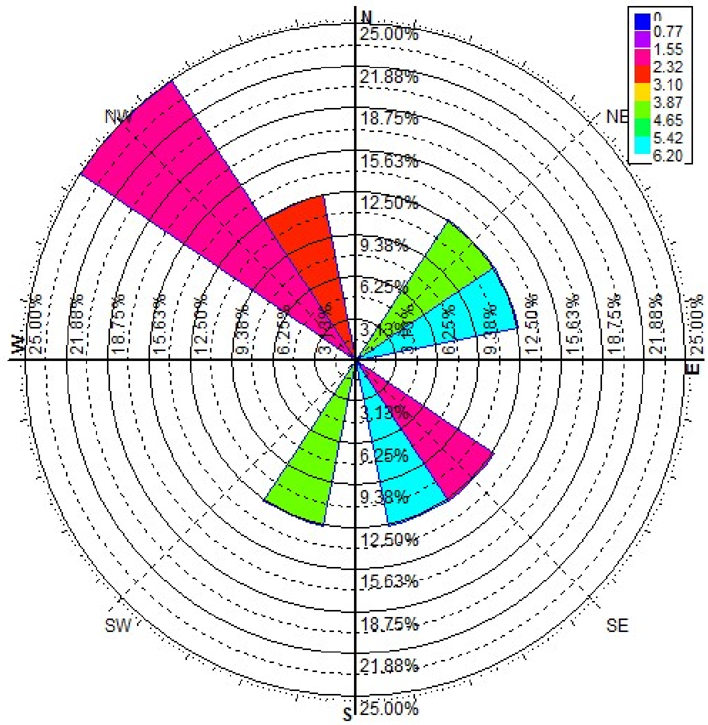


Table - Wind Speed and Air Direction of AS4

	Sample Name	Coordinates		Remark
		Latitude(N)	Longitude(E)	Sensitive Areas
	AS-4	22° 21'4.94"N,	96° 54'50.62"E	Naung Peng Rail way station

Date	Sample point	Time	Wind Speed (km/h)	Wind Direction (degree)	Wind Direction (cardinal point)
21.5.2019	Air Sample 4	8: 00 AM	7.2	358°	N
		9: 00 AM	6.5	315°	NW
		10: 00 AM	4.4	293°	WNW
		11: 00 AM	5.8	319°	N W
		12: 00 PM	7.1	312°	N W
		13: 00 PM	5.4	352°	N
		14: 00 PM	5.1	18°	NN E
		15: 00 PM	6.4	329°	NN W

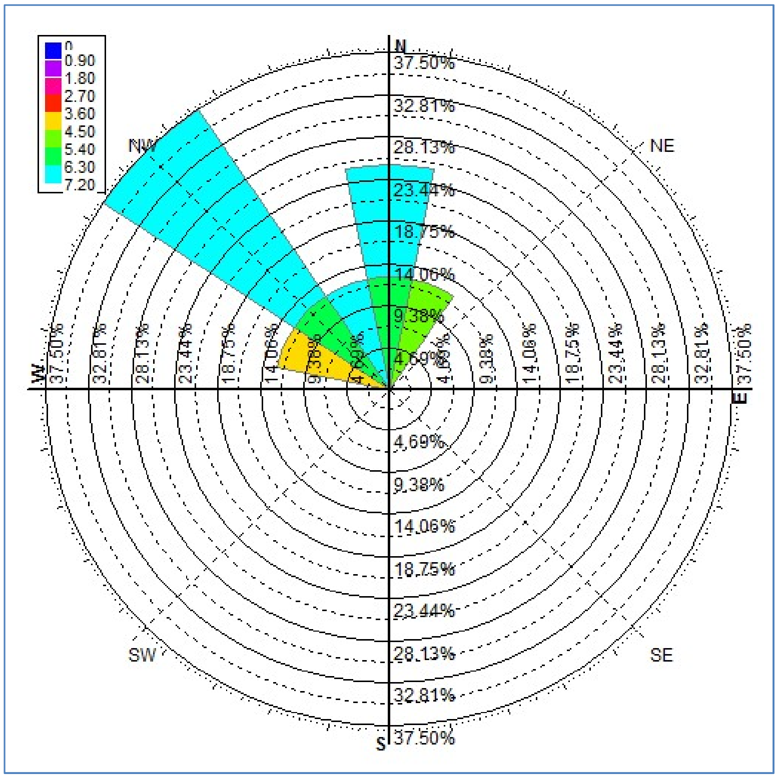


Figure -Wind Rose Diagram at AS4

Table - Wind Speed and Air Direction of AS5

Sr. No	Sample Name	Coordinates		Rem	
		Latitude(N)	Longitude(E)	Sensitive Areas	
6	AS-5	22° 37'5.20"N,	97° 17'40.17"E	Hsipaw Railway Station	
Date	Sample point	Time	Wind Speed (km/h)	Wind Direction (degree)	Wind Direction (cardinal point)
22-5-.2019	Air Sample 5	8: 00 AM	5.6	182°	S
		9: 00 AM	4.6	292°	WNW
		10: 00 AM	4.3	38°	NE
		11: 00 AM	5.2	327	NW
		12: 00 PM	3.2	178°	S
		13: 00 PM	3.5	51°	NE
		14: 00 PM	2.1	69°	ENE
		15: 00 PM	3.1	340°	NNW

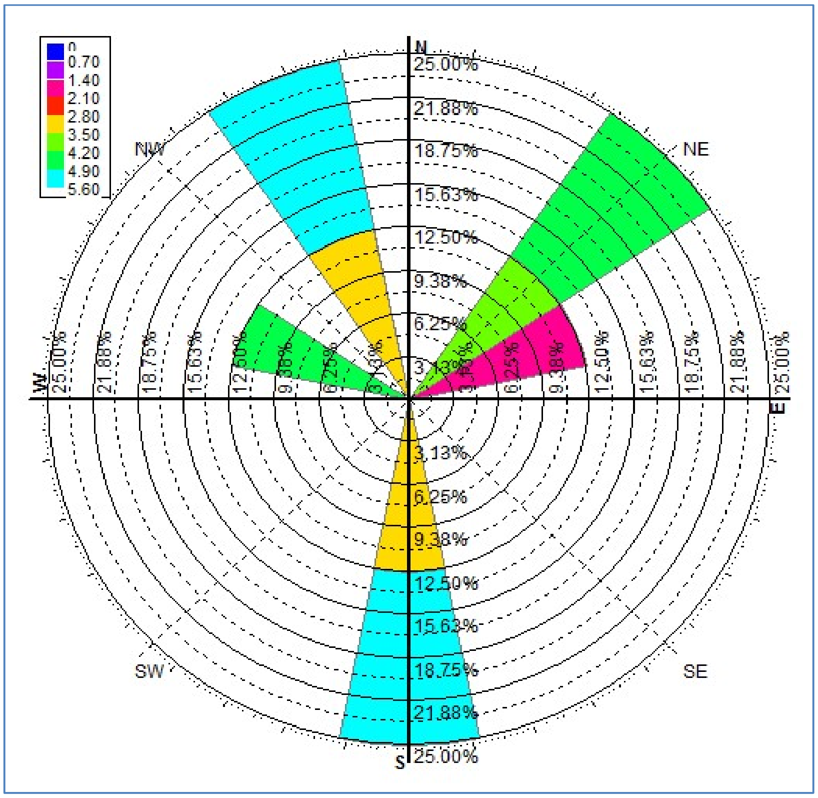


Figure - Wind Rose Diagram at AS5

Table - Wind Speed and Air Direction of AS6

Sr. No	Sample Name	Coordinates		Remark
		Latitude(N)	Longitude(E)	Sensitive Areas
7	AS-6	22° 58'22.88"N,	97° 43'50.33"E	Lashio Railway Station

Date	Sample point	Time	Wind Speed (km/h)	Wind Direction (degree)	Wind Direction (cardinal point)
23-5-2019	Air Sample Point AS-6	9: 00 AM	1.6	246°	WSW
		10: 00 AM	1.3	198°	SSW
		11: 00 AM	2.9	221°	SW
		12: 00 PM	2.8	269°	W
		13: 00 PM	4.6	216°	SW
		14: 00 PM	2.7	64°	ENE
		15: 00 PM	6.7	66°	ENE
		16: 00 PM	5.5	331°	NNW

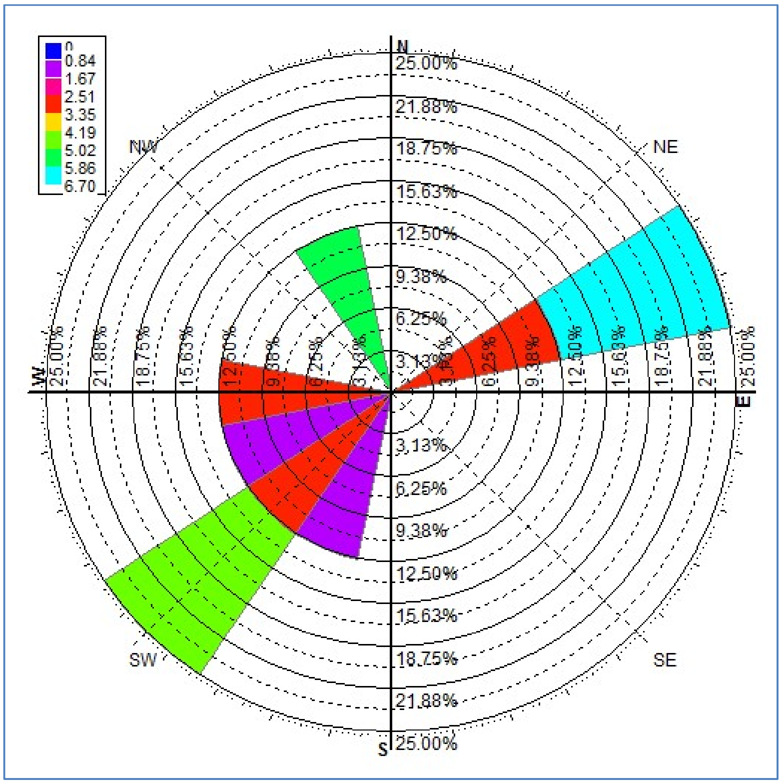


Figure - Wind Rose Diagram at AS6

According to above results, there will be no effect on wind speed and direction due to transmission towers and vice versa.

5.4.1.1. Measurement of Air Quality during Dry Season Comparing with the Air Quality Standards and Guidelines

CO, CO_2, NO_2, SO_2, O_3, PM_{10} and $PM_{2.5}$ are measured at the proposed MUSE- MANDALAY RAILWAY PROJECT Project site from myitnge to lashio (7 points). The site is in the pre construction stage and the collected data shown below are due to the movement of vehicles along the road and the transportation works. The standards for applicable to the possible air pollutants were determined from review of Myanmar National Environmental Emission Guideline and World Health Organization (WHO) Guideline. The average concentrations of pollutants at three sampling points for about 8 hours total, 8 hours for each are shown in the table below.

Table 5.10 - Average concentrations of pollutants at the sample points for 8 hours for each

Sr. No	Sample Name	Coordinates		Rem
		Latitude(N)	Longitude(E)	Sensitive Areas
1	AS0	21° 51'11.93"N,	96° 4'17.38"E	Myitnge Railway Station
2	AS-1	21° 52'48.75"N,	96° 13'34.70"E	Ohn Chaw Tar Zone
3	AS-2	22° 2'13.97"N,	96° 27'57.83"E	Pyin Oo lwin Railway Station
4	AS-3	22° 3'30.29"N,	96° 29'51.88"E	Pyin Oo Lwin Industrial Zone Public Area
5	AS-4	22° 21'4.94"N,	96° 54'50.62"E	Naung Peng Rail way station
6	AS-5	22° 37'5.20"N,	97° 17'40.17"E	Hsipaw Railway Station
7	AS-6	22° 58'22.88"N,	97° 43'50.33"E	Lashio Railway Station

Sample Time	Sensitive Areas	Average Value Parameters					
		CO_2 (ppm)	CO (ppm)	SO_2 (ppm)	NO_2 (ppb)	PM_{10} (µg/ m^3)	$PM_{2.5}$ (µg/ m^3)
Time 8 hours for each points	Myitnge Railway Station	479	6	1	31	29	11
	Ohn Chaw Tar Zone	498	15	4	29	43	22
	Pyin Oo lwin Railway Station	524	3	2	21	22	10
	Pyin Oo Lwin Industrial Zone Public Area	519	7	1	21	21	14
	Naung Peng Rail way station	509	11	3	12	26	10
	Hsipaw Railway Station	526	5	1	21	28	17
	Lashio Railway Station	491	9	1	19	29	18

O_3 is formed when heat and sunlight causes chemical reaction between NO_X and VOC so since the main gaseous emission is CO_2 which is emitted from machines and vehicles, ozone gas was not measured as NO_X and VOC were not formed during construction and operation phases.

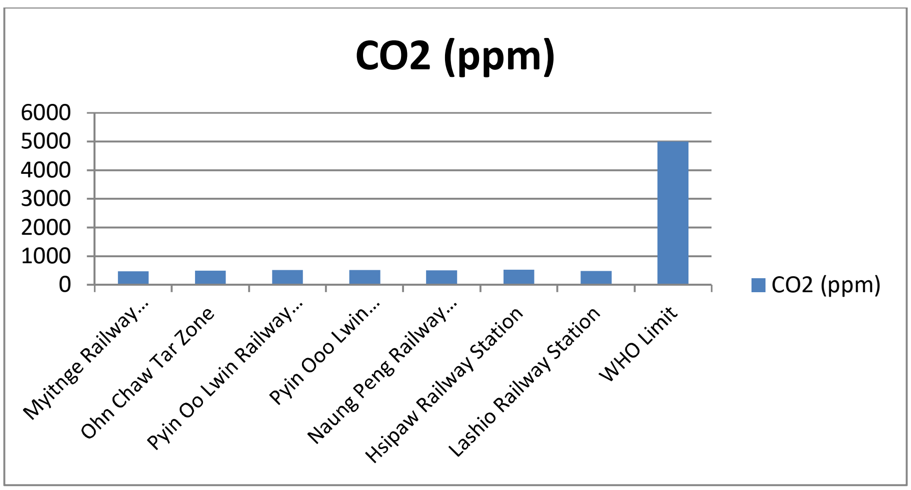
Table 5.11 - Comparison of average concentrations of polluatants with WHO Guidelines and NAAQS

Pollutants (8 hrs)	Myitnge Railway Station	Ohn Chaw Tar Zone	Pyin Oo Lwin Industrial Zone Public Area	Naung Peng Railway Station	Hsipaw Railway Station	Lashio Railway Station	WHO Guideline Values	NAAQS
CO_2 (ppm)	*479*	498	519	509	526	491	600 ppm	-

CO (ppm)	6	15	7	11	5	9	25 ppm	35 ppm (8 hrs)
NO_2 (ppb)	31	29	21	12	21	19	200 ppb	100 ppb (1 hr)
PM $_{10}$ (µg/m^3)	29	43	21	26	28	29	100 µg/m^3	150 µg/m^3 (24 hrs)
PM $_{2.5}$ (µg/m^3)	11	22	14	10	17	18	35 µg/m^3	35 µg/m^3 (24 hrs)
SO_2 (ppm)	1	4	1	3	1	1	50 ppm	0.5 ppm (3 hours)

(i) Analysis of Air Quality with WHO Guidelines

The chart below show that the concentration of Carbon Dioxide (CO2) measured in all the sampling times at sampling point was between the ranges of 479 ppm – 526 ppm.



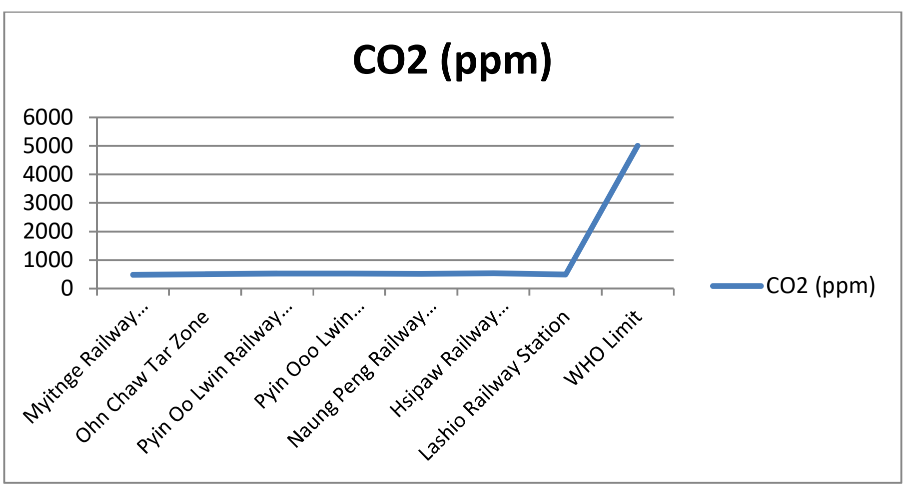
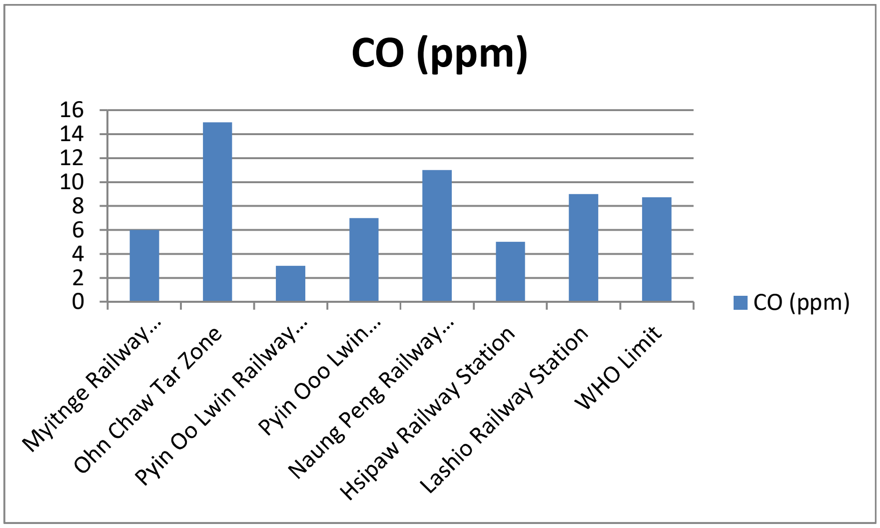
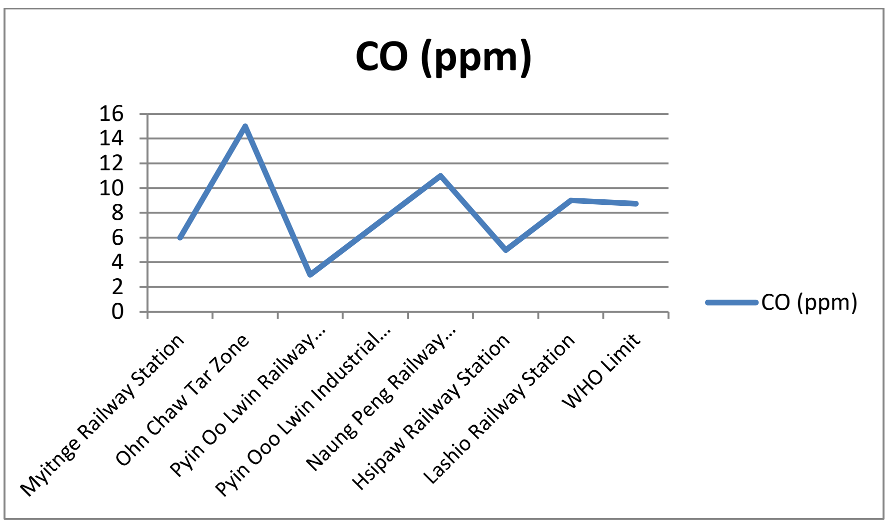


Figure – Concentration of Carbon Dioxide

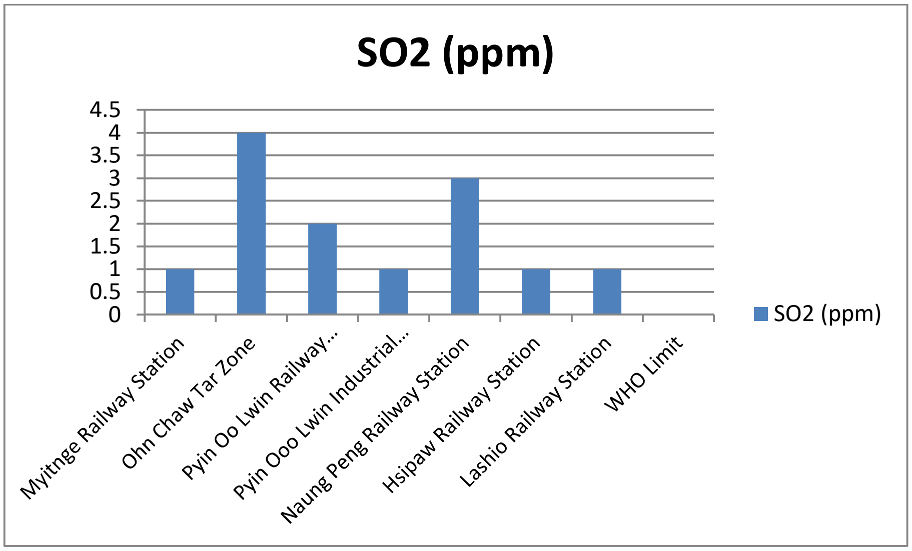
The concentration of Carbon Dioxide measured in all the sampling times at sampling point was below the Occupational Safety and Health Administration (OSHA) Guidelines, which Permissible Exposure Limit (PEL) for CO2 of 5,000 ppm averaged over an 8-hour work day. CO_2 concentration of 526 ppm was the highest and 479 ppm was the lowest at the proposed area. The chart below show that the concentration of Carbon Monoxide (CO) measured in all sampling times at sampling point 1 was between the ranges of 5 ppm – 15 ppm.





The concentration of Carbon Monoxide measured in all the sampling times at sampling point was above the World Health Organization (WHO) Guidelines, , which specifies 8.729 ppm for the limitation of CO concentration for 8 hours. CO concentration of 15 ppm was the highest and 5 ppm was the lowest at the proposed area.

The chart below show that the concentration of Sulfur Dioxide (SO_2) measured in all sampling times at sampling point was between the ranges of 1 ppm and 4 ppm.



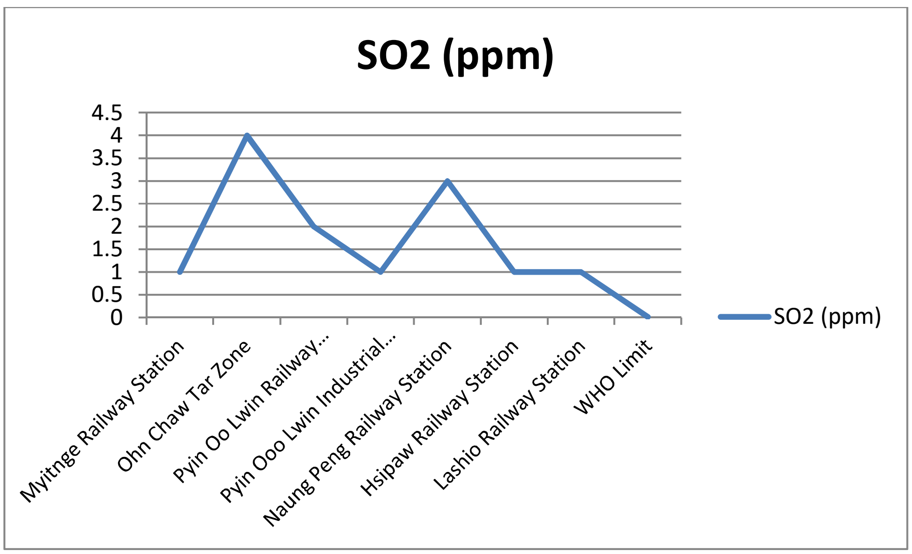
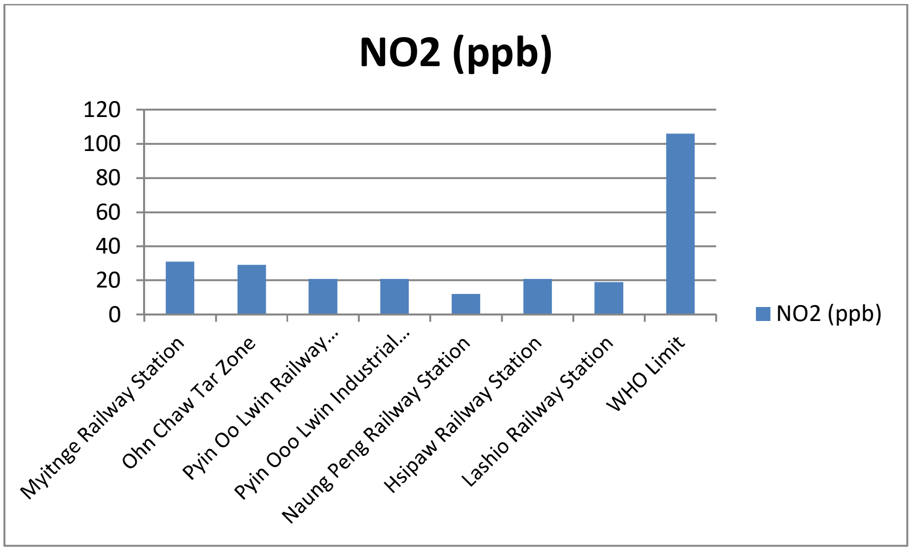


Figure – Concentration of Sulfur Dioxide

The concentration of Sulfur Dioxide measured in all the sampling times at the sampling point was above the World Health Organization (WHO) Guideline, which specifies 0.015 ppm for the limitation of SO_2 concentration for 24 hours. SO2 concentration of 4 ppm was the highest and 1 ppm was the lowest at the proposed area.

The chart below show that the concentration of Nitrogen Dioxide (NO_2) measured in all sampling times at sampling point 1 was between the ranges of 12 ppb – 31 ppb.



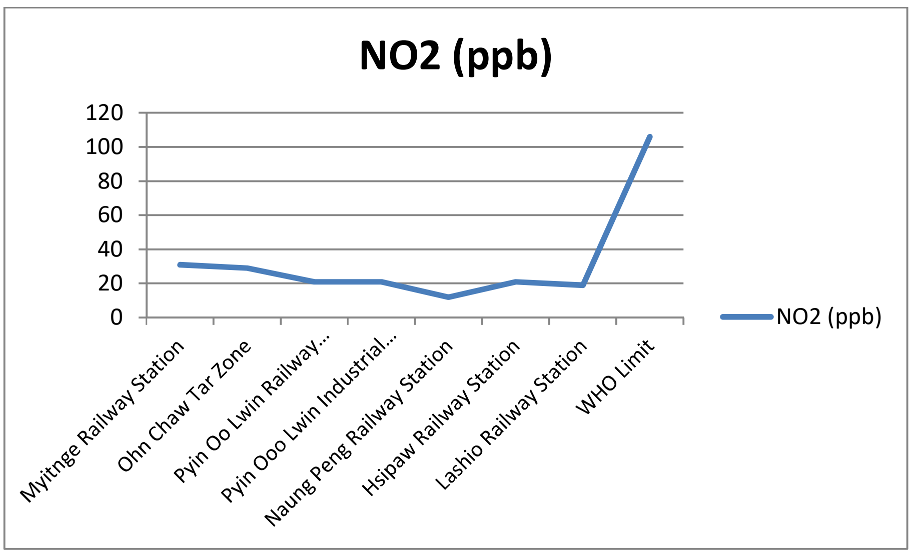
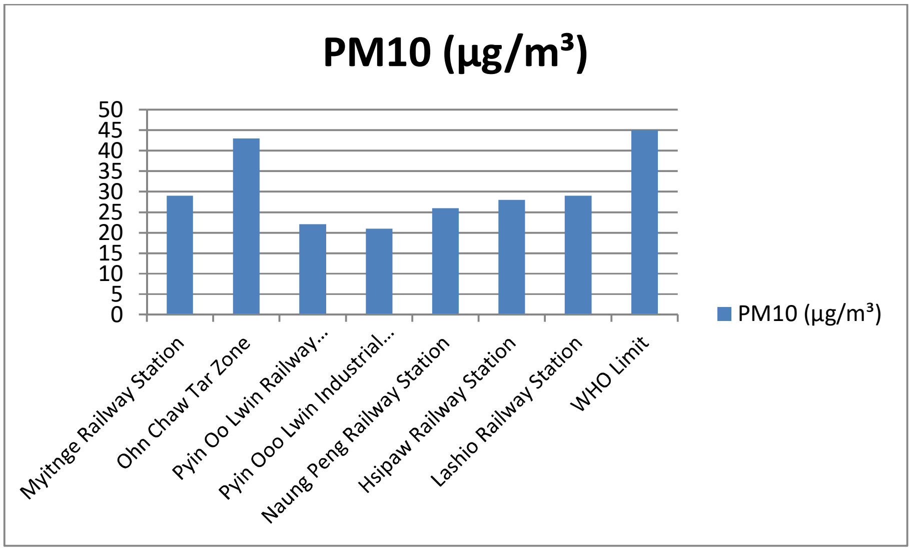


Figure – Concentration of Nitrogen Dioxide

The concentration of Nitrogen Dioxide measured in all the sampling times at sampling point was below the World Health Organization (WHO) Guideline, which specifies 13 ppb for the limitation of NO_2 concentration for 24 hours and 106 ppb for 1hr. NO_2 concentration of 31 ppb was the highest and 12 ppb was the lowest at the proposed area.

The chart below show that the concentration of Particulate Matter (PM_{10}) measured in all sampling times at sampling point was between the ranges of 21µg/m^3 – 43µg/m^3.



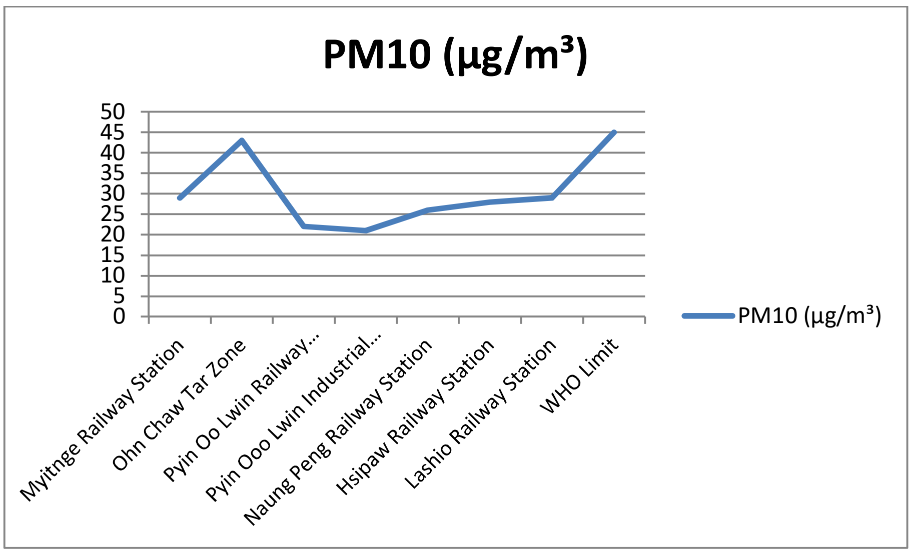
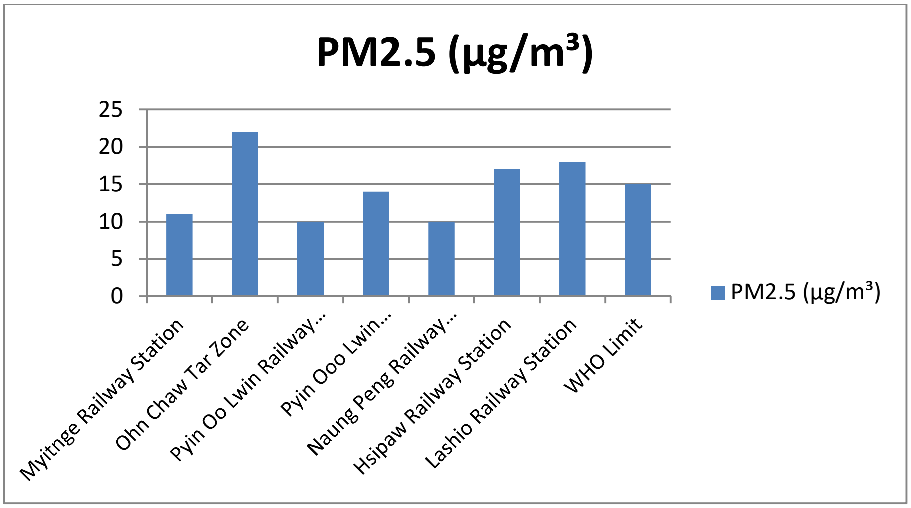


Figure – Concentration of Particulate Matter

The concentration of Particulate Matter measured at sampling point was below the limit of World Health Organization (WHO) which specifies 45 µg/m^3 for the limitation of PM10 concentration for 24 hours. PM_{10} concentration of 43µg/m^3 was the highest and 21µg/m^3 was the lowest at the proposed area.

The chart below show that the concentration of Fine Particulate Matter ($PM_{2.5}$) measured in all sampling times at sampling point was between the ranges of 10 µg/m^3 – 22µg/m^3.



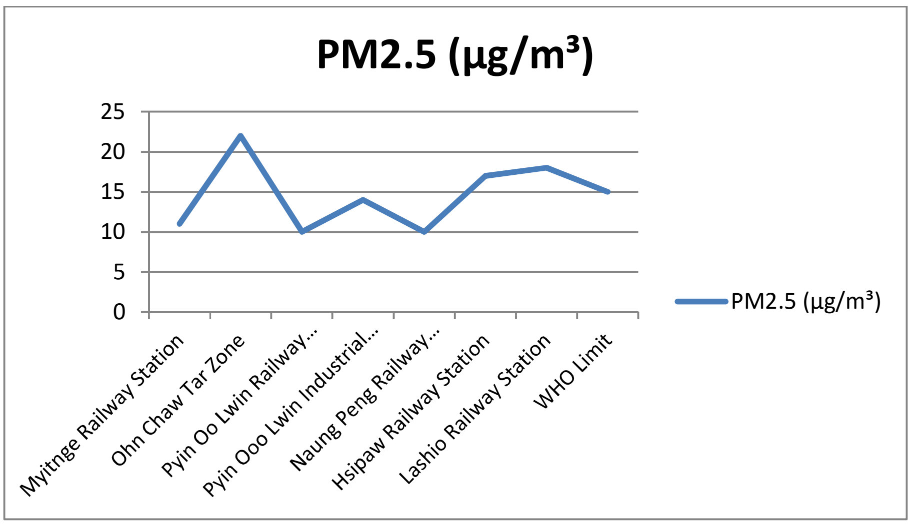


Figure – Concentration of Fine Particulate Matter

The concentration of Fine Particulate Matter measured in all the sampling times at the sampling point was above the World Health Organization (WHO) Guideline which Guideline which specifies 15µg/m^3 for the limitation of $PM_{2.5}$ concentration. $PM_{2.5}$ concentration of 22µg/m^3 was the highest and 10µg/m^3 was the lowest at the proposed area.

(ii) Analysis of Air Quality Results with NAAQS

The air quality measured in sampling locations are less than NAAQS except for results of SO_2. Sulphur dioxide in all 7 locations are more than its given standard of 0.5ppm. The highest emissions are in Oh Chaw Tar Zone and Naung Peng which is 4 ppm and 3 ppm and the possible emission sources can be from houses, cars and bikes as the sampling locations are located near roads.

5.4.1.2. Measurement of Air Quality for Wet Season Comparing with the Air Quality Standards and Guidelines

CO, CO_2, NO_2, SO_2, O_3, PM_{10} and $PM_{2.5}$ are measured at the proposed Muse- Mandalay Railway Project site from Pyinoolwin to Muse (8 points). The site is in the pre construction stage and the collected data shown below are due to the movement of vehicles along the road and the transportation works. The standards for applicable to the possible air pollutants were determined from review of Myanmar National Environmental Emission Guideline and World Health Organization (WHO) Guideline and NAAQS. Eight sampling points for about 8 hours total, 8 hours for each are shown in the table below and measured in August 2019.

Table 5.12 - Measuring Points of Air Quality

S/N	Name of Places	GPS Coordinate	
		Latitude (N)	Longitude (E)
1	Oak Pho Village (Pyin Oo Lwin)	22.071081°	96.399531°
2	Shwe Pyi Nyunt Villag (Naung Cho)	22.304525°	96.833933°
3	Baw Gyo Pagod (Hsipaw)	22.583272°	97.233222°
4	Sam Laung	22.676006°	97.507519°
5	Lashio West (NE 350m)	22.984836°	97.706414°
6	Theinni	23.306658°	97.974528°
7	Nam Hpak Ka	23.689414°	97.817433°
8	Muse	24.000783°	97.940464°

Moreover, the further parameters for air quality that are temperature and air humidity were measured at the proposed Muse- Mandalay Railway Project site from Pyinoolwin to Muse (8 points).

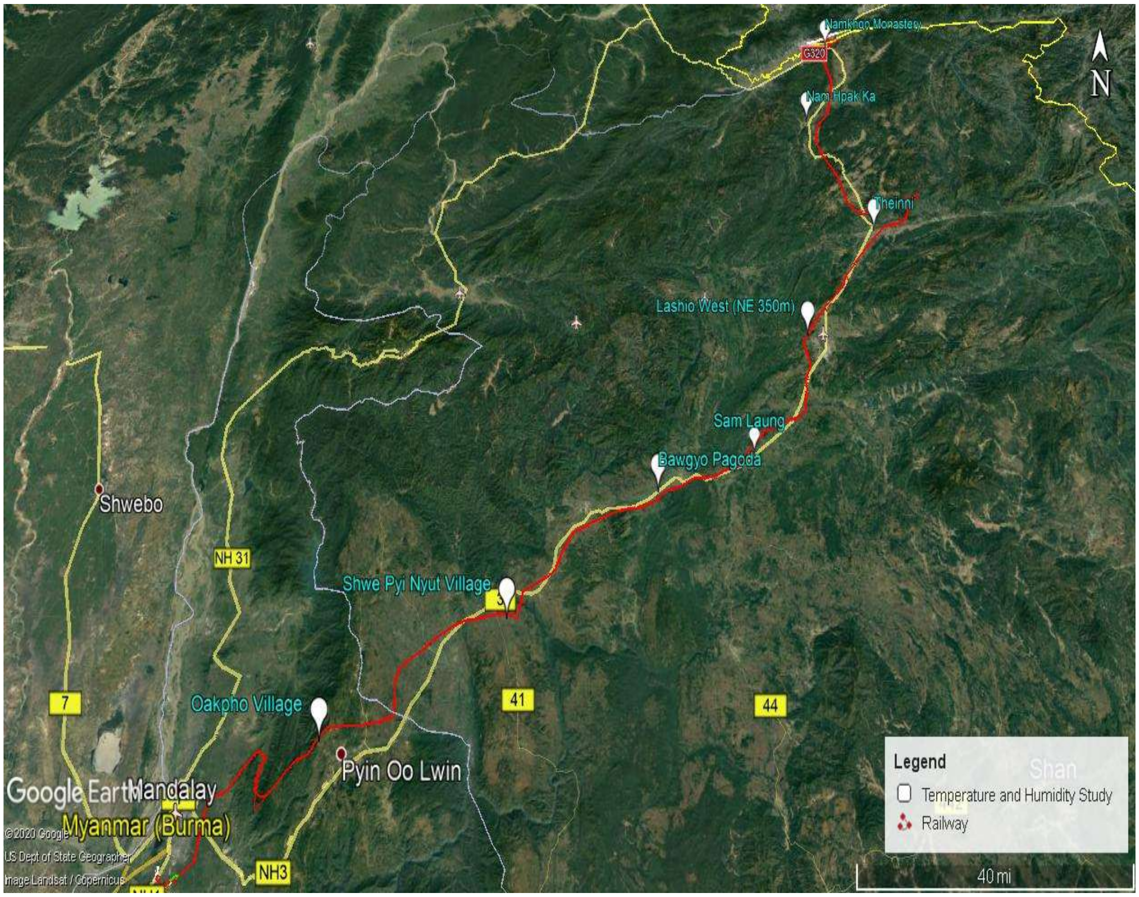


Figure 5.15 - Locations of Temperature and Humidity Study along the Proposed Project Muse-Mandalay Railway

Table 5.13 - General Conditions of Ambient at the time of Sampling on Points

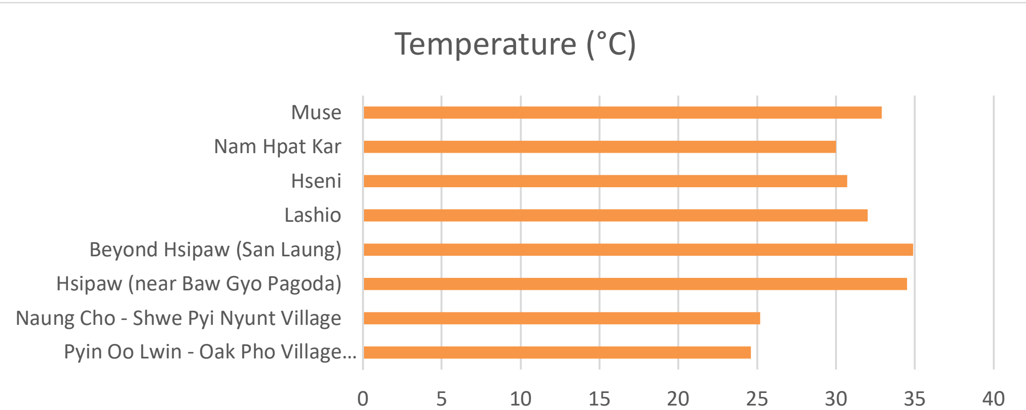
No.	Place	Location		Temperature (°C)	Air Humidity (%RH)
		Latitude(N)	Longitude(E)		
1	Pyin Oo Lwin - Oak Pho Village (Monastery)	N 22° 04’ 15.87”	E 096° 23’ 58.30”	24.6	98.7
2	Naung Cho - Shwe Pyi Nyunt Village	N 22° 18’ 16.29”	E 096° 50’ 02.16”	25.2	93.9
3	Hsipaw (near Baw Gyo Pagoda)	N 22° 34’ 59.78”	E 097° 13’ 59.62”	34.5	71.9
4	Beyond Hsipaw (San Laung)	N 22° 40’ 33.66’	E 97° 30’ 17.4”	34.9	62.9
5	Lashio	N 22° 59’ 05.41”	E 097° 42’ 23.09”	32	59.9
6	Hseni	N 23° 18’ 23.97”	E 097° 58’ 28.30”	30.7	72.6

7	Nam Hpat Kar	N 23° 41' 21.89"	E 097° 49' 02.76"	30	72.4
8	Muse	N 24° 00' 03.10"	E 097° 56' 25.90"	32.9	64.8

Table 5.14 - Average concentrations of pollutants at the sample points for 8 hours for each

Sample Time	Sensitive Areas	Average Value Parameters					
		CO_2 (ppm)	CO (ppm)	SO_2 (ppm)	NO_2 (ppb)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
Time 8 hours for each points	Pyin Oo Lwin - Oak Pho Village (Monastery)	321	2	0.2	22	12	10
	Naung Cho - Shwe Pyi Nyunt Village	227	4	0.1	14	16	15
	Hsipaw (near Baw Gyo Pagoda)	367	7	0.35	27	17	14
	Beyond Hsipaw (San Laung)	175	3	0.05	16	14	12
	Lashio	421	9	0.4	24	19	17
	Hseni	287	4	0.3	15	14	13
	Nam Hpat Kar	254	2	0.09	12	10	11
	Muse	451	8	2	29	17	19

Temperature Results for Muse-Mandalay Railway



	Pyin Oo Lwin - Oak Pho Village (Monastery)	Naung Cho - Shwe Pyi Nyunt Village	Hsipaw (near Baw Gyo Pagoda)	Beyond Hsipaw (San Laung)	Lashio	Hseni	Nam Hpat Kar	Muse
Temperature (°C)	24.6	25.2	34.5	34.9	32	30.7	30	32.9

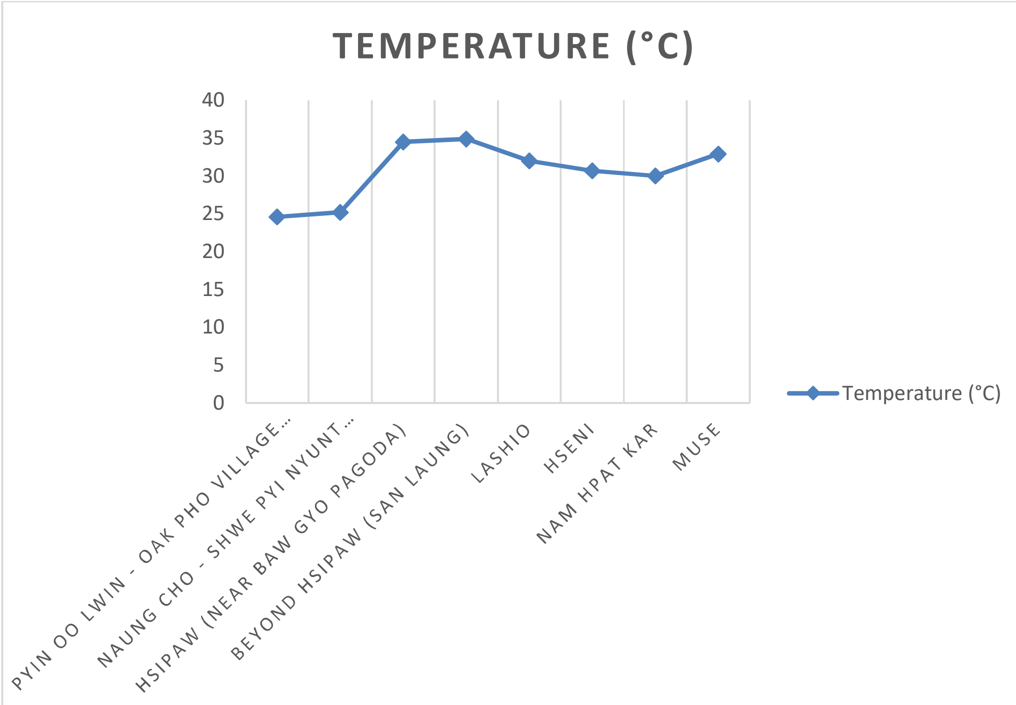
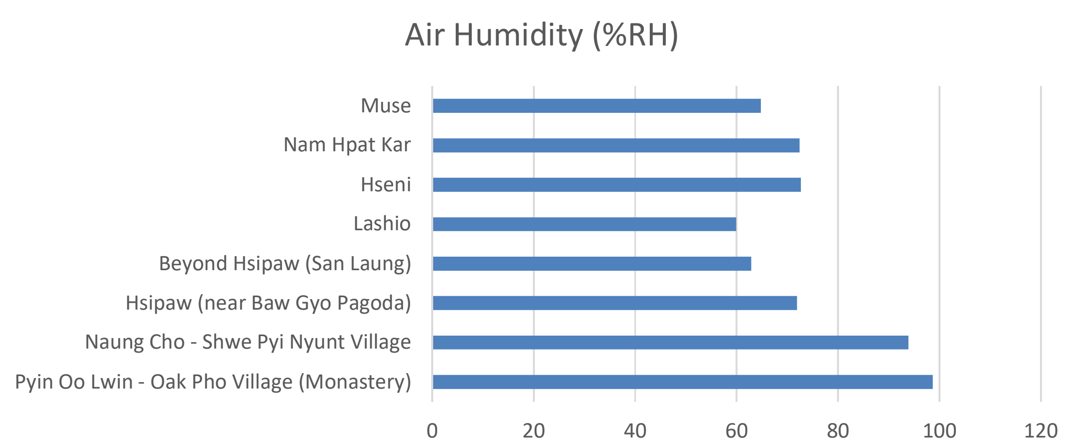


Figure – Temperature Results in Muse-Mandalay Region

Air Humidity Results for Muse-Mandalay Railway



	Pyin Oo Lwin - Oak Pho Village (Monastery)	Naung Cho - Shwe Pyi Nyunt Village	Hsipaw (near Baw Gyo Pagoda)	Beyond Hsipaw (San Laung)	Lashio	Hseni	Nam Hpat Kar	Muse
Air Humidity (%RH)	98.7	93.9	71.9	62.9	59.9	72.6	72.4	64.8

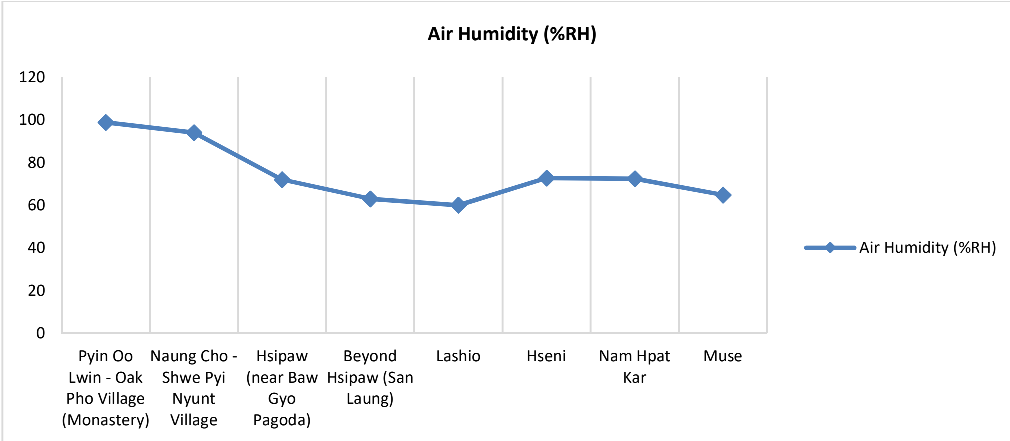


Figure 5.16 – Air Humidity Results for Muse-Mandalay Region

Figure 5.17 -Recorded Photos about measuring temperature and air humidity

Table 5.15 - Comparison of Wet Seasons Air Quality Results with WHO Guidelines and NAAQS

Pollutants (8 hrs)	Pyin Oo Lwin - Oak Pho Village	Naung Cho - Shwe Pyi Nyunt Village	Hsipaw (near Baw Gyo Pagoda)	Beyond Hsipaw (San Laung)	Lashio	Hseni	Nam Hpat Kar	Muse	**WHO Guideline Values**	**NAAQS**
CO_2 (ppm)	321	227	367	175	421	287	254	451	600 ppm	-
CO (ppm)	2	4	7	11	9	4	2	8	25 ppm	35 ppm (8 hrs)
NO_2 (ppb)	22	14	27	16	24	15	12	29	200 ppb	100 ppb (1 hr)
PM_{10} ($\mu g/m^3$)	12	16	17	14	19	14	10	17	100 $\mu g/m^3$	150 $\mu g/m^3$ (24 hrs)
$PM_{2.5}$ ($\mu g/m^3$)	10	15	14	12	17	13	11	19	35 $\mu g/m^3$	35 $\mu g/m^3$ (24 hrs)
SO_2 (ppm)	0.2	0.1	0.35	0.05	0.4	0.3	0.09	2	50 ppm	0.5 ppm (3 hours)

(i) Analysis of Air Quality Results with WHO Guidelines

All the air quality results for wet seasons are less than WHO Guidelines as most of the sampling points are taken in villages and during wet season, PM 10 and PM 2.5 will be low.

(ii) Analysis of Air Quality Results with NAAQS

All the air quality results for wet seasons are less than NAAQS except for SO_2 in Muse since Muse is a city, air emission from cars, houses and bikes will be high. As most of the sampling points are taken in villages and during wet season, PM 10 and PM 2.5 will also be low.

5.4.1.3. Air Dispersion Comparison at Average 8 hours on No Project and Emission Conditions from Project (Construction Phase)

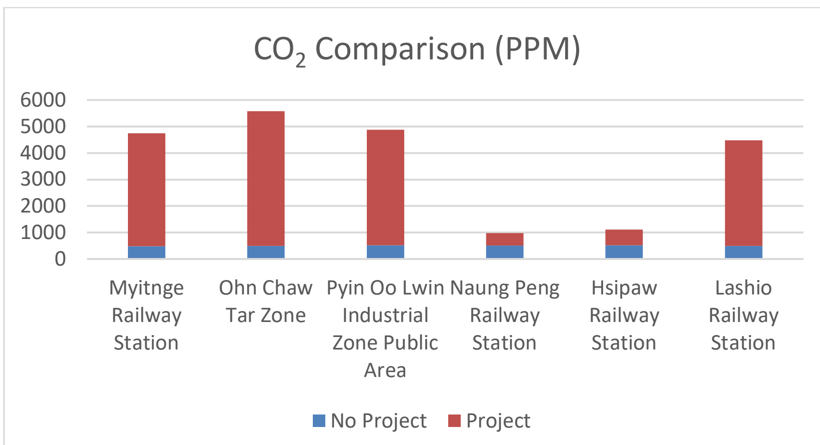
The air dispersion is predicted by using AERMOD VIEW modelling software. Wind speeds, wind directions and gas emission rate are used as input data. And the software gives the concentration level of gases as results. The machines and their emission rates are assumed to be able to predict the possible concentration levels of gases in the construction phase. At Naung Peng Railway Station and Hsipaw Railway Station, the wind speed is measured over 6 km/s and 4 km/s average, thus the concentration levels at those points are lower compared to the other points. The air quality in Pyin Oo Lwin Railway Station and Pyin Oo Lwin Industrial Area is close to the each other so only 1 point will be taken while comparing. The prediction is done by assuming the construction works are 8 hours continuous operation. But the actual construction work will be discontinuous operation meaning the concentration levels can be lower than the predicted model. The concentration levels of pollutants for Dry Season is used as the concentration phase will be carried during dry season. Therefore, it is used to produce emissions from Project Condition. The construction phase will not be carried out during Wet Season. The concentration levels of pollutants are shown in following tables and figures.

Table 5.16 – Average Concentration of pollutants at the sample points for 8 hours for each in No Project Condition

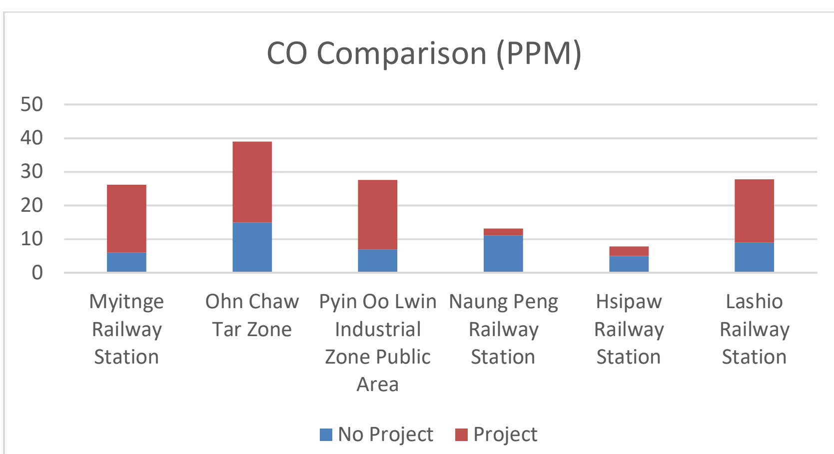
Sample Time	Sensitive Areas	Average Value Parameters					
		CO_2 (ppm)	CO (ppm)	SO_2 (ppm)	NO_2 (ppb)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
Time 8 hours for each point	Myitnge Railway Station	479	6	1	31	29	11
	Ohn Chaw Tar Zone	498	15	4	29	43	22
	Pyin Oo Lwin Industrial Zone Public Area	519	7	1	21	21	14
	Naung Peng Railway Station	509	11	3	12	26	10
	Hsipaw Railway Station	526	5	1	21	28	17
	Lashio Railway Station	491	9	1	19	29	18

Table 5.17 – Estimated Average Concentration of pollutants from project at the sample points for 8 hours

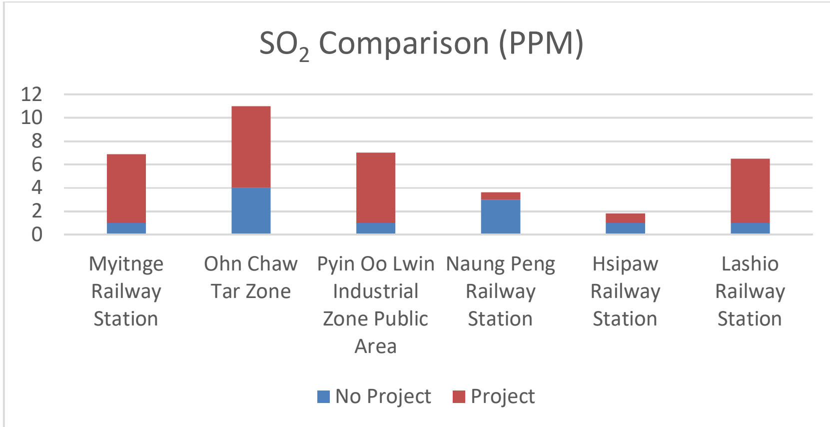
Sample Time	Sensitive Areas	Average Value Parameters					
		CO_2 (ppm)	CO (ppm)	SO_2 (ppm)	NO_2 (ppb)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
Time 8 hours for each point	Myitnge Railway Station	4268	20.1	5.88	45.8	4.03	3.92
	Ohn Chaw Tar Zone	5085	24	7.01	54.6	4.796	4.669
	Pyin Oo Lwin Industrial Zone Public Area	4366	20.6	6.02	46.85	4.12	4.01
	Naung Peng Railway Station	463.4	2.19	0.639	4.97	0.437	0.426
	Hsipaw Railway Station	592	2.8	0.817	6.36	0.559	0.544
	Lashio Railway Station	3992	18.8	5.5	42.8	3.77	3.67



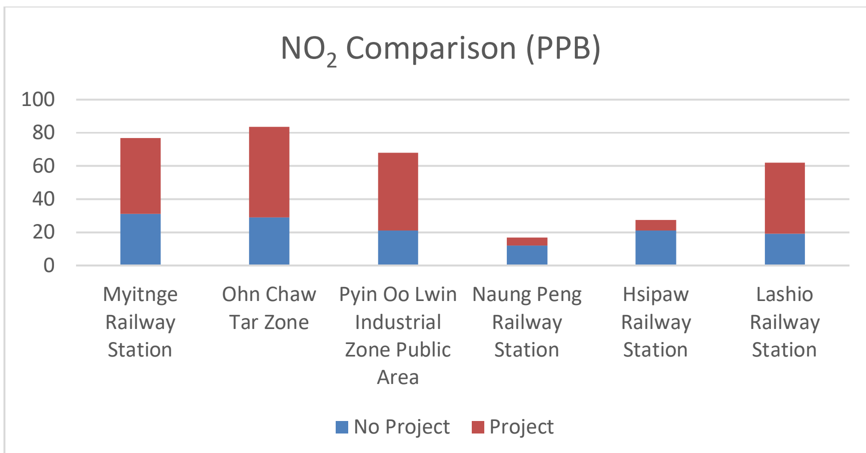
CO_2



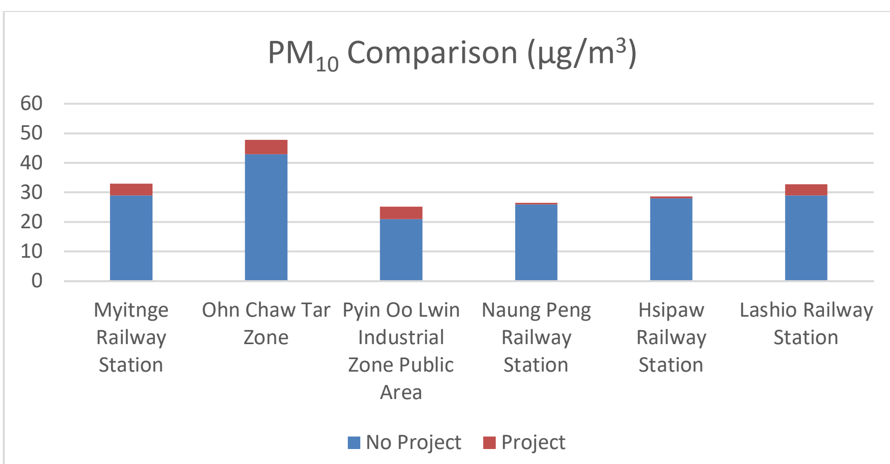
CO


SO2 Comparison (PPM)
12
10
8
6
4
2
0
Myitnge Railway Station
Ohn Chaw Tar Zone
Pyin Oo Lwin Industrial Zone Public Area
Naung Peng Railway Station
Hsipaw Railway Station
Lashio Railway Station
No Project
Project

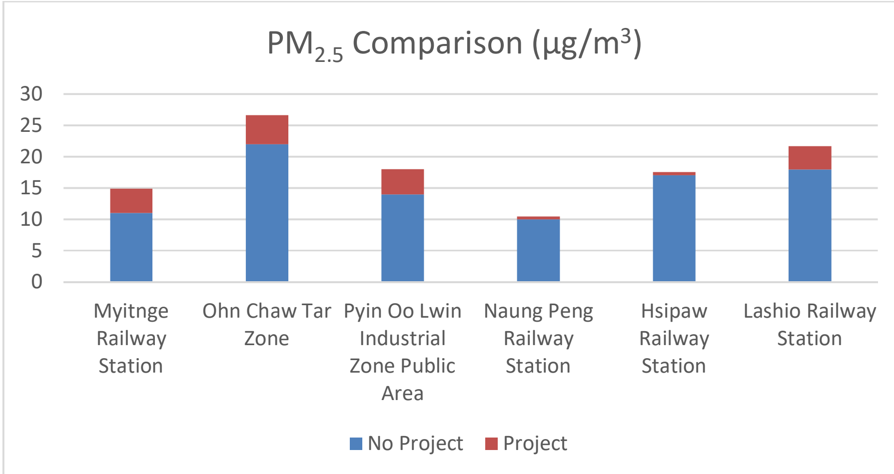
SO_2


NO2 Comparison (PPB)
100
80
60
40
20
0
Myitnge Railway Station
Ohn Chaw Tar Zone
Pyin Oo Lwin Industrial Zone Public Area
Naung Peng Railway Station
Hsipaw Railway Station
Lashio Railway Station
No Project
Project

NO_2


PM10 Comparison (µg/m3)
60
50
40
30
20
10
0
Myitnge Railway Station
Ohn Chaw Tar Zone
Pyin Oo Lwin Industrial Zone Public Area
Naung Peng Railway Station
Hsipaw Railway Station
Lashio Railway Station
No Project
Project

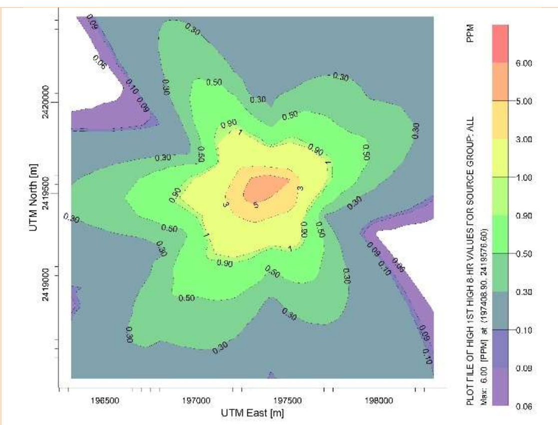
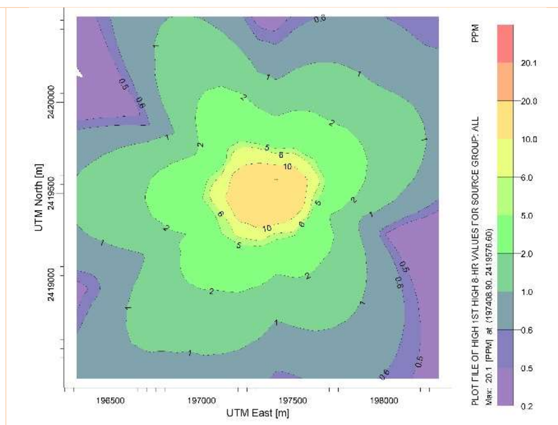
PM_{10}



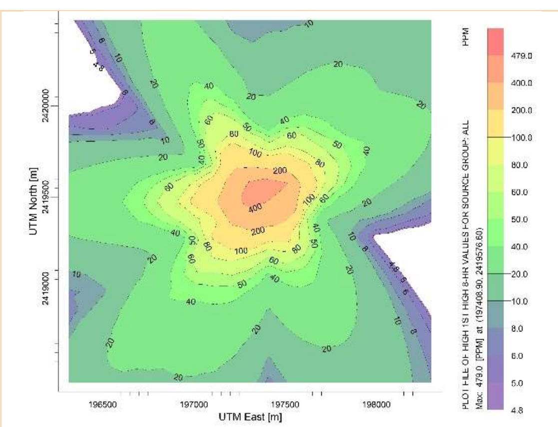
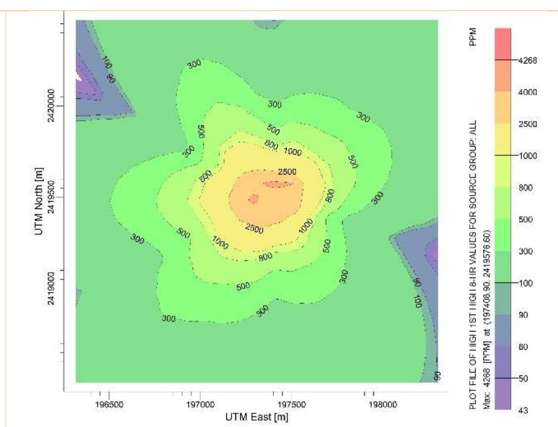
$PM_{2.5}$

Myitnge Railway Station

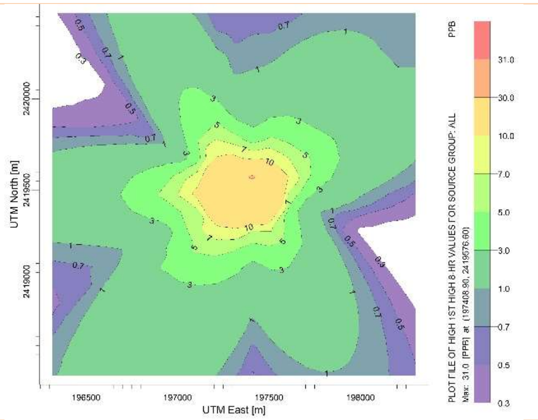
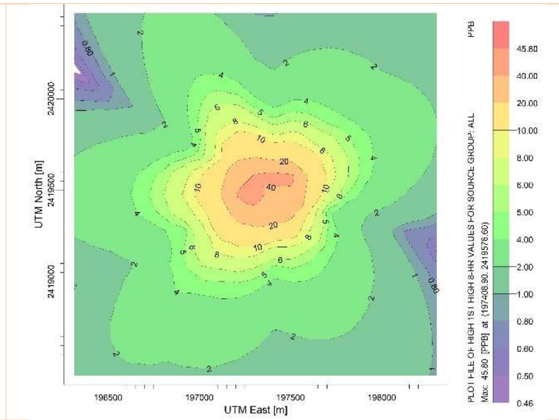
CO

	
No Project Condition	Emission Condition from Project

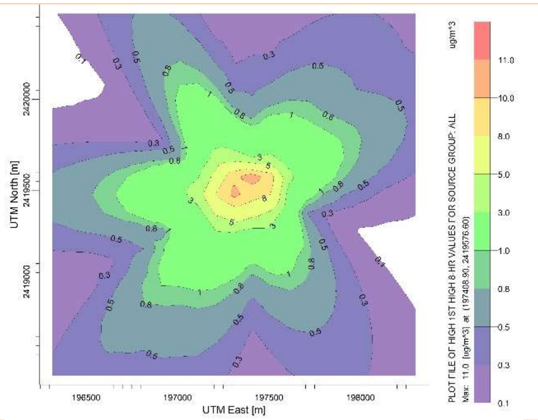
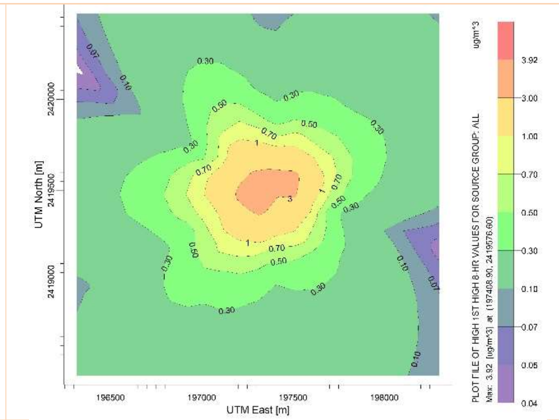
CO_2

	
No Project Condition	Emission Condition from Project

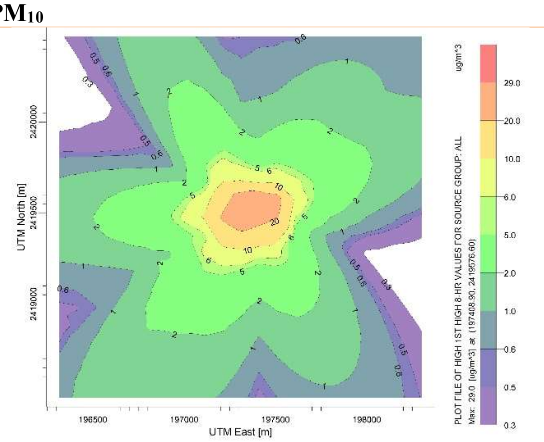
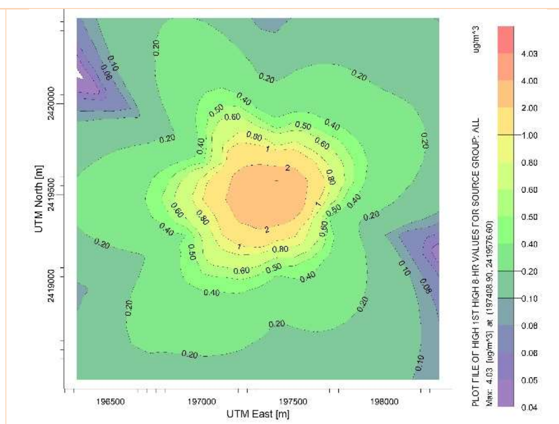
NO_2

	
No Project Condition	Emission Condition from Project

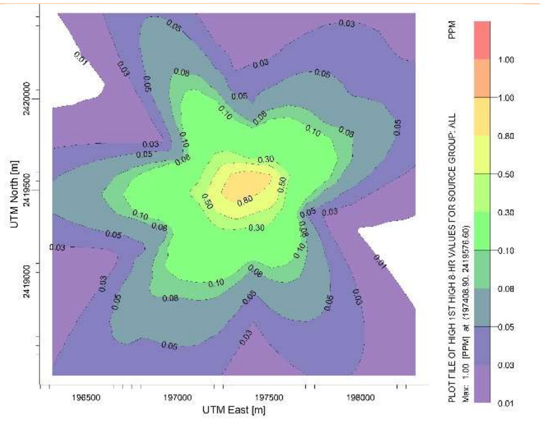
PM2.5

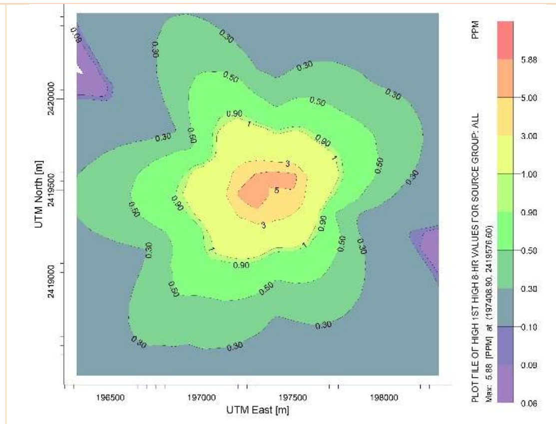
	
No Project Condition	Emission Condition from Project

PM10

	
No Project Condition	Emission Condition from Project

SO_2

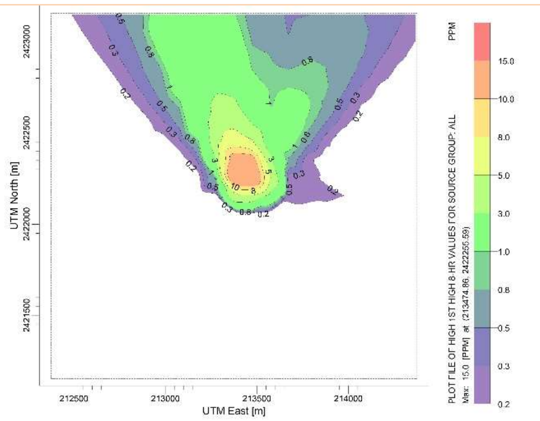


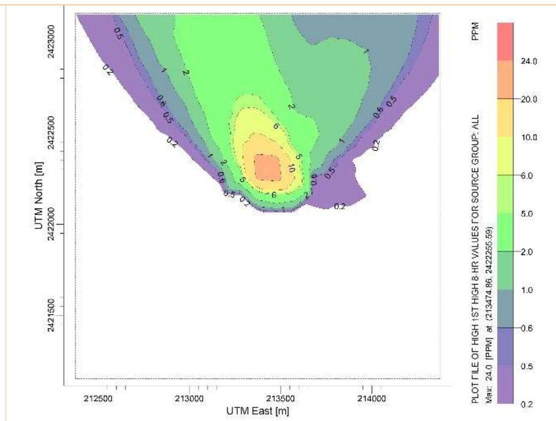


No Project Condition	Emission Condition from Project

Ohn Chaw Tar Zone

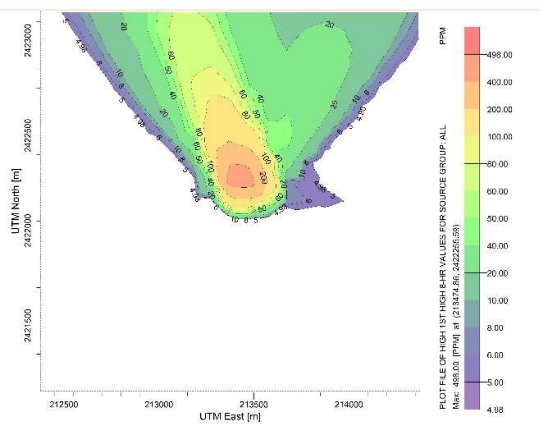
CO

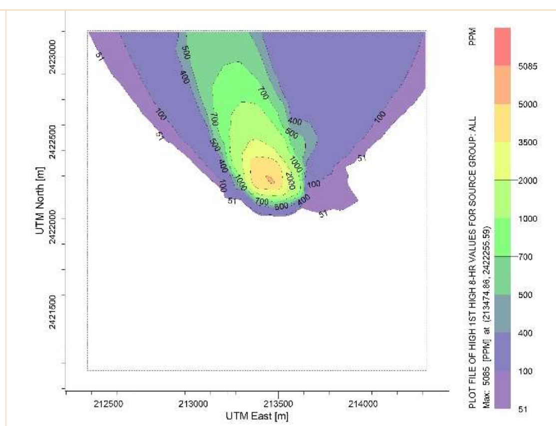




No Project Condition	Emission Condition from Project

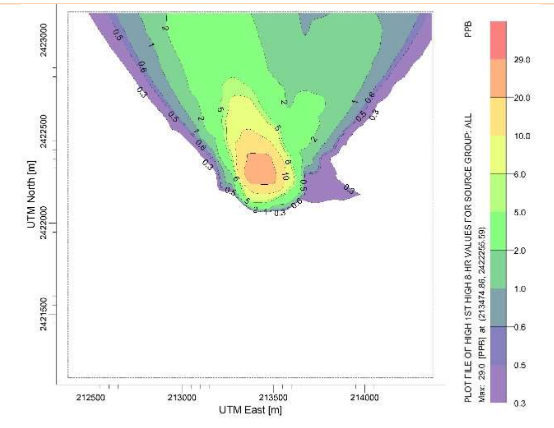
CO_2





No Project Condition	Emission Condition from Project

NO_2



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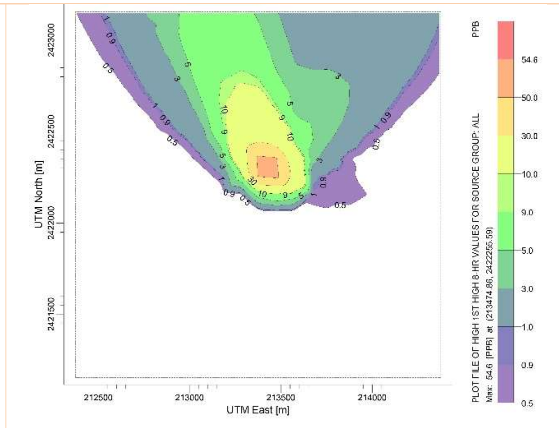
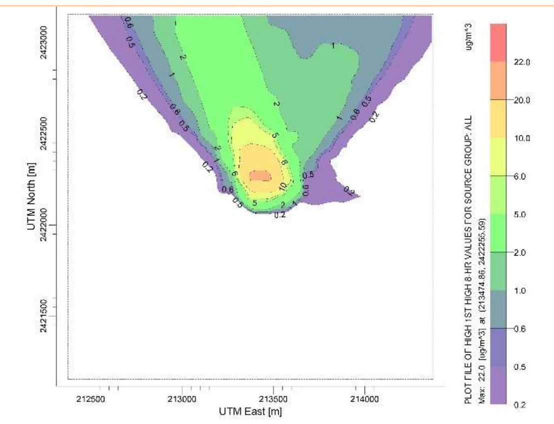


Emission Condition from Project

$PM_{2.5}$



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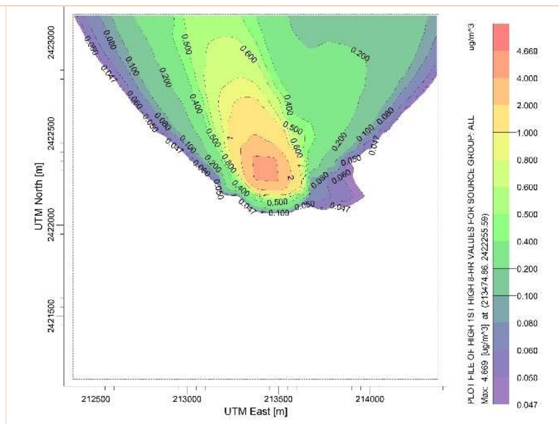
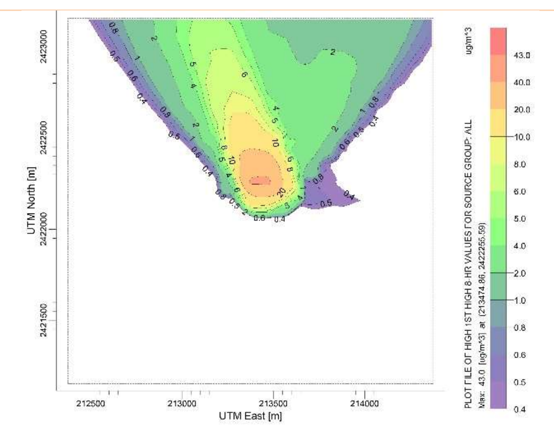


Emission Condition from Project

PM_{10}



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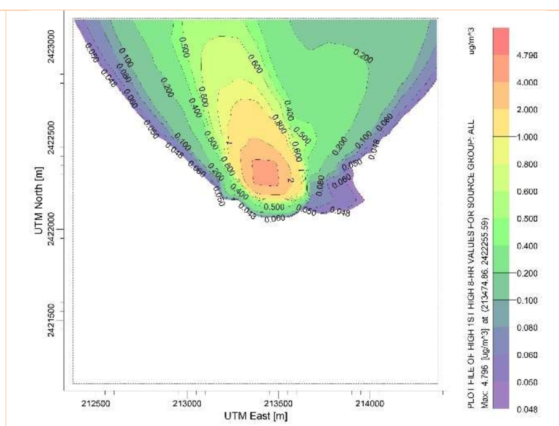
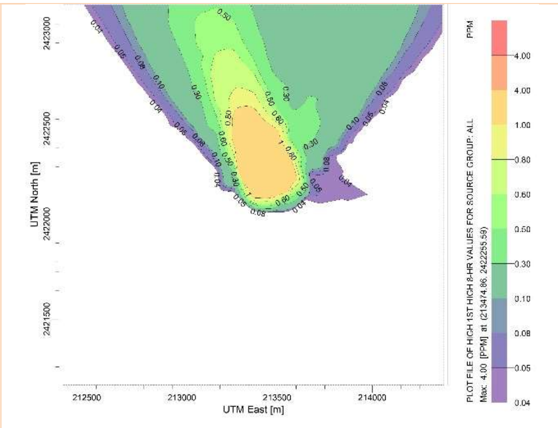


Emission Condition from Project

SO_2



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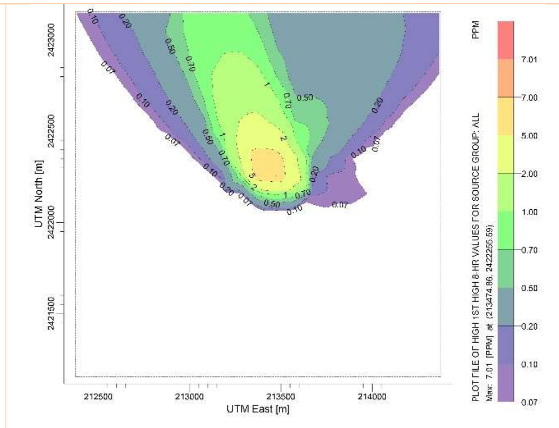
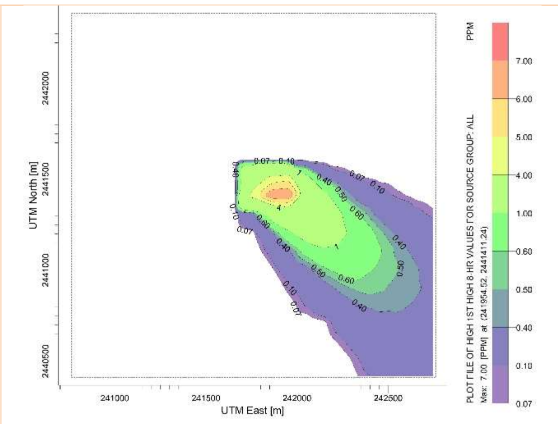


Emission Condition from Project

Pyin Oo Lwin Industrial Zone Public Area

CO



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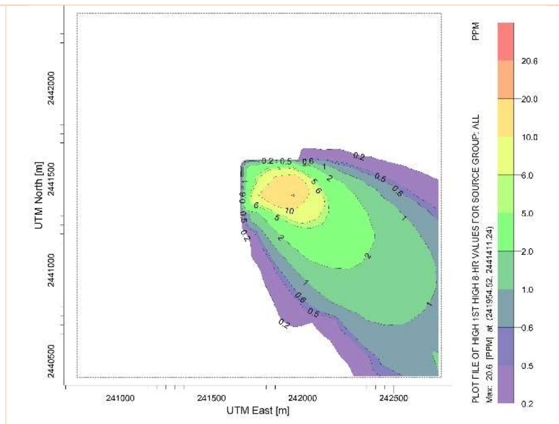
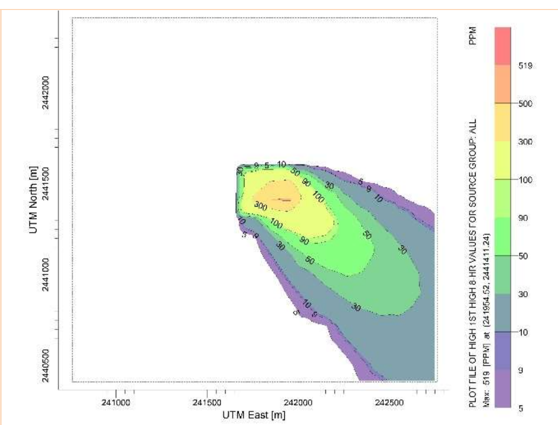


Emission Condition from Project

CO_2



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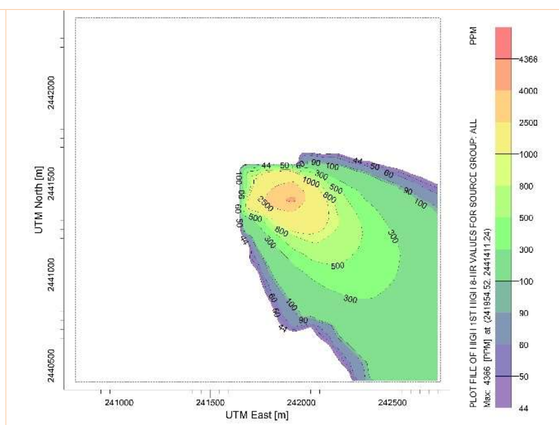
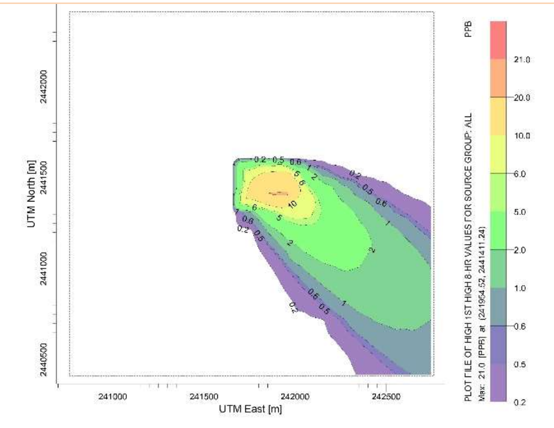


Emission Condition from Project

NO_2



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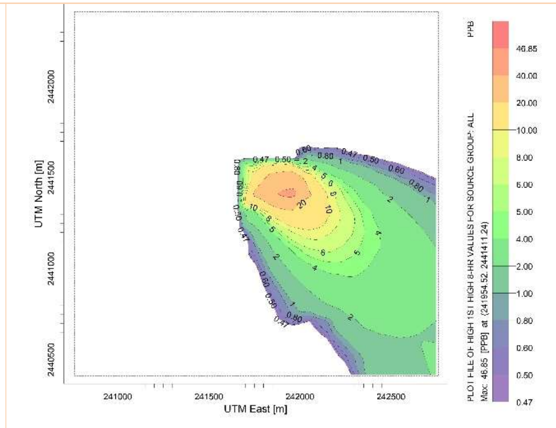
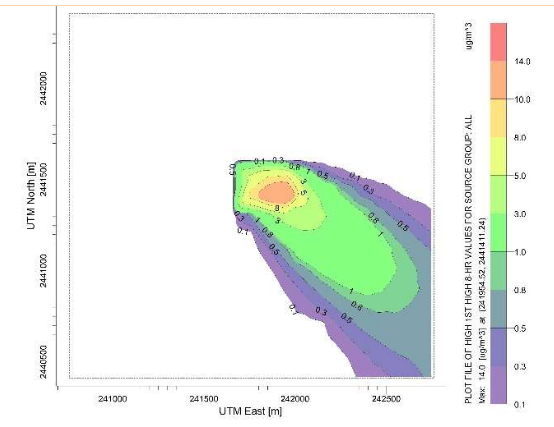


Emission Condition from Project

$PM_{2.5}$



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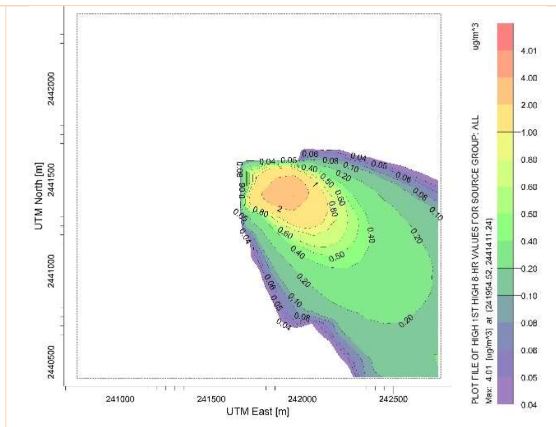
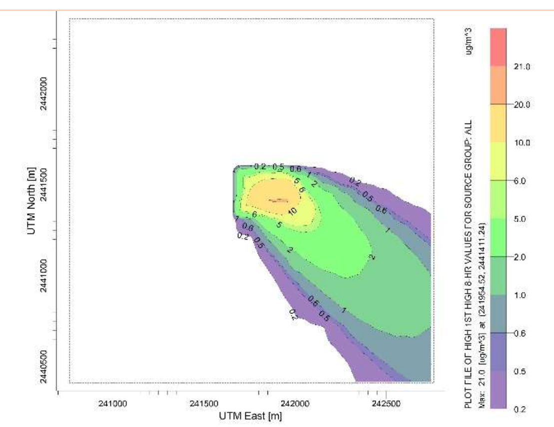


Emission Condition from Project

PM_{10}



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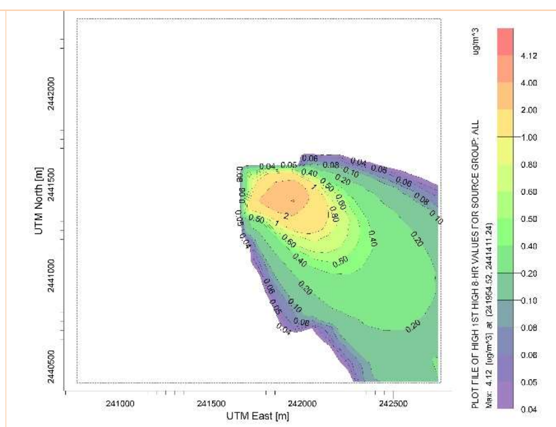
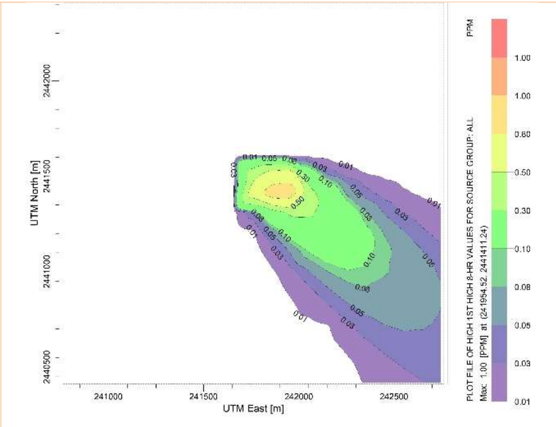


Emission Condition from Project

SO_2



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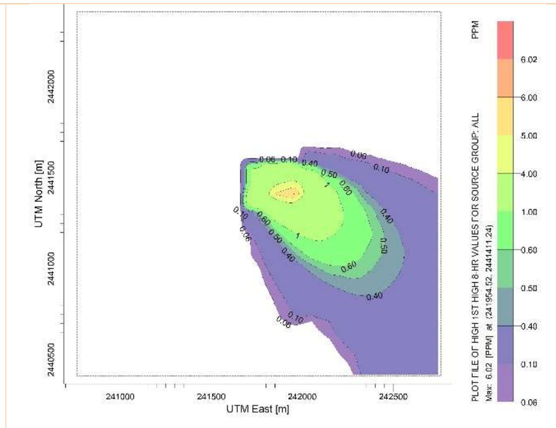
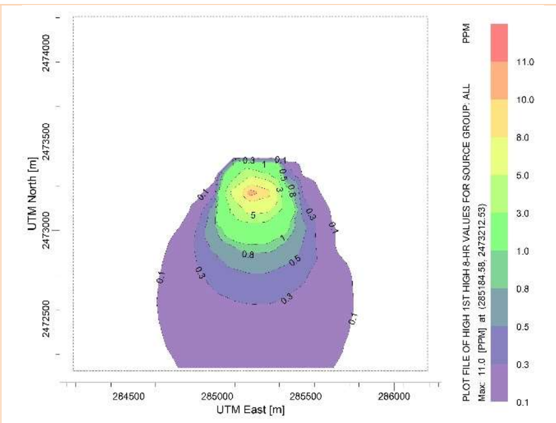


Emission Condition from Project

Naung Peng Railway Station

CO



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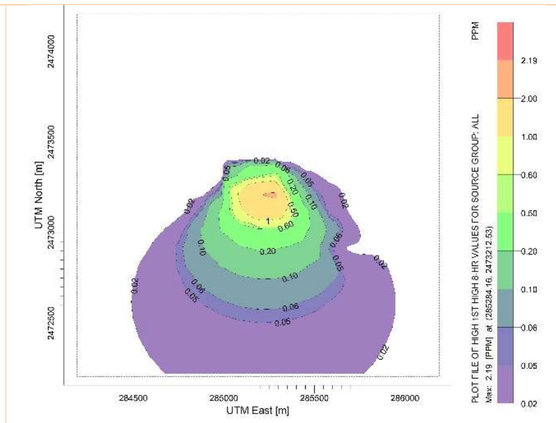
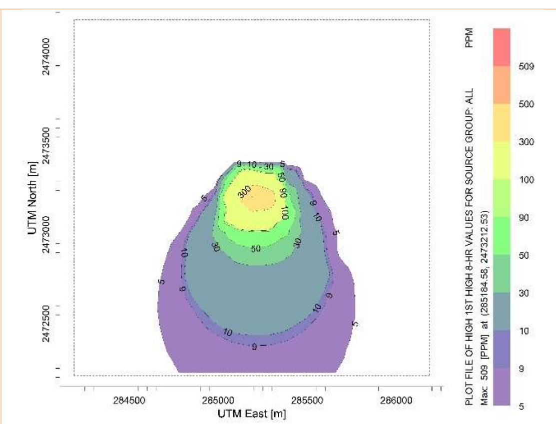


Emission Condition from Project

CO_2



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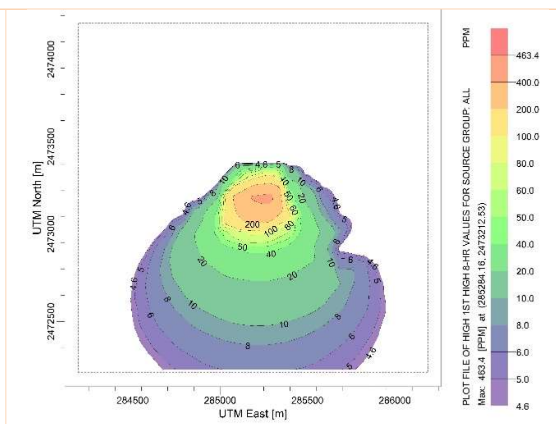
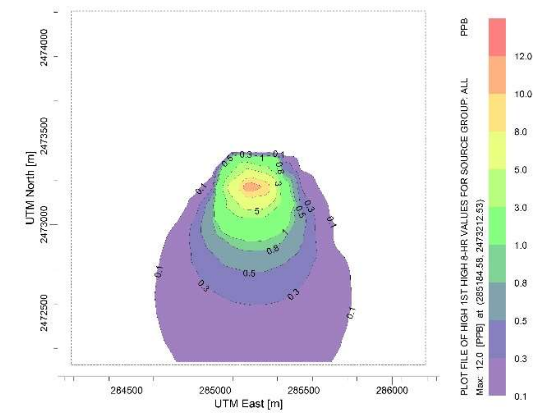


Emission Condition from Project

NO_2



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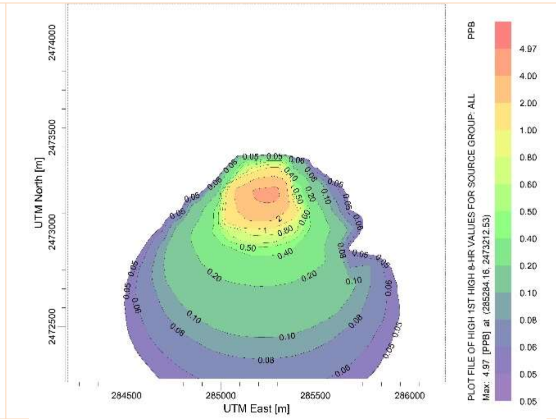
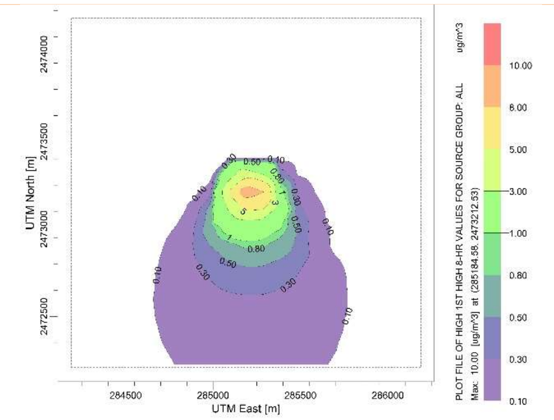
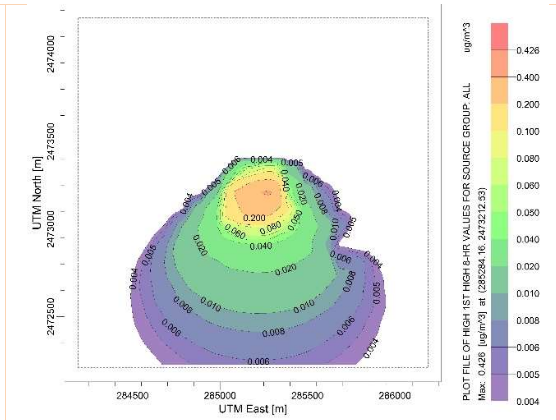


Emission Condition from Project

$PM_{2.5}$

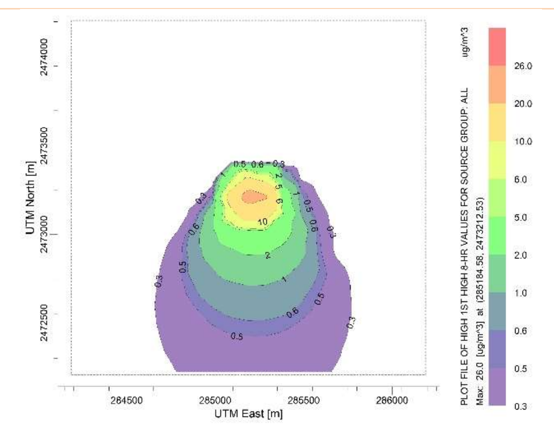


No Project Condition



Emission Condition from Project

PM_{10}



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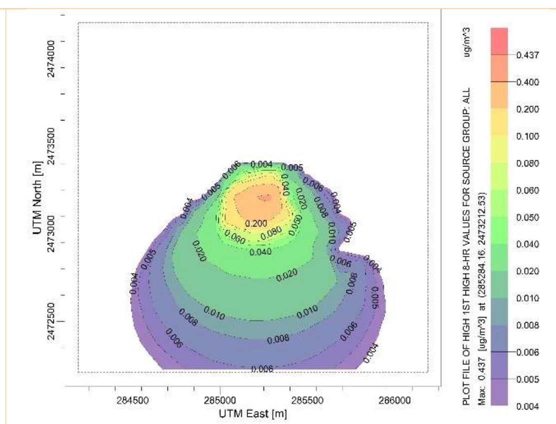

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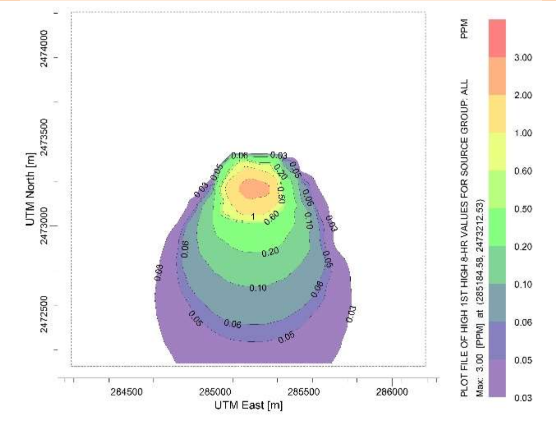

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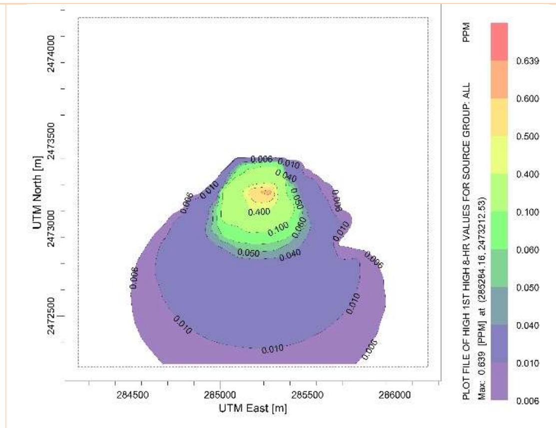
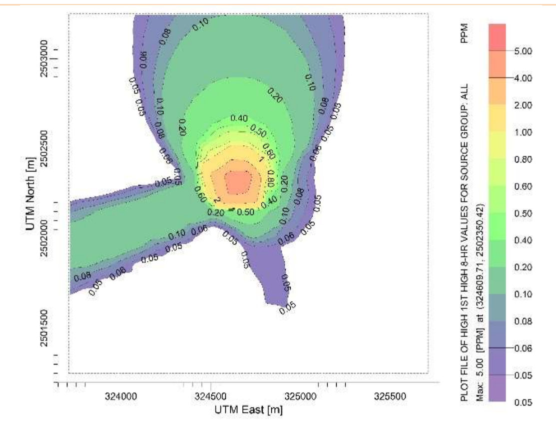


Emission Condition from Project

Hsipaw Railway Station

CO



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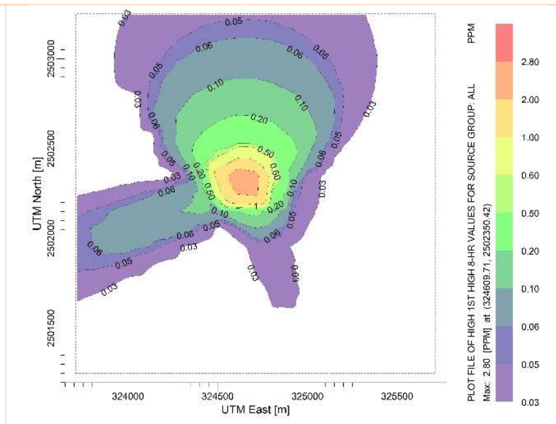

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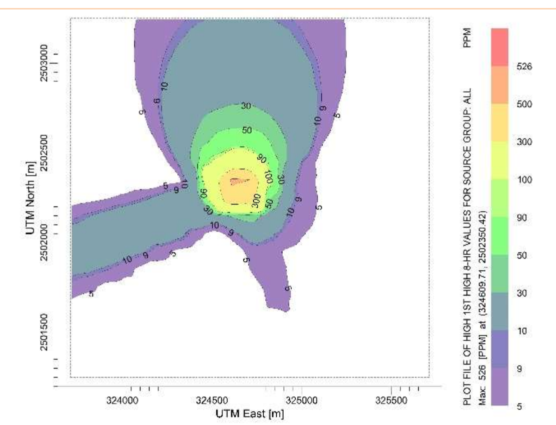

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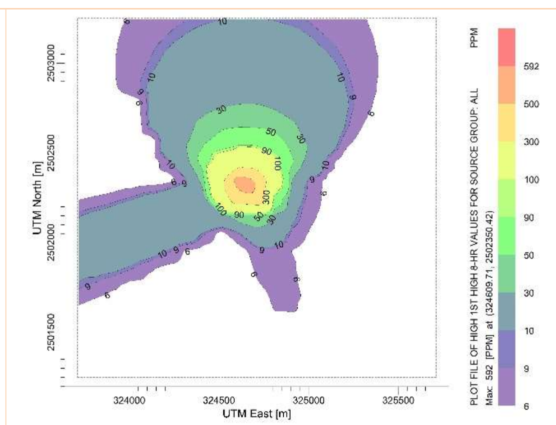

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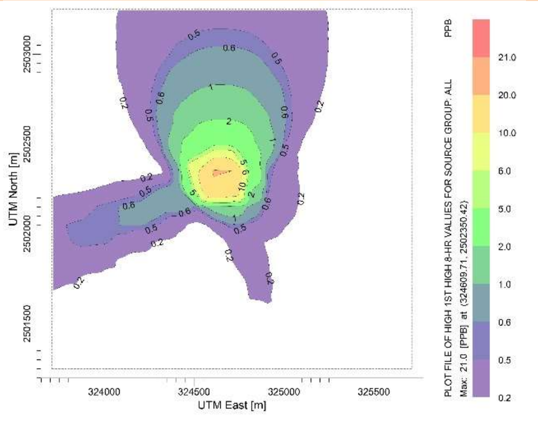

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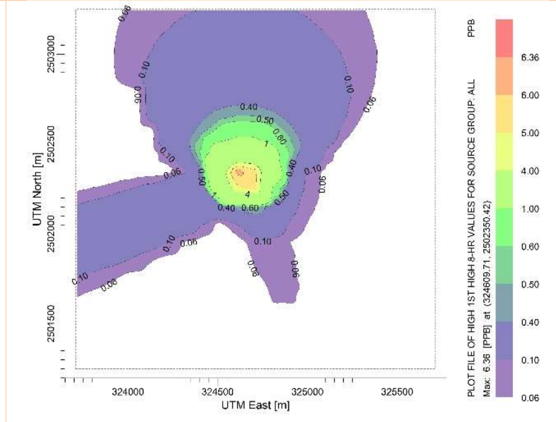
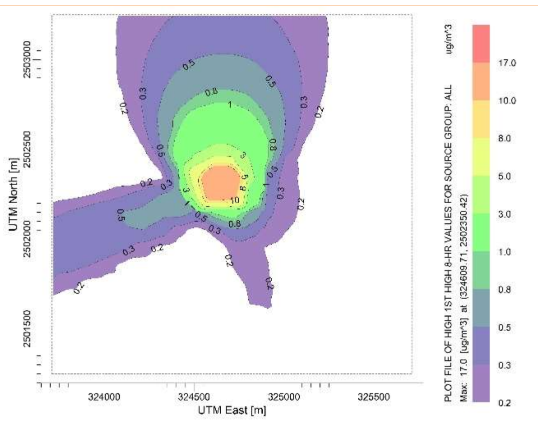


Emission Condition from Project

$PM_{2.5}$



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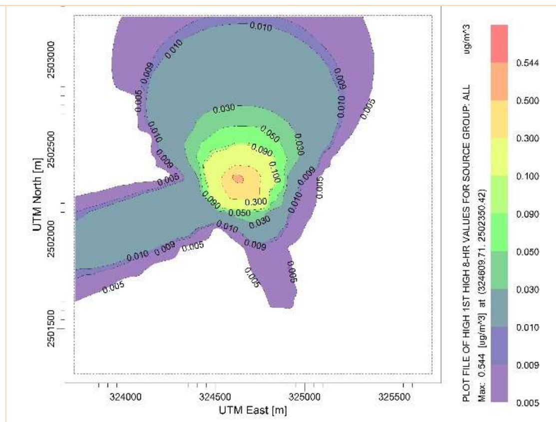

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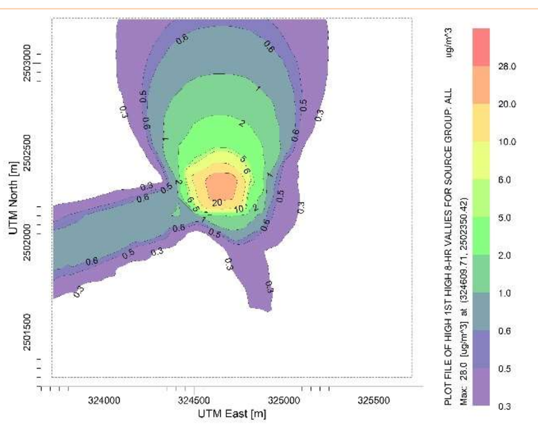

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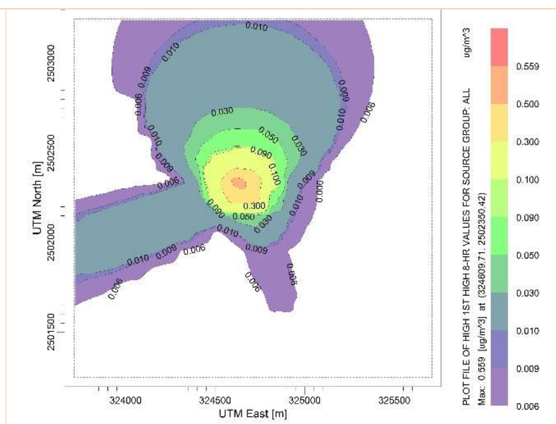

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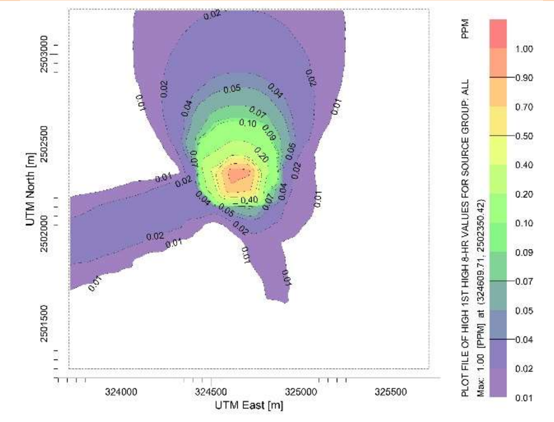
SO_2



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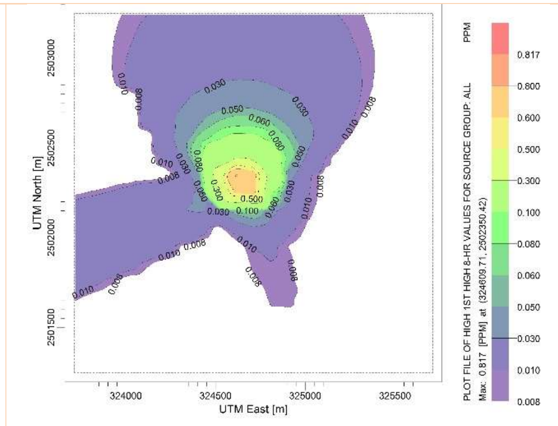
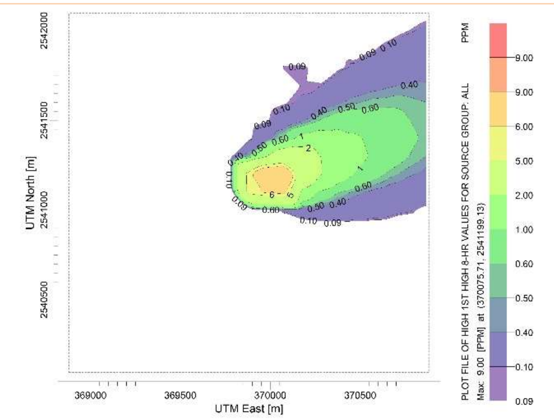


Emission Condition from Project

Lashio Railway Station

CO



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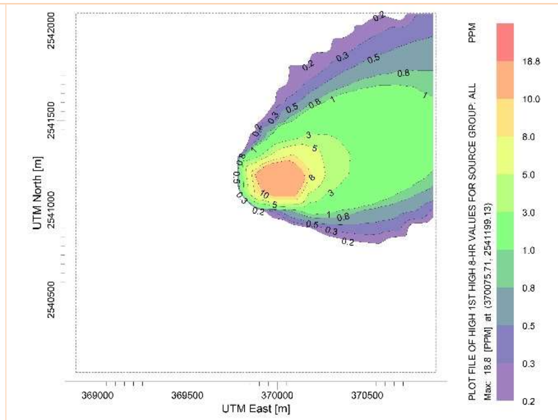

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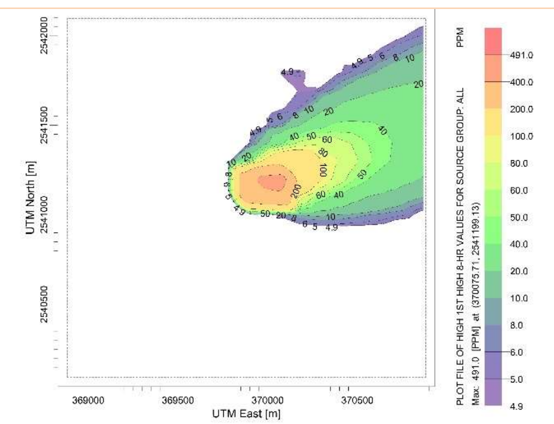

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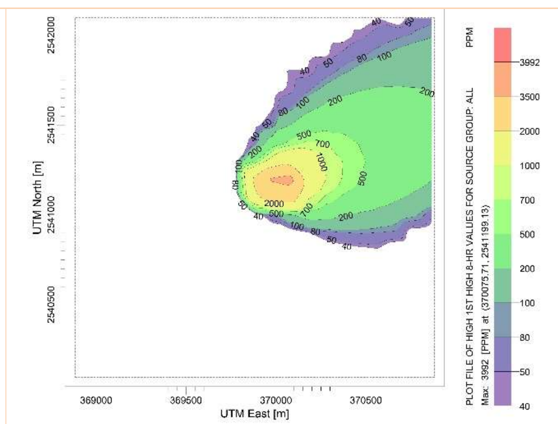

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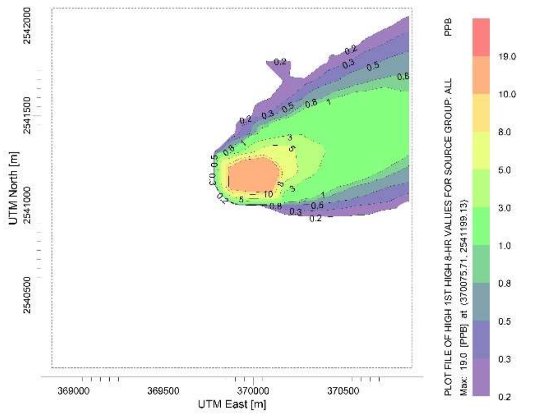
NO_2



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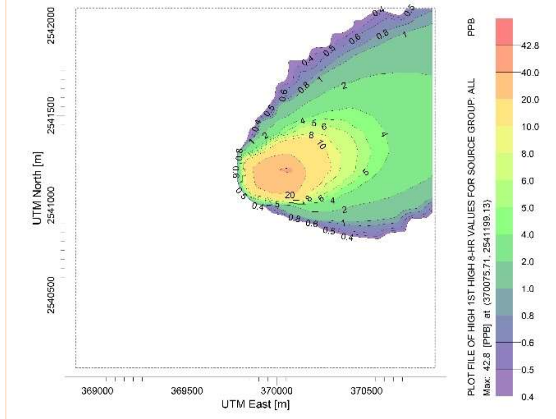
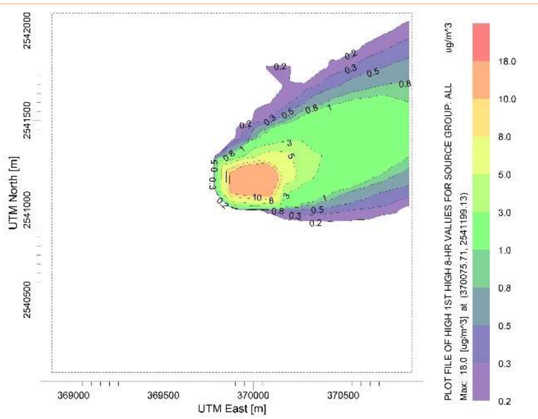


Emission Condition from Project

$PM_{2.5}$



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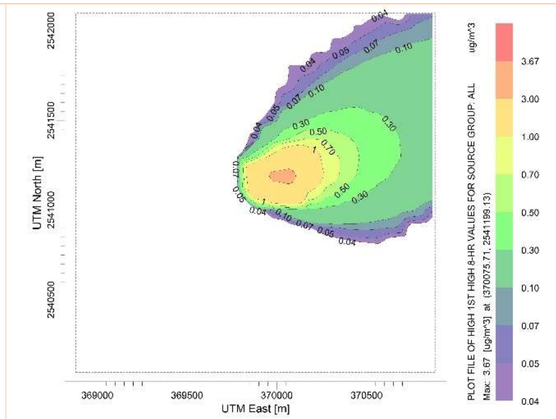

Emission Condition from Project

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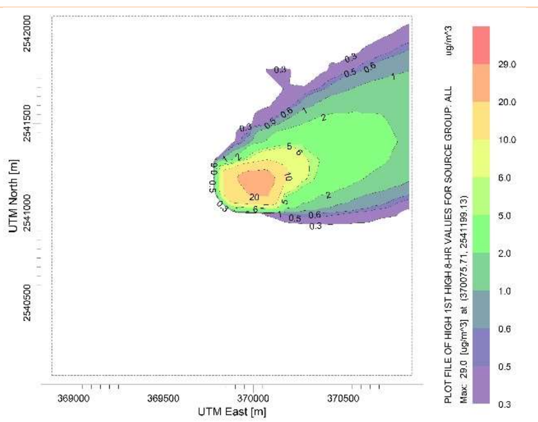

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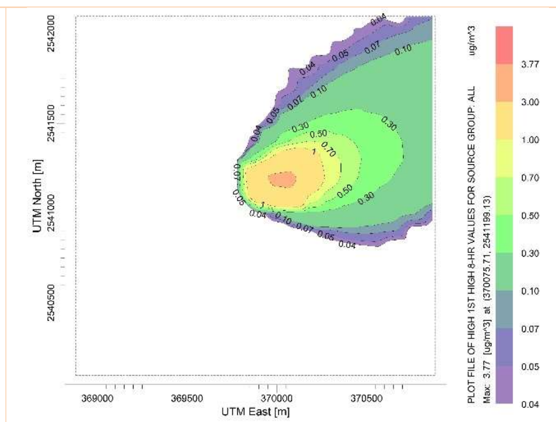

Emission Condition from Project

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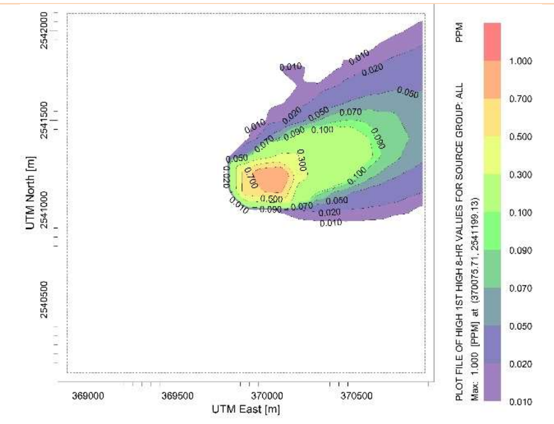

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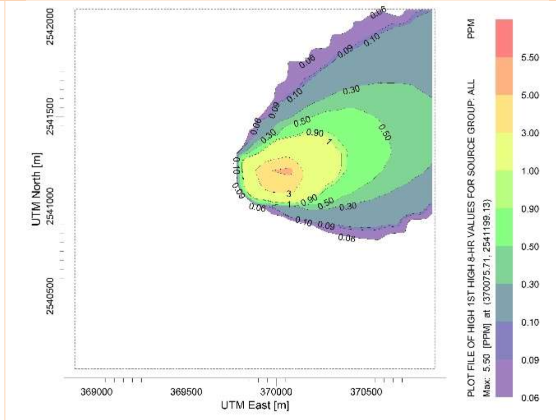


Emission Condition from Project

5.4.2. Existing Noise Level Monitoring

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors most commonly used in noise analysis.

- **Equivalent Sound Level (L_{Aeq})**: Leq represents an average of the sound energy occurring over a specified period. In effect, Leq is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The 1-hour A-weighted equivalent sound level (Leq[h]) is the energy average of A- weighted sound levels occurring during a one-hour period, and is the basis for noise abatement criteria (NAC).
- **Percentile-Exceeded Sound Level (L_{xx})**: Lxx represents the sound level exceeded for a given percentage of a specified period (e.g., L10is the sound level exceeded 10% of the time, and L90 is the sound level exceeded 90% of the time).
- **Maximum Sound Level (L_{max})**: L_{max} is the highest instantaneous sound level measured during a specified period.
- **Day-Night Level (L_{dn})**: Ldn is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.
- **Community Noise Equivalent Level (CNEL)**: Similar to Ldn, CNEL is the energy

average of the A-weighted sound levels occurring over a 24-hourperiod, with a 10-dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m., and a 5-dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

The vegetation along the surface is dense. The project area is mainly located in rural areas, with a small number of residential areas. No obvious noise and vibration sources are observed, and acoustic environment and vibration environment are good.

Noise Level Guidelines

As Myanmar is still attempting to regulate the noise level standards for different sectors, World Bank IFC General Environmental, Health and Safety Guidelines are used for reference. They can be used to address impacts of noise beyond property boundary of the facilities. The guidelines show the impacts should not exceed the levels presented in the following table, or result in a maximum increase in background level of 3 dB at the nearest receptor location off-site.

Table - NEQG Noise Level Standards

Noise Level Guidelines		
	One Hour L_{Aeq} (dBA)	
Receptor	Day time 07:00 – 22:00	Night time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Study Methods

Measurement time

The noise under investigation is measured for sufficient time to establish that the measured value adequately represents the subject source noise. The source noise is measured over a time interval of at least 15 minutes or, if the noise continues for less than 15 minutes, the duration of the source noise.

Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert.

Measurement location

Normally, when undertaking a noise assessment, it is essential to make note of the following on a site map:

- location of noise source
- background noise measurement location
- source noise measurement location
- topography between noise source and sensitive receivers.

The station should be located at the ambient level i.e. away from the direct source, away from any vibration and any obstruction.

Methodology for selection of noise level monitoring locations

The ambient noise monitoring is conducted at 16 locations in vicinities of the project route. The first 7 locations of noise measurement are taken in May 2019 and the another 9 points are measured in August 2019. The sources of noise are vehicles passing by nearby road, people talking, birds chirping, dogs barking, sound in operation nearby, ambulance siren arriving, sound system from nearby commercial building. During construction phase, the sources will be from operation of batching plant and construction machineries and during operation, it will be from running of trains.

Except for the area in Mandalay Division, the area in Shan State where the alignment passess are mostly in remote area which is partially controlled by EAOs and so difficult to made monitoring in that areas during crisis period of EAOs and Myanmar Military between 2019 to 2020. So it was unable to carry out noise level monitoring in nearsest places close to alignment and existing noise level monitoring were conducted near the intersection point of railway and road way. Therefore, the survey for noise level monitoring was carried out on chosen parts of NH3 highway (Muse to Mandalay) which is closest to the railway line. Moreover, the selected monitoring point is near location of batching plant (focal place of construction site) and residential areas. Since the noise level will be generated mainly from batching plant and site during construction stage, there will be high noise level due to operation of concrete batching plant and construction activities. Moreover, during impact assessment of operation phase, there is less impact on noise level the project will use electric-train so sampling points will not be needed for further monitoring. So, noise level monitoring near batching plant (focal place of construction site) during construction phase will be enough for all phases. Moreover, noise level monitoring at specified place will be conduct as in EMP-OP if necessary.

Table 5.18 - Measurement location

Sr. No	Sample Name	Coordinates		Remark
		Latitude(N)	Longitude(E)	Sensitive Areas
1	NS-0	21°51'11.93"N,	96° 4'17.38"E	AS0, Myitnge Railway Station
2	NS-1	21°52'48.75"N,	96°13'34.70"E	Ohn Chaw Tar Zone
3	NS-2	22° 2'13.97"N,	96°27'57.83"E	Pyin Oo lwin Railway Station
4	NS-3	22° 3'30.29"N,	96°29'51.88"E	Pyin Oo Lwin Industrial Zone Public Area
5	NS-4	22°21'4.94"N,	96°54'50.62"E	Naung Peng Rail way station
6	NS-5	22°37'5.20"N,	97°17'40.17"E	Hsipaw Railway Station
7	NS-6	22°58'22.88"N,	97°43'50.33"E	Lashio Railway Station

Noise Measurement Results

The noise environment at the project is dominated by human activities, with most activities during daytime hours.

The noise monitoring results are summarized in the following table to demonstrate baseline noise levels at the monitoring sites. There has been no development in the area since this time that would have led to a change in the baseline noise environment. As most of the monitoring stations are near the Muse-Mandalay Road, all of the cumulative noise level are mainly sourced from vehicle movement in Muse-Mandalay Road.

Existing Noise Levels

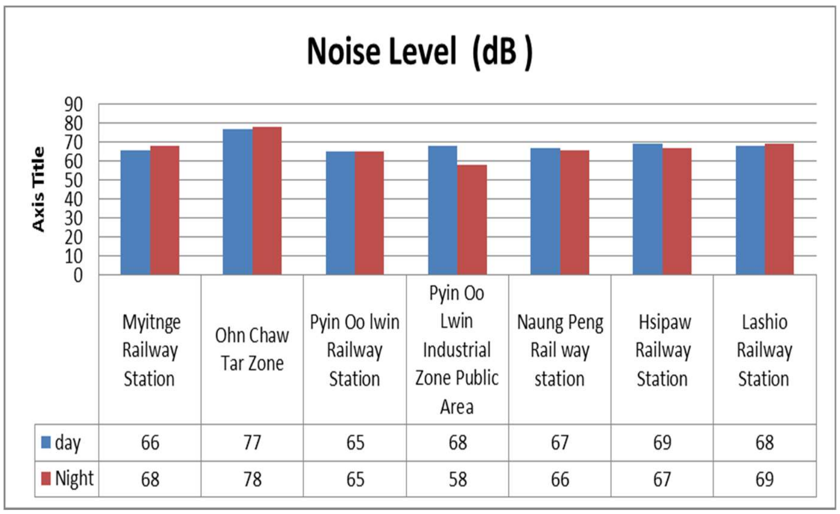
Noise level survey at the vicinity of the project was done by the team. The noise stations, the noise levels and their coordinates are shown in the following table. The following noise results are compared with the NEQG noise level standards.

Table 5.19 - Noise Measurement Results Comparing with Noise Level Guideline

Sample Name	Sensitive Areas	Noise Level (dB)		NEQG Standards		Latitude(N)	Longitude(E)
		day	night	day	night		
NS-1	Myitnge Railway Station	66	68	Residential/ institutional		21°51'11.93"N,	96° 4'17.38"E
NS-2	Ohn Chaw Tar Zone	77	78	55	45	21°52'48.75"N,	96°13'34.70"E

NS-3	Pyin Oo lwin Railway Station	65	65			22° 2'13.97"N,	96°27'57.83"E
NS-4	Pyin Oo Lwin Industrial Zone Public Area	68	58	**Industrial**		22° 3'30.29"N,	96°29'51.88"E
NS-5	Naung Peng Rail way station	67	66	70	70	22°21'4.94"N,	96°54'50.62"E
NS-6	Hsipaw Railway Station	69	67			22°37'5.20"N,	97°17'40.17"E
NS-7	Lashio Railway Station	68	69			22°58'22.88"N,	97°43'50.33"E

According to NEQG Noise Level Standards, limit of noise level for industrial, commercial is 70DbA at daytime and night time. But at Ohn Chaw Tar zone, the noise level around this area is a little bit beyond the limit because of Ohn Chaw Tar Zone is near highway road and also this road is used mostly for transportation.



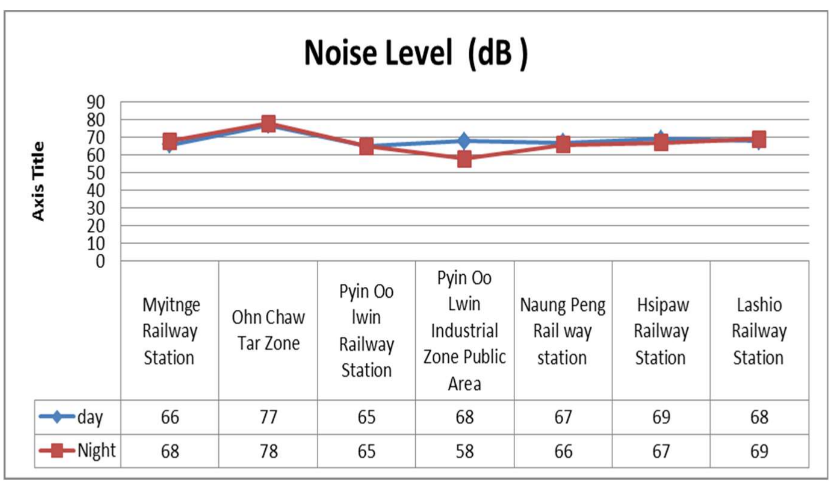


Figure 5.18 – Noise level near Ohn Chaw Tar Zone

Noise Level Monitoring along Muse-Mandalay Railway

For noise quality measurement, more sampling points are added more to measure specifically for EIA Study at the proposed Muse- Mandalay Railway Project site from Pyinoolwin to Muse (8 points).

Table 5.20 - Measurement location for Noise Level

No.	Place	Coordinates	
		Latitude(N)	Longitude
1	Pyin Oo Lwin – Oak Pho Village (Monastery)	N 22° 04' 15.87"	E 096° 23' 58.30"
2	Naung Cho – Shwe Pyi Nyunt Village	N 22° 18' 16.29"	E 096° 50' 02.16"
3	Goke Hteik	N 22° 20' 08.94"	E 096° 51' 53.42"
4	Hsipaw (near Baw Gyo Pagoda)	N 22° 34' 59.78"	E 097° 13' 59.62"
5	Beyond Hsipaw (San Laung)	N 22° 40' 33.66'	E 97° 30' 17.4"
6	Lashio	N 22° 59' 05.41"	E 097° 42' 23.09"
7	Hseni	N 23° 18' 23.97"	E 097° 58' 28.30"
8	Nam Hpat Kar	N 23° 41' 21.89"	E 097° 49' 02.76"
9	Muse	N 24° 00' 03.10"	E 097° 56' 25.90"

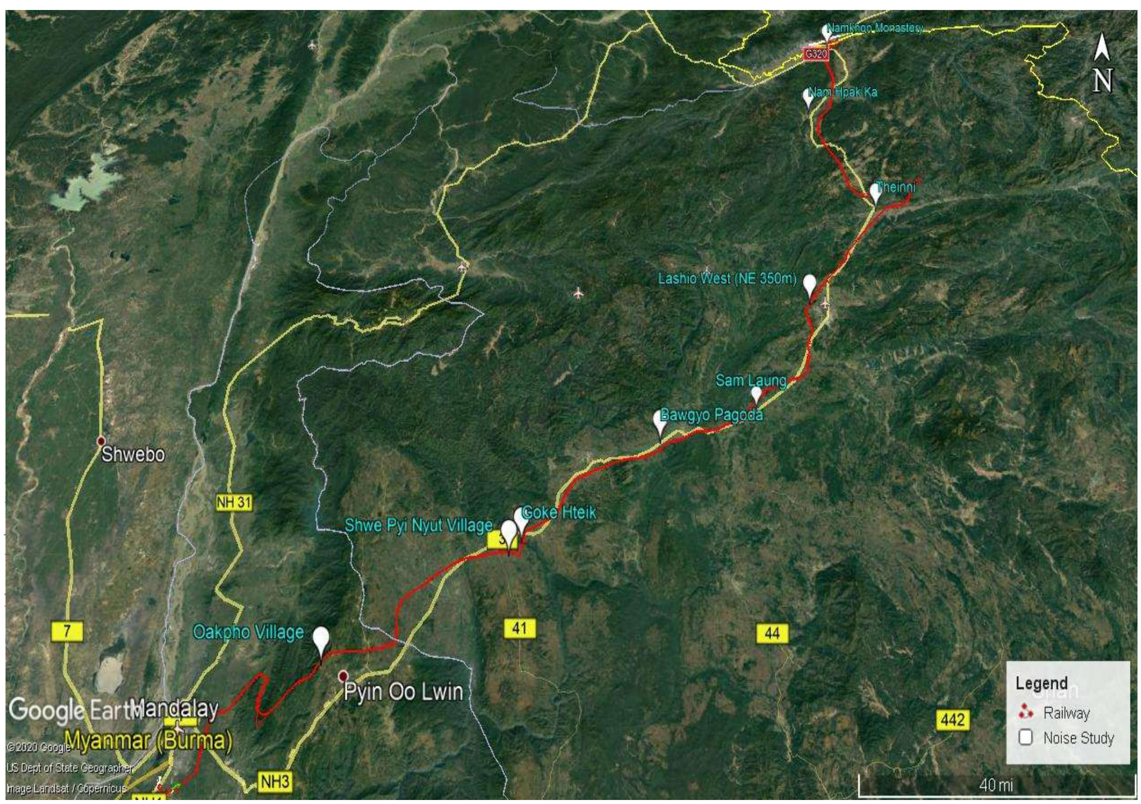


Figure 5.19 – Noise Study location along the Proposed Muse-Mandalay Railway Project

Noise Level Monitoring Results

Noise level survey at the vicinity of the project was done by the team. The noise stations, the noise levels and their coordinates are shown in the following table.

Table 5.21 – Noise Level Results

No.	Place	Location	Noise (dB)		NEQG Standards	
			Lowest	Highest	Day	Night
1	Pyin Oo Lwin - Oak Pho Village (Monastery)	N 22° 04' 15.87" E 096° 23' 58.30"	40	45.4	Residential/ institutional	
2	Naung Cho - Shwe Pyi Nyunt Village	N 22° 18' 16.29" E 096° 50' 02.16"	44.2	48.4		
3	Goke Hteik	N 22° 20' 08.94" E 096° 51' 53.42"	47.6	53	55	45
4	Hsipaw (near Baw Gyo Pagoda)	N 22° 34' 59.78" E 097° 13' 59.62"	51	57.8		
5	Beyond Hsipaw (San Laung)	N 22° 40' 33.66' E 97° 30' 17.4"	42.7	78.6	Industrial	
6	Lashio	N 22° 59' 05.41" E 097° 42' 23.09"	51.9	61.6		
7	Hseni	N 23° 18' 23.97" E 097° 58' 28.30"	50.7	56.1	70	70
8	Nam Hpat Kar	N 23° 41' 21.89" E 097° 49' 02.76"	50.4	53.3		
9	Muse	N 24° 00' 03.10" E 097° 56' 25.90"	42.7	45		

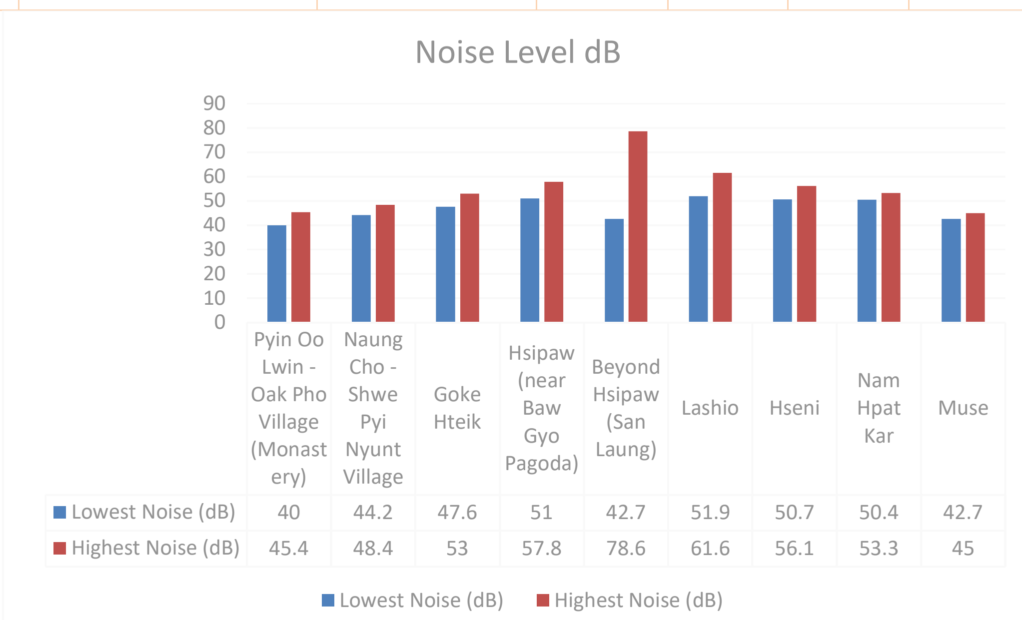


Figure 5.20 - Recorded photos for noise level monitoring

Noise Quality Results

The noise level in Myitnge Railway Station, Ohn Chaw Tar Zone, Pyin Oo Lwin Railway Station, Naung Peng Rail way, Hsipaw Railway Station, Lashio Railway Station, Goke Hteik, Hsipaw (near Baw Gyo Pagoda), Lashio, and Hseni exceed the NEQG standards which is 55dB during day time and 45dB during night time in residential/institutional area. Since the noise sampling points were near the town and beside the railway, the possible sources of noise during the day can be from vehicles along the road, trains and domestic noise from residential areas. During the night, the sources of noise can be from sounds of animals; for example, barking and howling of dogs, vehicles along the road especially trucks and talking of people within the neighborhood.

In Pyin Oo Lwin-Oak Pho Village (Monastery), Naung Cho – Shwe Pyi Nyunt and Muse do not exceed the NEQG Standards which is 55dB during day time and 45dB during night time in residential/institutional area. Since the sampling points are in village area, the source of noise can be mostly from motor bikes and domestic noises from residential areas. In Pyin Oo Lwin Industrial Zone Public Area, the result of noise level is below its NEQG standard for industrial area which is 70dB during the day and night. Its sources of noise can be from vehicles along the road, trains and domestic noises from residential areas. For Goke Hteik,and Beyond Hsipaw (San Laung), the results are below during the night but in day time, it exceeds the NEQG standard of 55dB. The possible sources of noise can be from transportation and domestic noises from residential areas.

5.4.3. Existing Water Quality Monitoring

Water Quality Sampling Points

Water qualities will be tested in all of the rivers and streams along the railway alignment as follow:

Sample -1, Shweli River
Sample -2, Nant Paung Stream
Sample -3, Nant Khaing Stream
Sample -4, Namtu Stream
Sample -5, Pan Phet Stream
Sample -6, A-T Stream
Sample -7, Sint In Stream
Sample -8, Kho Lone Stream
Sample -9, Dokehtawady River
Sample -10, Kyin Thi Stream
Sample -11, Gok Twin Stream
Sample -12, Yae Ni Stream
Sample -13, Se Taw Gyi Canal,
Sample -14, Myaung Ma Gyi Stream,
Sample -15, Myaing Gyi Stream,
Sample -16, Dokehtawady River

As the total construction period of all of the railway will be 5 years, the water quality will be collected for two seasons to cover the construction period.

Limitations for water sampling points

Water sampling is carried out based on the followings.

- Collection of samples is avoided at locations where there is high turbulence or flow.
- All samples must be representative, which means that the determinants in the sample must have the same value as the water body at the place and time of sampling.

- Water samples are selected from trend station that refers to a monitoring location designed to show how the parameters at a specific point on a water course vary over time due to the influence of human activities. Water qualities will be tested in all the rivers and streams along the railway alignment. Therefore, the water sampling will covered for the whole railway.

Methodology for Selection of Water Sampling Locations

The water sampling point locations are selected in the rivers and streams where the river are located along the route. There is no need to take sample on streams which are formed during wet seasons as the construction phase will only run during dry seasons.

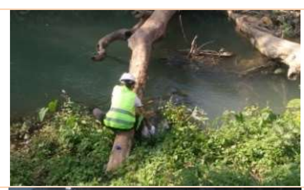
5.4.3.1. Water for Dry Seasons

The locations will also be illustrated as shown in the following figures.

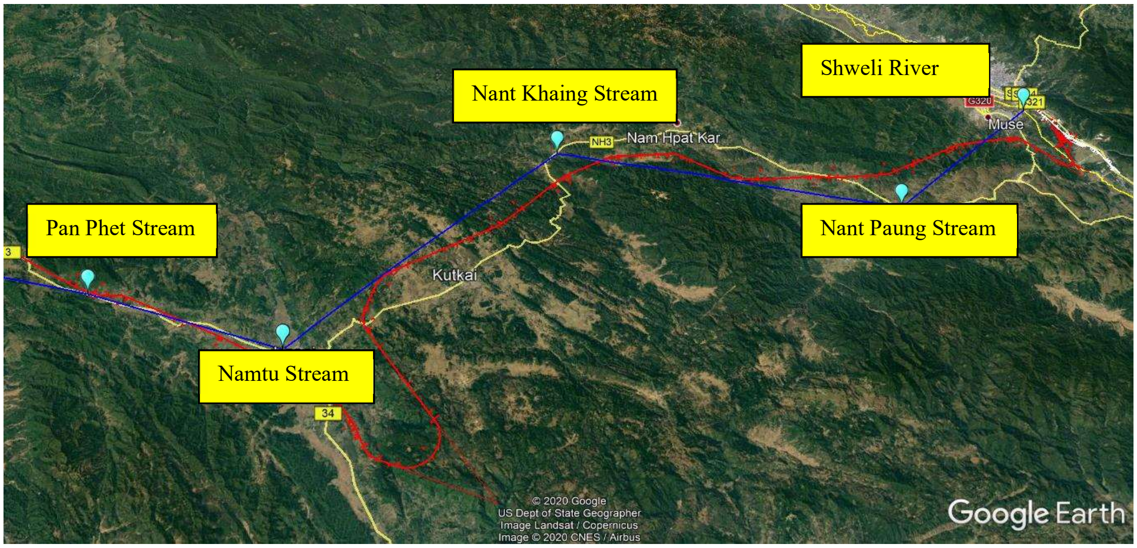
Table - Locations of the Water Quality Sampling

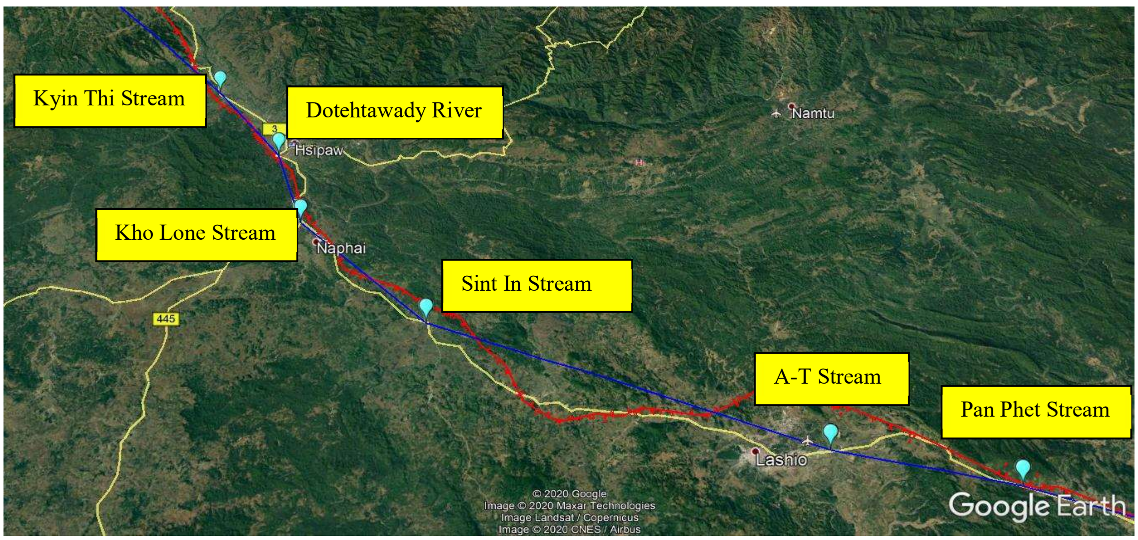
The exact locations and recorded photos during water quality sampling are as follow:

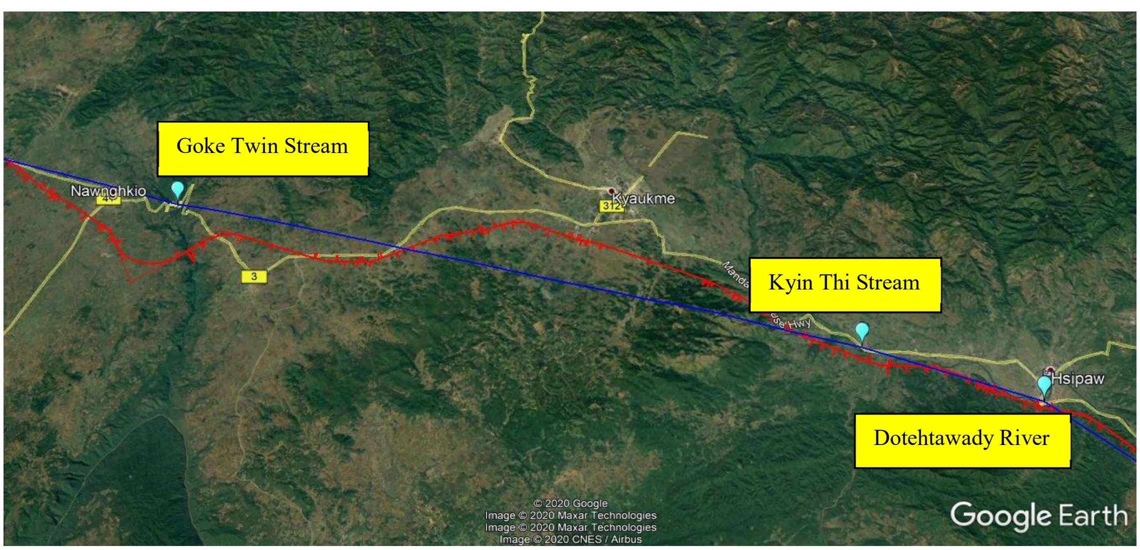
SN	Name	GPS Corrdinate		Collected Water Samples
		Lattitude	Longitude	
1	Shweli River (Muse)	24.01721°	97.90384°	
2	Nant Paung Stream (Muse)	23.85798°	97.97741°	
3	NantKhaing Stream (Kutkai)	23.57058°	97.81950°	

4	Namtu Stream (Thenni)	23.28817°	97.95394°	
5	Pan Phet Stream (Thenni)	23.13200°	97.84320°	
6	A-T Stream (Lashio)	22.99409°	97.76455°	
7	Sint In Stream (Lashio)	22.70178°	97.53847°	
8	Kho Lone Stream (Hsipaw)	22.61445°	97.39456°	
9	Dokehtawady River (Hsipaw)	22.60728°	97.30748°	
10	Kyin Thi Stream (Kyauk Me)	22.56428°	97.20963°	

11	Goke Twin Stream (Naung Cho)	22.35489°	96.83371°	
12	Yae Ni Stream (Pathein Gyi)	21.99596°	96.12399°	
13	SeDaw Gyi Stream (Pathein Gyi)	21.91917°	96.18635°	
14	Myaung Ma Gyi Stream (Amarapura)	21.85159°	96.12443°	
15	Myaing Gyi Stream (Min Village)	21.84470°	96.10187°	
16	Dokehtawady River (Myit Nge)	21.83646°	96.07781°	


Nant Khaing Stream
Shweli River
Nam Hpat Kar
Muse
Pan Phet Stream
Nant Paung Stream
Kutkai
Namtu Stream
Google Earth


Kyin Thi Stream
Dotehtawady River
Hsipaw
Namtu
Kho Lone Stream
Naphai
Sint In Stream
A-T Stream
Pan Phet Stream
Lashio
Google Earth


Goke Twin Stream
Nawnghkio
Kyaukme
Kyin Thi Stream
Hsipaw
Dotehtawady River
Google Earth

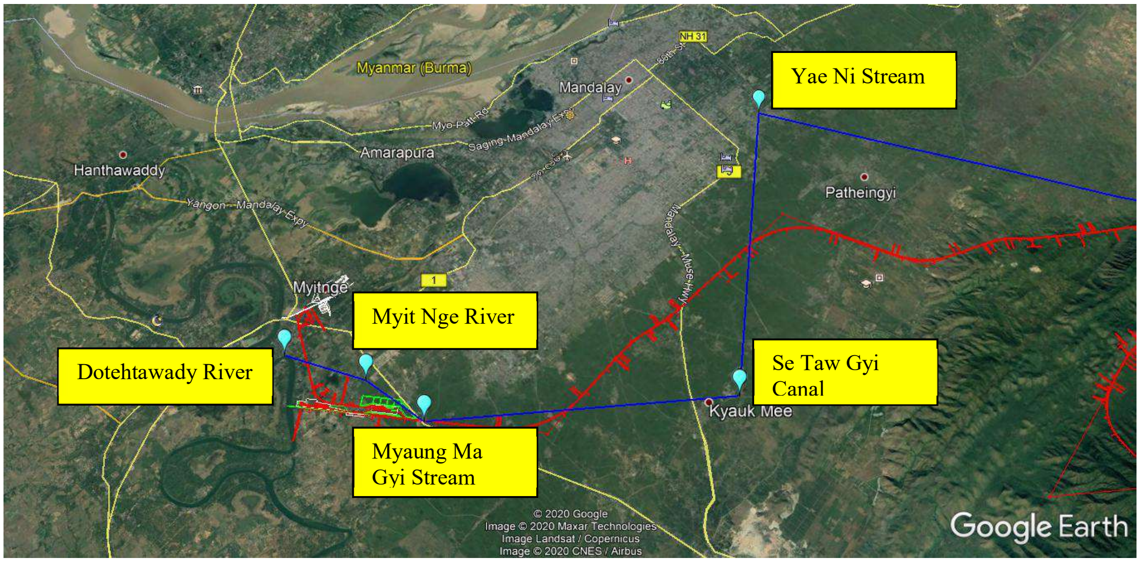


Figure 5.21 - Locations of Water Quality Sampling for Dry Season

Table 5.22. Water Quality Testing Results for Dry Season

Analyses	Unit	Shwe Li River	Nant Paung Stream	Nant Khaing Stream	Nmatu Stream	Pan Phat Stream	A-T Stream	Sint In Stream	Kho Lone Stream	Dokehtawady River	Kyin Thi Stream	Gok Twin Stream	Yae Ni Stream	Se Taw Gyi Canal	Myaung Ma Gyi Stream	Myaing Gyi Stream	Dokehtawady River	Max. Permissible Limit
Colour (TCU)	Pt-Co	4	38	2	3	2	7	2	1	4	20	5	9	4	30	20	2	15
Turbidity	NTU	1	35	1	2	Nil	2	1	Nil	1	5	2	2	2	5	7	Nil	5
Total dissolved solvents (TDS)	mg/l	74.5	134	185	226	238	197	212	277	176	128	193	92.8	235	125	264	186	1000
Chloride	mg/l	6.75	4.5	11.25	13.5	6.75	9	6.75	6.75	6.75	6.75	9	4.5	99	6.75	18	4.5	250
Total hardness (as Ca CO_3)	mg/l	85	170	200	200	170	260	230	180	210	200	200	90	100	130	170	220	500
Iron	mg/l	0.25	1.95	0.2	0.2	0.2	0.25	0.15	0.1	0.25	0.8	0.3	0.6	0.25	1.1	0.55	0.15	1
pH		7.47	7.79	8.19	8.03	7.43	8.27	7.75	7.46	8.18	7.88	6.87	7.35	7.59	7.65	7.9	7.95	6.5-8.5
Sulphate	mg/l	5	25	5	4	4	6	23	120	20	9	4	10	4	12	9	7	250
Calcium	mg/l	18	24	20	12	10	16	12	8	12	16	10	26	36	12	8	20	200
Magnesium	mg/l	11.2	30.8	42	47.6	40.6	61.6	56	44.8	50.4	44.8	49	7	2.8	28	42	47.6	150
Electrical conductivity	µs/cm	141.4	267	363	447	458	410	427	548	367	243	379	181.8	462	253	538	367	1500

Maximum Permissible Limit is from National Drinking Water Quality Standard, Myanmar (2014)

Analysis of Water Quality Results For Dry Season

For the results in Nant Paung Stream, and Myaing Gyi Stream, it has 38 TCU which exceeds the maximum permissible limit of 15 TCU and the turbidity of the water is 35 NTU which is higher than its limit of 5 NTU. The presence of iron in the river is also high which is 1.95mg/l exceeding its limit of 1mg/l. For Myaung Ma Gyi Stream, it has 30 TCU which exceeds the maximum permissible limit of 20 TCU and the presence of iron is 1.1mg/l exceeding its limit of 1mg/l. For Myaing Gyi Stream, the turbidity of the water is 7 NTU which is higher than its limit of 5 NTU. Iron is common in most rocks and when those rocks are weathered down over time, the minerals from the rocks are dissolved and small pieces are released into the water causing color changes. Color changes in water and turbidity can also be caused by high flow rate, soil erosion, algae blooms, decaying plants and animal.

5.4.8.3.2. Water Quality Testing Results for Wet Seasons

Water quality will also be collected for wet seasons as follow:

Location of Water Quality Sampling in Wet Seasons

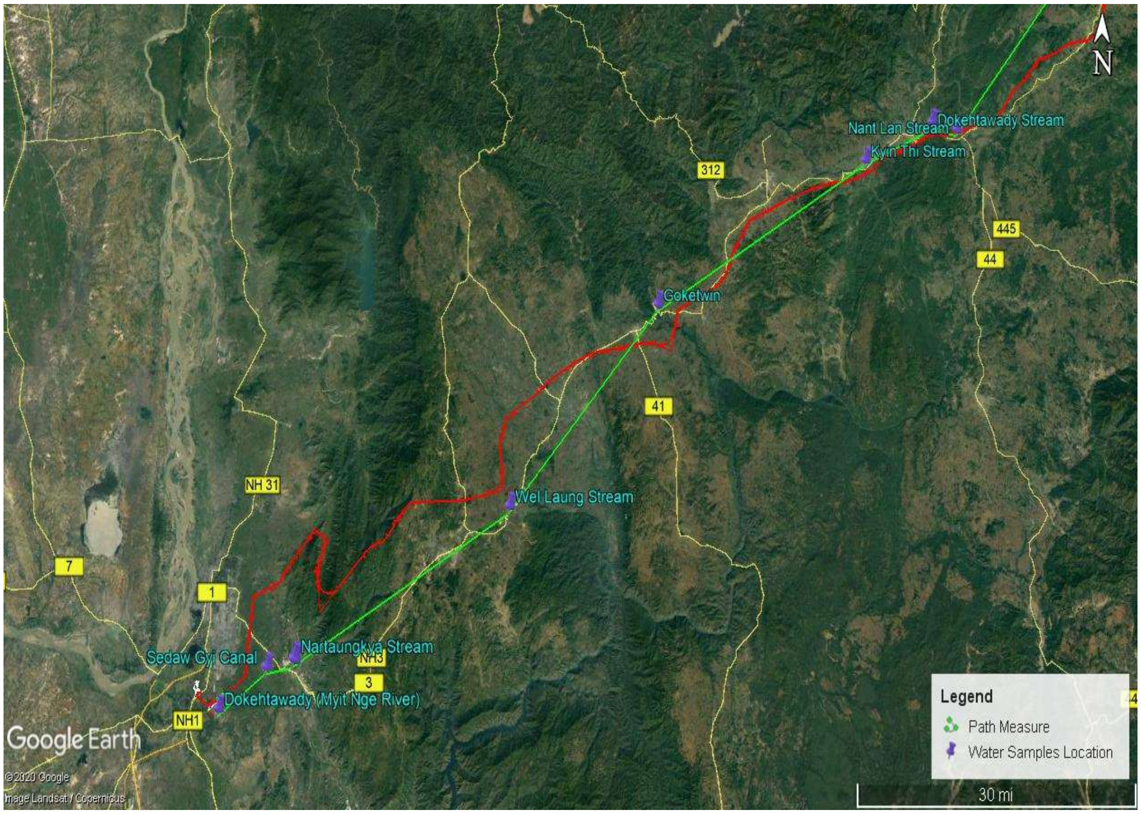
The following table shows the locations of water quality sampling in wet seasons.

Table 5.23 - Location of Water Samples in Wet Season

SN	Name	GPS Corrdinate		Collected Water Samples
		Lattitude	Longitude	
1	**Namkhon Monastery (Muse)**	24.00058°	97.940547	
2	**Nam Paw Stream (Muse)**	23.85798°	97.97741°	

3	**Natural Spring Near Nam Paw Stream (Muse)**	23.800891°	97.920002°	
4	**Nam Khaing Stream (Kutkai)**	23.57058°	97.81950°	
5	**Namtu Stream (Theinni)**	23.28817°	97.95394°	
6	**Pan Phet Stream (Theinni)**	23.13200°	97.84320°	
7	**Nant Lam Stream (Hsipaw)**	22.61445°	97.39456°	
8	**Dokehtawady River (Hsipaw)**	22.60728°	97.30748°	

9	**Kyin Thi Stream (Hsipaw)**	22.56428°	97.20963°	
10	**Goke Twin stream (Naung Cho)**	22.35489°	96.83371°	
11	**Wel Laung Stream (Pyin Oo Lwin)**	22.082172°	96.580458°	
12	**Nartaungkya Stream (Pathein Gyi)**	21.880704°	96.226655°	
13	**Sedaw Gyi Cannal**	21.91917°	96.18635°	
14	**Dokehtawady(Myit Nge River)**	21.83646°	96.07781°	



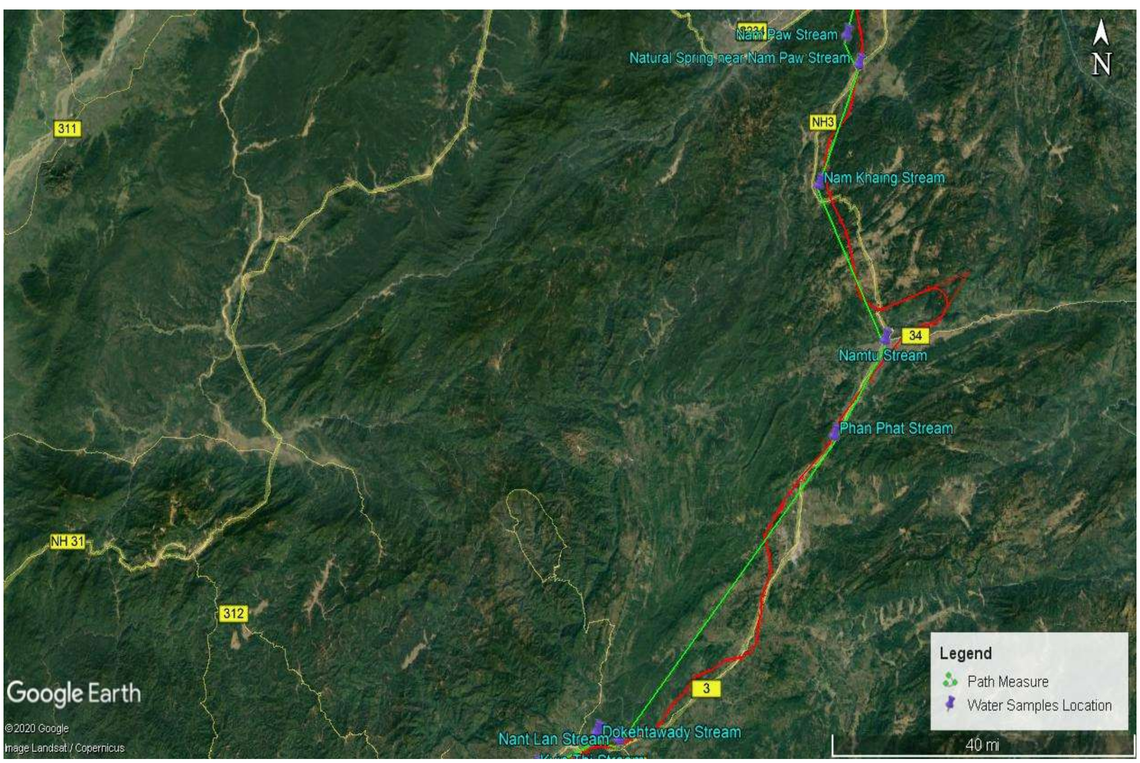


Figure – Water Sample Location

Table 5.24 - Water Quality Testing Results for Wet Season

Analyses	Unit	Namkhon Monastery	Nam Paw Stream	Natural Spring Near Nam Paw Stream	Nam Khaing Stream	Namtu Stream	Pan Phet Stream	Nant Lam Stream	Dokehtawady	Kyin Thi Stream	Goke Twin stream	Wel Laung Stream	Nartaungkya Stream	Sedaw Gyi Cannal	Dokehtawady(Myit Nge River)	Maximum Permissible Limit
Calcium	mg/l	24	33	44	49	69	63	73	34	32	42	79	70	29	50	200
Chloride	mg/l	7.68	7.68	8.65	6.72	12.49	8.65	12.49	8.65	12.49	8.65	21.14	15.37	8.16	9.13	250
Conductivity	µs/cm	0.244	0.329	0.691	0.447	0.568	0.578	0.658	0.431	0.297	0.377	0.740	0.592	0.258	0.454	1500
Magnesium	mg/l	<5	<5	6	6	9	7	10	<5	5	6	11	9	<5	8	150
pH	-	7.44	7.36	7.08	7.64	7.24	7.43	7.36	7.2	7.17	7.14	7.1	7.11	7.15	7.2	6.5-8.5
Sulphate	mg/l	ND	ND	2.1	ND	3.6	ND	46.2	3.9	ND	ND	2.4	2.1	ND	6.6	250
Total Hardness as $CaCO_3$	mg/l	88.5	157.5	381	328.5	264	412.5	345	200	116	170	403	300	95.5	197	500
Total Iron	mg/l	0.5	0.2	ND	0.1	0.2	<0.1	0.1	0.5	1	1	ND	0.1	1	<0.1	1
Total Dissolved Solids	mg/l	95	128	380	280	360	360	258	190	80	172	320	198	103	196	1000
Turbidity	NTU	9.47	36.2	9.29	21.1	24.4	11.5	24.4	35.5	55.6	35.8	10.5	47.6	48.8	14.1	5

Maximum Permissible Limit is from National Drinking Water Quality Standard, Myanmar (2014)

Analysis of Water Quality Results for Wet Season

The water quality results in all these 14 water bodies during wet season do not exceed its maximum permissible limit except for the turbidity. The result of turbidity in all these water bodies that are measured in wet season exceeds its maximum limit of 5 NTU. Turbidity typically increases during high flow events (heavy rain, etc) as soil particles are washed off from streets, agricultural fields and more. The results have shown that the turbidity in all 14 water surfaces have exceeded the maximum limit of 5 NTU because of the wet season, rain causes to increase the turbidity of water.

5.4.4. Existing Soil Quality Monitoring

As the construction of tunnel will impact on soil quality during construction stage, soil quality will be monitored and will have to be tested in laboratory.

Sample Point Selection

To determine the chemical composition of soil quality, the sample points are selected at the project site, rivers' bank and inside the farm land.

Soil sampling is selected from river banks and agricultural lands. The wearing away of soil found along the river banks will lead to the accumulation of sediment which in turn will increase the river pollution problem. The amount of soil erosion loss depends on the combination of the strength of the rain to cause erosion and the ability of the soil to withstand the rain. The soil resistance against erosion depends on several factors such as soil structure, infiltration level and organic matter content. For the agricultural lands, the amount of nutrients in the soil is needed to be monitored for the adequate amount of the necessary nutrients to meet the needs of the crops to be grown.

The sampling points are selected for 20 locations from river bank soil and agricultural soil in vicinities of the project route. Therefore, these samples are to be considered enough for representatives of river banks and agricultural land near the project route. The construction of railway will have very little impact on soil quality because the nature of railway construction is liner construction (small area in a short time) and so soil quality monitoring is not required to monitor along the railway line. If necessary, soil quality will be monitored in a specific area as in EMP-OP during implementation phase.

Table 5.25 - Locations of Soil Sample Points for Dry Season

SN	Name	GPS Corrdinate		Collected Soil Samples
		Lattitude	Longitude	
1	Phat Man Soil (I)	23.84672°	97.96399°	
2	Lower Nam Phat Loon Soil (I)	23.57058°	97.81950°	
3	Theinni Soil(I)	23.28817°	97.95394°	
4	Hang Lu Soil(I)	23.13200°	97.84320°	
5	Pang Huauk Soil	22.61445°	97.37921°	

6	Hsipaw Soil (I)	22.60728°	97.30748°	
7	Kyin Thi Soil(I)	22.56428°	97.20963°	
8	Goke Twin Soil	22.35489°	96.83371°	
9	Sedaw Gyi Soil	21.91917°	96.18635°	
10	Myit Nge Soil	21.83646°	96.07781°	

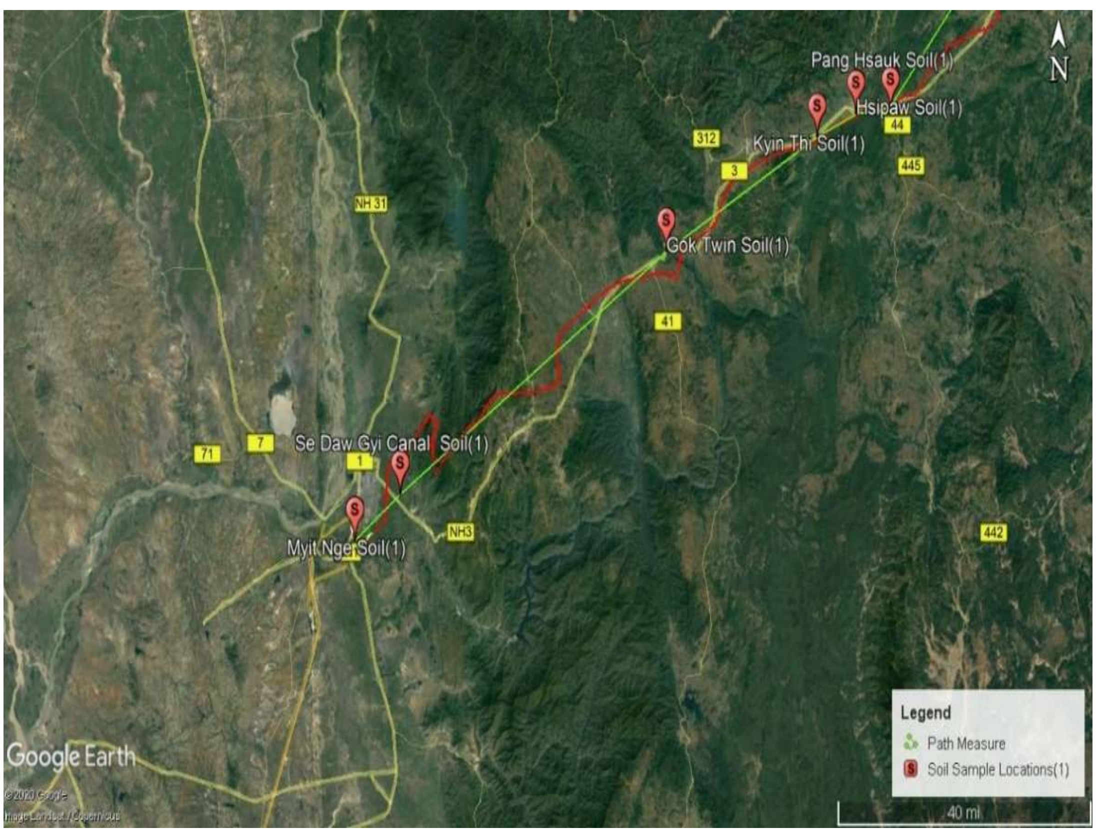
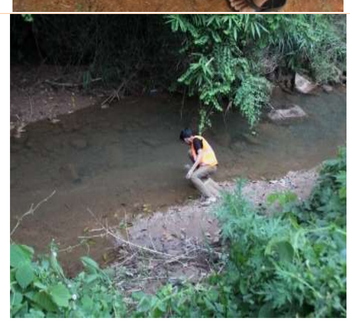


Figure 5.22 - Locations of Soil Quality Sampling along the Railway Line for Dry Season

Table 5.26 - Locations of Soil Sample Points for Wet Season

SN	Name	GPS Corrdinate		Collected Soil Samples
		Lattitude	Longitude	
1	Phat Man Soil (II)	23.800891°	97.9200002°	
2	Lower Nam Phat Loon Soil (II)	23.569606°	97.819422°	
3	Theinni Soil(II)	23.288344°	97.954061°	
4	Hang Lu Soil(II)	23.119017°	97.836422°	
5	Pang Huauk Soil(II)	22.611375°	97.378211°	

6	Hsipaw Soil (II)	22.621989°	97.334172°	
7	Kyin Thi Soil(II)	22.564178°	97.209489°	
8	Goke Twin Soil(II)	22.354586°	96.833431°	
9	Sedaw Gyi Soil(II)	21.872109°	96.182244°	
10	Myit Nge Soil(II)	21.819177°	96.106333°	

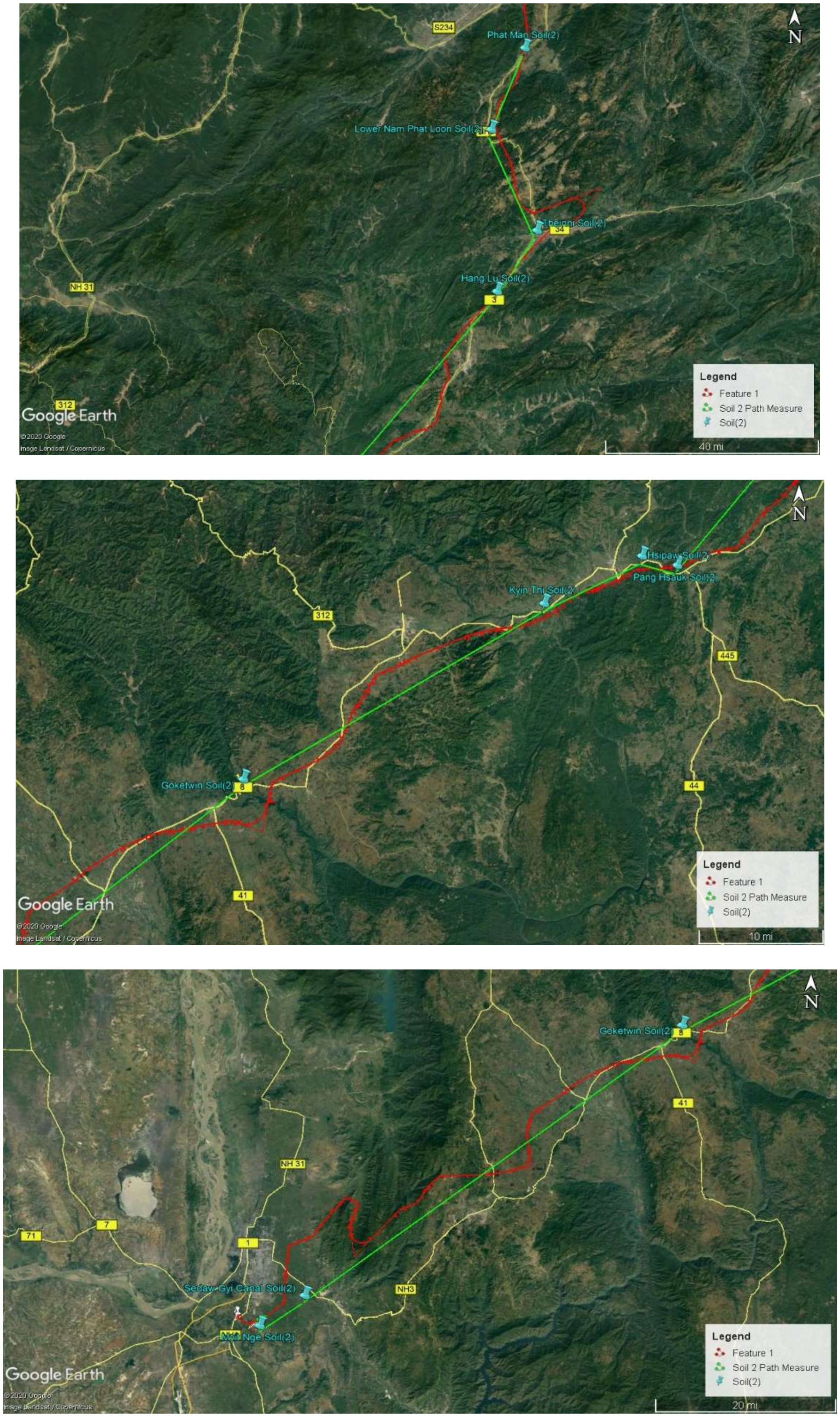


Figure 5.23 - Locations of Soil Quality Sampling along the railway Line in Wet Season

Table 5.27 (a)- Soil Quality Results (Dry Season)

Sr No.	Sample (Soil 1)	pH Soil:Water 1:2.5	Texture	Organic Carbon	Total N	CEC	Available Nutrients		Water Soluble Meq/q100gm		Interpretation of results	
							P	K_2O	Cl^-	$SO_4^=$	Cl^-	$SO_4^=$
1	Hang Lu	Slightly alkaline	Sandy Loam	Low	Medium	High	Low	Medium	0.19	0.37	Low	Low
2	Kyin Thi	Moderately alkaline	Sandy clay loam	Very low	Low	High	Medium	High	0.30	0.14	Low	Low
3	Sedaw Gyi Cannal	Moderately alkaline	Sandy Loam	Medium	Low	Very High	Very High	High	0.19	0.21	Low	Low
4	Hsipaw	Moderately alkaline	Sandy Loam	Very Low	Very low	Medium	Medium	High	0.15	0.18	Low	Low
5	Goke Twin	Moderately alkaline	Loamy sandy	Very Low	Low	Medium	Low	Medium	0.23	0.14	Low	Low
6	Myit Nge	Moderately alkaline	Sandy Loam	Low	Medium	Very high	High	High	0.80	0.25	Low	Low
7	Pang Hsauk	Moderately alkaline	Sandy Loam	Low	Medium	Very high	Medium	Medium	0.23	1.01	Low	Low
8	Phat Man	Moderately alkaline	Sandy Loam	Low	Medium	Medium	Medium	Medium	0.19	0.18	Low	Low
9	Lower Nam Phat Loon	Slightly alkaline	Sandy Loam	Medium	Medium	Medium	Low	Medium	0.23	0.33	Low	Low
10	Theinni	Moderately alkaline	Loamy sandy	Medium	Low	High	Medium	Low	0.15	0.18	Low	Low

Table 5.27 (b) - Soil Quality Results (Dry Season)

Sr No.	Sample (Soil 2)	pH Soil:Water 1:2.5	Texture	Organic Carbon	Total N	CEC	Available Nutrients		Water Soluble Meq/q100gm		Interpretation of results	
							P	K_2O	Cl^-	$SO_4^=$	Cl^-	$SO_4^=$
11	Phat Man	Slightly alkaline	Clay	Low	Medium	High	Low	High	0.38	0.21	Low	Low
12	Goke Twin	Moderately alkaline	Loam	Very low	Low	Medium	Low	Medium	0.19	0.21	Low	Low
13	Pang Hsauk	Moderately alkaline	Sandy loam	Very low	Low	High	Low	Medium	0.34	0.14	Low	Low
14	Hang Lu	Moderately alkaline	Sandy loam	Very low	Low	Medium	Low	Medium	0.27	0.14	Low	Low
15	Kyin Thi	Moderately alkaline	Sandy loam	Low	Low	Medium	Medium	High	0.30	0.10	Low	Low
16	Myit Nge	Moderately alkaline	Sandy loam	Low	Medium	Very high	Medium	High	0.49	0.25	Low	Low
17	Lower Nam Phat Loon	Moderately alkaline	Sandy loam	Very low	Low	Medium	Medium	Medium	0.34	0.21	Low	Low
18	Sedaw Gyi Canal	Moderately alkaline	Clay loam	Low	Medium	Very high	High	High	0.38	0.10	Low	Low
19	Hsipaw	Moderately alkaline	Sandy loam	Medium	Medium	High	Medium	High	0.23	0.10	Low	Low
20	Theinni	Moderately alkaline	Sandy clay loam	Very low	Low	Very High	Medium	Medium	0.19	0.25	Low	Low

Table 5.28 (a) - Soil Quality Results (Wet Season)

Sr No.	Sample (Soil 1)	Moisture	pH soil:water 1:2.5	Texture				Organic Carbon %	Humus %	Total N	CEC	Exchangeable Cations Meq/100gm						Available Nutrients	
				Sand %	Silt %	Clay %	Total %					Ca^{++}	Mg^{++}	K^{+}	Na^{+}	H^{+}	Al^{++}	P ppm Olsen	K_2O Mg/ 100gm
1	Hang Lu	3.54	7.50	69.90	16.72	13.38	100.00	1.77	3.06	0.22	26.98	24.95	1.31	0.36	0.36	-	-	7.47	16.80
2	Kyin Thi	5.35	7.93	48.90	26.72	24.38	100.00	0.82	1.41	0.15	32.09	25.43	1.34	3.99	1.33	-	-	8.46	148.42
3	Sedaw Gyi Cannal	4.08	7.75	62.90	25.72	11.38	100.00	3.35	5.78	0.15	41.67	33.66	4.62	2.28	1.11	-	-	61.31	106.99
4	Hsipaw	1.46	7.81	76.90	10.72	12.38	100.00	0.79	1.35	0.03	21.43	19.92	0.64	0.43	0.44	-	-	10.56	20.10
5	Goke Twin	0.78	8.15	86.90	4.72	8.38	100.00	0.04	0.07	0.18	14.25	11.49	1.91	0.26	0.59	-	-	4.84	12.09
6	Myit Nge	7.66	7.78	56.90	20.72	22.38	100.00	1.10	1.90	0.23	43.67	34.98	6.17	0.94	1.58	-	-	13.87	44.20
7	Pang Hsauk	7.70	7.69	71.90	11.72	16.38	100.00	1.63	2.81	0.21	47.54	43.21	3.43	0.41	0.49	-	-	10.83	19.50
8	Phat Man	10.02	7.91	63.90	13.72	22.38	100.00	1.04	1.80	0.21	19.08	14.08	4.22	0.38	0.39	-	-	10.23	18.02
9	Lower Nam Phat Loon	11.71	7.33	70.90	13.72	15.38	100.00	2.03	3.50	0.24	18.70	14.34	3.58	0.33	0.44	-	-	5.44	15.63
10	Theinni	8.00	8.07	86.90	4.72	8.38	100.00	0.35	0.61	0.15	26.85	24.80	1.38	0.21	0.47	-	-	9.14	9.79

Table 5.28 (b) - Soil Quality Results (Wet Season)

Sr No.	Sample (Soil 2)	Moisture	pH soil:water 1:2.5	Texture				Organic Carbon %	Humus %	Total N	CEC	Exchangeable Cations Meq/100gm						Available Nutrients	
				Sand %	Silt %	Clay %	Total %					Ca^{++}	Mg^{++}	K^{+}	Na^{+}	H^{+}	Al^{++}	P ppm Olsen	K_2O Mg/ 100gm
11	Phat Man	4.48	7.38	33.9	22.72	43.38	100.00	1.41	2.43	0.22	26.10	16.57	7.95	0.76	0.82	-	-	7.54	35.81
12	Goke Twin	4.54	8.20	46.9	31.72	21.38	100.00	0.17	0.29	0.11	22.11	19.20	1.99	0.24	0.68	-	-	6.27	11.30
13	Pang Hsauk	2.44	8.08	70.9	15.72	13.38	100.00	0.71	1.22	0.18	39.50	36.97	1.03	0.24	1.00	-	-	4.51	11.07
14	Hang Lu	1.36	7.94	66.9	19.72	13.38	100.00	0.95	1.64	0.14	19.78	17.98	1.28	0.23	0.29	-	-	3.65	10.95
15	Kyin Thi	3.45	7.95	66.9	19.72	13.38	100.00	1.01	1.89	0.16	23.91	17.05	5.90	0.48	0.47	-	-	9.53	22.38
16	Myit Nge	2.44	8.01	53.9	30.72	15.38	100.00	1.71	2.94	0.22	51.19	45.45	3.90	0.96	0.89	-	-	11.90	44.92
17	Lower Nam Phat Loon	1.57	8.00	76.9	13.72	9.38	100.00	0.79	1.36	0.16	22.60	19.30	2.57	0.29	0.44	-	-	10.16	13.41
18	Sedaw Gyi Canal	4.63	8.06	36.9	26.72	36.38	100.00	1.54	2.65	0.22	55.20	44.46	6.64	1.81	2.30	-	-	16.35	84.91
19	Hsipaw	3.73	7.82	53.90	34.72	11.38	100.00	2.20	3.79	0.24	34.79	29.58	3.29	0.48	1.44	-	-	10.80	22.43
20	Theinni	1.42	7.77	54.90	24.72	20.38	100.00	0.95	1.64	0.18	49.16	44.94	3.21	0.26	0.75	-	-	10.55	12.17

Analysis of Soil Quality Results For Dry Season

Soil Texture

The soil texture of Hang Lu, Sedaw Gyi Canal, Myit Nge, Pang Hsuak and Lower Nam Phat Loon is sandy loam which is very nutritious and fertile for plants to grow. Kyin Thi and Phat Man has a soil texture of sandy clay loam which has a moderate ability to hold nutrients and leaching is less severe. Goke Twin and Theinni have loamy sand which is fine-textured, low water holding capacity and fast drainage rates.

pH

The soil of Hang Lu and Lower Nam Phat Loon has a pH level of slightly alkaline condition which is a best condition for nutrient availability and suitable for most crops. The other 8 soil sample are moderately alkaline due to presence of sodium, potassium or calcium salts in graywater. High ph level in either direction negatively affect the availability of key nutrients required by plants.

Organic Carbon

Hang Lu, Myit Nge, Pang Hsauk and Phat Man are found to be low in its soil organic carbon which can limit the soil's ability to produce nutrients for sustainable plant production so it needs organic or inorganic fertilizer application to be productive. Kyin Thi, Hsipaw and Goke Twin has very low organic carbon so its need more fertilizers. Sedaw Gyi Canal, Lower Nam Phat Loon and Theinni has medium organic carbon so no fertilizer is required.

Total N

The total amount of nitrogen in Hang Lu, Myit Nge, Pang Hsauk, Phat Man and Lower Nam Phat Loon is in medium range which is an adequate level for most crops. The other 5 soil samples are low in nitrogen so plants are stunted as plants cannot make proteins, amino acids and even its very DNA. Fertilizers should be provided for deficiency of nitrogen in soil.

CEC (Cation Exchange Capacity)

Hang Lu, Kyin Thi, Sedaw Gyi Canal, Myit Nge, Pang Sauk and Theini has high CEC in soil as the soil is slightly and moderately alkaline which the excess soluble and carbonate salts will inflate CEC results. The other 4 soil samples have medium CEC in soil.

Available P

The rating of P in Hang Lu, Goke Twin and Lower Nam Phat Loon is low so it will produce weak plants that are prone to witling, discoloration and inadequate fruit. Therefore, phosphorus can be added in a form of fertilizers, manures and other forms. Soil PH has a large influence on phosphorus availability and solubility. Kyin Thi, Hsipaw, Pang Hsauk and Phat Man have a medium rating of P so it is an adequate level for most crops. Sedaw Gyi Canal and Myit Nge are high in P and it is adequate for crop growth and yield, and maybe necessary for heavy feeding crops. But excess of P can lead to nutrient pollution in surface water run-off.

Available K

Kyin Thi, Sedaw Gyi Canal, Hsipaw and Myit Nge are high in potassium so it can be unhealthy for plants because it affects the way the soil absorbs other critical nutrients. Theinni is low in K can limit crop growth and can be improved either in quantity or quality by the supplementation of the deficient nutrient. The other 5 soil samples are medium in K so it is an adequate level for most crops.

Analysis of Soil Quality Results for Wet Season

Soil Texture

The soil texture of the other 6 soil samples is sandy loam which is very nutritious and fertile for plants to grow. Phat Man has a soil texture of clay in wet season. Goke Twin has a texture of loam soil where stickiness and non-adhesiveness are in balance. Theinni have sandy clay loam which has a moderate ability to hold nutrients and leaching is less severe. Sedaw Gyi Canal has a texture of clay loam soil has nearly equal parts of sand, slit and clay.

pH

The soil of Phat Man has a pH level of slightly alkaline condition which is a best condition for nutrient availability and suitable for most crops. The other 8 soil sample are moderately alkaline due to presence of sodium, potassium or calcium salts in graywater. High ph level in either direction negatively affect the availability of key nutrients required by plants.

Organic Carbon

Phat Man, Kyin Thi, Myit Nge and Sedaw Gyi Canal are found to be low in its soil organic carbon which can limit the soil's ability to produce nutrients for sustainable plant production so it needs organic or inorganic fertilizer application to be productive. Goke Twin, Pang Hsuak, Hang Lu, Lower Nam Phat Loon and Theinni has very low organic carbon so its need more fertilizers. Hsipaw has medium organic carbon so no fertilizer is required.

Total N

The total amount of nitrogen in Phat Man, Myit Nge, Sedaw Gyi Canal and Hsipaw is in medium range which is an adequate level for most crops. The other 6 soil samples are low in nitrogen so plants are stunted as plants cannot make proteins, amino acids and even its very DNA. Fertilizers should be provided for deficiency of nitrogen in soil.

CEC (Cation Exchange Capacity)

Phat Man, Pang Hsuak, Myit Nge, Sedaw Gyi Canal, Hsipaw and Theinni has high CEC in soil as the soil is slightly and moderately alkaline which the excess soluble and carbonate salts will inflate CEC results. The other 4 soil samples have medium CEC in soil.

Available P

The rating of P in Phat Man, Hang Lu, Goke Twin and Pang Hsauk is low so it will produce weak plants that are prone to witling, discoloration and inadequate fruit. Therefore, phosphorus can be added in a form of fertilizers, manures and other forms. Soil PH has a large influence on phosphorus availability and solubility. Kyin Thi, Myit Nge, Lower Nam Phat Loon, Hsipaw and Theinni have a medium rating of P so it is an adequate level for most crops. Sedaw Gyi Canal are high in P and it is adequate for crop growth and yield, and maybe necessary for heavy feeding crops. But excess of P can lead to nutrient pollution in surface water run-off.

Available K

Phat Man, Kyin Thi, Myit Nge, Sedaw Gyi Canal and Hsipaw are high in potassium so it can be unhealthy for plants because it affects the way the soil absorbs other critical nutrients. The other 5 soil samples are medium in K so it is an adequate level for most crops.

5.4.5. Vibration Level Monitoring

Vibration levels were measured at points along the proposed Muse-Mandalay Railway. The measurements are taken in places which are Pyin Oo Lwin-Oak Pho Village (Monastery), Naung Cho- Shwe Pyi Nyunt Village, Goke Hteik, Hsipaw (near Baw Gyo Pagoda), Beyond Hsipaw (San Laung), Lashio, Hseni, Nam Hpat Kar and Muse. These locations are identified as vibration sensitive area. The following figures shows the location of vibration level assessment.

Hseni

Testing

Hsipaw (near Baw Gyo Pagoda)

Lashio

Naung Cho (Shwe Pyi Nyunt Village)

Pyin Oo Lwin (Oak Pho Village)

Figure 5.24 - Recorded Photos for Vibration Measurement

Figure 5.25- Recorded Seismograph Results Along the Proposed Project Muse-Mandalay Railway

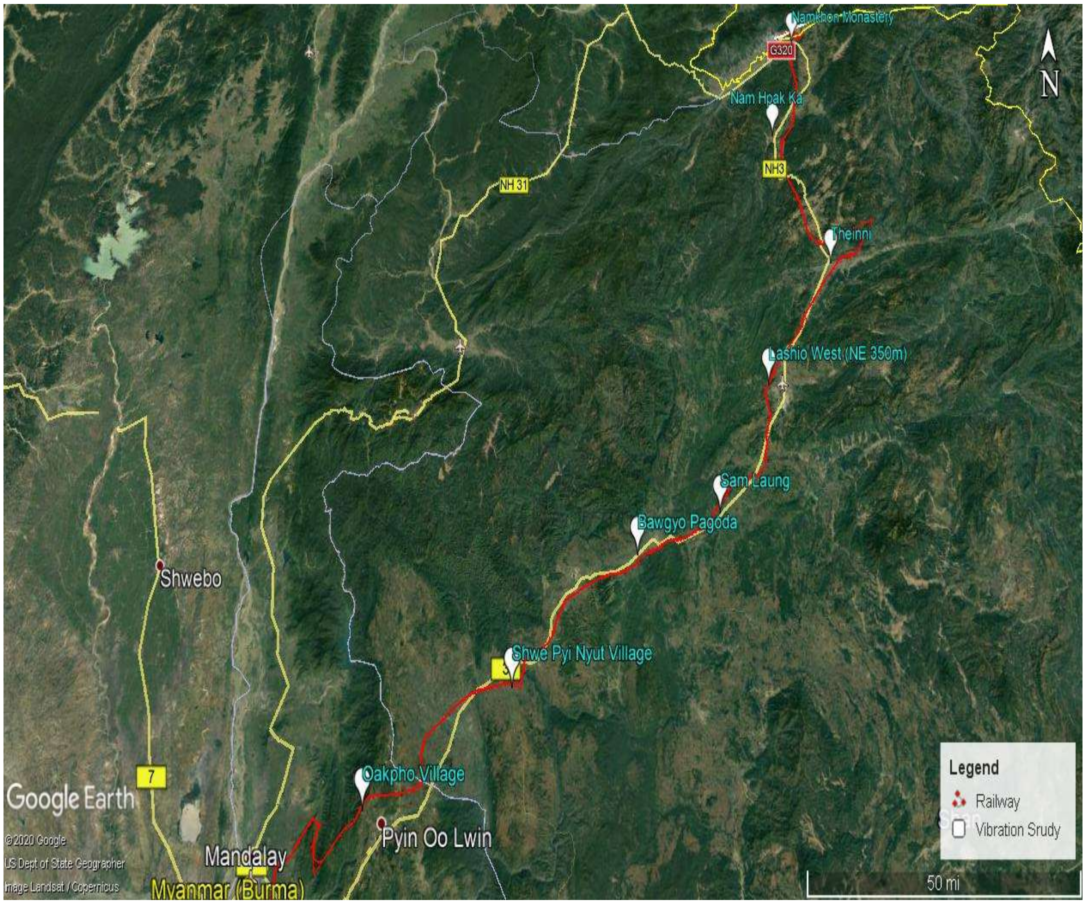


Figure 5.26 - Location of Vibration Monitoring in Google Map

Table 5.29 - Measuring Results for Vibration Level

Place	Location	L(mm/s)	V(mm/s)	T(mm/s)
Pyin Oo Lwin - Oak Pho Village (Monastery)	N 22° 04’ 15.87” E 096° 23’ 58.30”	1.85	0.475	0.350
Naung Cho - Shwe Pyi Nyunt Village	N 22° 18’ 16.29” E 096° 50’ 02.16”	1.24	0.275	0.220
Goke Hteik	N 22° 20’ 08.94” E 096° 51’ 53.42”	1.05	0.245	0.320
Hsipaw (near Baw Gyo Pagoda)	N 22° 34’ 59.78” E 097° 13’ 59.62”	0.235	0.345	0.250
Beyond Hsipaw (San Laung)	N 22° 40’ 33.66’ E 97° 30’ 17.4”	0.325	0.224	0.211
Lashio	N 22° 59’ 05.41” E 097° 42’ 23.09”	0.275	0.375	0.275

Hseni	N 23° 18’ 23.97” E 097° 58’ 28.30”	0.725	0.275	0.500
Nam Hpat Kar	N 23° 41’ 21.89” E 097° 49’ 02.76”	0.214	0.244	0.220
Muse	N 24° 00’ 03.10” E 097° 56’ 25.90”	0.250	0.175	0.225

Range of L, V, T – from 0.1 mm/s to 200 mm/s
Range of Air Overpressure – from 100 to 140 dB Linear Peak

L – Love Wave: A major type of surface wave having a horizontal motion that is shear or transverse to the direction of propagation (travel).

V – Peak Particle Velocity (also known as PPV)

T – Travel Time: The time required for a wave train to travel from its source to the point of observation.

Methology for Selection of Vibration Sampling Points

Except for the Mandalay Region, the area in Shan State where the railway line passess through are in remote area which is difficult for the monitoring and so it was unable to carry out survey in nearest places close to the alignment line. Therefore, the monitoring for vibration was carried out on chosen parts of NH3 highway (Muse to Mandalay) which is closet to the railway line. Moreover, there seems to be very little industrial businesses in Shan State so for that reason (no vibration sources), the existing vibration level will be lower than its guideline and the monitoring of vibration levels along the road way will cover for the whole railway alignment. The vibration level monitoring at bridges will make as in EMP-OP.

Analysis of Vibration Results with Australian Standards (AS2187.2)

The location of the results are mostly in human confort area which is within the village and the results have stated that the maximum peak velocity (V_{max}) in the location of 9 places is less than its given standard of 5mm/s (long term). Since the project is still ongoing and will take much time to take up to operation stage, the results of the vibration are less than its limit so there is no disturbance to the surrounding locals.

5.4.6. Physical Components

5.4.6.1. Topography

The topography along the Muse-Mandalay Railway can be divided into two geomorphological zones. The geomorphological features of each zone are as follows:

Shan State plateau: Muse~Mandalay East section belongs to Shan State plateau. Most of the area has an altitude of 700-1500 m and above. The top of the plateau is generally a planation surface with relatively low-lying relief. The surface relief is generally tens of meters to 100m, with deep valley development. The terrain is generally high in the north and low in the south, intercalated with the geomorphic unit of plateau basin.

Ayeyarwady basin: Mandalay East ~ Mandalay South section belongs toAyeyarwady basin. The area is generally peneplain and low hilly area. The terrain is flat and open. The area between Mandalay and Meiktila West is Mandalay-Thazi valley area, which develops in the north-south direction. The Ayeyarwady tributary system is relatively developed in the middle and east of the valley. The surface of the area is dominated by the Miocene-Pliocene strata. The surface red weathering crust is well developed. The low-lying area is distributed with a swamp facies gray fine sand layer and cultivated soil. Thin river fine sand layers and sand gravel layers are developed along the banks of main rivers. The overall terrain is high in the west and low in the east, with an altitude of 80-180m. It is mainly characterized by the geomorphological characteristics of flat valleys intercalated with hummocky topography with very small relief. The overall terrain is flat, with surface relief ranging from a few meters to more than ten meters.

Shan State plateau

Ayeyarwady basin

5.4.6.2. Engineering Geology

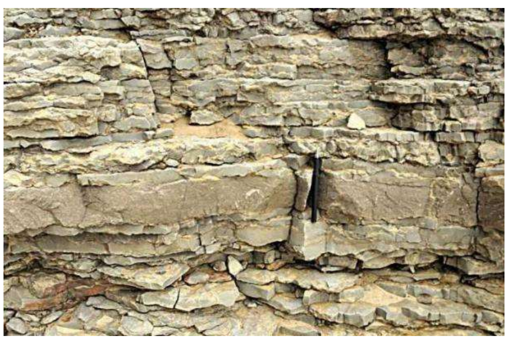
(a) Formation lithology

The stratigraphic development spans are large in Myanmar, ranging from the Proterozoic to the Cenozoic. There are basically sedimentary deposits from the Proterozoic to the Quaternary strata in the Shan State plateau.

The most typical strata passed through by tunnels of the entire line consist of: upper paleozoic (Pz_2) dolomite, dolomite limestone and argillaceous limestone, Sinian-Cambrian (Z-∈) argillaceous sandstone, Silurian (S) argillaceous limestone, and Ordovician (O) siltstone with limestone and shale.

Dolomite

Argillaceous sandstone



Argillaceous limestone

Siltstone with limestone and shale

(b) Geological structure

(1) Geodetic background

(2) Muse-Mandalay Railway runs across the northern region of Myanmar from north to south. The project is within the two first-order tectonic units of the Gangdese-Nyainqentanglha fold system (II) and the India-Myanmar-Sumatra fold system (III). See figure belows.

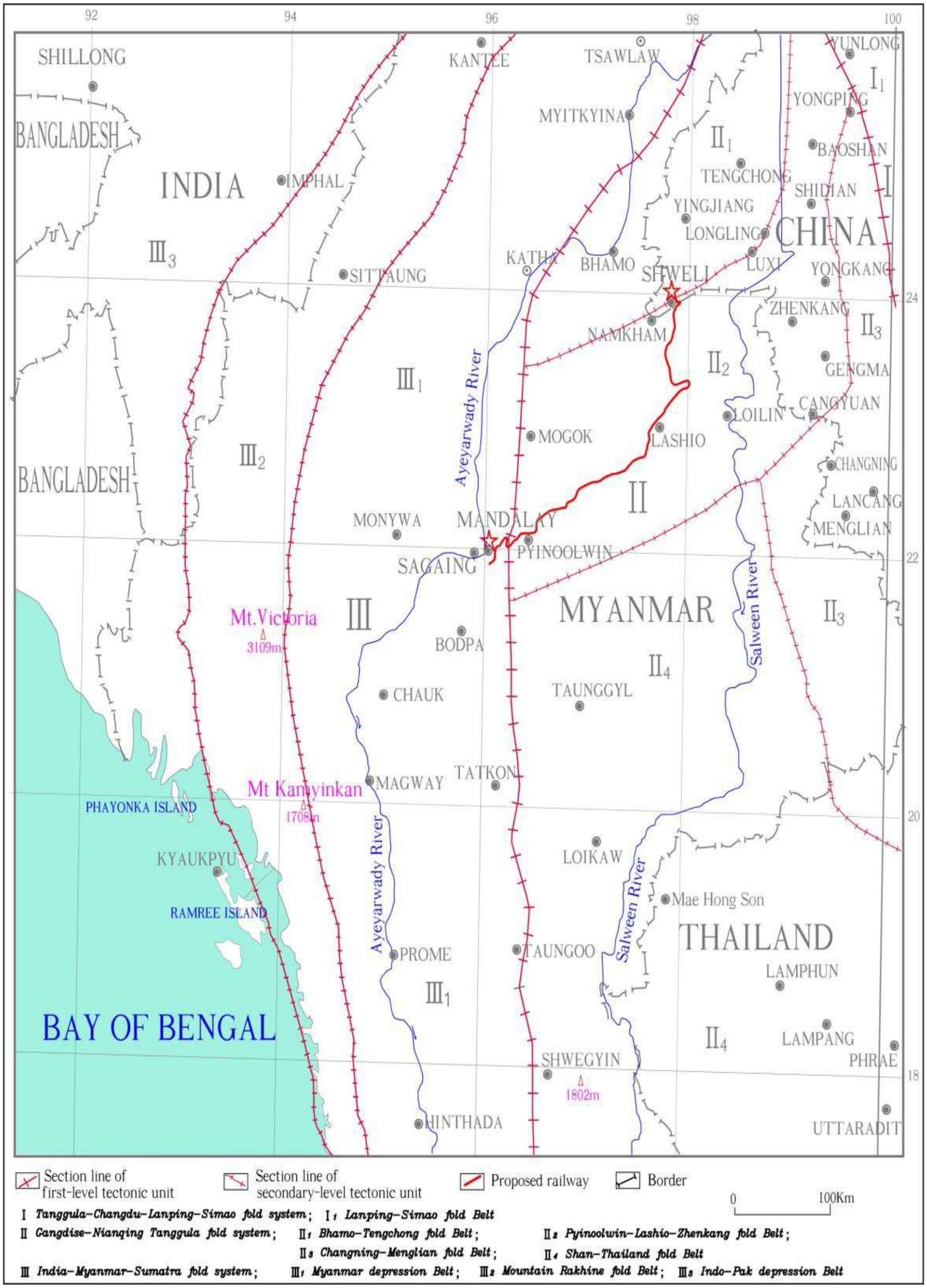


Figure 5.27 - Zoning Map of Regional Tectonic Elements

(2) New tectonic movement characteristics

The line is located in the Shan - Thailand area (composed of the Shan State plateau and the northern plateau of Thailand), which turned into a relatively stable plot after the end of the Mesozoic, with the overall uplift as the main, and the difference activity is not obvious. The topography of the plateau is slightly higher in the north and gradually decreases to the south. The height of the mountains is between 1000m and 1500m and the highest is about 2000m. On the basis of the large-scale overall intermittent uplift, there is still a significant fault-block differential movement in the survey area due to the impact of fault activities.

(3) Main structural features along the line

(i) Fold

The proposed railway, stretching across a wide area, is located on the east side of the Mandalay-Thazi synclinorium.

Mandalay-Thazi synclinorium: The west of Mandala-Meiktila section is the Mandalay-Thazi valley area. The development of this valley is controlled by the Mandelay-Thazi synclinorium, the syncline deformation structure of the late new age stratum. The Miocene-Pliocene mudstone and argillaceous siltstone are widely distributed in the syncline core, and there are thin Quaternary alluvial deposits in the core.

The wings (mainly the west wing) are distributed with the Miocene sandstone and mudstone intercalated with conglomerate. From the distribution of the stratum, the syncline should be relatively gentle, and the axial plane tends to the west side, which also includes some sub-level wide anticlines and synclines. The near-SN Sagaing fault zone passes through the middle of the syncline valley, resulting in the complexity of deformation in the zone.

(ii) Fault

Main fault structures in the area are in varying directions, NNW, near-SN, NE and NEE. There are six main faults near the Railway: Bangpaman fault (F_9), Kyankme fault (F_{7-1}) and Kunlong fault (F_{7-2}) - the branch faults of Nantinghe fault (F_7), Lashio fault (F_8), Gohteik fault (F_6) and Sagaing fault (F_4). Among them, the active faults of Holocene are the Nantinghe fault (F_7) and the Sagaing fault (F_4).

The outline Map of Regional Tectonics sees following figure.

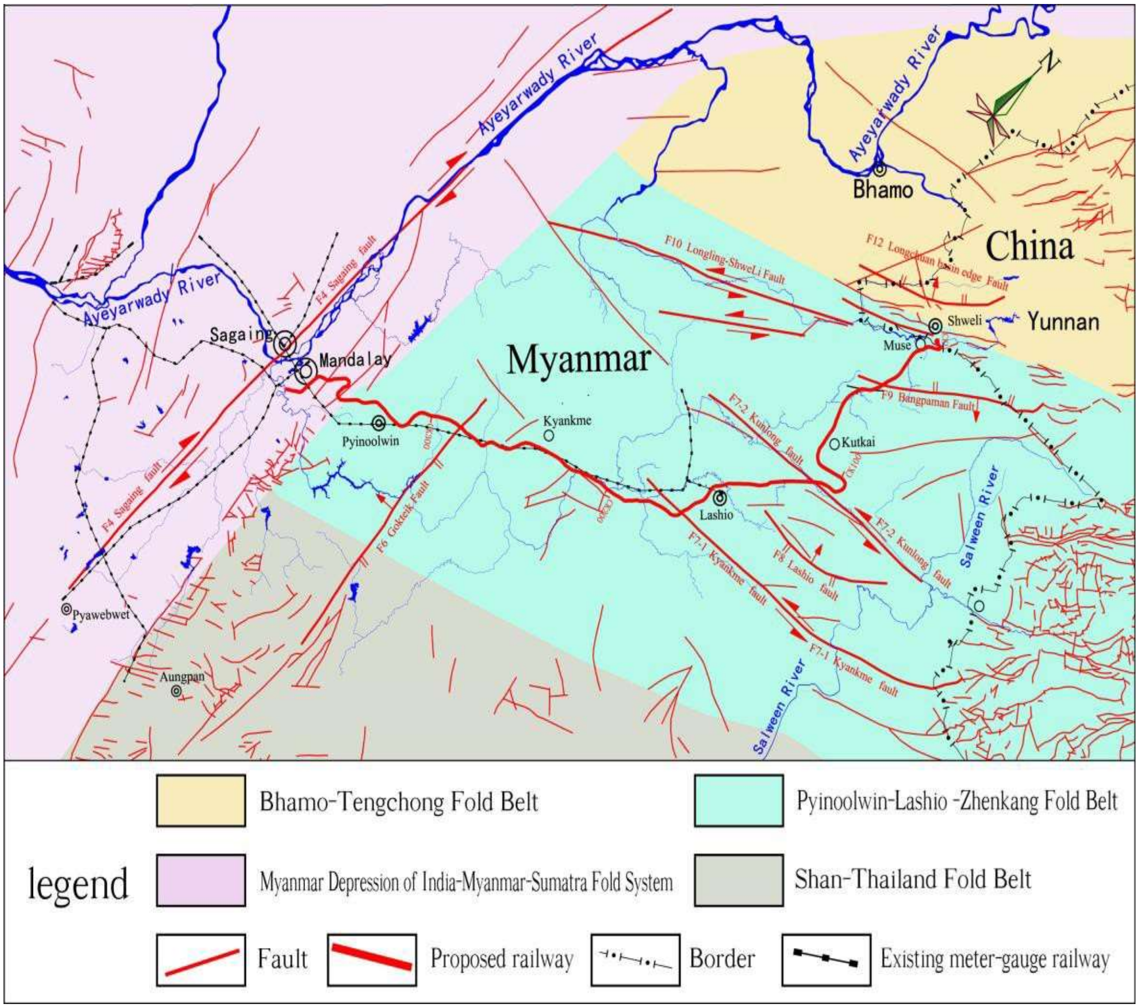


Figure 5.28- Outline Map of Regional Tectonics

5.4.6.3. Ground Motion Parameter Zoning

The seismic peak ground acceleration along the line and the characteristic period of the seismic response spectrum (10% probability of exceedance in 50 years) are shown as in Table.

Table 5.30- Zoning of Seismic Ground Motion Parameters of Muse-Mandalay Railway

Mileage	Length(km)	Seismic peak ground acceleration (g)	Characteristic period of the seismic response spectrum (s)
CK0+000~CK219+600	249	0.2	0.45
CK219+600~CK272+700	39.5	0.3	0.45
CK272+700~CK338+500	65.8	0.2	0.45
CK338+500~CK382+700	44.2	0.3	0.45
CK382+700~CK398+300	15.6	≥0.4	0.45

(c) Features of Engineering Geology

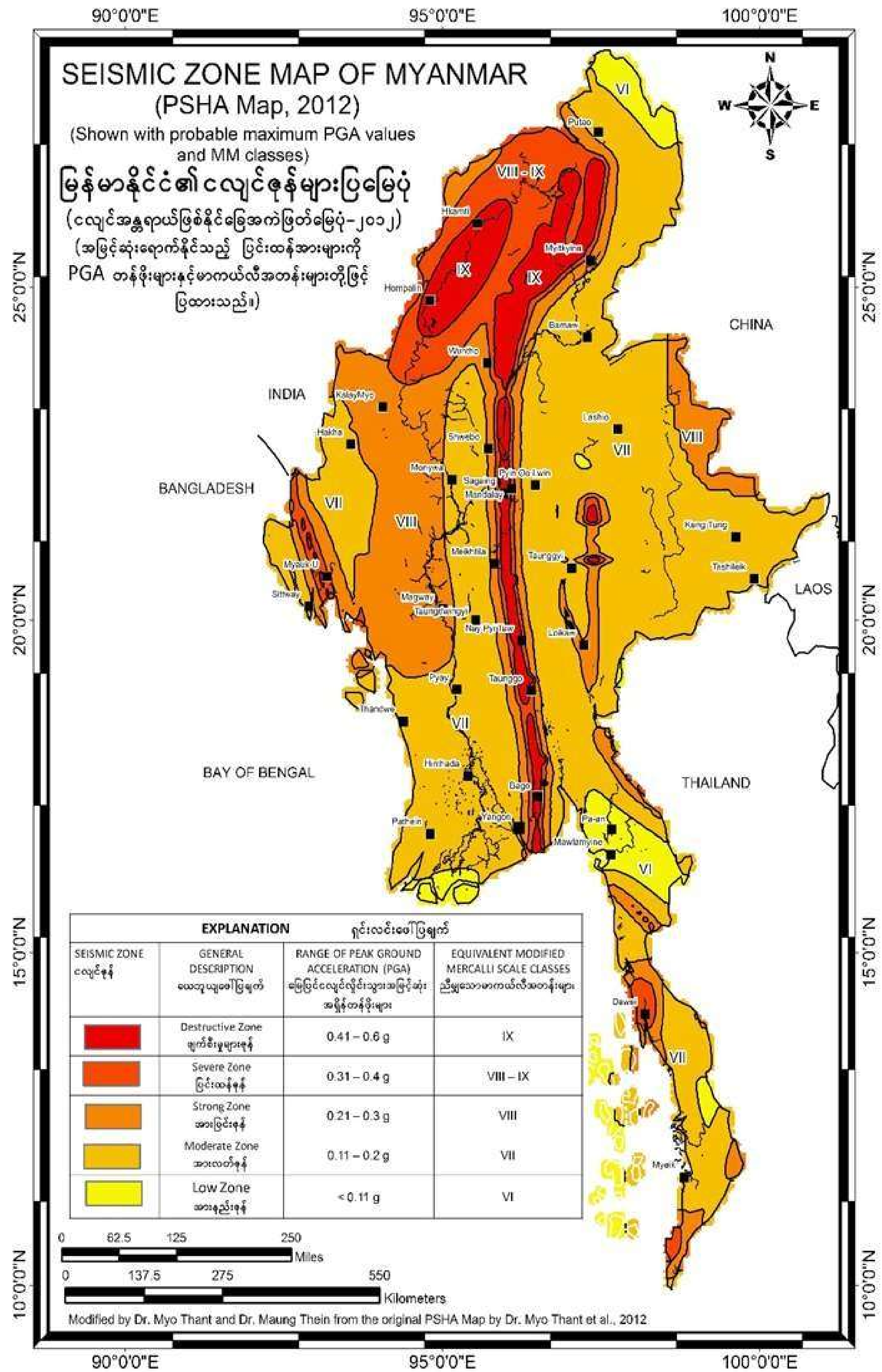
The surveyed area is basically located on the Shan State plateau, belonging to the Shan-Thailand upwraping area, and the terrain and geological conditions are very complex. Affected by neotectonic movement, the geological action along the railway is intensive. The terrain is undulating, the valleys are intertwined, the geotechnical structure is loose and broken, and carbonates are widely distributed. There is developed adverse geology along the line, and various kinds of geological disasters occur frequently.

The main line-side engineering geological problems include high intensity seismic region and deep active fault, karst, high ground temperature, landslide, talus, bedding, rockfall, liquefaction of sand soil, high ground stress (rockburst and soft rock large deformation), mining area and goaf, harmful gases, radioactive product, soft soil, mollisol and expansive rock and soil.

(d) Seismicity

Geographically, Myanmar is a land located at the southern part of major earthquake belt, known as the Alpide Belt (Richter, 1958) which is a young orogenic belt formed by the collision of Australian-Indian Plate and Eurasian Plate. Due to this seismotectonic situation, the country is exposed to hazard of large earthquakes. A seismic zone map of Myanmar (see Fig. 5.18) shows that the Innwa-Mandalay-Sagaing area lies very close to the Sagaing Fault, the main source of earthquakes in Myanmar and it is the largest, and perhaps the youngest and presumably the most active fault in Myanmar (see also Win Swe & Win Naing, 2004).

Seismicity along the course of the Sagaing Fault is quite well known since the days of the Myanmar kings, because many of ancient royal capitals of Myanmar, such as Hanthawady (Bago), Kaetumade (Taunggoo), Ava (Innwa), Zayyarpura (Sagaing), Yadanapura (Amarapura), and Yadanapon (Mandalay), and Tagaung were incidently located on or close to the Sagaing fault zone. The intermittent slips along the fault have caused earthquakes at (from north to south) Putao (1908), Tagaung (1946), Thabeikkyin (2012), Sagaing (1956), Innwa (1839), Swa (1929), Phyu (1930) and Yangon (1927).



Probabilistic Seismic Hazard Assessment Map (PSHA Map) of Myanmar showing expected peak ground acceleration (PGA) values with 100% probability in 500 years. (Note: 0.21 - 0.3 g zone in the northern part of Shan State is taken from the Seismic Zone Map of Myanmar by Dr. Maung Thein et al., 2005)

Figure 5.29 – Seismic Zone Map of Myanmar

(e) Earthquake and Active Faults

Among active faults formed along the line since late Pleistocene - Holocene, the most active large-scale ones are Sagaing and Nanting River faults. Both are Holocene regional active faults that induced earthquakes above Magnitude 7 and are likely to induce earthquakes above Magnitude 7 in the future.

(1) Nanting River fault (F_7)

It comprises Kyaukme fault ($F_{7\text{-}1}$) and Kunlong fault ($F_{7\text{-}2}$) near the project site.

(i) Kyaukme fault ($F_{7\text{-}1}$)

With an overall strike of 70°~80°, it dips toward SE or NW at 50°~80°; it is 100km long in the region; the fracture zone is dozens of meters to hundreds of meters in width. Strong extrusion in the fracture zone has led to formation of large amounts of mylonite. The squeezed lens and tectonite often exhibit gray, black and white strips, suggesting past occurrence of multi-phase activity. Tunnels affected by this fracture zone are Man Loi 1# Tunnel, Man Loi 2# Tunnel, Man Loi 3# Tunnel, Myin Gwin Tunnel and Kyaung Gon Tunnel, all of them about 20km away; this fracture zone has some impact on tunnel works.

(ii) Kunlong fault ($F_{7\text{-}2}$)

With a strike of 70°~90°, it dips toward SE or NW at 50°~80°; it is 150km long in the region. It develops mainly in Ordovician, Silurian, Triassic, Jurassic, Cretaceous and Cenozoic strata. It appears as a grayish green and white compresso-crushed zone up to 100m wide, with strong mylonitization and common crushing signs, developed schistosity in fault gouge, multiple hot springs and high pressure gas springs along the fault zone. This fault mainly affects Nawng Yen 1# Tunnel; the CK102+400~CK102+600 section intersects with the fault at an angle of 68°.

(2) Sagaing fault zone

It is a deep, large fault extending up to one kilometer in the region and located at the junction of Baoshan-Shan-Thai mass and west Myanmar mass, submerging south into Andaman Sea. It is also a major seismically active belt in the region. Strong earthquakes above Magnitude 7 occurred near Mandalay-Sagaing and to its north as well as in and north of Bago. This fault is about 9km from the alignment at the closest point; the surface is covered with soil layer, with no tectonic sign. This fault mainly affects Pyinoolwin Tunnel, Sin Byu In 1# Tunnel, Sin Byu In 2# Tunnel, Sin Byu In 3# Tunnel, Sakangyi 1# Tunnel, Sakangyi 2# Tunnel, Taung Kyun 1# Tunnel, Taung Kyun 2# Tunnel and Tok Hka Taung Tunnel, all of them 12~38km away. It has some impact on tunnel works.

(f) Underground hot spring

Four hydrothermal activity zones exist along the line; they are respectively located in Bangpaman fault zone, Kunlong fault zone and its branch fault, Lashio fault zone and Hispaw south-Kyang yin fault zone.. The hot spring discovered in the field survey is given in the figure.

Hot Spring

(g) Karst

The carbonate rocks (limestone and dolomite) along the line are mainly distributed on the Shan State plateau (Muse-Mandalay section). According to statistics, there are 25 places with karst conditions along the line, with a total length of 297.08km, accounting for 72.46% of the line length. The strata consist of upper Paleozoic (Pz_2) dolomite with dolomite limestone; karst is weakly-strongly developed, with surface karst trace, solution crack, karren, karst cave, karst depression and sinkhole.

Karst cave

Karst depression

(h) Landslide and talus

Landslides along the line are mainly distributed in Muse-Mandalay section on Shan State Plateau; they are bypassed by the alignment, thus having no impact on the alignment. Landslides and talus at a total of 24 locations are near the alignment.

Landslide

Talus

(i) Dangerous rock & rockfall

Rockfall mostly occurs on the slope of deep-cut valley in hard rock and steep slope on the verge of some basins, posing great hazards to the Project. The alignment shall bypass sections with high mountains, steep slopes, rock formations deeply cut by joints and dense overhanging rocks wherever possible; if this is impossible, comprehensive treatment measures such as clearing, slope protection with wire mesh and support shall be taken to ensure safety during construction and operation.

Dangerous Rock and Rockfall

(j) Bedding

The distribution of sedimentary rocks along the line is long, and the angle between the strike of the rock stratum and the line in some sections is less than 45°, posing a bedding problem. Excavation is likely to cause bedding slide, especially in soft rock which softens easily when meeting water. The bedding has a big impact on slope stability.

Bedding

(k) Earthquake-induced Liquefaction

The line is located in a high seismic intensity area, where Quaternary loose saturated sandy soil is prone to earthquake-induced liquefaction. Sand liquefaction problems exist in Lashio basin (Lashio Station) and Thazi valley in Ayeyarwady basin. Saturated sand layers within 20m depth below the surface on the riverbed, flood plain and terrace in tributaries of Ayeyarwady River are prone to sand liquefaction.

Table 5.31 – Consideration Factors for Earthquake-induced Liquefaction Effect

S/N	O-D mileage	Project item	Unfavorable geology	Engineering geology features	Hydrogeology features	Comments on engineering measures
1	CK376+740～CK377+960	Bridge	Sand liquefaction	It is distributed in surface silty sand and fine sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 2.5 m thick. Peak acceleration of ground motion in the survey area is 0.30g. The standard penetration test method is used to determine the liquefaction level as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Bridges shall use pile foundations to pass through the liquefied soil layer or adopt other corresponding anti-liquefaction measures in face of the same. Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.
2	CK379+800～CK381+000	Subgrade	Sand liquefaction	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 2.5 m thick. Peak acceleration of ground motion in the survey area is 0.30g. The standard penetration test method is used to determine the liquefaction level as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.

3	CK381+400～CK383+040	Subgrade	Sand liquefac-tion	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 2.5 m thick. Peak acceleration of ground motion in the survey area is 0.30g. The standard penetration test method is used to determine the liquefaction level as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.
4	CK386+450～CK387+880	Subgrade	Sand liquefac-tion	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 2.5 m thick. Peak acceleration of ground motion along CK386+450～CK387+560 is 0.30g and that of CK387+560～CK387+880 is 0.4g . The standard penetration test method is used to determine the liquefaction level as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures. Beg

5	CK388+320～CK389+240	Subgrade	Sand liquefaction	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 2.5 m thick. Peak acceleration of ground motion in the survey area is 0.40g. The standard penetration test method is used to determine the liquefaction level as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.
6	CK390+320～CK394+300	Subgrade	Sand liquefaction	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 2.5 m thick. Peak acceleration of ground motion in the survey area is 0.40g. The standard penetration test method is used to determine the liquefaction level as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.

7	CK397+400～CK398+300	Subgrade	Sand liquefac-tion	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is sedimentary soil of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 5 m thick. Peak acceleration of ground motion in the survey area is ≥0.40g. As per engineering experience and comparisons, the liquefaction level is considered as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.
8	LC1K0+000～LC1K4+169.87	Subgrade	Sand liquefac-tion	It is distributed in surface silt, fine sand, medium sand and gravelly sand along the line in the Ayeyarwady Basin. It is alluvial-proluvial deposit of the Quaternary Holocene (Q_4^{al+pl}), being slightly dense, saturated, and 1 to 5 m thick. Peak acceleration of ground motion in the survey area is ≥0.40g. As per engineering experience and comparisons, the liquefaction level is considered as mild to moderate.	Surface water exists in the seasonal gullies, which have running water in the rainy season, but dry up or have small water flow in the dry season. Groundwater is medium to well developed, and is mainly pore water in the Quaternary overburden.	Subgrades shall go through calculation before passing through those areas, and it is recommended to take corresponding anti-liquefaction measures.

(l) Soft soil and loose soft soil

Soft soil and loose soft soil are mainly distributed along the line in basins (Shwe Li, Lashio and Theinni basins) and Ayeyarwady basin area (Mandalay), ranging from 0-5m to 5-15m in thickness; 0-5m thick soft soil and loose soft soil are distributed sparsely in paddy fields, water pond and low-lying gullies.

(m) Expansive Soil

Weathered red clay and Neozoic (N) residual soil in Sinian-Cambrian (Z- ∈) and upper Paleozoic (Pz_2) carbonatite areas are weakly expansive, and moderately-highly expansive locally; most of them have a high liquid limit.

Red clay

(n) Expansive Rock

Tertiary (N) mudstone and clay rock along the line are weakly expansive. The alignment should avoid the slope in front of expansive rock mountains and the junction zone of different geomorphic units and run perpendicular to ridge axis.

Tertiary Mudstone

5.4.6.4. Meteorology

The climate along the line is a tropical monsoon climate zone, which can be divided into three seasons: cool, hot and rain.

(1) The cool season is generally after mid-September, the temperature rises, and the cyclone gradually declines. It is officially entering the cool season until mid-November, and will begin to turn into the hot season in early March of the second year. The cool season is most typical from December to January, with faint northeast wind or northwest wind and sunshine. The average monthly temperature is between 15°C-22°C, which is the mildest and pleasant season.

(2) The hot season generally begins in early March, and the temperature rises rapidly. It reaches the highest peak in the whole year from April to May. The average monthly temperature is generally above 25 °C . The rainfall is generally rare with massive evaporation.

(3) The rainy season generally begins after mid-May, and fully started after mid-June. Until mid-September, the rainy season begins to turn into the cool season.

According to the statistics of major cities along the line, the rainfall in Shan State Plateau is moderate. The average annual rainfall of Lashio is 1329mm. The average annual rainfall in Mandalay is 901mm.

Table5.32 . Main Areas Meteorological Parameters along the Line

Content		Ruili	Muse	Kutkai	Theinni	Lashio	Mandalay
Temperature (℃)	Highest temperature in history	36.0	35.0	35.0	34.0	28.0	41.5
	Lowest temperature in history	3.7	-	-	0.4	-1.9	12.4
	Average highest temperature in 2009	28.0	30.7	30.7	29.9	32.5	32.3
	Average lowest temperature in 2009	16.9	14.2	9.7	15.0	12.1	21.8
Rainfall	Annual average rainfall (mm).	1364	1329	1771	1453	1329	901
	Annual average rainy days (day)	150	93	108	97	94	83

5.4.6.5. Hydrogeology

(a) Surface Water along the Railway Line

The water system along the route is mainly the Ayeyarwady River and its tributaries. The route passes through larger rivers, including the Shwe Li River, and rivers within the territory of Myanmar like the Nan Paw River, the Nam Hkai River, the Nam Tu River, the Nam Yao River, the Nam Tu miy Nge-R River, the Nam Ma River and Nam ban ton River. The Shwe Li River and Nam Tu River are the first tributaries of Ayeyarwady River; the Nam Paw River, Nam Hkai River, Nam Yao River, Nam Ma River and Nam ban ton River belong to the tributaries of Nam Tu River.

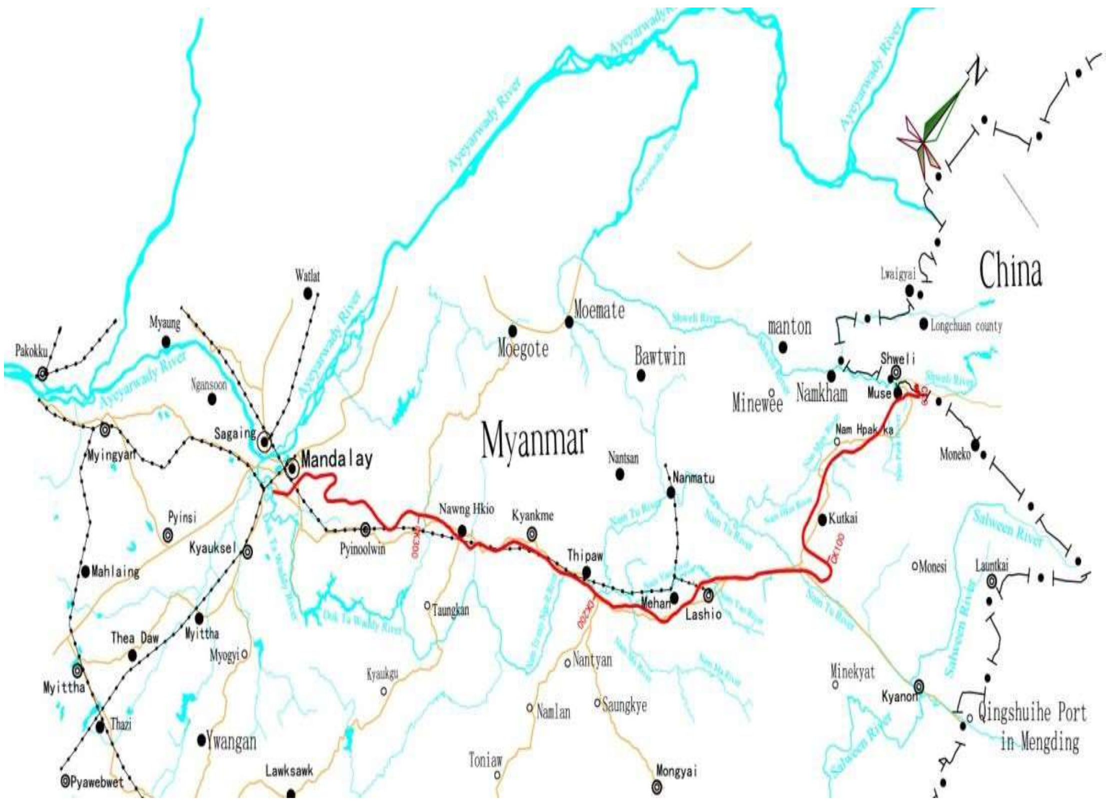


Figure 5.30 - Ayeryarwady River Water System

(1) The Ayeyarwady River, one of the large rivers in the Indo-China Peninsula and the longest river in Myanmar with 2030km long within the country, runs from north to south across Myanmar, passing through the northern mountains, the central dry regions and the southern delta. The River, which has more than 30 tributaries with a drainage area of 430,000 km² covering 8 divisions (states) of Kachin state, Chin State, Mandalay Division, Sagaing division, Magway division, Bago Division, Ayeyarwady Division and Rangoon Division, 32 counties

and 90 towns. Myanmar scholars divide the Ayeyarwady River into three parts: upstream, midstream and delta. The Ayeyarwady River generally flows windingly from north to south and reaches the sea at southwest corner, facing the Bay of Bengal in the west and linking with the Andaman Sea in the south. With many rivers in the vicinity and flowing into the sea simultaneously, a unique landform forms. The main tributaries of the Ayeyarwady River are the Chindwin River, the Myitnge, the Mu River, the Yaw River, the Mon River and the Nam tu River.

Ayeyarwady River

(2) Shwe Li River, called Nam Mao River by Dai ethnic group, also known as Mengmao River. The total length of Shwe Li River is about 332km and the drainage area is about 5,576km^2. It is an important river in the west of Yunnan Province, China. Its main stream and tributary are all parts of Ayeyarwady river system. In China, through Tengchong, Longling and Lianghe, Longchuan, there are Mangshi River (Longchuan River) flows into Shwe Li River in Mangshi (Dehong). Shwe Li River has a length of about 53km located in China and a width of about 100-200m. After Ruili, it flows to west along the Myanmar-China border and flows into Ayeyarwady River. The once-in-a-hundred-year flow of Shwe Li River connecting line at the bridge location is 2,870m^3/s.

Shwe Li River

(3) Nam Ma River, a tributary of Nam Tu River, is about 105km long, and the drainage area is about 2,702.5km^2. The width of main channel of the bridge location is about 50m, and the once-in-a-hundred-year flow is about 485 m^3/s.

(4) Nam Tu miy Nge-R River, the upstream of which is the intersection of Nam Tu River and Nam Ma River. The basin length is about 230km, and the drainage area is about 14,100km^2,

and the main channel of the bridge location is about 96m wide, and the once-in-a-hundred-year flow is about 2,231m^3/s. For the tributary Nam ban ton River, the basin length is about 36.5km, and the drainage area is about 809km^2. For the tributary Nam pan his River, the basin length is about 50km, and the drainage area is about 681km^2. These two rivers finally flow into the Nam Tu miy Nge-R River.

This project mainly passes through Shan Plateau in northern mountain area of Myanmar, and goes through Pyinoolwin and then into the Ayeyarwady river basin in Mandalay plain. The rainfall in Shan Plateau is mostly sudden rainstorm. In a year, the rainy season is long with abundant rainfall. The rainfall intensity is large but the duration is short. The terrain within this area is severely cut by the water flow, forming plenty of gullies and valleys, and the catchment condition is good. The surface water is relatively developed, and the vegetation is dense. The surface is easy to form ponding, so the flow and water level of the mountain river changes greatly with the seasons.

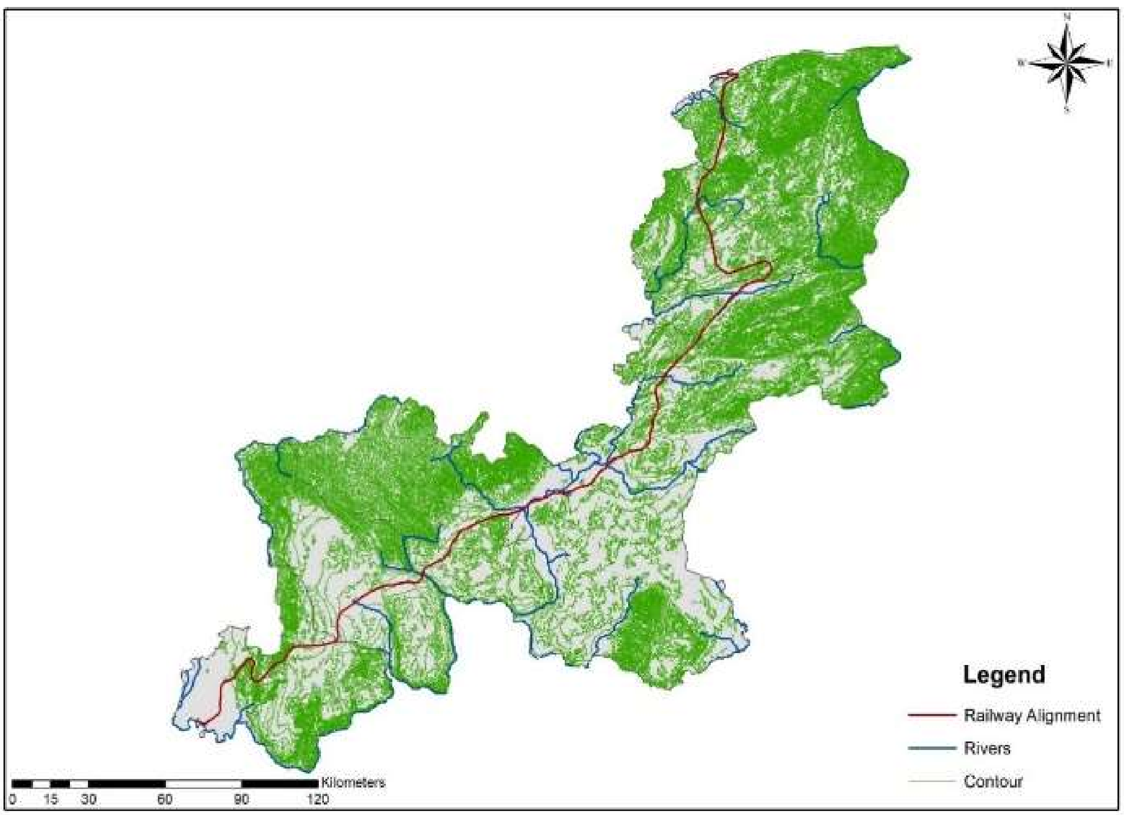


Figure 5.31 - Mandalay – Muse Railway Topography Map

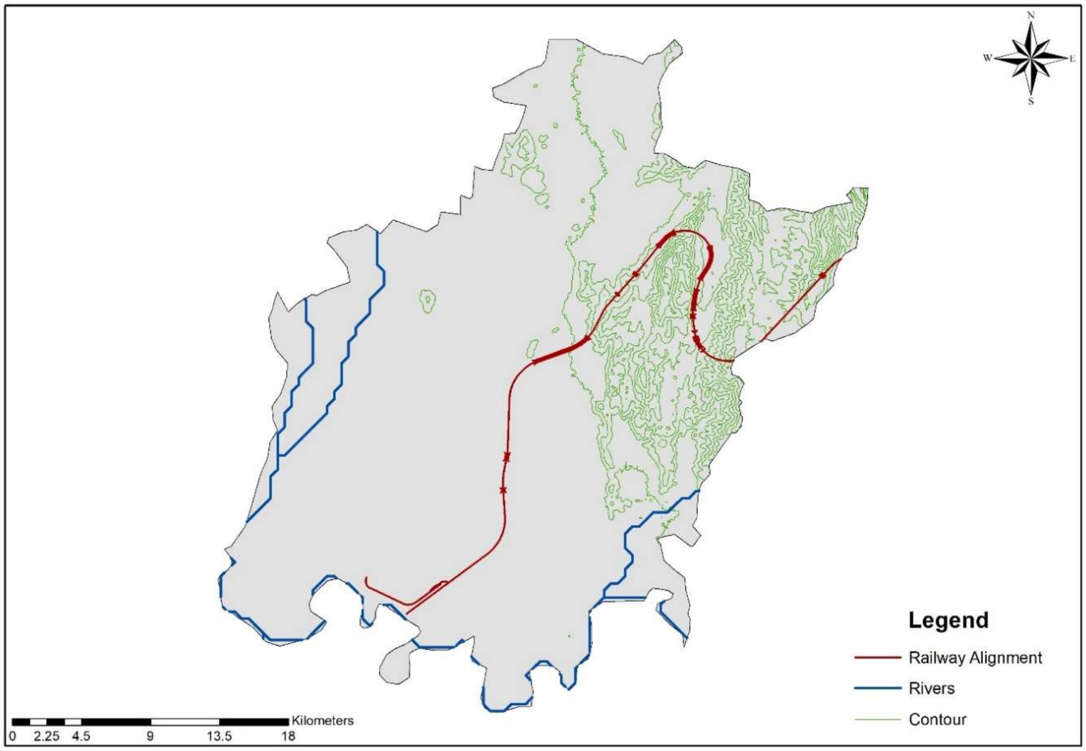


Figure 5.32 - Major Rivers in Mandalay in Topography Map

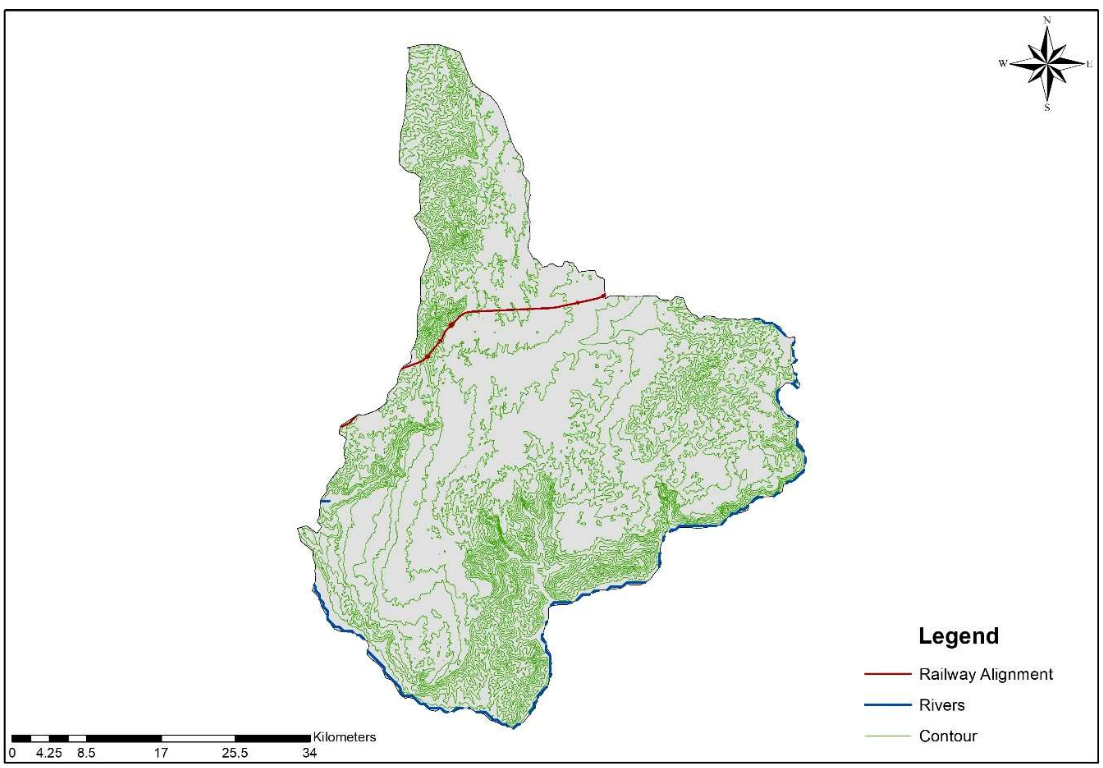


Figure 5.33- Major Rivers in Topography Map (Pyin Oo Lwin)

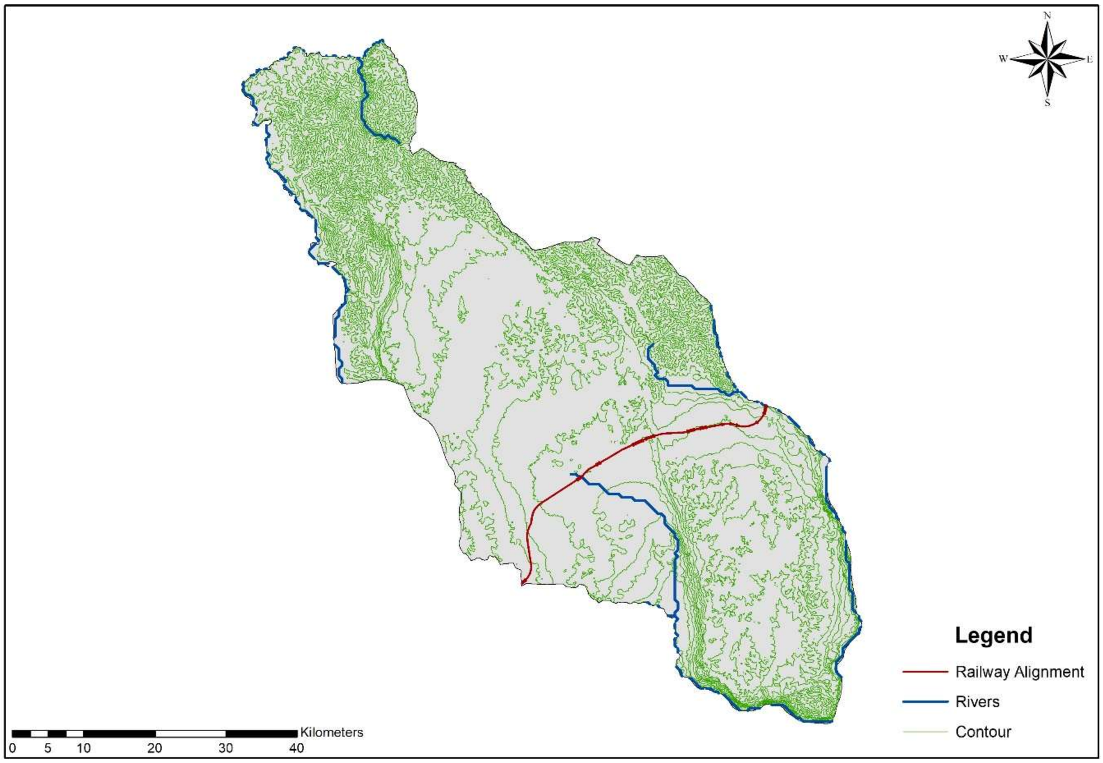


Figure 5.34 - Major Rivers in Topography Map (Nawnghkio)

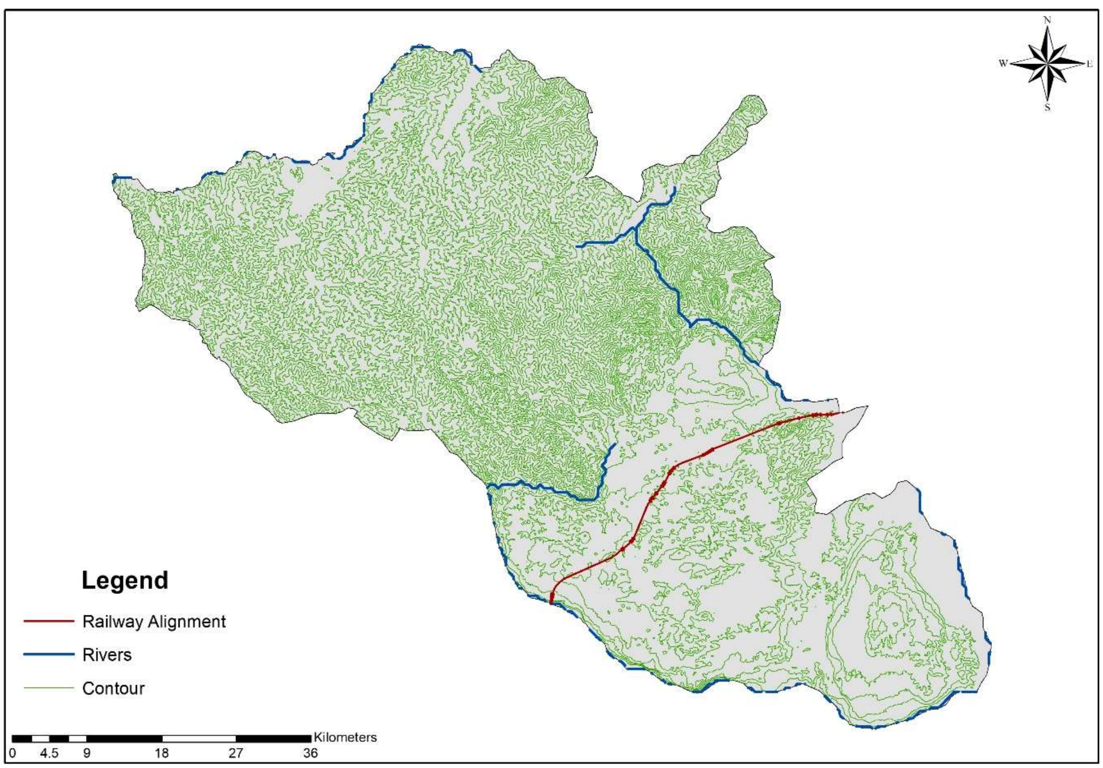


Figure 5.35- Major Rivers in Topography Map (Kyaukme)

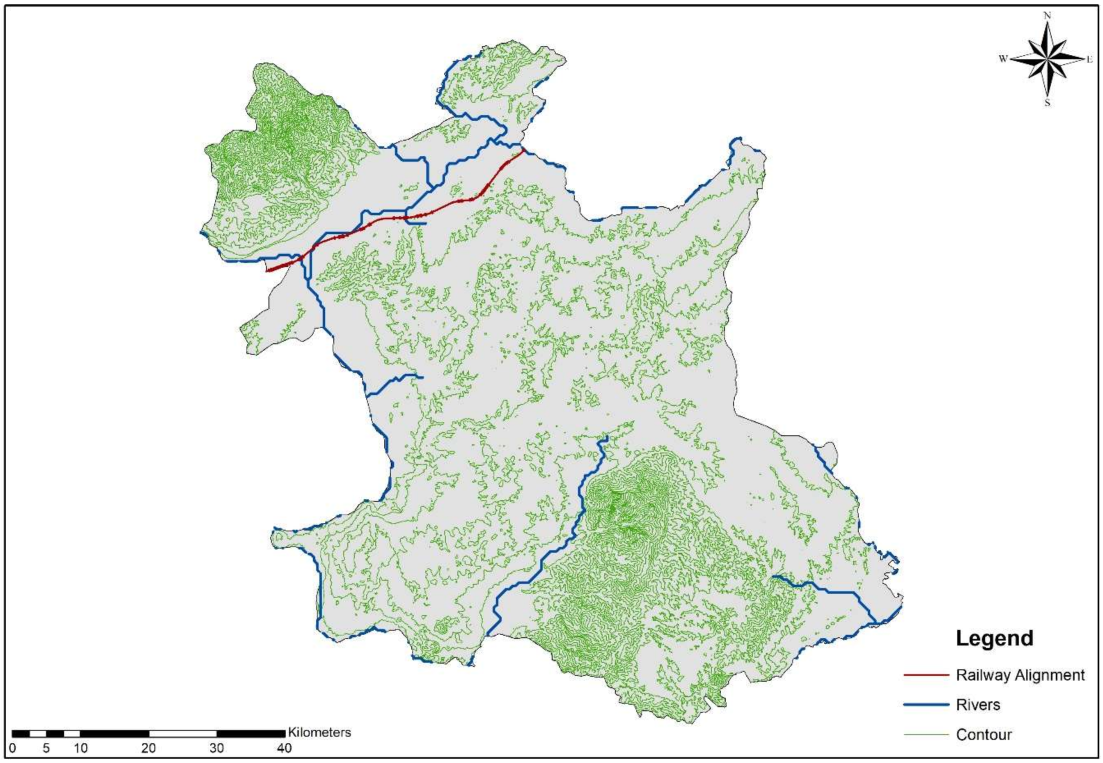


Figure 5.36 - Major Rivers in Topography Map (Hsipaw)

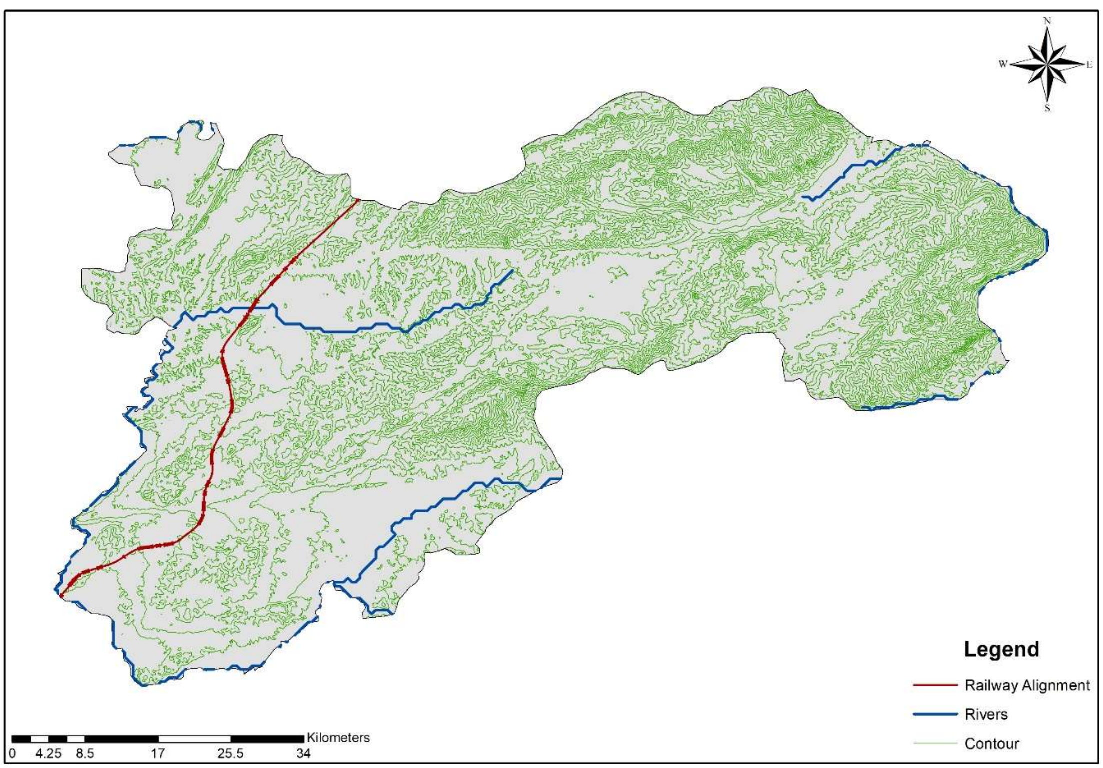


Figure 5.37 - Major Rivers in Topography Map (Lashio)

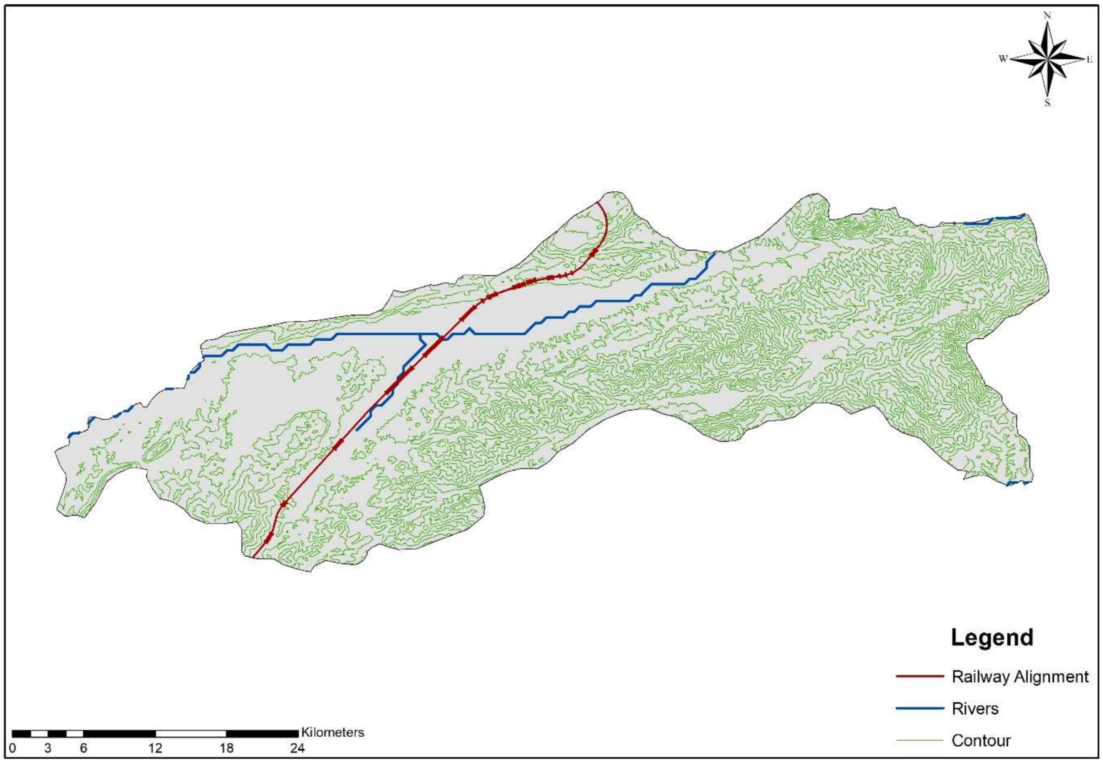


Figure 5.38 - Major Rivers in Topography Map (Hseni)

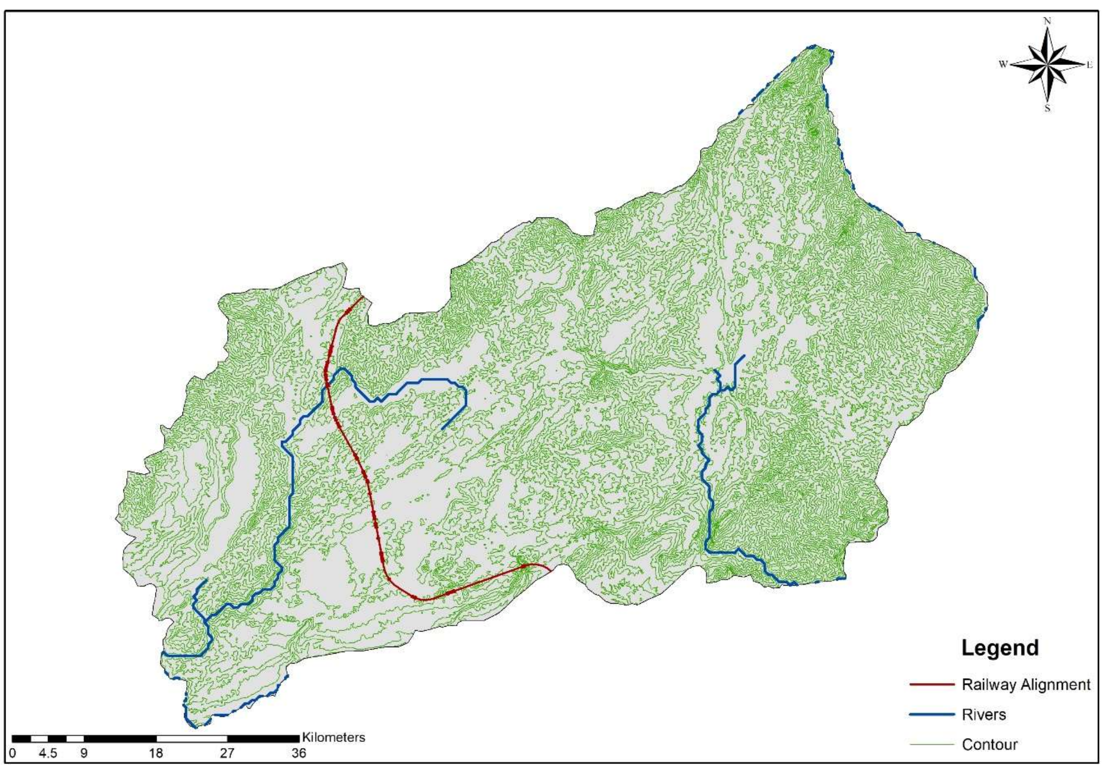


Figure 5.39 - Major Rivers in Topography Map (Hseni)

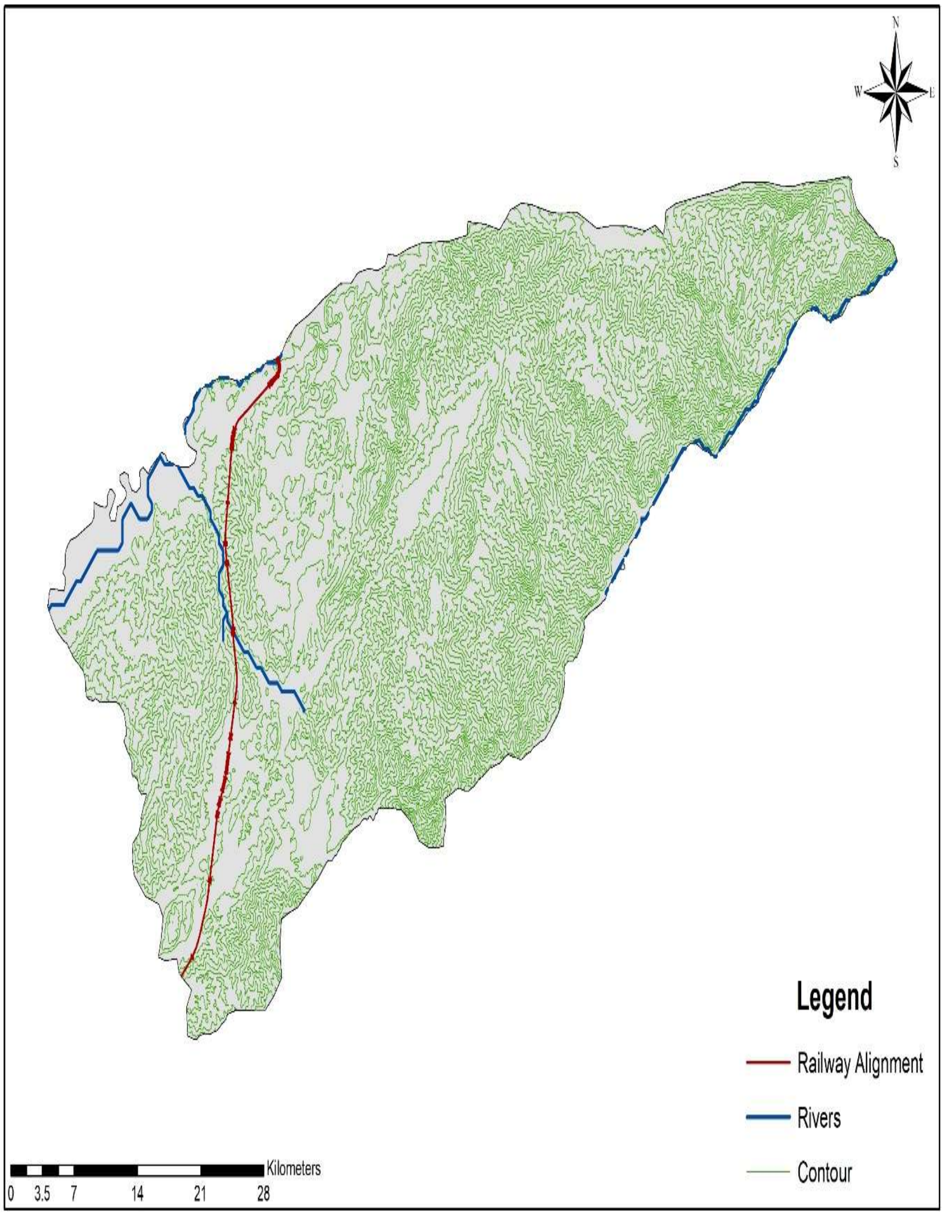


Figure 5.40 - Major Rivers in Topography Map (Muse)

According to the study about topography maps, all of the major rivers were flowed from south to north (from South Shan State to Mandalay Region).

(b) Natural Spring along the Railway Line

In order to inform the hydrological impact assessment, a site walkover was carried out by the hydrologist to record observations and features of watershed area, natural spring and surface water body as shown in the following figures.

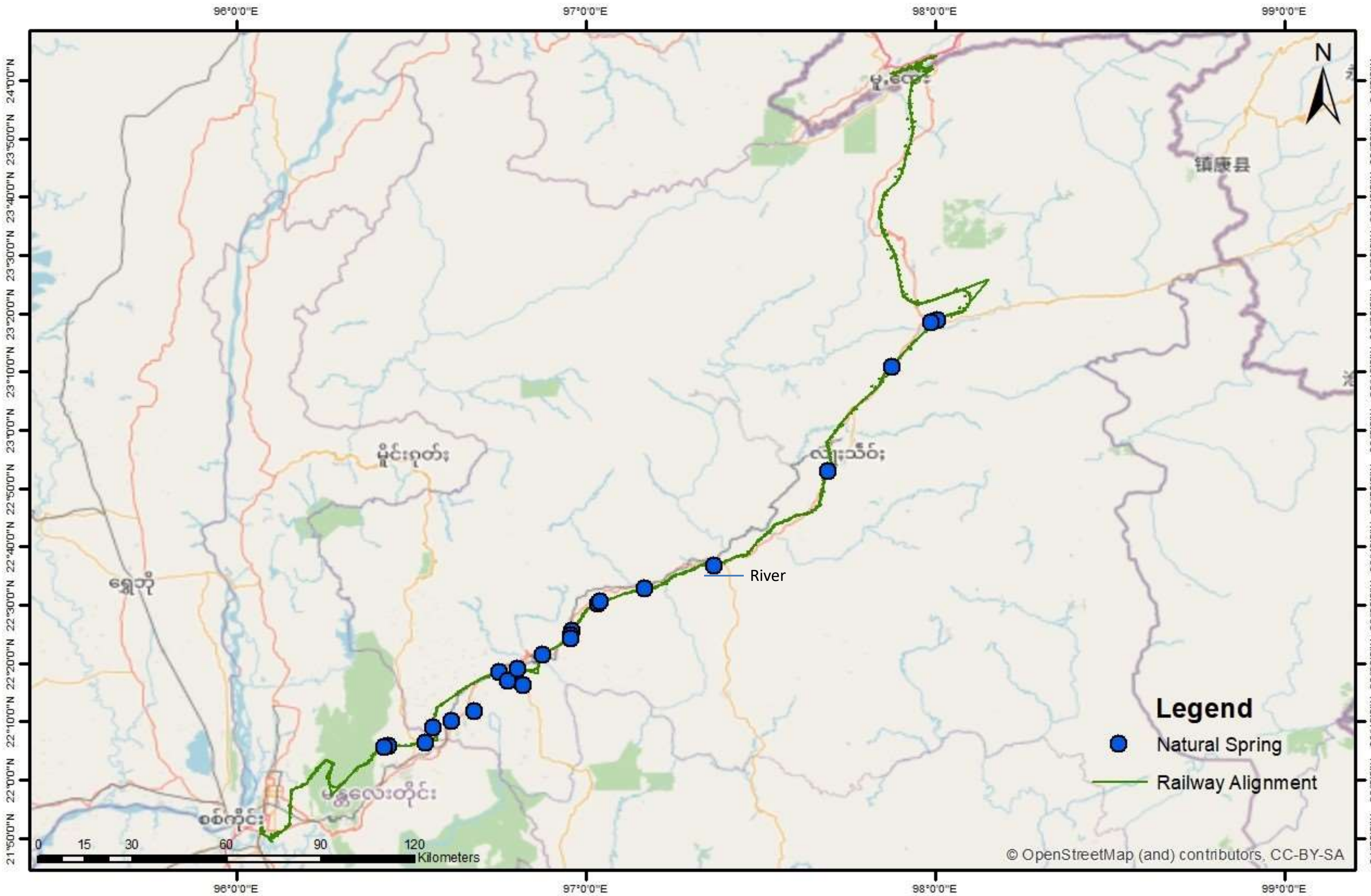


Figure 5.41 – Natural Springs and Rivers along the MMR (Source: EGT EIA Team, 2020)

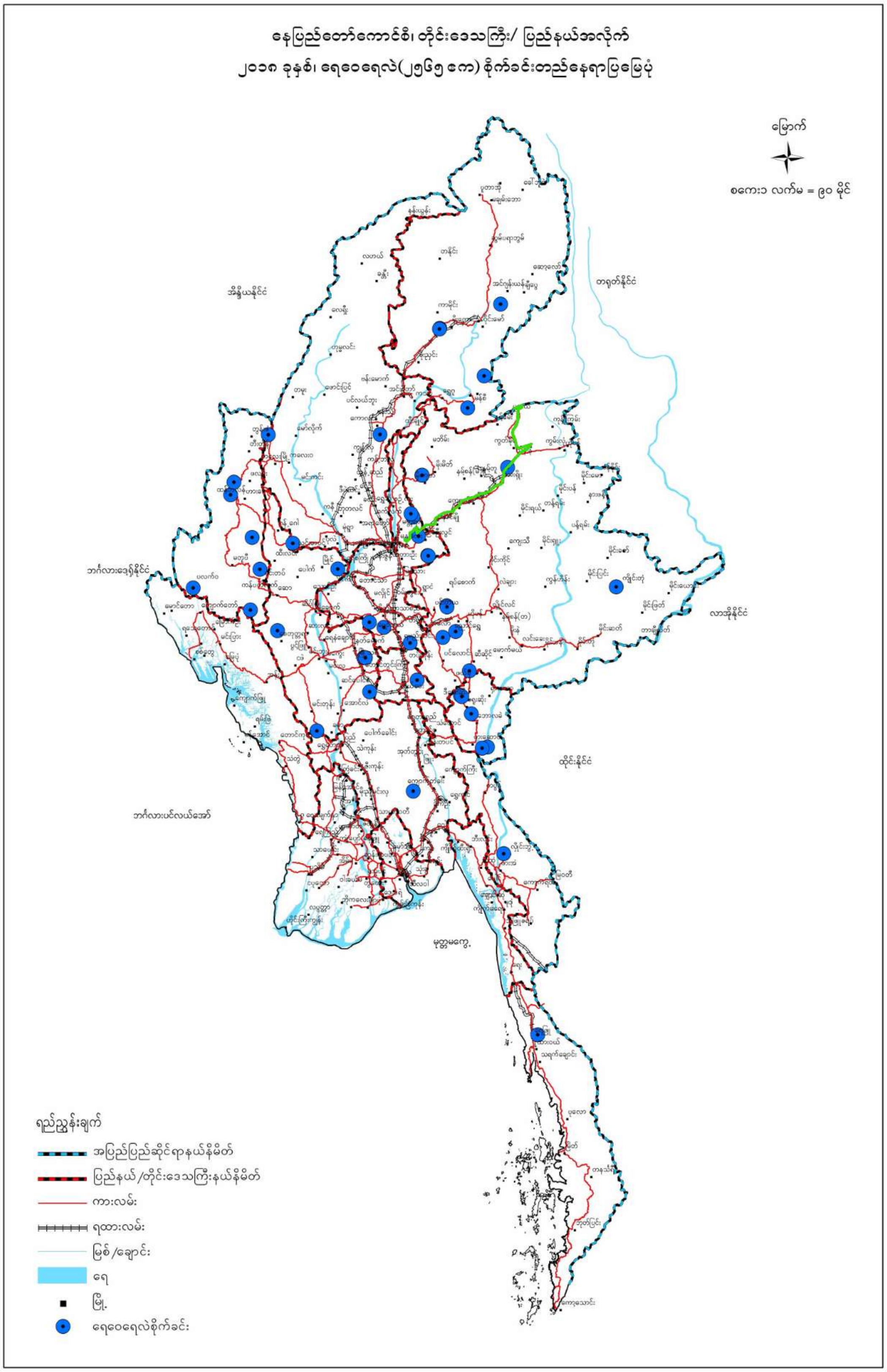


Figure 5.42 – Locations of Plantation for Watershed (Source: DOF, 2018)

Table 5.33 – Location of Natural Spring along the Railway Line

No.	Village Name (Natural Spring)	Location	Description
1.	Mang Chat	23.313305°, 98.008298°	Natural water spring
2.	Wane Line	23.309188°, 97.988722°	Natural water spring
3.	Nar Chat	23.181866°, 97.877292°	Natural water spring
4.	Mehan	22.883921°, 97.694954°	Natural water spring
5.	Pang Hsauk	22.611549°, 97.367325°	Natural water spring
6.	Nwang Ann	22.546527°, 97.166665°	Natural water spring
7.	Pang Ywang	22.508405°, 97.039741°	Natural water spring
8.	Mway Taw	22.503216°, 97.033525°	Natural water spring
9.	Na Ai Hkant	22.425912°, 96.961091°	Natural water spring
10.	Khite Tone Home	22.414476°, 96.957989°	Natural water spring
11.	Kone Kaw (Kyaukme)	22.405297°, 96.957967°	Natural water spring
12.	Kyaung Gone	22.358234°, 96.877519°	Natural water spring
13.	Myat Chae Nu	22.271596°, 96.821246°	Natural water spring
14.	Taung Quarter	22.316893°, 96.803754°	Natural water spring
15.	Ngokkalay	22.281051°, 96.775510°	Natural water spring
16.	Lone Yone	22.308319°, 96.750980°	Natural water spring
17.	Kon Gyi	22.196934°, 96.678743°	Natural water spring
18.	Kyein Ga Naing	22.166371°, 96.615714°	Natural water spring
19.	Anauk Kyu Inn	22.148223°, 96.563513°	Natural water spring
20.	Middle Pin Lain	22.105234°, 96.539294°	Natural water spring
21.	Kone Kaw (Pyin Oo Lwin)	22.095427°, 96.435934°	Natural water spring
22.	Pan Oo Taung	22.092211°, 96.423717°	Natural water spring

23.	Pyin Oo Lwin Watershed	22.100212°, 96.465955°	Watershed Area
24.	Lashio Watershed	23.046681°, 97.758647°	Watershed Area
25.	Shweli River (Muse)	24.01721°, 97.90384°	Surface water body
26.	Nant Paung Stream (Muse)	23.85798°, 97.97741°	Surface water body
27.	Nant Khaing Stream (Kutkai)	23.57058°, 97.81950°	Surface water body
28.	Namtu Stream (Thenni)	23.28817°, 97.95394°	Surface water body
29.	Pan Phet Stream (Thenni)	23.13200°, 97.84320°	Surface water body
30.	A-T Stream (Lashio)	22.99409°, 97.76455°	Surface water body
31.	Sint In Stream (Lashio)	22.70178°, 97.53847°	Surface water body
32.	Kho Lone Stream (Hsipaw)	22.61445°, 97.39456°	Surface water body
33.	Dokehtawady River (Hsipaw)	22.60728°, 97.30748°	Surface water body
34.	Kyin Thi Stream (Kyauk Me)	22.56428°, 97.20963°	Surface water body
35.	Goke Twin Stream (Naung Cho)	22.35489°, 96.83371°	Surface water body
36.	Yae Ni Stream (Pathein Gyi)	21.99596°, 96.12399°	Surface water body
37.	Se Taw Gyi Cananl (Pathein Gyi)	21.91917°, 96.18635°	Surface water body
38.	Myaung Ma Gyi Stream (Amarapura)	21.85159°, 96.12443°	Surface water body
39.	Myaing Gyi Stream (Min Village)	21.84470°, 96.10187°	Surface water body
40.	Dotehtawady River (Myit Nge)	21.83646°, 96.07781°	Surface water body

(c) Ground Water Characteristics

There are three types of groundwater along the line, which are pore water in Quaternary loose rock, bedrock fissure water and karst water.

Pore water in Quaternary Loose Rock

Along the railway line, pore water mainly occurs in the pores between Quaternary unconsolidated sediment particles of various geneses; the aquifers are mostly distributed in layers with even water content; in natural state, the free level of groundwater is consistent with the burial patterns of strata. Pore water in loose rocks along the line generally occurs in Quaternary alluvial-proluvial and deluvial-proluvial layers, red weathering crust and coastal marine deposit formation. Pore water in Quaternary alluvial-proluvial and deluvial-proluvial layers is mainly distributed on both sides of the Ayeyarwady River and its tributaries and within certain scope of the Shan State Plateau Quaternary Basin (such as Theinni, Lashio and Hispaw basins) and river banks. In red weathering crust on the surface of the Shan State Plateau Area, the shallow groundwater is generally buried 1–10m deep and mostly developed along the interface of red weathering crust and bedrock.

Bedrock Fissure Water

Bedrock fissure water occurs in diagenetic fissures, structural fissures and weathered fissures in consolidated and semi-consolidated rocks of various geologic ages (which are mainly clastic rocks, magmatic rocks and metamorphic rocks). The distribution of aquiferis restricted by the development of diagenetic fissures. Bedrock fissure water along the line is mainly distributed in sandstone, mudstone and other clastic rock areas in Triassic, Jurassic, Silurian, Ordovician and Sinian-Cambrian strata on the Shan State Plateau; bedrock fissure water is generally buried 8–15m deep and locally emerges in the form of spring from both sides of intrenched streams and ravines.

Karst water

It means the groundwater occurring in the karst channels, fissures and caves of carbonate rocks. The occurrence, runoff and discharge conditions of this groundwater depend on karst development and distribution characteristics. The karstic fissure water aquifers along the line are distributed in the soluble rock areas on the Shan State Plateau from Muse–Na Hpai–Lashio to the northeast of Mandalay. Carbonate rocks widely distributed in this section have medium–strong water abundance. Water is mainly concentrated in Upper Palaeozoic (Pz2) and Sinian-Cambrian (Z-∈) pure carbonate rocks of high karstification level, and karst forms including karst depressions, funnels, underground rivers and karst caves are moderately–heavily developed. Karst water level is affected significantly by surface elevation and topography and water often emerges as spring in mountain front areas and valley slope areas.

5.4.7. Biodiversity Environment

This Environmental Impact Assessment (EIAR) report identifies potential environmental impacts associated with the proposed of Mandalay-Muse New Railway Project's Alignment

Construction. The following section presents the summarized results of field observations, and literature data on flora and fauna composition of the corridor along the existing and planned project, starting from the railway station Mandalay to Muse. It contains the habitats description, distribution, impact and mitigation measure. Electrical power is very essential for improvement of socio-economic condition of people in Myanmar through industrialization and creating more employment opportunities. Indeed transportation is an essential role to develop the country. In order to overcome fact, it is necessary to install new power plants for the railway project. In this regard, this biodiversity report is to be conducted before constructing new power plant. For this, a survey has been conducted in the proposed area. From a point of view of the main biodiversity features the whole project can be divided in two distinctive parts. The project sites is located that on the route of Mandalay-Muse areas. Study area was divided into two parts, Part I (plain area, Armarapura and Patheingyi) and Part II (hill area, Pyin Oo Lwin to Muse).Study sites were allocated into six study sites in Part I and forty nine study sites in Part II. The biodiversity survey was conducted from May 2019 to November 2019. The base line study and specimen collection of terrestrial fauna, especially as major groups are vertebrate (birds, reptiles, lizards and fishes especially visual observation) and invertebrate (butterflies, dragonflies and damselflies visually during survey). A total of (64) plant species and (89) fauna species were recorded in Part I and (80) plant species and (112) fauna species in Part II. Regarding the population and density: in study Part I, the highest abundance were found in (5) species, as very common, (48) species were found as uncommon in plant species and (7) species, as very common, (13) species were found as uncommon in bird species; (9) species as very common, (2) species as uncommon in insect species. According to surveyed results, the highest density was found as Mimosaceae family (7.81%) species and the lowest was found (24) families (1.56%) in plant species. The highest density was found in Columbidae (10.811%) and the lowest species was found in (18) families (2.703 %) in bird species. In study site Part II, the base line study and specimen collection of terrestrial fauna, especially as major groups are vertebrate (birds, reptiles, lizards and fishes especially visual observation) and invertebrate (butterflies, dragonflies and damselflies visually during survey). According to the survey results, total of 112 fauna species recorded in and around the Mandalay-Muse New Railway Project Area. According to the survey results, about total Mammals fauna 7 species 5 order and 6 families were recorded. According to the survey results, surrounding of the Mandalay-Muse New Railway Project area, about total Avian fauna 59 species 12 order and 30 families were recorded. Surrounding of the Pyin Oo Lwin area, about 39 species of Avian Fauna belonging to 9 order and 23 families were recorded with different population abundance. Surrounding of the Naung Hkio to Kyaukme Survey about 30 species of Avian Fauna belonging to 7 order and 18 families were investigated that the different categorize bird species as insectivore, omnivores and carnivorous. Biodiversity team observed that the surrounding of Lashio to Muse survey, about 22 species of Avian Fauna belonging to 3 order and 12 families were recorded. During survey period, about 9 species of reptilian species belonging to 2 order and 7 families were recorded at the study site. Biodiversity survey group are observed that there are about total 26 species of Butterfly as well as male and female belonging to 7 families in surrounding of the all project area. The survey team investigated that the surrounding of the site of Project Construction Area, about 13 species Dragonfly and Damselfly species belonging to one order and 2 families (Libellulidae and Coenagrionidae) were recorded with different population abundance. This report is a review of the Environmental Impact Assessment Report (EIAR) for flora, in and around the Mandalay-Muse New Railway Project Area. A total of 80 flora species were recorded during the survey periods. The habit of identified species consists of seven different types, including tree, shrub, herb, climber, bamboo and parasitic shrub. Some of tree species are planted for landscaping beside the rail way yard and some of trees are planted and culturally retained for water resources around the village sites. Most of shrubs and herbs were naturally grow on road sites and understorey layer of tree species. In the conservation point of view: according to IUCN red list, in study Part I, all of plant species are last concern (LC). Almost bird species are last concern (LC) except (1) species (Hooded Treepie) is near threatened (NT) and (1) species (White-vented Myna) is vulnerable (VU). For Part II study area, According to the IUCN Red List, four Least Concerned species and two near threatened status noted from the survey area. The identification of the possible impact of the project recommended mitigation measures for all negative impacts identified. Environmental Impact Assessment is the prediction of consequences to the environment of a proposed project development measures. It could be both positive or negative impacts and one of the most important tools for achieving sustainable development. This report identifies potential environmental impacts associated with the proposed of communication, commercial trades and others. The survey team investigated that four types of impacts as well as negative and positive impacts, reduction of the species diversity (negative impact), loss of habitats(negative impact), noise impact (negative impact), as fauna and flora were observed in these projects. Next, the family income can be improved concerning with the project during the construction and operation period. The result of project can make the working opportunities of local people (both manual laborer and technicians). The impacts on environmental condition will be analyzed statistically and evaluated according to International Association of Impact Assessment-IAIA Guidelines as the impact factors, impacted items and impact degree are determined. As the assumption, by the advantages of the project, it may be support for communication, commercial trades and other factors of developed country. Regarding with EIA Assessment, this report is a review of the Environmental Impact Assessment Report (EIAR) for flora, in and around the Mandalay-Muse New Railway Project Area. A total of 164 flora species were recorded during the survey periods. The habit of identified species consists of seven different types, including tree, shrub, herb, climber, bamboo and parasitic shrub. Some of tree species are planted for landscaping beside the rail way yard and some of trees are planted and culturally retained for water resources around the village sites. Most of shrubs and herbs were naturally grow on road sites and understorey layer of tree species. According to the IUCN Red List, four Least Concerned species and two near threatened status noted from the survey area. 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Biodiversity Survey Team

Table 5.34 -Biodiversity Survey Team for Mandalay-Muse New Railway Project

Sr.	Biodiversity Survey Team	Official Position	Status (All Technical Specialists)
1.	Dr Nyo Nyo Lwin	Professor Department of Biology, Yangon University of Education	Team Leader Ecology & Biodiversity Senior Consultant
2.	Prof. Weine Nway Nway Oo	Head of Department Department of Biotechnology Technological University (Kyaukse)	Team Leader Ph.D (Biotechnology) Member of NBSAP, 2011
3.	Dr. Nyunt Lwin	Lecturer Department of Zoology Kyuause University	Team Leader Ph.D (Ecology)
4.	Dr Wah Wah Khaing	Associate Professor Department of Botany, Pathein University	Research Member Ph.D (Environmental Science, YU) (Flora Expert)
5.	Dr Theingyi Soe Myint	Lecturer Department of Zoology, University of Yangon	Research Member Ph.D (Ichthyology, YU) Ichthyologist
6.	U Htoo Htoo Aung Lwin	Assistant Lecturer Department of Zoology, University of Yangon	Research Member Ph.D (Candidate, YU) Ichthyologist
7.	Dr. Thein Tun Oo	Lecturer Department of Botany, Yadanabon University	Research Member PhD (Botany) (Flora Expert)
8.	Dr. Ye Ye Win	Lecturer Department of Botany, Yadanabon University	Research Member PhD (Botany) (Flora Taxonomist)
9.	U Shein Htet Aung	sistant Lecturer partment of Zoology, Mandalay University	Research Member PhD Prelim (Zoology); MSc, MRes (Ornithology) (Fauna Expert)
10.	U Kyaw Lwin	Carrier Researcher	Research Member Field specialist, Insect, mammal and herpet
11.	U Naing Oo	Carrier Researcher	Research Member Field Specialist, Plant

5.4.7.1. Flora and Fauna (Amarapura and Patheingyi)

(1) Aims and Objectives

To collect and identify of plant and animal species in study area

To record dominant species of plants and animals

To analysis of composition of plants and animals

To assess the potential impacts and to suggest the mitigation measure

(2) Methods

The animals and floristic data, and ecological data collection were conducted by the following methods in the study area.

(i) Study area and study sites

The study area is conducted on Muse-Mandalay Railway from Amarapura Township to Patheingyi Township. Six study sites were allocated by based on habitats in this study area and remarked on Google Earth. Site I (Sauk Taw Wa) I is at Latitude 21°50'31.20"N and Longitude 96° 7'10.68"E; Site II (Sin Bo) is at 21°52'0.33"N and 96° 8'46.74"E; Site III (Ngwe Taung) at 21°53'34.23"N and 96°10'13.57"E; Site IV (Tha Le Kone) at 21°55'16.12"N and 96°11'1.27"E; Site V (Ye Kyi, South) is at 21°57'7.26"N and 96°11'7.77"E and Site VI (Yetagon Taung) is situated at 21°57'50.59"N and 96°12'41.48"E

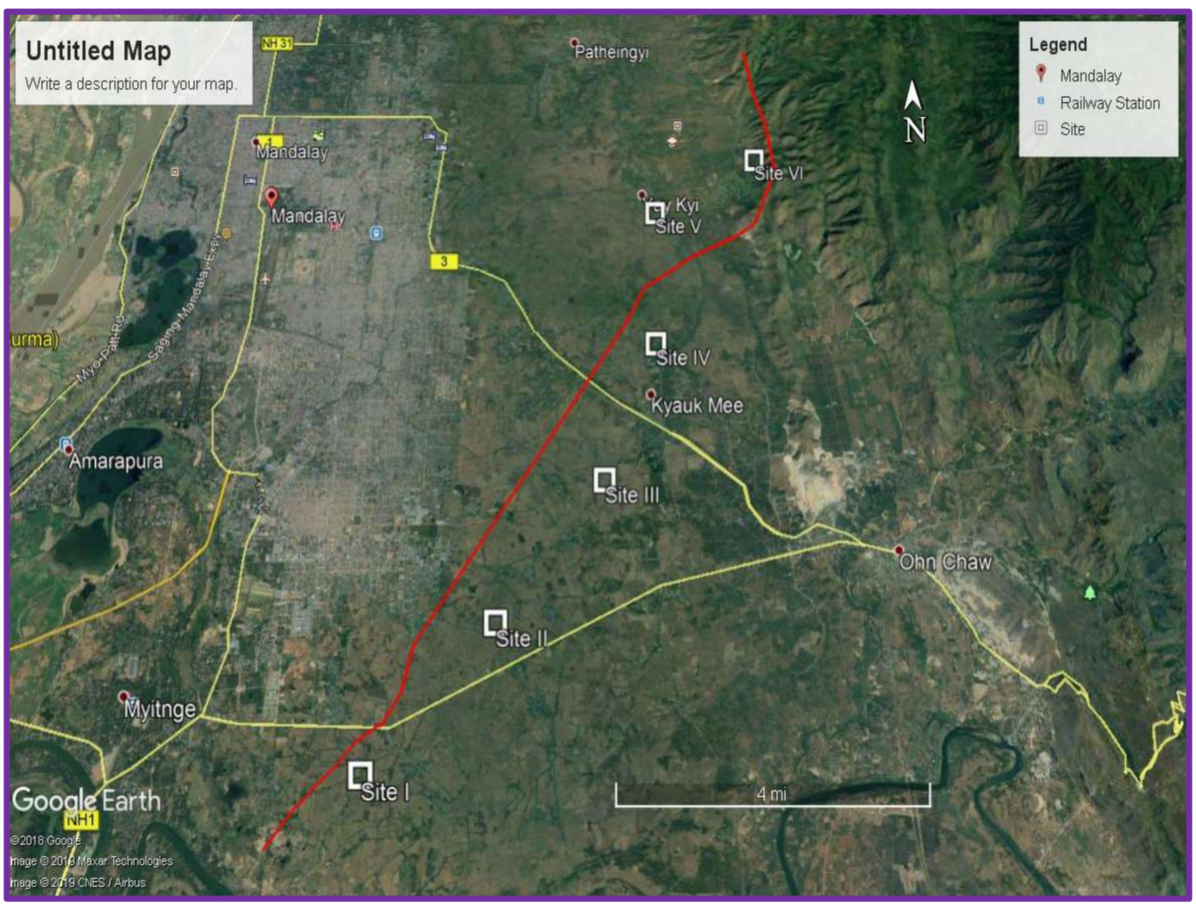


Figure 5.43 - Map of study sites

(ii) Study design

Classification of landscape based on satellite data: is often used to classify the landscape into different vegetation categories and decide about the sampling strategy. We have also followed same strategy of classifying the landscape into discernible units. Further, we have used ground truth points to calibrate the classification of the landscape into distinct units.

At each sampling site, an appropriate data collection line was designated to cover the area of each sampling site. One permanent transect line running from north to south with 50 m width was established in each study site.

Vegetative sampling was made based on plot method. Sampling with quadrat plots were allocated along the either side of each transect line. The minimum distance between two plots was 100m. Each plot was measured a length of 30m and width of 10m. Plants species as well as their total number within each plot were recorded.

(iii) Survey methods

Five kinds (Birds, Fish & Crust, mammals, herpets and insects) animals were surveyed for the diversity assessment. Animals were observed and recorded using a binocular. The photos were taken with digital camera. Most animal species were spotted with binoculars and photographs were taken, some species which could not be recorded on photographs although their occurrence was also recorded were included. The animals were surveyed two times, once in the morning from 7:00 am to 10:00 am and once in the evening from 3:00 pm to 6:00 pm and conducted a month. Line transect count method was carried out, walking along the study points. Data counting were used by direct and estimation methods, followed after Bibby *et al.*(2008). Some mammals and herpets were surveyed as interviewed methods.

Plate 1 Interview (Questionnaires' Survey) and Field survey

(iv) Insects

Insects were caught and taken as voucher specimens. Flying insects were caught by insect net; beetles were collected by digging the grounds, peering the tree barks with the knife. Some beetles in the trees were shaken out and fall down on the ground; these insects were collected by hands and a pairs of forceps.

(v) Fish & Crustacea

Fish & crust were recorded by direct catching method in/near the paddy field.

(vi) Herpet

Snakes, lizards and frogs were caught and taken as voucher species and were identified. Snakes were caught by snake stick, lizards were shot by rubber bands, and frogs were collected in their roosting habitats. Some snakes were surveyed as interviewed methods.

(vii) Birds

Birds were recorded using the watching methods with the help of binoculars. Species identification was examined using the field guide books. Counting of bird number and habitat utilization were observed. Species richness and observed frequency were assessed for species diversity.

(viii) Mammals

Direct count method, remains of animal's body parts such as skin, spines, antlers, etc. Footprints and interviewed methods were used for mammal survey.

(3) Data analysis

Relative abundance

The recorded data was analyzed as follows after Bisht *et al*., 2004:

$$\text{Relative abundance} = \frac{\text{No. of individuals of a species}}{\text{No. of individuals of all species}}$$

The average relative abundance was categorized adopted by Bisht *et al*. (2004)

uC = uncommon having relative abundance of less than 0.0100
C = common having relative abundance of 0.0100 and above but less than 0.0500
vC = very common having relative abundance of 0.0500 and above

Diversity

The relative diversity (RDi) of families was calculated using the following formula (Torre-Cuadros *et al.,* 2007):

$$\text{RDi} = \frac{\text{No. of species in a family}}{\text{Total number of species}} \times 100$$

(4) Identification

Birds were identified following Symthies (2001) and Robson (2015). Mammals were identified followed after by according to mentioned references, U Tun Yin (1993) and Francis C.M, (2008). Identification and classification of herptiles followed after Smith (1935, 1943), Das (2010) and Guraraja (2010). Identification and classification of insect species were classified according to Hill (1983), Ghosh (1940), Pathak and Khan (1994) and Borror and Delong (1964). Plant species were checked against Handley and Chit Ko Ko (1987), Kress *et al*. (2003) and consulted with Department of Botany, Yadanabon University.

Plate 2 Identification for some species

(5) Observation and Results

64 species of flora belong to 54 genera under 40 families were recorded. Among them, 56 species are trees, 6 species are climbers, 4 species are herbs, 3 species are shrub, 1species is bamboo and also 1 species is grass. In fauna recorded, there are 89 species belonging to ; among these, 22 species are insects, 4 species are fishes, 1 species is crab, 10 species are herpet, 37 species are bird and 5 species are mammals.

(i) Flora

In the study area, the highest dominant of flora were covered by paddy field and follower after Mango and banana orchards and some are gardens. The details of 64 flora species at study site in Armarapura and Patheingyi can be seen in Appendix F.

Paddy field

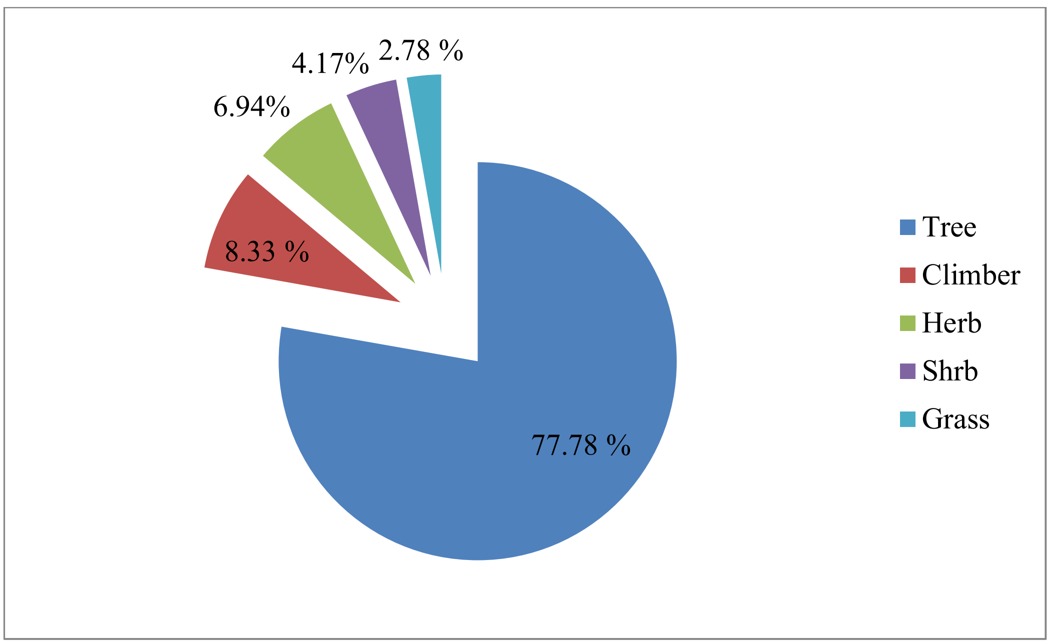
Mango orchard

Thapay garden

Banana and Gandama garden

Figure 5.44 - Occurrence of plant species at study sites

Composition and Abundance of Plant Species



(7) Evaluation of Biomass for Transmission Line

Forest acts an important part of the global cycle, storing carbon in both trees and soil. The large quantity of woody tissue that tree contain mean forest have the highest carbon density of all living things. The world forest is prominent sites to study of climate change, not only in terms of total net carbon emission but also in term of global storage capacity. Therefore this study focuses on carbon emissions but also in terms of above ground biomass of different species. Above ground biomass is an essential aspect of studies of carbon stocks and the effects of deforestation and carbon sequestration on the global carbon balance. Selected species that have been assessed were Tectona grandis(Teak), Xyliaxylo carpa(Pyinkadoe), Pterocarpus macrocarpus(Padauk),Pinus kesiya(Htinyu), Gmelina arborea(Yemane), Cassia mimosoides(Mezali), Vernicia fordii(Tansi), Quercus dealbata(Kywatsr), Amoora rohituk(Thitni), Neonauclea excels(Thitpayaung), Shorea obtuse(Thitya), Shorea siamensis(Ingyin),Terminalia crenulata(Taukkyant),Cephalostachyum pergracile(Tin-wa), Thyrsostachys oliveri(Thatnat-wa), Dendrocalamus strictus(Hmyin-wa), Bambusa tulda(Thaik-wa). For estimation of aboveground biomass, the first is to estimate wood volume of each species depending the diameter at breast height (DBH) and tree height(H).

The mixed forest which has been focused on study area was established on Shan State and Mandalay region such as kutkai, hsipaw, kyaukme, naung cho and pyin oo lwin. Pterocarpus macrocarpus(Padauk) has received the highest value in volume while Bambusa tulda(Thaik-wa) has the lowest value. This means that the former species has the great compatibility with the site conditions of reserved forest. The DBH, tree height and values of volume for each species was described in Table.

Table 5.35 - Volume per stem (m^3) and biomass (kg/stem) of different species

No:	Species		DBH (cm)	Tree Height (m)	Volume/stem (m3)	Biomass (kg/stem)
	Common Name	Scientific Name				
1	Teak	Tectona garndis	25	20	0.412388	409.0059225
2	Pyinkadoe	Xylia xylocarpus	28	20	0.517299	513.0570292
3	Pakdauk	Pterocarpus macrocarpus	32	25	0.84457	837.6441293
4	Pine	Pinus kesiya	20	18	0.237535	235.5874114
5	Yemane	Gmelina arborea	22	18	0.287418	285.0607677
6	Mezali	Cassia mimosoides	25	15	0.309291	306.7544419
7	Tung si	Vernicia fordii	19	18	0.214376	212.6176388
8	Kywatsr	Quercus dealbata	15	25	0.185574	184.0526651
9	Thitni	Amoora rohituk	25	17	0.350529	347.6550341
10	Thitphayau ng	Neonauclea excelsa	24	20	0.380056	376.9398582
11	Thitya	Shorea obtuse	23	21	0.366497	363.4917434
12	Ingyin	Shorea siamensis	21	23	0.334628	331.8837658
13	Taukkyan	Terminalia crenulata	28	18	0.465569	461.7513263
14	Bamboo (Tin-wa)	Cephalostachyum pergracile	9.5	18	0.053594	53.15440969
15	Thanat_wa	Thyrsostachys oliveri	7	15	0.024248	24.04954824

16	Hmyin-wa	Dendrocalamus strictus	7	16	0.025865	25.65285146
17	Thaik-wa	Bambusa tulda	6.5	14	0.000462	0.458086633
18	Coffee		2	3.5	0.000462	0.458086633
19	Macadama		3	15	0.004454	4.417263963

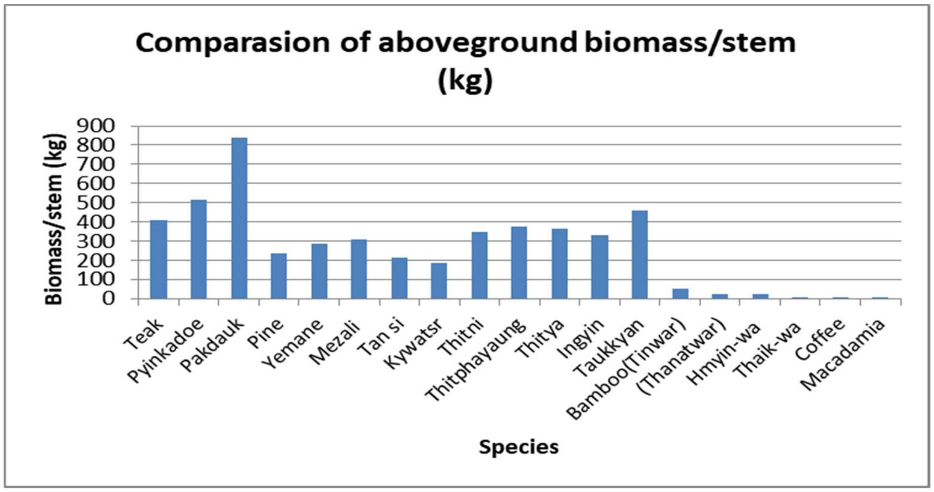


Figure 5.45 - Comparison of above ground biomass of different species

Above ground biomass of above species in which most of them is regarded as commercially important species in Myanmar such as Teak, Pyinkadoe, Padauk, Ingyin and Thitya. Among these species, Pterocarpus macrocarpus(Padauk) has the highest value of aboveground biomass. According to the result, Tectona grandis(Teak), Xyliaxylo carpa(Pyinkadoe), and Neonauclea excels(Thitpayaung) have high aboveground biomass so that they can be regarded as highly prioritized species for reforestation activities for railway projects.

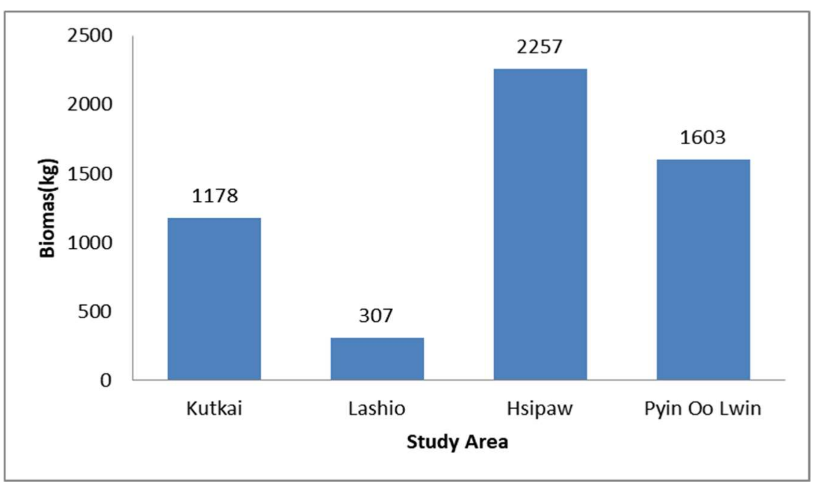


Figure 5.46 - Comparison of above round biomass of study site for tunnel passing through the foreset

According to the result, Hsipaw has the highest value of aboveground biomass having 2257kg, Pyin Oo Lwin has the second largest area having 1603kg, Kutkai has 1178kg and Lashio has the smallest aboveground biomass 307 kg. In Hsipaw, Tansi, Padauk, Teak, Yemane, Mezali and Pyinkadoe are present and padauk has the largest aboveground biomass compared with the other. So, these species be regarded as highly prioritized species for reforestation activities for railway project and padauk can be regarded as the most important species. Therefore, this native species can be replanted in near area around the degraded forest and need to be reforestation with approximate amount.

(8) Fauna

The details of fauna species at study site in Armarapura and Patheingyi can be seen in Appendix F.

Composition and diversity

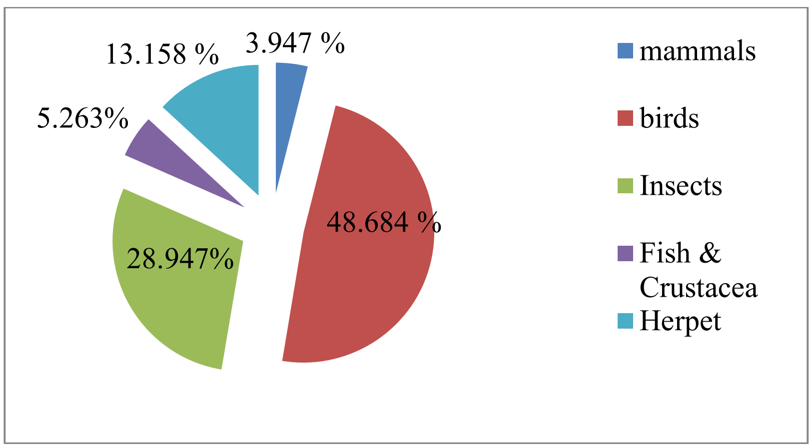


Figure 5.47 - Species composition of mammals, birds, insects, fish & crustacea and herpet recorded from Armarapura and Patheingyi at Muse-Mandalay Railway

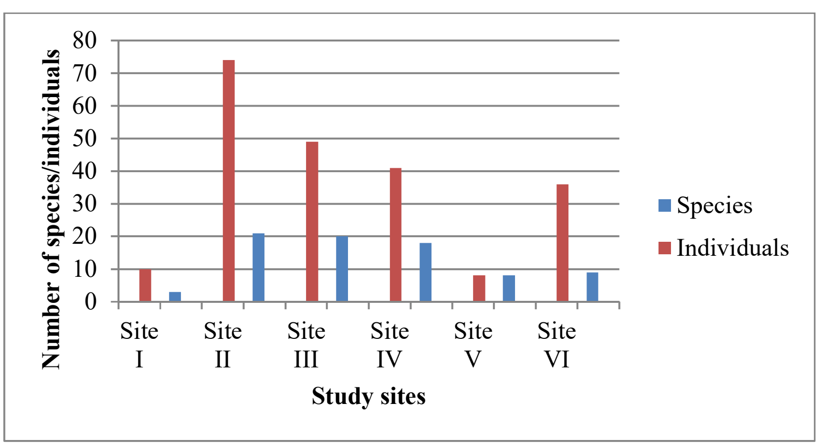


Figure 5.48- Composition of insect species recorded in five study sites from Armarapura

and Patheingyi at Muse-Mandalay Railway

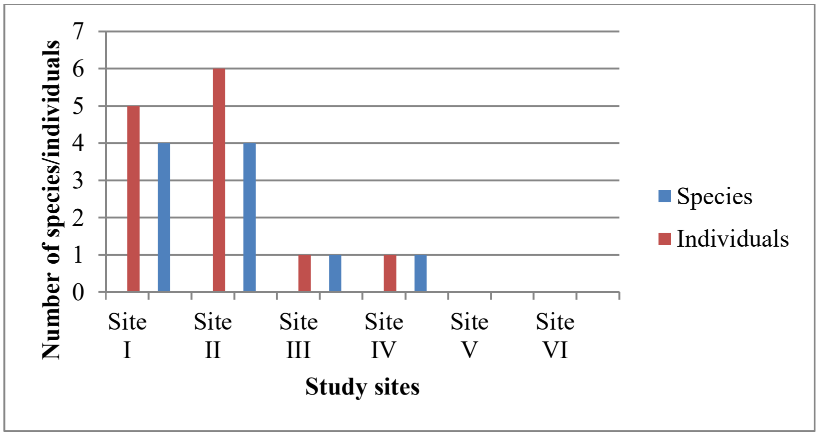


Figure 5.49 - Composition of fish and crustacea species recorded in five study sites from Armarapura and Patheingyi at Muse-Mandalay Railway

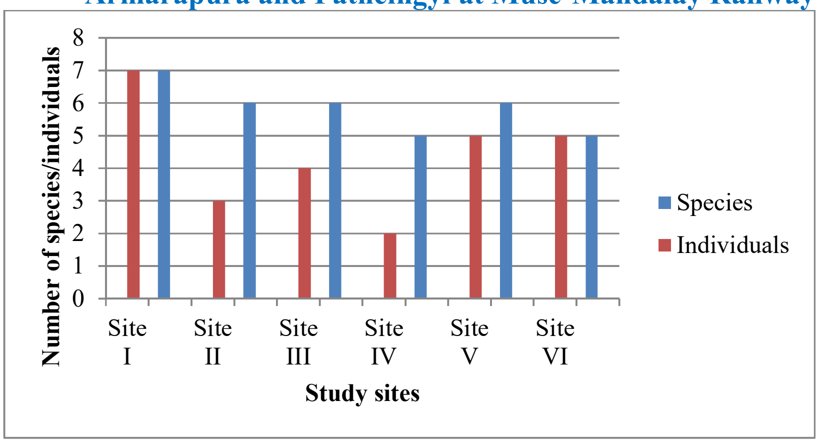


Figure 5.50 - Composition of herpet species recorded in five study sites from Armarapura and Patheingyi at Muse-Mandalay Railway

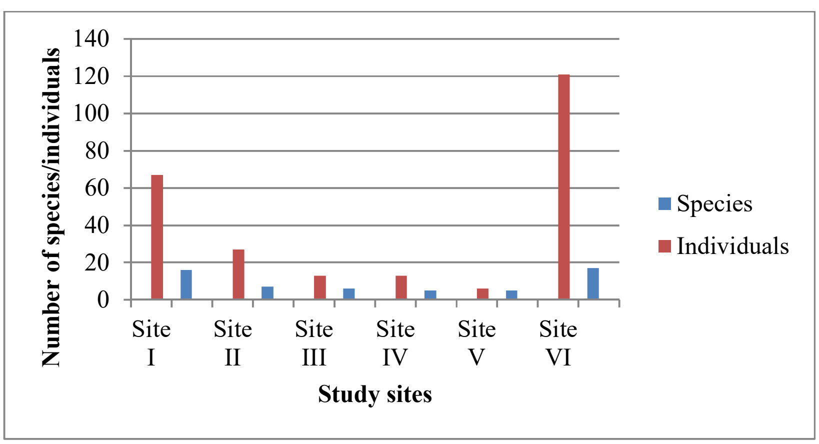


Figure 5.51 - Composition of bird species recorded in five study sites from Armarapura and Patheingyi at Muse-Mandalay Railway

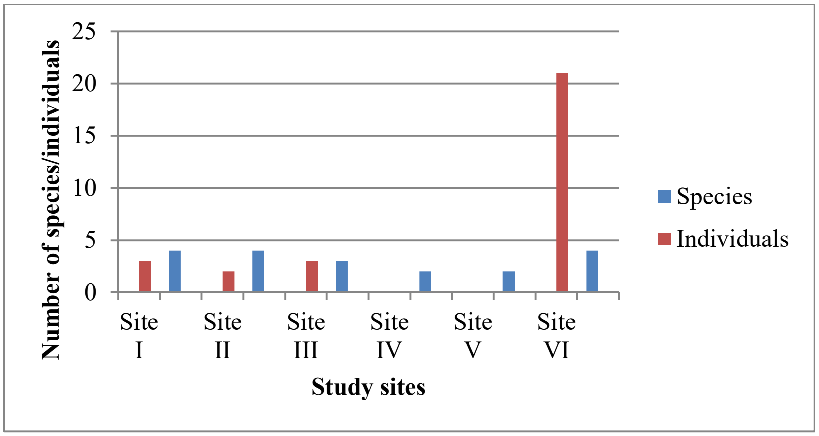


Figure 5.52 - Composition of mammal species recorded in five study sites from Armarapura and Patheingyi at Muse-Mandalay Railway

5.4.7.2. Flora and Fauna (Pyin Oo Lwin)

(Biodiversity survey of pyin oo lwin, naung hkio, his paw, kyaukme, lashio, thein ni, kutkai, muse)

(i) Survey Areau

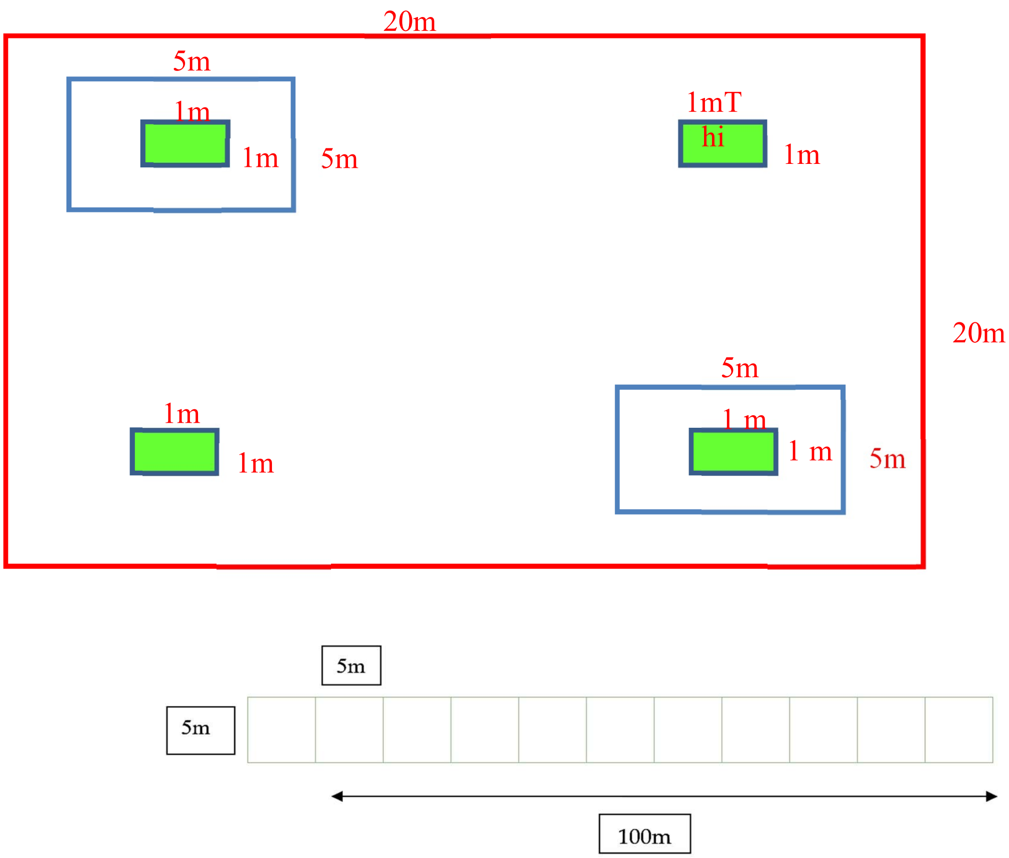
The Mandalay-Muse Railway New Project is located that on the route of Mandalay-Muse areas (especially by Pyin Oo Lwin, Naung Hkio, ,Kyaukme, Hispaw, Lashio, Thenni, Kukkai and Muse). According to the Specimen collection of fauna and flora data within the 10 km radius of major project area are discovered because of there are enough food sources in these study area.

(ii) Survey Method (Flora)

The floristic data collection was conducted by the following methods in the study Area.

Random transecting method

To get representative checklists of the tree species and plant collection was also carried out by 5 to 10 meter transect lines were laid down and observed near the railway site and another wherever possible. In each sub-transects line, every plant species was listed and counted. In addition, all plant species (trees, shrubs, herbs, and cultivated plant) around the area were recorded and listed. The species identification was carried out by using key to the families of flowering plants and appropriate literature. A global positioning system (GPS) was used to navigate and mark coordinates between the target line respectively and tree species and the spatial location (latitude, longitude and altitude) of each plot was measured by using a Global Positioning System (GPS). Materials used for recording are measuring tape for sample transecting, digital camera for recording.



Layout for Sampling Design by Quadrat Method (Santra *et al.,* 1999)

Data Collection

To investigate the plant species diversity, species richness, evenness, frequency and dominance, randomly quadrat method were established around the proposed points of yard, 20 quadrates (5mx5m) for shrubs layer and 40 quadrates (1m x1m) for herbs layer were set up and observed (Santra *et al*., 1999) in each site. All the herbaceous species in each quadrat were listed and counted. Sample trees within the points and vicinity area also listed, counted and measured on its Girth at Breast Height and height with measuring tape. The spatial location (latitude, longitude and altitude) of each plot was measured by using a Global Positioning System (GPS). **Identification**

Plants specimens were identified with a checklist of the trees, shrubs, herbs, and climbers of Myanmar (Kress et al., 2003).

Data Analysis

The collected field data were calculated by using Jackknife estimate of species richness (Heltshe and Forrester, 1983), Evenness (Shannon-Wiener function, 1963) and species

Diversity; Shannon-Wiener index (H), and Simpson index (D) (Magurran, 1998). Quantitative analysis such as density, frequency, and abundance of herbaceous species were determined by Curtis and McIntosh (1950). After field survey, data entry was carried out in excel work sheet. For identification of threaten species, it is conducted matching with IUCN red list version 2016.3.

Jackknife estimate of species richness

According to the Heltshe and Forrester (1983), the formula of Jackknife estimate of species richness is:

$$\hat{S}=S\left(\frac{n-1}{n}\right)^k$$

$\hat{S}$ = Jackknife estimate of species richness

S = observed total number of species in "n" sample plots

n = Total number of plots sample

k = number of unique species

Plant Species Diversity

According to the Magurran (1998), species diversity is often expressed by two indices, namely, Shannon-Wiener index (H), Evenness (E) and Simpson index (D).

Shannon-Wiener Index

$$H=-\sum_{i=1}^{s}(p_i)(\log_2 p_i)$$

H = index of species diversity

S = number of species

p_i= proportion of total sample belonging to the i^{th}

Simpson Index

$$D=1-\sum_{i=1}^{s}(p_i)^2$$

D= Simpson's index of species diversity

S= number of species

P_i= proportion of individual of i species in the community

Evenness

Species evenness is a measure of how equitable the species numerically in a community.

Shannon-Wiener function (1963) was used for the measure of evenness as follow;

$$E = \frac{H}{H_{\max}}$$

$$H_{\max} = Log_2 S$$

E = evenness (range 0-1)

H = index of species diversity

S = number of species

$H_{\max}$=species diversity under conditions of maximal equitability

Evaluation of density and frequency

The important quantitative analysis such as density, frequency, and abundance of tree species, shrubs and herbs species were determined as per Curtis and McIntosh (1950).

(iii) Survey Method (Fauna)

Primary data collection through direct observation, interview, individual/target group consultation such as- common resident faunas (mammals, birds, reptiles, amphibians, fishes, various kinds of insect include butterfly, dragonfly and damselfly etc.).

For the secondary data collection, the team will review the following materials: project reports, research, concept notes, documents, monitoring reports, baseline data, reports shared to relevant organizations, field reports & data, specific information & data, and any other materials during the desk review. All collected specimens were scaled photographed, morphometric characters were recorded and preserved in suitable containers with appropriate concentration of formalin for taxonomical identification and further study. The butterfly and dragonfly were photographed soon after the collection and measurements were also taken to the Department of Zoology, University of Yangon for key characteristics. The identified species were translated to scientific name with assistance of the senior researcher at Department of Zoology, University of Yangon.

As the flora survey, during the site visit, the different biodiversity features, habitat and landscape units present at the site were identified. Walk-through-surveys were conducted around the site and all terrestrial and aquatic plant species observed were recorded by randomizes. Photographs were taken of all species for later identification. Flora species identification was carried out by using key to the families of flowering plants and appropriate literature and confirmed by matching with herbarium specimens of Department of Botany, University of Yangon. Diversity of plant species were presented in tabulated forms. Representative checklists of the terrestrial and aquatic species, plant collection was also carried out by visual observation along the project area.

Point count method, Line transects, Capture and Mark

Point counts are a commonly used method for determining the relative abundance of birds. A point count consists of standing at a predetermined location, usually along the road-side, and counting all birds seen or heard during a set period of time.

Point counts are used to record a variety of birds, including those species that may not visit a feeder. It is a simple method that provides a uniform way of counting birds over time or across locations. In large areas, randomly allocated point counts can be used as representative samples for the area. Fauna (Invertebrate & Vertebrate) Survey will cover:

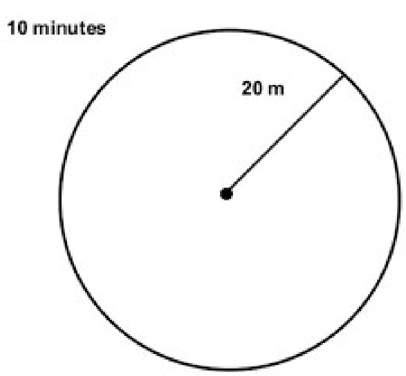
• Baseline survey of fauna was undertaken within each habitat type of the Study Area (including intertidal habitats), using the point count method and line transects method.

• For each major habitat type, point count locations were selected to quantitatively assess the Invertebrate and Vertebrate community in the area.

Point count method

For Birds, Ten minutes will be spent at each point, with all Birds seen or heard within 20 m being counted. Count duration, it can vary from 2-20minutes. Record only these birds seen during count duration. Do not include for analysis those birds seen while walking between two points. Used distances Not very far (>200m), Not very close (<20m).

• Butterflies encountered outside counting points but within the Study Area was also recorded to produce a complete species list. Signs of breeding, host plant were recorded.

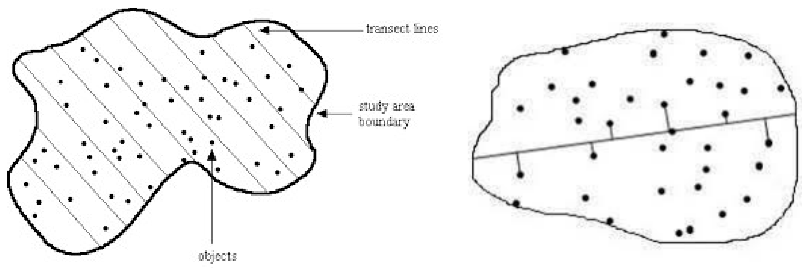


(A)

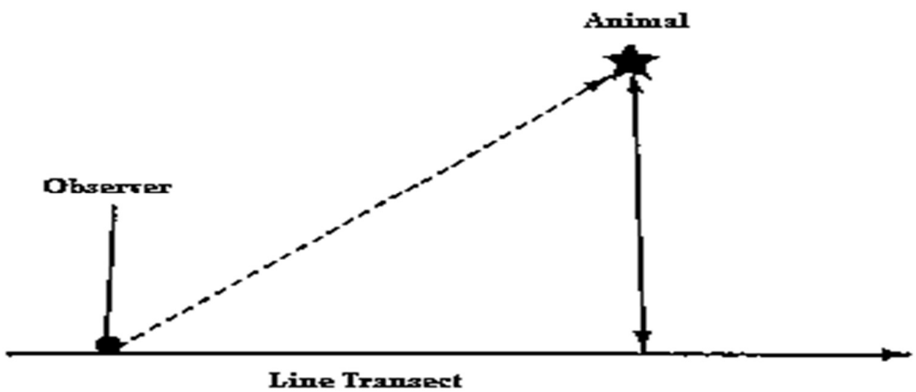
(B)

Line transects Method

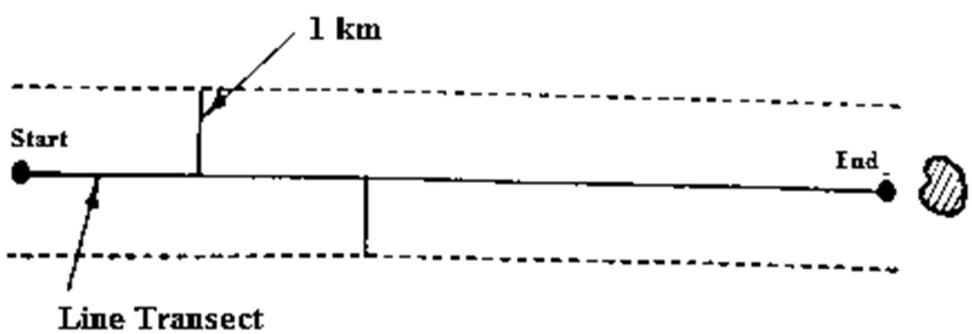
Line transect sampling is a distance sampling method for estimating the abundance of animal populations. One key assumption of this method is that all animals are detected at their initial location.



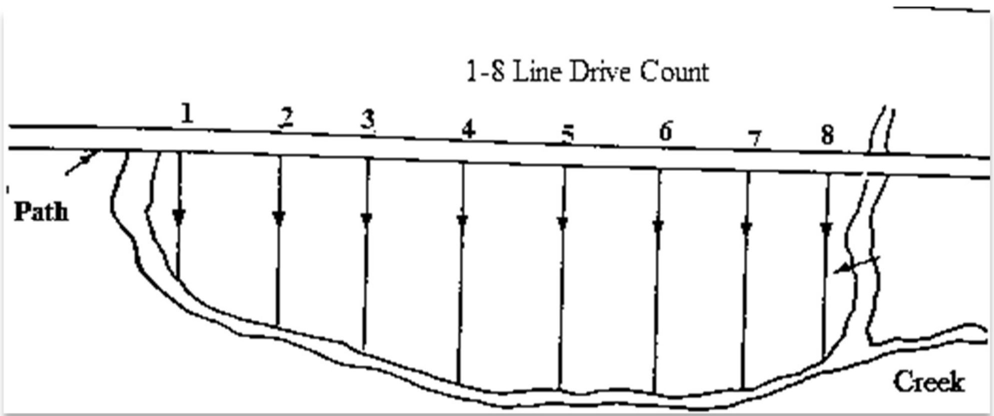
(A) Line & Point Count



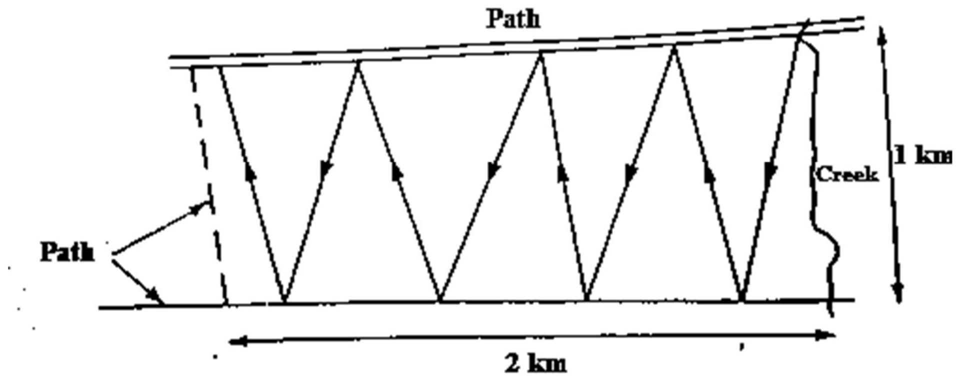
(B) Line Transect



(C) Fixed width Transect



(D) Line Drive Count



(E) Line Cross Count (less than 4-5km^2)

Capture and Mark

Mark and recapture is a method commonly used in ecology to estimate an animal population's size where it is impractical to count every individual. A portion of the population is captured, marked, and released. Later, another portion will be captured and the number of marked individuals within the sample is counted.

Natural and Physical Environment Anlysis

As far as it is concerning about Habitat Evaluation System (HES), Environmental Impact Assessments (EIA) technically exmained two major habitat types were observed, namely: (1) patches of mixed vegetation with scattered trees, and (2) human habitation area in these study area. The project was conducted for the assessment of the species diversity of flora groups such as trees, small trees, shrubs, herbs and climbers to predict the impacts and biotic ecology.

Biodiversity survey group observed within short period to collect the data of fauna. Our term identified as to observe their fur and feathers, dens, nests, trails and burrows for not seen face to face species. Important data of some wildlife animals collected about the interview survey of native villagers. Biodiversity group investigated base on the conditions of survey areas to use scans and spot observation method.

The survey team learnt that the fudamental assumption underlying HES is that the persence or absence, abundance, and diversity of animal population in habitat or community are determined by basic biotic and abiotic factors that can be readily quantified. The carrying capacity of a habitat for a given species or groups of spcies is coorelated with basic chemical, physical, and biotic characteristics of the habitats.

Topography: Topographical data of land cover and vegetation will be obtained through field survey and pictured with the help of GPS and related equipments and software. Some of these data will be collected visually from field survey.

Biological Condition: Fauna and flora occuring in the vicinity of around the Project area will be visually surveyed and recorded with the help of scaled photographs. They will be identified taxonomically using appropriate references result.

Terrestrial Fauna Survey

The base line study and specimen collection of terrestrial fauna, especially as major groups are vertebrate (mammals, birds, reptiles, lizards and fishes especially visual observation) and invertebrate (butterflies, dragonflies, damselflies and many kinds of insects visually during survey). Fish surveys were conducted by direct observation in aquatic habitats and opportunistically checking fishing gear. Secondary data was collected from villagers and catches inspected. They are carried out in and around Project Area. Habitat preferences, relative abundances and diversity assessment were examined. Diversity of fauna species were presented in tabulated forms. Possible impacts (negative and positive impacts) were investigated and mitigation measures were proposed. Collected specimens were checked with the IUCN Redlist and CITE appendices.

(iv) Observation and Results (Pyin Oo Lwin to Muse)

Floristic composition

A total of 86 flora species were recorded during the survey periods. The habit of identified species consists of seven different types, including tree, shrub, herb, climber, bamboo, epiphyte (orchid) and parasitic shrub. Some of tree species are planted for landscaping beside the rail way yard and some of trees are planted and culturally retained for water resources around the village sites. Most of shrubs and herbs were naturally grow on road sites and understorey layer of tree species. According to the IUCN Red List, four Least Concerned species and two near threatened status noted from the survey area.

Vegetation types

Along the railway site area, different forest types were observed accordingly to the elevation, namely: (1) hill semi evergreen forest (2) tropical mix evergreen and deciduous forest (3) semi-indaing forest (4) Open degraded forest and farmland ecosystem.

Table - Survey Activities and Results

Location (Project site)	GPS positions	Survey Activities	Achievements
Pyin Oo Lwin	N 22˚ 02’ 12.433” E 096˚ 27’ 54.289”	Along the proposed railway way line of station, villages and cultivated land	Collected 63 species
Naung Hkio to Hsipaw	N 22˚ 20’ 04.321” E 096˚ 51’ 53.058”	Along the proposed rail way line and near Gote Htaik area	Collected 40 species
Lashio to Muse	N 22˚ 81’53.592” E 097˚ 66’ 46.27”	Survey along the rail-road	Collected 48species

Pyin Oo Lwin Area

Vegetation Survey and Habitat

Along the railway site at Pyin Oo Lwin Area, different habitat and vegetation types were observed, namely: (1) patches of hill semi evergreen forest (2) tropical mix evergreen and deciduous forest (3) Open degraded land (4) human habitation area (5) farmland ecosystem.

Floristic compositions and Species Diversity

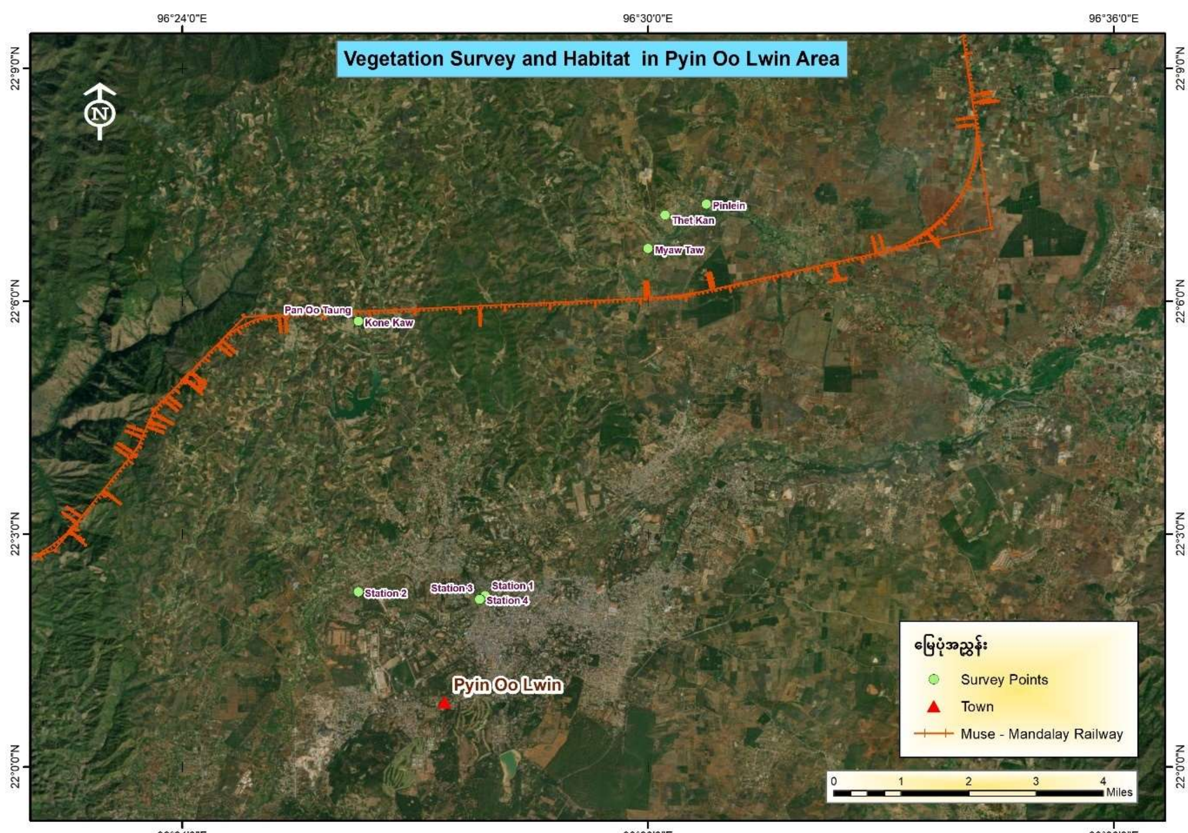
A total of 63 species belong to 35 families and 59 genus were identified at Pwin Oo Lwin area. The majority of the plants species recorded were trees (26species) followed by herbs (17 species), shrubs (12) and bamboo (3) and grass (1). According to results of Shannon-Wiener and Simpson Index, floral diversity of shrub and herb was found to be moderate; (3.70, 0.70), (3.10, 0.62) respectively. In this study height density and frequency reveled the species of *Castanopsis tribuloides* and *Colona floribunda* in canopy layer; *Tithonia diversifolia* and *Clerodendrum bracteatum* in shrub community and *Biden pilosa* and *Ageratina adenophora* in herb community of understory layers. The details list for flora species at Pyin Oo Lwin Area is in Appendix F.

Significant IUCN red list species

In this study *Schima wallichii* fall in Least Concerned species and *Dalbergia cultrata* fall in Near Threatened species under globally threatened species (IUCN, 2016).

Table - Survey Activities and Achievements

Location (Project site)	GPS positions	Elevation	Survey Points	Achievements
Pyin Oo Lwin	N 22˚ 02’ 12.433” E 096˚ 27’ 54.289”	1145m	Station 1	**63 spp.**
	N 22˚ 02’ 15.427” E 096˚ 26’ 16.263”	1090m	Station 2	
	N 22˚ 02’ 09.687” E 096˚ 27’ 50.416”	1090m	Station 3	
	N 22˚ 02’ 09.732” E 096˚ 27’ 50.075”	1092m	Station 4	
	N 22˚ 05’ 44.703” E 096˚ 26’ 16.263”	1179m	Kone Kaw village	
	N 22˚ 05’ 44.689” E 096˚ 26’ 16.291”	1140m	Pan Oo Taung village	
	N 22˚ 06’ 40.754” E 096˚ 30’ 00.000”	1119m	Myaw Taw village	
	N 22˚ 07’ 06.723” E 096˚ 30’ 13.293”	1114m	Thet Kan village	
	N 22˚ 07’ 15.203” E 096˚ 30’ 45.126”	1084m	Pinlein village	



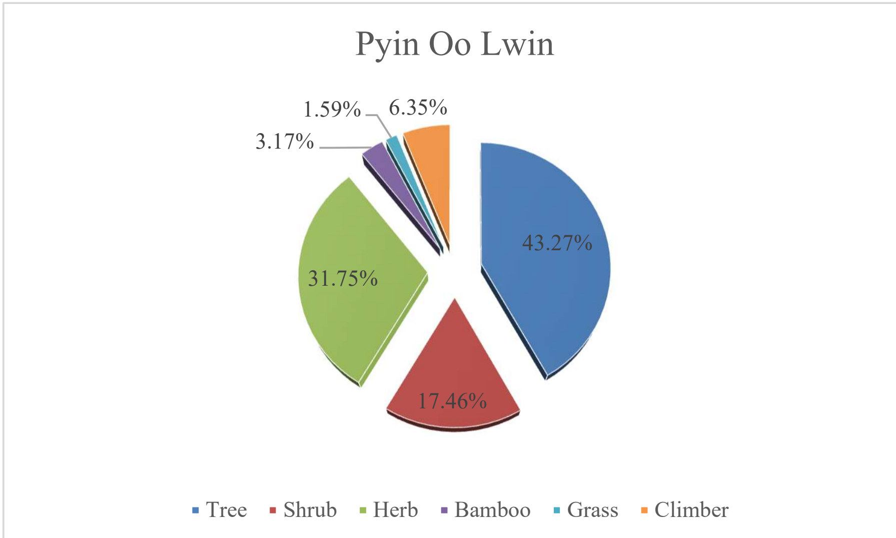


Figure 5.53 - Composition of recorded plant species at Pyin Oo Lwin Area

Naung Hkio to Hsipaw Area

Vegetation Survey and Habitat

Along the railway site at Naung Hkio Area, different habitat types were observed, namely: (1) tropical mix evergreen and deciduous forest (2) semi-indaing forest (3) Open degraded forest (4) human habitation area (5) farmland ecosystem.

Floristic compositions and Species Diversity

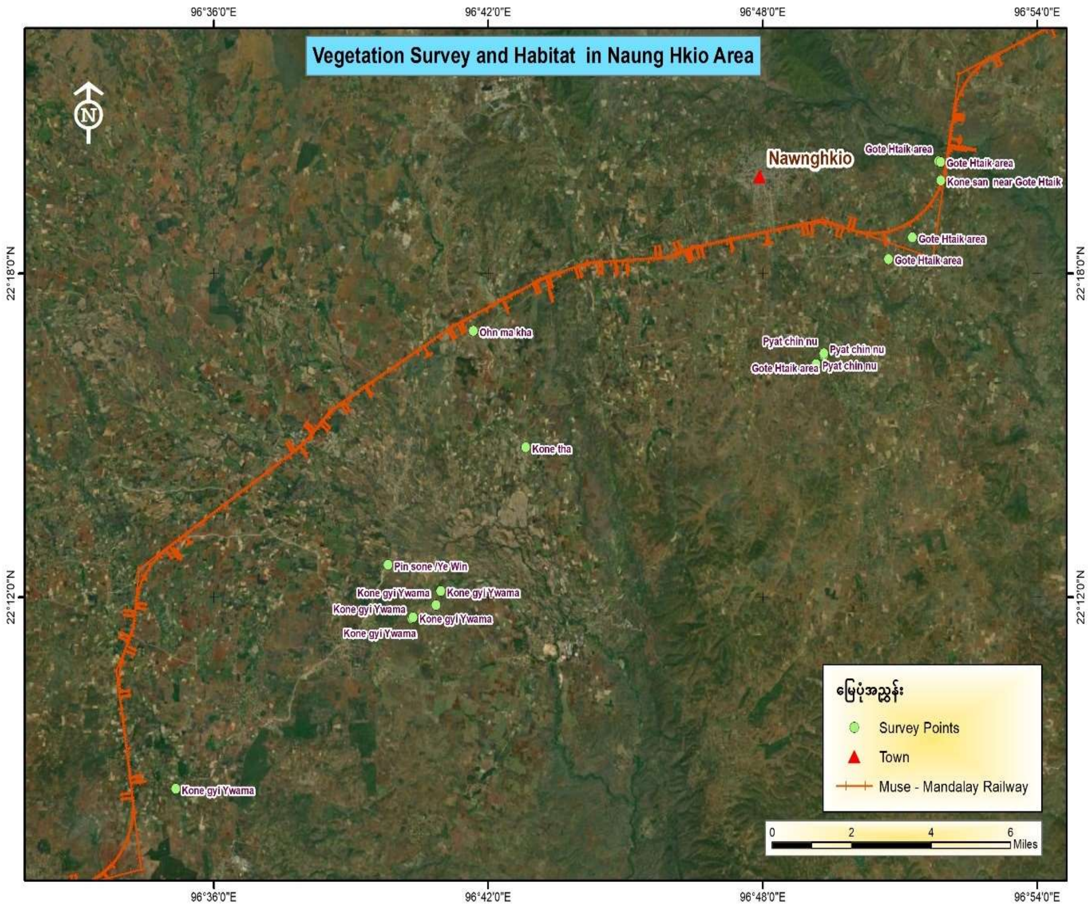
A total of 40 species belong to 20 families and 37 genus were identified at Naung Cho area. The majority of the recorded plants species were trees (17 species) followed by herbs (9 species), shrubs (10), climber (2 species), parasitic shrub (1 species) and grass (1). According to results of Shannon-Wiener and Simpson Index, floral diversity of shrub and herb was found to be moderately low; (2.50, 0.63), (3.11, 0.67) respectively. In this study height density and frequency revealed the species of Tithonia diversifolia, and Chromolaena odorata in shrub community and Biden pilosa and Celosia argentea in herb community of understory layers. Tectona grandis, Dalbergia cultrata and Shorea siamensis were frequently found in tree layers according to secondary data. The details list for flora species at from Naung Hkio to Hsipaw Area is in Appendix F.

Significant IUCN red list species

In this study, four species namely; Schima wallichii, Schleichera oleosa, Shorea siamensis and Chukrasia tabularis fall in Least Concerned species under globally threatened species (IUCN, 2016).

Table - Survey Activities and Results

Location (Project site)	GPS positions	Elevation	Survey points	Achievements
Naung Hkio	N 22˚ 14’46.590” E 096˚ 42’ 49.50”	701m	Kone tha village	40 spp.
	N 22˚ 11’36.616” E 096˚ 40’20.151”	680m	Kone gyi Ywama village	
	N 22˚ 11’36.616” E 096˚ 40’20.151”	680m	Kone gyi Ywama village	
	N 22˚ 11’51.111” E 096˚ 40’51.819”	670m	Kone gyi Ywama village	
	N 22˚ 12’06.842” E 096˚ 40’57.944”	671m	Kone gyi Ywama village	
	N 22˚ 08’26.724” E 096˚ 35’10.501”	670m	Kone gyi Ywama village	
	N 22˚ 11’37.556” E 096˚ 40’21.881”	670m	Kone gyi Ywama village	
	N 22˚ 12’35.873” E 096˚ 39’48.867”	687m	Pin sone , Ye Win	
	N 22˚ 16’56.174” E 096˚ 41’40.873”	752m	Ohn ma kha village	
	N 22˚ 16’31.180” E 096˚ 49’20.221”	1024m	Pyat chin nu village	
	N 22˚ 16’29.180” E 096˚ 49’20.221”	1047m	Pyat chin nu village	
	N 22˚ 16’19.328” E 096˚ 49’10.104”	915m	Pyat chin nu village	
	N 22˚ 18’16.231” E 096˚ 50’45.040”	878m	Gote Htaik area	
	N 22˚ 16’31.180” E 096˚ 49’20.211”	868m	Gote Htaik area	
	N 22˚ 18’40.207” E 096˚ 51’16.117”	870m	Gote Htaik area	
	N 22˚ 19’43.427” E 096˚ 51’ 53.80”	780m	Kone san village near Gote Htaik	
	N 22˚ 20’04.898” E 096˚ 51’50.916”	716m	Gote Htaik area	
	N 22˚ 20’04.311” E 096˚ 51’53.058”	714m	Gote Htaik area	



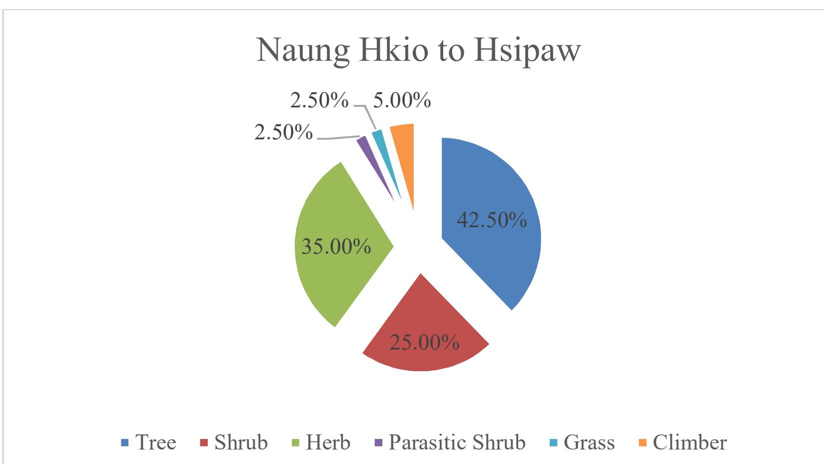


Figure 5.54 - Composition of recorded plant species at Naung Hkio to Hsipaw Area

Lashio to Muse Areas

Vegetation Survey and Habitat

Along the railway site at Lasho, Thenni, Kukkai and Muse, different habitat types were observed, namely: (1) tropical mix evergreen and deciduous forest (2) hill evergreen forest (3) Open degraded forest.

Floristic compositions and Species Diversity

A total of 48 species belong to 26 families and 42 genus were identified at Lasho areas. The majority of the recorded plants species were trees (17 species) followed by herbs (11 species), shrubs (11), climber (3 species), bamboo (2 species), epiphyte orchid (3 species) and grass (1). According to results of Shannon-Wiener and Simpson Index, floral diversity of shrub and herb was found to be moderately height; (3.26, 0.68), (3.50, 0.70) respectively. In this study height density and frequency revealed the species of Tithonia diversifolia, and Lantana camara in shrub community and Barleria cristata and Ageratum conyzoides in herb community of understory layers. Schima wallichi, and Prunus cerasoides were frequently found in tree layers according to secondary data. The details list for flora species at from Lashio and Muse Area is in Appendix F.

Significant IUCN red list species

In this study four species namely; Schima wallichii and Dendrobium aphyllum fall in Least Concerned species under globally threatened species (IUCN, 2016).

Table - Survey Activities and Achievements

Location (Project site)	GPS positions	Elevation (m)	Survey points	Achievements
Lashio	22°56'17.72"N 98° 8'17.45"E	1605	Kaung Mat Keng village	48 sp.
	22°57'2.13"N 98° 8'17.45"E	1684	Hkaing Chin village	
	22°46'28.23"N 97°38'40.12"E	782	Naung Mon village	
	22°28'25.74"N 97°38'40.12"E	1288	Naung Lan village	
	22°52'17.04"N 97°41'16.13"E	921	Loi Lunt village	
	22°48'55.29"N 97°39'52.66"E	914	Khay Nin	
	22°49'44.23"N 97°40'11.47"E	948	San Phyat village	
	23° 2'7.91"N 97°44'39.92"E	809	Hopeik village	
	23˚10'54.55"N 97˚ 52' 39.88"E	2096		
	23˚ 28'39.75"N 97˚ 53' 20.01"E	2097	Honar village	
	24˚00'11.81"N 97˚ 56' 21.6"E	2927	Weimain village	

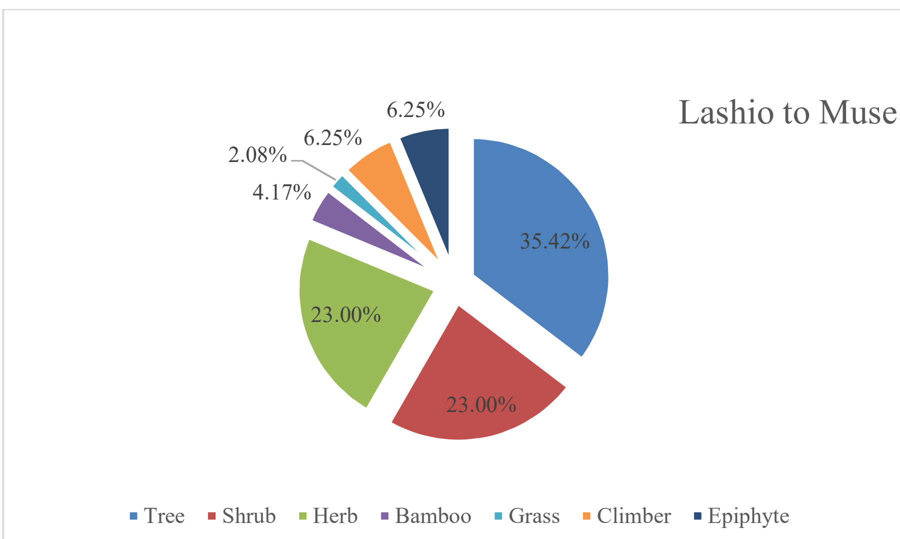


Figure 5.55 - Composition of recorded plant species at Lashio to Muse Area

CLASSIFICATION OF TERRESTRIAL FAUNA

Fauna (Vertebrate)

Mammals

According to the survey results, about total Mammals fauna 7 species 5 order and 6 families were recorded. In Biodiversity survey, Grey squirrel (Callosciurus pygerythrus) is also recorded on the trees of surrounding the study sites (near Pyin Oo Lwin, Naung Hkio, His Paw, Kyaukme and Lashio site Survey). According to the interview survey of native villagers, some wildlife animals, especialy eurasian wild pig, wild cat were recorded as popular fauna.

The caves of this area is limestone caves and many bat species use caves for alternate refuge, some species rely on caves for day roosting and protection from predators. According to the survey results, as bats species, about total Mammals fauna 3 species one order and 2 families were recorded in Lashio area. Leschenaulti's Rousette or Fulvous fruit bat Rousettus leschenaultia, Pearson's horseshoe bat Rhinolophus pearsonii and Malayan Horseshoe bat Rhinolophus malayanus are also recorded in Shwe Gu Cave (between 22˚ 57' 16.0" N and 97˚ 43' 27.2" E, elevation 829m), Kyauk Taung Cave (between 22˚ 56' 14.50" N and 97˚ 44' 04.82" E, elevation 825m), Kyauk Khwe Taung Cave (between 22˚ 56' 07.67" N and 97˚ 42' 50.05" E, elevation 875m). The details list of Mammals Species recorded near from Pyin Oo Lwin to Lashio Site can be seen in Appendix F.

Birds

According to the survey results, about total Avian fauna 59 species 12 order and 30 families were recorded. Surrounding of the Pyin Oo Lwin area, about 39 species of Avian Fauna belonging to 9 order and 23 families were recorded with different population abundance. Surrounding of the Naung Hkio to Kyaukme Survey about 30 species of Avian Fauna belonging to 7 order and 18 families were investigated that the different categorize bird species as insectivore, omnivores and carnivorous. Biodiversity team observed that the surrounding of Lashio to Muse survey, about 22 species of Avian Fauna belonging to 3 order and 12 families . Not only bird species but also the nests with eggs near the study site are found as various habitat types.

The most commonly observed all year round resident birds include, beneficial insectivorous species like Scarlet Minivet Pericrocotus flammeus, Hooded Treepie Rypsirina cucullata, Grey-Chinned Minivet Pericrocotus solaris, White Wagtail Motacilla alba, Asian Palm Swift Cypsiurus balasinensis, Plain Flowerpecker Dicaeum concolor, Plain Martin Riparia paludicola, Oriental Magpie Robin Copsychus saularis, Green Bee-Eater Merops orientalis, Black Drongo Dicrurus macrocercus, Ashy Drongo Dicrurus leucophaeus, Bronzed Drongo Dicrurus aeneus, Grey Bushchat Saxicola ferrea, Pied Bushchat Saxicola caprata, White-throated babbler Turdoides gularis, Grey-Headed Canary Flycatcher Culicicapa ceylonensis and Slender-Billed Oriole Oriolus tenuirostris, as the insectivorous group are identified in this survey.

During the bird survey, Red Vented Bulbul Pycnonotus cafer, Red-Whiskered Bulbul Pycnonotus jocosus, Streak-eared Bulbul Pycnonotus blanfordi, Black-Crested Bul Bul Pycnonotus melanicterus, House Sparrow Passer domesticus, Eurasian Tree Sparrow Passer montanus, Plain-Backed Sparrow Passer flaveolus, Scaly-Breasted Munia Lonchura punctulata, Oriental Turtle-Dove Streptopelia orientalis, Spotted Dove Streptopelia chinensis, House Crow Corvus splendens, Large-Billed Crow Corvus macrorhynchos, Crested Myna Acridotheres cristatellus, Common Myna Acridotheres tristis, Collared Myna Acridotheres albocinctus, Vinous-Breasted Starling Sturnus burmannicus, Rock Pigen Columba livia, Scarlet-Backed Flowerpecker Dicaeum cruentatum and Rufous Treepie Dendrocitta vagabunda, Indian Roller Coracias benghalensis, Red Jungle fowl Gallus gallus, Slender-Billed Oriole Oriolus tenuirostris are also recorded as omnivores and common resident birds.

Coppersmith Barbet Megalaima haemacephala is usually solitary, sluggish and slow moving with heavy dipping flight. They feed on fruits, seeds, buds and nectar in this area by observation. Olive-Backed Sunbird Nectatinia jugularis is also identified as nectarivore species. Grey-Headed Parakeet Psittacula finschii and Thick-Billed Green Pigeon Treron curvirostra, were recorded by the fruiting bird species.

The carnivorous species are recorded by White Throated Kingfisher Halcyon smymensis,, Great Egret Casmerodius albus, White Throated Kingfisher Halcyon smymensis, and Greater Coucal Centropus sinensis in this study. Long-Tailed Shrike Lanius schach, Burmese Shrike Lanius collurioides, Brown Shrike Lanius cristatus, Great Egret Casmerodius albus, Black-Capped Kingfisher (Halcyon pileata), Indian Pond Heron (Ardeola grayii), Black Kite Milvus migrans, Black-Shouldered Kite Elanus axillaris, and Lesser Kestrel Falco naumanni are also found in various habitats at project area.

According to survey results, insectivorous species are quite effective in reducing insect pest populations. Some species also can serve as an indicator or trigger organism, indicating possible environmental trouble, as declines in their relatively abundant numbers may precede other more obvious effects of environmental stress. The details list for birds from Pyin Oo Lwin to Muse can be seen in Appendix F.

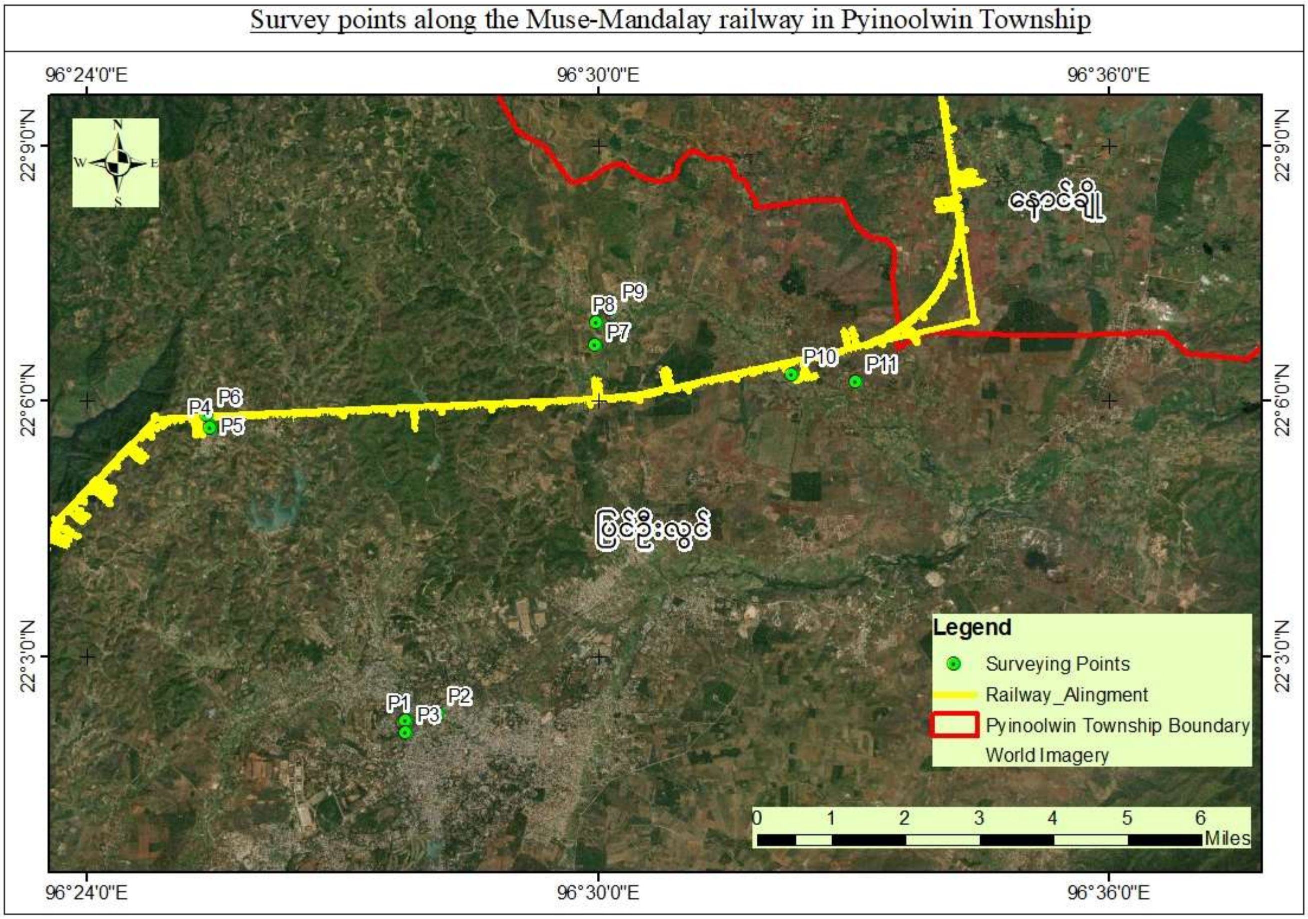
According to the survey results, the following different categorize of bird species are followed:

Table - Different categorize of bird species from Mandalay-Muse Railway New Project areas (especially by Pyin Oo Lwin, Naung Hkio, Kyaukme, Hispaw and Lashio, Thenni, Kukkai and Muse).

Sr.	Types of bird species	Number of Species
1.	Insectivorous species	19
2.	Omnivores species	23
3.	Carnivorous species	14
4.	Fruit-eating species	3
	Total	59

GPS Points (Pyin Oo Lwin -P)

Point	North Latitude	East Longitude	Elevation (m)	Remark
P1	22° 02' 14.4"	096° 27' 45.1"	1082	-
P2	22° 02' 20.0"	096° 28' 07.3"	1064	-
P3	22° 02' 06.1"	096° 27' 45.1"	1063	-
P4	22° 05" 42.5"	096° 25' 27.2"	1167	Taung Pyo & Taung Pyo Extended Reserved Forest
P5	22° 05' 41.0"	096° 25' 27.2"	1159	Taung Pyo & Taung Pyo Extended Reserved Forest
P6	22° 05' 49.9"	096° 25' 25.0"	1154	Water spring
P7	22° 06' 39.8"	096° 29' 58.9"	1110	-
P8	22° 06' 55.4"	096° 29' 59.1"	1125	-
P9	22° 07' 04.4"	096° 30' 09.8"	1131	-
P10	22° 06' 18.3"	096° 32' 17.4"	1025	-
P11	22° 06' 13.3"	096° 33' 02.3"	1018	-
P12	22° 2'22.93"	096°21'58.76"	962	503.20m from Sakhan Gyi Reserved Forest

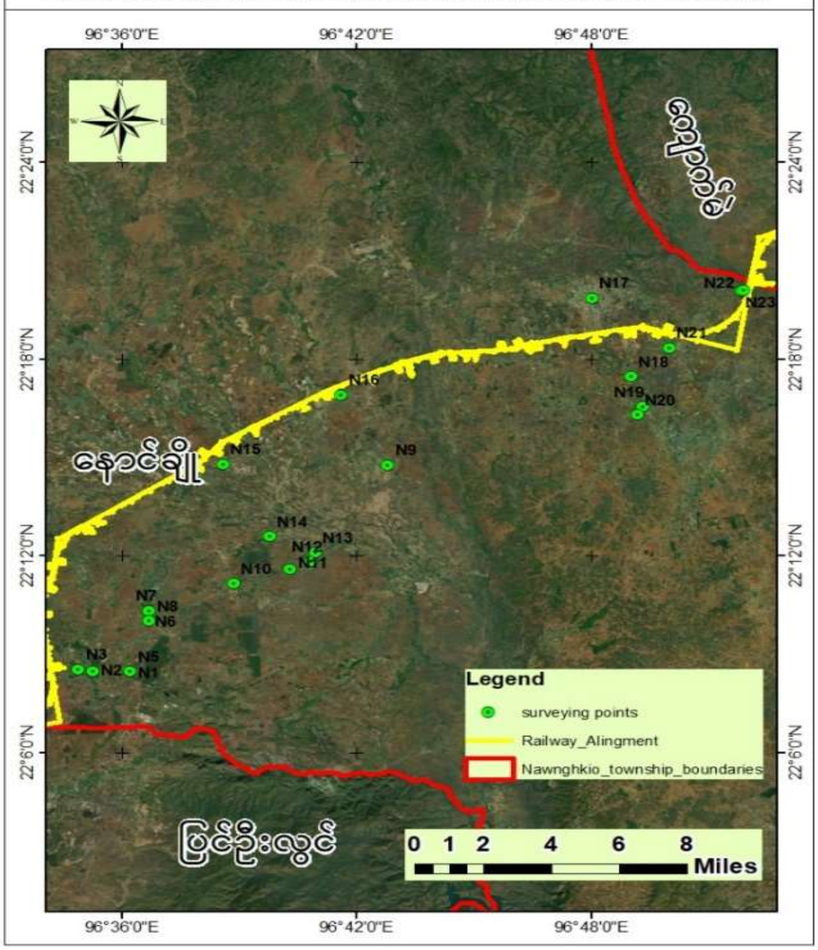


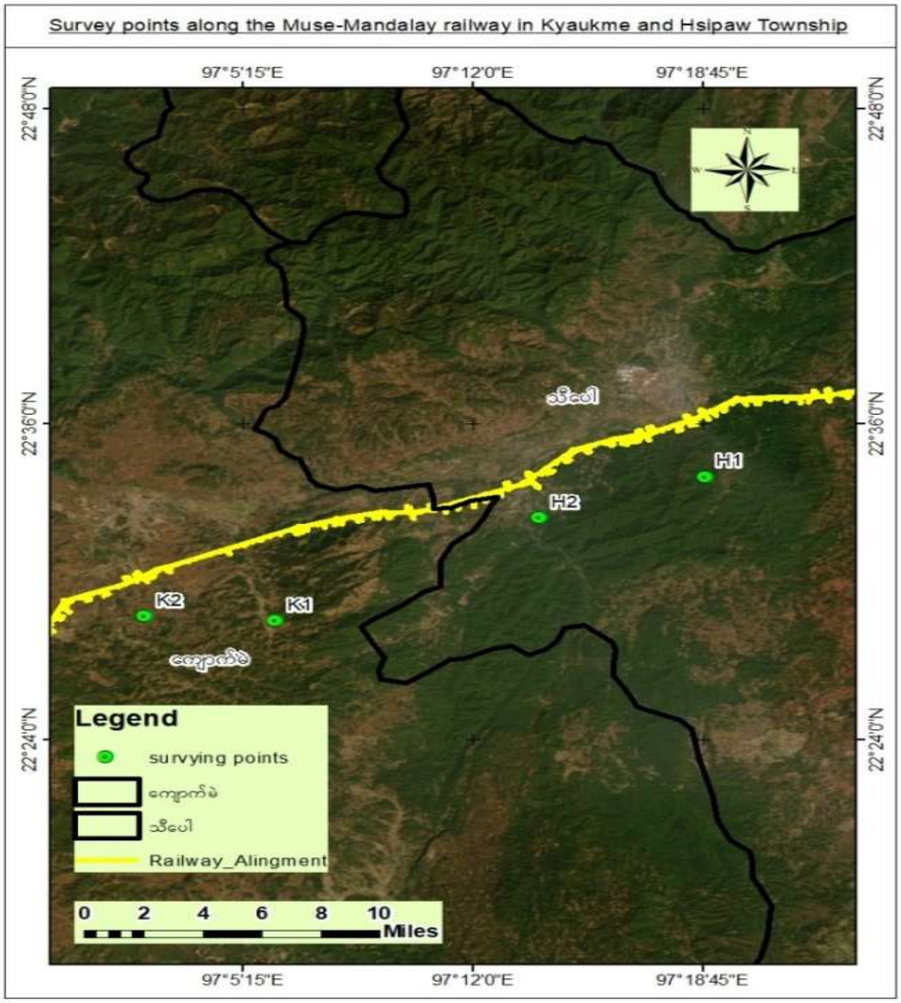
GPS Points (Naung Hkio -N)

Point	North Latitude	East Longitude	Elevation (m)	Remark
N1	22° 08' 28.6"	096° 36' 14.7"	850	
N2	22° 08' 28.5"	096° 35' 17.5"	917	
N3	22° 08' 33.0"	096° 34' 55.0"	965	
N5	22° 08' 28.7"	096° 36" 14.4"	859	
N6	22° 10' 17.5"	096° 36' 41.2"	836	
N7	22° 10' 20.3"	096° 36' 43.9"	831	
N8	22° 10' 01.8"	096° 36' 43.8"	810	
N9	22° 14' 46.6"	096° 42' 49.5"	691	
N10	22° 11' 09.6"	096° 38' 53.5"	714	
N11	22° 11' 36.6"	096° 40' 19.3"	687	
N12	22° 11' 50.0"	096° 40' 51.7"	676	
N13	22° 12' 06.7"	096° 40' 58.0"	663	
N14	22° 12' 35.7"	096° 39' 48.9"	678	
N15	22° 14' 48.3	096° 38' 36.7"	750	
N16	22° 16' 55.2"	096° 41' 38.0"	755	
N17	22° 19' 52.1"	096° 48' 02.7"	866	
N18	22° 17' 28.2"	096° 49' 02.4"	978	
N19	22° 16' 32.7"	096° 49' 19.9"	1027	
N20	22° 16' 18.3"	096° 49' 12.4	1041	
N21	22° 18' 21.1"	096° 50' 00.7"	909	

N22	22° 20' 04.0"	096° 51' 51.4"	717	Goketwin Reserved Forest & Goketwin Extended Forest
N23	22° 20' 06.9"	096° 51' 54.1"	709	Goketwin Reserved Forest & Goketwin Extended Forest
N24	22°17'41.93"N	096°42'46.07"E	792	Nwang Hkio Reserved Forest
GPS Points (Kyaukme, -K and Hispaw –H)				
K1	22° 24' 11.8"	096° 57' 33.3"	2489	
K2	22° 21' 31.1"	096° 52' 39.9"	2498	
H1	22° 33' 46.0"	097° 13' 23.1"	1373	
H2	22°33'42.28"	097°13'14.56"	1350	590m from Tein Lon Reserved Forest

Survey points along the Muse-Mandalay railway in Nawnghkio Township

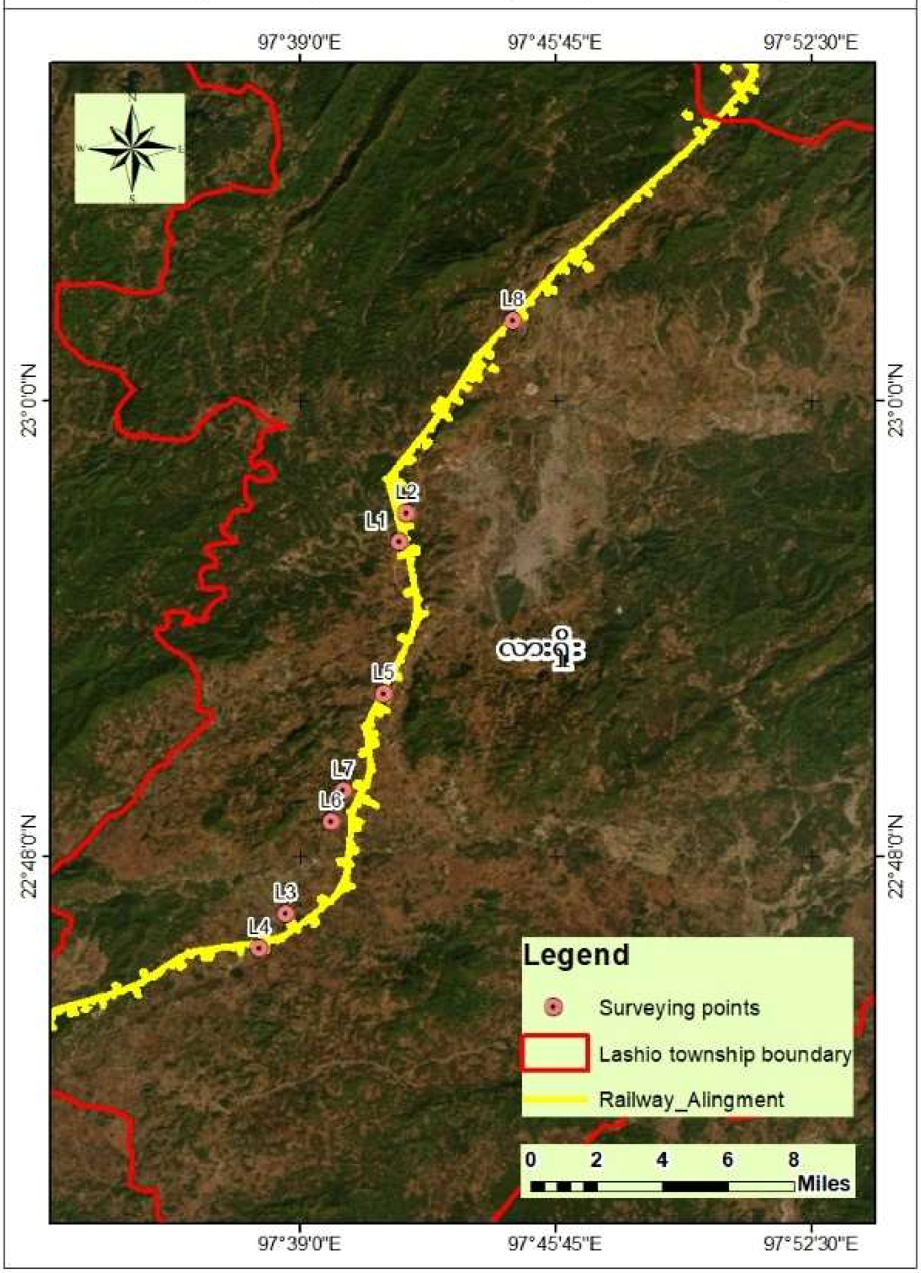




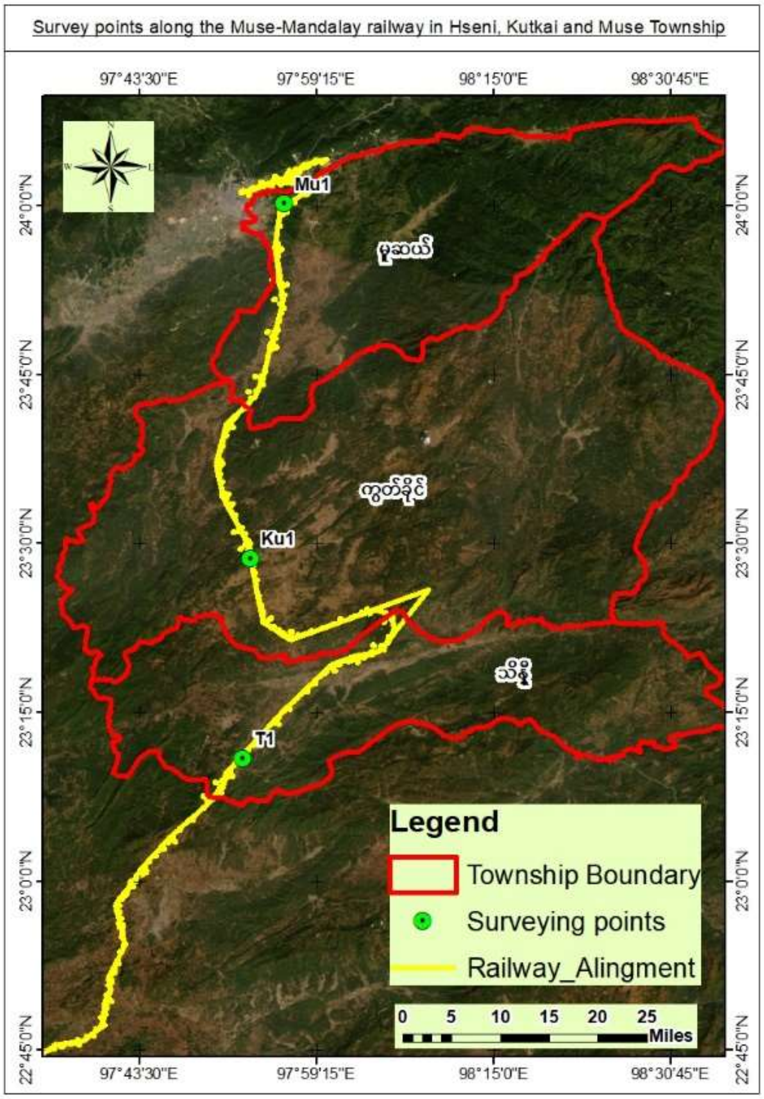
GPS Points (Lashio -L)

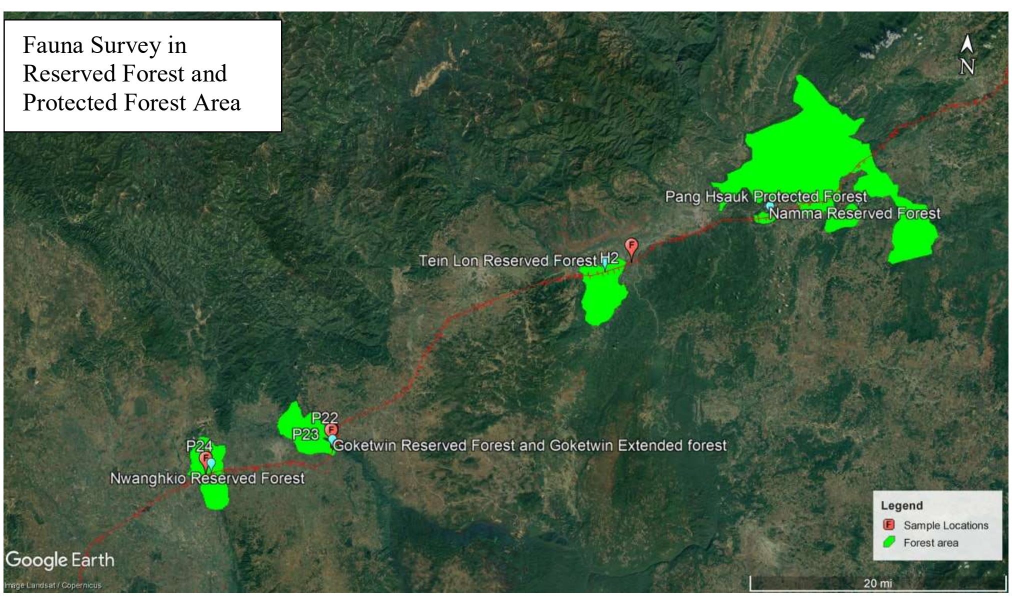
Point	North Latitude	East Longitude	Elevation (m)	Remark
L1	22°56'17.72"N	98° 8'17.45"E	1605	Kaung Mat Keng village
L2	22°57'2.13"N	98° 8'17.45"E	1684	Hkaing Chin village
L3	22°46'28.23"N	97°38'40.12"E	782	Naung Mon village
L4	22°28'25.74"N	98° 8'17.45"E	1288	Naung Lan
L5	22°52'17.04"N	97°41'16.13"E	921	Loi Lunt village
L6	22°48'55.29"N	97°39'52.66"E	914	Khay Nin
L7	22°49'44.23"N	97°40'11.47"E	948	San Phyat village
L8	23° 2'7.91"N	97°44'39.92"E	809	Hopeik village
L9	23° 6'24.21"N	97°49'15.70"E	951	84m from Bone Mon
GPS Points (Thein Ni- T, Kutkai-Ku and Muse -Mu)				
T1	23˚ 10’54.55”	97˚ 52’ 39.88”	2096	-
Ku1	23°28'5.59"	97°53'32.65"	2097	Honar village, 69m from Ho Nar Reserved Forest

Ku2	23°33'24.96"	97°51'28.33"E	1182	215m from Kaung Lain Protected Forest, 567m from Nam Hpak Loon Protected Forest and 493m from Nam Phat Loon (Lower) Village
Mu1	24˚ 00'11.81"	97˚ 56' 21.6"	2927	Weimain village



Survey points along the Muse-Mandalay railway in Lashio Township


Survey points along the Muse-Mandalay railway in Hseni, Kutkai and Muse Township
97°43'30"E
97°59'15"E
98°15'0"E
98°30'45"E
24°0'0"N
23°45'0"N
23°30'0"N
23°15'0"N
23°0'0"N
22°45'0"N
Mu1
Ku1
T1
မူဆယ်
ကွတ်ခိုင်
သိန္နီ
Legend
Township Boundary
Surveying points
Railway_Alingment
0 5 10 15 20 25
Miles


Fauna Survey in
Reserved Forest and
Protected Forest Area
N
Pang Hsauk Protected Forest
Namma Reserved Forest
Tein Lon Reserved Forest
H2
P22
P23
Goketwin Reserved Forest and Goketwin Extended forest
P24
Nwanghkio Reserved Forest
Legend
Sample Locations
Forest area
Google Earth
20 mi

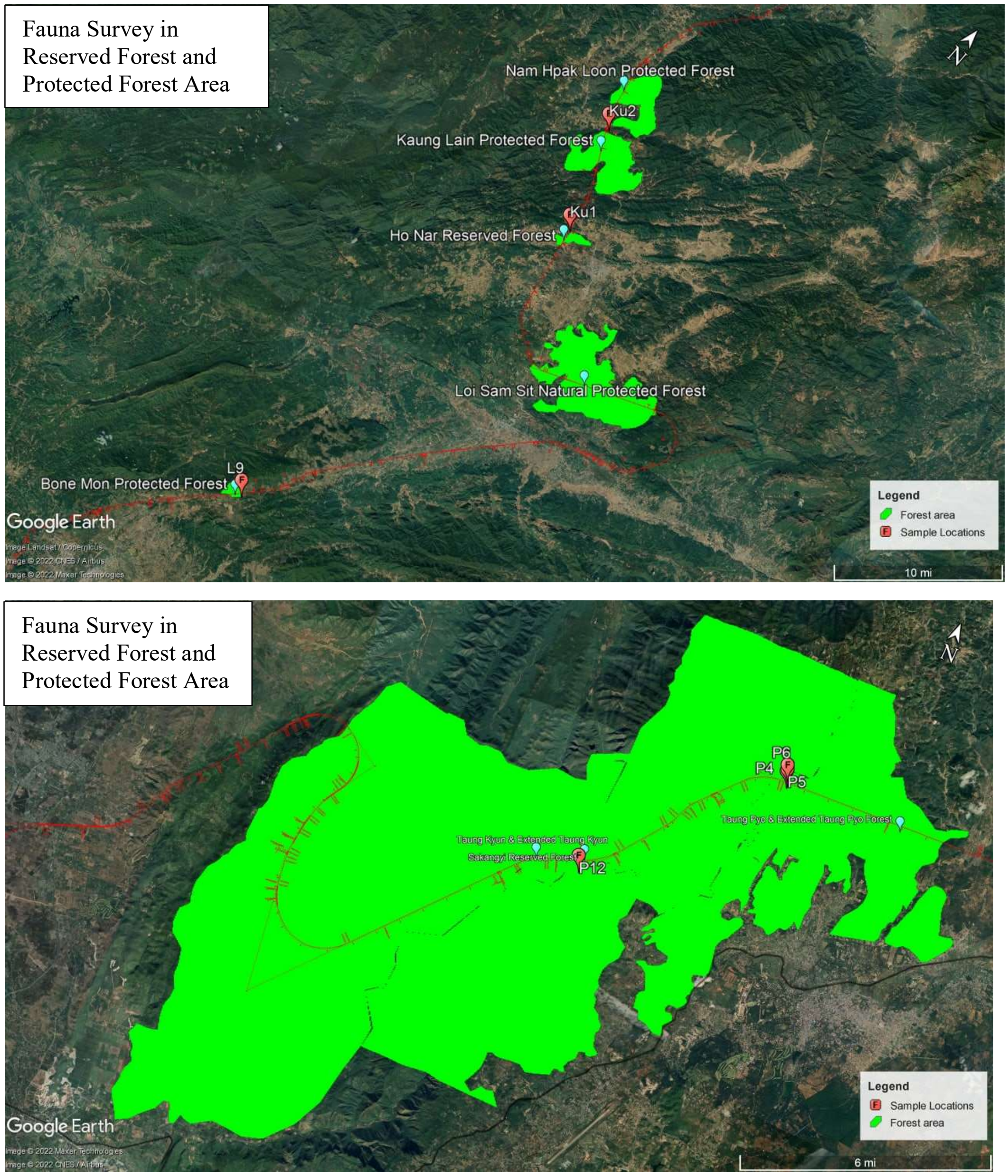


Figure 5.56 – Fauna Survey in Reserved Forest and Protected Area

Reptilian

During survey period, about 9 species of reptilian species belonging to 2 order and 7 families were recorded at the study site. Two lizard species; Garden Fence Lizard Caltoes versicolor and East Indian Brown Mabuya Mabuya multifasciata were identified during field survey. According to interview records, four snake species; These are King Cobra Ophiophagus hannah, Russell's viper Daboia russelii, Banded Krait Bungarus fasciatus, Chequered keelback water snake Xenochrophis piscator rarely come to few number in this project area. King cobra is a venomous snake, endemic to forest. It is threatened by habitat loss and has been listed as

Vulnerable status (VU) on the IUCN Red List. According to interview records, there were caught accidentally some snakes both poisonous and non-poisonous snakes in this area according to report by the local people. According to interview records, 3 Turtle and Tortoise species Oldham's Leaf Turtle Cyclemys oldhamii (NT), Myanmar Black Turtle Melanochelus trijuga (NT) and Yellow-Headed-Tortoise Indotestudo elongata (EN) were recorded. These are threatened by habitat loss and have been listed as Threatened status on the IUCN Red List. The details list of Reptilian can be seen in Appendix F.

Invertebrate

Invertebrates are abundantly found in the nearby the Mandalay-Muse Railway New Project. In Survey areas, many different kinds of invertebrates such as various kinds of butterflies, dragonflies, damselflies and other species (bees, grasshoppers, moths) were recorded.

Butterfly

Butterflies are important as one of the external agents of the Entomophily. These insects visit one flower after another gathering pollen and nector certainly have an important role in play of the process of pollination.

The relationship between butterfly and plants plays an important role in an ecosystem. Flowering plants need butterfly species for pollination and the butterflies require suitable plant species to serve as their host plants to complete their life cycle. Flowering plants are also sources of food for the adult butterfly species as they ecological specialization of butterflies by cross-pollinating the plants.

Biodiversity survey group are observed that there are about total 26 species of Butterfly as well as male and female belonging to 7 families in surrounding of all project sites. The details lists for butterfly from Pyin Oo Lwin to Muse can be seen in Appendix F.

Dragonfly

Dragonflies are valuable as indicators of aquatic and terrestrial ecosystem health and also play a vital role as prey and predator to maintain the balance of tropic levels of food chain. The prey of the adults consists mostly of the harmful insects of crops, orchards and forests and thus has a regulatory impact on the agro-forestry. Their aquatic larvae constitute a natural biological control over mosquito larvae and thus help to control several epidemic diseases like malaria, dengue, filaria etc. Adult odonates feed on mosquitoes, black flies and other blood-sucking flies and act as an important bio-control agent of these harmful insects. Odonates were thus increasingly recognized due to the direct role of predators in ecosystem and their value in indicators of water quality.The survey team investigated that the surrounding of the Mandalay-Muse Railway New Project areas (especially by Mandalay, Patheingyi, Pyin Oo Lwin, Naung Hkio, Lashio), about 13 species Dragonfly and Damselfly species belonging to one order and 2 families (Libellulidae and Coenagrionidae) were recorded with different population abundance. The detail lists of dragon fly from Pyin Oo Lwin to Muse can be seen in Appendix F.

Species Diversity of Terrestrial Fauna from Mandalay-Muse Railway New Project Areas

According to survey results, especially some of these data collected visually from field survey within short period to collect the data of fauna. So, these areas are assessed as a least diversity of terrestrial and aquatic fauna representing six different groups such as vertebrate (mammals, bird, reptile) and Invertebrate (Butterfly, Dragonfly and Damselfly). There are total of 112 fauna species recorded around the Mandalay-Muse Railway New Project Areas The list of fauna is mentioned as follows:

Table - Species Occurrence of Terrestrial Fauna from Mandalay-Muse Railway New Project Area

Sr.	Vertebrate						Invertebrate			
	Mammal		Bird		Reptilian		Butterfly		Dragonfly/Damselfly	
	No. family	No. species	No. family	No. species	No. family	No. species	No. family	No. species	No. family	No. species
	4	5	30	59	7	9	7	26	2	13
	Total Species Number – 112									

Current Environmental Aspects

According to the recorded data, plenty of fauna, especially as major groups are vertebrate (mammals, birds, reptiles (Turtle and Tortoise and lizards) and invertebrate (butterflies, dragonflies, damselfly and many kinds of insects visually during survey) about 500 Meter and 1000 Meter surrounding in and around the project area are discovered because of there are enough food sources in these study area.

IUCN and CITES Appendices

(i) Fauna survey

In fauna survey, four fauna species were recorded as threatened species under the IUCN

RedList and CITES appendices in this project area at the survey time.According to interview survey results, on the mammals species, Northern Pig-Tailed *Macaca leonine and* Marbled Cat *Pardofelis marmorata* were recorded as VU- Vulnerable status. On reptile's survey, King Cobra *Ophiophagus Hannah* and Yellow-Headed-Tortoise *Indotestudo elongate* were recorded as VU- Vulnerable and EN- Endangered status. Near Threatened (NT) and Least Concern (LC) meanclose to become extinct in the nature without include threatened species.

CITES

The Convention in International Trade in Endangered Species (CITES) is a United Nations Treaty organization, the largest and thus most powerful of the international treaties to protect endangered animals and plants. At present, 177 countries are members (Parties) of CITES. There is a three species CITES list in the study area. Myanmar as a party country of CITIES we have to follow the rules and regulations of CITIES convention. According to the CITIES Convention

Appendix I lists species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate). Article VII of the Convention provides for a number of exemptions to this general prohibition.

Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species whose specimens in trade look like those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. No import permit is necessary for these species under CITES (although a permit is needed in some countries that have taken stricter measures than CITES requires). Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild.

Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation. International trade in specimens of species listed in this Appendix is allowed only on presentation of the appropriate permits or certificates.

SN	Order/Family	Species	Common Name	Local Name	CITES	Appendix
Reptile						
1	Viperidae	*Daboia siamensis*	Viper	Mwe-pwe	√	III
2	Gekkonidae	*Gekko gecko*	House lizard	Totk-taet	√	II
Mammal						
3	Cercopithecidae	*Macaca mulatta*	Rhesus macaque	myaut-sat	√	II

Wild Life Trade

Wildlife Trade is a global epidemic. The Illegal Wildlife Trade is a multi-million dollar business run by dangerous criminal syndicates that deal in the harvesting and trading of wild species and their body parts. With high demand from a growing Asian middle class stoking the fire, this trade is the biggest threat facing wildlife today.

Myanmar is a global hub for illegal wildlife trade. Because of our remaining wilderness and abundant wildlife our forests are a prime source for some of the most poached species such as tigers, Asian elephants and pangolins. To make matters worse, Myanmar is situated next to the notorious lawless Golden Triangle region, the global illegal wildlife hypermarket.

Each year, hundreds of millions of plants and animals are caught of harvested from the wild and then sold as food, pets, ornamental plants, leather, tourist curios, and medicine. While a great deal of this trade is legal and is not harming wild populations, a worrying large proportion is illegal and threatens the survival of many endangered species. (WWF Myanmar,2020)

According to the UNODC report(2018) , Myanmar is a strategically relevant country in the illegal wildlife trade, nestled between several important source, transit and destination countries. Yet, as transportation infrastructure in the country and the region continues to improve and expand, the importance of Myanmar as a transit location for wildlife smuggling may also increase in the future. We have to consider about wildlife trade and any other smuggling process and have to cooperate with the regional authorities.

While the majority of illegal wildlife trade happens at a commercial level, tourists sometimes participate unknowingly by buying or traveling with illegal items. These are most often bought as souvenirs or gifts for friends and families. When buying souvenirs and gifts, make sure that you are not contributing to the illegal trade in wildlife. That is why the local authorities have to made the awareness program for local communities and tourists.

Summary of globally threatened species in Myanmar

Taxonomic Group	Global Threat Status			
	Critically Endangered	Endangered	Vulnerable	Total
Mammals	4	9	26	39
Birds	4	8	33	45
Reptiles	4	10	7	21
Invertebrates	0	0	1	1
Plants	13	12	13	38
Total	25	39	80	144

Source : Myanmar: Investment Opportunities in Biodiversity Conservation, 2005

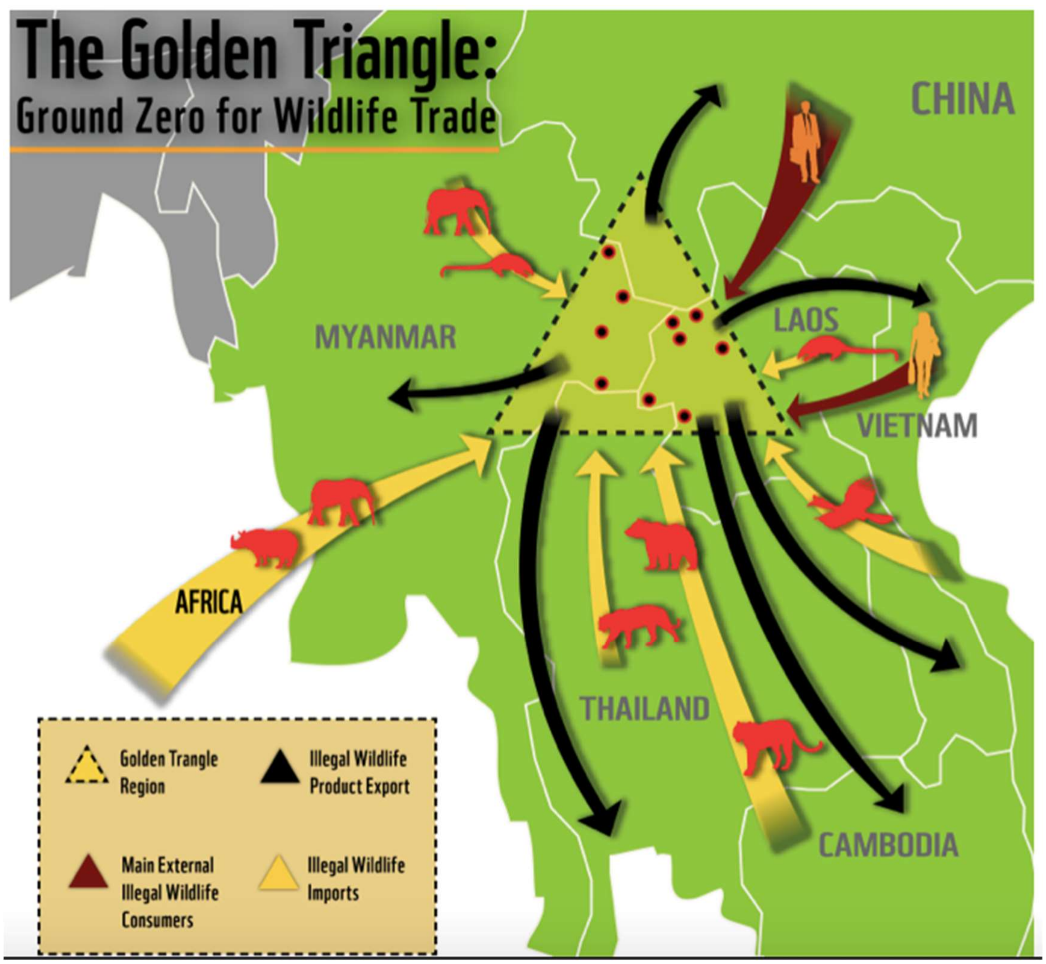


Figure 5.57- Showing the Wildlife Trade Path

Table 5.36 - Overview of available information on species in use or trade and estimates of legal and illegal trade, by taxonomic group

	Species Overview	Legal Trade Estimates	Illegal Trade estimates
Mammals	~ 5,400 species (Wilson and Reeder, 2005); > 1,000 utilized for food and medicine (TRAFFIC, 2010); ~ 900 CITES-listed (UNEP-WCMC (Comps.), 2016).	CITES trade11: ~ 280,000 ‘ whole’ 12 wild- sourced mammals annually. Overall, legal international trade, particularly in non-CITES species, appears to be unquantified.	No global estimates, but estimates for some taxa and commodities exist (1,215 rhinos illegally killed in 2014 (TRAFFIC, 2015), 17,000 elephants killed in 2011 at MIKE sites (CITES CoP16 Doc.53.1 Addendum), ~18,750 ivory seizures over the period 1989- 2013 recorded in ETIS (CITES Standing Committee document SC65 Doc.42.1), ~227,000 pangolins killed in Asia between 2000 and 2013 (Challender et al., 2015)); many reports of instances of ITW.
Birds	~ 10,000 species (BirdLife International, 2013b); ~ 4,500 utilized, for example as pets, food, or for sport hunting (BirdLife International, 2008); ~ 3,300 traded (Butchart, 2008); ~ 1,500 CITES-listed (UNEP-WCMC (Comps.), 2016).	CITES trade: ~ 90,000 ‘whole ’ wild- sourced birds annually. Several million birds each year in domestic and international trade, particularly finches, weavers, parrots and raptors (BirdLife International, 2015b).	No global estimates although regional estimates for some taxonomic groups exist (25 million birds illegally killed in the Mediterranean per year (BirdLife International, 2015b)); many reports of instances of ITW.
Reptiles	~ 10,000 species (Pincheira-Donoso et al., 2013; Uetz and Hošek, 2015); ~ thousands utilized and traded (e.g. ~3,500 species/subspecies of reptiles and amphibians imported as pets into the EU (Newman, 2014); ~ 800 CITES-listed (UNEP-WCMC (Comps.), 2016).	CITES trade: ~ 1.8 million ‘ whole’ wild- sourced reptiles annually. Overall, legal international trade, particularly in non-CITES species, appears to be unquantified.	No global estimates, but estimates for some species and commodities exist; many reports of instances of ITW.
Amphibians	~ 7,400 species (Frost, 2014); > 200 utilized for food, > 260 for pet trade and many for medicinal purposes (Carpenter et al., 2007); ~ 150 CITES-listed (UNEP-WCMC (Comps.), 2016).	CITES trade: ~ 15,000 ‘whole ’ wild- sourced amphibians annually. For example, more than 20 million wild- caught live amphibians (CITES and non-CITES species) legally imported into the United States 2001-2009 (Herrel and van der Meijden, 2014).	No global estimates, but estimates for some taxa and commodities exist; many reports of instances of ITW.
Fish	~ 33,000 species (Froese and Pauly, 2014); > thousands utilized (e.g. 1,200 traded as aquarium fish (Cato and Brown, 2003) , ~ 800 traded for food (Ababouch, 2005); ~ 100 CITES-listed; five species of sharks, one sawfish and the	CITES trade: ~ 40,000 ‘whole ’ wild- sourced fish annually. Global catch of 90 million tonnes annually (FAO, 2012).	Global illegal and unreported fishing estimated at 11-12 million tonnes annually (Agnew et al., 2009).

	genus Manta were listed at the most recent CoP (UNEP-WCMC (Comps.), 2016).		
Invertebrates	~ 1,000,000 species (Roskov et al., 2014); > thousands utilized (e.g. > 2,000 insect species (Ramos-Elorduy, 2009) and > 300 marine invertebrate taxa are used as food (Anderson et al., 2011)); ~ 2,200 CITES-listed, predominantly corals (UNEP-WCMC (Comps.), 2016).	CITES trade: ~ 2.5 million ‘ whole’ wild-sourced invertebrates annually. Marine and freshwater mollusc and crustacean catch alone > 13 million tonnes in 2012 (FAO, 2014a). Up to 30- 50 tonnes of red and black13 coral and > 2,500 tonnes of shells also traded each year (Tissot et al., 2010).	No global estimates, but estimates for some taxa and commodities exist; many reports of instances of ITW.
Timber	~ 100,000 species of trees (BCGI, 2007) - not all produce exploitable timber; > 1,600 traded commercially (Mark et al., 2014); ~ 700 CITES-listed trees; five species and two genera were listed at the two most recent CoPs (UNEP-WCMC (Comps.), 2016).	137 million m3 roundwood, 124 million m3 sawnwood, 77 million m3 wood- based panels and 223 million tonnes of pulp/paper products in 2013 (FAO, 2015a).	8-10 per cent of the value of global wood products (Seneca Creek Associates and Wood Resources International, 2004); In 2004, just under half of all tropical logs, sawn timber and plywood in trade were estimated to be illegally sourced (Lawson and MacFaul, 2010).
Plants	~ 300,000 species (BGCI, 2014); > 20,000 traded for medicinal purposes alone (WHO et al., 1993); ~ 30,000 CITES-listed, the majority orchids (UNEP-WCMC (Comps.), 2016).	CITES trade: ~ 24 million ‘ whole’ wild- sourced plants annually.	No global estimates, but estimates for some taxa and commodities exist; many reports of instances of ITW.

Source: UNEP 2017

Impact on Biodiversity and Ecosystem

The most area where the alignment passes has been heavily influenced by human activities of township building and agriculture farmland cultivation. Investigated plants are common species in this area. Due to the influence from local residents, there is a not important fauna and flora resource in the alignment corridor. For this reason, proposed project is little impacts on wild animals in human habitation area. Bats have long been known as the cave-dwellers par excellence. The degree of ecological dependence on caves as shelter is highly variable for bats. Most bats species are able to use multiple kinds of roosts in caves.

From the point of view **of the bats,** caves must be protected to allow species most dependent on this kind of shelter to maintain viable populations. From the point of view of the cave communities, all bat species, independent of their conservation status, must be locally protected in project areas. Even in the case of bat species, the control must be carefully managed, allowing the maintenance of a minimum population size to support the cavernicoles dependent on vampire bat guano. On the other hand, bat guano is an important food source for many subterranean organisms, especially for species restricted to subterranean habitats, totally dependent on the resources present in these habitats and prone to rapid extinction following any ecological disequilibrium. Therefore, protecting bats is a fundamental part of any program or action on project by contractors for conservation of subterranean systems.

Through the field survey, it was observed that biodiversity in the project area was rich because of there are enough food sources and available conditions for wild animals in these areas.Though clearing the vegetation due to the implementation of the project, greening of the public space along and near the rail -road will help to mitigate the change of biodiversity and ecosystem. Therefore, the development of the project will be able to cause any significant impact on biodiversity and ecosystem of the region. The avoidance is essential to maintain the integrated habitat and is the most effective way to protect local resources.

In the course of construction and operation of tunnel conditions for development of flora and fauna should not be disturbed; deforestation and cutting down of bushes, change of hydrological mode of water objects, deterioration of ways of animals migration, reduction of the sizes of populations, extinction of species are inadmissible.

Construction and operation of the Project will have only a minimal effect on existing flora and fauna. During construction, a short-term impact on ecology is likely to occur in and around the sites, material stockpiling areas, and worksites due to vegetation clearance. A permanent but relatively minor impact on ecology is likely to occur due to the alignment of any unstable section. Vegetative cover stripped from these locations will be kept for landslide and slope protection. Contractors will be responsible for putting new vegetation in removal sites. Construction vehicles should use temporary roads constructed to minimize damage to agricultural land and local access roads. Where local roads are used, they will be repaired to their original condition after the completion of work. Compaction around trees will be performed carefully to avoid damage to the tree drip-line.

Potential impacts from construction worker camps include poaching of edible animals and birds in the locality, despite prohibitions. The contractors will be responsible for providing adequate knowledge to workers regarding the protection of fauna. Workers will be trained regarding nature protection and the need to avoid cutting down trees during construction. Contractors will be responsible for supplying appropriate fuel in the work camps to prevent fuelwood collection.

(ii) Flora Survey

In flora survey, there are a number of species of flora in the various parts of Mandalay, Pyin Oo Lwin, Naung Hkio, and Lashio, some of which are Least Concerned and Near Threatened species could be found in different parts of the Project area. Potential impacts to flora and fauna include (i) destruction of vegetation for earth works, and (ii) temporary habitat occupation which will disturb fauna movements at certain locations of the alignment.

Above-ground Biomass

Above-ground biomass is the most visible of all the carbon pools, and changes in it an important indicator of change or the impact of an invention on benefits related to both carbon mitigation and others matters. Above-ground biomass is a key pool for most land-based projects.

This study focused in Pyin Oo Lwin and Naung Cho in sample area, and calculated aboveground

biomass regression for land use. We focused on the (7) common species and, which contain 17 species observed in the sample area. However, species diversity, density and carbon stocks may vary for different forests and different ecological region, which are topics of further research.

Furthermore, this finding of this study provides a baseline carbon storage of the forest and to preventing carbon emissions from tropical forests as largest and most immediate carbon stock impact in the short term (IPCC 2007). In addition to predicts a better understanding of land use along the railway project and can contribute sustainable, resilient, of the project/country. In order to know the current carbon stock, this study estimated aboveground carbon in the forest. The storage of higher C in the forests emphasizes the importance of maintaining and increasing the number of reserved area.

Name	DBH(cm)	Ht(m)	SD(tree/ha)	BA(m^2/ha)	V(m^3/ha)	AG-C
Teak	33.4	13.8	32	4.636	38.7	108.464
Pyinkadoe	73.7	16.1	4	11.866	27.48	91.299
Padauk	28.94	19.83	9	5.739	11.741	60.03
Bamboo	8	20	25	1.6	2.514	11.04
Pine	21	30	15	6.3	15.59	69.02
Yamanay	25	20	15	5	14.73	67.12
Melzali	15	20	15	10	2.651	28.78

AG-C= VOB*WD*BEF
Where:
WD= Wood Density
VOB= Biomass of inventory volume

BEF= Biomass expression factor\
BEF= Exp (3.213-0.506*ln BV)
BV= WD*VOB
Aboveground baboo biomass $Y=0189D^{1.956}$ Kg

(11) Potential Impacts on Fauna And Flora

(i) Natural Environment

Muse - Mandalay Segment is Shan plateau topography, most of which are at an altitude of 700m ~ 800m or above, the top of the plateau surface generally presents relatively low and gentle planation surface, the surface fluctuation is generally tens to hundreds of meters, deep valleys are developed. Most of the natural vegetation is secondary evergreen broad-leaved forest with partial residual tropical monsoon rain forest.

Along the railway site area, different forest types were observed accordingly to the elevation, namely: (**1) hill semi evergreen forest (2) tropical mix evergreen and deciduous forest (3) semi-indaing forest (4) Open degraded forest and farmland ecosystem**.

During the survey none of the trees are in the list of threatened plant species. It is expected hundreds of trees along the railway track will be cut or removed. Impacts on flora, fauna and biodiversity are expected to be limited and temporary because trees observed along the railway line are commonly found in public parks, other greenery areas and along the roads in Mandalay to Muse.

Figure 5.58- Images Showing Vegetation Scenery Result of the Survey Area

(12) Impacts Classification

The impacts of fauna and flora are classified and their range varies in space and time. The intensity of these impacts (negative and positive) is classified according to the following criteria:

- Loss of habitats
- Noise impact
- Development of country
- Family income and working opportunities

(13) Identification and Assessment/ Analysis Impacts

The following method will be applied to assess the environmental impacts of the Mandalay-Muse Railway New Project mainly on Biodiversity. Conclusively, each source of impact has been assessed by four parameters; Magnitude, Duration, Extend (area) and Probability.

Some Limestone Caves near Lashio Area

Shan State covers almost a quarter of Myanmar and is the most mountainous area in the country. This state also constitutes the largest part of the Northern Indo-Chinese biogeographic zone in Myanmar (Tun Yin, 1993). Most caves in the State are important archaeological sites that feature splendid pieces of ancient cultures.

Limestone caves (*Rhinolophus pearsonii* and Malayan Horseshoe bat *Rhinolophus malayanus*are also recorded in Shwe Gu Cave (between 22˚ 57' 16.0" N and 97˚ 43' 27.2" E, elevation 829m), Kyauk Taung Cave (between 22˚ 56' 14.50" N and 97˚ 44' 04.82" E, elevation 825m), Kyauk Khwe Taung Cave (between 22˚ 56' 07.67" N and 97˚ 42' 50.05" E, elevation 875m)) were conducted and bat species use caves for alternate refuge, some species rely on caves for day roosting and protection from predators. According to the survey results, as bats species, about total Mammals fauna 3 species one order and 2 families were recorded in Lashio area. Leschenaulti's Rousette or Fulvous fruit bat *Rousettus leschenaultia*, Pearson's horseshoe bat.

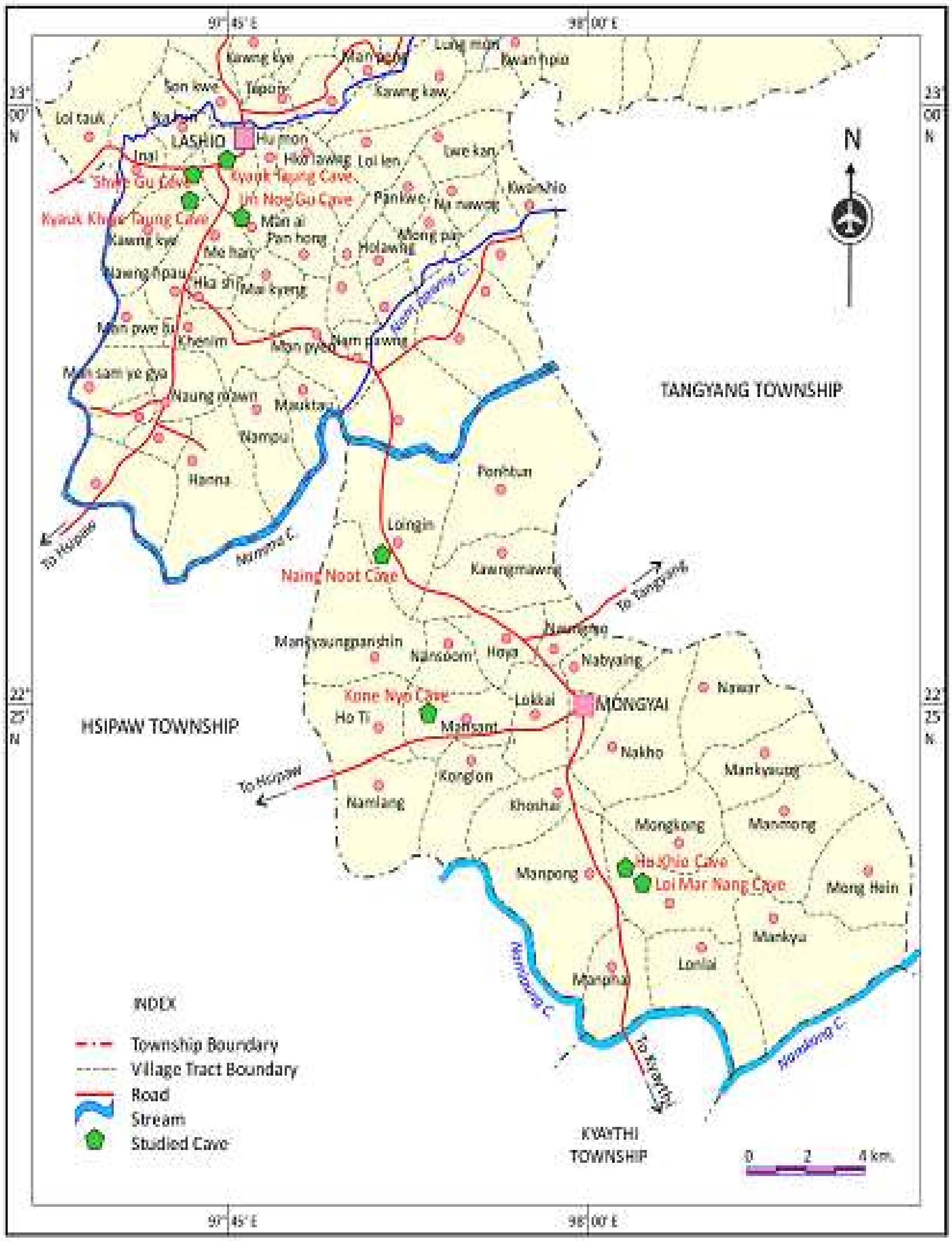


Figure 5.59 - Location map of studied cave

Source: Land Records Department, Lashio

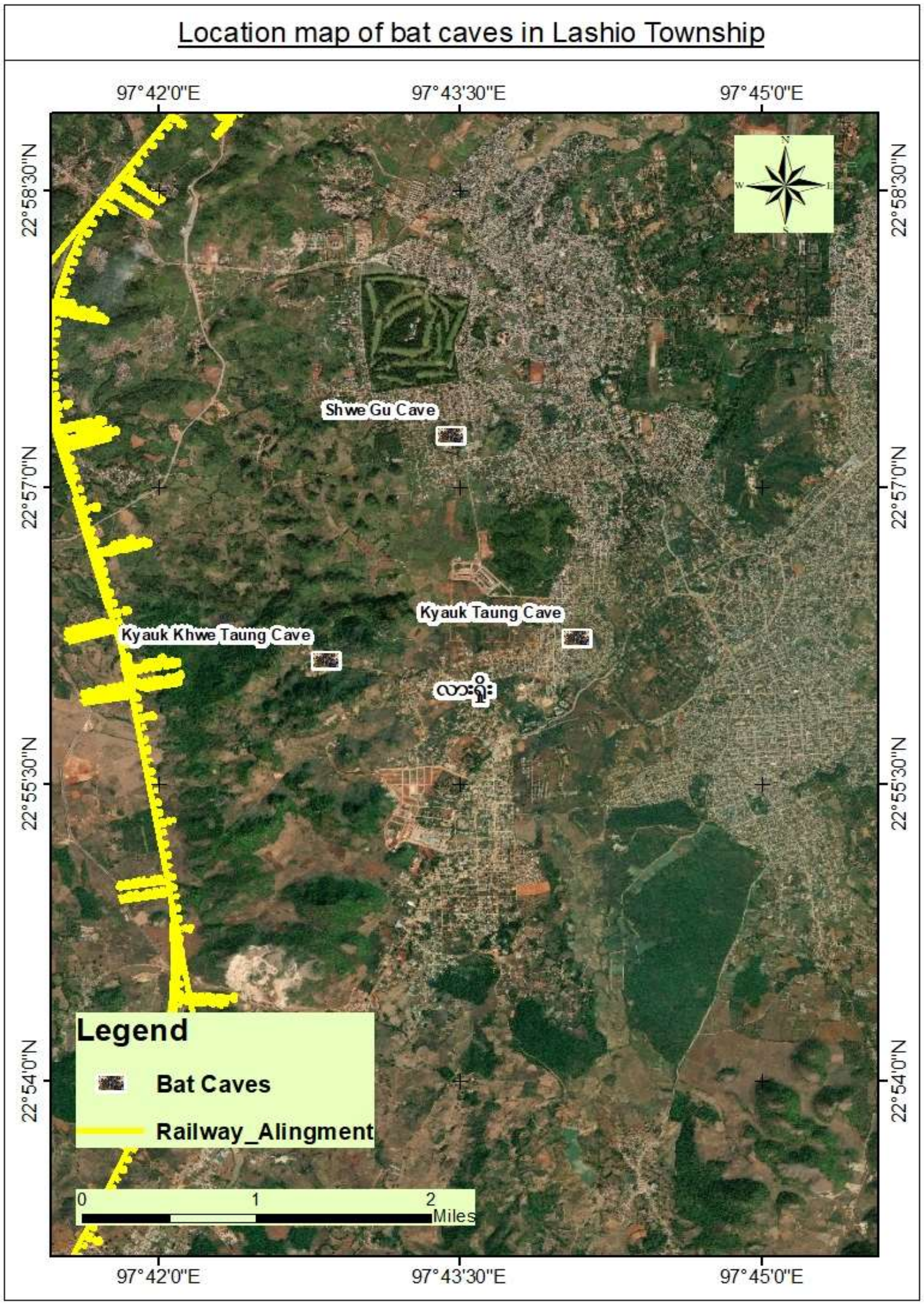


Figure 5.60- Map of the study sites of bat caves in Lashio

No	Name	Estimated distance from railway (km)
1	Shwe Gu Cave	3.340
2	Kyauk Taung Cave	3.890
3	Kyauk Khwe Taung Cave	1.745

Figure - Image of Shwe Gu Cave

Figure - Image of Kyauk Taung Cave

Figure - Image of Kyauk Khwe Cave

Biological Resource Management Plan

The Critical role that biological resources play in sustaining human life has in the last two decades received considerable if belated attention. In 1992 a board framework for the conservation and use of the world's biological resources – The Convention on Biological Diversity (CBD) – was agreed by the United Nations Conference on Environment and Development (the Earth Summit). Despite increasing recognition, however, the worlds' biological resource continues to be lost at an alarming rate, and particularly so in developing countries where many of the remaining resources are concentrated. (World Bank 2002)

The overarching objective of "Biological Resource Management Plan" is to provide strategies and management actions necessary to sustain the country's biological resources.

Recommended biological resource management objectives for proposed railway project are to:

- Protect species and habitats of along the railway project
- Maintain and preserve native biological diversity
- Reduce the spread of invasive species and provide integrated controls of noxious weeds
- Where and when feasible, improve degraded habitats in a strategic manner to increase landscape connectivity and native diversity
- Reduce and minimize fragmentation of habitats
- Maintain landscape that provide regional connectivity to habitats surrounding railway project.
- To meet these objectives, BRMP provides a set of generally directives for proposed railway project operation.
- Develop a flora replantation plan particularly for native species
- Educated employees of environmental responsibilities during inductions including treating all native fauna species as protected.

Effect of Transmission Line Construction

As we stated in biodiversity report above section some potential effects related to transmission line construction are physical changes to wildlife habitat and temporary disturbance to wildlife from the presence of construction workers and machinery.

Effects of the Physical Presence of Transmission Lines

The physical presence of transmission lines can have an effect on wildlife. These potential effects include long-term changes to habitat, bird strikes, access issues, noise effects and associated avoidance behavior, and electric and magnetic fields.

Biodiversity Richness in Myanmar

Taxonomic group	Species	Number
Species of vascular plants of Gymnosperms and angiosperms		11,800
Mammals		258
Bird species		1,056
Reptile	Snakes	153
	Lizards	87
	Turtles and tortoise	32
Amphibians	Frogs and toads	79
	Caecilians	2
	Salamander	1
Fresh water fish		310
Marine water fish		465
Medicinal plant		841
Bamboo		96
Rattan		37

Protected Areas & Species

According to the data of Forest Department, there are 36 protected area and 577 wildlife species (completely protected), 318 wildlife species (normally protected), and 914 wildlife species (seasonally species) in Myanmar. Elephant, Indian Bison, Serow, Braking Deer, *Green Pea Fowl Pavo muticus* are protected species in Shan State.

Sensitive Season

The Ayeyawady Dolphin Protected Area (ADPA) stretches 74 km of river starting from Mingun in the south up to Kyaukmyaung and Singu townships in the north. And Irrawaddy dolphin breed in December through June. The proposed railways project far from Mingun(10.87 miles), Kuaukkmyaung (50.78 miles), and Singu (43.03 miles) respectively. According to the variation of breeding season on difference species, educated employees of environmental responsibilities during inductions including treating all native fauna species as protected.

Important Areas and Transmission Corridors

According to the data of BANCA, there are 57 of IBAs and 5,589,800 ha IBA area, 7 of EBAs in Myanmar. The IBAs, EBAs and migratory bird list (see the appendix) of Mandalay region and Shan State are listed as below.

No	Regions of Conservation Importance	
1	Important Bird Areas	Mehon (Doke-hta Wady River)
2		Yemyet Inn
3	Endemic Bird Areas	Irrawaddy plains

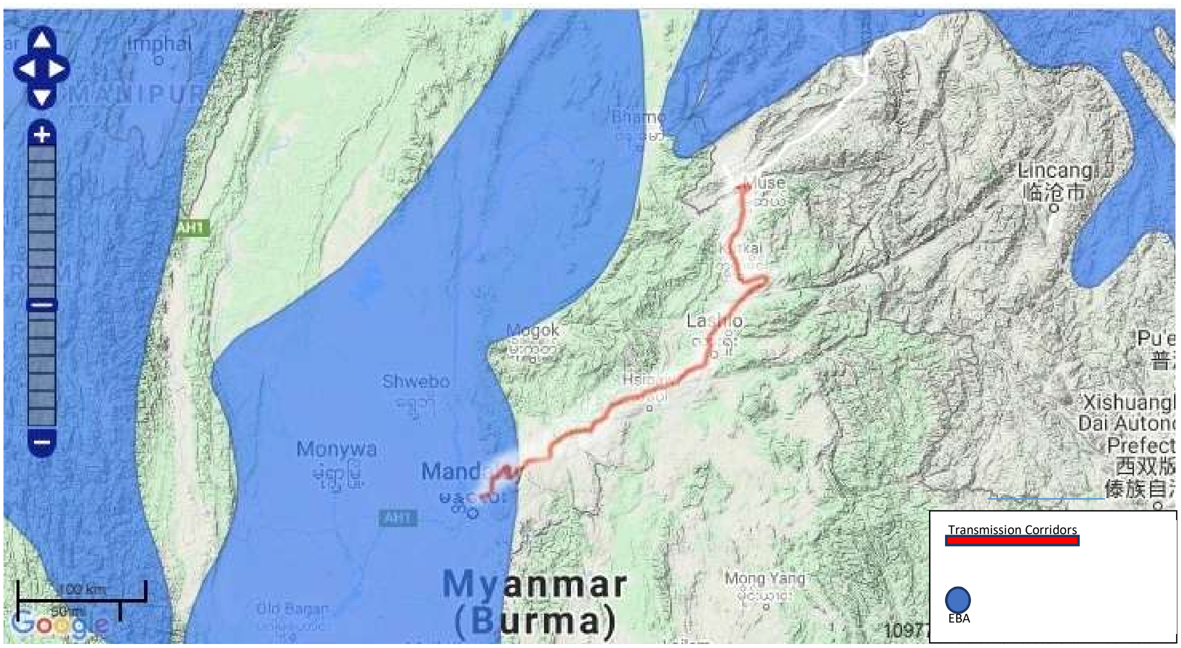


Figure 5.61 - EBAs and Transmission Corridors
Source : BANCA 2020

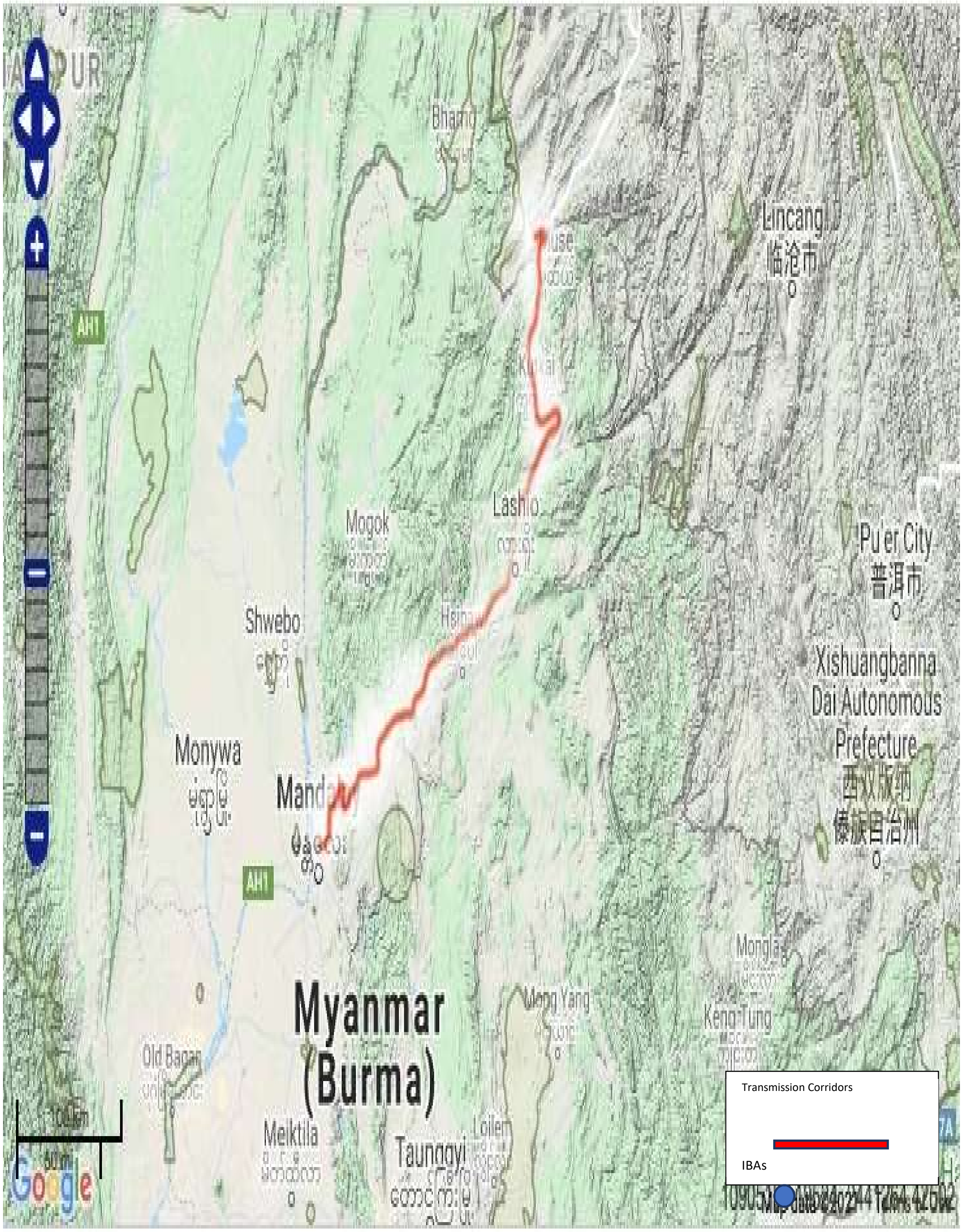


Figure 5.62- IBAs and Transmission Corridors

Source : BANCA, 2020

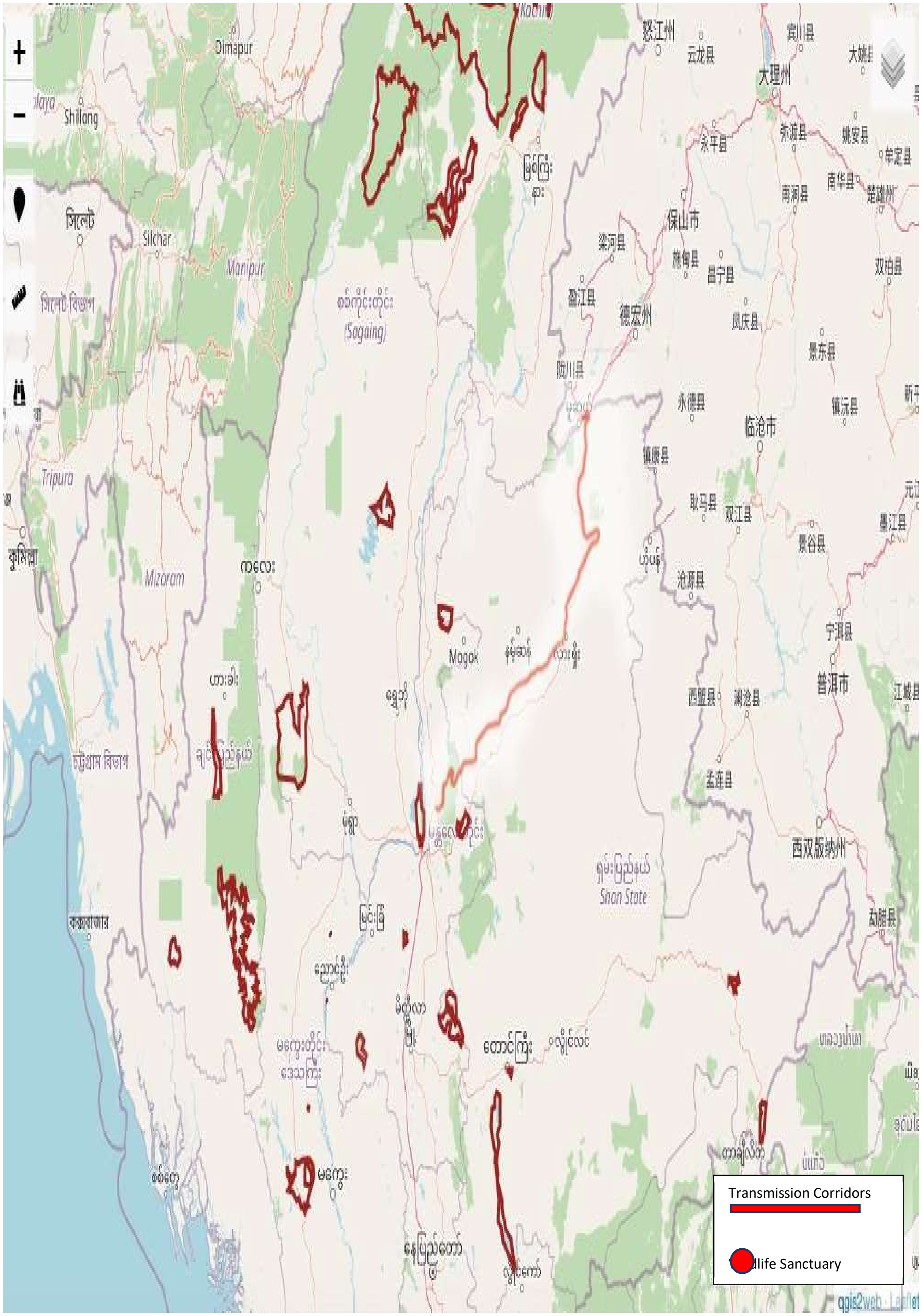


Figure 5.63 - Wildlife Sanctuary and Transmission Corridors

Figure 5.64 - KBAs and Transmission Corridors
Source: WCS Myanmar

EHS Guidelines for Electric Power Transmission and Distribution

Avian and Bat Collisions and Electrocutions

Bird and bat deaths from electrocution and collision with power lines are an ongoing environmental issue affecting operation of electrical transmission and distribution lines. When the birds and bats collide with electrical power line infrastructure, their electrocution also can result in electrical outages affects service reliability and cause wildfires.

The combination of the height of transmission towers and distribution poles and the electricity carried by transmission and distribution lines can pose potentially fatal risk to birds and bats through collisions and electrocutions. Avian collisions with power lines can occur in large numbers if located within daily flyways or migration corridors, or if groups are traveling at night or during low light conditions (e.g., dense fog). In addition, bird and bat collisions with power lines may result in power outages and fires.

Recommended prevention and control measures to minimize avian and bat collisions and electrocutions include.

- ❖ Aligning transmission corridors to avoid critical habitats (e.g., nesting grounds, heronries, rookeries, bat foraging corridors, and migration corridors);
- ❖ Maintaining 1.5 meter (60-inch) spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;
- ❖ Retrofitting existing transmission or distribution systems by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g., insulated" V's"), changing
- ❖ the location of conductors, and / or using raptor hoods;
- ❖ Considering the installation of underground transmission and distribution lines in sensitive areas (e.g., critical natural habitats);
- ❖ Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.

We will follow the "Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution" for Avian and Bat collisions and electrocutions impacts.

Collision and Mortality Rate

According to the Avian Power Line Interaction Committee the adding to the difficulty in providing an overall assessment of collision mortality is that bird collisions do not usually cause power outages and consequently are not usually discovered. On the other hand, electrocutions are more likely to cause power outages. To generate collision estimates for a particular power line, power line segments have to be selected randomly for mortality monitoring and should represent a diversity of habitats. Collision mortality can be relatively high or low depending upon the species, habitat, and the local circumstances. Below the table provides recommendations for collision monitoring studies. This is the summary of considerations and issues for designing site specific collision, mortality rates monitoring,

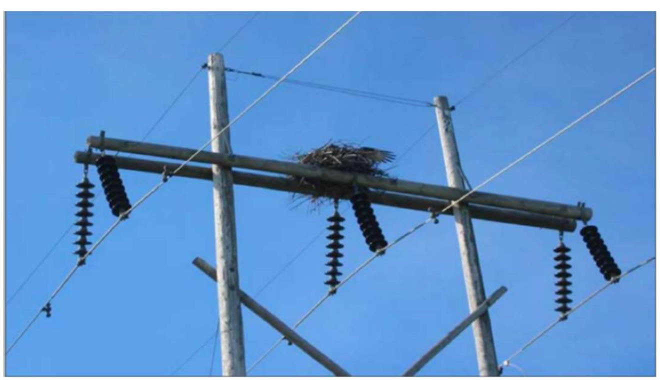
Table: 5.37 - Design for collision and mortality

Considerations for site specific collision monitoring	Issues Related to Estimating Mortality Rates
Behavioral Monitoring - Bird density - Evaluation criteria - Estimating bird flight height - Study segments	Equations for Calculating Mortality Rate - Accuracy - Variability in methods
Mortality Monitoring - Differences in sampling design - Question to ask - Data to record	Sampling Biases - Crippling loss - Searcher efficiency - Habitat differences

Source: Avian Power Line Committee

Birds use the structures

In the other hands, transmission line structures can enhance habitats for birds by providing additional breeding and roosting sites, and hunting and feeding perches. Many species of birds nest on utility distribution and transmission structures including hawks, and eagles.



Hawks and eagles will occasionally use transmission structures as nesting sites

Protected tree species

According to the forest department fact and figure, in total 16 tree species have been declared as protected species in order to prevent their over-utilization. The species are protected either in the whole country or in a specific region. In addition to these tree species, some medicinal plants and orchid species are protected throughout the whole country.

Table 5.38 - Protected tree species in Myanmar by region

(Forest Department Fact and Figure,2006)

Scientific name	Common Name	Region		
		Whole Country	Upper Myanmar	Lower Myanmar
Tectona grandis	Teak	✖		
Pentace burmanica	Thitka	✖		
Xantolis burmanica	Thitcho	✖		
Hopea odorata	Thigan	✖		
Xylia xylocarpa	Pyinkado	✖		
Acacia catechu	Sha	✖		
Pterocarpus macrocarpus	Padauk	✖		
Excoecaria agallocha	Thayaw	✖		
Shorea obtusa	Thit-ya	✖		
Shorea siamensis	Ingyin	✖		
Pinus khasya	Tinshu	✖		
Dipterocarpus alatus	Kanyin			✖
Lindera assamica	Karaway			✖
Cinnamomum pachyphyllum	Hmanthin			✖
Lagerstroemia floribunda	Kamaung			✖
Prunus cerasoides	Cherry		✖	

Vegetation management

Transmission line and right-of-way maintenance have less of an affect on wildlife and wildlife habitat than construction activities. However, all forms of vegetation management change wildlife habitat by producing stable, low-growing vegetation. These rich low growing plants often benefit wildlife by providing food and cover and may increase foraging and nesting opportunities.

Invasive Plant Species

According to the Fifth national report to the united nations convention on biological diversity (2014, March) the total number of known species by taxonomic group, is; 11,824 plants, 252 mammals, 1,056 birds, 293 reptiles, 139 amphibian and 775 fish. This is an increase over the Fourth national Report of 24 plant species, one mammal species, 21 reptile species and 57 amphibian species, of which 22 reptiles and 6 amphibian species are believed endemic to Myanmar. However, comprehensive, country wide surveys are still needed to determine the total number of species in the country. In the other hands, Asia-Pacific Forest Invasive Species Network (APFISN) stated that, 32 invasive species of insect, aquatic plant, herb, shrub, vine, grass, tree, microorganism, mammal, bird and fish in Myanmar.

Plant species diversity in Myanmar (Forest Department 2003)

Category	No. of species
Plants	11800
Bamboo	102
Rattan	50
Shrubs	1696
Orchids	841

An invasive species is an organism that causes ecological or economic harm in a new environment where it is not native. Invasive species can harm both the natural resources in an ecosystem as well as threaten human use of these resources. An invasive species can be introduced to a new area via the ballast water of oceangoing ships, intentional and accidental releases of aquaculture species, aquarium specimens or bait, and other means. Invasive species are capable of causing extinctions of native plants and animals, reducing biodiversity, competing with native organisms for limited resources, and altering habitats. This can result in huge economic impacts and fundamental disruptions of coastal and Great Lakes ecosystems.

According to our study some invasive species such as *Leucaena Leucocephala* were observed in proposed project area. In our cutting or clearing plants process, we will negotiate and request for approval from Forest Department. Moreover, in cutting or clearing plants process we will avoid native plant species as much as we can and we will be replanting with the guidance of Forest Department. In the replanting process, native plant species are priority.

Ecoregions in Myanmar

Myanmar as a country, one of the richest biodiversity hotspots in the world. MONREC (Ministry of Natural Resources and Environmental Conservation) defined Ecoregions in

Myanmar. An ecoregion (ecological region) is an ecologically and geographically defined area that is smaller than a bioregion, which in turn is smaller than a biogeographic realm. Ecoregions cover relatively large areas of land or water and contain characteristic, geographically distinct assemblages of natural communities and species. The biodiversity of flora, fauna, and ecosystems that characterize an ecoregion tends to be distinct from that of other ecoregions. Biodiversity or conservation ecoregions are relatively large areas of land or water where the probability of encountering different species and communities at any given point remains relatively constant, within an acceptable range of variation. According to the WWF, we can take these steps based on ecoregions, - trends in environmental change, - current protection status of key landscapes and habitats. Based on the data of MONREC, Myanmar have the 19 ecoregions all around the country. These are as follow,

Table 5.39 - Ecoregions

SN	Ecoregion	Area (km^2)	%
1	Central Indochina dry forests	4.0	0.0
2	Chin Hills-Arakan Yoma montane forests	29,810.7	4.4
3	Eastern Himalayan alpine shrub and meadows	5,316.6	0.8
4	Eastern Himalayan broadleaf forests	285.5	0.0
5	Eastern Himalayan Subalpine conifer forests	38.5	0.0
6	Irrawaddy dry forests	35,459.4	5.2
7	Irrawaddy freshwater swamp forests	15,308.8	2.3
8	Irrawaddy moist deciduous forests	139,806.4	20.7
9	Kayah-Karen montane rain forests	56,113.1	8.3
10	Lower Gangetic Plains moist deciduous forests	3.0	00
11	Mizoram-Manipur-Kachin rain forests	71,183.0	10.5
12	Myanmar Coast Mangroves	15,889.0	2.4
13	Myanmar coastal rain forests	66,338.2	9.8
14	Northeast India-Myanmar pine forests	83.0	0.0
15	Northern Indochina subtropical forests	139,582.7	20.6
16	Northern Triangle subtropical forests	54,595.4	8.1

17	Northern Triangle temperate forests	10,813.4	1.6
18	Nujiang Langcang Gorge alpine conifer and mixed forests	4,635.2	0.7
19	Tenasserim-South Thailand semi evergreen rain forests	30,734.1	4.5
	Total	676,000.0	100.0

Source : IFC (2017)

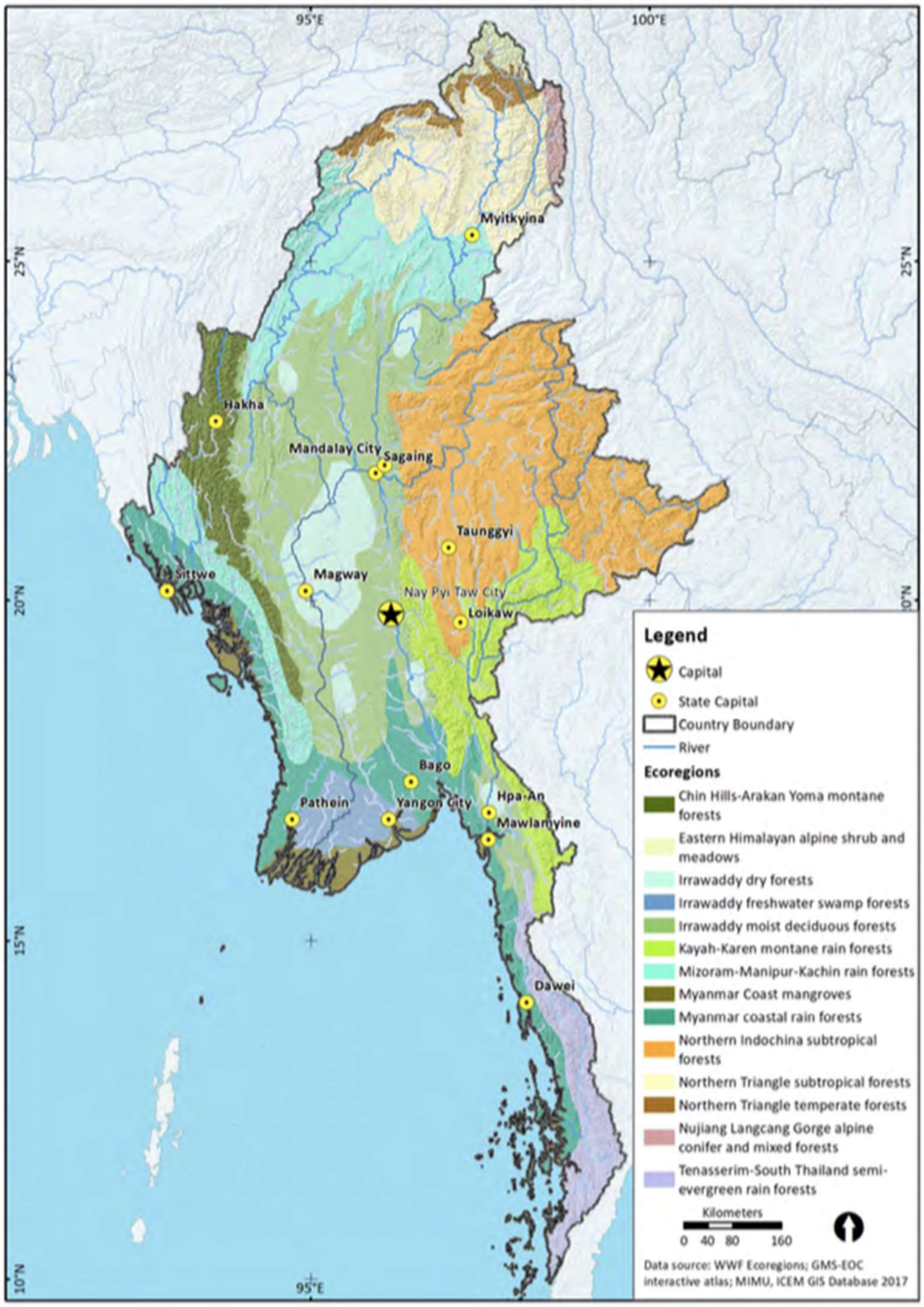


Figure 5.65- Ecoregions in Myanmar

Source: IFC (2017)

Thit Ta Pin Taung Forest Area

As the railway route is close to **Thit Ta Pin Taung forest area,** which is environmental sensitive area of water resources for the local community of surrounding villages and to protect near forest areas in Pyin Oo Lwin Township. As Thit Tapin Taung is massive, it's extremely difficult to carry out conservation work. However locals said there are colonial-era stone posts and fences demarcating the area. So to conduct the project, the old posts and fences may be kept or new ones erected. Either way, the main task is conservation. The area around Thit Tapin Taung is within the forest and the Forestry Department is responsible to conduct conservation work there and has been planting 150 acres of pine trees. There are three lakes at Thit Tapin Taung which have supplied water to Pyin Oo Lwin town since the colonial era. Residents also rely on it for drinking water. Some 16 areas of the lake were recognised as watershed areas. Due to the disappearing forest, the lakes have decreased in size, said an official of the Forestry Department.

Construction of railway line may result in the deterioration of lowered infiltration rate of soil water content, reduction of available water content of soil by the elimination of surface vegetation and thus the construction should avoid to this area.




Images of Thit Ta Pin Taung Area

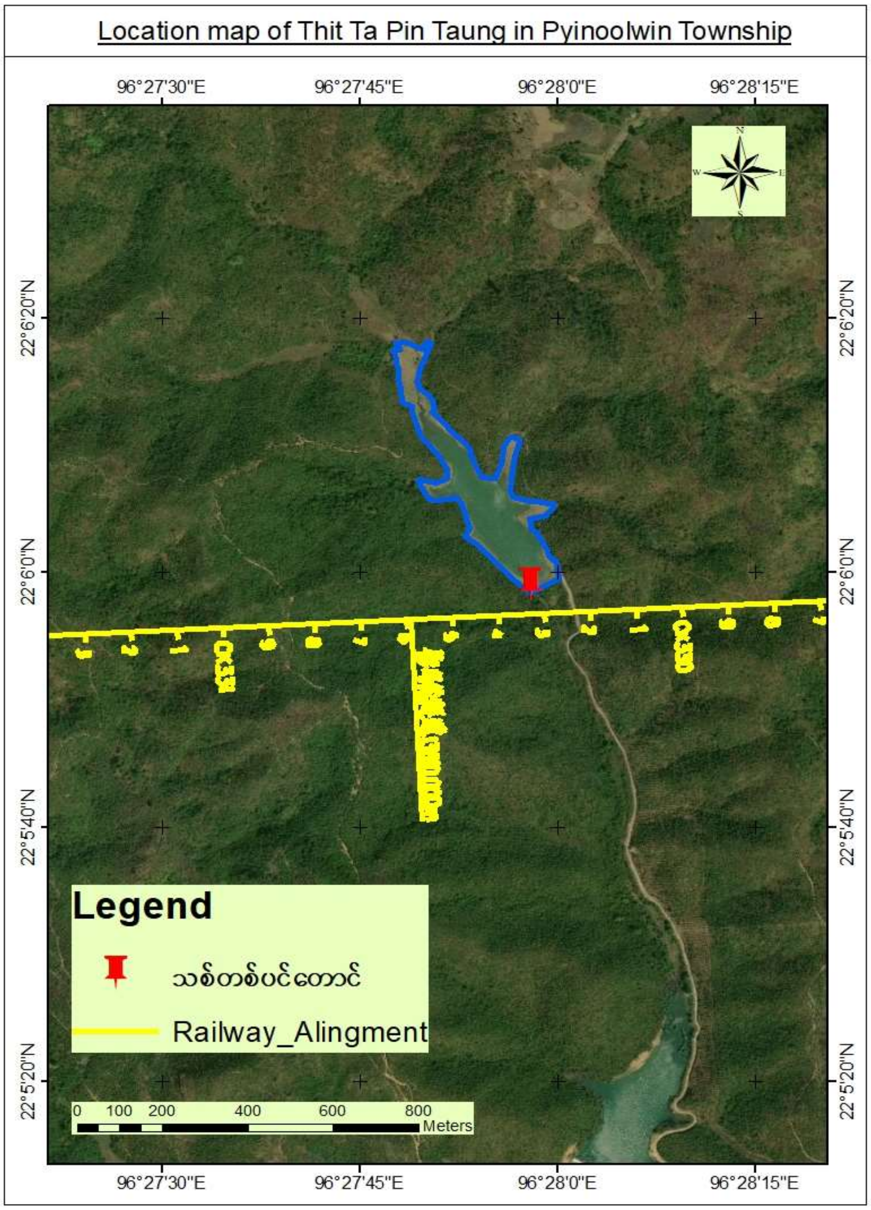


Figure 5.66 - Location Map of Thit Ta Pin Taung

No	Name	Estimated distance from railway (km)
1	Thit Ta Pin Taung	0.075

Mehon-Doke-hta Wady River key biodiversity area (KBA)

The neighboring predictable area of particular biodiversity importance is the Mehon-Doke-hta Wady River key biodiversity area which found between the Pyin Oo Lwin Wildlife Sanctuary. Although, this area does not have any legal status but it is considered as an International Bird Area (IBA) by Birdlife International.

Overall, the biodiversity recorded in the Project's direct and indirect impact zones was not found to be unique, but, the ecosystems, habitats and species documented are relatively widespread and should considered most important from a conservation perspective.

(14) Overall Suggestions for Biodiversity Environment

- The project is huge, long and also will drill into the mountains, underlay soil for the railway track and use a lot of construction materials. It is going to surely affect the ecosystem, original forest areas, water resources and farmlands, even if they use highest technology methods.
- The status and sensitivities of the ecological components of the project environment were carefully established and assessed through literature research, field observation, public consultation and literature review.
- The ecological assessment carried out for the proposed project suggests low to moderate scale of adverse impacts, which can be reduced to acceptable level through recommended mitigation measures as mentioned in the EIA.
- As BRI, large infrastructure project, often have an irreversible environmental impact. If it is implemented in a forested area, it will surely create deforestation, and this contributes tends to climate change in the host country.
- Deforestation will be driven by the conversion of forests into plantations for agricultural commodities like bananas and rubber, supported by authorized investment and these rapidly expanding plantations grow tissue culture bananas, and the clonal genetic material and monoculture production require constant applications of chemical fertilizers and pesticides will be poisoned local communities' water supplies and ecosystems.
- It is important to note that, some areas in Myanmar are environmentally, politically and socially sensitive, so, project implementation needs to be handled carefully and must take those issues into consideration.

- Large areas of near protected forest in the project areas would be cut down to make way for power stations, as the railway line's 100 mph trains and it will be using electricity and thus many hectares of forest would be axed and also a threat to the nature of the Shan highlands because, the high-speed railway would create a lot of noise and vibration.
- Trees and plants along the planned proposed route may be removed or cut. These may include culturally important and old trees. There is a possibility of impacts due to the management of plants in order to recover trees felled during construction period.
- As for animal ecology, they constitute an important component of the natural ecosystem. The animal communities are important because of their uses as sources of biodiversity conservation and research studies, recreation, and more importantly the provision of protein in the diet of rural communities. The study area is an important habitat for some species of animals. For the present and foreseeable future, this study area is the important vegetation zone as regards conservation and utilization.
- Ecologically, the animal population plays an important role in the transfer of food energy and cycling of essential elements in the ecosystem. The study area is endowed with a large variety of animal species. The Phylum Arthropoda dominated the invertebrate community and is represented by insects, spiders, etc. Occurrence, abundant and diversity butterfly species were depend on the cultivated plant species. In this area was variety of cultivated plants and butterfly species and other insect races are more diverse and abundant.
- Bird species are found in vary habitat and depend on available food, breeding habitat and shelter for them. In this study, the most dominant species were found in bird fauna. On the whole, birds have received more attention than other groups of vertebrates in this area. This, no doubt, is due partly to the efforts of the others ornithologists society and partly to the fact that most birds are conspicuous and easy to observe. The avian population was preponderant in terms of numbers and types. They include Spotted Dove, Green bee-eater, House sparrow and House crow.
- The mammalian community was made up of diverse organisms. The most abundance of mammal species was Rhesus macaque (Monkey) and the small mammals encountered were mainly included Squirrel and Common Rat.
- Animal's habitats are the specific environment or ecological conditions in which species lives. Most habitat descriptions are based on vegetation, which reflects the climate, soil type, and other features of the local environment, and which supports the animal life in a given location. Efforts to measure habitat variables often focus on vegetation structure and

attempt to quantify the presence and abundance of different plant species in the habitat.

- It is concluded that the abundance of animal species depend on food availability and suitable habitat. However habitat can change over time due to the harvesting and utilization of the natural resources by human being and seasonal change. As the habitat changes along multifaceted biological and environmental gradients, a particular animal species can appear increase or decrease in number.
- The interactions of the various ecological and socio-economic component of the existing environment with the known activities of the proposed project were used along with other source references to identify, characterize and evaluate the potential and associated impacts. Mitigation measures were subsequently develop for adverse impact based on IAIA, available technology and others considerations.
- Improvement of the logistics- organization of transport to and from the Facility. The creation of new jobs.
- Base for the future development of the country and continuation of the long term operation of this project.
- The water intake installation should also be constructed in the optimal manner as far as the intervention into the natural environment under protection in question is concerned. Accordingly, all building works should not be performed in the hatching season.
- The magnetic fields created by power lines do not affect the health or reproductive capacity of farm animals or present a danger to native fauna.
- From a practical point of view, the electric fields created by transmission lines have no adverse effect on crops, pasture grasses or native flora, other than trees, growing under or near to the lines.
- The proposed project is considered to be of immense potential and associated benefits and environmentally friendly. ecological impacts can be managed and controlled by the proposed mitigation measure/ EMP.
- The construction activities and the changes in traffic during operation are not expected to result in any significant impact on habitats or fauna of conservation importance, . The loss of existing fauna will be mitigated, eg by removing vegetation and felling trees where birds may be nesting outside the nesting period and by planting replacement trees after construction. With these measures the resulting impact on biodiversity and nature conservation interests is considered to be of minor significance.
- Careful implementation of the pre-construction mitigative measure will make the

likelihood or scale of the construction period impacts less.

- The power supply development projects serves as an important employment generator and provide huge direct and indirect employment opportunity during construction period and operation period.
- During construction and operation of the project, ensure compliance with regulatory environmental requirements, related guidelines and/or recommended control levels.

(15) Mitigation Measure

Mitigation measures are required for items which are expected to cause impact on the environment. By due execution of these mitigation measures, proposed rail way project will be able to become an environmentally friendly mode of transportation. Implementation of appropriate mitigation measures during the construction and operation phases will minimize the negative impacts of the project to acceptable levels.

Mitigation measures at preconstruction/construction stages shall be proposed below.

Table 5.40- Mitigation Measures in Preconstruction stage

Item of Impact	Mitigation Measure	Implementation Organization	Responsible Organization
Biota and Ecosystem Human habitation area Reserved forest and Protected area	- Construction yards shall be planned to keep damages to trees and plants to a minimum. - Removed trees and plants shall be replanted at proper locations as exsitu. - Road side trees shall be removed and replanted at proper location as much as possible. - Training of construction workers to raise awareness of environmental protection requirements, - Construction yards shall be planned to keep damages to trees and plants to a minimum. - Construction yards shall be located as far as possible from reserved forest and protected area.	Contractor	Related state organizations
Impact on Geology	- In case of finding of mineralized zones along the tunnel alignment during excavation, it will be brought	Contractor	

	to the notice of the local authorities for the directions from their end. - Appropriate blasting design will be adopted which will consider safety and for ecology.		

Tolerance to Damage for Tree

Minimum Distances between Structures and Trees and Required Tree Protection

Type of Structure	Minimum Distance
All	CRR+10 ft
Buildings	Lesser of 20 ft or CRR²
Sidewalk or Driveway	10 ft

Where CRR= Critical Root Radius (ft.)

The critical root radiui with respect to tree stem diameters are described below.

Tree Stem Diameter (in.)	Critical Root Radius (ft.)
2	2.5
4	5
6	7.5
8	10
10	12.5
12	15
14	17.5
16	20
18	22.5
20	25
22	27.5
24	30
26	32.5
28	35
30	37.5
32	40
34	42.5
36	45
38	47.5
40	50

Table 5.41- Mitigation Measures in Operation Stage

Item of Impact	Mitigation Measure	Implementation Organization	Responsible Organization
Biota and ecosystem Human habitation area Reserved forest and Protected area	- Fences shall be installed at Embankment and Cutting sections in order to prevent animals from entering the railway tracks. - Removed and replanted plants shall be improve - Replenish vegetation at the station regularly - Proper maintenance of trees and other vegetation along the rail way yard	Contractor	Related state organizations

Table 5.42 – Mitigation Measures in Decommission Phase

Item of Impact	Mitigation Measure	Implementation Organization	Responsible Organization
To Protect Environment Reserved forest	The project requires the removal of structure and around stations. Decommission would be carried out by licensed contractors, in accordance with relevant regulatory requirements, and the project environmental management.	Contractor	Related organizations

Construction Mitigation Measures

The mitigation of potential impacts from the Proposed Scheme are as follow. The mitigation strategy for the Proposed Scheme will include standard, best practice approaches for the habitats present and the species they may support including:

- Avoidance of sensitive and/or valuable features;
- Timing of site clearance operations such as felling of trees to avoid the most sensitive periods (this will be dependent on which species are present);
- Creation of replacement habitat to mitigate for habitat losses, through planting and creation of features such as ponds and hibernacula;
- If possible translocation of fauna;
- New planting to reconnect habitats fragmented during construction;

• Minimize lighting during construction;
• Use of lighting types, directional lighting and shields which are of lower impact to bats and some nocturnal

MITIGATION MEASURES: Noise and vibration

-In the actual construction work, the scheduled management will be performed to ensure leveling of the sound level of construction work wherever possible, and the state-of-the-art low-noise equipment will be introduced. Thus, efforts will be made to minimize the noise impact. Indeed the noise from transformer noise reduction is a measure to reduce noise by using airflow ducts with sound-absorbing linings or special structural forms.

-Trees have been studied as possible tools for reducing noise. Plants absorb, diffract and reflect sound, the balance varies with the frequency at which the sound is generated.

Material and equipment transportation vehicles will be placed under the scheduled management to ensure that the sound level of the construction work will be leveled. Measures for reducing generation of noise such as requirements for installation of mufflers and speed reduction in the residential area will be taken wherever possible, whereby vehicle noise impact will be minimized.

- Removal of invasive plant species for example through application of herbicide in advance of works; and
- Compliance with good practice procedures such as the NEQG/ECD Guidance.

Operational Phase Mitigation Measures

The mitigation of potential impacts from the Proposed are as follow,

- Provision of planting to screen disturbance from trains;
- Use of directional lighting and shields to prevent light spillage;
- Provision of appropriate drainage to prevent run-off of pollutants into adjacent habitats.
- Railway line will be a fragmenting object for some species' populations, since it will impose a burden to the migration. The barrier effect can be reduced by installing adequate animal crossings.

Decommission Phase Mitigation Measure

The project requires the removal of structure and around stations. Decommission would be carried out by licensed contractors, in accordance with relevant regulatory requirements, and the project environmental management.

The following list identifies further measures to reduce or avoid impacts to fauna species and their habitats:

(a) Further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential for the site.
(b) Ensure there is selective clearing of the vegetation this allows future re-growth and regeneration. This will ensure minimal disruption of wild fauna’s natural movement, territoriality, and other ecological processes.

(c) With regards to environmental aspect, the location of project area already occupied with landscape and wild plants of small forest type. Terrestrial organisms may not be affected by the presence of construction of the building by control the habitat loss and noise.

(16) Monitoring

Monitoring initiate a mechanism for implementing mitigation measures for the potential negative environmental impacts and monitor the efficiency of these mitigation measures based on relevant environmental indicators. Monitoring shall be making continuous during construction and operation phases of this project. Furthermore, environmental monitoring of the project will be undertaken regularly through of its operation to ensure that the measures are being implemented properly.

Habitat and Wildlife Population Management

Lower numbers of wildlife species near railways can be achieved by controlling populations (e.g., selective hunting, trapping), or by habitat modification. Changes in habitat structure along railway verges may also increase animals' capability to detect and evade the train.
Population control of a particular species may sometimes be used to reduce its numbers near railways. This method should only be applied on very common species, or those that can compromise human safety due to collisions. This method has been used to prevent collision with vehicles on roads (Glista et al. 2009), but its use in railways may not be as necessary since most animals will not affect trains' movements.

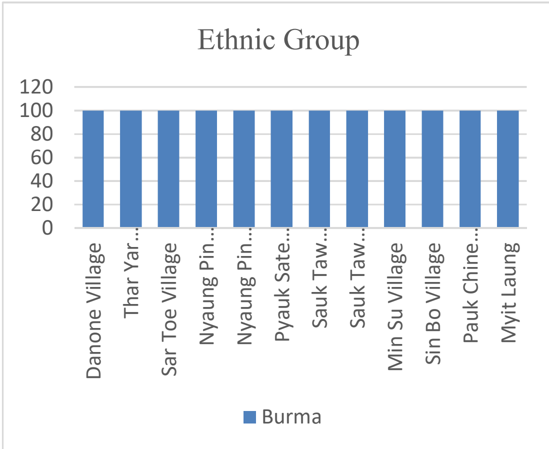
5.4.8. Socio-Economic Components

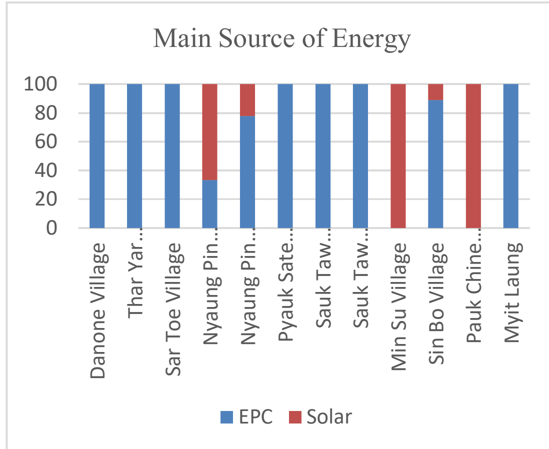
Resulting from Primary Data Collection

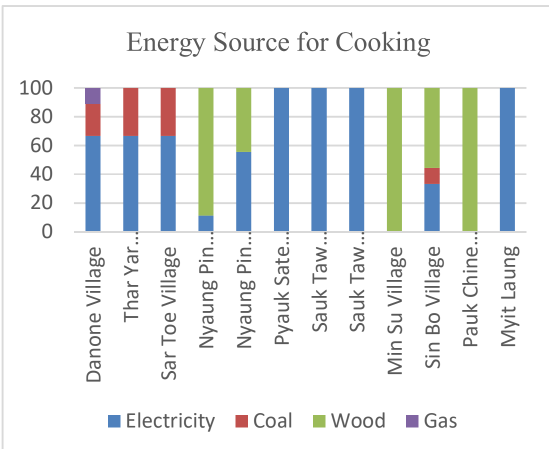
According to the data analysis, the following are the main socio-economic data resulting from primary data collection (household survey).

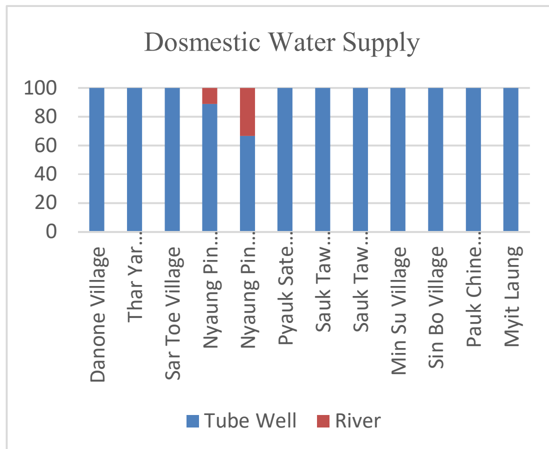
(a) Socio-economic data of Mandalay (Amarapura) Township

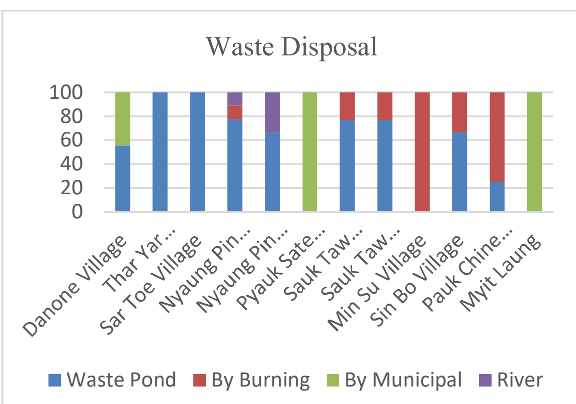
According to the household data collection, Burma is the major ethnic group within the Amarapura Township. The only one dominant religion of the people in Amarapura Township is Buddhist. Most of the households in this Township obtained their domestic water from tube well and drinking water from bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and other is from solar energy. In this Township, the main source of income are from framing, trading, industry work and other.

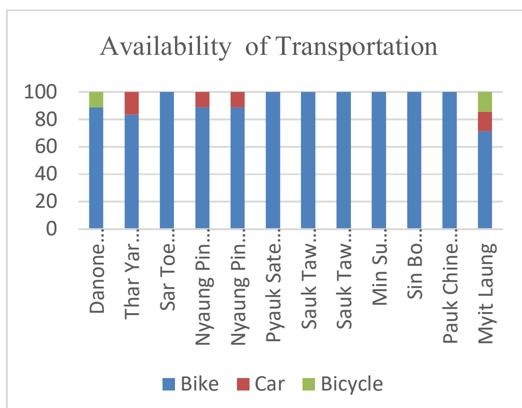

Ethnic Group
120
100
80
60
40
20
0
Danone Village
Thar Yar...
Sar Toe Village
Nyaung Pin...
Nyaung Pin...
Pyauk Sate...
Sauk Taw...
Sauk Taw...
Min Su Village
Sin Bo Village
Pauk Chine...
Myit Laung
Burma


Main Source of Energy
100
80
60
40
20
0
Danone Village
Thar Yar...
Sar Toe Village
Nyaung Pin...
Nyaung Pin...
Pyauk Sate...
Sauk Taw...
Sauk Taw...
Min Su Village
Sin Bo Village
Pauk Chine...
Myit Laung
EPC
Solar

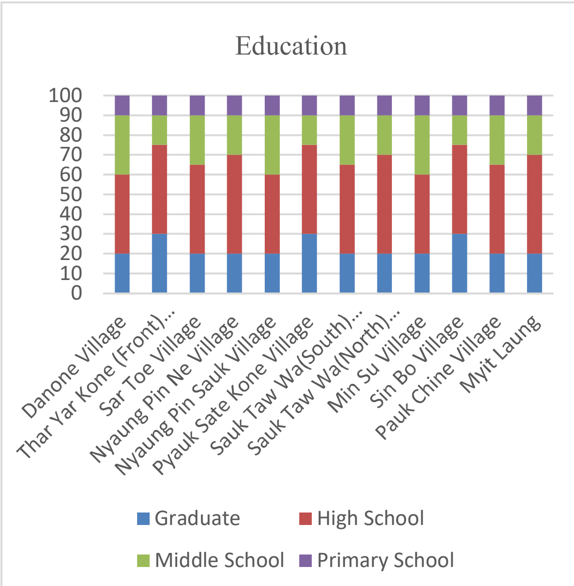

Energy Source for Cooking
100
80
60
40
20
0
Danone Village
Thar Yar...
Sar Toe Village
Nyaung Pin...
Nyaung Pin...
Pyauk Sate...
Sauk Taw...
Sauk Taw...
Min Su Village
Sin Bo Village
Pauk Chine...
Myit Laung
Electricity
Coal
Wood
Gas

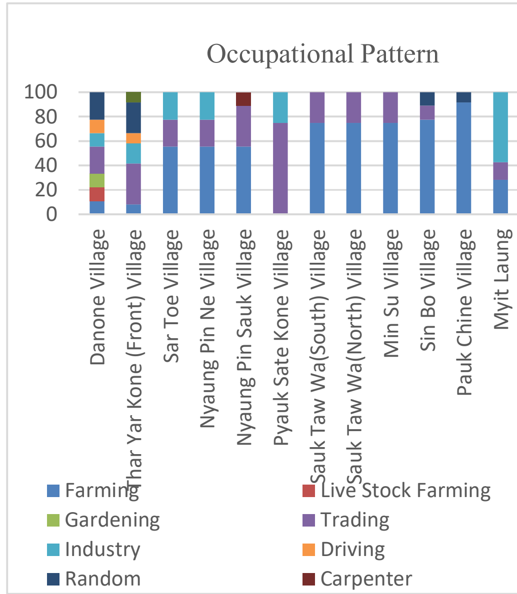

Dosmestic Water Supply
100
80
60
40
20
0
Danone Village
Thar Yar...
Sar Toe Village
Nyaung Pin...
Nyaung Pin...
Pyauk Sate...
Sauk Taw...
Sauk Taw...
Min Su Village
Sin Bo Village
Pauk Chine...
Myit Laung
Tube Well
River

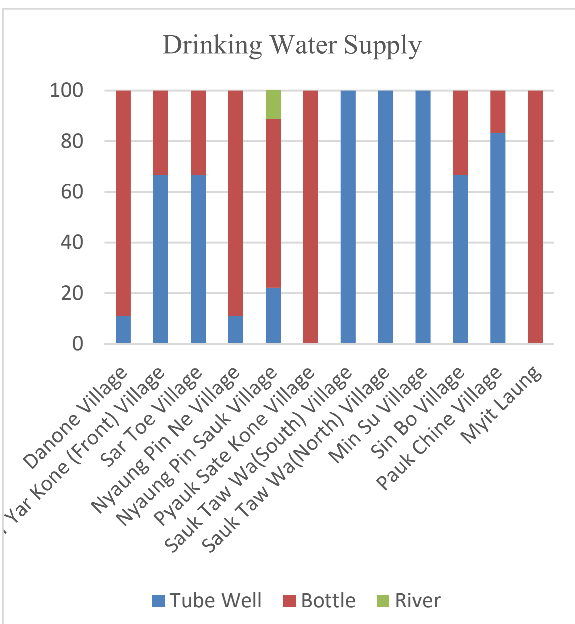

Waste Disposal
100
80
60
40
20
0
Danone Village
Thar Yar...
Sar Toe Village
Nyaung Pin...
Nyaung Pin...
Pyauk Sate...
Sauk Taw...
Sauk Taw...
Min Su Village
Sin Bo Village
Pauk Chine...
Myit Laung
Waste Pond
By Burning
By Municipal
River

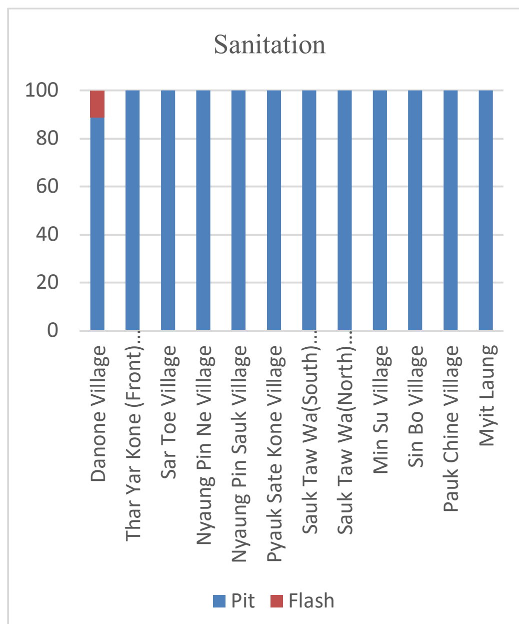

Availability of Transportation
100
80
60
40
20
0
Danone...
Thar Yar...
Sar Toe...
Nyaung Pin...
Nyaung Pin...
Pyauk Sate...
Sauk Taw...
Sauk Taw...
Min Su...
Sin Bo...
Pauk Chine...
Myit Laung
Bike
Car
Bicycle

(b) Socio-economic data of Mandalay (Pathein Gyi) Township

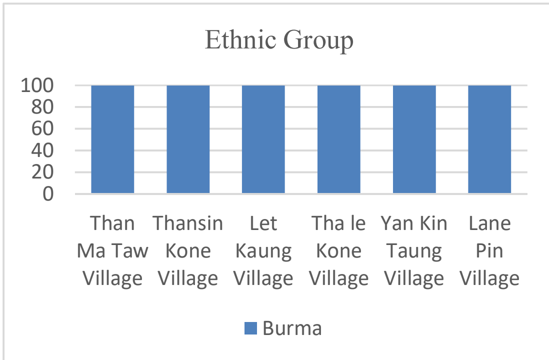


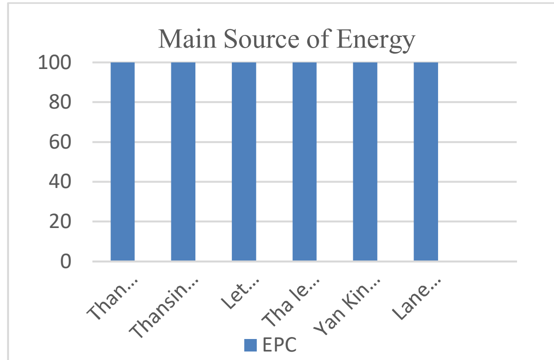


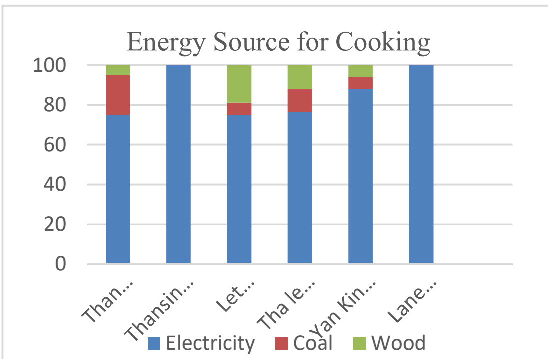


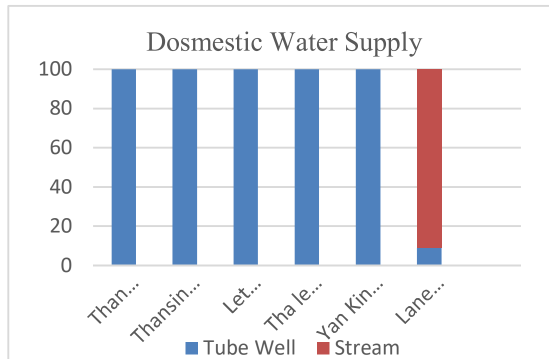


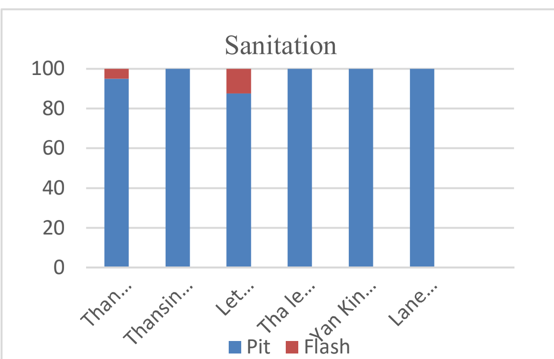
According to the household data collection, Burma is the major ethnic group within the Pathein Gyi Township. The only one dominant religion of the people in Pathein Gyi Township is Buddhist. Most of the households in this Township obtained their domestic water from tube well and drinking water from bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC). In this Township, the main sources of income are from framing, trading, livestock and other.

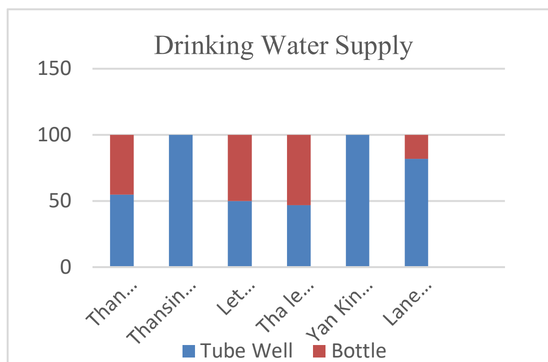

Ethnic Group
100
80
60
40
20
0
Than Ma Taw Village
Thansin Kone Village
Let Kaung Village
Tha le Kone Village
Yan Kin Taung Village
Lane Pin Village
Burma

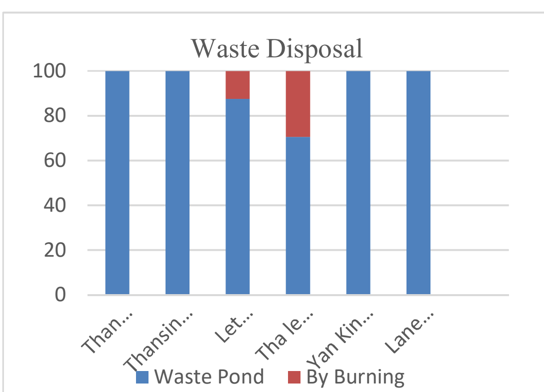

Main Source of Energy
100
80
60
40
20
0
Than...
Thansin...
Let...
Tha le...
Yan Kin...
Lane...
EPC

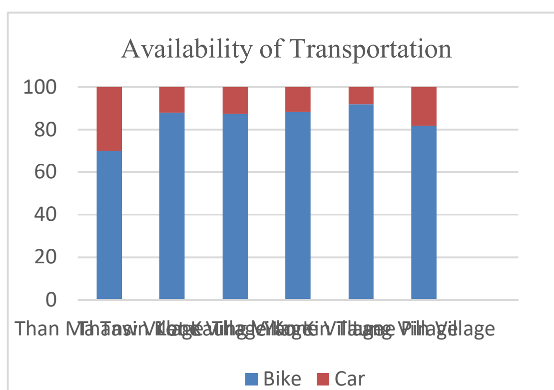

Energy Source for Cooking
100
80
60
40
20
0
Than...
Thansin...
Let...
Tha le...
Yan Kin...
Lane...
Electricity
Coal
Wood

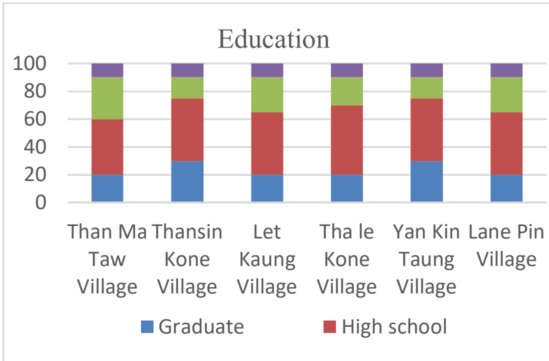

Dosmestic Water Supply
100
80
60
40
20
0
Than...
Thansin...
Let...
Tha le...
Yan Kin...
Lane...
Tube Well
Stream

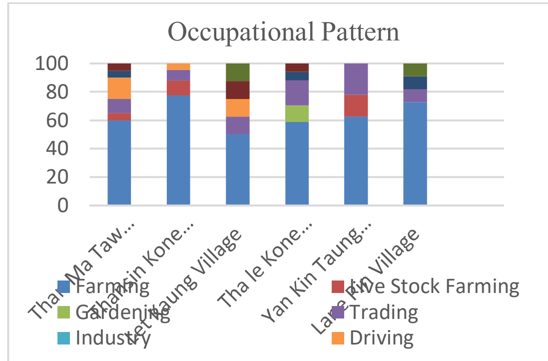

Sanitation
100
80
60
40
20
0
Than...
Thansin...
Let...
Tha le...
Yan Kin...
Lane...
Pit
Flash


Drinking Water Supply
150
100
50
0
Than...
Thansin...
Let...
Tha le...
Yan Kin...
Lane...
Tube Well
Bottle


Waste Disposal
100
80
60
40
20
0
Than...
Thansin...
Let...
Tha le...
Yan Kin...
Lane...
Waste Pond
By Burning

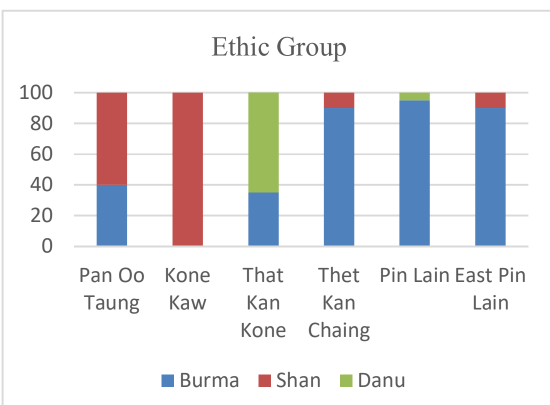

Availability of Transportation
100
80
60
40
20
0
Bike
Car

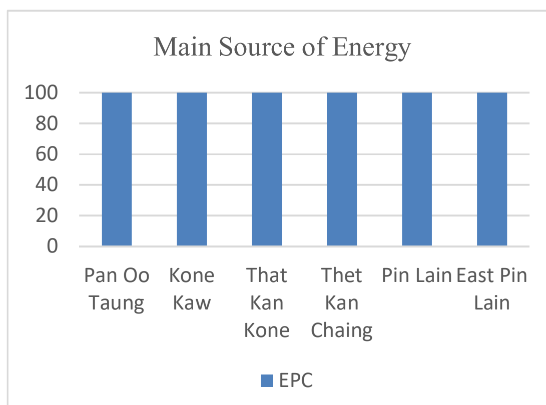


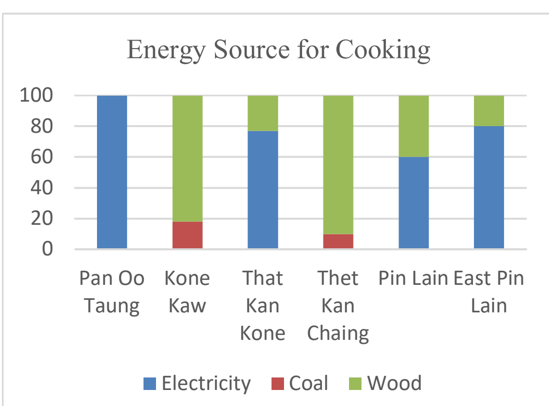


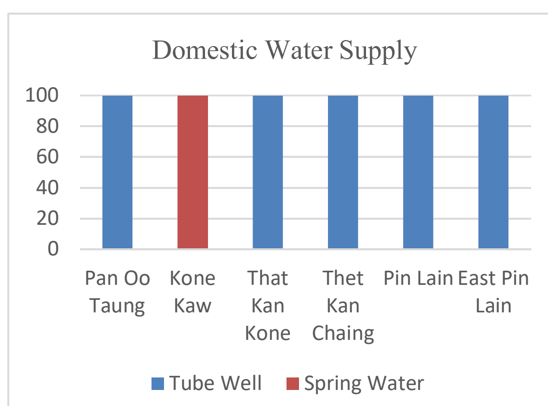
(c) Socio-economic data of Pyin Oo Lwin Township

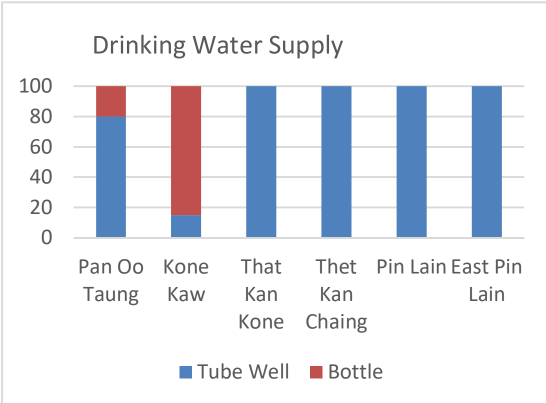
According to the household data collection, Shan, Burma and Danu are the major ethnic groups within the Pyin Oo Lwin Township. The only one dominant religion of the people in Pyin Oo Lwin Township is Buddhist. Most of the households in this Township obtained their domestic water from tube well and spring water and drinking water obtained from tube well. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC). In this Township, the main sources of income are from framing, trading and other.

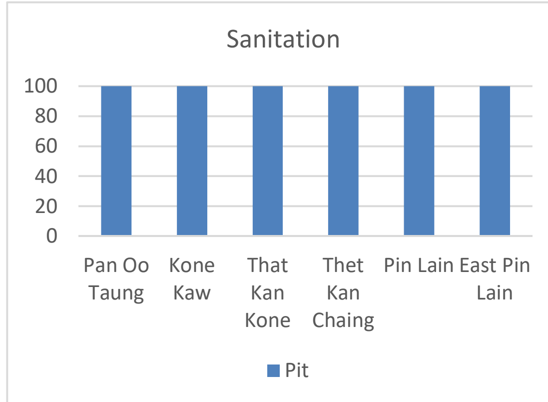


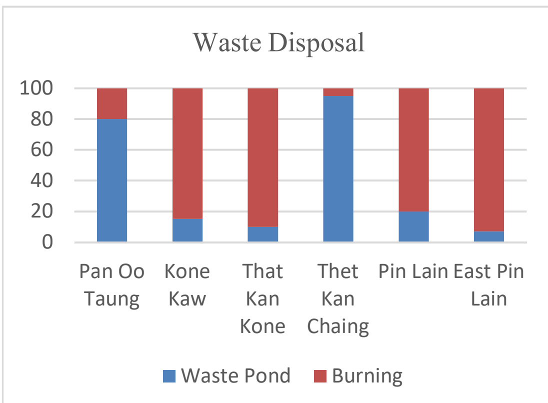


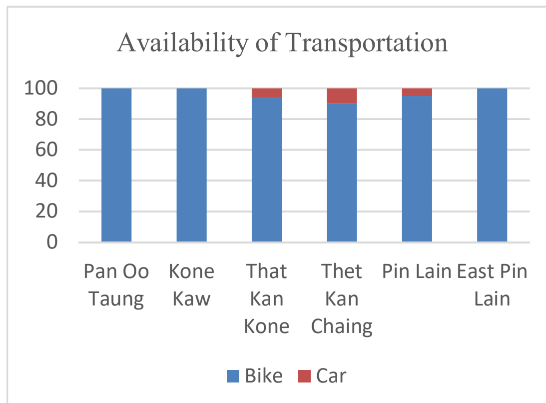


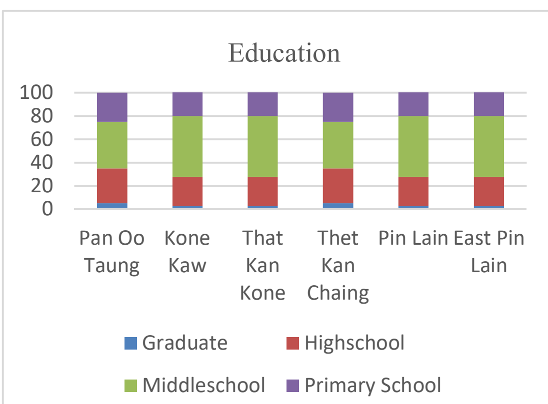


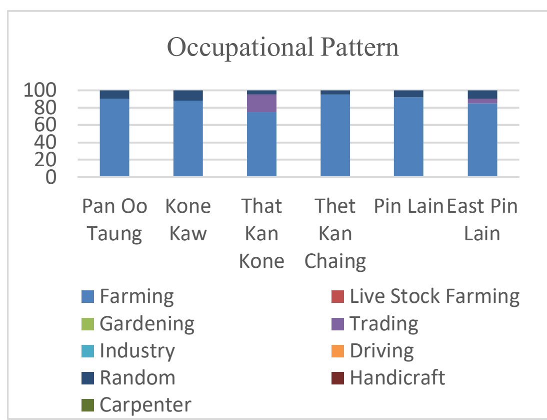






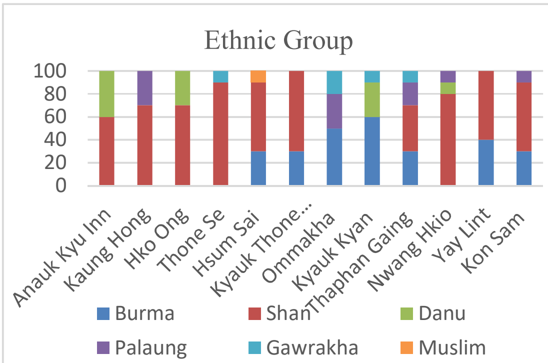


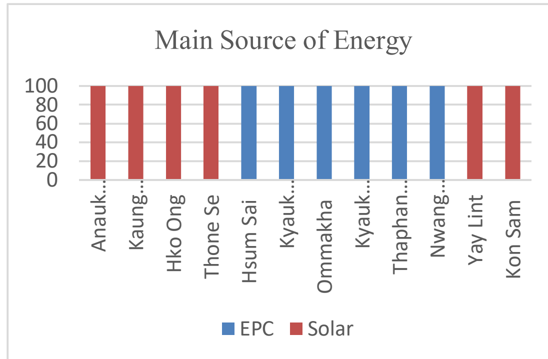


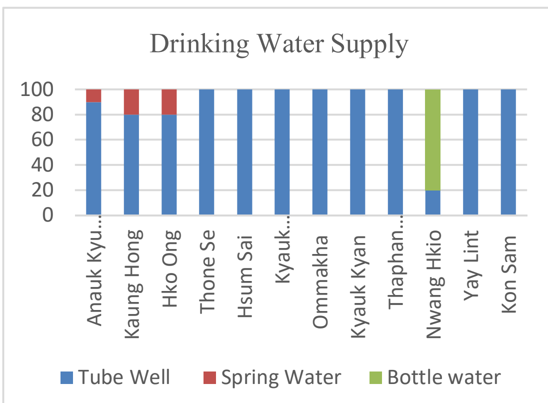


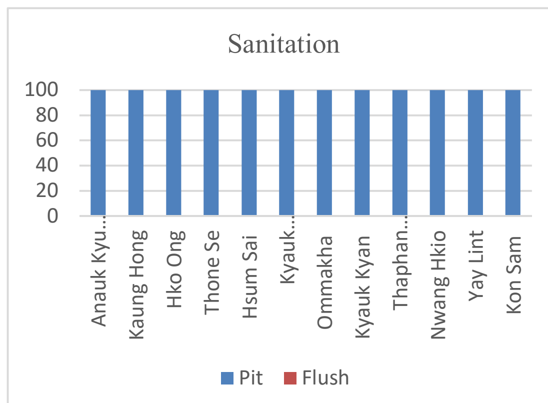
(d) Socio-economic data of Nwang Hkio Township

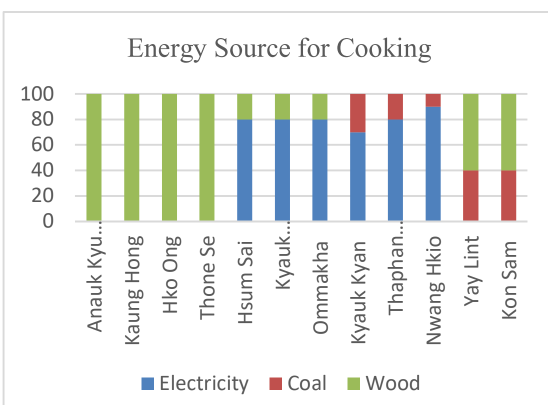
According to the household data collection, Shan, Burma and Danu are the major ethnic groups within the Nwang Hkio Township. The only one dominant religion of the people in Nwang Hkio Township is Buddhist. Most of the households in this Township obtained their domestic water from tube well and spring water and drinking water obtained from tube well. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and solar energy. In this Township, the main sources of income are from framing, trading, livestock and other.

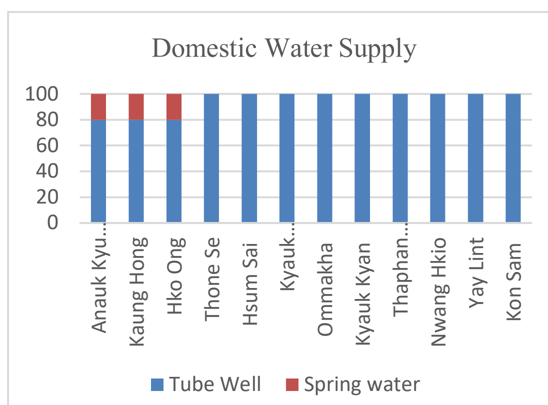


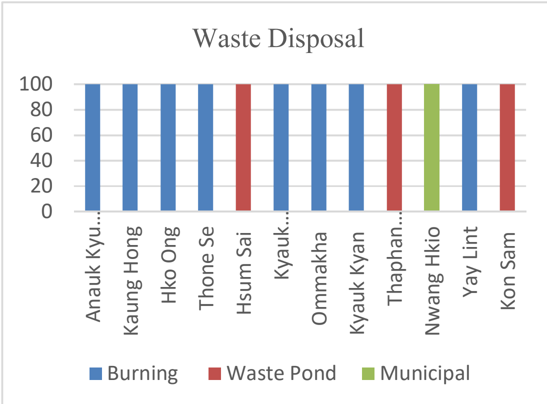


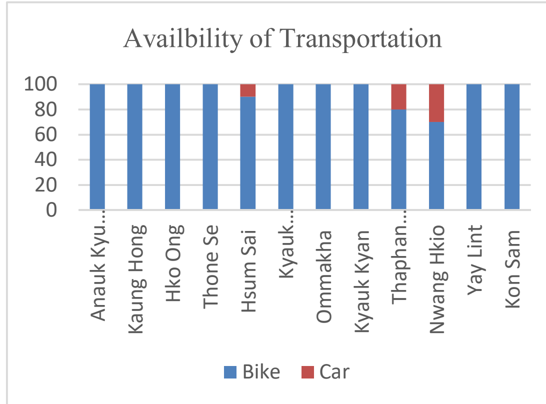


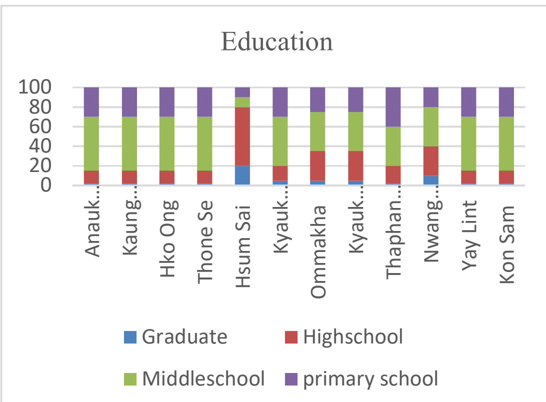


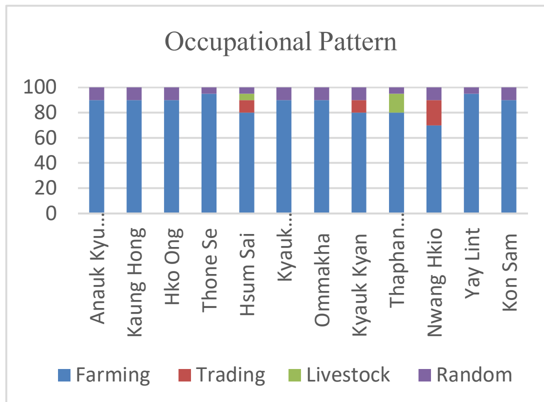






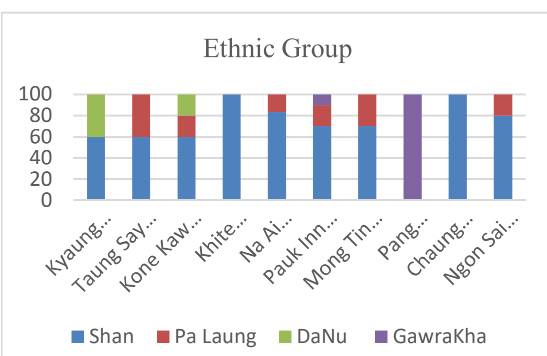


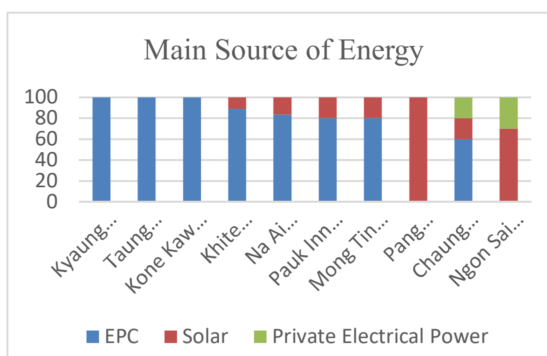


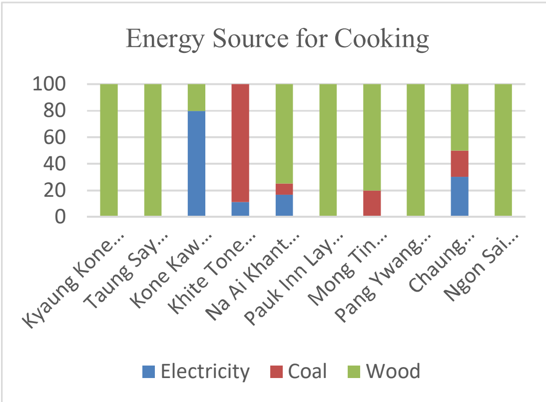


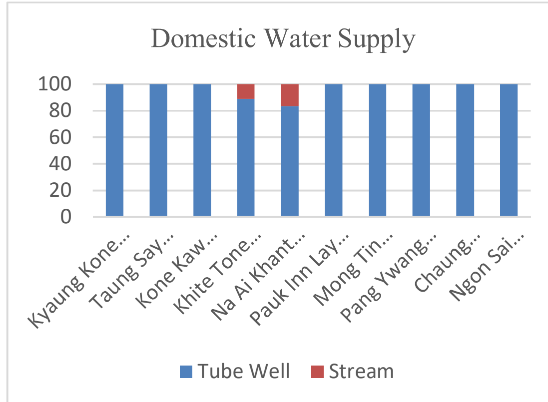
(e) Socio-economic data of Kyaukme Township

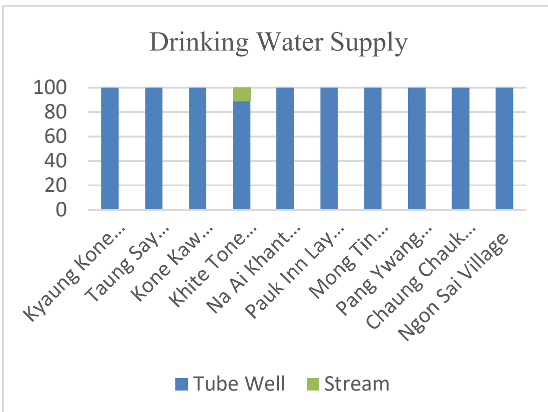
According to the household data collection, Shan, Palaung and Danu are the major ethnic groups within the Kyaukme Township. The only one dominant religion of the people in Kyaukme Township is Buddhist. Most of the households in this Township obtained their domestic water from tube well and stream water and drinking water obtained from tube well. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and solar energy. In this Township, the main sources of income are from framing, handicraft, trading, livestock and other.

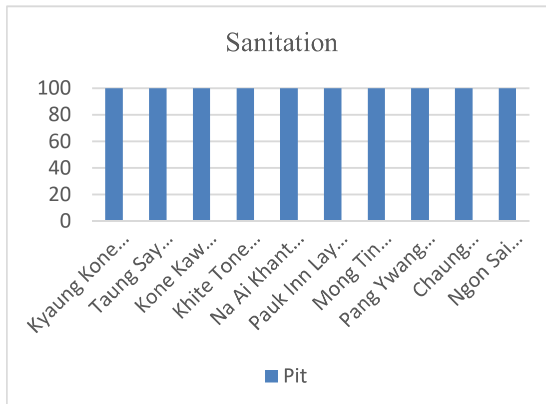


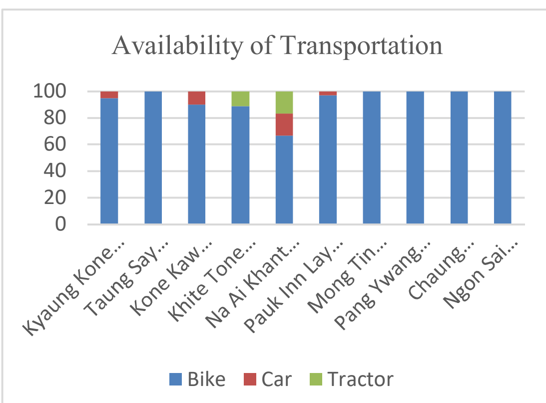


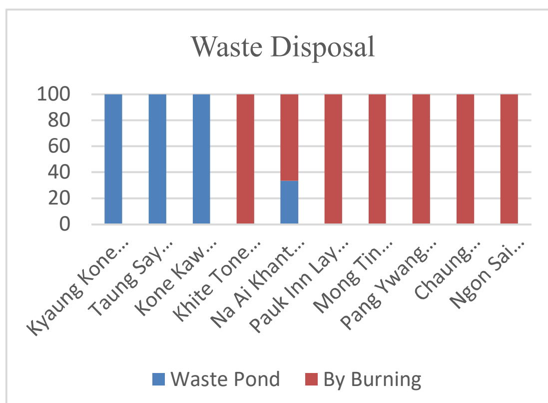

Energy Source for Cooking
100
80
60
40
20
0
Kyaung Kone...
Taung Say...
Kone Kaw...
Khite Tone...
Na Ai Khant...
Pauk Inn Lay...
Mong Tin...
Pang Ywang...
Chaung...
Ngon Sai...
Electricity
Coal
Wood

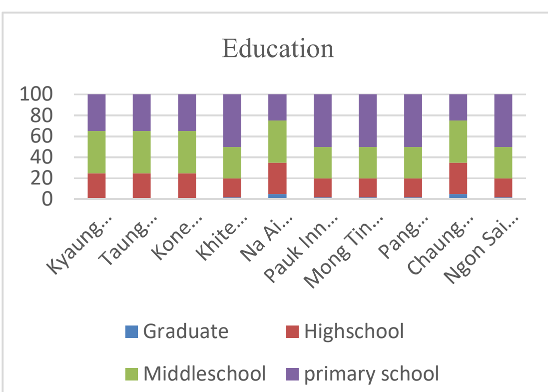

Domestic Water Supply
100
80
60
40
20
0
Kyaung Kone...
Taung Say...
Kone Kaw...
Khite Tone...
Na Ai Khant...
Pauk Inn Lay...
Mong Tin...
Pang Ywang...
Chaung...
Ngon Sai...
Tube Well
Stream

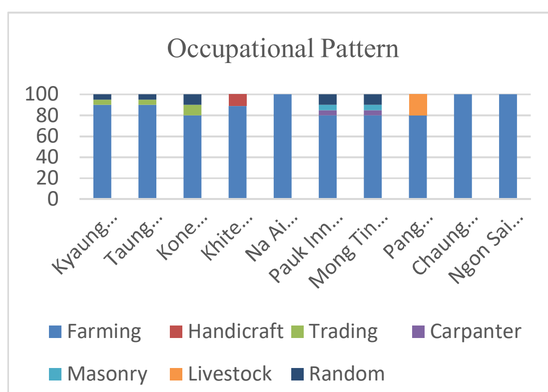

Drinking Water Supply
100
80
60
40
20
0
Kyaung Kone...
Taung Say...
Kone Kaw...
Khite Tone...
Na Ai Khant...
Pauk Inn Lay...
Mong Tin...
Pang Ywang...
Chaung Chauk...
Ngon Sai Village
Tube Well
Stream


Sanitation
100
80
60
40
20
0
Kyaung Kone...
Taung Say...
Kone Kaw...
Khite Tone...
Na Ai Khant...
Pauk Inn Lay...
Mong Tin...
Pang Ywang...
Chaung...
Ngon Sai...
Pit


Availability of Transportation
100
80
60
40
20
0
Kyaung Kone...
Taung Say...
Kone Kaw...
Khite Tone...
Na Ai Khant...
Pauk Inn Lay...
Mong Tin...
Pang Ywang...
Chaung...
Ngon Sai...
Bike
Car
Tractor

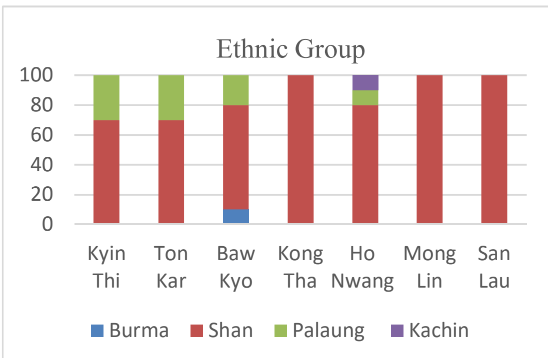

Waste Disposal
100
80
60
40
20
0
Kyaung Kone...
Taung Say...
Kone Kaw...
Khite Tone...
Na Ai Khant...
Pauk Inn Lay...
Mong Tin...
Pang Ywang...
Chaung...
Ngon Sai...
Waste Pond
By Burning

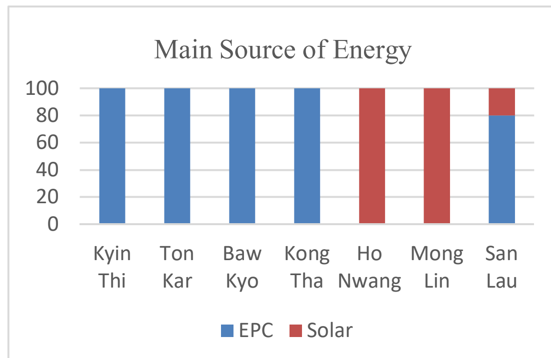

Education
100
80
60
40
20
0
Kyaung...
Taung...
Kone...
Khite...
Na Ai...
Pauk Inn...
Mong Tin...
Pang...
Chaung...
Ngon Sai...
Graduate
Highschool
Middleschool
primary school

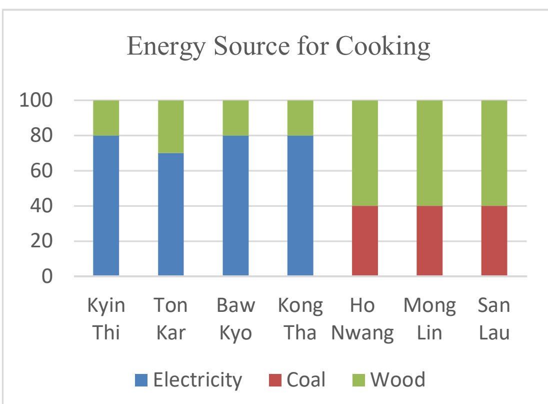

Occupational Pattern
100
80
60
40
20
0
Kyaung...
Taung...
Kone...
Khite...
Na Ai...
Pauk Inn...
Mong Tin...
Pang...
Chaung...
Ngon Sai...
Farming
Handicraft
Trading
Carpanter
Masonry
Livestock
Random

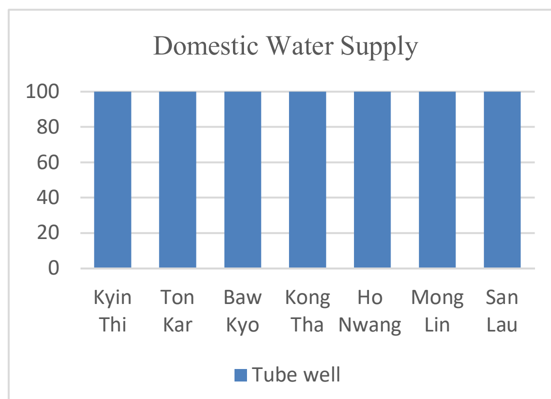
(f) Socio-economic data of Hsipaw Township

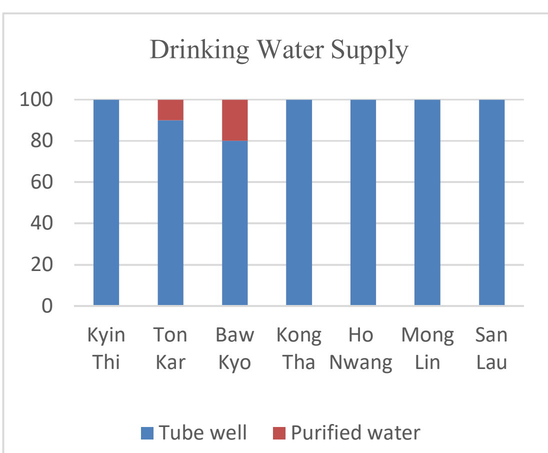
According to the household data collection, Shan, Palaung, Kayin and Kachin are the major ethnic groups within the Hsipaw Township. The dominant religion of the people in Hsipaw Township are Buddhist and Christian. Most of the households in this Township obtained their domestic water from tube well and drinking water obtained from tube well and bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and solar energy. In this Township, the main sources of income are from framing, trading and other.

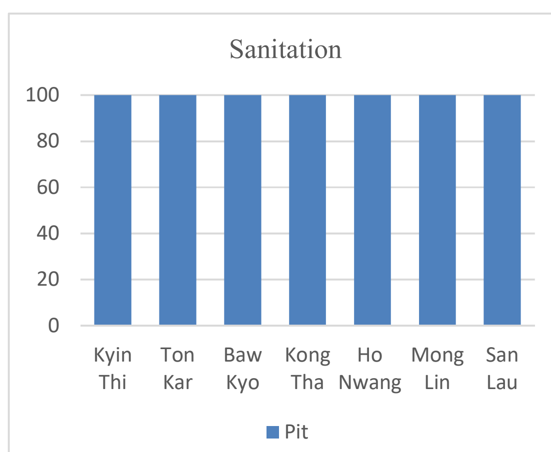


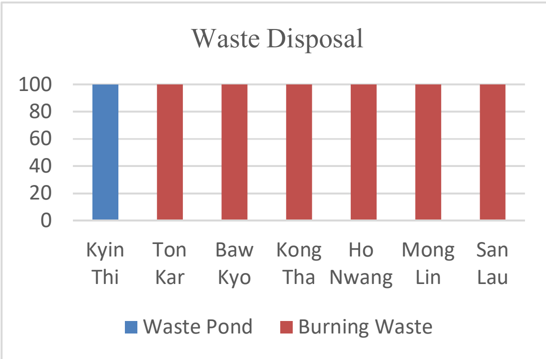


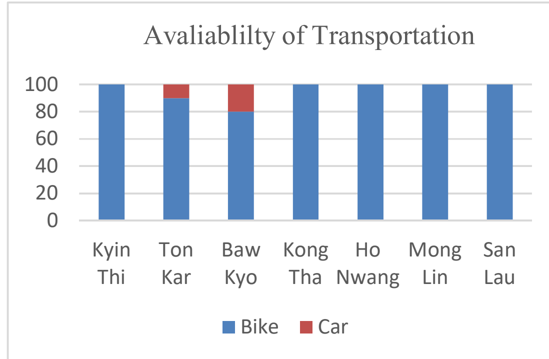


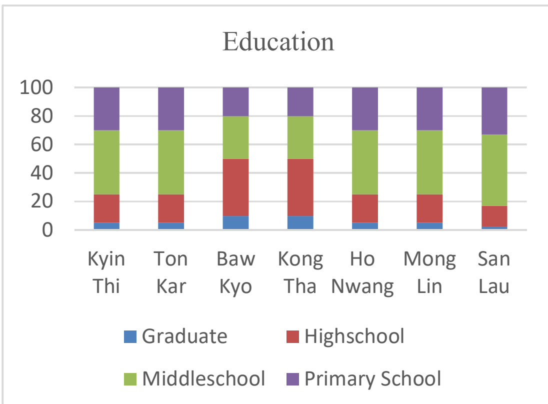


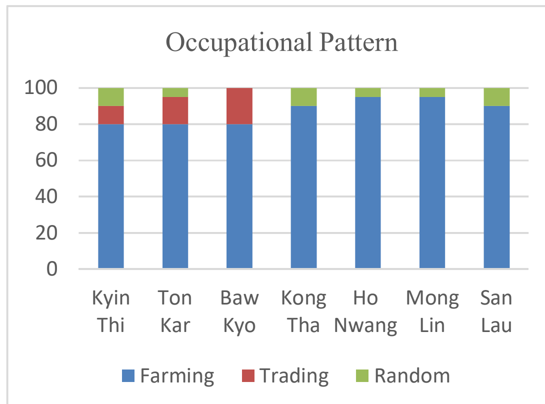






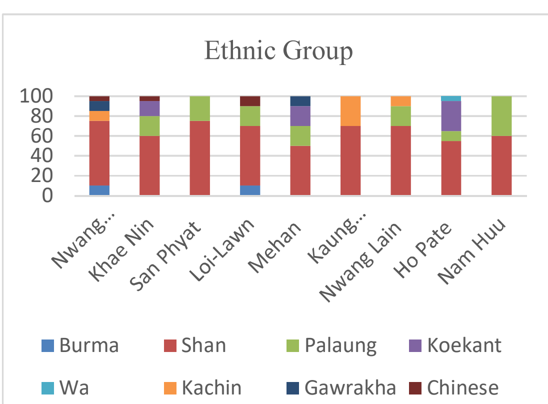


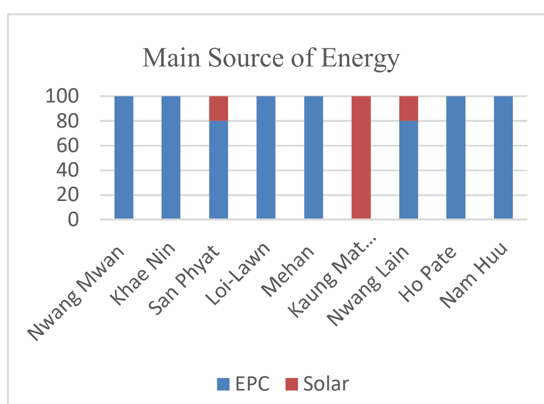


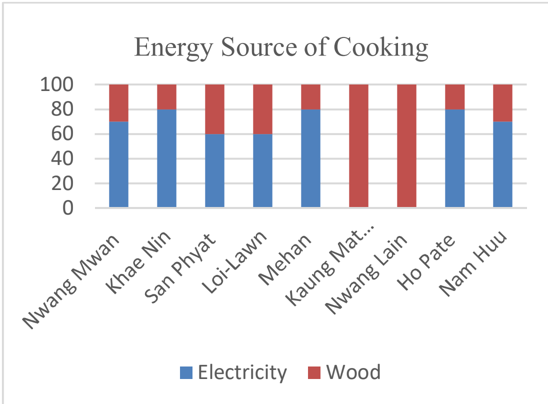


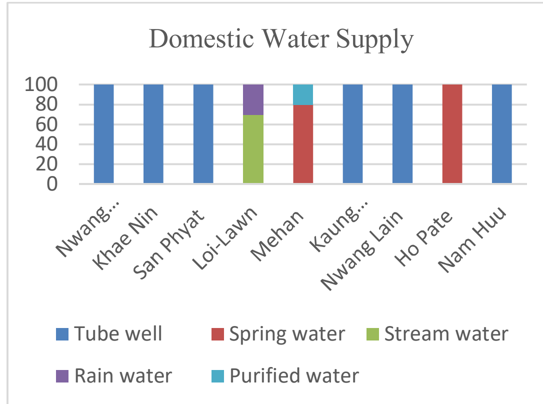
(g) Socio-economic data of Lashio Township

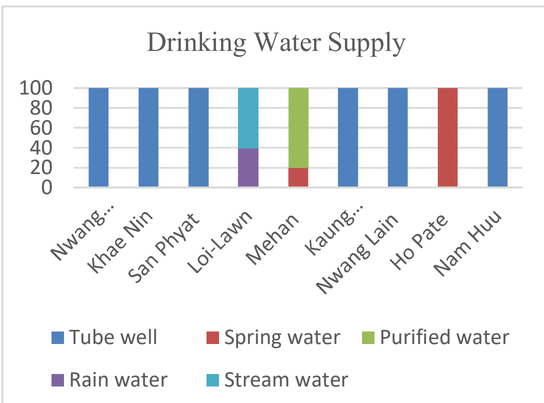
According to the household data collection, Shan and Koekant are the major ethnic groups within the Lashio Township. The dominant religion of the people in Lashio Township are Buddhist and Christian. Most of the households in this Township obtained their domestic water from tube well, spring water and stream water and drinking water obtained from tube well, spring water and bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and solar energy. In this Township, the main sources of income are from framing, trading and other.

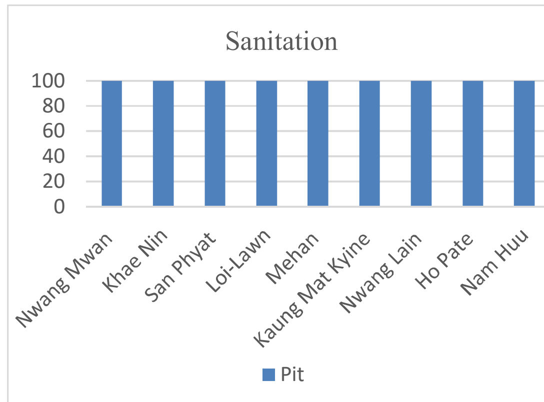


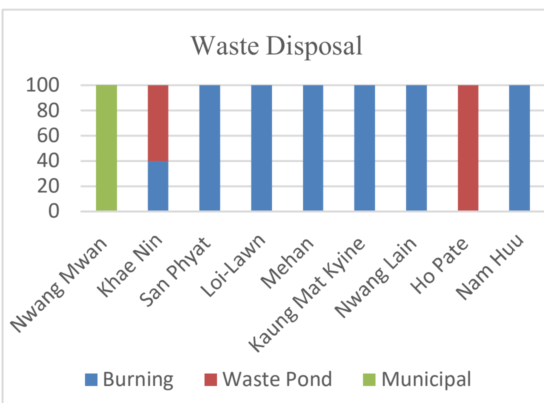


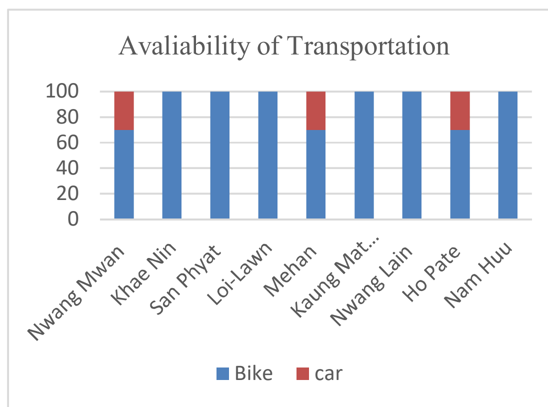

Energy Source of Cooking
100
80
60
40
20
0
Nwang Mwan
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung Mat...
Nwang Lain
Ho Pate
Nam Huu
Electricity
Wood

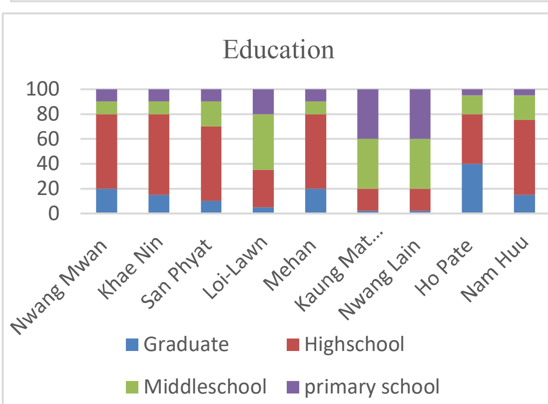

Domestic Water Supply
100
80
60
40
20
0
Nwang...
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung...
Nwang Lain
Ho Pate
Nam Huu
Tube well
Spring water
Stream water
Rain water
Purified water

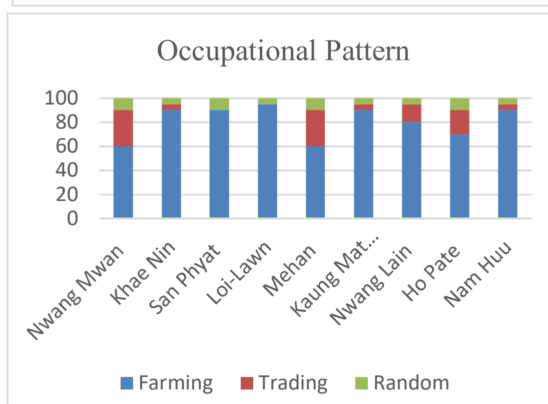

Drinking Water Supply
100
80
60
40
20
0
Nwang...
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung...
Nwang Lain
Ho Pate
Nam Huu
Tube well
Spring water
Purified water
Rain water
Stream water


Sanitation
100
80
60
40
20
0
Nwang Mwan
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung Mat Kyine
Nwang Lain
Ho Pate
Nam Huu
Pit


Waste Disposal
100
80
60
40
20
0
Nwang Mwan
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung Mat Kyine
Nwang Lain
Ho Pate
Nam Huu
Burning
Waste Pond
Municipal

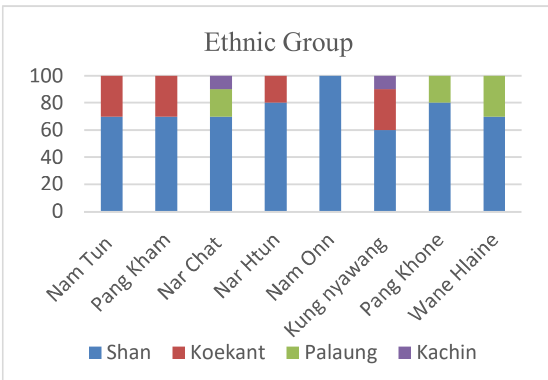

Avaliability of Transportation
100
80
60
40
20
0
Nwang Mwan
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung Mat...
Nwang Lain
Ho Pate
Nam Huu
Bike
car

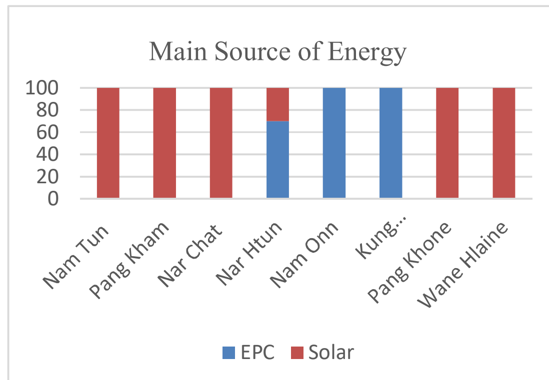

Education
100
80
60
40
20
0
Nwang Mwan
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung Mat...
Nwang Lain
Ho Pate
Nam Huu
Graduate
Highschool
Middleschool
primary school

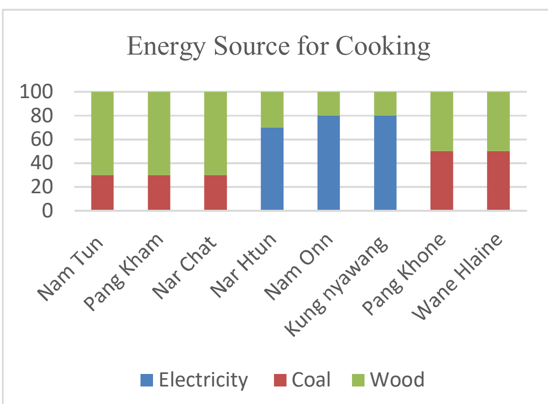

Occupational Pattern
100
80
60
40
20
0
Nwang Mwan
Khae Nin
San Phyat
Loi-Lawn
Mehan
Kaung Mat...
Nwang Lain
Ho Pate
Nam Huu
Farming
Trading
Random

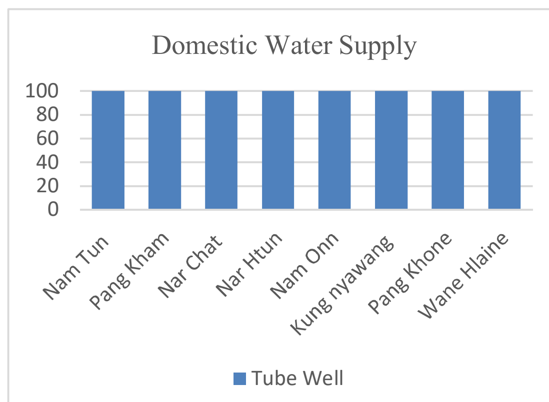
(h) Socio-economic data of Hseni Township

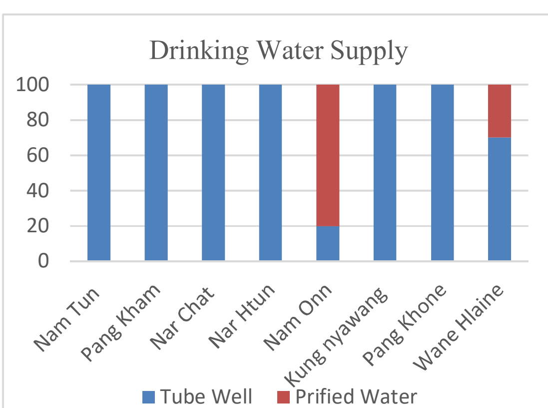
According to the household data collection, Shan, Palaung, Kachin and Koekant are the major ethnic groups within the Hseni Township. The dominant religion of the people in Hseni Township are Buddhist and Christian. Most of the households in this Township obtained their domestic water from tube well and drinking water obtained from tube well and bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and solar energy. In this Township, the main sources of income are from framing, trading and other.

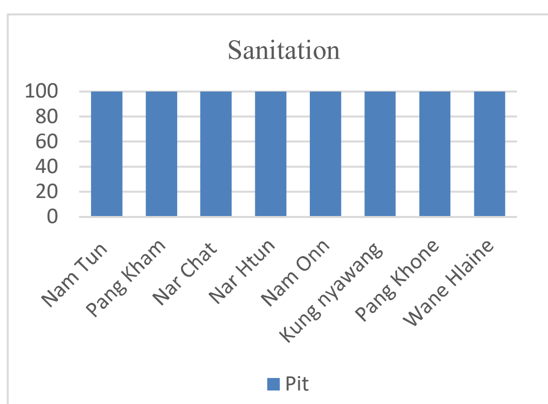


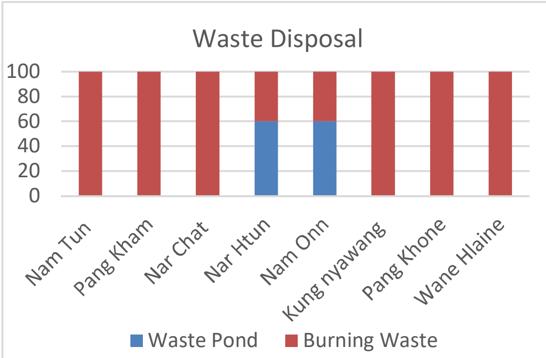


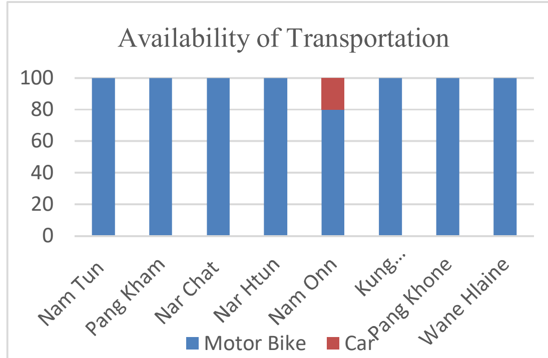


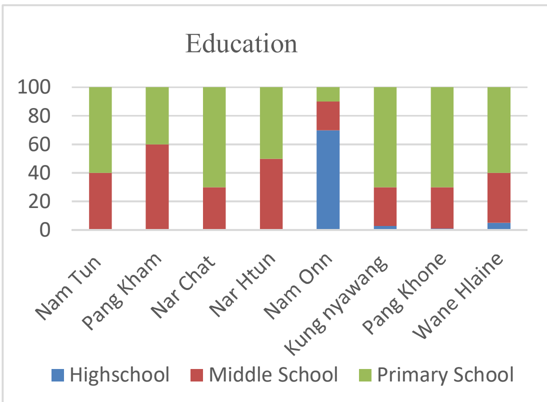


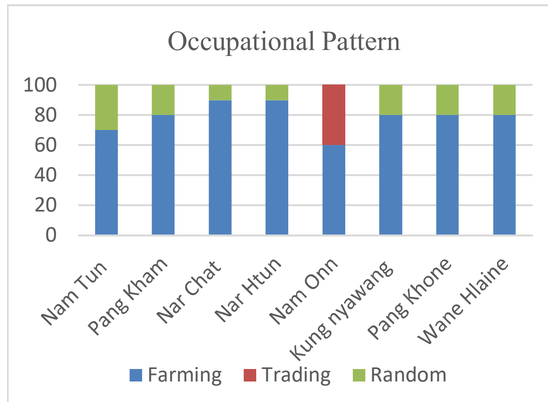






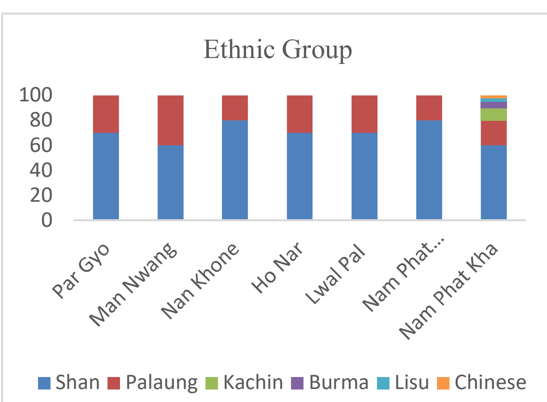


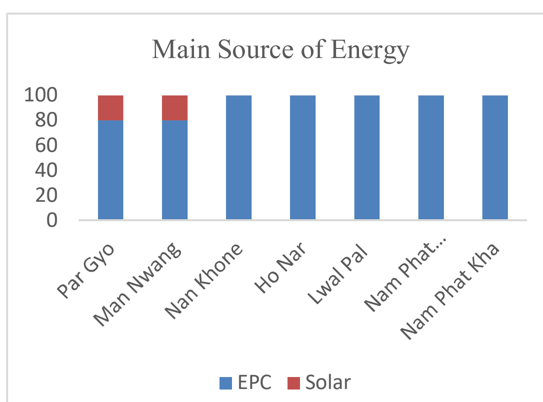


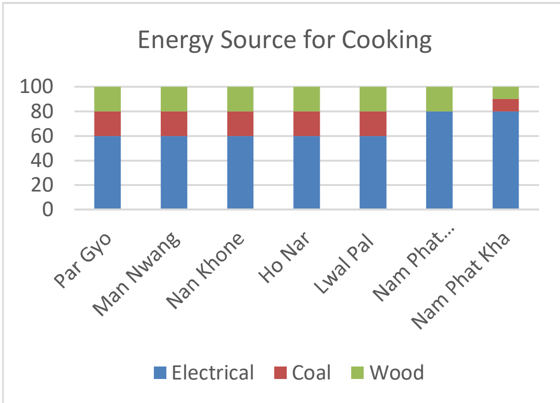


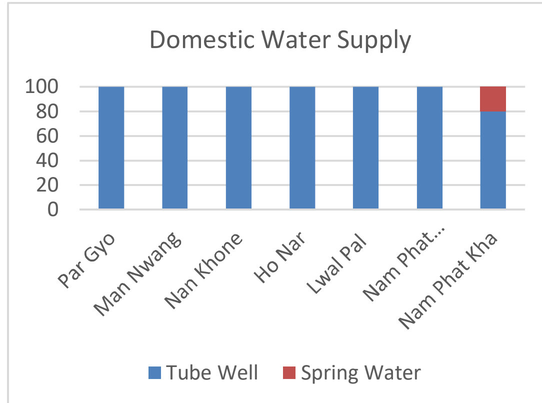
(i) Socio-economic data of Kutkai Township

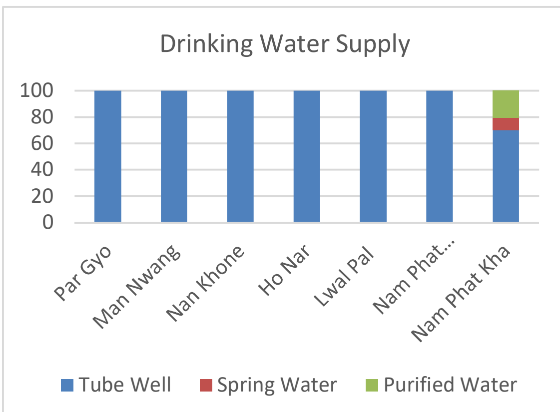
According to the household data collection, Shan, Palaung and Kachin are the major ethnic groups within the Kutkai Township. The dominant religion of the people in Kutkai Township are Buddhist and Christian. Most of the households in this Township obtained their domestic water from tube well and spring water and drinking water obtained from tube well and bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and solar energy. In this Township, the main sources of income are from framing, trading, auto repair shops and other.

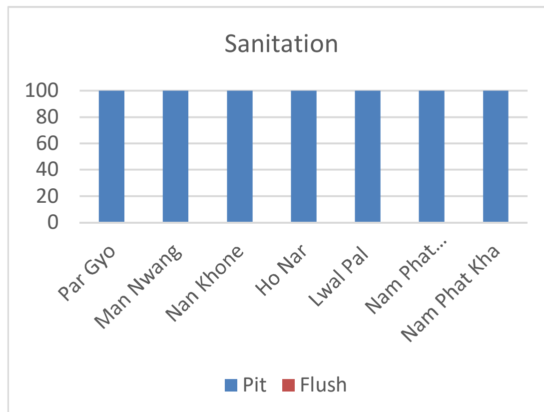


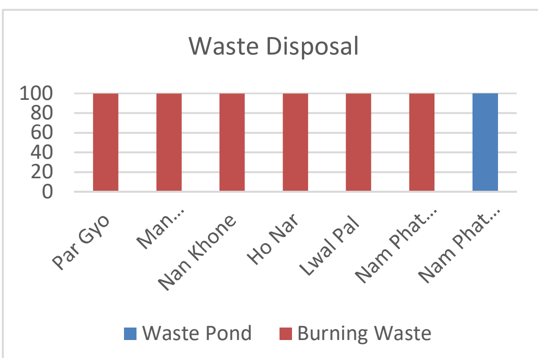


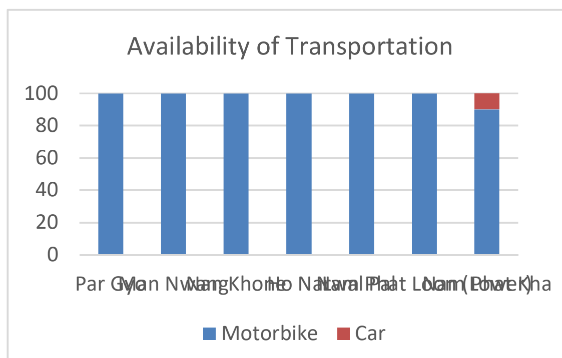

Energy Source for Cooking
100
80
60
40
20
0
Par Gyo
Man Nwang
Nan Khone
Ho Nar
Lwal Pal
Nam Phat...
Nam Phat Kha
Electrical
Coal
Wood

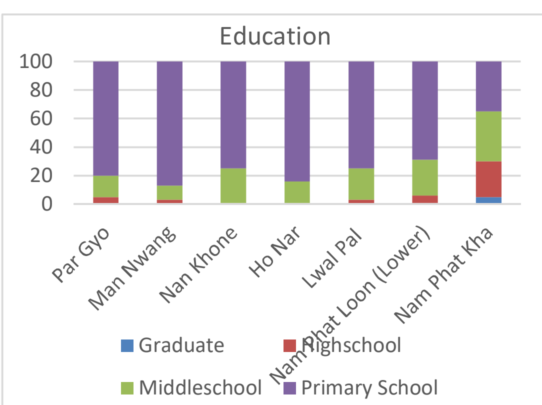

Domestic Water Supply
100
80
60
40
20
0
Par Gyo
Man Nwang
Nan Khone
Ho Nar
Lwal Pal
Nam Phat...
Nam Phat Kha
Tube Well
Spring Water

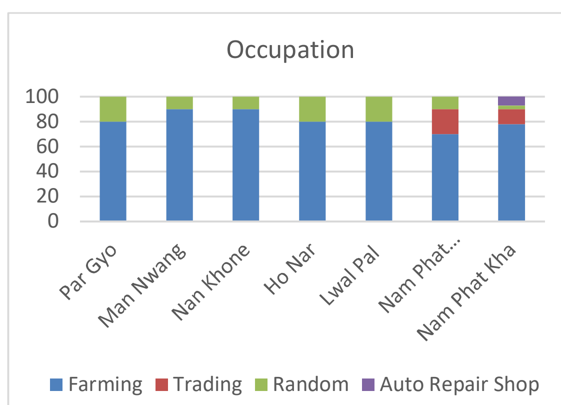

Drinking Water Supply
100
80
60
40
20
0
Par Gyo
Man Nwang
Nan Khone
Ho Nar
Lwal Pal
Nam Phat...
Nam Phat Kha
Tube Well
Spring Water
Purified Water


Sanitation
100
80
60
40
20
0
Par Gyo
Man Nwang
Nan Khone
Ho Nar
Lwal Pal
Nam Phat...
Nam Phat Kha
Pit
Flush


Waste Disposal
100
80
60
40
20
0
Par Gyo
Man...
Nan Khone
Ho Nar
Lwal Pal
Nam Phat...
Nam Phat...
Waste Pond
Burning Waste

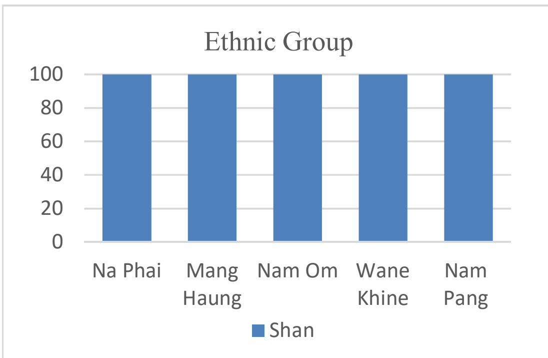

Availability of Transportation
100
80
60
40
20
0
Motorbike
Car

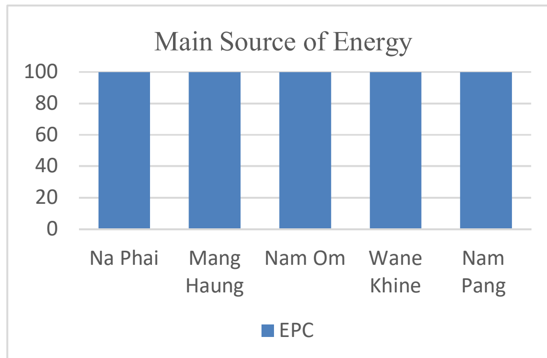

Education
100
80
60
40
20
0
Par Gyo
Man Nwang
Nan Khone
Ho Nar
Lwal Pal
Nam Phat Loon (Lower)
Nam Phat Kha
Graduate
Highschool
Middleschool
Primary School

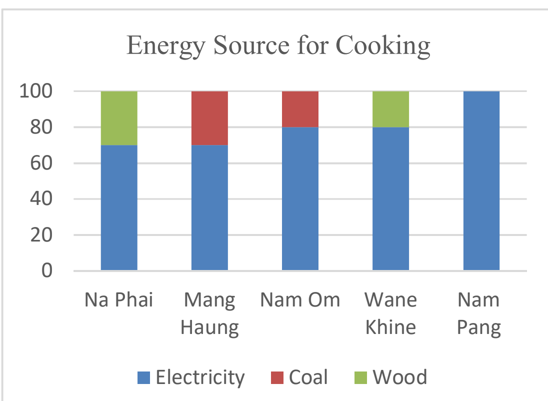

Occupation
100
80
60
40
20
0
Par Gyo
Man Nwang
Nan Khone
Ho Nar
Lwal Pal
Nam Phat...
Nam Phat Kha
Farming
Trading
Random
Auto Repair Shop

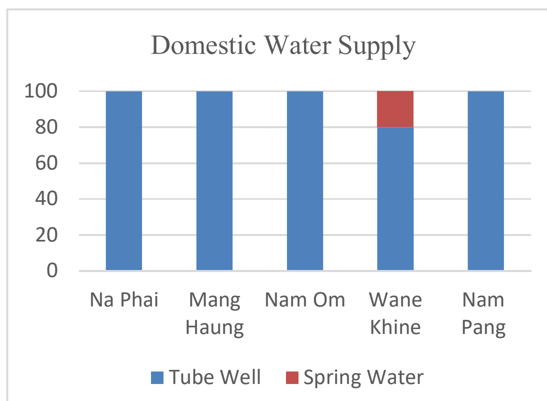
(j) Socio-economic data of Muse Township

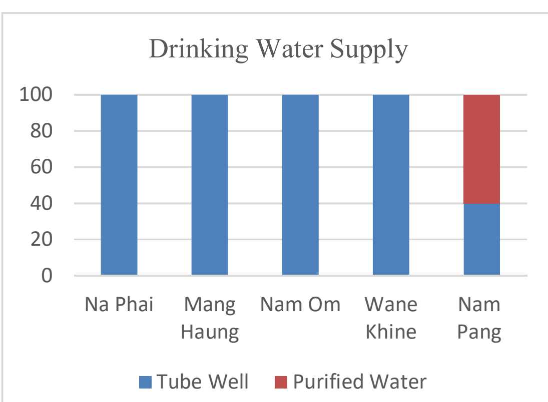
According to the household data collection, Shan are the major ethnic groups within the Muse Township. The dominant religion of the people in Muse Township is Buddhist. Most of the households in this Township obtained their domestic water from tube well and spring water and drinking water obtained from tube well and bottled water. Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC). In this Township, the main sources of income are from framing, trading and other.

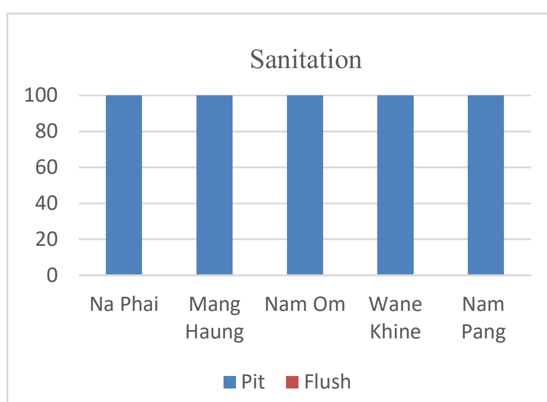


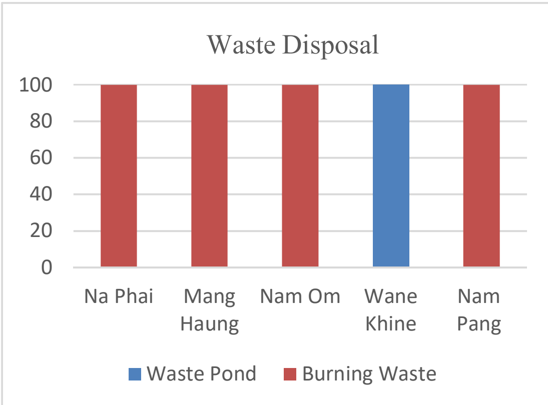


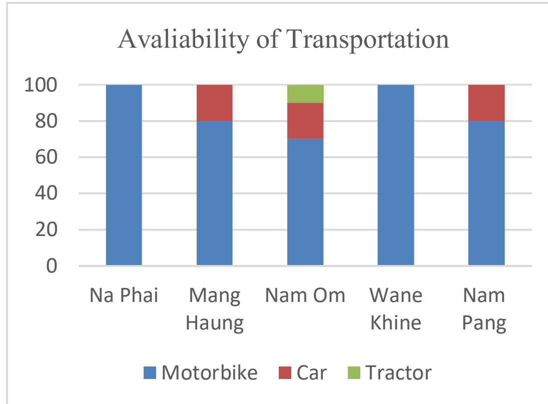


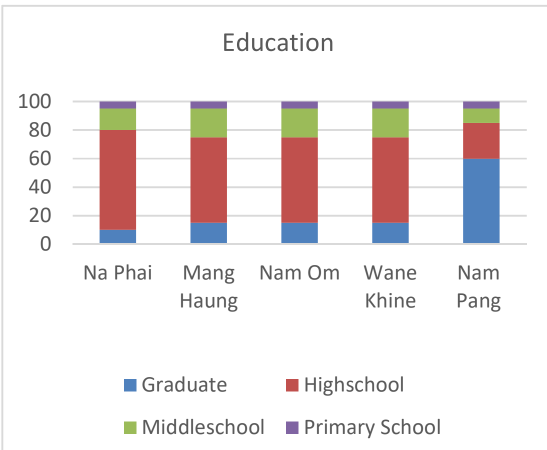












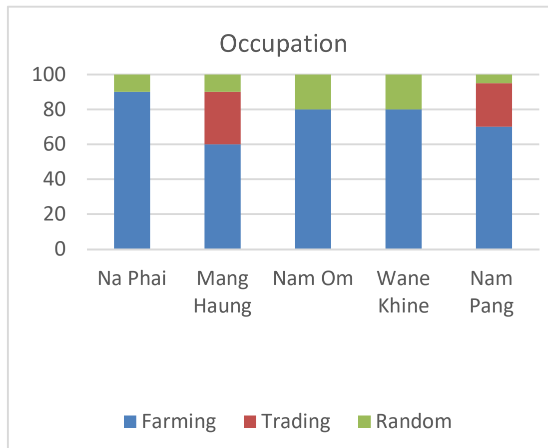


Table 5.43 - Analysis of Primary Data Collection

Baseline Data	Analysis of Baseline Data	
	Mandalay	Shan
Ethic Group	Burma is the major ethic among the townships in Mandalay region.	Shan is the major ethic group while Palaung, Kachin, Koekant, Kayin, Danu are minor ethic group in Shan region.
Main Source of Energy	Majority of electricity is from EPC while in some area, solar energy is also used.	People get electricity mostly from EPC and solar energy except for Muse, its electricity source is mainly from EPC.
Energy Source of Cooking	People mainly use electricity for cooking but in Amarapura, they use wood mainly.	In Shan region, people mostly use electricity to cook but minority of them use coal and wood. While in Hseni and Kyauk Me, they mainly use wood for cooking.
Domestic Water and Drinking Water Supply	Most people use domestic water from tube well while drinking water from bottled water.	Majority of the townships use tube well for its domestic water and also use the well for drinking except for the Muse, people mostly use bottled water to drink.
Sanitation	Pit is the most common use in both regions.	

Waste Disposal	Both the regions burn waste in order to dispose them but in area, they bury it in ground or throw in waste pond.	
Transportation	Bike is the most common in transportation but some also use car.	Bike and bicycle are the mainly use for transportation but car is also used sometimes.
Occupation	People in Mandalay region mostly do industrial works, trading and farming.	In Shan region, farming is the most common occupation while breeding livestock and trading are the second most common.
Average Monthly Income	Overall, people gain more income in Mandalay compare to the working in Shan State and their common income range is within 150000-300000 kyats.	
Education	According to social surveys, it is found that Grade 4 is the most common education level in both region but there are also ones who finished high school or also have high education level.	
Household's Expenditure	People mostly use its expenditure for food but they use it rarely for education and health.	

Secondary Data Collection

The following data shows the reginal data of village tracks that the proposed railway passes through in each township. These data are obtained from 2014 Myanmar Population and Housing Census released from Department of Population Ministry of Labour, Immigration and Population and some are from local information of State/Region from Department of General Administration

(a) National income

Among the areas passed by Muse -Mandalay Railway, except Muse, Lashio and Mandalay, where the per capita income is higher and the people are richer, the other areas have low per capita income and there are more rural poor people.

Figure 5.67- Typical Village Building along the Line

Figure 5.68– Agricultural Lands along the Railway Line

(b) Domestic water supply

In the area along Muse-Mandalay Railway, except parts of the city in Muse, Lashio, Mandalay and other cities have good urban water supply, the living water supply in other towns and rural areas along the line mainly relies on the extraction of shallow groundwater. Groundwater is generally buried at a depth of about 2-3 m. Most of the villages along the railway line are used natural spring water as drinking and domestic water.

Figure 5.69 – Typical Village Well along the Line

Figure 5.70 – Domestic Use for Natural Spring along the Line

(c) Education

The towns of Sintgaing and Pyinoolwin in Mandalay have good basic and higher education. Other towns are too far away from educational centers and lack good teachers and facilities. There are more rural families in Shan State, and it is difficult for their children to go to middle schools. The main reason is that rural areas are far from cities and towns, and poverty in rural families force children to drop out of school and start working to support their families.

(d) Socio-economic Indicators

Mandalay Region Figures at a Glance

Number of Districts	7
Number of Townships/Sub Townships	30
Total Population	6,165,723
Population Male	2,928,367 (47.49%)
Population Female	3,237,356 (52.51%)
Percentage of urban population	35%
Area (Km^2)	30,888.1
Population density (per Km^2)	199.6
Median age	28.2
Number of private households	1,323,191
Sex ratio	91 males per 100 females
Literacy rate (persons aged 15 years and over)	93.8%

Type of Identity Card (persons aged 10 years and over)	Number	Percent
Citizenship Scrutiny	3,903,980	75.8
Associate Scrutiny	4,394	0.1

Naturalised Scrutiny	14,200	0.3	
National Registration	55,423	1.1	
Religious	44,273	0.9	
Temporary Registration	14,579	0.3	
Foreign Registration	1,003	Less than 0.1%	
Foreign Passport	4,360	0.1	
None	1,104,228	21.4	
Labour force participation	Both sexes	Male	Female
Age 10 and over	58.1%	73.2%	44.8%
Age 15 and over	63.9%	81.7%	48.6%
Age 15 - 64	67.9%	85.4%	52.4%
Employment to population ratio	Both sexes	Male	Female
Age 10 and over	56.2%	70.8%	43.3%
Age 15 and over	62.0%	79.3	47.1%
Age 15 - 64	65.7%	82.8%	50.7%
Material for housing	Wall	Floor	Roof
Dhani/Theke/In leaf	2.0%	-	14.0%
Bamboo	72.1%	24.8%	6.7%
Earth	0.1%	23.0%	-
Wood	6.0%	29.5%	0.1%
Corrugated sheet	0.2%	-	74.6%
Tile/Brick/Concrete	18.4%	21.5%	2.0%
Other	1.2%	1.2%	2.6%
Main source of energy for cooking			
Electricity	21.3%		
LPG	0.1%		
Kerosene	Less than 0.1%		
Biogas	0.1%		
Firewood	62.0%		
Charcoal	15.6%		
Coal	0.3%		
Other	0.5%		
Main source of energy for lighting			
Electricity	39.4%		
Kerosene	0.4%		

Candle	14.0%
Battery	22.4%
Generator (private)	11.1%
Water mill (private)	0.7%
Solar system/energy	8.1%
Other	3.9%
Main source of drinking water	
Tap water/piped	11.2%
Tube well, borehole	46.6%
Protected well/spring	18.4%
Bottled/purifier water	9.4%
TOTAL Improved	*85.6%*
Unprotected well/spring	2.0%
Pool/pond/lake	3.5%
River/stream/canal	5.3%
Waterfall/rainwater	1.4%
Other	2.2%
TOTAL Unimproved	*14.4%*
Main source of water for non-drinking use	
Tap water/piped	14.9%
Tube well, borehole	53.8%
Protected well/spring	15.0%
Unprotected well/spring	2.0%
Pool/pond/lake	5.3%
River/stream/canal	5.8%
Waterfall/rainwater	1.0%
Bottled/purifier water	0.1%
Other	2.1%

Availability of communication amenities	
Radio	39.6%
Television	52.7%
Landline phone	4.5%
Mobile phone	40.9%
Computer	3.7%
Internet at home	7.8%
% with none of the items	24.0%
% with all of the items	0.5%

Availability of Transportation equipment	
Car/Truck/Van	4.4%
Motorcycle/Moped	58.2%
Bicycle	39.6%
4-Wheel tractor	1.5%
Canoe/Boat	1.7%
Motor boat	0.5%
Cart (bullock)	28.0%

Shan State Figures at a Glance

Number of Districts	14
Number of Townships/Sub-Township	83
Total Population	5,824,432
Population Male	2,910,710 (49.97%)
Population Female	2,913,722 (50.03%)
Percentage of urban population	24%
Area (Km^2)	155,801.38
Population density (per Km^2)	37.4

Median age	24.4		
Number of private households	1,169,569		
Sex ratio	100 males per 100 females		
Literacy rate (persons aged 15 years and over)	64.6%		
Type of Identity Card (persons aged 10 years and over)	Number	Percent	
Citizenship Scrutiny	2,754,540	59.9	
Associate Scrutiny	5,805	0.1	
Naturalised Scrutiny	16,043	0.4	
National Registration	141,594	3.1	
Religious	18,259	0.4	
Temporary Registration	22,253	0.5	
Foreign Registration	5,071	0.1	
Foreign Passport	11,249	0.2	
None	1,626,375	35.3	
Labour force participation	Both sexes	Male	Female
Age (10 and over)	67.0%	76.6%	57.4%
Age (15 and over)	74.4%	85.9%	63.1%
Age (15 - 64)	77.5%	88.6%	66.4%

Employment to population ratio	Both sexes	Male	Female
Age (10 and over)	65.5%	74.9%	56.3%
Age (15 and over)	73.0%	84.2%	61.9%
Age (15 – 64)	75.9%	86.8%	65.1%
Material for housing	Wall	Floor	Roof
Dhani/Theke/In leaf	0.5%	-	16.5%
Bamboo	47.9%	30.7%	0.4%
Earth	1.3%	11.2%	-
Wood	20.2%	29.3%	0.1%
Corrugated sheet	0.9%	-	75.3%
Tile/Brick/Concrete	28.4%	27.6%	7.1%
Other	0.8%	1.2%	0.6%

Main source of energy for cooking	
Electricity	15.1%
LPG	0.2%
Kerosene	0.1%
Biogas	0.7%
Firewood	76.7%
Charcoal	6.8%
Coal	0.2%
Other	0.2%
Main source of energy for lighting	
Electricity	33.4%
Kerosene	4.0%
Candle	17.3%
Battery	3.8%
Generator (private)	2.0%
Water mill (private)	10.2%
Solar system/energy	26.6%
Other	2.7%
Main source of drinking water	
Tap water/piped	20.0%
Tube well, borehole	5.6%
Protected well/spring	17.7%

Bottled/purifier water	11.4%
TOTAL Improved	*54.7%*
Unprotected well/spring	9.0%
Pool/pond/lake	4.2%
River/stream/canal	9.9%
Waterfall/rainwater	17.3%
Other	4.9%
TOTAL Unimproved	*45.3%*

Main source of water for non-drinking use	
Tap water/piped	24.2%
Tube well, borehole	6.9%
Protected well/spring	19.9%
Unprotected well/spring	8.6%
Pool/pond/lake	4.8%
River/stream/canal	12.4%
Waterfall/rainwater	17.3%
Bottled/purifier water	0.2%
Other	5.7%
Availability of communication amenities	
Radio	23.3%
Television	54.6%
Landline phone	4.9%
Mobile phone	34.4%
Computer	2.9%
Internet at home	3.9%
% with none of the items	34.1%
% with all of the items	0.4%
Availability of Transportation equipment	
Car/Truck/Van	4.5%
Motorcycle/Moped	63.6%
Bicycle	12.3%
4-Wheel tractor	6.9%
Canoe/Boat	1.6%
Motor boat	0.7%
Cart (bullock)	17.8%

(e) Overview of Important Economic Nodes along the Proposed Project

Myanmar is located in the west of Indo-China Peninsula in Southeast Asia. It is bordered by India and Bangladesh in the northwest, China in the northeast, Thailand and Laos in the southeast, the Andaman Sea in the south, the Bay of Bengal in the southwest and the total length of the coastline is 1930 km. The country has seven provinces, seven states and two central municipalities directly under the Central Government. Its territory area is about 67.65×104 km^2. It is the fortieth largest country in the world and the second largest country in Southeast Asia. In 2017, the total population was 53.39 million, ranking 26th in the world, with an urbanization rate of 34.7%.

In recent years, the government has carried out economic system reform aimed at establishing a market economy, encouraged the development of private enterprises and actively introduced foreign capital. The gross domestic product (GDP) has grown significantly. The total GDP in2015/16 is about 55.813 billion USD, and the per capita GDP is about 1064 USD. Compared with 2014/15, it has increased by 7%, and the average growth rate in recent years is about 7%, which is much higher than the average growth rate of the Association of Southeast Asian Nations (ASEAN) of 4.5%.

This line directly attracts Shan and Mandalay provinces. The main economic data of the two provinces are shown in the table below.

Table 5.44- Major Economic Indicators for the Fiscal Year 2015/2016 along the Line

Indicator	Unit	Mandalay Province	Shan State	Total
Area	10^4 km^2	3.7	15.58	19.28
Population	10,000 persons	615	619	1234
Population density	person/km^2	166	40	64
GDP	100 million USD	53.53	61.36	114.89
Per capita GDP	USD	870.48	991.25	931.06

Muse: Muse is located on the northern border of Shan State, with a population of about 450,000 (2014). Muse Port is the largest land trade port between Myanmar and China, with a trade volume of 5.8 billion USD in fiscal year 2017-2018, accounting for 86% of the border trade between Myanmar and China, ranking the first.

Lashio: Lashio is a city in northern Myanmar. It is a military, political, economic and transportation center in northern Shan State. It is also an important gateway to China in northern Myanmar. It is about 130 km away from the border port city Wanding of Yunnan

Province in China. It is the end point of the Sino-Myanmar Highway. Lashio is about 280 km away from Mandalay, Myanmar's second largest city, with a population of about 610,000. The main crops are rice, corn, tea, coffee and tobacco. The main minerals are coal, iron, oil, natural gas, rutile and a variety of non-ferrous metals. The meter-gauge railway links Mandalay, and the highway connects Taunggyi, capital of Shan State, in the south, and Yunnan, China, in the north. Rangoon, Myanmar's second largest city can also be reached by airlines.

Mandalay: Mandalay provincial capital, the 2nd largest city in Myanmar, is located at the intersection of the four economic corridors in the country (north-south, east-west, northeast-southwest corridors). It is an economic, educational, transportation and medical center in northern Myanmar. As of October 2017, the total population of Mandalay City was 17.227 million, accounting for 27% of the province. The GDP in fiscal year 2015/2016 was about 2.5 billion USD, accounting for 41% of the province. The industrial structure of agriculture, industry and service industry was 3.5: 38.0: 58.5, mainly in service industry.

(f) Population and Nationality

Myanmar has a rich and colorful culture. There are 135 ethnic groups, including Bama and some ethnic minorities, such as Kachin, Kaye, Karen, Mon, Ruokai and Shan. Two states/provinces with different ethnic groups living are passed by this project. Details are as follows:

Shan State: The total population is about 6.19 million. The main ethnic groups are Wa, Shan, Kachin, Lahu, Balang and Chinese.

Mandalay Province: The total population is about 6.15 million. The main ethnic groups are Burmese and Dai. The nations along the line are shown in the table below.

Table 5.45 -Nationalities Distribution along the Project Area

State/Region	Main nation	Other nations
Mandalay Region	Bamar	Mostly are Han-Chinese, Indians and Shan, etc.
Shan State	Shan	Pa-O, Dai, Dongan Qiao, Danu, Blang, etc.

Generally speaking, the population of Lashio and Ayeyarwady River Plain is denser, while the population of Ruokai Mountains is sparse, and part of it belongs to no-man land.

Ethic Group near the proposed project

Muse

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	24021	151868	15.81%
2	Kaya	15		0.009%

3	Kayin	228		0.15%
4	Chin	158		0.1%
5	Mon	17		0.01%
6	Burma	21006		13.83%
7	Ya Khine	114		0.07%
8	Shan	58332		38.43%
9	Pa Laung	12721		8.38%
10	Le Sue	2365		1.56%
11	Le Shaw	1549		1.02%
12	Wa	138		0.09%
13	Larhu	9		0.005%
14	Mone Won	9544		6.28%
15	Koe Kkant	2512		1.65%
16	Pa-Oh	3		0.002%
17	Foreigner	19136		12.6%

Lashio

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	18162	296392	6.13
2	Kaya	66		0.02
3	Kayin	1736		0.46
4	Chin	1333		0.45
5	Mon	154		0.05
6	Burma	49379		16.66
7	Ya Khine	610		0.21
8	Shan	89364		30.15
9	Pa Oh	45		0.02
10	Da Nu	30		0.01
11	Pa Laung	26217		8.85
12	Koe Kant	73053		24.65
13	Lah Hu	5522		1.9
14	Le Sue	3415		1.15
15	Le Shaw	589		0.19
16	Wa (Lwal La)	7080		1.72
17	Myaung Ze	749		0.22
18	Mone Won	10747		0.02
19	Other	6854		2.31
20	Foreigner	1282		0.43

Si Paw

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	581	193170	0.301
2	Kaya	21		0.011
3	Kayin	153		0.079
4	Chin	186		0.096
5	Mon	21637		11.201
6	Burma	5		0.003

7	Ya Khine	166		0.087
8	Shan	146269		75.720
9	Da Nu	52		0.027
10	Koe Kant	1818		0.941
11	Le Shaw	49		0.025
12	Pa Laung	15250		7.895
13	Lah Hu	140		0.072
14	Le Sue	2139		1.107
15	Other	3278		1.697
16	Wa (Lwal La)	771		0.399
17	Mone Won	593		0.307
18	Inn Thar	4		0.002
19	Pa Oh	5		0.003
20	Foreigner	53		0.027

Thein Ni

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	5176	58428	8.85
2	Kaya	-		-
3	Kayin	102		0.17
4	Chin	118		0.20
5	Mon	18		0.03
6	Burma	3019		5.15
7	Ya Khine	72		0.12
8	Shan	30764		53.03
9	Pa Oh	8		0.01
10	Da Nu	14		0.02
11	Mone Won (Koe Kant)	10466		17.58
12	Pa Laung	1997		3.40
13	Le Shaw	354		0.6
14	Le Sue	1496		2.58
15	Lah Hu	3086		5.25
16	Lwal La (Wa)	558		0.95
17	Myaung Sie	688		1.17
18	Other	500		0.85

Kutkai

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	45798	191222	24
2	Kaya	18		0.009
3	Kayin	105		0.054
4	Chin	96		0.06
5	Mon	23		0.012
6	Burma	4507		2.36
7	Ya Khine	93		0.05
8	Shan	12699		6.64
9	Pa Laung	47757		25
10	Le Sue	2558		1.34

11	Myaung Ze	521		0.27
12	Koe Kant	4435		2.32
13	Mone Won	55252		29
14	Le Shaw	10033		5.3
15	Inn Thar	5		0.003
16	Da nu	7		0.004
17	Lah Hu	14		0.01
18	Other	1140		0.6

Naung Cho

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	1368	132433	1.03
2	Kaya	22		0.02
3	Kayin	215		0.2
4	Chin	265		0.2
5	Mon	44		0.03
6	Burma	31927		24.09
7	Ya Khine	143		0.1
8	Shan	44808		33.8
9	Da Nu	47756		36.03
10	Koe Kant	810		0.61
11	Pa Laung	324		0.24
12	Lah Hu	143		0.1
13	Le Sue	286		0.21
14	Other	4322		3.26

Pyin Oo Lwin

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	11904	215293	5.52
2	Kaya	49		0.02
3	Kayin	1028		0.47
4	Chin	907		0.42
5	Mon	28		0.01
6	Burma	172553		80.15
7	Ya Khine	92		0.04
8	Shan	15005		6.97
9	Pa Oh	-		-
10	Da Nu	-		-
11	Taung Yoe	-		-
12	Pa Laung	-		-
13	Other	13582		6.31

Patheingyi

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	39	227613	0.02
2	Kaya	4		0.0001
3	Kayin	69		0.03

4	Chin	34		0.01
5	Mon	26		0.01
6	Burma	226892		99.98
7	Ya Khine	40		0.02
8	Shan	317		0.14
9	Other	-		-

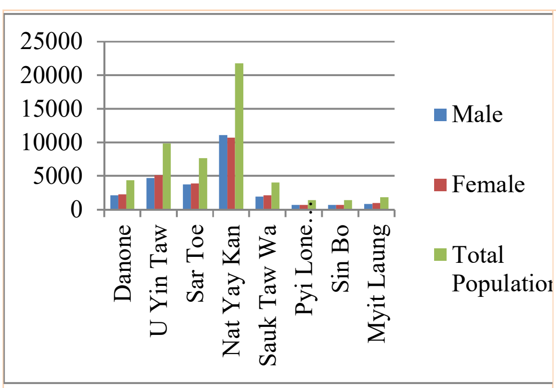
Amarapura

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	18	203359	0.008
2	Kaya			
3	Kayin	11		0.005
4	Chin	43		0.021
5	Mon	4		0.002
6	Burma	203254		99.948
7	Ya Khine	17		0.008
8	Shan	12		0.005

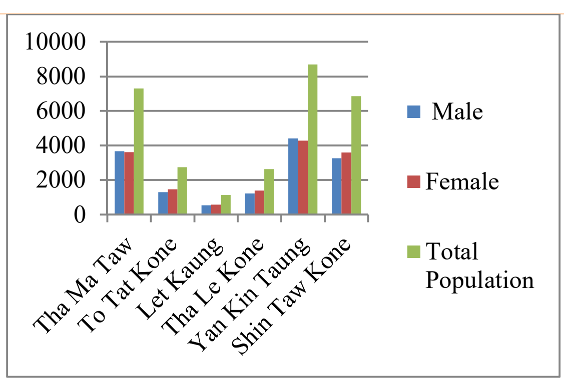
Kyauk me

No.	Ethnic Group	Population	Total Population	Population %
1	Kachin	3431	173724	1.97
2	Kayin	190		0.11
3	Chin	134		0.08
4	Mon	35		0.02
5	Burma	23487		13.77
6	Ya Khine	140		0.08
7	Shan	99273		57.14
8	Da Nu	1012		0.58
9	Koe Kant	1944		1.12
10	Pa Laung	32230		18.55
11	Wa	34		0.02
12	Le Shaw	96		0.06
13	Le Sue	728		0.42
14	Other	4849		2.85

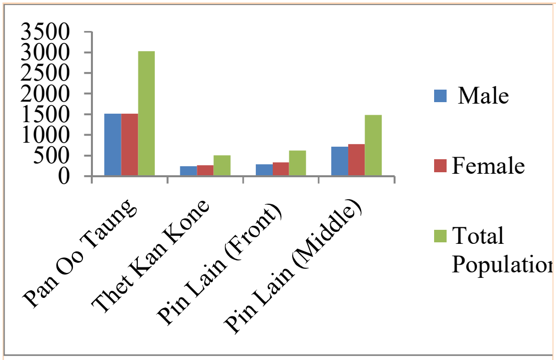
Resulting from Secondary Data Collection For Each Township
(1) Population and Gender



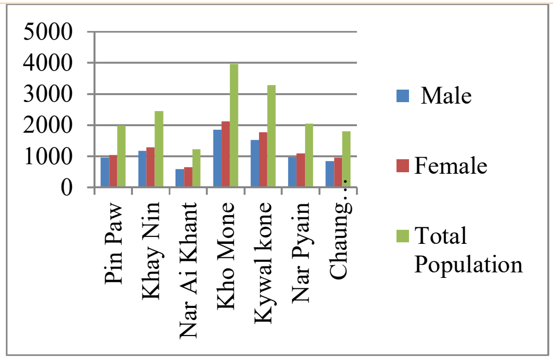
Amarapura Township



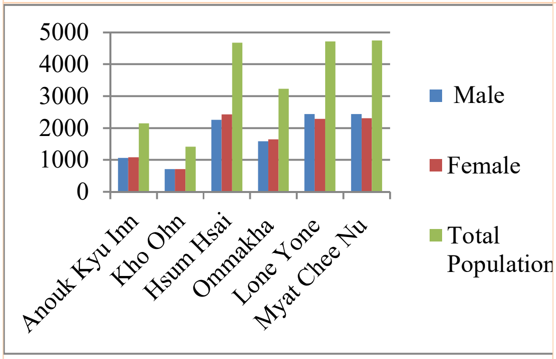
Pathein Gyi Township



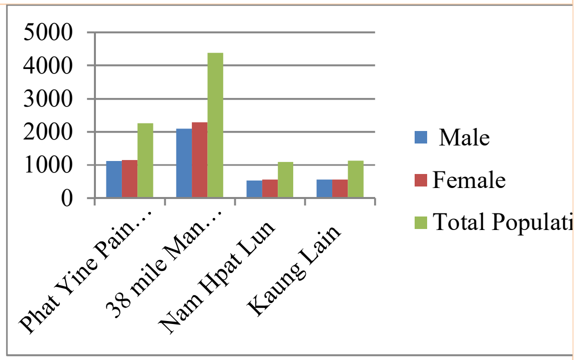
Pyin Oo Lwin Township



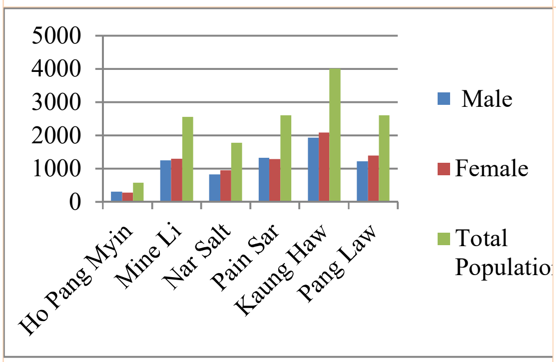
Kyaukme Township



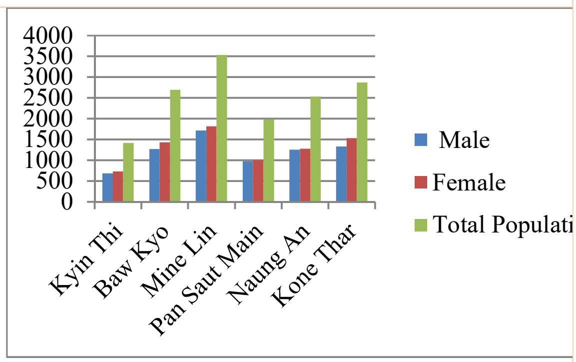
Nwang Hkio Township



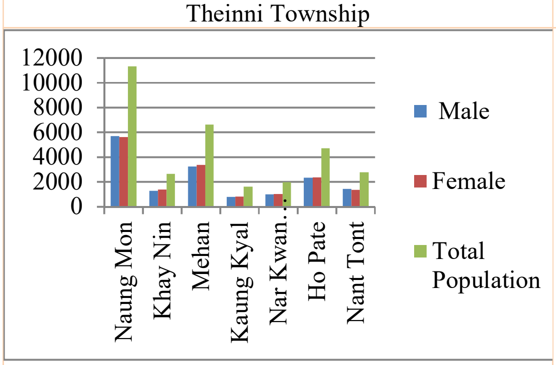
Kutkai Township



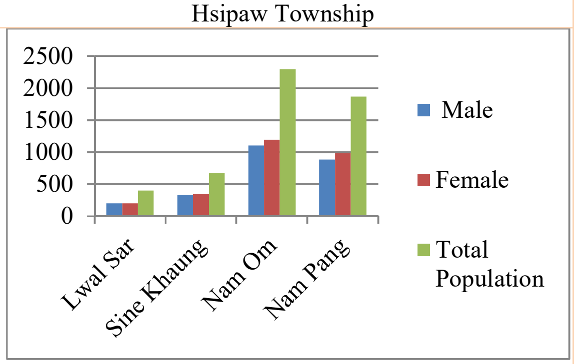
Theinni Township



Hsipaw Township

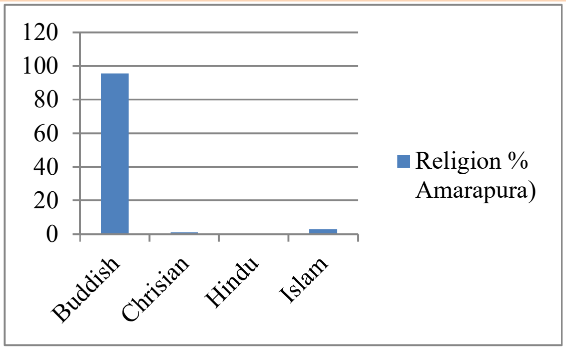


Lashio Township

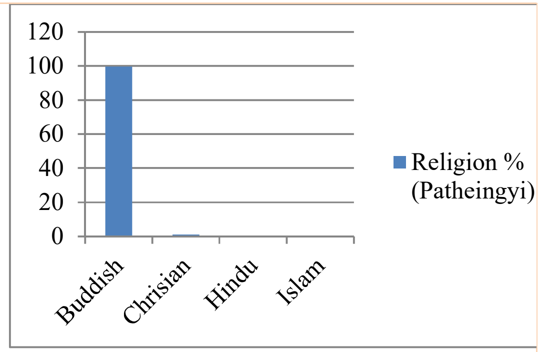


Muse Township

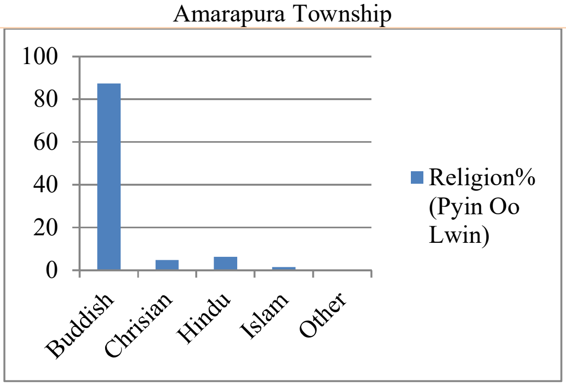
(2) Religion



Amarapura Township



Pathein Gyi Township



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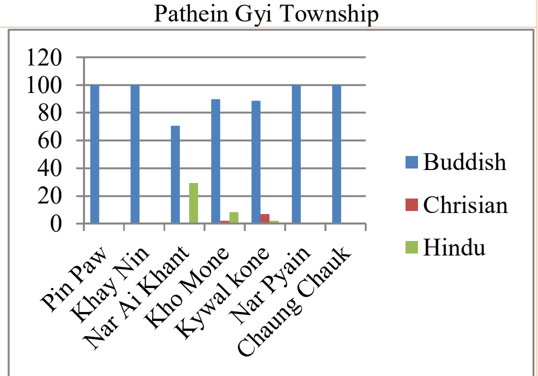
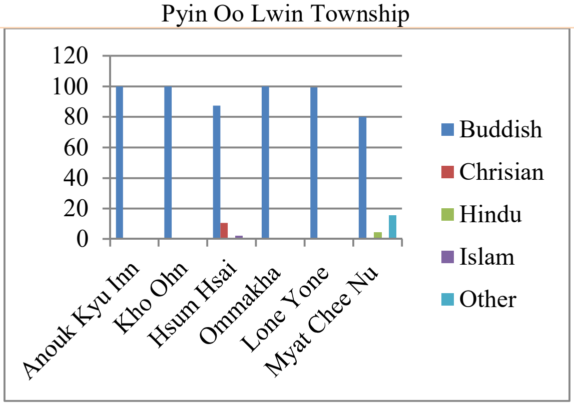


Kyaukme Township



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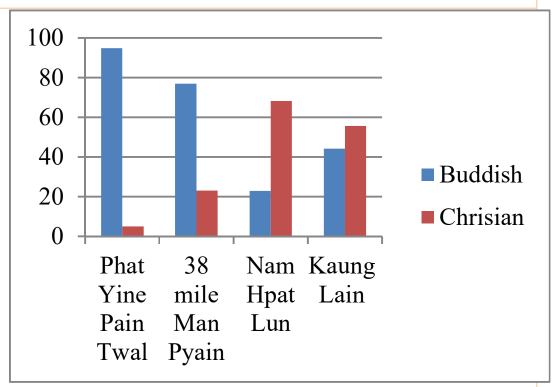
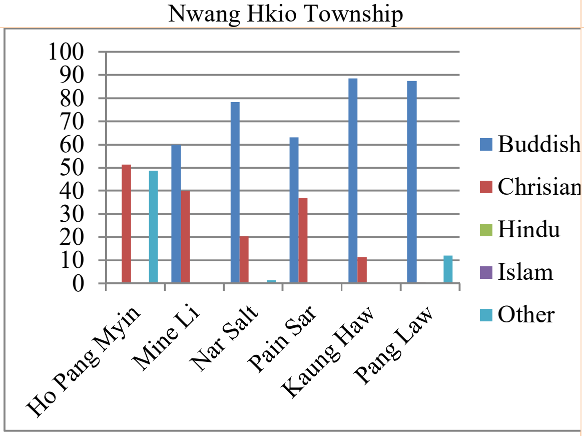
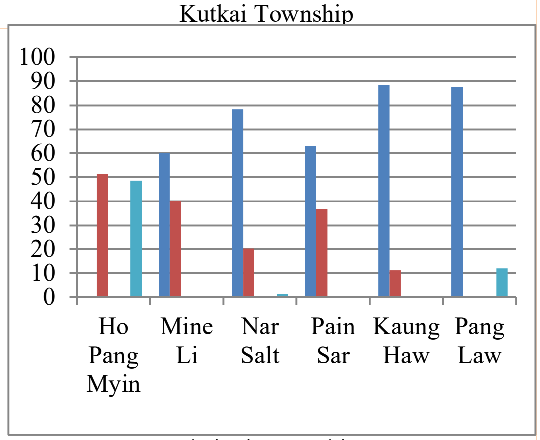


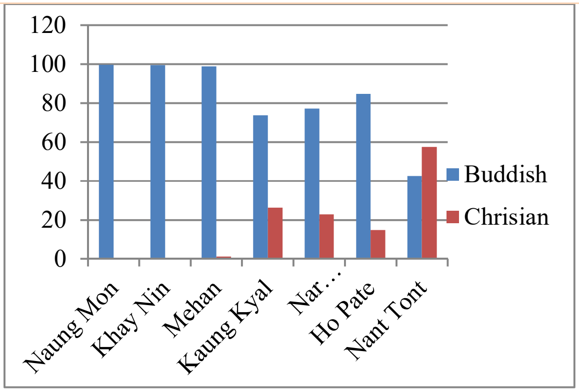
Kutkai Township



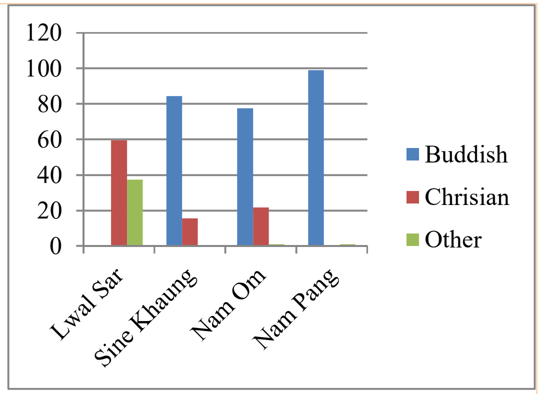
Hsipaw Township



Theinni Township

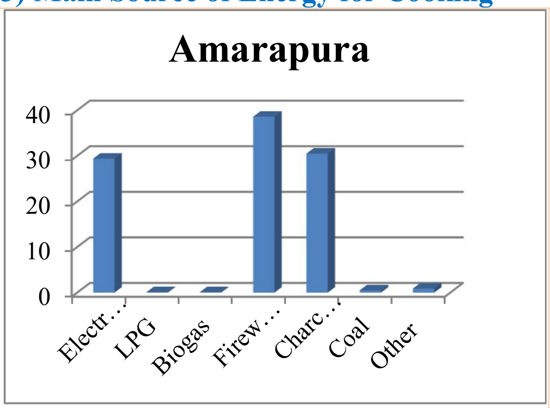


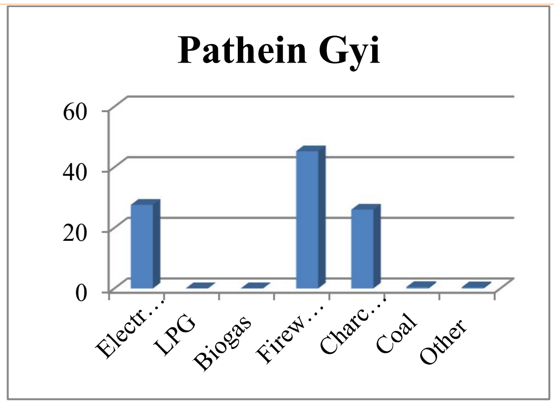
Lashio Township

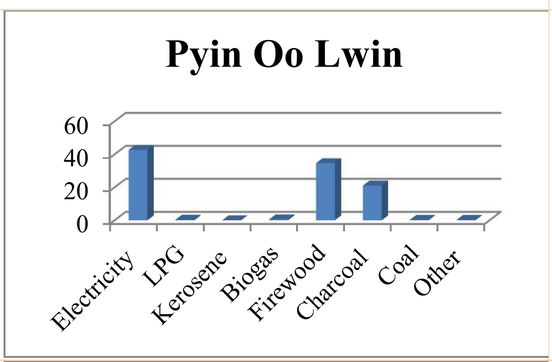


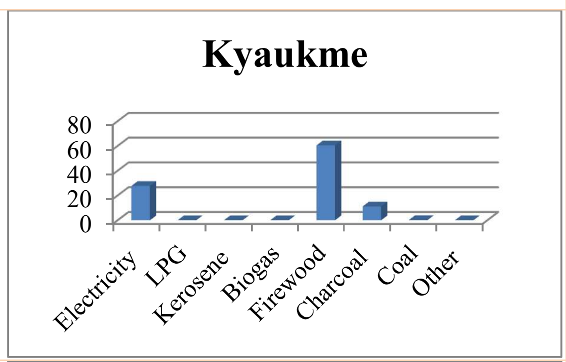
Muse Township

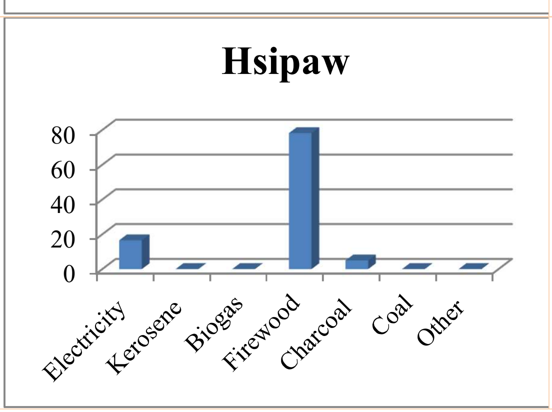
(3) Main Source of Energy for Cooking

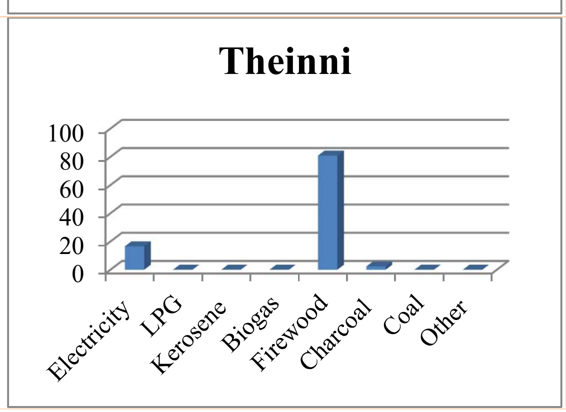


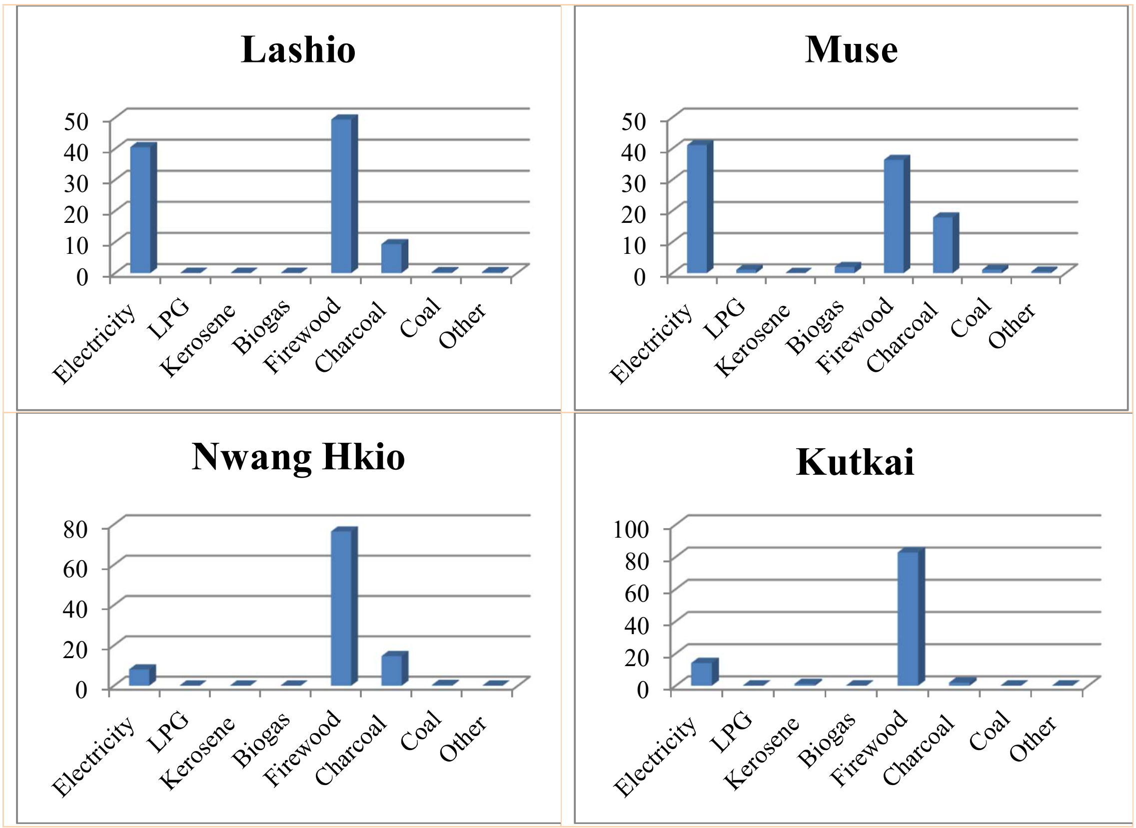




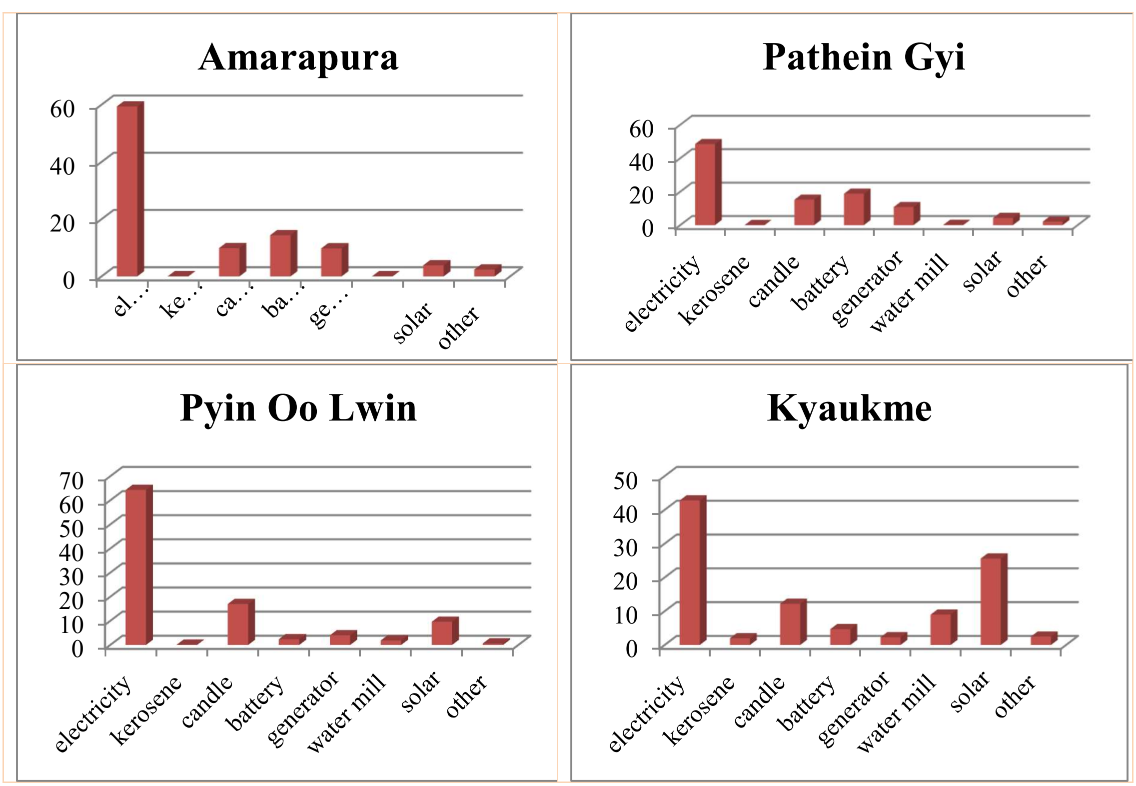


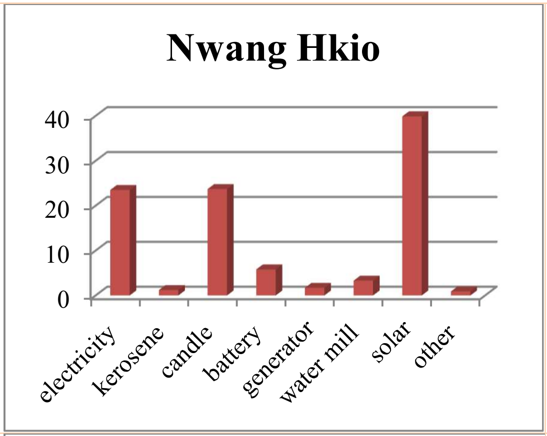


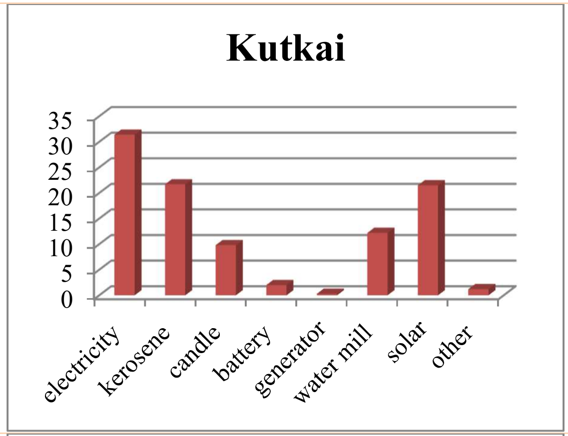


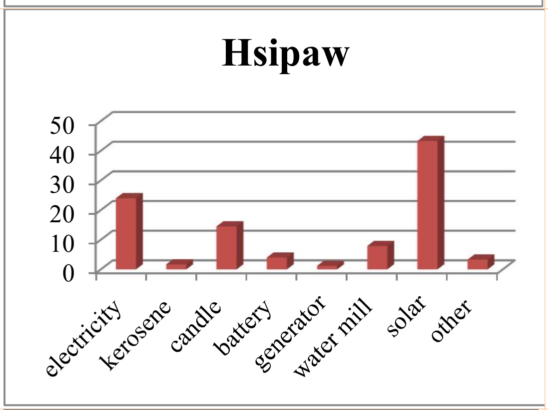


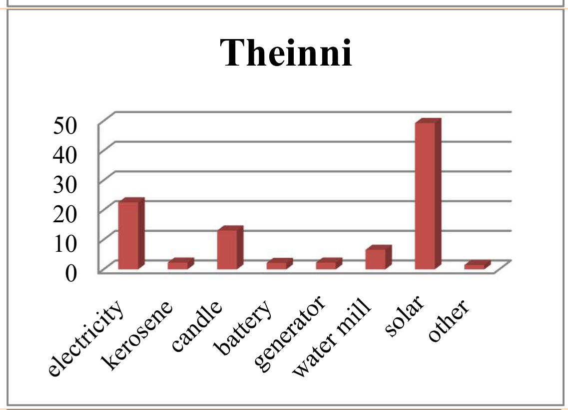
(4) Main Source of Energy

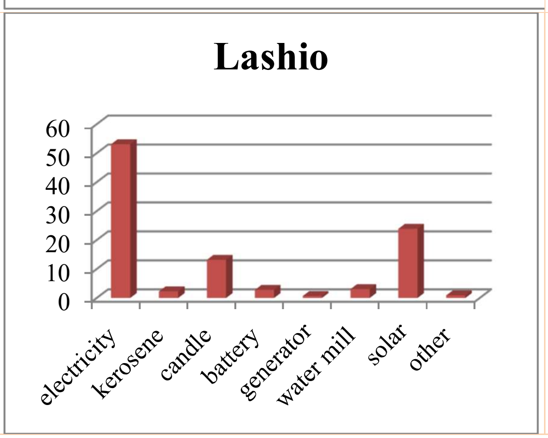


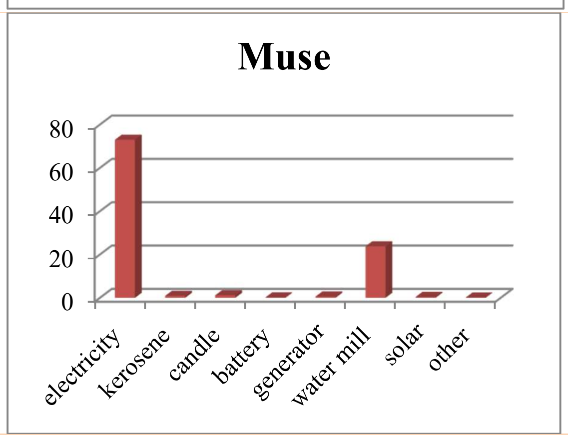




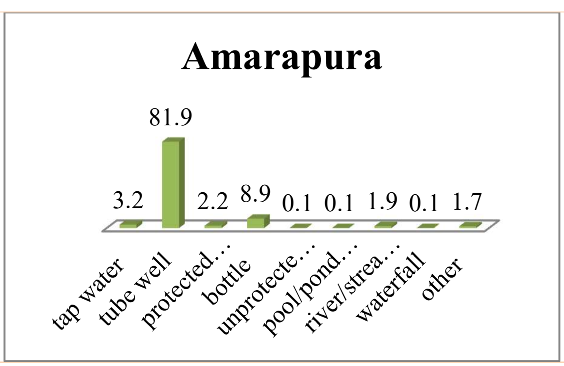


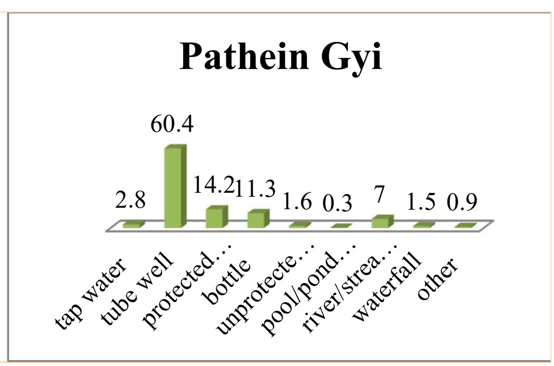


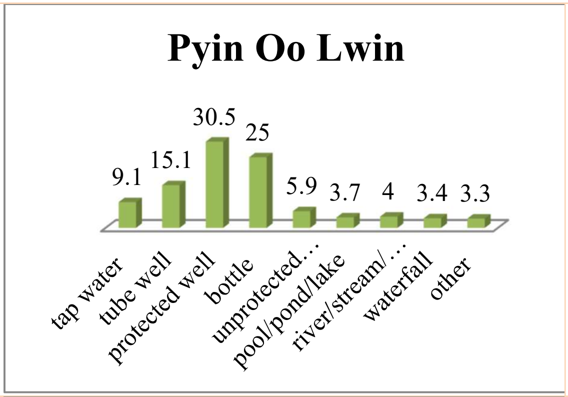


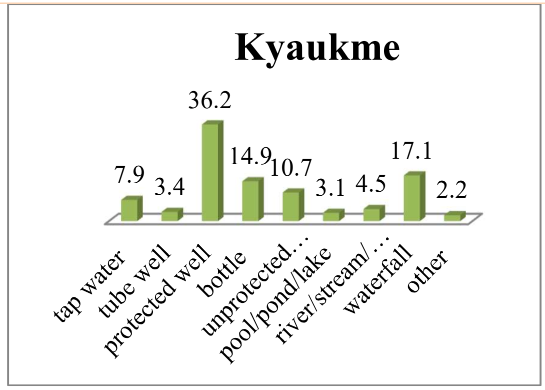


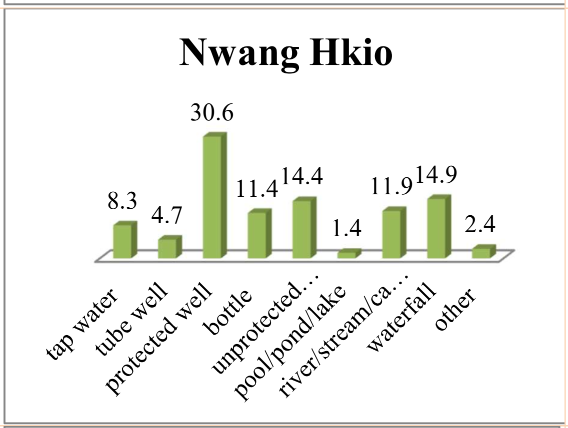
(5) Drinking Water Source

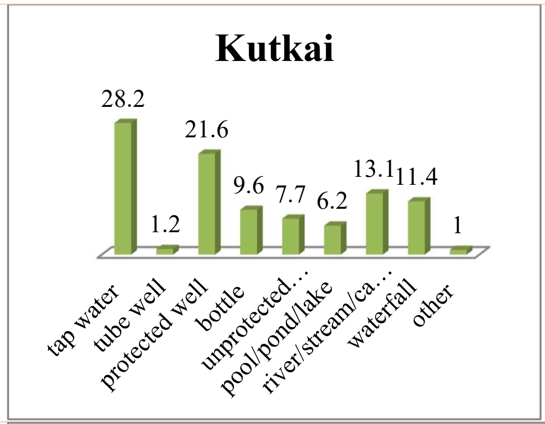


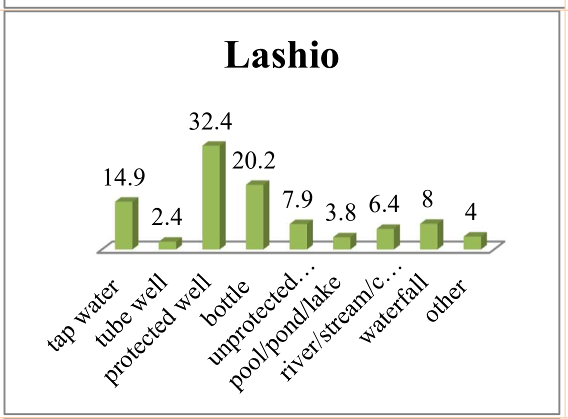


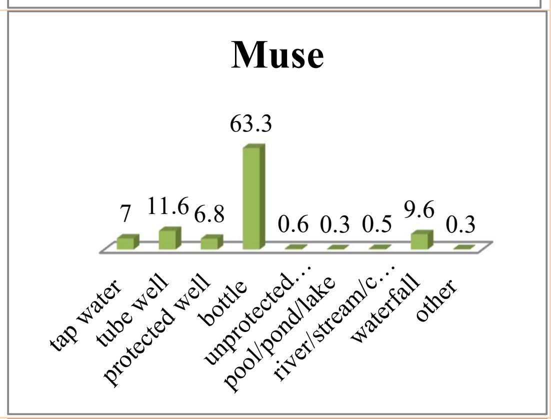

Pyin Oo Lwin
9.1
15.1
30.5
25
5.9
3.7
4
3.4
3.3
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/…
waterfall
other

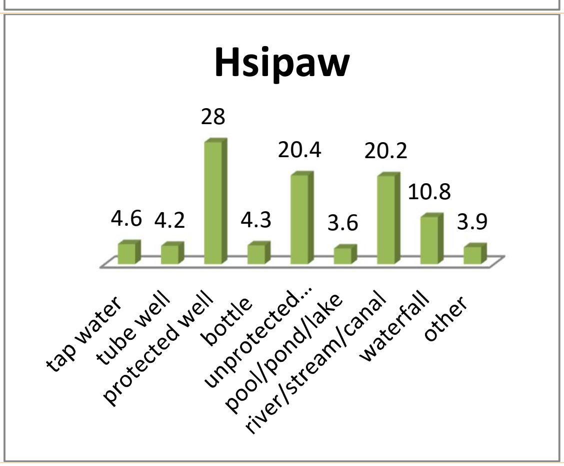

Kyaukme
7.9
3.4
36.2
14.9
10.7
3.1
4.5
17.1
2.2
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/…
waterfall
other

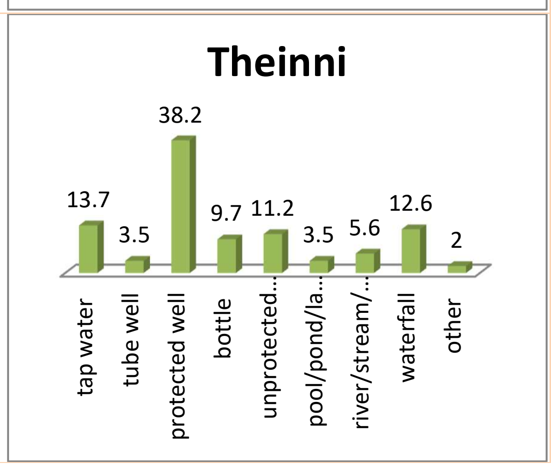

Nwang Hkio
8.3
4.7
30.6
11.4
14.4
1.4
11.9
14.9
2.4
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/ca…
waterfall
other


Kutkai
28.2
1.2
21.6
9.6
7.7
6.2
13.1
11.4
1
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/ca…
waterfall
other

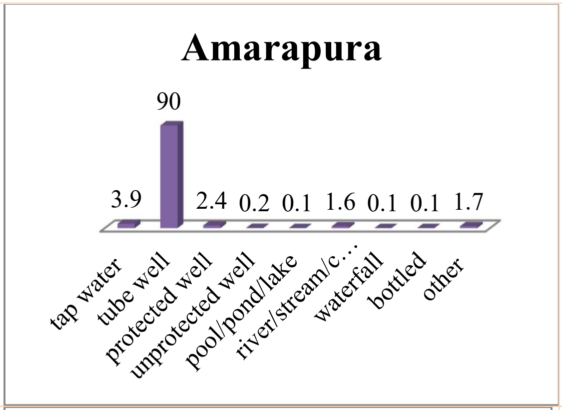

Lashio
14.9
2.4
32.4
20.2
7.9
3.8
6.4
8
4
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/c…
waterfall
other

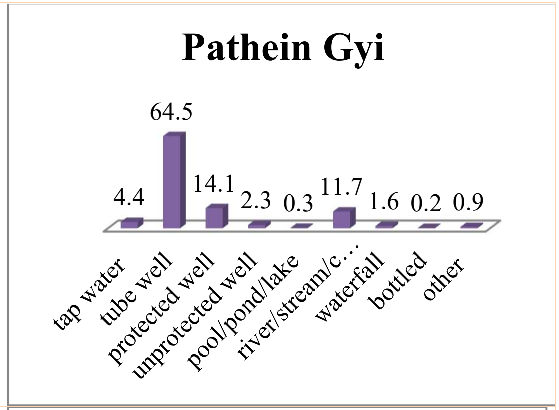

Muse
7
11.6
6.8
63.3
0.6
0.3
0.5
9.6
0.3
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/c…
waterfall
other

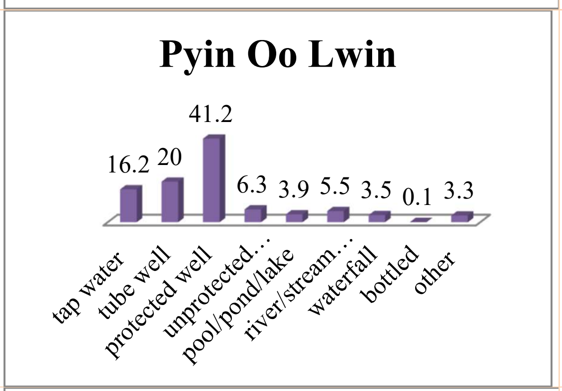

Hsipaw
4.6
4.2
28
4.3
20.4
3.6
20.2
10.8
3.9
tap water
tube well
protected well
bottle
unprotected…
pool/pond/lake
river/stream/canal
waterfall
other

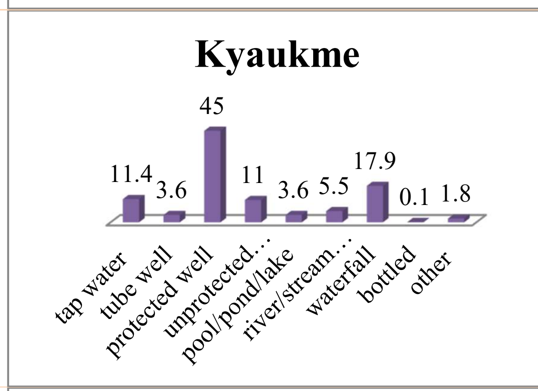

Theinni
13.7
3.5
38.2
9.7
11.2
3.5
5.6
12.6
2
tap water
tube well
protected well
bottle
unprotected…
pool/pond/la…
river/stream/…
waterfall
other

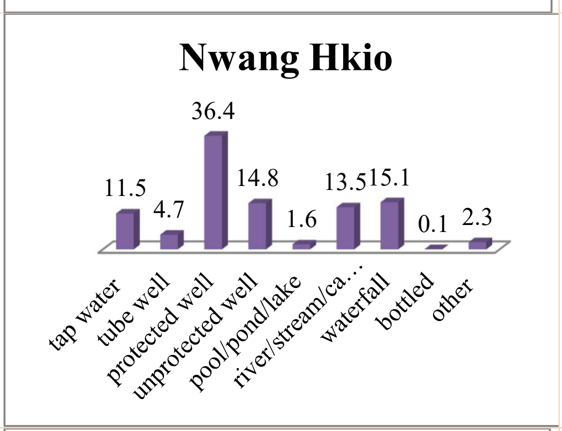
(6) Domestic Water Supply

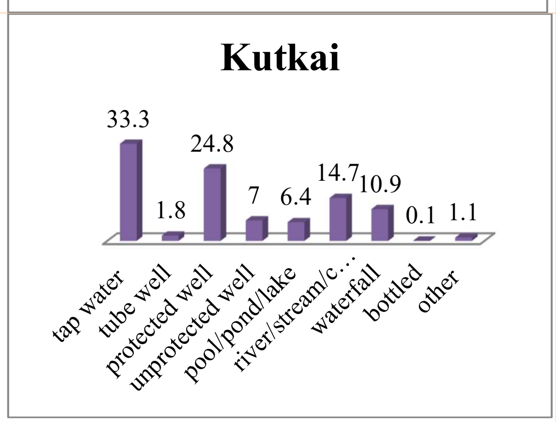


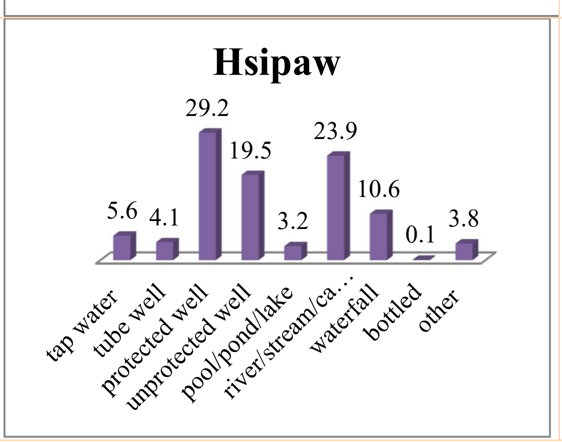


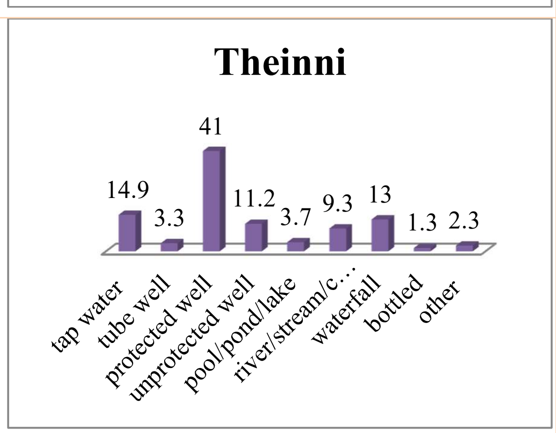


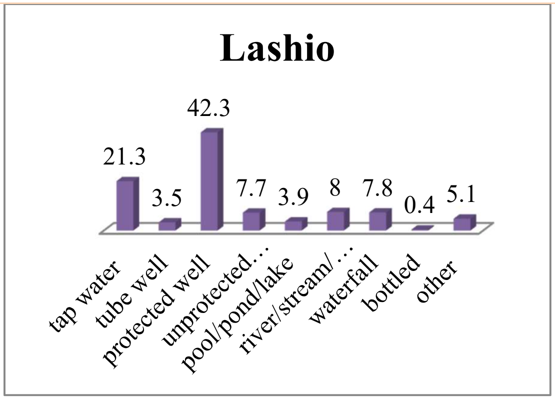


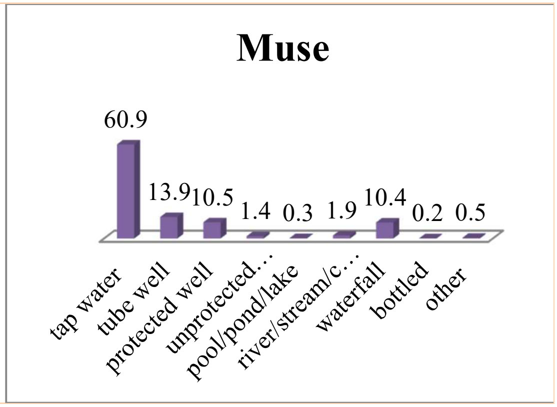












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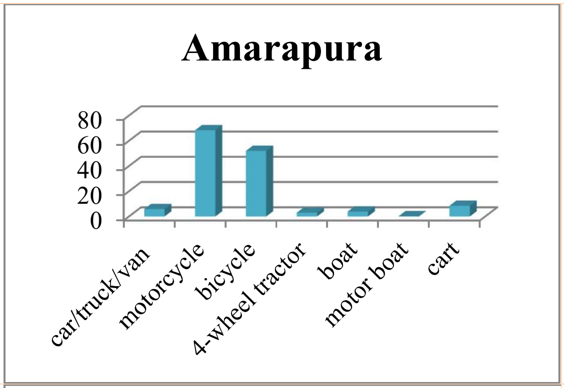
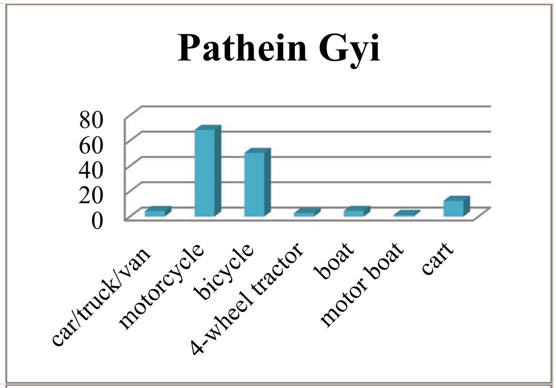
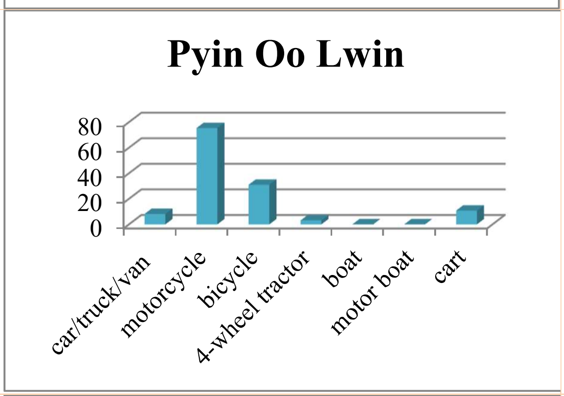
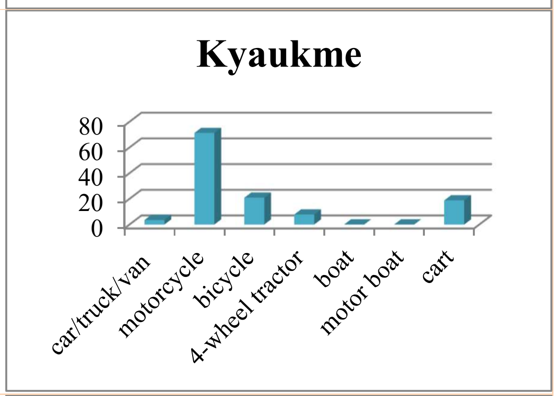
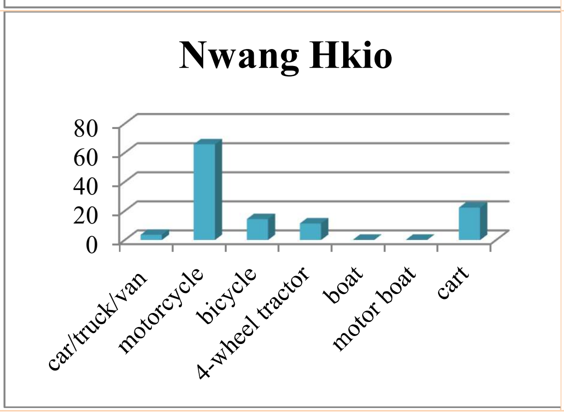
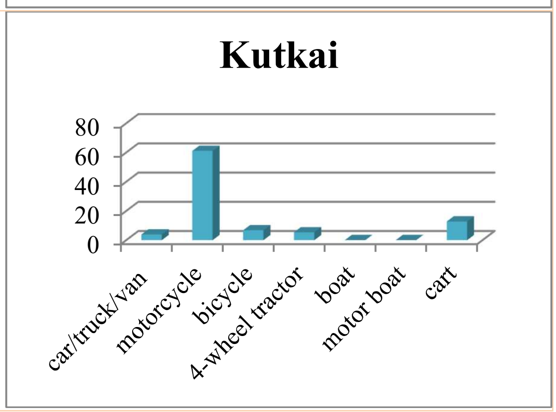


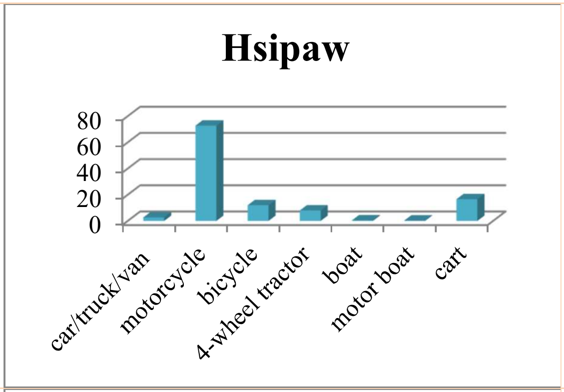


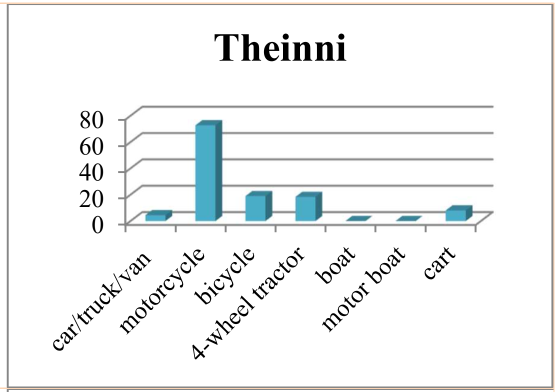


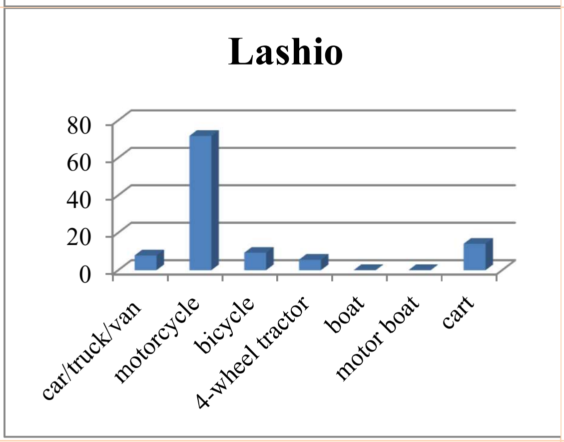


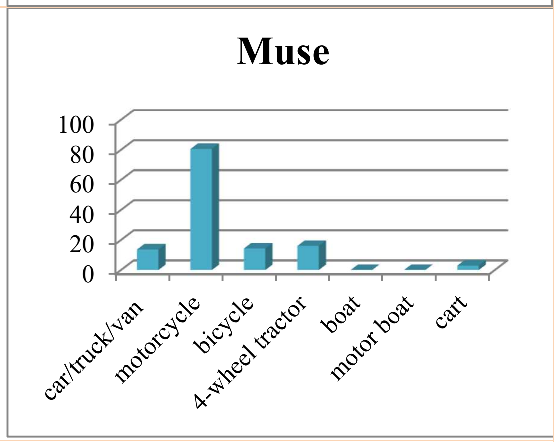












(8) Education

Township	Education				
	School	No. of Schools	No. of Teacher	No. of Students	Teacher/ Student Ratio
Patheingyi	Higher Education	7	725	8131	1:11
	BEHS	6	342	11508	1:33
	BEHS Branch	5	126	3965	1:31
	BEMS	6	110	3921	1:35
	BEMS Branch	2	22	595	1:27
	Post-primary school	19	197	8245	1:19
	BEPS	73	426	8254	1:27
	Preschool	-	-	-	-
	Monastic School	29	399	7900	1:19
Pyin Oo Lwin	Higher Education	1	141	2018	1:14
	BEHS	9	516	14828	1:28
	BEHS Branch	7	173	4687	1:27
	BEMS	13	198	4990	1:25
	BEM Branch	19	194	4098	1:21
	Post-primary school	16	118	1846	1:15
	BEPS	81	408	6270	1:15
	Preschool	3	5	66	1:13

	Monastic School	1	2	54	1:27
Amarapura	Higher Education	4	878	19878	1:23
	BEHS	7	410	13941	1:34
	BEHS Branch	5	116	2936	1:25
	BEMS	8	173	4924	1:28
	BEMS Branch	2	27	960	1:35
	Post-primary school	19	209	5942	1:28
	BEPS	64	381	7109	1:18
	Preschool	7	14	185	1:13
	Monastic School	6	55	954	1:17
Heinsi	Higher Education	-	-	-	-
	BEHS	3	93	3386	1:34
	BEHS Branch	2	31	1035	1:33
	BEMS	1	10	183	1:18
	BEMS Branch	5	56	1545	1:27
	Post-primary school	4	31	726	1:23
	BEPS	46	173	3076	1:18
	Preschool	7	5	71	1;14
	Monastic School	-	-	-	-
Hsipaw	Higher Education	-	-	-	-
	BEHS	6	166	5123	1:32
	BEHS Branch	6	117	3650	1:30
	BEMS	1	9	202	1:22
	BEMS Branch	16	146	4214	1:28
	Post-primary school	27	142	3510	1:24
	BEPS	150	436	8216	1:19
	Preschool	11	19	120	1:22
	Monastic School	9	90	2095	1:23
Kutkai	Higher Education	-	-	-	-
	BEHS	7	215	6333	1:29
	BEHS Branch	1	26	790	1:30
	BEMS	7	96	3355	1:34
	BEMS Branch	11	111	4100	1:36
	Post-primary school	28	123	3561	1:28
	BEPS	203	608	18137	1:29
	Preschool	11	17	423	1:24
	Monastic School	2	7	199	1:28
Kyukme	Higher Education	-	-	-	-
	BEHS	7	253	8090	1:31
	BEHS Branch	4	88	2192	1:24
	BEMS	5	51	1045	1:20
	BEMS Branch	9	108	3573	1:33

	Post-primary school	33	221	4813	1:21
	BEPS	200	600	9892	1:16
	Preschool	1	11	309	1:28
	Monastic School	6	69	1380	1:20
Lashio	Higher Education	4	380	5151	1:13
	BEHS	11	657	27699	1:33
	BEHS Branch	10	310	9939	1:32
	BEMS	3	65	1910	1:29
	BEMS Branch	23	319	9659	1:30
	Post-primary school	-	-	-	-9
	BEPS	113	352	7170	1:20
	Preschool	14	27	448	1:16
	Monastic School	9	125	3629	1:27
Muse	Higher Education	-	-	-	-
	BEHS	7	280	8545	1:31
	BEHS Branch	5	1124	4266	1:34
	BEMS	2	30	891	1:30
	BEMS Branch	3	331	1266	1:40
	Post-primary school	14	132	3229	1:25
	BEPS	51	214	3630	1:17
	Preschool	14	17	351	1:20
	Monastic School	4	20	570	1:29
Naungkio	Higher Education	-	-	-	-
	BEHS	8	231	8361	1:36
	BEHS Branch	8	132	2772	1:21
	BEMS	13	152	3182	1:21
	BEMS Branch	13	104	2805	1:27
	Post-primary school	34	183	3345	1:18
	BEPS	103	411	5247	1:13
	Preschool	25	57	1038	1:18
	Monastic School	2	15	401	1:27

(9) Employment Rate

Township	No. of Employment	Employee in workplace	No. of Employment	% of unemployment
Mandalay (Amarapura)	127713	118607	9106	7.13
Mandalay (Pathein Gyi)	194567	188809	5758	2.95
Pyin Oo Lwin	137903	137057	846	0.006
Nwang Hkio	75083	73341	1742	2.32
Kyaukme	75261	757080	1091	1.44
Hsipaw	88940	87961	979	4.4
Lashio	185873	138234	47639	25.63
Hseni	44841	17619	1145	2
Kutkai	94980	90341	3959	4.2
Muse	135734	72973	4388	3.23

(10) Occupational Patterns

Township	Government Employee	Services	Agriculture	Livestock	Trade	Industry	Fisheries	Self-employed	Others
Mandalay (Amarapura)	4528	217	20038	20400	39545	21056	-	9544	1979
Mandalay (Pathein Gyi)	2637	17119	32060	4279	81316	8600	-	15679	17119
Pyin Oo Lwin	6892	1279	289	29	1007	62	-	4230	7830
Nwang Hkio	2046	5563	42338	14377	3774	2520	20	2001	2098
Kyaukme	3253	2558	32280	251	1657	231	-	17020	19938
Hsipaw	1987	997	46620	4382	16117	2230	-	8682	3696
Lashio	5289	4754	59908	4670	10606	1283	-	18406	33318
Hseni	768	1250	12070	25	375	200	-	881	1075
Kutkai	1878	4025	56147	3171	4689	734	-	13449	6248
Muse	3081	6356	39992	1937	29008	9310	-	5467	21814

Table 5.46 - Analysis of Secondary Data Collection

Baseline Data	Analysis of Baseline Data	
	Mandalay	Shan
National Income	According to secondary data, the income is higher in Muse, Lashio and Mandalay while the other areas have low income.	
Domestic Water Supply	Only areas in Muse, Lashio and Mandalay has good urban water supply but in rural areas, people use spring water as drinking and domestic water.	
Education	In Mandalay, Pyin Oo Lwin, Lashio and Muse, they have good basic and higher education except for some parts in Shan State especially in Hseni, Naung Cho, Kut Kai, Thipaw and Kyauk Me, there are more rural families in those areas.	
Employment	The employment rate in Pyin Oo Lwin is the highest as it is 99% while in Amarapura, its rate is 92.87%. In Shan State, the highest employment rate is in Theini where Lashio has the lowest employment of 74%.	
Main Source of Cooking	In Mandalay, Pyin Oo Lwin and Muse, electricity is the main source for cooking but in rural areas such as Hseni, Kutkai and Naung cho, wood and coal are the main source for cooking.	
Main Source of Electricity	The main source of electricity is from EPC but in rural areas especially in Shan State, solar energy is used.	
Transportation	Bike is the most used transportation in both regions but in Shan State such as in rural areas, bicycle is also used. Car is used sometimes and it is used more commonly in Mandalay, Pyin Oo Lwin and Muse.	
Ethic Group	In Lashio, Muse, Hsipaw and Theinni, Shan is the major ethic group while in Pyin Oo Lwin, Patheingyi and Amarapura, Burma is the major ethic group. Danu is the major ethic group in Naung Cho and the majority ethic group of KutKai is Kachin and Pa Laung.	

5.4.9. Public Health Components

In Myanmar, there are better public health systems in Muse, Lashio and Mandalay urban areas, including municipal hospitals and community (private) medical points. The public health system in other remote areas is incomplete.

Malaria is a major public health problem in Myanmar. In the region where the project is located, the incidence of malaria is ≤5 cases per 1000 people, and the mortality rate of malaria is the highest in Shan State (6-7 cases per 100,000 people), followed by Mandalay Province (≤ 1 case per 100,000 people). The main cause of death is the inadequate medical service system.

In addition to malaria, dengue fever is a disease that occurs mainly in high-density cities and towns. The rainy season from May to June is the peak period of dengue fever spreading. The spreading of dengue fever is mainly caused by the bite of Aedes mosquitoes. According to preliminary investigation, more people in Shan State than in Mandalay Province do not use mosquito nets, and the incidence rate is higher.

Township Health Profile

The following table shows that the location and type of health care facilities occurred along the railway alignment.

Table 5.47 – Township Health Profile

Township			
Amarapura	**Name of Hospital**	**Location**	**Number of Bed**
	Public Hospital	Sin Swe Put Quarter	25
	Ye Lonn Kyaw	Ye Lonn Kyaw Village	16
	Ta Lin Gyi	Ta Lin Gyi Village	16
	Ta Mote Soe	Ta Mote Soe Village	16
	Railway Hospital	Myint Nge	50
	Number of Clinics		
	35		
	Name of Main Health Center		
	7		
	Name of Sub-Health Center		
	22		
	No of Doctors	**No of Nurses**	
	17	29	
Patheingyi	**Name of Hospital**	**Location**	**Number of Bed**
	Patheingyi Hospital	Myo Ma Quarter	25
	Kyauk Mee Tite Nal Hospital	Kyauk Mee Village	16
	University Hospital (Technology)	Shin Taw Kone Village	16
	University Hospital (Computer)	Dahat Taw Village	16
	Lung Hospital (Upper Myanmar)	Mae Kin Kone Village	200

	U Hla Tun Cancer Foundation	Mae Kin Kone Villlage	50
	Nyein Chan Specialist Hospital	Kyauk Me Village	16
	Ohn Chaw Myat Si Hospital	Ohn Chaw Village	100
	Number of Clinics		
	35		
	Name of Main Health Center		
	5		
	Name of Sub-Health Center		
	25		
	No of Doctors		**No of Nurses**
	19		33
Pyin Oo Lwin	**Name of Hospital**	**Location**	**Number of Bed**
	Pyin Oo Lwin	-	300
	Zee Pin Gyi	-	50
	Wek Won Tike Town	-	16
	Chan Tar Thu Kha	-	25
	Sate Ta Thu Kha	-	15
	Ar Yaw Gyan	-	25
	Aung Thitsar	-	25
	Number of Clinics		
	18		
	Name of Main Health Center		
	6		
	No of Doctors		**No of Nurses**
	96		162
Kyauk Me	**Name of Hospital**	**Location**	**Number of Bed**
	Public Hospital	No.1 Quarter	150
	Naung Pane District Hospital	Naung Pane	16
	Pone Wo District Hospital	Pone Wo	16
	Mine Lone District Hospital	Mine Lone	16
	Mine Ngok District Hospital	Mine Ngok	16
	Number of Clinics		
	18		
	Name of Main Health Center		
	3		
	No of Doctors		**No of Nurses**
	21		59
Naung Cho	**Name of Hospital**	**Location**	**Number of Bed**
	Naung Cho Public Hospital	Naung Cho Township	25
	Taung Shay Tite Nal Hospital	Taung Shay Village	16
	Thone Sal District Hospital	Thone Sal Village	16
	Bant Bway Tite Nal Hospital	Bant Bway Village	16
	Number of Clinics		
	7		
	Name of Main Health Center		
	7		
	Name of Sub-Health Center		

	28		
	No of Doctors	**No of Nurses**	
	4	21	
Kutkai	**Name of Hospital**	**Location**	**Number of Bed**
	Kutkai Hospital	2nd Quarter	50
	Tar Moe Nye Hospital	4th Quarter	25
	Nant Phat Kar Hospital	3rd Quarter	16
	Kaung Khar	3rd Quarter	16
	Mone Sie Hospital	Mone Sie Village	16
	Number of Clinics		
	10		
	Name of Main Health Center		
	10		
	Name of Sub-Health Center		
	30		
	No of Doctors	**No of Nurses**	
	10	35	
Thein Ni	**Name of Hospital**	**Location**	**Number of Bed**
	Public Hospital	N0.3 Quarter	25
	San Laung District Hospital	San Laung Village	16
	Nant Sa Lat District Hospital	Nant Sa Lat Village	16
	Number of Clinics		
	5		
	Name of Main Health Center		
	3		
	Name of Sub-Health Center		
	13		
	No of Doctors	**No of Nurses**	
	7	21	
Hsi Paw	**Name of Hospital**	**Location**	**Number of Bed**
	Public Hospital	Hsi Paw	100
	25 beds Hospital (Nant Lan)	Nant Lan group	25
	16 beds Hospital (Sin Kywat)	Sin Kywat group	16
	Number of Clinics		
	2		
	Name of Main Health Center		
	6		
	Name of Sub-Health Center		
	24		
	No of Doctors	**No of Nurses**	
	24	57	
Lashio	**Name of Hospital**	**Location**	**Number of Bed**
	Public Hospital	Lashio	500
	Nant Paung District Hospital	Lashio	16
	Mine Yaw District Hospital	Lashio	16
	Naung Mon District Hospital	Lashio	16
	Yu Li Kha	Lashio	16
	Namt Khone	Lashio	16
	Thu Kha Myaing	Lashio	16
	Kaung Khant	Lashio	16

	Aung Hospital	Lashio	80
	Number of Clinics		
	27		
	Name of Main Health Center		
	8		
	Name of Sub-Health Center		
	37		
	No of Doctors	**No of Nurses**	
	5	8	
Muse	**Name of Hospital**	**Location**	**Number of Bed**
	Muse Public Hospital	Muse	100
	Mone Koe Public Hospital	Muse	16
	Pant Sine Public Hospital	Pant Sine	16
	Mant Hero Public Hospital	Mant Hero	16
	Mone Paw Public Hospital	Pant Sine	16
	Number of Clinics		
	4		
	Name of Main Health Center		
	4		
	Name of Sub-Health Center		
	16		
	No of Doctors	**No of Nurses**	
	21	84	

The following tables show the number of infected and dead of HIV/AIDS and commom diseases occoured in townships that the railway passes.

HIV/AIDS

No.	Township	2018-2019		2019-2020	
		Infected	Dead	Infected	Dead
1	Muse	264	2	284	11
2	Lashio	10	-	6	-
3	Si Paw	182	7	121	19
4	Thein Ni			23	-
5	Kutkai	10	-	13	-
6	Naung Cho	99	6	-	-
7	Kyaukme	119	26	79	33
8	Pyin Oo Lwin	-	-	251	17
9	Patheingyi	9	-	26	-
10	Amarapura	57	6	25	6

Common Diseases occurred

No.	Township	Type of Disease													
		Diarrhea		TB		Stomach Ailment		Hepatitis		Pneumonia		Malaria		ARI	
		Infected	Dead	Infected	Dead	Infected	Dead	Infected	Dead	Infected	Dead	Infected	Dead	Infected	Dead

1	Muse	2405	-	306	9	288	-	74	-	-	-	-	-		
2	Lashio	1628	-	310	-	319	-	-	-	-	-	19	-		
3	Si Paw	1455	1	255	4	222	-	6	-	-	-	5	-		
4	Thein Ni	1119	-	12	-									744	-
5	Kutkai	643	-	17	3	86	-	1	-	-	-	-	-		
6	Naung Cho	2349	-	104	-	549	-	11	-	-	-	194	-	-	-
7	Kyaukme	838	-	119	3	125	-	10	-	-	-	-	-	-	-
8	Pyin Oo Lwin	1531	1	167	-	402	-	24	-	341	-	-	-		
9	Patheingyi	1990	-	344	41	679	-	3	-	-	-	16	-	-	-
10	Amarapura	967	-	207	-	170	-	6	-	-	-	1	-	-	-

5.4.10. Traffic Study

5.4.10.1. Traffic Condition

Since the project is near located in the relatively populated municipal area and the nature of the project is highly interrelated with the traffic conditions especially in daytime, EIA team took a traffic study and prepared vehicle movements summaries at Muse-Mandalay Road. The purpose of the traffic study is to study the counts of vehicle movements through NH3 road and to know the peak period hours. This peak hour will help to reduce the cumulative traffic impacts due to the more vehicles during construction and operation phases of the proposed project.

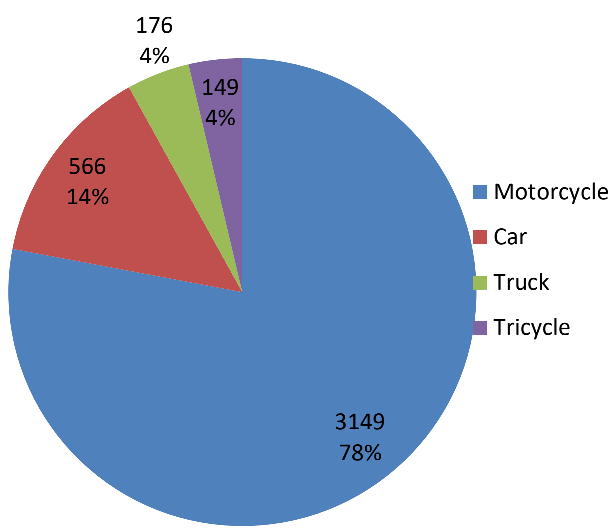
5.4.10.2. Materials and Methods

EIA team uses both of the video record and self counted by surveyors to the vehicles entering the NH3 Road. The reason to choose this point for traffic study is to analyse the vehicles entering the NH3 road during working and weekend days.

Summary of Vehicle Movements in Weekend Day

	SUMMARY OF VEHICLE MOVEMENTS	
	LOCATION: NH3 Rd	
TOWNSHIP: Lashio		CITY: Lashio
OBSERVER: EIA Team		DATE: 20.8.2019 (Sat)
WEATHER: Clear		Weekend Day
REMARK:		

	VEHICLE MOVEMENTS				
TIME		Types of Vehicles			Total
BEGIN	Motorcycle	Car	Truck	Tricycle	
7:00(Am) – 10:00 (Am)	850	157	49	47	1103
11:00(Am) – 2:00 (Pm)	561	96	34	27	718
4:00(Pm) – 7:00 (Pm)	986	184	56	51	1277
7:30(Pm) – 9:30 (Pm)	752	129	37	24	942
	Traffic Volume				4040
4:00(Pm) – 7:00 (Pm)	Peak Period Hours	1277			
	Peak Period Traffic Volume				
4:00(Pm) – 7:00 (Pm)	986	184	56	51	

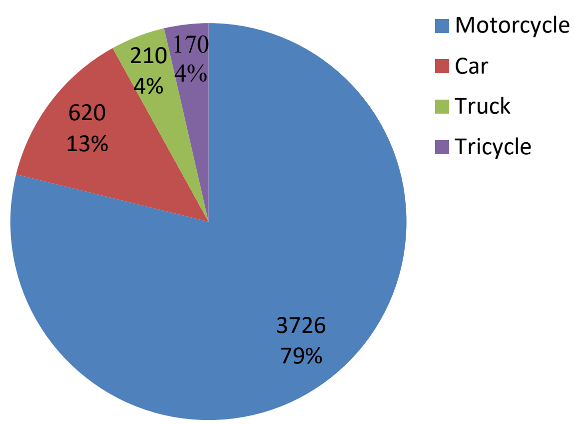


Types of Vehicles Counted in Mandalay-Lashio Road (Weekend Day)

According to the traffic count result in weekend day, morning peak hour occurs at 7:00-10:00 am, midday peak at 11:00 am-2:00 pm, evening peak at 4:00-7:00 pm and night peak at 7:30-9:30 pm. At morning peak hour, peak volume is 1103 vehicles. In this period, vehicles coming from NH3 road as the time is inbound hours at the beginning of weekend day. At midday peak hour, peak volume is 718 vehicles. In this period, vehicles moving in all inbound and outbound directions were about the same amount. At evening peak hour, peak volume is 1277 vehicles. At night peak hour, peak volume is 942 vehicles. Comparing to morning peak volume, the peak volume recorded between 4:00-7:00 pm is significantly high. And weekend day peak volume is 4040 vehicles.

Summary of Vehicle Movements in Working Day

	SUMMARY OF VEHICLE MOVEMENTS				
	LOCATION: NH3 Rd				
TOWNSHIP: Lashio			CITY: Lashio		
OBSERVER: EIA Team			DATE: 19.8.2019 (Fri)		
WEATHER: Clear			Work Day		
REMARK:					
	VEHICLE MOVEMENTS				
TIME		Types of Vehicles			Total
BEGIN	Motorcycle	Car	Truck	Tricycle	
7:00(Am) – 10:00 (Am)	971	163	62	51	1247
11:00(Am) – 2:00 (Pm)	657	108	39	28	832
4:00(Pm) – 7:00 (Pm)	1205	207	67	59	1538
7:30(Pm) – 9:30 (Pm)	893	142	42	32	1109
	Traffic Volume				4726
7:00(Am) – 10:00 (Am)	Peak Period Hours	1538			
	Peak Period Traffic Volume				
7:00(Am) – 10:00 (Am)	1205	207	67	59	



Types of Vehicles Counted in Mandalay-Lashio Road (Working Day)

According to the traffic count result in working day, morning peak hour occurs at 7:00-10:00 am, midday peak at 11:00 am-2:00 pm, evening peak at 4:00-7:00 pm and night peak at 7:30-9:30 pm. At morning peak hour, peak volume is 1247 vehicles. In this period, vehicles coming from NH3 road as the time is inbound hours at the beginning of work day. At midday peak hour, peak volume is 832 vehicles. In this period, vehicles moving in all inbound and outbound directions were about the same amount. At evening peak hour, peak volume is 1538 vehicles. At night peak hour, peak volume is 1109 vehicles. Comparing to morning peak volume, the peak volume recorded between 7:00-10:00 am is significantly high.

5.4.10.3. Conclusion for Traffic Study

According to the study, the vehicle movements in weekend day is greater 14.5% generation rate of in working day vehicles volume as many visitors coming to Pyin Oo Lwin, Thi Paw and Muse.

5.4.11. Cultural Components

5.4.11.1. The Distribution of Archaeology and Cultural Heritage in Mandalay Region

The distribution of cultural relics and monuments along the project is as follows:

- **Amarupa Ancient City**: located in the southwest of Mandalay City, the ancient city was built in 1364, and for more than 500 years, it has been the capital for the Awa Dynasty, and Aungzeya Dynasty for several times. The proposed railway line is about 9 km away from the ancient city.
- **Innwa Ancient City**: Located in the southwest of Mandalay, on the west bank of the Ayarwaddy River. Sagaing was built in the 14th century and was the capital of the Shan Kingdom from 1760 to 1764. The proposed railway line is about 13 km away from the ancient city.

Innwa is a major site including a lot of archaeological monuments and sites. In assessment project, these sites must be explored to identify how significant features of archaeological evidences will be come out in making assessment of impacts as well as the appropriate plan for mitigation process.

The existing risk especially disaster risk management is not efficient to protect and preserve the cultural environment of Innwa area. The topographic feature of the site is distinctively risky with the river confluence and erosion as well as the transportation and heavy loading of shipping. The elevation and features of Innwa is facing with the very crowded development plan recently.

The significant feature found nearby the project area is the concrete structure concerning with the ancient warfare and brick monastery concerned with the ancient religious dedication. Furthermore, it is closely related to the area of city walls and moats, which challenged by the river erosion due to the heavy loading of shipping and some other river formation. The earthquake is also the most important risk for this area.

(a) Queen Me Nu Brick Monastery - Maha Aungmye Bonzan Monastery (1822)

It is popularly known as Me Nu Ok Kyaung "Me Nu's Brick Monastery" that was built in 1818 by Nanmadaw Me Nu, the famous Chief Queen of Bagyidaw. For the residence of her religious Preceptor, the Nyaunggan Sayadaw, the Queen Me Nu donated this monastery. The earthquake of 1838, damaged it, and in 1873, it was restored by Sinbyumashin, Queen of Mindon, and a daughter of Nanmadaw Me Nu. The building is markedly different from traditional Burmese monasteries, which are constructed with wood, not masonry.

Figure - Queen Me Nu Brick Monastery

(b) Tha Bye Dan Fortress (1878)

The remain of Thabyedan (Thapyaytan) fortress was built by King Mindon between 1874 and 1878 to defend against the British during the third Anglo-Burmese War. It is near the Innwa Bridge. It could be related to the risk of deterioration such as human threats and development plans. But, the appropriate mitigation plan can provide the preservation of cultural significance of this site and the cultural landscape should also be emphasized in every stages of the development plans in many ways.

Figure - Tha Bye Dan Fortress

Figure - Description Pillar of Tha Bye Dan Fortress

(c) Innwa Bridge (1934)

Innwa bridge was built by British Colonial Government and it has 16 span cantilever bridge was the only structure to span the Ayeyarwady River until recently. Although now superseded by a parallel 2005 road bridge, it is still in use for railway and local road traffic.

Figure - Innwa Bridge

(d) Innwa City Wall (East and North) (14th -19th Century AD)

The northern part of Innwa is nearby the bank of Ayeyarwady River and the Eastern partis on the bank of Duthavati (Myitnge) River. These two areas are usually eroded by rivers in every rainy season. Because of the water transportation and tourism development, the challenges of this ancient urban landscape are often impacting on the landscape. The most risky impact is wasting sewage and garbage around the cultural heritage monuments.

In both of north and east, there are the places of jetty that the local and tourist can enter into the ancient cultural area by waterway. These jetties should be measured to get the loading of using the waterway to be accessible. In the time of heavy rain, these parts were usually flooded not to be accessible by car or some vehicles. Therefore, the flash flood is also the major risk for cultural heritage. The development plan can frighten the cultural landscape by their preparedness of construction and operation processes. But, it is depending on their respective types of plan. As for oil storage tanks project, even though it may be considered the various types of risks for the cultural heritage, there can be drawn out these possible impacts of visual and cumulative aspect.

(e) U-bein Bridge

Also known as the "Valentine Bridge", located in the southwest side of Mandalay City, spanning across Taungthaman Lake, built in 1851, with a 160-year history. The bridge is built of 1086 pieces of teak trees, the length of which is 1.2 km. The whole bridge is built of teak. It is the most precious treasure in Myanmar with its ancient color and rich local characteristics. The proposed railway line is about 7 km away from the bridge.

Figure 5.71- Location Plan of Railway and Cultural Relics

Consideration of Potential Impact to Cultural and Heritage in Mandalay Region

Although the tunneling will use drilling and blasting process that will impact on archeological site, there will no tunnel construction in Mandalay Region and the nearest archeology and cultural heritage site is 7km away from the railway alignment. So there will be no impact on cultural and heritage in Mandalay Region due to railway tunnels construction.

5.4.11.2. The Distribution of Archeology and Cultural Heritage in Shan State

Being a mountainous region, most of the Pagodas as well as some shrines are found in mountains as shown in the following figures.

Figure – Some Pagodas in Mountain

Some Shan people worship 'Guardian Spirits' by enshrining as their traditional belief as shown in the following figures.

Figure – Some Shrines beside the Road and in Mountain

5.4.11.3. Key Archaeology and Cultural Heritage along the Railway Line

The archaeological and cultural heritage along the railway includes:

1. Archaeological remains
2. Historic buildings
3. Historic Landscape

The study area that has been used for the current desk based data collection is defined by the route alignment of the Proposed Scheme, and an area extending 300m in all directions, sufficient to capture any features likely to be directly affected by the Proposed Scheme and taking into account any future minor design/route changes. A second study area of 500m in all directions of the route alignment has been considered to establish potential impacts on the setting of designated heritage assets.

Table 5.48 - Lists of Cultural Heritage Assets

Name of cultural heritage	Approximate distance to nearest part of proposed route (meter)	Latitude	Longitude	Category	Description	Location
Yan Tine Aung Pagoda	3278.95	22° 55.986'N	97° 43.809'E	Pagoda	Yan Tine Aung Pagoda is located at the entrance of Lashio city. The Pagoda is very famous in Lashio city.	**Lashio**
Lashio Hot spring	5707.79	22° 59.453'N	97° 46.477'E	Landscape	Lashio Hot Spring is famous tourist attraction in northern Shan State. This natural hot spring is made with the multiple swimming pool and the private bathrooms for the visiting people.	
Mansu Shan Buddhist Monastery	7107.79	22° 57.270'N	97° 45.802'E	Building	Thiri Mingalar Mansu Monastery, which has gained prominence as the home of Sayadaw Maha Thaddamma Zawtika Zay Baddanda Ponnya Nanda, who is known for anyone who needs it, regardless of religion or race stands in the big compound in downtown Lashio in Shan State.	
Hu Mon Dam	10363.75	22° 55.969'N	97° 48.020'E	Dam	Hu Mon Dam is special for whom want to relax and swim. The well-known activity is that the visitors can ride the water slide with their own along the flowing water slope.	
Sasana Year 2500 Pagoda	5568.79	22° 57.035'N	97° 44.945'E	Pagoda	-	
Baw Kyo Pagoda	1079.05	22° 35.030'N	97° 14.025'E	Pagoda	Built in the 12th century, the temple is located in Bawgyo village, several miles from the town of Hsipaw. Every march, the temple is the site of a Buddhist festival that commemorates the pagoda's founding.	**Hsipaw**
Haw Sao Pha (Shan Palace)	2458.94	22° 37.650'N	97° 18.247'E	Building	Haw Sao Kya Seng with the age of 96 years was built in 1924 for Saopha Sao Kya Seng (1947 to 1959) who was a politician, a mining engineer, an agriculturalist and the last Saopha of Hsipaw State, Myanmar, and Inge Sargent, known as Maha Devi. Sao Kya Seng was considered by the Shan people as one of the Shan national leaders who promoted federalism and democracy, together with Sao Shwe Thaik and Sao Hkun Hkio.	
Hsipaw Hot Spring	4939.53	22° 38.204'N	97° 16.281'E	Landscape	It is situated in Kyankhin Village, Hsipaw Township, Northern Shan State. Organizer normally stores the hot water from the spring to 30 foot long, 15 foot wide and 4 foot deep concrete tank and collects 200MMK per vistor to raise funds for preservation of the natural hot spring. People who want to take a hot spring bath can swim at two concrete tanks within the area. Hot spring bathing assists with cardiovascular disease and nervous system imbalance. An average of 200 people visits the hot spring in each day.	

Gokhteik	981.83	22° 20.612'N	96° 51.566'E	Landscape	The Gohteik viaduct is between the two towns of Pyin Oo Lwin, the summer capital of the former British colonial administrators of Burma, and Lashio, the principal town of northern Shan State. It is the highest bridge in Myanmar and when it was completed, the largest railway trestle in the world. The bridge was constructed in 1899 by the Pennsylvania and Maryland Bridge Construction Company, and opened in 1900. The viaduct measures 689 metres (2,260 ft) from end to end. The Viaduct is described as "a monster of silver geometry in all the ragged rock and jungle, its presence was bizarre".	**Nawng Hkio**
Inn Wine Waterfall	11935.17	22° 10.657'N	96° 43.384'E	Landscape	Naung Cho City's Inn Wine waterfall is known to be one of the most beautiful waterfalls in Myanmar and has become one of the top places interested by tourist to visit along with the peaceful nature of Naung Cho City. It is situated near Sin Shwe Le (2) Sugar Manufacturing Industry.	
Upper Yeywa Hydropower Plant	23395.31	22° 14.596'N	97° 5.846'E	Dam	The construction of 280-megawatt Upper Yeywa hydropower project is planned to finish in 2022 and it will produce 1.409 billion kilowatts hours of electricity annually, according to Ministry of Electricity and Energy. Hydropower Implementation Department is developing Upper Yeywa hydropower project on Dotawady River about 20 miles away from Kyaukme in northern Shan State. The electricity generated from the dam project will be accessed to national grid and it will be provided 2.7 million people (about 6.6 per cent of total population) more, announced the ministry.	
Pwe Kouk Waterfall	4460.77	22° 4.142'N	96° 33.383'E	Landscape	The water fall is located suburb of Pyin Oo Lwin, and small waterfall and park, and it is the type of multiple waterfall. This sightseeing spot is almost for Myanmar people, and there is a pagoda, close to the waterfall, MaharAnhtoo Kanthar Pagoda. This pagoda is famous for Myanmar people.	**Pyin Oo Lwin**
Pate Chin Myaung Cave	6261.10	22° 5.757'N	96° 37.216'E	Landscape	Peik Chin Myaung is a limestone stalactite cave situated south of Wetwun village, 23 km from Pyin Oo Lwin, Myanmar. The cave was firstly developed by local Nepalese or Gakhar and later co-opted by the Myanmar government as a tourist attraction in 1990. The cave covers an area of 45 acres, where local plants named Peik Chin, alike long pepper vine used to grow by the mouth of the cave. It is estimated to be 230 million to 310 million years old from the formation of limestone and hillocks. After the establishment of shrines with many Buddhist stupas inside the cave, it has also been called Maha Nadamu cave.	
Shwe Myin Tin Pagoda	6790	22° 2.319'N	96° 28.906'E	Pagoda	Shwe Myin Tin Pagoda is located 0.42 kilometer from Mandalay-Muse Highway.	

Dat Taw Gyaint Waterall	7242.92	21° 58.817'N	96° 23.216'E	Landscape	Dat Taw Gyaint is a tufa waterfall formed by limestone rich water from a karst spring. It, also commonly known as Anesakan Falls, is a magical waterfall with a blue, natural and refreshing swimming hole. Nestled at the bottom of a jungle canyon, this waterfall sits beside a small temple and is one of the best hidden gems in Myanmar. Dat Taw Gyaint Waterfall is located along the road from Mandalay to Pyin Oo Lwin near a small village known as Anesakhan	
Purcell Tower	7960.58	22° 1.603'N	96° 27.846'E	Building	Purcell Tower stands in the heart of the town, Pyin Oo Lwin. The clock was one of the few made in 1934 by Gillete and Johnson Co. of England in commemoration of the Silver Jubilee of the reign of King George V of Britain.	
Taung Kyaung Gyi Monastery	8150	22° 1.485'N	96° 27.867'E	Building	-	
Orchid Nan Myaing Hotel	8464.88	22° 0.928'N	96° 27.035'E	Building	Orchid Hotel Nan Myaing is a hotel in a good neighborhood, which is located at Pyinoolwin. Not only well positioned, but Orchid Hotel Nan Myaing is also one of hotels near the following Atumashi Monastery within 34.77 km and Kuthodaw Pagoda within 34.82 km. 24-hours front desk is available to serve from check-in to check-out, or any assistance what is needed.	
Candacraig Hotel	9037.58	22° 1.073'N	96° 28.694'E	Building	It is a historic building in Pyin Oo Lwin. Dating from 1904 and formerly the British Club, this colonial pile comes complete with side turrets and is set in attractively manicured gardens. There's a slightly spooky air to the place – many locals believe it's haunted and it has been closed for long-delayed renovations for a while. But the gates are normally open, so cycle in for a look.	
National Kandawgyi Botinical Garden	11097.99	21° 59.637'N	96° 28.168'E	Landscape	The National Kandawgyi Botanical Gardens (formerly National Botanical Gardens) is a 177 hectare botanical garden located in the Alpine town of Pyin Oo Lwin, situated at an elevation of 1000 meters (3,605 ft) and 69 km (43 mi) by road from Mandalay. It was first established in 1915 as the Maymyo Botanical Gardens by Alex Roger, a Forest Officer. The original site was 30 acres and was modelled after the Kew Gardens of England with the help of an amateur gardener called Lady Cuffe. The Botanical Gardens has three museums. The Fossils Museum houses fossils of mammals, reptiles, and invertebrates, and the Petrified Wood Museum displays fossils of plants, colorful stones, toddy-palm roots, as well as things made from fossils of plants. The Butterfly Museum has various species of butterflies from Nepal, Taiwan, South America, Japan and South East Asia.	

Thitsar Myaing (Tapsy Villa)	8924.87	22° 1.111'N	96° 28.309'E	Building	These are the representatives of architecture, town planning, and infrastructure introduced by British Colonial Regime during the period of the end of Second World War. Nowadays most of these buildings is changed to hotels, restaurants, and tourist attractions.	
Cherry Myaing (Linduden)	9872.51	22° 0.592'N	96° 28.536'E	Building		
Hinthar Myaing (Jacobstowe)	9696.14	22° 0.689'N	96° 28.277'E	Building		
Thazin Myaing	9584.93	22° 0.741'N	96° 28.455'E	Building		
Gandamar Myaing (Croxton)	9116.12	22° 1.004'N	96° 28.218'E	Building		
Htinshu Myaing	9155.99	22° 0.974'N	96° 28.516'E	Building		
Yuzana Myaing (Knowle)	10273.76	22° 0.369'N	96° 28.421'E	Building		
Maha Ganda Yone Monastery	5594.70	16° 51.189'N	96° 9.586'E	Building	The monastery is known for its strict adherence to the Vinaya, the Buddhist monastic code. The monastery was first established by Agatithuka Sayadaw, a Thudhamma-affiliated monk around 1908, as a meditation monastery for forest-dwelling monks. A thousand Buddhist monks and novices line up every morning, at 10 o'clock, to receive their meal of the day at Mahar Gandar Yone Monastery.	**Mandalay**
Shwenanda w Monestery	5870.45	22° 0.040'N	96° 6.821'E	Building	Shwenandaw Monastery (Golden Palace Monastery) was built in 1878 by King Thibaw Min, who dismantled and relocated the apartment formerly occupied by his father, King Mindon Min, just before Mindon Min's death, at a cost of 120,000 rupees. The building was originally part of the royal palace at Amarapura, before it was moved to Mandalay, where it formed the northern section of the Hmannan (Glass Palace) and part of the king's royal apartments. The building was heavily gilt with gold and adorned with glass mosaic work. The monastery is known for its teak carvings of Buddhist myths, which adorn its walls and roofs. The monastery is built in the traditional Burmese architectural style. Shwenandaw Monastery is the single remaining major original structure of the original Royal Palace today.	

Maha Atulawaiyan (Atumashi) Kyaungdawgyi	5980.14	22° 0.064'N	96° 6.756'E	Building	The Atumashi Monastery (formally Maha Atulaveyan Kyaungdawgyi) was built in 1857 by King Mindon at a cost of 500,000 rupees. The original structure burned down in 1890 after a fire in the city destroyed both the monastery and the 30 feet (9.1 m) tall Buddha image, as well as complete sets of the Tipitaka. During the fire, a 19.2-carat diamond, which adorned the Buddha image (originally given to King Bodawphaya by Maha Nawrahta, the Governor of Arakan) disappeared as well. In 1996, Burma's Archaeological Department reconstructed the monastery with prison labor.	
Kuthodaw Pagoda	6193.64	22° 0.281'N	96° 6.774'E	Pagoda	Kuthodaw Pagoda (formally titled Mahalawka Marazein) contains the world's largest book lied at the foot of Mandalay Hill and was built during the reign of King Mindon. In the grounds of the pagoda are 729 kyauksa gu or stone-inscription caves, each containing a marble slab inscribed on both sides with a page of text from the Tripitaka, the entire Pali Canon of Theravada Buddhism. In 2013, UNESCO plaque indicating that the Maha Lawkamarazein or Kuthodaw Inscription Shrines at Kuthodaw Pagoda, were inscribed on to the Memory of the World Register.	
Sanda Muni Pagoda	6369.83	22° 0.211'N	96° 6.587'E	Pagoda	Sandamani Pagoda is a Buddhist stupa located southwest of Mandalay Hill and was commissioned by King Mindon Min in 1874 as a memorial to Mindon Min's younger brother, Kanaung Mintha. This pagoda contains the graves of the Kanaung, Sagu Mintha, Malun and Maingpyin Princes. It also contains an iron image of the Buddha cast by Bodawpaya of the Konbaung dynasty in 1802. The statue reportedly weighs 40,924.8 pounds (18,563.2 kg).	
Kyauktawgyi Pagoda	6708.50	22° 0.268'N	96° 6.396'E	Pagoda	Kyauktawgyi Pagoda in Amarapura was built in 1847 by King Bagan Min on the model of the Ananda Pagoda at Bagan. It exemplifies a type of architecture, which though borrowed from the Indian designs at Pagan, was constructed entirely by Burmese architects. The artistic interest of the temple lies in the numerous frescoes with which its four porches are adorned. The pagoda is crowned with a five-tiered pyatthat roof.	
Mahawizayayanthi Pahtoedawgyi	6879.92	21° 54.677'N	96° 3.390'E	Pagoda	Pahtodawgyi is a Buddhist pagoda located in Amarapura, north of the Taungthaman Lake. It was built in 1819 by King Bagyidaw.	**Manadalay**
Mandalay Palace	6960.92	21° 59.579'N	96° 5.772'E	Building	The Mandalay Palace known as The Famed Royal Emerald Palace is the last royal palace of the last Burmese monarchy. The palace was constructed between 1857 and 1859 and was the primary royal residence of King Mindon and King Thibaw, the last two kings of Myanmar. The palace is famous for Great Audience Hall, Lion Throne Room, Watch Tower, Royal	

					Mausoleums and Glass Palace. Throughout the British colonial era, the palace was seen by the Burmese as the primary symbol of sovereignty and identity. Much of the palace compound was destroyed during Second World War by allied bombing; only the royal mint and the watch tower survived. A replica of the palace was rebuilt in the 1990s with some modern materials. Today, Mandalay Palace is a primary symbol of Mandalay and a major tourist destination.	
Su Taung Pyae Pagoda	7340.74	22° 0.892'N	96° 6.449'E	Pagoda	Su Taung Pyae Pagoda is located at the top of the Mandalay Hill. Mandalay Hill is known for its abundance of pagodas and monasteries, and has been a major pilgrimage site for Burmese Buddhists for nearly two centuries. A panoramic view of Mandalay from the top of Mandalay Hill alone makes it worthwhile to attempt a climb up its stairways.	
Bagaya Monastery	7663.28	21° 55.144'N	96° 3.537'E	Building	This magnificent monastery is also known as Maha Waiyan Bontha Bagaya Monastery. During King Hsinbyushin's reign (1763–1776), Maha Thiri Zeya Thinkhaya, town officer of Magwe built the monastery in the Bagaya monastic establishment and dedicated to Shin Dhammabhinanda. The monastery, which was built with 267 gigantic teak wood posts, has a structure of great dimensions: 188 feet (57 m) high in length and 103 feet (31 m) in width. The monastery is decorated with splendid Burmese architectural works such as carvings, floral arabesques, the ornamentation with curved figurines and the reliefs of birds and animals as well as small pillars decorated on the wall, the artistic works of Inwa Era. . It is one of the famous tourist attractions in Myanmar.	
Mahar Myat Muni Pagoda	7855.09	21° 57.111'N	96° 4.707'E	Pagoda	The Mahamuni (literal meaning; The Great Sage) Buddha Temple is a Buddhist temple and major pilgrimage site, located southwest of Mandalay. Ancient tradition refers to only five likenesses of the Buddha, made during his lifetime; two were in India, two in paradise, and the fifth is the Mahamuni Buddha image in Myanmar. The temple has a central shrine and is framed by an extensive grass lawn. A major annual pagoda festival is held in early February, at the end of the Buddhist Lent to celebrate the history of the pagoda.	
U-bein Bridge	7000	21° 53.495'N	96° 3.471'E	Landscape	U Bein Bridge is a crossing that spans the Taungthaman Lake near Amarapura. The 1.2-kilometre (0.75 mi) bridge was built around 1850 and is believed to be the oldest and once longest teakwood bridge in the world. It features 1,086 pillars that stretch out of the water, some of which have been replaced with concrete.	

Maha Aungmye Bonzan Monastery	8963.03	21° 51.502'N	95° 59.070'E	Building	Maha Aungmye Bonzan Monastery is commonly known as the Me Nu Brick Monastery. The monastery was built by Queen Nanmadaw Me Nu in 1818. This monastery is one of the finest specimens of Myanmar architecture during the Konbaung Period (19th century). Its architecture is in simulation of wooden monasteries with multiple roofs and a prayer hall of seven-tiered superstructure.	
Amarapura Ancient City	9000	21° 54.228'N	96° 2.966'E	Archaeolo gical Remains	Amarapura is a former capital of Myanmar during the Konbaung period (1783–1821 and 1842–1859). It is historically referred to as Taungmyo (Southern City) in relation to Mandalay. Amarapura today is part of Mandalay, as a result of urban sprawl. The township is known today for its traditional silk and cotton weaving, and bronze casting. It is a popular tourist day-trip destination from Mandalay.	
Shwe In Bin Monastery	9256.34	21° 57.972'N	96° 3.956'E	Building	Shweinbin Monastery was built in the tradition of Burmese teak architecture in 1895 by a Sino-Burmese merchant married to a Burmese woman of royal extraction. The monastery's construction strictly adheres to traditional rules of Burmese monastic architecture and includes all of the designated pyatthat-crowned pavilions.	
Soon U Ponya Shin Pagoda	9863.10	21° 54.121'N	95° 59.547'E	Pagoda	One of the most tourist attraction places on Sagaing Hills is Soon U Pon Nya Shin Pagoda and is connected by a set of covered staircases that run up the 240 meters hill and is one of the oldest temples on Sagaing Hills. It was built in 1312 by Minister Pon Nya. An annual Pagoda festival is held on Full Moon Day of Warso, the fourth month of the Myanmar Calendar, which falls in July of each year. It is famously known to have the earliest Soon (food) offered by angels before any human	**Sagaing**
Uminkoeze Pagoda	9850.68	21° 54.298'N	95° 59.697'E	Pagoda	Uminkoeze pagoda is situated in Sagaing Hill, Sagaing.	
Sagaing City	13000	21° 54.952'N	95° 57.728'E	Landscape	Sagaing is the capital of the Sagaing Region and is located in the Irrawaddy River, 12 mi to the south-west of Mandalay on the opposite bank of the river. Sagaing with numerous Buddhist monasteries is an important religious and monastic centre. The pagodas and monasteries crowd the numerous hills along the ridge running parallel to the river. The central pagoda, Soon U Ponya Shin Pagoda, is connected by a set of covered staircases that run up the 240 m (790 ft) hill.	
Mingun Pahtodawgyi	17206.57	22° 3.051'N	96° 1.055'E	Archaeolo gical Remains	The Mingun Pahtodawgyi is an incomplete monument stupa in Mingun. The ruins are the remains of a massive construction project begun by King Bodawpaya in 1790 which was intentionally left unfinished. The pahtodawgyi is seen as the physical manifestations of the well-known	

					eccentricities of Bodawpaya. The completed stupa would have been the largest in the world at 150 metres (490 ft). Huge cracks are visible on the structure from the earthquake of 23 March 1839.	
Mingun Bell	17319.29	22° 3.180'N	96° 1.070'E	Archaeological Remains	King Bodawpaya also had a gigantic bell cast to go with his huge stupa. The Mingun Bell, weighing at 90 tons, is today the second largest ringing bell in the world. The weight of the bell in Burmese measurement, is 55,555 viss or peiktha (1 viss = 1.63 kg), handed down as a mnemonic "Min Hpyu Hman Hman Pyaw", with the consonants representing the number 5 in Burmese astronomy and numerology.	
Mya Thein Tan Pagoda	17609.28	22° 3.351'N	96° 0.992'E	Pagoda	Mya Thein Tan Pagoda also known as Hsinbyume Pagoda is a large pagoda on the northern side of Mingun in Sagaing Region and was built in 1816 by Bagyidaw. It is dedicated to the memory of his first consort and cousin, Princess Hsinbyume. The pagoda's design is a great departure from Burmese pagoda design norms. It is based on descriptions of the mythical Sulamani pagoda on Mount Meru, and the lower parts of the pagoda represent the mountain. Seven concentric terraces represent the seven mountain ranges going up to the Mount Meru according to Buddhist mythology.	

There are no well-known cultural heritage such as Archaeological remains, Historic buildings and Historic landscapes within the 500 meters of EIA study area. Pagoda, monasteries and religious areas will also be avoided although it does not consider as historical places.

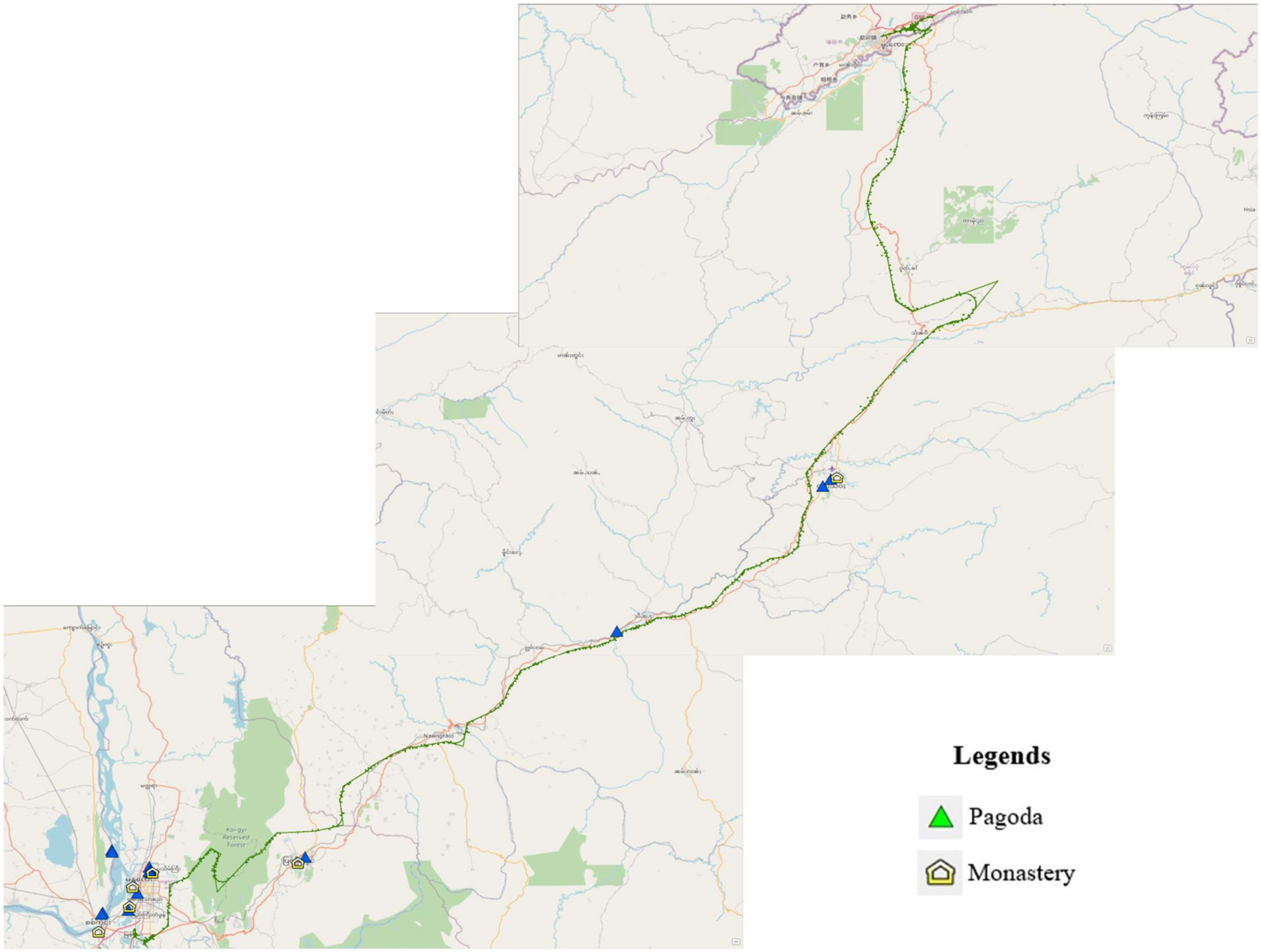


Figure 5.72 - Pagodas and Monastries within 500 km along the Alignment

5.4.12. Environmental Sensitive Areas around Traction Substations and along the Transmission Line

5.4.12.1. Environmental Sensitive Area

Environmental sensitive areas around traction substations and along the transmission line will be study by overlay mapping technique as follow.

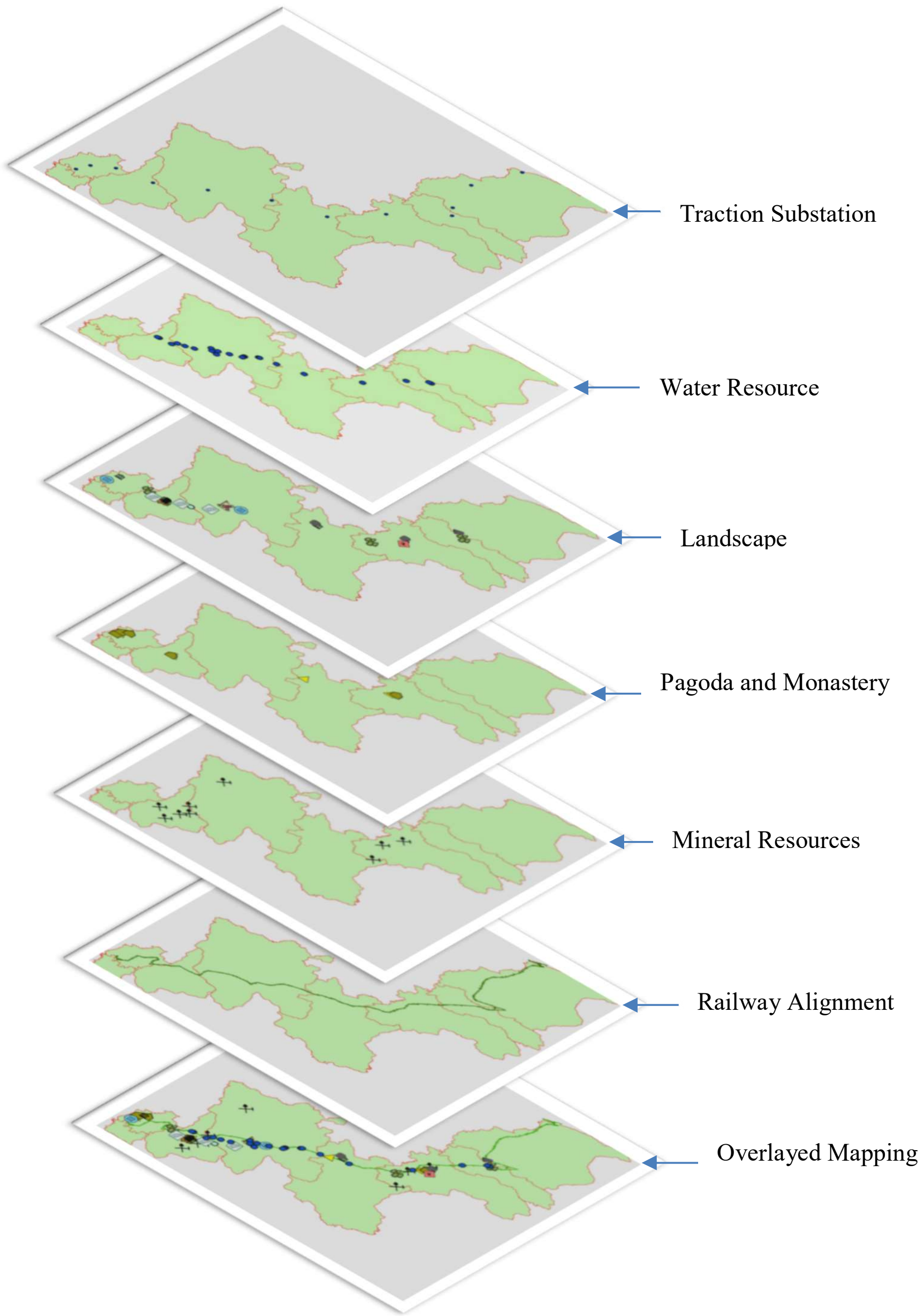


Figure 5.73 – Overlay Mapping of Traction Substation

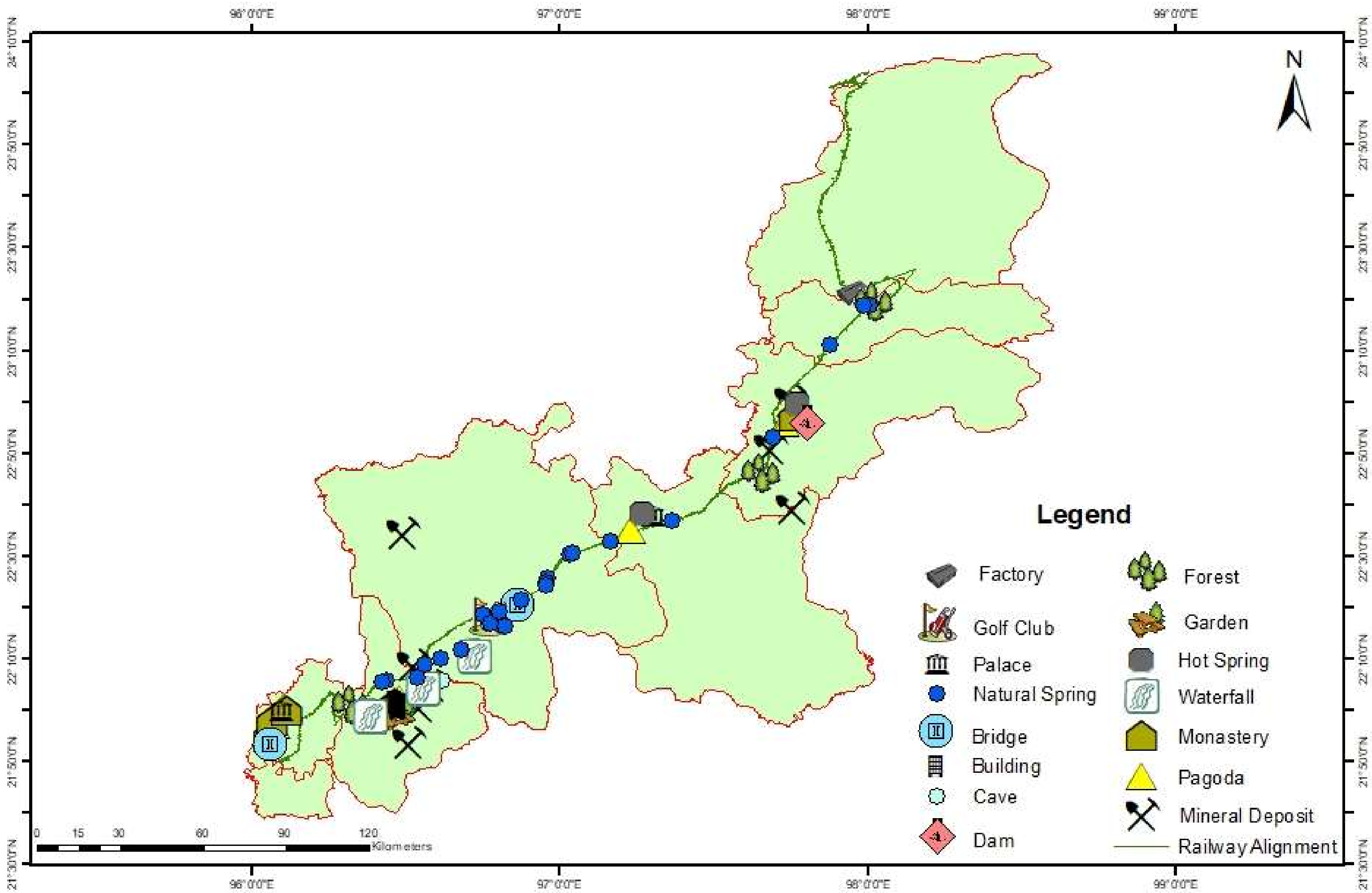


Figure 5.74 - Overlayed Map of Sensitive Areas along the Muse-Mandalay Railway

Table 5. 49– Consideration of Sensitive Zones within 500m beside the Access Road to Transmission Line

No.	Type of Project	Station Name	Location	Residential Area		Surface Water Resources		Landscape and Visual	
				Village	Location			Forest Area	Agricultural Land
1.	Access Road	Muse	24.006486, 97.954332	Nan Pann	24.014952, 97.957032	-	-	Forest	Agricultural Land
				Wane Mine	24.002076, 97.939476				
2.		Nam Hpak Ka	23.660356, 97.852678	-	-	-	-	Forest	Agricultural Land
3.		Kutkai	23.469516, 97.894684	Ho Nar	23.468220, 97.892402	-	-	Forest	Agricultural Land
4.		Theinni	23.293231, 97.985080	-	-	Nam Tu River	23.289810, 97.976761	-	Agricultural Land
5.		Lashio West	22.981536, 97.705398	-	-	-	-	Forest	Agricultural Land
6.		Nam Un	22.771006, 97.656280	Naung Mon	22.764907, 97.637856	-	-	Forest	Agricultural Land
7.		Hsipaw	22.597323, 97.300881	Nwang Eain	22.602100, 97.302230	Myit Nge River	22.599445, 97.295479	Forest	Agricultural Land
8.		Kyaukme	22.492722, 97.020461	-	-	-	-	-	Agricultural Land
9.		Nawng Hkio	22.310013, 96.801553	Taung Quarter	22.316893, 96.803754	Natural Spring	22.316893, 96.803754	-	Agricultural Land
10.		Pyinoolwin	22.105295, 96.540374	East Pin Lain	22.104714, 96.549211	-	-	Thit Ta Pin Taung Forest	Agricultural Land

				Middle Pin Lain	22.105234, 96.539294	Natural Spring	22.105234, 96.539294	Thit Ta Pin Taung Forest	Agricultural Land
11.		Mandalay East	21.945631, 96.157707	Bo Tat Gone	21.926714, 96.150118	Paw Taw Mu Canal	21.944724, 96.154545	-	Agricultural Land
				Shin Taw Gone	21.935598, 96.148471				
				Thant Zin Gone	21.923191, 96.148111				
				Lat Kaung	21.922025, 96.158469				
				Thale Gone	21.915023, 96.155310				
				Ywar Shay	21.910429, 96.155531				
12.		Mandalay South	21.840919, 96.115836	Sauk Taw Wa	21.852743, 96.115185	-	-	-	Agricultural Land
				Min Su	21.858199°, 96.128463°				
				Pauk Chine	21.868409°, 96.142784°				
				War Yone Pin	21.844165, 96.128938				

According to the above table, most of the environmentally sensitive areas along the access road to traction stations are residential areas, natural springs, rivers and canals, agricultural lands and forest areas including Thit Ta Pin Taung Protected Forest.

Table 5.50- Consideration of Sensitive Areas within 1km radius of Traction Substations

Traction Substation	Location	Sensitive Areas	LOCATION	Reserved Forest	Location
Muse	24.017334°, 97.963574°	Nan Pann	24.014952°, 97.957032°	-	-
Nam Hpak Ka	23.655504°, 97.848845°	-	-	-	-
Mang Pang	23.368520°, 97.933000°	Par Gyo	23.370266°, 97.929377°	-	-
Theinni	23.297936°, 97.986293°	-	-	-	-
Lashio	22.985658°, 97.705226°	-	-	-	-
San Lau	22.671759°, 97.483302°	-	-	-	-
Chaung Chauk	22.540959°, 97.141796°	-	-	-	-
Nwang Hkio	22.314877°, 96.809115°	Taung Quarter	22.313778°, 96.803853°	-	-
Pyinoolwin	22.107502°, 96.533279°	East Pin Lain	22.104714°, 96.549211°	-	-
		Middle Pin Lain	22.105234°, 96.539294°	-	-
CK 365	22.050643°, 96.278481°	-	-	Kai Gyi Reserved Forest	22.050643°, 96.278481°
Mandalay South	21.847319°, 96.121101°	Sauk Taw Wa	21.852743°, 96.115185°	-	-
		War Yone Pin	21.844165°, 96.128938°	-	-
Mandalay East Switching Post	21.949295°, 96.153631°	-	-	-	-

According to the above table, most of the environmentally sensitive areas around the traction substations are residential areas and Kai Gyi Reserved Forest.

Table 5.51- Consideration of Sensitive Areas within 0.5 km beside the Transmission Line

		Residential Area		*Ecologically Important Area*		*Historical, Archaeological, Cultural and Heritage*		*Mineral Abundance Areas*		*Surface Water Resources*		*Landscape and Visual*	
		Village	*Location*	*Protective Area*	*Location*	*Sensitive Zone*	*Location*	*Resources Area*	*Location*	*Source*	*Location*	*Source*	*Location*
Border to Muse Station (24.006486, 97.954332)	1	Nam Sonn	24.030702, 97.982782	-	-	-	-	-	-	-	-	-	-
	2	Nan Pann	24.014952, 97.957032	-	-	-	-	-	-	-	-	-	-
Muse Station (24.006486, 97.954332) to Pang Hkam Station (23.924275, 97.930225)	3	Wane Mine	24.002076, 97.939476	-	-	-	-	-	-	-	-	-	-
	4	Kaung Khan	23.989151, 97.927925	-	-	-	-	-	-	-	-	-	-
Man Hwang Station (23.840273, 97.935907) to Na Hpai Station (23.735083, 97.907042)	5	Nan Om	23.826240, 97.935353	-	-	-	-	-	-	-	-	-	-
	6	Phat Mhan	23.977210, 97.916416	-	-	-	-	-	-	-	-	-	-
	7	Mhan Haunn	23.777568, 97.908184	-	-	-	-	-	-	-	-	-	-
Na Hpai Station (23.735083, 97.907042)	8	Mine Mine	23.719454, 97.898163	-	-	-	-	-	-	-	-	-	-

to Nan Hpak Ka Station (23.660356, 97.852678)													
Nan Hpak Ka Station (23.660356, 97.852678) to Pang Nin Station (23.570530, 97.851733)	9	-	-	-	-	-	-	-	-	Nam Khai River	23.604513, 97.841143	-	-
Pang Nin Station (23.570530, 97.851733) to Kutkai Station (23.469516, 97.894684)	10	Nam Phat Loon	23.560408, 97.851887	-	-	-	-	-	-	-	-	-	-
	11	Mang Lon	23.532197, 97.872483	-	-	-	-	-	-	-	-	-	-
	12	Lwal Pal	23.480092, 97.894311	-	-	-	-	-	-	-	-	-	-
Kutkai Station (23.469516, 97.894684) to Mang Peng Station (23.371909, 97.931348)	13	Ho Nar	23.468220, 97.892402	-	-	-	-	-	-	-	-	-	-
	14	Nam Khone	23.439460, 97.895019	-	-	-	-	-	-	-	-	-	-
	15	Man Nawng	23.418225, 97.902488	-	-	-	-	-	-	-	-	-	-
	16	Par Gyo	23.370266, 97.929377	-	-	-	-	-	-	-	-	-	-
Mang Peng Station (23.371909, 97.931348) to Nwang Yen Station (23.399132, 98.055187)	17	-	-	38 miles Man Pying Animal Exami nation Center	23.365911, 97.948227	-	-	-	-	-	-	-	-

Laban Pa Station (23.333072, 98.059699) to Theinni Station (23.293231, 97.985080)	18	-	-	-	-	-	-	-	-	-	-	Forest	23.324428, 98.016133
	19	Man Chat	23.313305, 98.008298	-	-	-	-	-	-	Natural Spring	23.313305, 98.008298	-	-
	20	Mang Sar Tone	23.309274, 97.999011	-	-	-	-	-	-	-	-	-	-
	21	Wane Line	23.309188, 97.988722	-	-	-	-	-	-	Natural Spring	23.309188, 97.988722	-	-
Theinni Station (23.293231, 97.985080) to Sam Lou Station (23.201112, 97.894590)	22	-	-	-	-	-	-	-	-	Nam Tu River	23.289810, 97.976761	-	-
	23	Naung On	23.278872, 97.969783	-	-	-	-	-	-	-	-	-	-
	24	Pan Sone	23.259018, 97.938860	-	-	-	-	-	-	-	-	-	-
	25	-	-	-	-	-	-	-	-	Nam Pang Stream	23.257000, 97.943131	-	-
	26	Kungmyaung	23.233243, 97.913675	-	-	-	-	-	-	-	-	-	-
	27	Nan Onn	23.206558, 97.902174	-	-	-	-	-	-	-	-	-	-
Sam Lou Station (23.201112, 97.894590) to Hang Lu Station (23.127267, 97.840565)	28	Nar Chat	23.181866, 97.877292	-	-	-	-	-	-	Natural Spring	23.181866, 97.877292	-	-
	29	Pan Kham	23.171638, 97.872338	-	-	-	-	-	-	-	-	-	-
	30	Nam Maw Hate	23.164425, 97.869158	-	-	-	-	-	-	-	-	-	-
	31	Pan Phat	23.144800, 97.854208	-	-	-	-	-	-	-	-	-	-
Hang Lu Station (23.127267, 97.840565) to Lashio	32	Nam Hu	23.085759, 97.798375	-	-	-	-	-	-	-	-	-	-
	33	Pan Hat	23.071928, 97.779249	-	-	-	-	-	-	-	-	-	-

North Station (23.048538, 97.759070)													
Lashio North Station (23.048538, 97.759070) to Lashio West Station (22.981536, 97.705398)	34	-	-	-	-	-	-	-	-	Lake	23.047041, 97.758620	-	-
	35	Ho Pate	23.044302, 97.756349	-	-	-	-	-	-	-	-	-	-
	35	-	-	-	-	-	-	-	-	Nam Yao River	23.011512, 97.722750	-	-
Lashio West Station (22.981536, 97.705398) to Mehan Station (22.870083, 97.688677)	36	Naung Laing	22.975586, 97.694733	-	-	-	-	-	-	-	-	-	-
	37	Khar Shi	22.950894, 97.695643	-	-	-	-	-	-	-	-	-	-
	38	Kaung Ma Kyan	22.938349, 97.694631	-	-	-	-	-	-	-	-	-	-
	39	Mal Han	22.883921, 97.694954	-	-	-	-	-	-	Natural Spring	22.883921, 97.694954		
	40	Lwin Lount	22.870793, 97.688123	-	-	-	-	-	-	-	-	-	-
Mehan Station (22.870083, 97.688677) to Nam Un Station (22.771006, 97.656280)	41	-	-	-	-	-	-	Sin Bo Coal Plant	22.849777, 97.689589	-	-	-	-
	42	San Pyat	22.814816, 97.667802	-	-	-	-	-	-	-	-	-	-
	43	Khay Ninn	22.794086, 97.675568	-	-	-	-	-	-	-	-		
Nam Un Station (22.771006, 97.656280) to Sint Eng Station	44	-	-	-	-	-	-	-	-	-	-	Forest area	22.770808, 97.652135
	45	Naung Mon	22.764907, 97.637856	-	-	-	-	-	-	-	-	-	-

(22.733224, 97.555773)													
Sint Eng Station (22.733224, 97.555773) to San Lau Station (22.673916, 97.487782)	46	-	-	-	-	-	-	-	-	Nam Paung Stream	22.708126, 97.521687	-	-
San Lau Station (22.673916, 97.487782) to Kong Tha Station (22.627581, 97.411773)	47	Ho Nwang	22.631058, 97.418032	-	-	-	-	-	-	-	-	-	-
Kong Tha Station (22.627581, 97.411773) to Hsipaw Station (22.597323, 97.300881)	48	Soot Lan	22.619744, 97.363305	-	-	-	-	-	-	-	-	-	-
	49	Pan Hsauk	22.611549, 97.367325	-	-	-	-	-	-	-	-	-	-
	50	Nwang Eain	22.602100, 97.302230	-	-	-	-	-	-	-	-	-	-
Hsipaw Station (22.597323, 97.300881) to Hsipaw South Station (22.570027, 97.237676)	51	Ton Kar	22.587546, 97.252104	-	-	-	-	-	-	-	-	-	-
	52	-	-	-	-	-	-	-	-	Nam Tu Myi Nge-R River	22.565116, 97.227588		

Hsipaw South Station (22.570027, 97.237676) to Chaung Chauk Station (22.539479, 97.144750)	53	Kyin Thi	22.564065, 97.222827	-	-	-	-	-	-	-	-	-	-
	54	Nam Onn	22.555872, 97.187512	-	-	-	-	-	-	-	-	-	-
	55	Ngon Sai	22.543566, 97.181939	-	-	-	-	-	-	-	-	-	-
	56	Nwang Ann	22.546527, 97.166665	-	-	-	-	-	-	Natural Spring	22.546527, 97.166665	-	-
Chaung Chauk Station (22.539479, 97.144750) to Kyaukme Station (22.492722, 97.020461)	57	Pang Ywang	22.508405, 97.039741	-	-	-	-	-	-	Natural Spring	22.508405, 97.039741	-	-
	58	Mway Taw	22.503216, 97.033525	-	-	-	-	-	-	Natural Spring	22.503216, 97.033525	-	-
Kyaukme Station (22.492722, 97.020461) to Myin Gwin Station (22.422319, 96.966095)	59	Na Ai Hkant	22.425912, 96.961091	-	-	-	-	-	-	Natural Spring	22.425912, 96.961091	-	-
Myin Gwin Station (22.422319, 96.966095) to Nam Ba Ton River Station (22.341234, 96.871000)	60	Khite Tone Home	22.414476, 96.957989	-	-	-	-	-	-	Natural Spring	22.414476, 96.957989	-	-
	61	Kone Kaw	22.405297, 96.957967	-	-	-	-	-	-	Natural Spring	22.405297, 96.957967	-	-
	62	Kyaung Kone	22.358234, 96.877519	-	-	-	-	-	-	Natural Spring	22.358234, 96.877519	-	-
	63	-	-	-	-	-	-	-	-	Nam Ba Ton River	22.339885, 96.867818	-	-

Nam Ba Ton River Station (22.341234, 96.871000) to Nawng Hkio Station (22.310013, 96.801553)	64	Myat Chae Nu	22.306392, 96.836849	-	-	-	-	-	-	-	-	-	-
	65	Kone Gyi Ma	22.315804, 96.828690	-	-	-	-	-	-	-	-	-	-
Nawng Hkio Station (22.310013, 96.801553) to Ommakha Station (22.275012, 96.677853)	66	Taung Quarter	22.313778, 96.803853	-	-	-	-	-	-	Natural Spring	22.313778, 96.803853	-	-
	67	Ngoke Ka Lay	22.310301, 96.771796	-	-	-	-	-	-	-	-	-	-
	68	-	-	-	-	-	-	-	-	-	-	Nawng Hkio Golf Club	22.306280, 96.765162
	69	Ban Bway	22.305213, 96.737448	-	-	-	-	-	-	-	-	-	-
	70	Ommakha	22.282294, 96.689727	-	-	-	-	-	-	-	-	-	-
Ommakha Station (22.275012, 96.677853) To Gangaw Station (22.216818, 96.590718	71	Kyin Ganai	22.268749, 96.658752	-	-	-	-	-	-	-	-	-	-
	72	Samasal	22.247475, 96.641875	-	-	-	-	-	-	-	-	-	-
Gangaw Station (22.216818, 96.590718) To Pyinoolwin Station	73	Lone Yone	22.188979, 96.568363	-	-	-	-	-	-	-	-	-	-
	74	Anauk Kyu Inn	22.148223, 96.563513	-	-	-	-	-	-	Natural Spring	22.148223, 96.563513	-	-

(22.105295, 96.540374)													
Pyinoolwin Station (22.105295, 96.540374) To Sin Byu In Station (22.082622, 96.403790)		East Pin Lain	22.104714, 96.549211	-	-	-	-	-	-	-	-	-	-
	75	Middle Pin Lain	22.105234, 96.539294	-	-	-	-	-	-	Natural Spring	22.105234, 96.539294	-	-
	76	Myawt Taw	22.100343, 96.495723	-	-	-	-	-	-	-	-	-	-
	77	-	-	-	-	-	-	-	-	Reservoir	22.099917, 96.466268	-	-
	78	Kone Kaw	22.095427, 96.435934	-	-	-	-	-	-	Natural Spring	22.095427, 96.435934	-	-
	79	Pan Oo Taung	22.092211, 96.423717	-	-	-	-	-	-	Natural Spring	22.092211, 96.423717	-	-
To Sin Byu In Station (22.082622, 96.403790) To Sakangyi Station (22.024931, 96.339346)	80	-	-	-	-	-	-	-	-	-	-	Kai Gyi Reserved Forest	22.017399, 96.295682
Sakangyi Station (22.024931, 96.339346) To Taung Kyun Station (22.004728, 96.259483)	81	-	-	-	-	-	-	-	-	-	-	Kai Gyi Reserved Forest	22.017399, 96.295682
Taung Kyun Station (22.004728, 96.259483) To Tok Kha Taung Station													

(22.016022, 96.220754)													
Tok Kha Taung Station (22.016022, 96.220754) to Mandalay East Station (21.945631, 96.157707)	82	-	-	-	-	-	-	-	-	Sedawgyi Canal	21.981115, 96.178485	-	-
	83	Lain Pin	21.976874, 96.177334	-	-	-	-	-	-	-	-	-	-
	84	Yankin Taung	21.978723, 96.165871	-	-	-	-	-	-	-	-	-	-
Mandalay East Station (21.945631, 96.157707) to Mandalay South Station (21.840919, 96.115836)	85	Bo Tat Gone	21.926714, 96.150118	-	-	-	-	-	-	-	-	-	-
	86	Shin Taw Gone	21.935598, 96.148471	-	-	-	-	-	-	-	-	-	-
	87	Thant Zin Gone	21.923191, 96.148111	-	-	-	-	-	-	-	-	-	-
	88	Lat Kaung	21.922025, 96.158469	-	-	-	-	-	-	-	-	-	-
	89	Thale Gone	21.915023, 96.155310	-	-	-	-	-	-	-	-	-	-
	90	Ywar Shay	21.910429, 96.155531	-	-	-	-	-	-	-	-	-	-
	91	Sauk Taw Wa	21.852743, 96.115185	-	-	-	-	-	-	-	-	-	-
	92	War Yone Pin	21.844165, 96.128938	-	-	-	-	-	-	-	-	-	-
Mandalay South Station (21.840919, 96.115836)	93	Sin Bo	21.876957, 96.152982	-	-	-	-	-	-	-	-	-	-
	94	Min Su	21.858199, 96.128463	-	-	-	-	-	-	-	-	-	-
	95	Pauk Chine	21.868409, 96.142784	-	-	-	-	-	-	-	-	-	-
	96	Min Ywar	21.843224, 96.099868	-	-	-	-	-	-	-	-	-	-
	97	Nyaung Pin Ni	21.835055, 96.086749	-	-	-	-	-	-	-	-	-	-

	98	Nyaung Pin Zout	21.827731, 96.095464	-	-	-	-	-	-	-	-	-	-
	99	Sar Toe	21.847448, 96.076049	-	-	-	-	-	-	-	-	-	-
	100	Sat Kway	21.842036, 96.071457	-	-	-	-	-	-	-	-	-	-
	101	Myo Pyin Gyi	21.837322, 96.075945	-	-	-	-	-	-	-	-	-	-
	102	Myit Laung	21.852678, 96.079742	-	-	-	-	-	-	-	-	-	-
	103	Danone	21.865502, 96.075499	-	-	-	-	-	-	-	-	-	-
	104	Pyauk Sake Kone	21.863664, 96.097978	-	-	-	-	-	-	-	-	-	-
	105	Ashay Thar Yar Gone	21.855179, 96.065068	-	-	-	-	-	-	-	-	-	-

According to the above table, most of the environmentally sensitive areas along the transmission lines are residential areas, natural springs, rivers and canals, reservoir, factory, quarry, Nawng Hkio golf club and Kai Gyi Reserved Forest.

5.4.12.2. Forest Area

The forest area and forest plantation that the railway will pass according to the alignment of FS study will be as follow. All of the data about the forest area and plantation were based on field survey data from local forest departments.

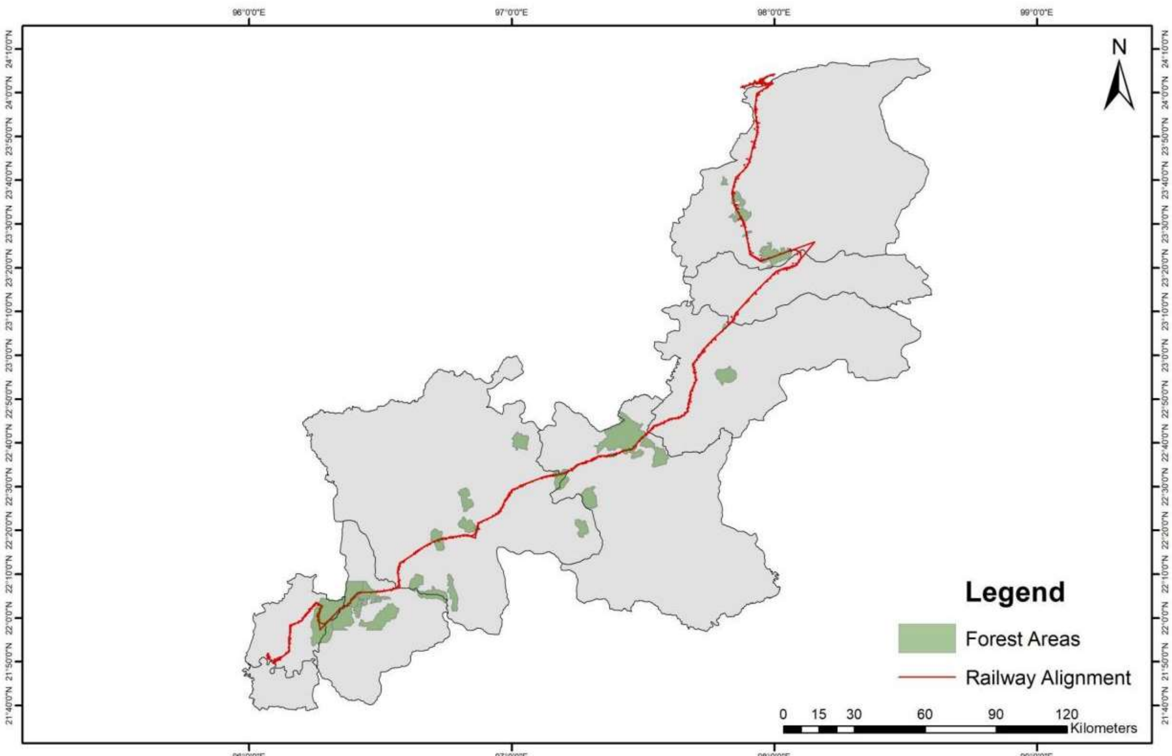


Figure 5.75 – Forest Area along the Railway Line in Argic Map

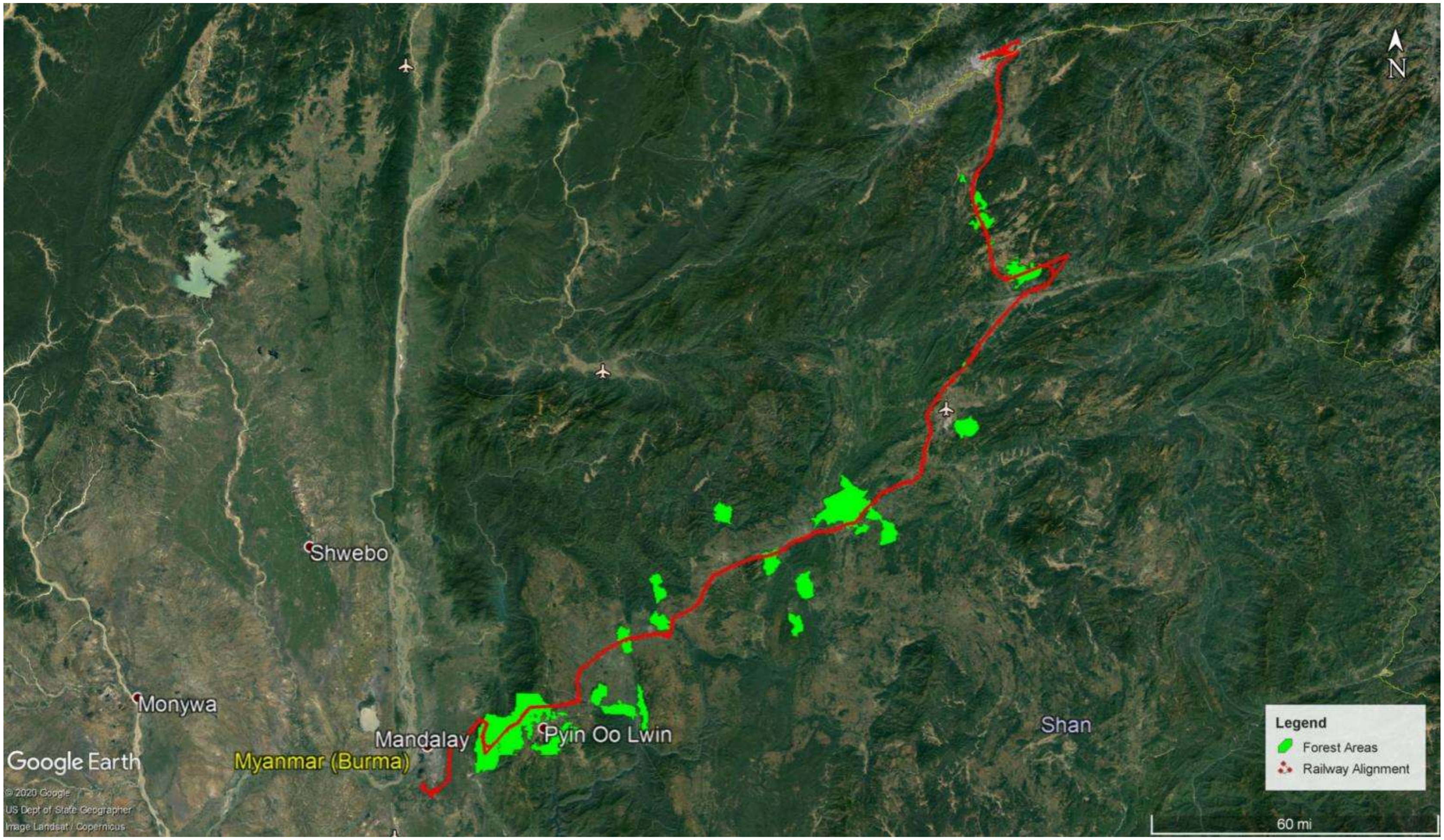


Figure 5.76– Forest Area along the Railway Line in Google Map

Table – Forest Area where the Railway will Pass

S/N	Railway Passing Region	Forest		Forest Plantation		Private Plantation		CF Plantation	
		Name	Area (Acres)	No. of owners	Area (Acres)	No. of owners	Area (Acres)	No. of owners	Area (Acres)
1.	**Muse**	-	-	-	-	-	-	-	-
2.	**Kutkai**	Ho Nar Reserved Forest	217	2	217	-	-	-	-
		Nam Hpak Loon Protected Forest	892	-	-	-	-	-	-
		Kaung Lain Protected Forest	1510	-	-	-	-	-	-
		Loi Sam Sit Natural Protected Forest	5352	-	-	-	-	-	-
3.	**Hseni**	-	-	-	-	-	-	-	-
4.	**Lashio**	Bone Mon Protected Forest	540	1	50	-	-	-	-
5.	**Hsipaw**	Tein Lon Reserved Forest	611	47	5530	3	32	6	678.47
		Namma Reserved Forest	2590	-	-	-	-	-	-
		Pang Hsauk Protected Forest	815	-	-	-	-	-	-
6.	**Kyaukme**	Tein Lon Reserved Forest	1702	-	-	-	-	35	189.79/20

		Goketwin Reserved Forest	15	-	-	1	15	-	-
7.	**Nawnghkio**	Nawnghkio Reserved Forest	2300	13	2370	15	1357	-	-
		Goketwin Extended Reserved Forest	653	-	-	-	-	-	-
8.	**Pyinoolwin**	Taung Kyun Reserved Forest	-	-	-	-	-	-	-
		Taung Kyun Extended Reserved Forest	-	-	-	-	-	-	-
		Sakhan Gyi Reserved Forest	-	-	-	-	-		-
		Taung Khaung Reserved Forest	-	2	717.87	-		4	24
		Taung Pyo Extended Reserved Forest	-	2	646.65	1	150	4	21.41
9.	**Mandalay**	Taung Kyun Reserved Forest	-	2	930	-	-	2018-19	3
		Taung Kyun Extended Reserved Forest	-	3	168	1	6	2018-19	2
		Sakhan Gyi Reserved Forest	-	4	377.5	-	-	-	-

5.4.12.3. Protected Area

Protected Areas are one of the most important tools for biodiversity conservation, safeguarding ecosystems services and preserving cultural landscapes. As of 2018, Myanmar has 42 Protected Areas. Seven of the Protected Areas are ASEAN Heritage Parks (AHPs) recognised for their biodiversity value within ASEAN countries; and five are Ramsar Sites (wetlands of international importance).

The above mentioned environmentally sensitive areas (such as Nature Reserve, National Park, Protected Area, National Park and ASEAN Heritage Park, Wildlife Sanctuary, Bird Sanctuary, Wildlife Park, Mountain Park, Wildlife Sanctuary and ASEAN Heritage Park, Elephant Range and Wildlife Sanctuary) are not included along Muse-Mandalay. Among them, totally 4 sensitive areas, Shwe-U-Daung Wildlife Sanctuary (87km away from the line) , Pyin-Oo-Lwin Wildlife Sanctuary (5km away from the line) , Minwuntaung Wildlife Sanctuary (18km away from the line) and Irrawaddy Dolphin P.A are close to Railway with 12.5km away from the line respectively. Shwe U Daung used to be a habitat for critically endangered species of Hairy Rhinoceros (*Dicerorhinus sumatraensis*), and the conservation priority for this site will be critical for restoring this rhinoceros. In addition, Shwe U Daung Wildlife Sanctuary serves as an important habitat for Asian elephant (endangered). Minwuntaung Wildlife Sanctuary serves as Key species protected for Barking deer, Hog deer, Avifauna. Although these areas were not close to the project area, but well planned management should be done for implementation around forest and environment.

Table 5.52 - Environmentally Sensitive Areas along Muse-Mandalay

Name of sensitive areas	Level	Issuing time	Area (km2)	Competent department	Protection object	Position relationship with the line
Shwe-U-Daung Wildlife Sanctuary	National	1929	117.97	Forest sector	Elephant, gaur, banteng, rusa, serow, bear	About 87km away from the line
Pyin-Oo-Lwin Widlife Sanctuary	National	1927	127.25	Forest sector	Muntjac, birds,	About 5km away from the line
Minwuntaung Wildlife Sanctuary	National	1972	205.88	Forest sector	Muntjac, birds,	About 18km away from the line
Irrawaddy Dolphin P.A	National	2005	327.53	Forest sector	Irrawaddy Dolphin	About 12.5km away from the line

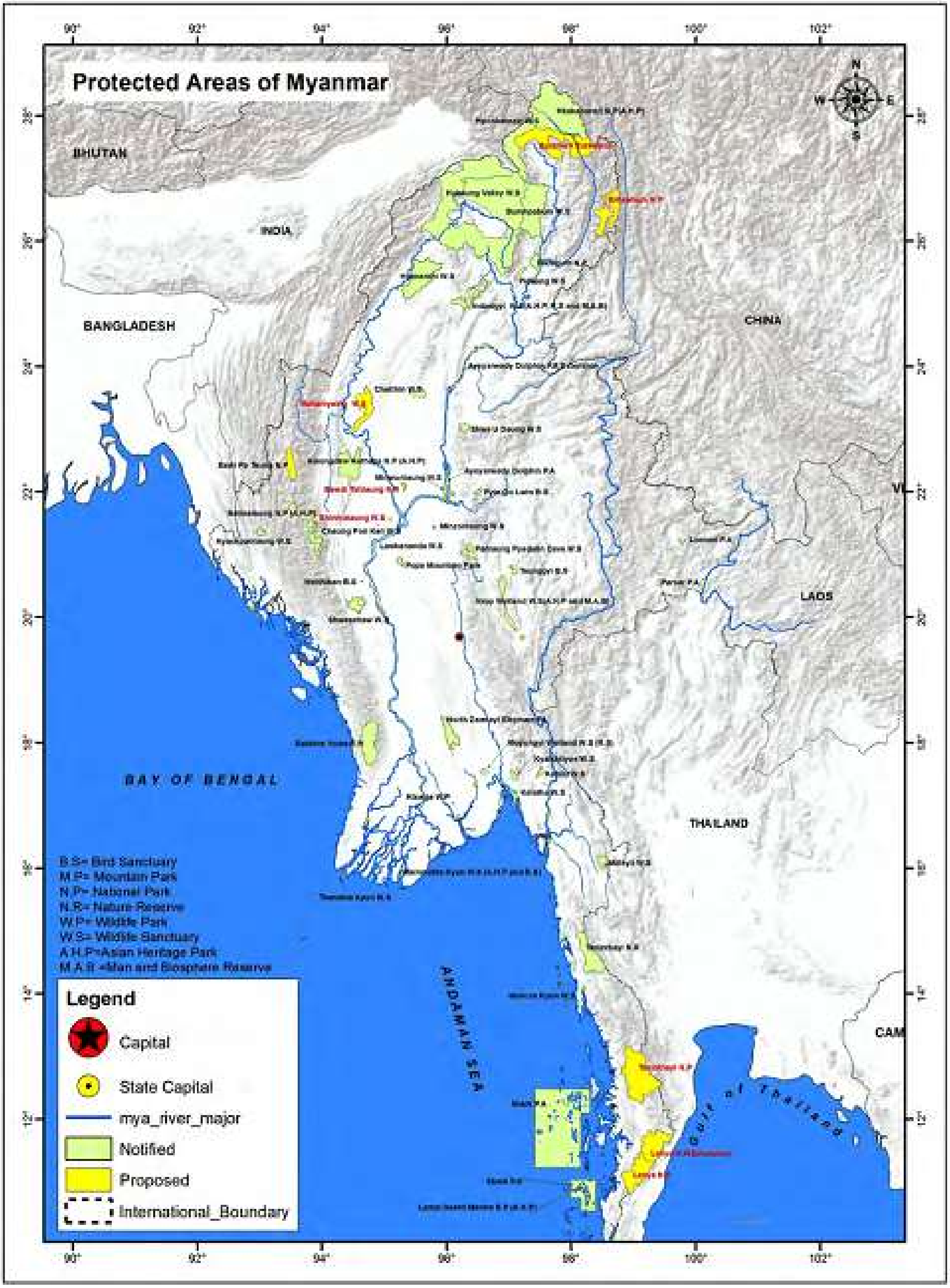


Figure 5.77 - Map of Protected Areas of Myanmar (Source: WCS, Protected Areas, 2017)

Figure 5.78- Location Plan of Railway and Shwe-U-Daung Wildlife Sanctuary

Figure 5.79 - Location Plan of Railway and Pyin-Oo-Lwin Wildlife Sanctuary

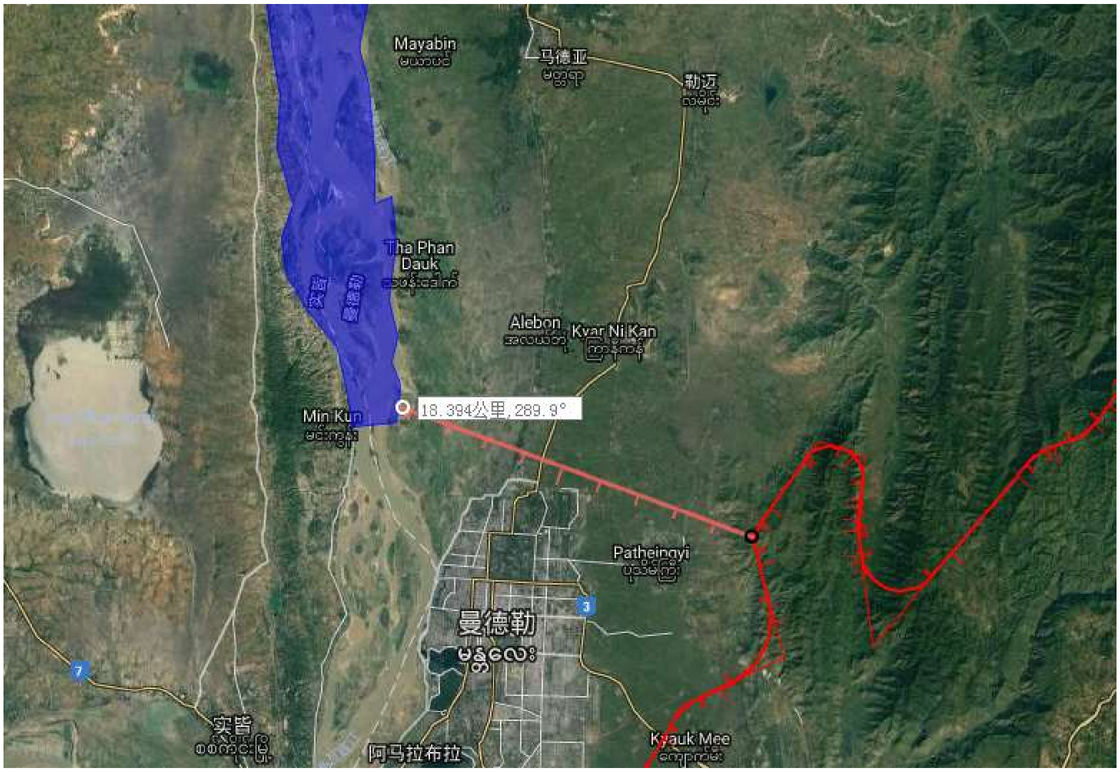


Figure 5.80- Location Plan of Railway and Irrawaddy Dolphin P.A

Figure 5.81- Location Plans of Railway and Minwuntaung Wildlife Sanctuary

5.4.13. Infrastructure and Services

(a) Transportation

(1) Mandalay Province

Mandalay is located in the central part of Myanmar. Compared with other places, Mandalay has a better transportation system, including roads, aviation, railways and waterways. The main mode of transportation in central Myanmar is highway. Three of the six main highways in Myanmar are located in Mandalay Province and adjacent Magwe Province, with Mandalay as the main hub. Starting from Mandalay, the network extends northward through Muse in northern Shan State to Kachin State and China, westward to western Myanmar and India, and southward toYangon.

The existing railway in Myanmar is basically in north-south direction, the branch line is in east-west direction, and the central railway station in Mandalay is the main hub. The main railway lines for passenger and freight transport are located between Rangoon and Mandalay. Starting from Mandalay, the railway branch lines extend eastward to Shan State, westward to Magwe Province and northward to Kachin State.

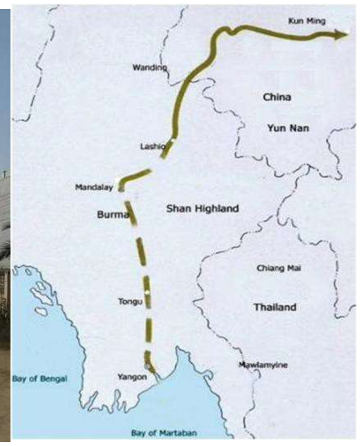
Mandalay has an international airport and serves as the central hub of central Myanmar. Most flights fly to Shan State in the East and Kachin State in the north. In addition, there are a few international flights, including direct flights to Kunming, China. Mandalay has a major port where passengers and goods are frequently transported to towns along the Ayarwaddy River.

(2) Shan State

Shan State's road network is not as developed as Mandalay Province. The most common transport route into northern Shan State is National Highways NH3 Highway, 450 km long. Lashio and Muse, which are major cities in northern Shan State, are connected to Mandalay through the NH3 Highway.

(b) NH3 Highway

NH3 highway, also known as "Stilwell Highway” in history, has the part in Chinese border, as No. 320 National Highway Western-Yunnan Section. The length in China is 850 kilometers long; it starts from Kunming to Shwe Li Wanding Port, the length from the Wanding port to the destination Lashio, Myanmar is 603 kilometers. It is an important transportation route connecting Southeast Asian countries. At present, it can reach Yangon, Bangkok, the capital of Thailand, to India in the west and Singapore in the southeast. There is onlyNH3 highway along the line, which is a two-way two-lane road with an existing width of 8m and asphalt concrete pavement.



The line also crosses NH3 Highway several times, and some sections are parallel with the existing highway, so the traffic is relatively convenient. For the purpose of not affecting ground traffic, this project adopts girder bridge and frame bridge for railway crossing highway, and adopts road relocation or interchange culvert for lower grade roads.

Table 5.53 - Individual Situation of Main Crossed Roads along the Line

S/N	Mileage	Crossing method and engineering measures	Remarks	S/N
1	CK9+880	CK9+560 Muse Station 2#frame bridge 2-10m	NH3	Highway underpass
2	CK31+650	CK31+330Kawng wing super major bridge(33×32)m simply supported girder bridge	NH3	Railway overcrossing highway
3	CK62+290	CK62+290 Pang nin Road-over bridge 5×32m	NH3	Highway overcrossing railway
4	CK88+100	Man peng1# tunnel	NH3	Highway overcrossin g railway
5	CIK133+66 5	CKI133+990Sam lou super major bridge5×32m simply supported girder bridge	NH3	Railway overcrossin g highway
6	CK151+630	Hang lu tunnel	NH3	Highway overcrossin g railway
7	CK154+900	Hang lu tunnel	NH3	Highway overcrossing railway
8	CK153+200 (After broken chain）	CK152+453Hka shi super major bridge 49×32m simply supported girder bridge	NH3	Railway overcrossing highway

9	CK164+559	CK164+599 Kawng has super major bridge 25×32m simply supported girder bridge	NH3	Railway overcrossing highway
10	CK198+180	CK198+040 Hsup lang major bridge 12×32m simply supported girder bridge	NH3	Railway overcrossin g highway
11	CK266+560	Tunnel	NH3	Highway overcrossin g railway
12	CK272+880	Tunnel	NH3	Highway overcrossing railway
13	CK273+680	CK273+680 2-16m rigid frame bridge	Road under constructio n	Highway underpass
14	CK279+884	CK279+884 2-16m rigid frame bridge	Road under constructio n	Highway underpass
15	CK291+050	CK291+519 Hu ka1#super major bridge 25×32m simply supported girder bridge	NH3	Railway overcrossing highway
16	CK394+550	Mandalay Road-over bridge 9×25m	NH3	Highway overcrossin g railway

Highway Bus Station

No.	Existing Bus Station	Location	Relation with the project
1	Chan Mya Shwe Pyi Highway Station	Mandalay	Existing Mandalay-Muse Highway
2	Thiri Pa Day Thar Highway Station	Pyin Oo Lwin	Existing Mandalay-Muse Highway
3	Lashio Bus Station	Lashio	Existing Mandalay-Muse Highway
4	Kyaukme Highway Bus Terminal	Kyaukme	Existing Mandalay-Muse Highway
5	Muse Highway Bus Station	Muse	Existing Mandalay-Muse Highway

(c) Existing Underground Pipelines

According to the survey data, there are many crossings between the newly built railway and the existing oil and gas pipelines, which have certain influence on the railway route. The main underground pipeline is the Myanmar-China oil and gas pipeline, with the diameter of 813mm-1,016mm. The starting point of Myanmar-China oil pipeline is located in Maday Island on the west coast of Myanmar. They enter China from Shwe Li, Yunnan Province, via Rakhine, Magwe, Mandalay and Shan State of Myanmar. The total length of crude oil and natural gas pipelines is 793km. Among them, the design capacity of Myanmar-China crude oil pipeline is 22 million tons/year, and the gas transmission capacity of Myanmar-China natural gas pipeline is 12 billion cubic meters/year. On July 28, 2013, gas transmission to China started.

The line is also intersected with a small number of local water supply and drainage pipelines, underground communication cables, oil and gas pipelines and other pipelines. When the railway crosses the underground pipeline, in principle, the method of relocation, reconstruction, in-situ protection are adopted. On the premise of meeting the relevant provisions regarding pipeline protection, railway culverts or railway bridges can be adopted for passing.

Path of Myanmar-China Oil and Gas Pipeline

Table- Summary table of intersections between Myanmar-China oil and gas pipelines and the Project

No.	Intersection Mileage	Measure Taken	Remarks
1	CK229+100	Pass through by Kyankme tunnel	Railway underpass
2	CK239+500	CK239+193Pawk ang1#super major bridge 25×32m simply supported girder bridge	Railway overcrossing highway
3	CK266+725	Pass through by Kyaunggon tunnel	Railway underpass
4	CK274+350	Gohteik Nam ban ton River super major bridge 2(6×32+(1×48+2×36) steel-concrete composite girder+(148+2×260+148m)steel-concrete double-layer composite	Railway overcrossing highway

		rigid frame+2×50msteel-concrete composite girder+18×32)	

(d) Power Supply System near Muse-Mandalay Railway line

From the geographical connection diagram of existing power networks in Myanmar, the proposed Muse-Mandalay Railway passes through Shan State and Mandalay Division. Among them, there are a large hydropower station Shweli with an installed capacity of 600MW in Shan State and a large hydropower station YEYWA with an installed capacity of 790MW, SEDAWGYI power plant with a capacity of 25MW and UPPER YEYWA Hydropower Station (under construction) with an installed capacity of 280MW in Mandalay.

There are also three 230kV substations, namely MANSAN, SHWESARYAN and MYAUKPYIN, and four 132kV substations including PYINOOLWIN, YADANARPON, INDUSTRIAL, AUNGPIN, etc. Shwesaryan–ManSan-Shweli double-circuit 230kV transmission line is in parallel with nearby main power network laid along the railway. The power supply of hydro-power stations along the line is comparatively abundant, but the power network of them is weak. For example, Muse-Pyinoolwin segment has no access to 132kV power grid. Only one existing substation-MANSAN 230kV substation is located 30km west of Lashio, connecting to SHWELI 600MW power station in the north, and to SHWESARYAN 230kV substation 20km south of Mandalay in the southwest. For Pyinoolwin-Mandalay segment, the power grid is more accessible, forming a 132kV power supply network, along which there are five 132kV substations and two 230 kV substations.

Even so, by reinforcing and constructing supporting power network, the requirement of power supply for this railway can be met.

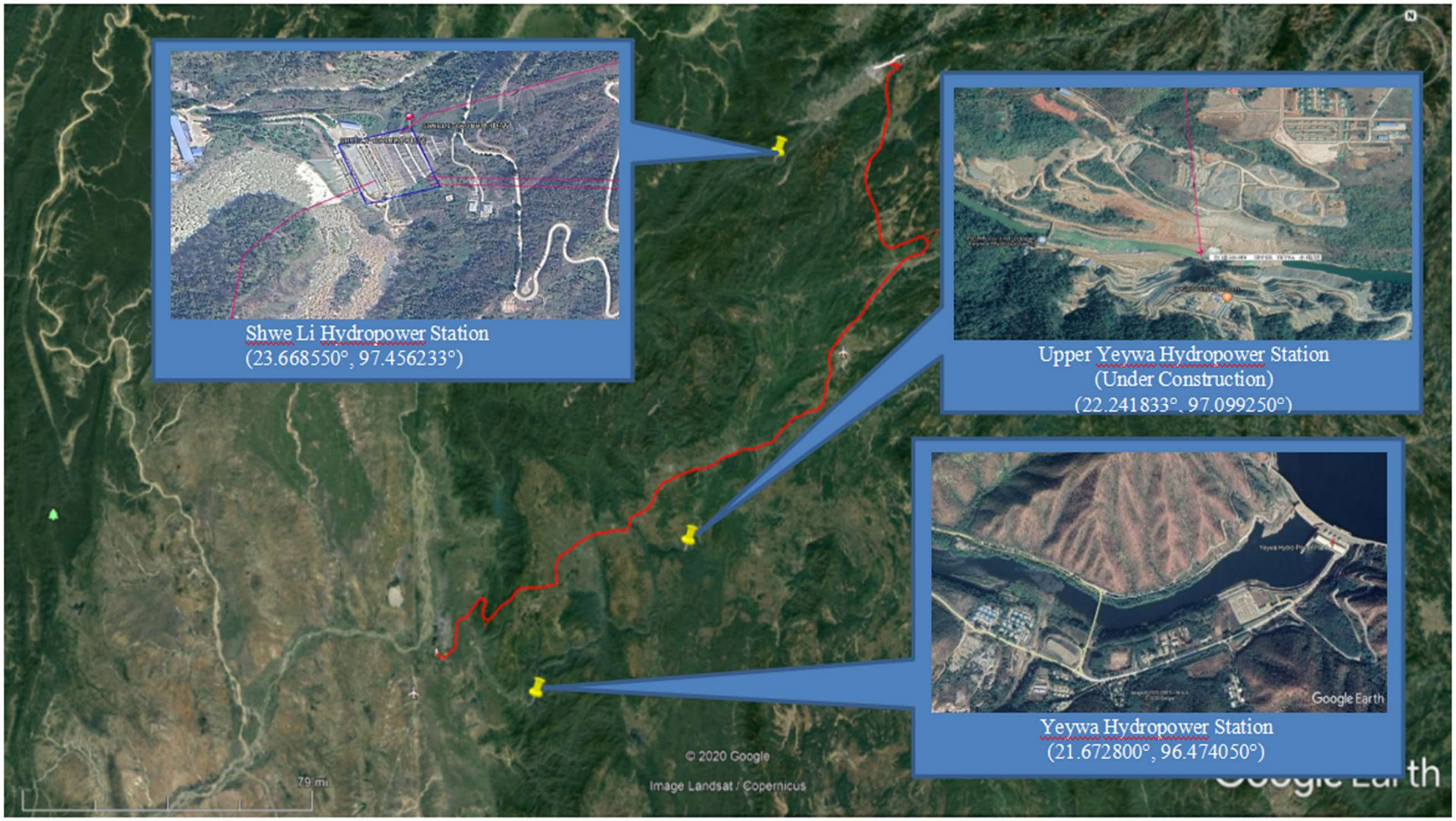


Figure 5.82 - Statistics on Power Stations near Muse-Mandalay Railway Line

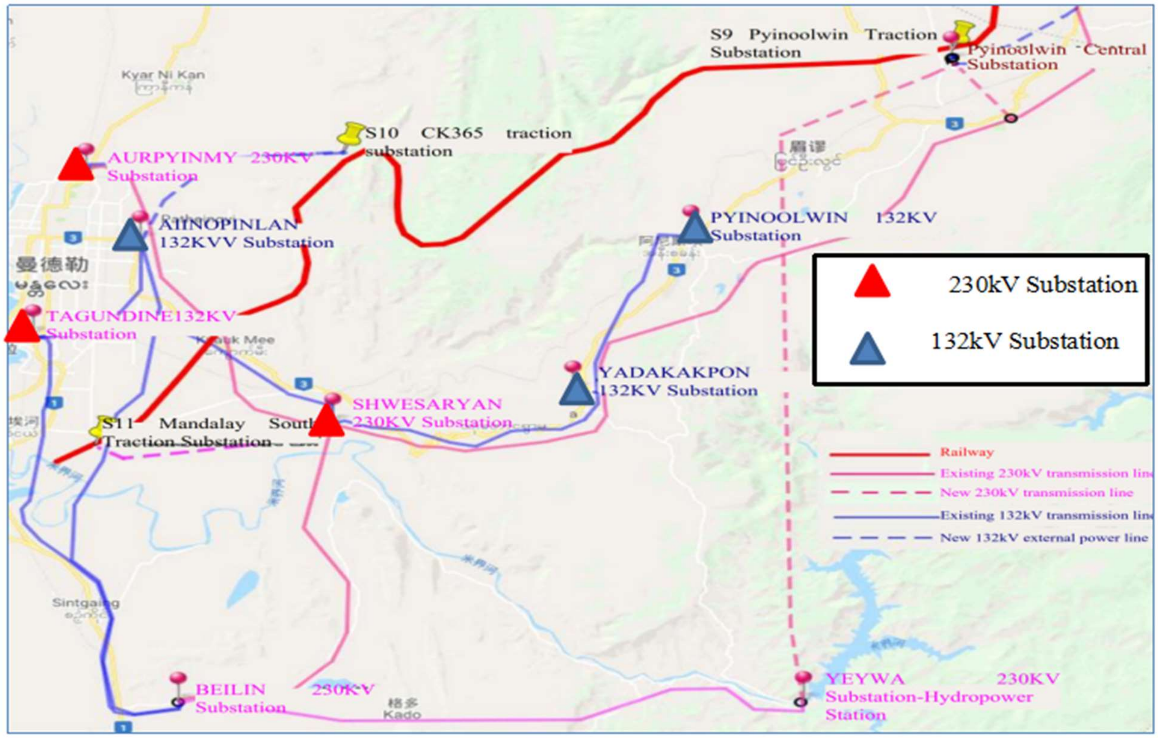


Figure 5.83- Statistics on 132/230kv Substations near Muse-Mandalay Railway Line

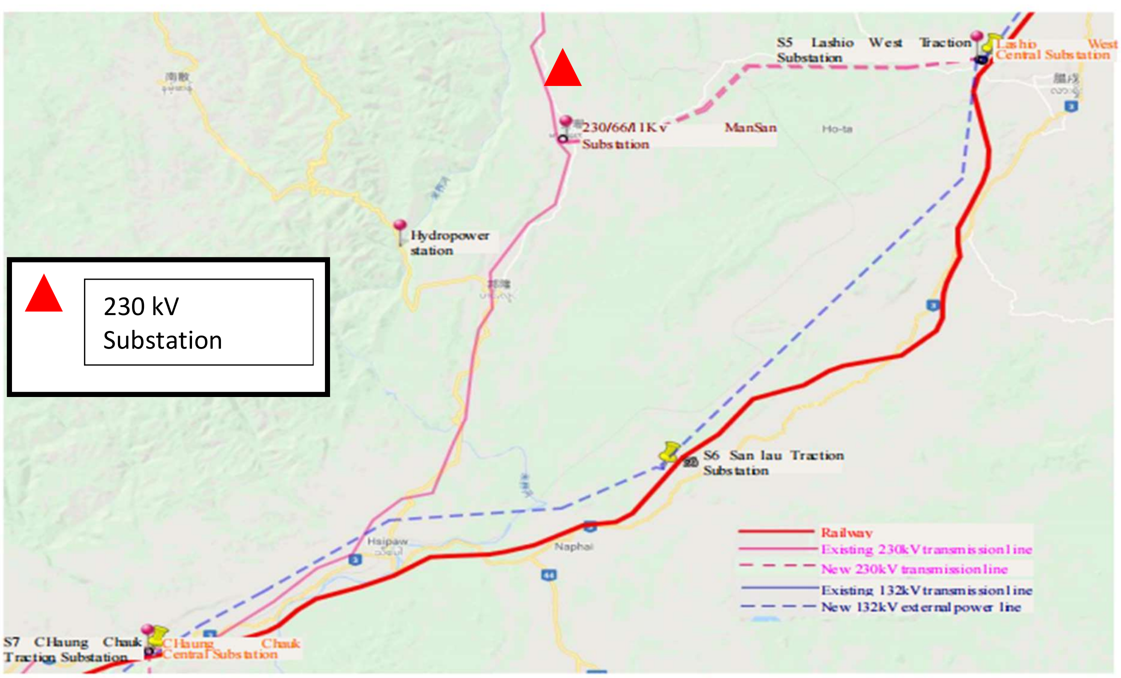


Figure 5.84- Statistics on 132/230kv Substations near Muse-Mandalay Railway Line

5.4.14. Visual Components

Shan State has beautiful landscape and it is also famous for its scenery. When the project is finished, power lines and traction substations to supply the train with electricity can be a visual impact on the landscape since it can be an eye sore for people who enjoy sightseeing.

Before Project

After Project

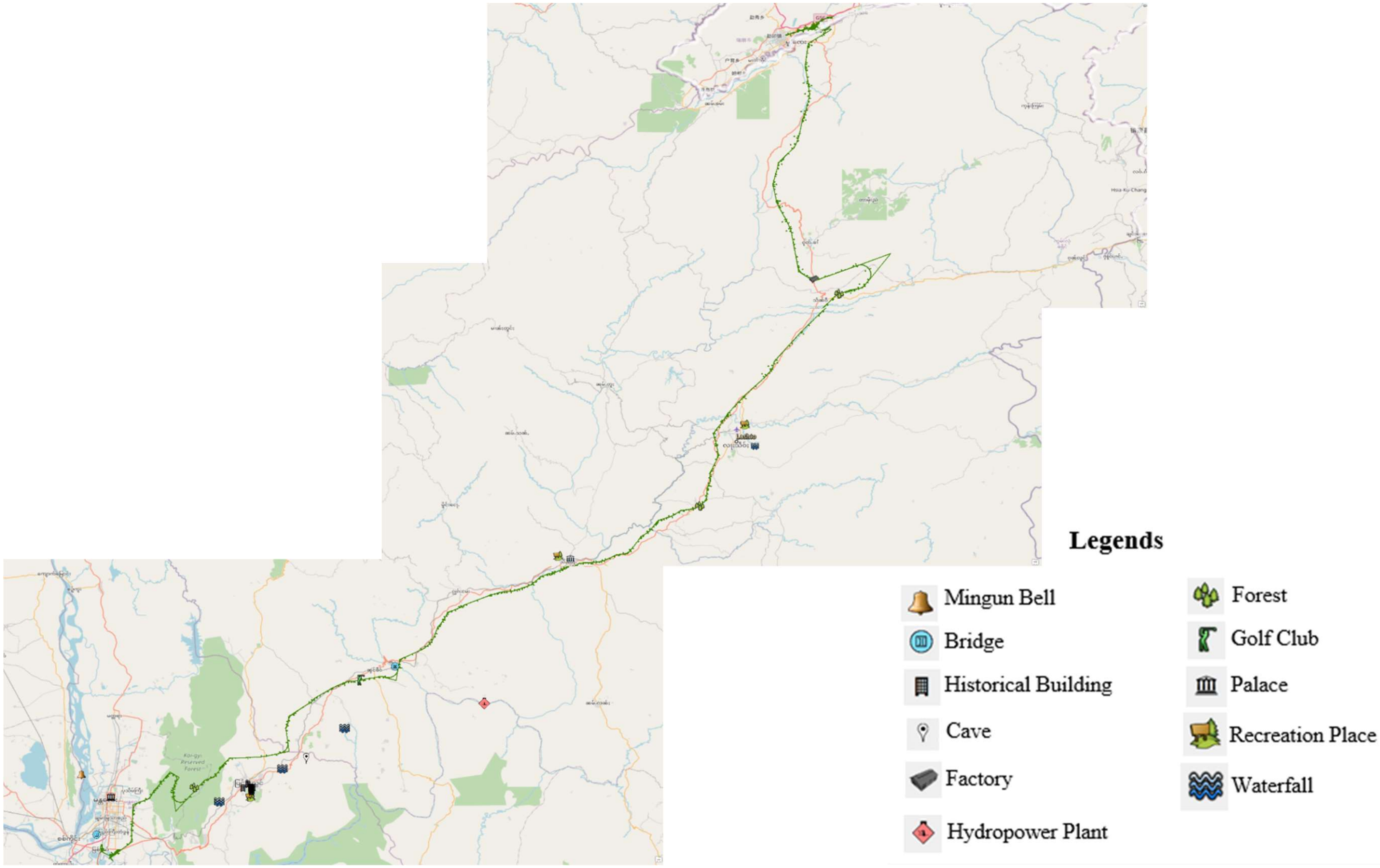


Figure 5.85 - Visually Sensitive Areas along the Railway

6.0 IMPACT ASSESSMENT AND MITIGATION MEASURES

6.1. Impact Assessment Methodology

6.1.1. Environmental Impact Assessment Methodology

Impacts will be assessed using information gathered during the baseline assessment in combination with previously collected data and the detailed project plan. The significance of the identified impacts will be determined using the approach outlined in Table 6.1. This incorporates two aspects for assessing the potential significance i.e. occurrence and severity, which are further sub-divided as indicated. The impact ranking will be described for both pre and post implementation of mitigation/management measures conditions.

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic Environmental system that can be attributed to human activities. The significance of the aspects/impacts of the process was rated by using a Matrix Method following the IAIA guidelines. The significances of the impacts were determined through a synthesis of the criteria below:

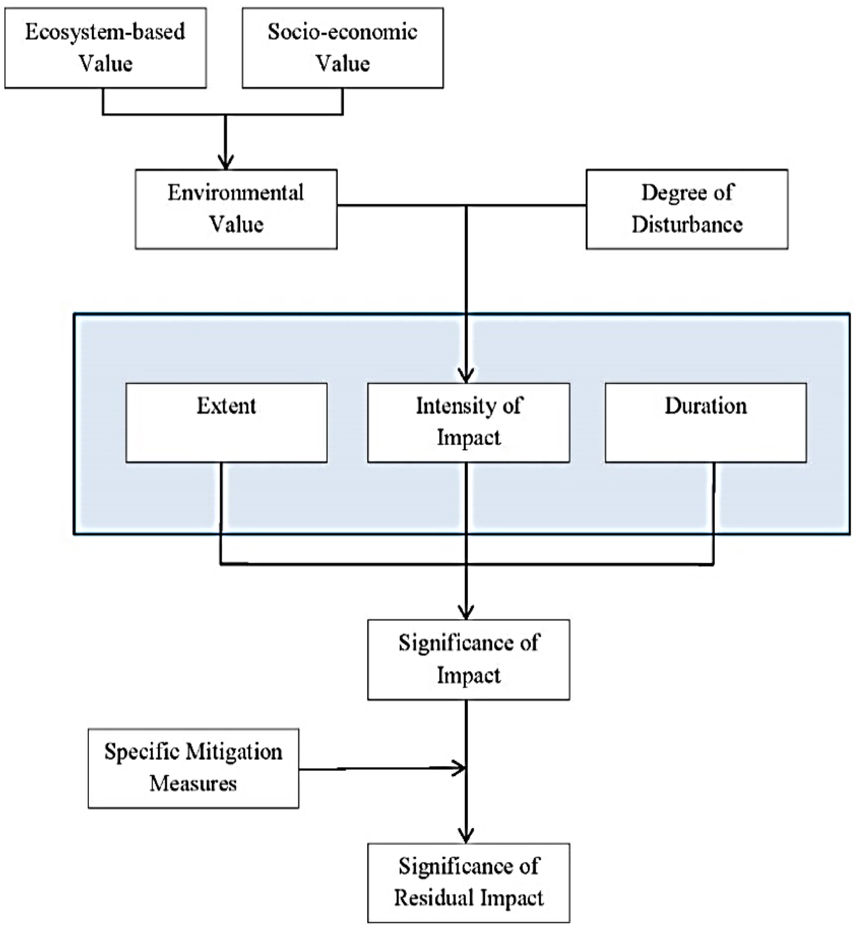


Figure 6.1 - Methodological Framework for Impact Assessment

The significances of the impacts were determined by using an index matrix that is based on four criteria of magnitude (M), Duration (D), Extend (E) (area) and Probability (P). According to the association of impact assessment – IAIA guidelines, the following terms are used to determine the effects and degrees of the impact.

Significant Point = (Magnitude+Duration+Extend) ×Probabililty

Significant Point (SP)	Impact Significance
< 15	No impact (-)
15-29	Low impact (U)
30-44	Moderate significant (C)
45-59	High significant (B)
> 60	Very high significant (A)

Magnitude

- If the impact is only insignificant, the index value is 1.
- If the impact is small and will have no effect, the index value is 2.
- If the impact is moderate and will result in minor changes, the index value is 3.
- If the impact is high and will result in significant changes, the index value is 4.
- If the impact is very high and will result in permanent changes, the index value is 5.

Duration

- If the impact is between 0-1 year in limited time of the project duration, index value is 1.
- If the impact is between 2-5 year in limited time of the project duration, index value is 2.
- If the impact is between 6-15 year in limited time of the project duration, index value is 3.
- If the impact is the life of operation in the project duration, index value is 4.
- If the impact is over shoot the project duration, index value is 5.

Extend (Area)

- If the impact occurs within the site, the index value is 1.
- If the impact occurs nearby limited area, the index value is 2.
- If the impact is limited to the local area, the index value is 3.
- If the impact is limited to the national stage, the index value is 4.
- If the impact is limited to the international stage, the index value is 5.

Probability

- If the impact is not going to happen, the index value is 1.
- If the impact is improbable, the index value is 2.
- If the impact is probable, the index value is 3.
- If the impact is highly probable, the index value is 4.
- If the impact is definite, the index value is 5.

Mitigation Requirement for Impact Significance

No.	Impact Significance	Mitigation Requirement
1	Very Low (Negligible)	No mitigation required
2	Low	Required a small number of additional mitigations
3	Low to Moderate	Require more or less additional mitigations
4	Moderate	Require a number of additional mitigations
5	Moderate to High	Require a number of additional mitigation or modification of the project design
6	High	Require additional mitigations plus modification of the project design or alternative action may be required

Prediction Confidence

Although not explicitly included in the criteria tables, there is uncertainty associated with the information and methods used in an ESIA because of its predictive nature. The certainty with which an impact analysis can be completed depends on a number of factors including:

- Understanding of natural/ecological and socio-economic processes at work now and in the future; and
- Understanding of present and future properties of the affected resource.

The level of prediction confidence for an impact analysis will be discussed when there are questions about the factors reviewed above. Where the level of prediction confidence makes a prediction of the impact problematic, a subjective assessment is made based on the available information, the applicability of information on surrogates and on professional opinion.

The level of prediction confidence is sufficiently low in some cases that an estimate of Environmental consequence cannot be made with a sufficient degree of confidence. Undetermined ratings are accompanied by recommendations for research or monitoring to provide more data in the future.

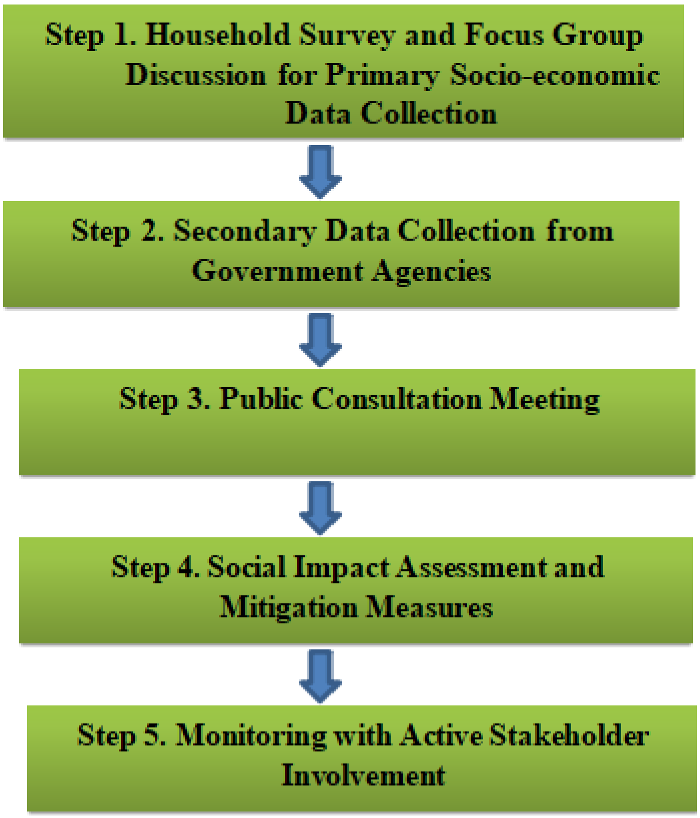
Development of Mitigation Measures

A common approach to describing mitigation measures for critical impacts is to specify a range of targets a predetermined acceptable range and an associated monitoring and evaluation plan. To ensure successful implementation, mitigation measures should be unambiguous statements of actions and requirements that are practical to execute. The following summarize the different approaches that may be used in prescribing and designing mitigation measures:

- Avoidance: e.g. mitigation by not carrying out the proposed action on the specific site, but rather on a more suitable site;
- Minimization: mitigation by scaling down the magnitude of a development, reorienting the layout of the project or employing technology to limit the undesirable Environmental impact;
- Rectification: mitigation through the restoration of Environments affected by the action;
- Reduction: mitigation by taking maintenance steps during the course of the action; and Compensation: mitigation through the creation, enhancement or acquisition of similar Environments to those affected by the action.

6.1.2. Social Impact Assessment (SIA) Methodology

The first phase of the Social Impact Assessment (SIA) will provide a baseline description of the study area, specifically focusing on the communities living and working in close proximity to the proposed development. The potential impacts of the proposed development on the social environment will be identified and assessed in terms of an agreed assessment methodology in the EIA phase. Mitigation measures will be proposed to enhance the positive impacts and reduce the significance of the negative impacts. SIA study area was considered after the discussions with key informers project managers from Myanma Railways (MR) and China Railway Eryuan Engineering Group Co., Ltd. (CREEC). and the heads of Village General Administrative Offices of nearest villages that the railway pass or cross nearby. Google Map and census are also used for the determination of SIA study area during pilot survey. To assess the baseline socio-economic conditions that may result from the development of the proposed project, the SIA team employed both quantitative and qualitative approaches as follow: Socioeconomic impact assessment for proposed project was conducted by the following procedures.



Main Steps in SIA Study

Step I: Household Survey and Focus Group Discussion

The collection of primary data will consist of focus group discussions and household surveys in the target study areas. Household sample survey will conduct to evaluate primary socio-economic conditions of the project area and to understand the mood, perceptions and extent of preparedness of the people towards the proposed project. The household survey will carry out to tap the baseline socio-economic conditions of project area and to assess project perceptions and attitudes of the local people. To get the accurate data, primary data collection will conduct by social specialist, social consultants, local authorities and local people.

(a) Survey Team

The team was formed with researchers from social, medical, and engineering sciences having research experiences in the field of social impact assessment and social management planning.

(b) Development of Survey Questionnaire

Socioeconomic aspects to be included in questionnaire will base on site visits and issues identified by interviews with local people and village heads during pilot survey. Items will formulate by the consultants and reviewed by social assessment team members as to clarity of item wordings and relevance to the socioeconomic domains measured. The survey questionnaire will designed to collect information as to the following household characteristics:

- household composition (age, gender, educational status, religion, ethnicity, language used and marital status);
- occupations;
- ownership of agricultural fields and livestock;
- energy sources and facilities;
- agricultural and other economic activities;
- daily movement patterns;
- income and expenditure patterns;
- access to and use of community services/facilities and natural resources;
- health and nutrition; and
- views/concerns/suggestions on the proposed project.

(c) Recruitment and Training

The enumerators will receive a training program prior to commencing with the fieldwork. The training program will include a briefing on the objectives of the survey, socioeconomic aspects to be measured, interview techniques as well as a detailed explanation of each question and its relevance to the survey objectives, how to pose the question and how to code the answer. Discussions will also held among participants about the socioeconomic conditions and initial questionnaire items will revise based on the discussion results. A set of guidelines will give to each enumerator for administration of survey questionnaire. In the field data collection activities, the enumerators will supervise by experienced supervisors with household survey.

(d) Data Collections

The project related data, factory layout plans and design parameter will be provided by China Railway Eryuan Engineering Group Co., Ltd. (CREEC). Primary data for public concerns, socio-economic and health profiles will be conducted by household survey.

(e) Data Analysis

In household survey data collection period, field supervisors will check and ensure the control of data quality. During field surveys, information obtained through household survey and interviews will corroborate through direct observation by the study team aiming at assessing social and cultural infrastructure existed in the project area, physical assets of people, and living conditions. Observations will back up by photographic records. Quantitative data will be coded and processed using SPSS statistical package. Qualitative data will be coded using standard methods.

6.1.3. Health Impact Assessment Methodology

There is no universally agreed formula for assessing public health significance, although assessments are mostly based on a subjective judgment about the magnitude of the potential health impacts (size of the affected population and scale of the positive or negative health impact); its likelihood of occurrence; and the degree of confidence in the impact actually occurring (based on scientific and other evidence of the health impact occurring in similar circumstances elsewhere). The following table shows a Health Impact Significance Rating Methodology of Green Tech EIA Team.

Table 6.1 - Health Impact Significance Rating Methodology

	Likelihood of Occurrence of Health Impact			Health Impact Rating
	Low	Medium	High	
Magnitude of Health Impact	Unlikely to occur	Likely to occur sometimes	Likely to occur often	
None	No significance	No significance	No significance	0
Low	Very Low	Low	Medium	1
Medium	Low	Medium	High	2
High	Medium	High	Very High	3

When analyzing health impacts, it is important to consider the magnitude, likelihood and public health significance of the potential impacts. This analysis will involve expert judgment based on a consideration of the evidence gathered and its applicability to the local context and the specific project.

Distributional, health equity and inequality impacts will be analyzed by examining how particular sub-groups within a population, particularly vulnerable groups, are likely to be affected by the project. The scoping and community profiling steps are likely to have already identified potentially vulnerable groups through existing local information on these individuals/groups or through community surveys and meetings with key informants e.g. community leader, community health worker or local NGO.

Health equity/inequality impacts occur when the projects benefits and harms are unevenly distributed. This includes where the risk is equally distributed, such as air pollution, but the impact is disproportionate – affecting particularly children, older people and those with existing ill health.

Analysis of health impacts will involve systematically determining the range of potential impacts, their relative importance and where, when and how likely they are to occur. The information for the HIA will be obtained from the primary data collection (household survey), literature review, community profile and Health Data from Pubic Health Department as well as knowledge and expertise of the HIA Consultant.

6.1.4. Risk Assessment Methodology

The following procedure should be used to reduce risks to a tolerable level (see Figure 2):

a) Identify the likely users for the product or system, including vulnerable consumers and others affected by the product;

b) Identify the intended use, and assess the reasonably foreseeable misuse, of the product or system;

c) Identify each hazard (including reasonably foreseeable hazardous situations and events) arising in the stages and conditions for the use of the product or system, including installation, operation, maintenance, repair and destruction/disposal;

d) Estimate and evaluate the risk to the affected user group arising from the hazard(s) identified: consideration should be given to product s or systems used by different user groups; evaluation can also be made by comparison with similar products or systems;

e) If the risk is not tolerable, reduce the risk until it becomes tolerable.

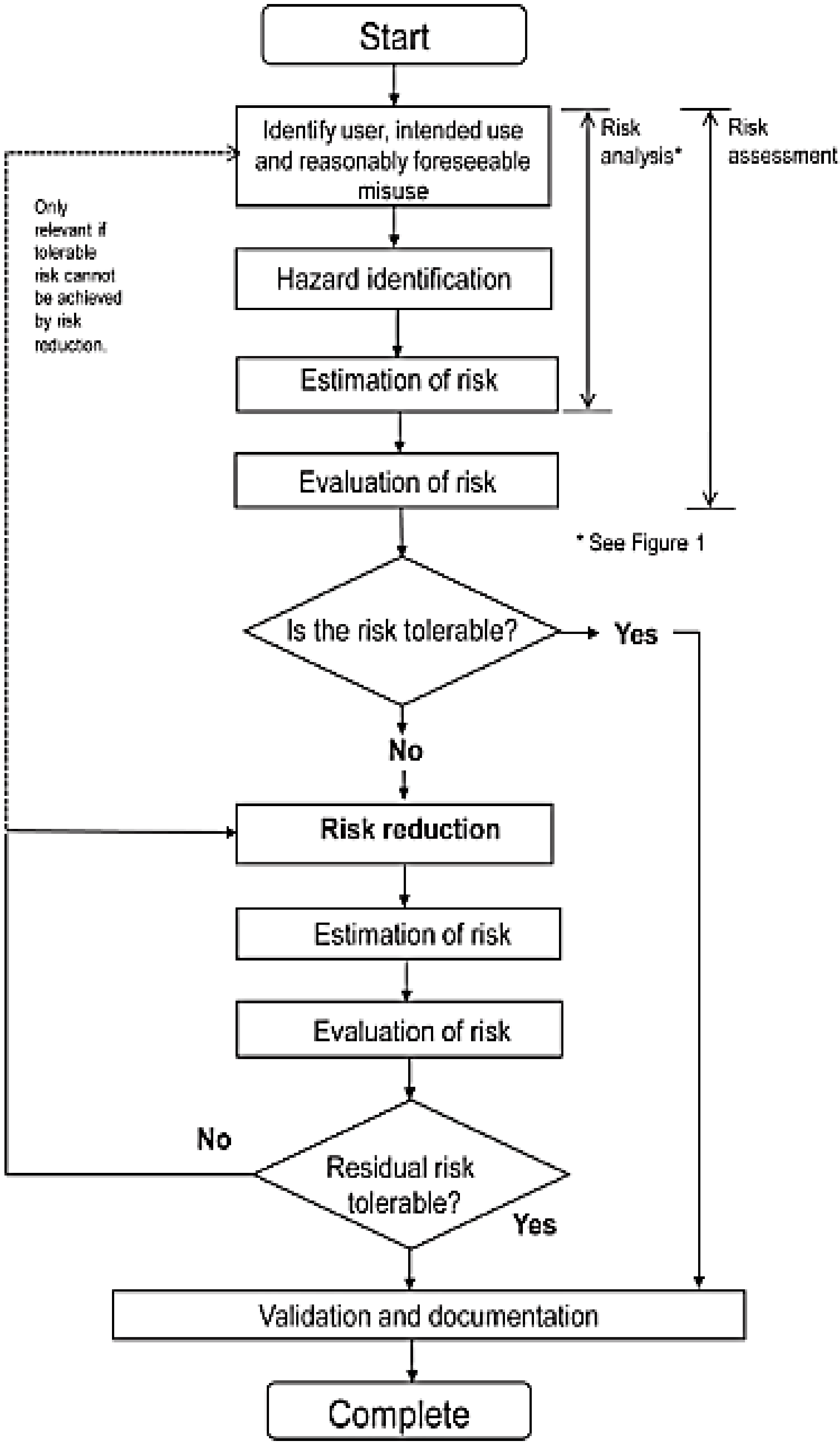
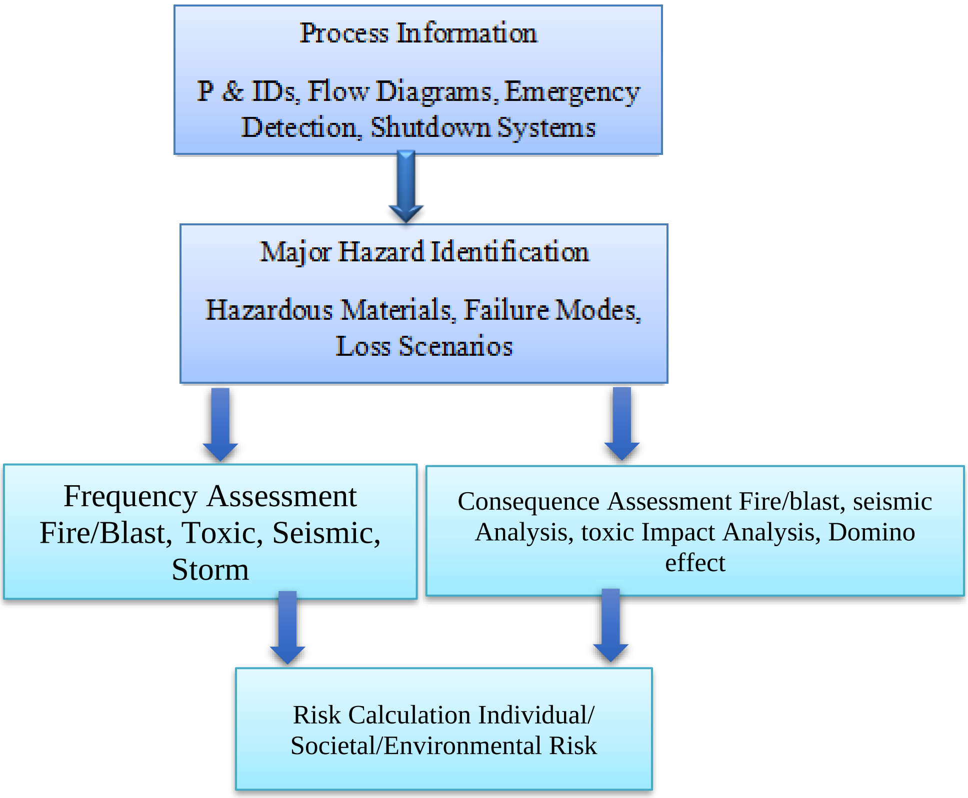


Figure 6.2 - Iterative Process of Risk Assessment and Risk Reduction

Risk Assessment Flow Diagram

Objectives

The following is the flow chart for risk assessment procedure.



Risk Calculation

Risk due to hazards at a storage tank terminal and its surroundings is composed of summation of all risks given no escalation (i.e. no domino effects) of undesired events and all risks given an escalation (i.e. domino effects) of undesired events:

$$Risk = \Sigma\ Risk\ |No\ Escalation + \Sigma Risk\ |Escalation$$

Table - Tolerability of Environmental Risk (Category Definitions) – Loss of Containment

Category	**Definitions**	
6	Catastrophic	- Major airborne release with serious off-site effects - Site shutdown - Serious contamination of ground water or water course with extensive loss of aquatic life
5	Major	- Serious toxic effect on beneficial or protected species - Widespread but not persistent damage to land

		- Evacuation of local populace - Temporary disabling and hospitalization - Serious toxic effect on beneficial or protected species - Widespread but not persistent damage to land - Significant fish kill over 5-mile range
4	Serve	- Hospital treatment required - Public warning and off-site emergency plan invoked - Hazardous substance releases into water course with 1/2-mile effect
3	Significant	- Severe and sustained nuisance, e.g. strong offensive odors or noise disturbance - Major breach of permitted emissions limits with possibility of prosecution - Numerous public complaint
2	Noticeable	- Noticeable nuisance off-site, e.g. discernible odors - Minor breach of permitted emission limits, but no environmental harm - One or two complaints from the public
1	Minor	- Nuisance on site only (no off-site effects) - No outside complaint.

UK HSE, "Safety and environmental standards for fuel storage sites", Process Safety Leadership Group, 2009. Environment Agency for England and Wales, "Integrated Pollution Prevention and Control (IPPC) Environmental Assessment and Appraisal of BAT", July 2003

Table - Tolerability Criteria of Environmental Risk

Category	Definition	Acceptable if frequency less than	Acceptable if reduced as low as is reasonably practical and frequency	Unacceptable if frequency above
6	Catastrophic	1.0E-06 per year	0E-04 to 1.0E-06 per year	0E-04 per year
5	Major	1.0E-06 per year	1.0E-04 to 1.0E-06 per year	0E-04 per year
4	Serve	1.0E-06 per year	1.0E-04 to 1.0E-06 per year	0E-02 per year
3	Significant	1.0E-04 per year	1.0E-04 to 1.0E-06 per year	0E-01 per year
2	Noticeable	1.0E-02 per year	1.0E+01 to 1.0E-02 per year	0E+01 per year
1	Minor	All shown as acceptable	-	-

Earthquake and Flood Risk Assessment Methodology

LIKELIHOOD (probability) How likely is the event to occur at some time in the (Linear Scale time specific matrix)	CONSEQUENCES What is the Severity of injuries /potential damages / financial impacts (if the risk event actually occurs)? *(Logarithmic Scale, property industry specific matrix)*				
	Insignificant	Minor	Moderate	Major	Catastrophic
	No Injuries First Aid No Envir Damage << $1,000 Damage	Some First Aid required Low Envir Damage << $10,000 Damage	External Medical Medium Envir Damage <<$100,000 Damage	Extensive injuries High Envir Damage <<$1,000,000 Damage	Death or Major Injuries Toxic Envir Damage >>$1,000,000 Damage
Almost certain - expected in normal circumstances (100%)	MODERATE RISK	HIGH RISK	HIGH RISK	CRITICAL RISK	CRITICAL RISK
Likely – probably occur in most circumstances (10%)	MODERATE RISK	MODERATE RISK	HIGH RISK	HIGH RISK	CRITICAL RISK
Possible – might occur at some time. (1%)	LOW RISK	MODERATE RISK	HIGH RISK	HIGH RISK	CRITICAL RISK
Unlikely – could occur at some future time (0.1%)	LOW RISK	MODERATE RISK	MODERATE RISK	HIGH RISK	HIGH RISK
Rare - Only in exceptional circumstances 0.01%)	LOW RISK	LOW RISK	MODERATE RISK	MODERATE RISK	HIGH RISK

Figure - 5x5 Risk Matrix
Source: kevinian.com

Fire Risk Assessment Methodology

Six-Step Method

This method entails a two-fold process:

1. Identifying the fire hazards (i.e. readily combustible or highly flammable materials, sources of heat, and unsatisfactory structural features).
2. Assessing the fire risk (i.e. the likelihood that a fire will occur and the consequences of such a fire on the people in the workplace).

The overall process may be carried out in six steps:

Step 1: Identify hazards,

Step 2: Identify people at risk,

Step 3: Remove/reduce hazards,

Step 4: Assign the risk category,

Step 5: Decide if existing fire safety arrangements are OK or need improving,

Step 6: Record findings.

Step 1: Identification of Hazards

Identifying hazards entails noting readily combustible materials or highly flammable substances. These would include such things as paints and thinners, flammable solvents, solvent-based adhesives, flammable gases, some plastic foams, large areas of bare hardboard, highly flammable and/or reactive chemicals etc.

It also entails noting sources of heat such as flames or sparks from processes, sources of frictional heat, ovens, kilns, incinerators, oil or gas fired equipment or heaters, matches and lighters, ducts or flues, light bulbs close to flammable materials, electrical wander leads, any electrical equipment, faulty wiring, portable heaters, etc.

Structural features that would constitute hazards by promoting the rapid spread of fire should therefore be identified. These would include such things as ducts and flues, unstopped holes that have been cut into fire resisting walls for the provision of services such as cables and pipe work, large areas of hardboard, chipboard, or blockboard, un-compartmented roof spaces. Excessively long escape routes and dead-end conditions that would prejudice the means of escape should also be identified.

Step 2: Identification of People at Risk

In identifying people who would be especially at risk in a fire, consideration should be given to any who are asleep, any who are present in large numbers, any who are unfamiliar with the layout of the premises and/or the exit routes, those who may be exposed to a particular or specific fire risk, those who have impairments such as sight, hearing, or mobility and young people or children.

Also taken into consideration should be any people who would be unable to react quickly enough or are unaware of the danger of fire because they are in remote areas, because they have learning difficulties, or because they are outside contractors who are unaware of the fire risks.

Step 3: Removal/Reduction of Hazards

The removal or reduction of hazards entailed in this stage of the risk assessment can have enormous benefits insofar as, at the end of the process, it will have produced a much safer environment.

For each of the hazards that have been identified in step 1, the question should be asked, "could it be removed, reduced, replaced, separated, protected, repaired, or cleaned?"

For example, the removal of excessive amounts of combustibles, the reduction in the areas of combustible wall linings, replacement of tungsten filament bulbs with fluorescent light fittings and solvent based adhesives being replaced with water-based ones, separating sources of heat from combustibles, protecting electrical equipment with thermostats, repairing damaged electrical flexes and damaged furniture, cleaning dirty flues and ducts.

At this stage it should be decided whether any of these removals or reductions are to be undertaken immediately, in the medium term, or in the long term.

Step 4: Assignment of Risk Category

On completion of step three, depending upon what hazards still remain it should be possible to assign a risk category to the workplace or, more likely, to individual parts of it.

The risk categories could be 'Low', 'Normal' and 'High': -

Low: There is hardly any risk from fire, few combustibles materials, no highly flammable substances, and virtually no sources of heat.

Normal: There are sufficient quantities of combustible materials and sources of heat to be of greater than low fire risk but that a fire would be likely to remain confined, or to spread but slowly.

High: There is a serious risk to life from fire, or there are substantial quantities of combustible materials, or there are any highly flammable substances, or there exists the likelihood of the rapid spread of fire, heat or smoke.

Step 5: Adequacy or Improvement of Fire Precautions

In this step, it is necessary to decide whether the existing fire safety measures are adequate or are in need of improvement. Possible improvements could include such steps as:

- Reduction of evacuation times/escape route lengths,
- Protection of escape routes,
- Provision of additional escape routes,
- Installation of a fire alarm system or more fire alarm call points,
- Provision of more fire signs,
- Installation of fire detection systems,
- Installation of a sprinkler system,
- Installation of an emergency lighting system,
- Institution of better programmes of fire safety training,

- Provision of, or increasing the number of fire extinguishers
- Provision of regular training and practice of fire and evacuation drills.

Step 6: Recording Findings

This simply entails recording the findings of the fire risk assessment, and should include the significant hazards found to be present, the details of any staff who are especially at risk, and the date on which the assessment was made.

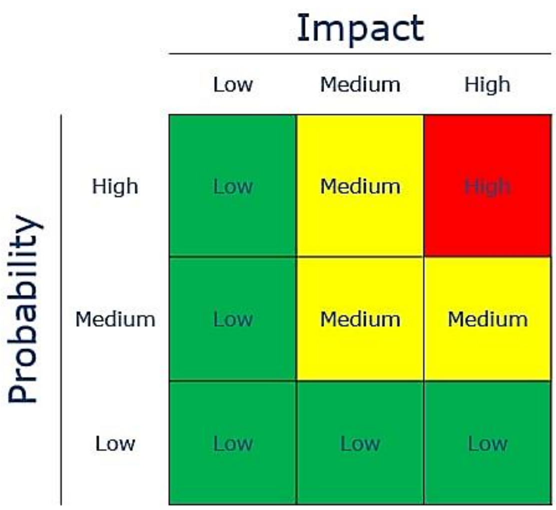


Figure: Classification of Fire Risk Level

Based on the fire incidents from 1983-2007, the States and Divisions have been categorized into the probability of High, Medium and Low level. Following criteria has been used:

High Probability: More than 100 average annual fire cases

Medium Probability: Between 100 and 50 average annual fire cases

Low Probability: Less than 50 average annual fire cases

Property loss level	Criteria
High Property Loss	Less than 100 Million Kyats
Medium Property loss	Between 100 to 200 Million Kyats
Low Property loss	More than 200 Million Kyats

Potential Risk and their Sources

Category	Potential Risk	Source
Risk in Culvert	Structural Collapse	- Structural overload of culvert - deterioration of culvert leading to loss strength

(Construction Phase)	Slope instability	- water leakage of the culvert leading to saturation of fill or foundation material - headwall has been subjected to erosion and collapses taking with it a portion of the road pavement
	Erosion by overtopping flows	- flow over the road
	Cross catchment flooding	- blockage or insufficient hydraulic capacity of the culvert
Risk in Bridge	Bridge structure risk by human factor	- due to terrorist such as explosion
Occupational and Community Health and Safety Risk	Slips and trips	- Spill and oil in the workplace - equipment used in site
	Electricity	- direct or indirect touch of electric wire
	Airborne fibres and toxins	- The erosion of the already installed, improperly taken down or stored asbestos as well as from the products that contain it.
	Asbestos	- demolition process
	Unintended collapse	- demolition process
	Material handling	- use of excavators and dump trucks
	Hand and vibration syndrome	-piling activity
	Noise	- piling activity
	Moving objects	- transport of material
	Working from height	- fall from height and from the installation of pier and beam
Disaster Risk	Earthquake risk	- seismic waves and fault zone near the working site
	Earthquake induced liquefaction risk	- high excess pore-water pressure generated by and accumulated during strong earthquake ground shaking or other rapid loading
	Flood risk	- high flow or overflow of water from a river or similar source of water occurring over a period of time - heavy rain spell - climate change - blocking of river channels by landslides
	Fire risk	- fire incidents from temporary facilities - flammable materials used on site - vehicle collision due to derailment -overheating due to high speed - electrocution - overheating of roof-mounted compressor heating and air conditioner units - burning locomotives - flammable materials carried on train

6.2. Considerable Project Development for Impact Assessment

The following phases will be considered in conducting of EIA for the proposed project.

(i) Pre-construction Phase

Pre-construction activities will involve removal of select vegetation, if any, and the grading and excavation of soils for the installation of structural foundations for power stations, and electricity supplies system. Site clearing activities for transmission lines will be included in that of alignment.

(ii) Construction Phase

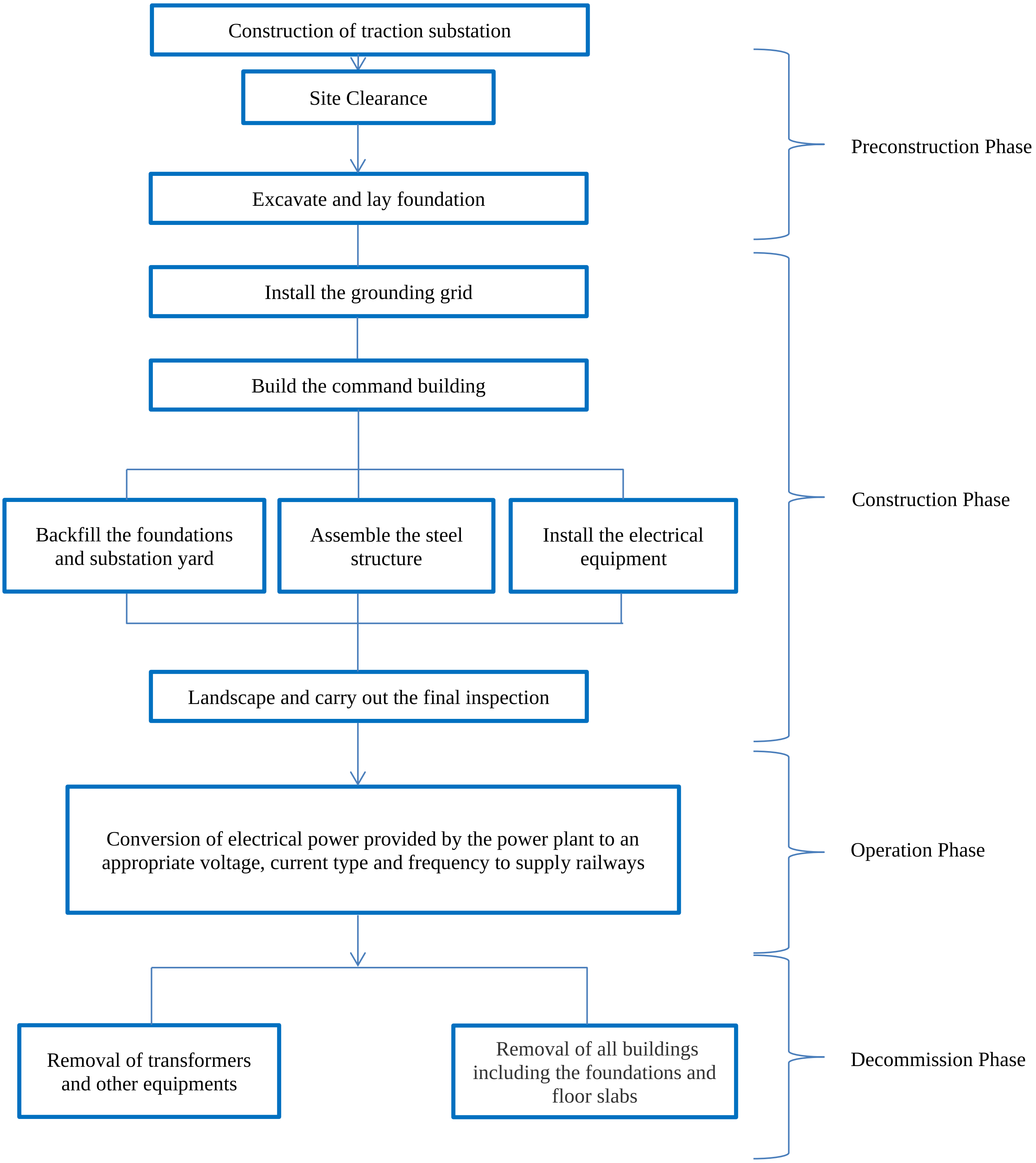
Construction activities will include installation of grounding grid, construction of temporary worker camps, access road construction, construction of command building, stringing activities and installation of electrical equipment, etc. The assembly of transformers, circuit breakers, CCTVs, circuit switchers, capacitors, and disconnect switches must be closely watched and tested to ensure proper assembly. This is especially true for transformers since their future trouble-free operation is very dependent on proper handling during assembly.

(iii) Operation Phase

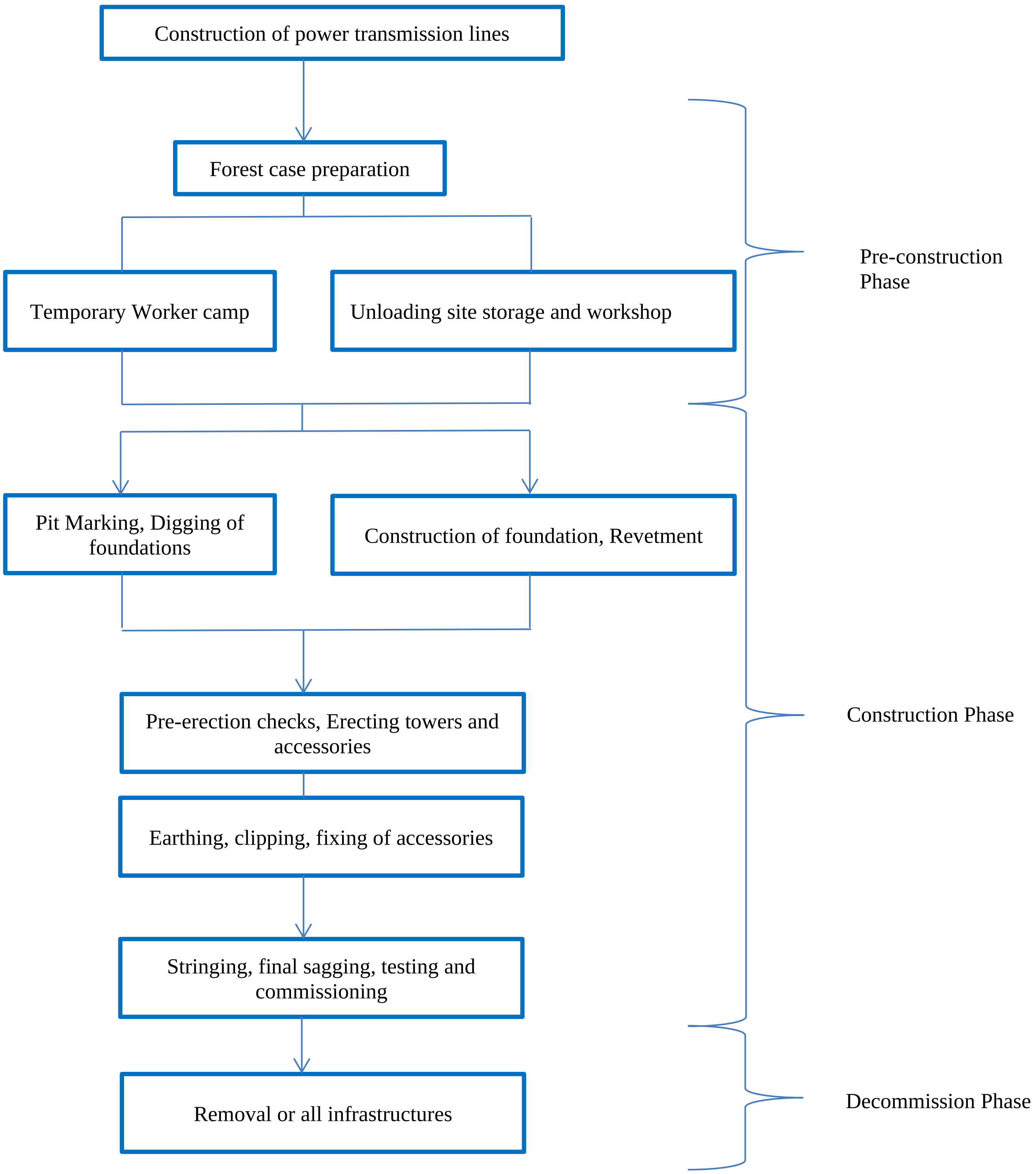
Operational and maintenance activities associated with the railway power supply system include the maintenance and clearing of transmission line, maintenance and painting of substations and transformers. It will also include filling of transformer fluid.

(iv) Decommissioning Phase

This will include demolition, decommissioning and destruction of power station and power line activities. In addition to steel structures, the control building will be disassembled and removed from the site. Fencing around the substation will be broken down and removed. The gravel or aggregate surface at the substation will loaded onto trucks and removed for sale and reuse. Foundations would be exposed using backhoes, bulldozers, and other heavy earth moving equipment.



Process Flow Chart for Construction of Traction Substation



Process Flow Chart for Construction of Transmission Lines

6.3. Anticipated Environmental Impacts and Mitigation Measures

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities. Anticipated environmental impacts for the proposed antimony roasting plant will be conducted into the entire life of the project. To cover the entire life of the project, it is necessary to conduct impact assessment for four major phases as follow:

(a) Pre- Construction Phase
(b) Construction Phase
(c) Operation Phase
(d) Decommissioning Phase

6.3.1. Anticipated Environmental Impacts during Pre-construction Phase

The main activities which will be done in pre-construction phase are removal of vegetation and earthwork activities, and access road construction. Site clearing activities for transmission lines will be included in that of alignment. The affected area of the railway alignment will include the affected area of transmission lines because transmission lines will exist 15ft away from the railway alignment on each side. So, some impacts due to construction of transmission lines will not be included in this section**.** The main impacts considered in this phase include:

1. Impact on Air Environment
2. Impact on Surface Water Environment
3. Impact on Soil Environment
4. Impact on Biodiversity Environment
5. Impact on Human Environment

6.3.1.1. Anticipated Impacts on Air Environment during Pre-construction Phase

The major impacts on air quality during the pre-construction phase will be fugitive dust generation, vehicular emissions and increased in noise level due to the site clearing and sand filling activities.

(a) Fugitive Dust Generation (Particulate Matter Emission)

During pre-construction phase, the main source of air pollution will be dust generation (PM) due to the movement of dozer and trucks for site clearing and ground leveling activities. Short-term impacts will be experienced by the workers, pedestrians passing along the public road near the project site.

Significant of Impacts of Fugitive Dust Generation during Pre-construction Phase before Mitigation Measures

The impact will be considered for each traction substation construction site. The nature of impact on air quality during pre-construction phase will not be significance due to minor earth working activities and pre-construction period as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Fugitive dust generation	Site clearing and ground leveling	2	1	2	4	20	Low Impact (U)

Consideration of Mitigation Requirement for Fugitive Dust Generation

The intensity of mitigation required for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation required considered by EIA team	Intensity of Mitigation Required	Responsibility
1.	Fugitive Dust Generation	Low Impact (U)	No	Yes	Minor	Pre-construction service provider(s)

Mitigation Measures for Dust Generation

Due to the minor mitigation requirement, dust will be countered by sprinkling of water during pre-construction phase. It is also the most cost-effective dust suppressant. Ground water will not use for this purpose. Water will be sprayed by using handheld spray as for small workplace.

Significant of Impacts of Fugitive Dust Generation during Pre-construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Fugitive dust generation	Site clearing and ground leveling	2	1	1	3	12	No Impact (-)

(b) Vehicular Emissions

The gaseous emissions such as CO_2, CO, NO_x and SO_2 were emitted during the operation of vehicles and machineries during the pre-construction phase including both on-site and the public.

Assumptions for Combustible Emissions					
Type of Construction Equipment	**No of Units**	**Hp Rated**	**Hrs/day**	**Days/yr**	**Total hp-hrs**
Excavator	1	300	8	60	576000
Bulldozer	1	300	8	60	576000
Tractor	1	100	8	45	120000
Truck	3	300	8	60	2304000

Emission factors (EF) with type of operation equipment (g/hp-hr)

Emission Factors							
Type of Construction Equipment	**VOC (g/hp-hr)**	**CO (g/hp-hr)**	**NOx (g/hp-hr)**	**PM-10 (g/hp-hr)**	**PM-2.5 (g/hp-hr)**	**SO2 (g/hp-hr)**	**CO2 (g/hp-hr)**
Excavator	0.34	1.3	4.6	0.32	0.31	0.74	536.3
Bulldozer	0.36	1.38	4.76	0.33	0.32	0.74	536.3
Roller	0.37	1.48	4.9	0.34	0.33	0.74	536.2
Truck	0.44	2.07	5.49	0.41	0.4	0.74	536

Emission Calculation Results with type of operation equipment (tons/yr)

Emission Calculation							
Type of Construction equipment	**VOC g/hp-hr**	**CO g/hp-hr**	**NOx g/hp-hr**	**PM-10 g/hp-hr**	**PM-2.5 g/hp-hr**	**SO2 g/hp-hr**	**CO2 g/hp-hr**
Excavator	0.05	0.21	0.73	0.05	0.05	0.12	85.13
Bulldozer	0.06	0.22	0.76	0.05	0.05	0.12	85.13
Roller	0.01	0.06	0.19	0.01	0.01	0.03	21.28
Truck	0.21	0.99	2.61	0.20	0.19	0.35	255.24
Total Emission	0.34	1.47	4.29	0.31	0.30	0.62	446.78

Significant of Impacts of Vehicular Emissions during Pre-construction Phase before Mitigation Measures

The nature of impact on air quality during pre-construction phase will not be significance due to minor earth working activities and pre-construction period as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Vehicular emission	Site clearing and ground leveling	2	1	3	4	24	Low Impact (U)

Consideration of Mitigation Requirement for Vehicular Emissions

The intensity of mitigation required for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation required considered by EIA team	Intensity of Mitigation Required	Responsibility
1.	Vehicular Emission	Low Impact (U)	No	Yes	Minor	MR (or) MR (or) Pre-construction service provider(s)

Mitigation Measures for Vehicular Emission

Due to the minor mitigation requirement on vehicular emission, there will require a plan to reduce in loading and unloading time and plan to reduce in idle time during working hours. Vehicles used during pre-construction phase will avoid local traffic time. Moreover, MR will put pressure to pre-construction services provider(s) to use machineries, vehicles and generator with good engine conditions and low sulphur content fuel oil to reduce gaseous emission. Regular maintenance of machineries, vehicles and generator is also required.

Significant of Impacts of Vehicular Emissions during Pre-construction Phase after Mitigation Measures

The nature of impact on air quality during pre-construction phase will not be significance due to minor earth working activities and pre-construction period as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Vehicular emission	Site clearing and ground leveling	2	1	3	3	18	Low Impact (U)

(c) Increased in Noise Level

Site clearing and earth working vehicle (dozer) and delivery vehicles (trucks) traveling to and from the site produced noise which will increase existing noise level in pre-construction phase. All of the calculation of predicted noise level during pre-construction phase will be based on Patrick Breysse, and Peter S.J. Lees., School of Public Health, Johns Hopkins University, Bloomberg, 2006. The required data for calculation of the noise levels will be used typical construction equipment prepared by "Handbook of Noise Control" as follow:

Typical Construction Equipment Noise Emission Levels

Equipment Type	Noise Level (dBA at 50 Feet)
Excavator	89
Bulldozer	87
Tractor	88
Truck (Medium and Heavy)	84

Source: Harris, C.M. "Handbook of Noise Control," McGraw Hill, New York, 1979

$$L_{eq}(site) = 10 * \log_{10}\left(\sum_{i=1}^{n} 10^{Leq\ (equipment)_i/_{10}}\right)$$

L_{eq}(site) = the A-weighted, overall equivalent sound level obtained by summing the individual equipment noise levels on an energy basis.

n = number of sources

L_{eq}(equipment) = the A-weighted, equivalent sound level at a receptor resulting from the operation of a single piece of equipment at distance D from source, dB(A).

Sound level L and Distance r

$$L_2 = L_1 - |20 \cdot \log\left(\frac{r_1}{r_2}\right)| \qquad L_2 = L_1 - |10 \cdot \log\left(\frac{r_1}{r_2}\right)^2|$$

$$r_2 = r_1 \cdot 10^{\left(\frac{|L_1 - L_2|}{20}\right)} \qquad r_1 = \frac{r_2}{10^{\left(\frac{|L_1 - L_2|}{20}\right)}}$$

L_2 = the A-weighted, equivalent sound level at a receptor resulting from the operation of a single piece of equipment at distance D (dB(A))

L_1 = Noise emission level of the particular piece of equipment at reference distance D (dB(A)

r_1 = Distance from the receptor to the piece of equipment (m)

r_2 = Reference distance where the source noise emission level was measured (m), i.e.50 ft (15.24 m)

Calculations

$$Leq = SPL_{site} = 10\log\left(\frac{10^{8.9}+10^{8.7}+10^{8.8}+3(10^{8.4})}{6}\right)$$

$$= 86.49 \text{ dBA}$$

L_1 = 86.49 dBA

L_2 = 55 dBA

r_1 = 15.24 m

r_2 =?

$r_2 = 15.24 \times 10^{\left(\frac{86.49-55}{20}\right)} = 572.12$ m

The villages inside 572.12 m will experience the noises from the construction site. Therefore, mitigation measures will have to be carried out to control the noises in the area that are below 572.12 m. Although all of the predicted noise levels are based on calculations and the actual noise level may change a little bit due to the factors such as seasonal wind direction and wind speed.

Significant of Impacts of Increased in Noise Level during Pre-construction Phase before Mitigation Measures

The nature of impact on air quality during pre-construction phase will not be significance due to minor earth working activities and pre-construction period as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise	Noise from dozer and trucks	3	1	2	4	24	Low Impact (U)

Consideration of Mitigation Requirement for Increased in Noise Level

The intensity of mitigation required for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation required considered by EIA team	Intensity of Mitigation Required	Responsibility
1.	Noise	Low Impact (U)	No	Yes	Minor	MR (or) Pre-construction service provider(s)

Mitigation Measures for Noise

According to the requirement of minor mitigation measures for noise during pre-construction phase and the nature noisy environment (near the public road), the following mitigation measures will do:

- Avoid the operation of noisy equipment and machineries and the use at the same time, and
- Limit the operation of noisy construction machineries at night.
- Regular maintenance of machineries.
- Use engines with good condition.

Significant of Impacts of Increased in Noise Level during Pre-construction Phase after Mitigation Measures

The nature of impact on air quality during pre-construction phase will not be significance due to minor earth working activities and pre-construction period as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise	Noise from dozer and trucks	3	1	1	3	15	Low Impact (U)

Residual impact on Air Environment during Pre-Construction Phase

After proper mitigation measures, the significance level will remain Very Low to Low. So, there will be no residual impact.

6.3.1.2. Anticipated Impacts on Surface Water Environment during Pre-construction Phase

For power transmission lines, site clearance activities and handling of fuel are involved in the alignment consideration because power transmission lines are situated along the railway alignment.

(a) Liquid Wastes

Improper handling of fuel oil and lubricants may constitute a risk for pollution of surface water. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the water quality.

(b) Solid Wastes

During pre-construction phase, site clearance activities will cause the temporary water pollution near water sources in the power substation.

Significant of Surface Water Pollution during Pre-construction Phase before Mitigation Measures

Impact on nearby surface water bodies, it will be low probability and not significant due to the amount of work in pre-construction phase as follow:

Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Increase in turbidity, oil and grease in nearby water bodies	Site clearing and earth working activities	3	1	2	4	24	Low Impact (U)
	Improper handling of fuel oil and lubricants	3	1	1	3	15	Low Impact (U)
	Domestic liquid wastes from pre-construction workers.	2	1	1	4	16	Low Impact (U)

Consideration of Mitigation Requirement for Surface Water Environment

The intensity of mitigation measures for surface water environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Intensity of Mitigation	Responsibility
1.	Increase in turbidity, oil and grease in nearby water bodies	Low Impact (U)	No	Yes	Minor	MR (or) Pre-construction service provider(s)

Mitigation Measures for Impacts on Surface Water Quality in Power Station

MR will do or will ensure pre-construction service provider(s) to do the following mitigation measures to protect the surface water quality during the pre-construction phases of the proposed project.

(a) Liquid Waste

The following prevention measures are needed to reduce surface water pollution during pre-construction phase.

(a) All stacking and loading areas will be provided with proper drains to prevent run off from the site to enter any water body.
(b) Waste water channels from the site will be connected to retention pond during pre-construction to prevent wastewater from entering the nearest water bodies.
(c) Avoid any leakage of oil and lubricant from vehicles and machineries used in pre-construction phase
(d) Use temporary sedimentation ponds during rainy reason

(b) Solid Waste

The following mitigation measures will be done.

a) Limit unnecessary earthworks;
b) Reuse suitable soil particles in earth filling activities during the construction of traction substation
c) Working in a small area at a point of time (phase wise construction);
d) Vegetation of bare areas after the pre-construction state.
e) Prevent over-excavation

Significant of Surface Water Pollution during Pre-construction Phase after Mitigation Measures

Impact on nearby surface water bodies, it will be low probability and not significant due to the amount of work in pre-construction phase as follow:

Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Increase in turbidity, oil and grease in nearby water bodies	Site clearing and earth working activities	3	1	2	3	18	Low Impact (U)
	Improper handling of fuel oil and lubricants	3	1	1	2	10	No Impact (-)
	Domestic liquid wastes from pre-construction workers.	2	1	1	3	12	No Impact (-)

Residual impact on Surface Water Environment during Pre-Construction Phase

After proper mitigation measures, the significance level will remain Very Low. So, there will be no residual impact.

6.3.1.3. Anticipated Impacts on Soil Environment during Pre-construction Phase

Impacts on soil and ground water environment during pre-construction phase will include the followings:

Impacts of Soil Quality

A small amount of domestic wastes will be produced from pre-construction workers. Improper handling of diesel and lubricants can also lead to leakage and it can impact on soil quality. Moreover, some biomass- unsuitable soil materials were generated from site clearing and tree cutting (bushes and small trees) activities during pre-construction phase. All of these solid wastes will have more or less impact on soil quality.

Significant of Impacts on Soil Environments before Mitigation Measures

Domestic wastes from pre-construction workers will be minimal due to the small number of workforce (about 30 people). Amount of scrub produced will also be negligible because the site small are to clear and there will very small number of trees to fell down (small trees). Moreover, according to the soil quality monitoring and geological investigation, soil type within the project are is not contained toxic mineral composition and not environmentally sensitive soil type (sandy soil). So, impacts on soil environment during pre-construction phase will be very low as shown in the following table.

Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Solid wastes	Site clearing and earth working activities	3	1	2	4	24	Low Impact (U)
	Domestic solid wastes from pre-construction workers	2	1	1	4	16	Low Impact (U)

Consideration of Mitigation Requirement for Soil Environment during Pre-construction Phase

The intensity requirement of mitigation measures for soil environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Soil contamination	Low Impact (U)	No	Yes	Minor	MR (or) Pre-construction service provider(s)

Mitigation Measures for Impact on Soil Environment during Pre-construction Phase

According to the need of the minor mitigation measures, all of the solid wastes produced from pre-construction phase will be systematically dispose according to the rules and regulations of MCDC. Accordingly, MR (or) pre-construction service provider will follow MCDC rules and regulations for solid waste management during the preconstruction phase. Moreover, MR will take special care on handling of diesel and lubricants to avoid leakage.

Significant of Impacts on Soil Environments after Mitigation Measures

Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Solid wastes	Site clearing and earth working activities	3	1	2	3	18	Low Impact (U)
	Domestic solid wastes from pre-construction workers	2	1	1	3	12	No Impact (-)

Residual impact on Soil and Groundwater Environment during Pre-Construction Phase

After proper mitigation measures, the significance level will remain Very Low. So, there will be no residual impact.

6.3.1.4. Anticipated Impacts on Biodiversity Environment during Pre-construction Phase

Anticipated impacts on biodiversity environment during pre-construction phase will be as follows:

(a) Impacts on Flora Diversity

Power lines require routine maintenance and operation. On some power line corridors, herbicides are used to control vegetation. When power lines and their access roads are placed in undeveloped areas, they can disturb forests, wetlands, and other natural areas. There will have too much tree cutting along the power lines and for the power substation. Therefore, there will have high impact on flora diversity. The biodiversity survey along the TL line indicates that a high level of disturbance already exists in the area, from grazing, lopping of trees, fodder leaf collection by local communities in the area. For transmission lines, the site clearing will be the same as alignment as transmission lines will be installed along the line. Therefore, the impact for site clearing of transmission lines will be the similar to flora diversity impact in alignment.

Affected plant species

Engineering land occupation will affect individual plant species, but will not change the floristic composition of plants in the evaluation scope. Affected plant species are common local species. Affected trees are mainly *Eucalyptus, Pterocarya stenoptera, black locust, Melia azedarach, cedrela sinensis, alder, paper mulberry, Excoecaria sebifera, coconut palm, banyan, etc.; other shrubs affected are mainly mulberry, lantana, Rumex hastatus, Coriaria sinica, Reinwardtia trigyna, HollygreenBarberry, raspberry, linden viburnum, Maesa doraena, sweet potato vine, Siberian Cocklebur, mountain loquat, Glochidion puberum*, etc.; affected grasses are mainly *crofton weed, Heteropogon contortus, Herba Euphorbiae, Euphorbia officinalis, Urtica japonica, Lotus philoxeroides, Echinacea, Poa pratensis, Snakeberry, Carpesium abrotanoides L., Lysimachia christinae Hance, Eupatorium odoratum, etc.*

Influences on vegetation (Flora)

The implementation of the project will occupy part of the farmland and forest land, and have a certain impact on the surface vegetation on both sides of the run of way.

Most of the subgrade areas are located in the areas of secondary vegetation types and artificial vegetation types (including farmland vegetation, etc.). Due to the nature of the project, in the power station construction, vegetation will need to be cleared and replaced with infrastructure, service roads and storm water management systems. This will have the greatest impact in areas where no lines are in place and within the areas earmarked as biodiversity hotspots.

Potential Impacts on Flora during Pre-Construction Phase (Power Station)

One of the most important impacts is the destruction of the vegetation cover along the strip of land to be occupied by the power station. In some cases it may occur that individuals of some plant species are present in this strip and are also destroyed, which further the risk of population and dispersal of the plant species. This means the elimination of the vegetation cover and earth movements to prepare the corridor for the laying down of the track and, therefore, the destruction and loss of the habitats along the land strip along the power line. In addition, there will be land temporarily used for the installation of construction camps were vegetation will also be cleared and earth movements carried out.

Significance of impacts

The pre-construction phase will have the greatest impact on the surrounding vegetation. This will definitely result in the disturbance of the vegetation and soils within the site especially.

Due to the site scale of disturbance in the pre-construction period on the surrounding vegetation when compared to its current state, i.e. the magnitude will be Medium, the overall significance of will be rated as Medium.

Impact assessments on the flora of the project area

Table - Impact index value and categories of flora in the Mandalay-Muse Railway New Project

No.	Impacts	Magnitude	Duration	Extend (area)	Probability	Total	Category
	Flora						
1	Loss of trees and other plant species	3	5	2	4	40	Moderate significant (C)

(Source: International Association of Impact Assessment-IAIA, 2014, www.iaia.org)

Consideration of Mitigation Requirement for Flora Diversity

The intensity of mitigation requirement for flora diversity according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact on flora diversity	Moderate significant (C)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Impact on Flora Diversity

Clearing of vegetation will be kept to a minimum, keeping the width and length of the earth works to a minimum. According to the consideration of intensity of mitigation measures (major scale), it is necessary to avoid tree cutting of road side plants and fence plants and re-planting the trees at twice of cutting and re-planting at other place for IUCN red list trees. So, MR will do or will force pre-construction service provider(s) to avoid tree cutting as much as possible at project site and no tree cutting beside the railway road construction.

Residual Impact

After mitigation measures, there will be residual impact on land acquisition and involuntary resettlement.

(b) Impacts on Fauna Diversity

Potential Loss of Habitats Impact

The loss of the habitats during the construction period is expected to have indirect impacts on surrounding habitat areas and associated biota. The vegetation also supports good shelter for many wildlife species. Habitat destruction is currently ranked as the primary cause of species extinction worldwide. Clearing of existing vegetation which may leads to loss of habitat. Some places in the construction area are likely to be lost due to direct and indirect construction activities for resident animals.

The impacts on fauna diversity due to tree-cutting mainly include:

- Loss of bird habitats caused by tree cutting is deemed reversible over a longer period of time, and
- Destruction of nests, burrows, and other animal sheltering/breeding structures;

Fragmentation of Forest and Wildlife Habitat

Construction needs the clearance of the land for site preparation and the use of land can have direct impacts in terms of destruction of habitats, fragmentation of forest and more subtle effects on biodiversity. Increased residents need for construction leads to fragmentation and isolation of forest. Forest size and level of fragmentation affects breeding birds. Noise and light generated during construction processes may not directly harm individual animals but it could affect feeding and breeding behaviors which could have negative impacts on long term population levels. The use of land may also divide up land and separate habitats which were previously adjacent. This can influence population dynamics especially for mobile species which rely on large habitats. The impact of fragmenting habitats on different species can be complex and can lead to gradual decline in populations which is difficult to attribute to a specific cause.

Significant of Impacts on Fauna Diversity

Since there will have too much tree cutting for the proposed project, the significance of the impacts is shown as follows:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise Impact on Habitat	Pre-construction machines and equipment	3	1	2	3	18	Low Impact (U)
Loss of Habitat	Clearing of existing vegetation	3	5	2	3	30	Moderate Significant (C)

Consideration of Mitigation Requirement for Fauna Diversity during Pre-construction Phase

The intensity requirement of mitigation measures for Fauna Diversity according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Noise Impact on Habitat	Low Impact (U)	No	Yes	Minor	Pre-construction service provider(s)
2.	Loss of Habitat	Moderate Significant (C)	Yes	Yes	Minor	Pre-construction service provider(s)

Mitigation Measures for Impacts on Fauna Diversity

It is necessary to avoid working at night for fauna species and cutting the fence plants. Sound proof measurement shall be constructed surrounding the construction site as needed. Borrow pit will be away from fauna diversity abundance area. MR also limit operation of noisy machineries and working at night during pre-construction phase. In view of the sections close to the Pyinoolwin wildlife reserve, the project form was optimized and the whole-tunnel passage was adopted, which effectively reduced the impact of the project to the animal passing.

Significance of Impacts on Fauna Diversity after mitigation measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise Impact on Habitat	Pre-construction machines and equipment	2	1	2	3	15	Low Impact (U)
Loss of Habitat	Clearing of existing vegetation	2	5	2	3	27	Low Impact (U)

Residual Impact

After mitigation measures, the impact rating is low and there is negligible residual impact on fauna diversity.

Impacts on Human Environment during Pre-construction Phase

The job opportunities and used machinery and equipment are shown in the following table.

Project Phase	**Duration**	**Total Work Force**	**Site Clearance Area for 11 Traction substation**	**Number of Equipment used**
Pre-Construction	2 Months	20	220 square meter	-1 dozer - 1 excavator - 1 tractor -3 truck

6.3.1.5. Anticipated Impacts on Human Environment during Pre-construction Phase

(i) Positive socio-economic Impacts

The positive socio-economic impact during pre-construction will be job creation. The proposed project will provide temporary employment opportunities (approximately 15 workers) for local people during pre-construction period (about 6 months).

Significant of Impacts on Socio-economic Enivronment during Pre-construction Phase

Job Creation without Enhancement Measures

Job creation during pre-construction phase can be considered as very low without enhancement measures due to the small number of workforce (about 15 people) and operators for dozer and truck will mainly outsourced from other places.

Anticipated Impact	Sources	Magnitude	Duration	Extend	Probability	Total	Category
Potential to Increase in household income	Jobs opportunities in pre-construction site	2	1	2	3	15	Low Impact (U)

Consideration of Mitigation Requirement for Job Creation during Pre-construction Phase

The intensity requirement of mitigation measures for job creation according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Potential to Increase in household income	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider

Enhancement Measures for Job Creation

Although this kind of positive impact will not benefit to local people in nearest villages, MR will make agreement with pre-construction contractor and sub-contractor to use local labor force as part of tender requirement. The implementation of the project will change the socio-economic life of the local people to a greater or lesser extent, and the project promises to prioritize local employment to meet their needs.

Impact Significance of Job Creation after Enhancement Measures

The impact will rise into very low to low after enhancement actions as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend	Probability	Total	Category
Potential to Increase in house- hold income	Jobs opportunities in pre-construction site	2	1	2	4	20	Low Impact (U)

(ii) Negative Socio-economic Impacts

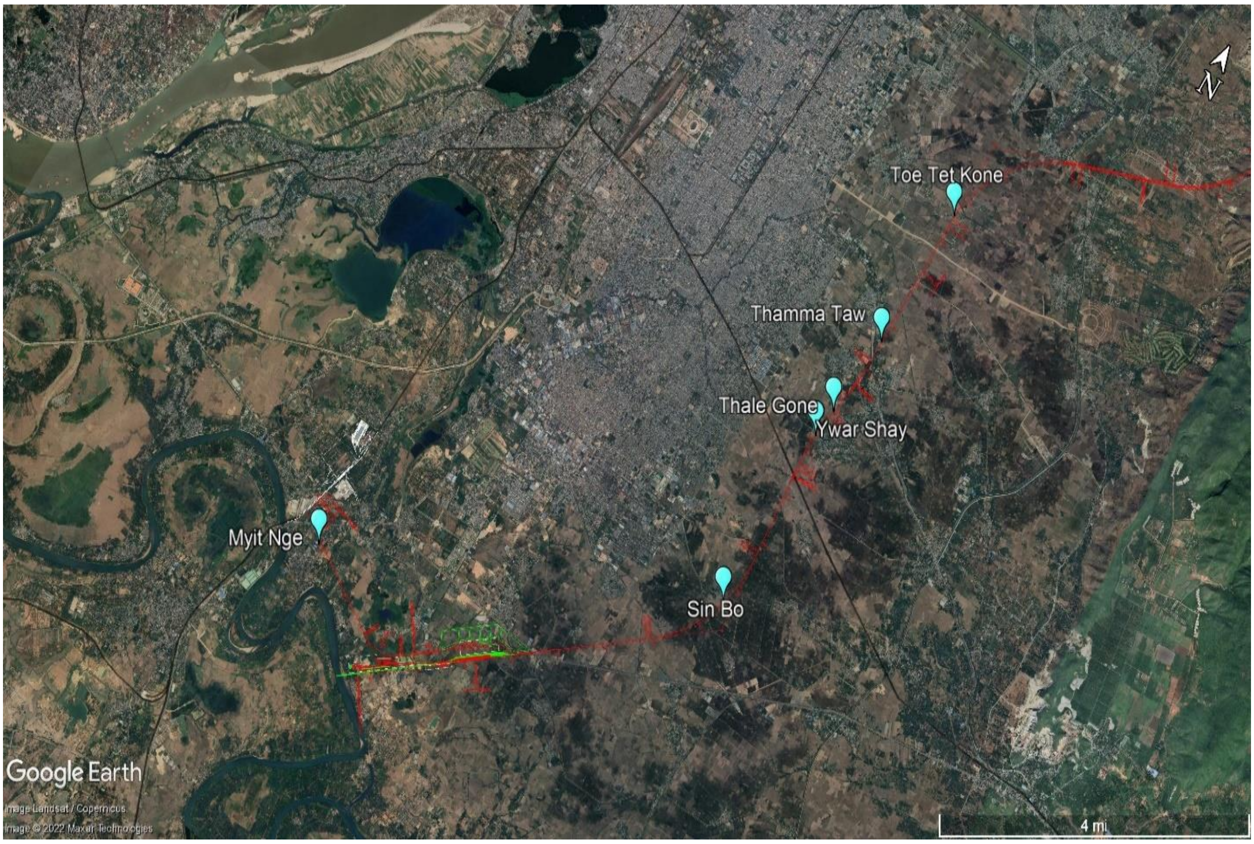
(a) Land Acquisition and Involuntary Resettlement

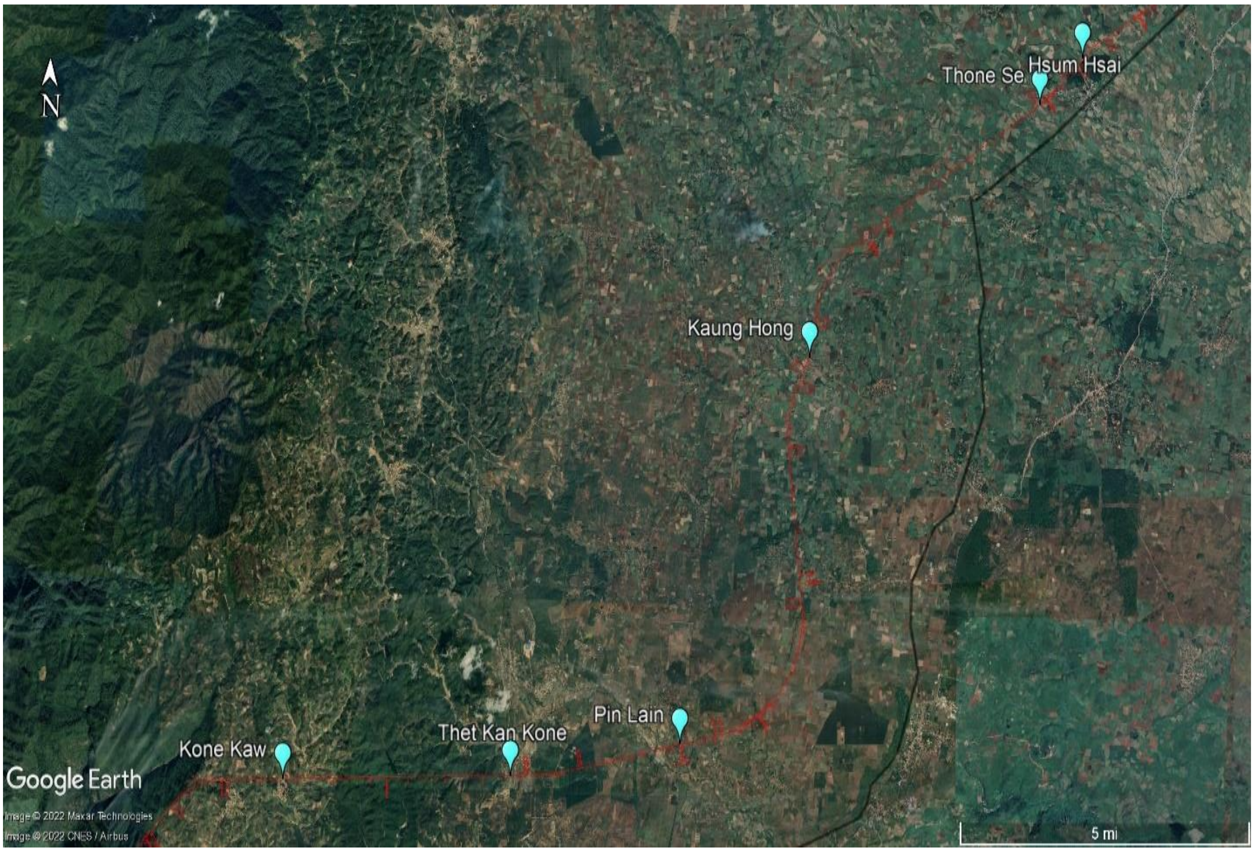
The total land area for traction substation is about 220 square meters. This land may pass through agricultural lands or other lands of local people. So, land use will affect socio-economic situation of local people.

The proposed alignment is very extensive and has sections of very large curve radii to enable high speed train operation. Due to these factors, relocation of a large number of residences cannot be avoided. The construction could result due to influx of migrant workers and associated induced development. The influx may cause a rise in the consumption of consumer goods in the local area, which will tend to boost up the local economy. Resettlement or/and relocation of buildings and other assets, involving some changes in livelihood of PAPs. Loss of income opportunity of some PAPs due to resettlement and shop owners, vendors or farmers to be affected by construction works. The residential areas that the railway alignment pass through are shown in the following table and figures.

Township	Villages	Coordinates	
		Latitude	Longitude
Mandalay (Amarapura)	Myit Nge	21°50'36.71"N	96° 4'30.27"E
	Sin Boe	21°52'38.63"N	96° 9'3.44"E
Mandalay (Pathein Gyi)	Ywar Shay	21°54'37.93"N	96° 9'4.92"E
	Thale Gone	21°54'57.08"N	96° 9'8.17"E
	Thamma Taw	21°55'52.01"N	96° 9'14.74"E
	Toe Tet Kone	21°57'27.76"N	96° 9'17.86"E
Pyin Oo Lwin	Kone Kaw	22° 5'51.62"N	96°26'11.97"E
	Thet Kan Kone	22° 6'1.23"N	96°29'44.60"E
	Pin Lain	22° 6'29.76"N	96°32'22.54"E
Nwang Hkio	Kaung Hong	22°11'23.76"N	96°34'13.69"E

	Thone Se	22°14'43.48"N	96°37'46.61"E
	Hsum Hsai	22°15'20.16"N	96°38'25.78"E
	Kyauk Thone Lone	22°16'4.35"N	96°39'35.19"E
	Ommakha	22°17'1.03"N	96°41'14.68"E
	Kyauk Kyan	22°18'12.18"N	96°44'16.65"E
	Nwang Hkio	22°18'49.60"N	96°48'13.87"E
	Yay Lint	22°18'56.89"N	96°49'43.28"E
	Kone Sam	22°19'20.07"N	96°51'40.60"E
Kyaukme	Khite Tone Home	22°24'48.72"N	96°57'32.98"E
	Pang Ywang	22°30'23.83"N	97° 2'34.27"E
	Nwang Mun	22°45'51.70"N	97°38'27.66"E
Lashio	Loi-Lawn	22°52'20.84"N	97°41'11.94"E
	Mehan	22°53'10.02"N	97°41'36.21"E
	Kaung Mat Kyine	22°56'14.32"N	97°41'48.60"E
	Nwang Lain	22°58'29.58"N	97°41'44.78"E
	Pang Hat	23° 4'25.92"N	97°46'47.21"E
	Nam Hu	23° 5'13.74"N	97°47'39.72"E
Kutkai	Man Nawng	23°25'5.13"N	97°54'4.38"E
	Ho Nar	23°28'5.23"N	97°53'29.95"E
	Nam Phat Loon (Lower)	23°33'40.56"N	97°51'9.30"E
Muse	Mang Haung	23°46'26.38"N	97°54'49.91"E
	Nam Onn	23°50'6.39"N	97°55'52.98"E
	Wane Kine	24° 0'4.65"N	97°56'22.38"E

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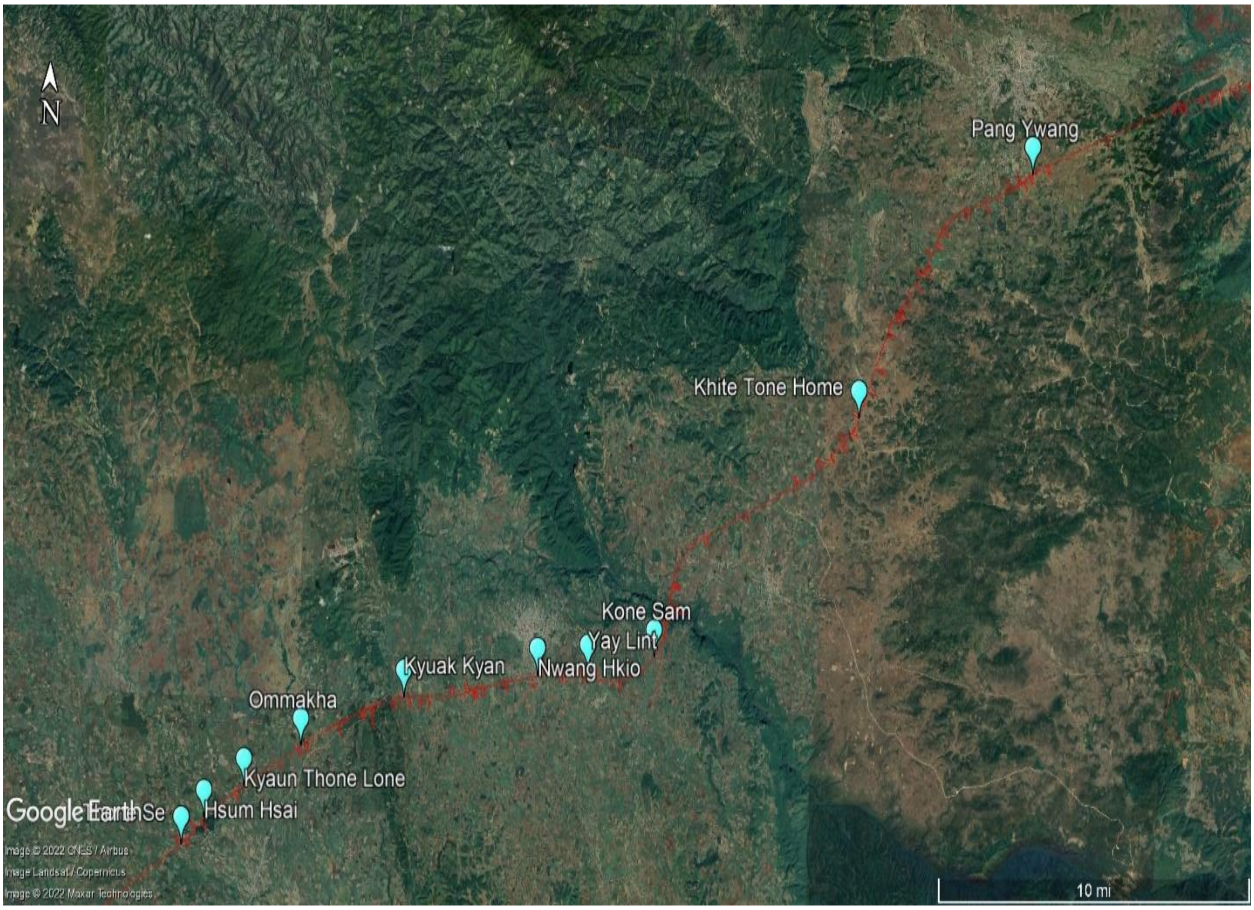
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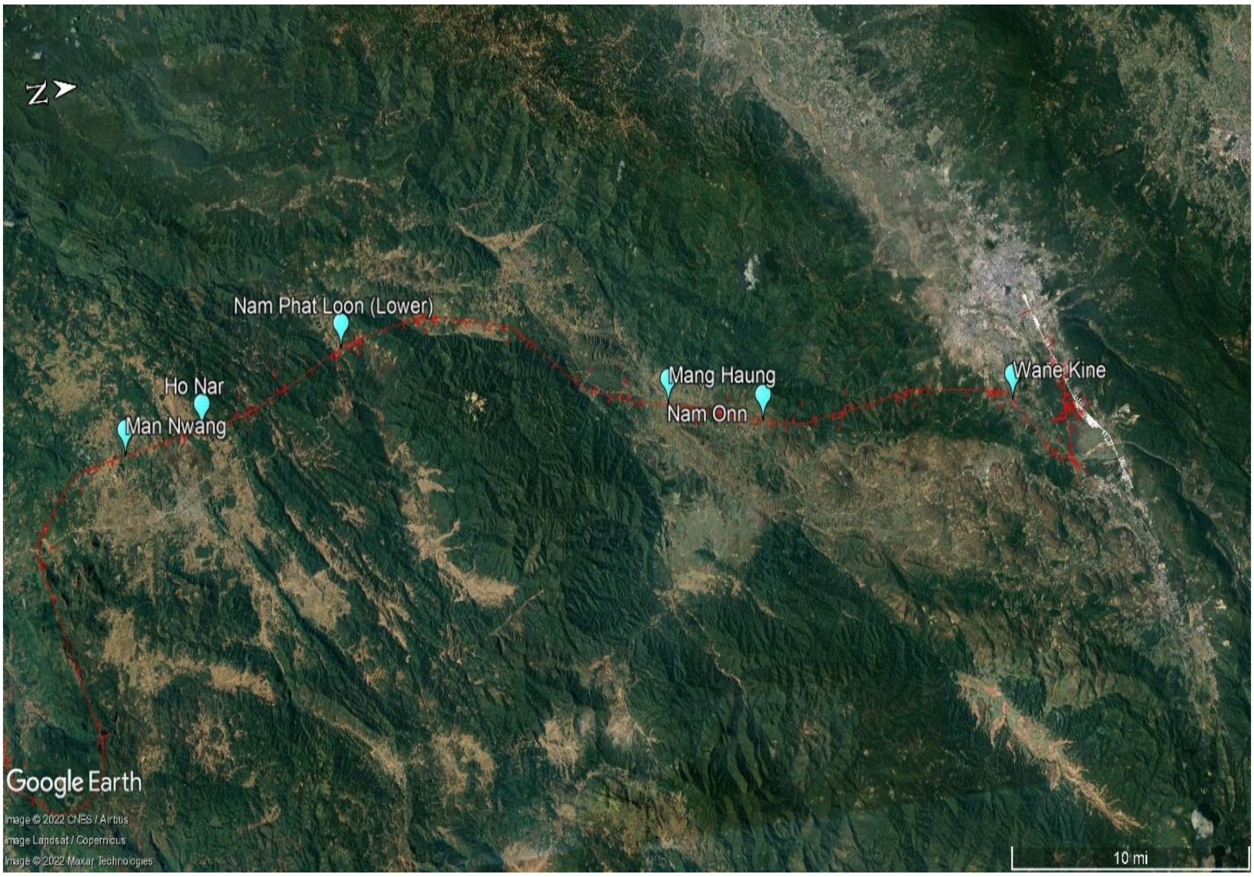


Figure – Residential Areas along the Railway Alignment

Significance of Impacts on Land Use during Pre-Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend	Probability	Total	Category
Land acquisition and involuntary resettlement	Permanent Land Use	5	5	2	4	48	High Significant (B)
	Temporary Land Use	4	4	2	4	40	Moderate Significant (C)

Consideration of Mitigation Requirement for Land Use during Pre-Construction Phase

The intensity requirement of mitigation measures for Land Use according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Permanent Land Use	High Significant (B)	Yes	Yes	Moderate	Construction Service Provider
2.	Temporary Land Use	Moderate Significant (C)	Yes	Yes	Moderate	Construction Service Provider

Mitigation Measures for Land Use during Pre-Construction Phase

Avoid land use for agricultural land, histological areas, archeological areas, forest area and ecologically sensitive areas as much as possible. Use overhead bridge as much as possible. The proposed project has provided compensation to the affected persons irrespective of their legally tenable ownership rights for the affected land. The acquisition of land and private property shall be carried out in accordance with the RAP. Compensation for affected structures and standing crops and assistance of livelihood restoration and assistance package will be planned in RAP. If there will have indigenous local people, conduct indigenous people's plan (IPP) for the indigenous people.

Significance of Impacts on Land Use during Pre-Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend	Probability	Total	Category
Land acquisition and involuntary resettlement	Permanent Land Use	4	5	2	3	33	Moderate Significant (C)
	Temporary Land Use	3	4	2	3	27	Low Impact (U)

Residual Impact

There will be some residual impact for land use. The mitigation measure for this impact will be according to the reasonable compensation for land use as per compensation program in RAP.

(b) Visual impact during Pre-construction Phase

Soil materials generated from site clearing activities can impact on visual amenity of receptors.

Significance of Visual Impacts during Pre-construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend	Probability	Total	Category
Visual impact	Construction material and waste from site clearance	3	1	1	3	15	Low Impact (U)

Consideration of Mitigation Requirement for Visual impacts during Pre-construction Phase

The intensity requirement of mitigation measures for Visual impacts according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Visual amenity of receptors	Low Impact (U)	No	Yes	Minor	Construction Service Provider

Mitigation Measures

1. Proper disposal of soil materials and other wastes
2. Roads providing access to the site should be maintained free of dust and mud.

Significance of Visual Impacts during Pre-construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend	Probability	Total	Category
Visual impact	Construction material and waste from site clearance	3	1	1	2	10	No Impact (-)

Residual Impact

After mitigation measure, there will be no residual impact for visual impact.

6.3.2. Anticipated Impacts during Construction Phase

The main activities which will be done in construction phase include installation of grounding grid, construction of temporary worker camps, access road construction, construction of command building, stringing activities and installation of electrical equipment. The affected area of the railway alignment will include the affected area of transmission lines because transmission lines will exist 15ft away from the railway alignment on each side. So, some impacts due to construction of transmission lines will not be included in this section. The main impacts considered in this phase include:

1. Impact on Air Environment
2. Impact on Surface Water Environment
3. Impact on Soil and Groundwater Environment
4. Impact on Biodiversity Environment
5. Impact on Human Environment

6.3.2.1. Anticipated Impacts on Air Environment during Construction Phase

(a) Fugitive Dust Generation

The construction of traction substations and power lines will mainly result in nuisance impacts in the form of dust. Large uncertainties are associated with emission estimates for these types of activities, resulting mostly in fugitive emissions. Traveling of vehicles on access road during construction period can also generate dust.

It will include emissions from on-site heavy-duty off-road vehicles, other light-duty vehicles and dust emissions as a result of the construction activities. The most important emissions will be NOx from the vehicles and dust from the earthworks. It will also result in mainly nuisance impacts in the form of dust.

These factors therefore do not justify a full modeling assessment for the construction phase of this project. However, the nuisance and other possible impacts will still be managed. Best practice and possible mitigation strategies are therefore recommended for the construction activities. Air quality impacts during construction are likely to result from the following sources:

- Dust from movement of haulage trucks and haulage of spoil for disposal
- Dust from stripping of vegetation and site formation pavement during road rehabilitation
- Dust from earthworks such as use of borrow pits, embankments and cut and fill

- Dust from loading, unloading and construction materials from borrow pits particularly in areas where receptors (people) are present such as in villages;
- Dust from concrete batching plants
- Dust entrained by wind from uncovered surfaces
- Minor increases in NOx and SOx from construction machinery and vehicles

The following tables indicate the impact description together with the proposed mitigation measures for the impacts relative to air quality for the project.

Evaluation of Dust Generation

Dust Generation during construction phase will be mainly resulted in nuisance impacts. Dust emissions as a result of the construction activities will include emissions from on-site heavy-duty off-road vehicles, other light-duty vehicles. Particulate matter (PMs) were released from transportation of construction materials and construction activities such as during excavation, movement of earth materials, unloading and mixing of construction materials, contact of construction machinery with bare soil, traffic movement on unpaved roads, transport of demolition waste, and exposure of bare soil and soil piles to wind. Short-term impacts will be experienced by the workers, pedestrians passing near the project site and local residents nearby.

The impact of fugitive dust sources on air quality depends upon the quantity as well as the drift potential of the dust particles emitted into the atmosphere. Large dust particles (i.e. over 100 mm in diameter) will settle close to the source and particles that are between 30 and 100 mm in diameter would likely undergo impeded settling.

The main dust impacts are likely to arise from particles with less than 30 mm in diameter, which have a greater potential to disperse over greater distance. Dust emissions vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing weather.

According to USEPA AP-42, construction dust particles are grouped into various particle sizes. Their size ranges are 1.25 mm, 3.75 mm, 7.5 mm, 12.5 mm, 22.5 mm, and the percentage of particles in each class was estimated to be 7%, 20%, 20%, 18% and 35%, respectively. Based on field measurements of suspended dust emissions from heavy construction projects like building and road construction, an approximate emission factor for construction operations is: 1.2 tons per acre of construction per month of activity. This value applies to construction operations with: (1) medium activity level, (2) moderate silt content (30%), and (3) semiarid climate (50 % of precipitation-evaporation (PE) index.

Normally, the particles (greater than 10 microns) will disperse following wind direction and will fall off in the distance of 6-9 meters from construction site. Moreover, for particulate matter smaller than 10 microns, the dispersion distance could be greater than a radius of (200-700) m from project site and the sensitive receptors are considered to be those within a 2 km radius of proposed site. The following tables show the estimated distance travelled between the relationship of wind speed and dust size particles.

Table 1: 10-micron particle

Wind Speed (mph)	Distance Traveled (miles)
3.1	.55
6.2	1.1
12.4	2.3
24.8	4.6
37.3	6.9
49.7	9.2

Table 2: 5-micron particle

Wind Speed (mph)	Distance Traveled (miles)
3.1	2.2
6.2	4.5
12.4	9
24.8	18
37.3	27
49.7	36.1

Emission Rate (Q)

The dust emission rate will be estimated according to equation (1):

$$Q(mg/s) = \frac{0.04\ (tons/acre/day) \times area \times 10^6 (mg/kg)}{24 \times 60 \times 60 (s/d)} \qquad \text{Equation (1)}$$

$$Q(mg/s) = \frac{40\ (kg/acre/day) \times area \times 10^6 (mg/kg)}{24 \times 60 \times 60 (s/d)} \qquad \ldots \qquad \text{Equation (1)}$$

The land use for main line of Muse-Mandalay Railway will be 37, 320,512 m^2 (9222 acres) during project life. By calculation of dust emission with above equation, it will be resulted Q = 4269444 mg/s

Dust Concentration (C)

The dust concentration is estimated by using equation (2):

$$C(mg/m^3) = \frac{Q(mg/s)}{d(m)*W(m/s)*M(m)} \qquad \text{Equation (2)}$$

Where,

C = Dust Concentration (mg/m3)

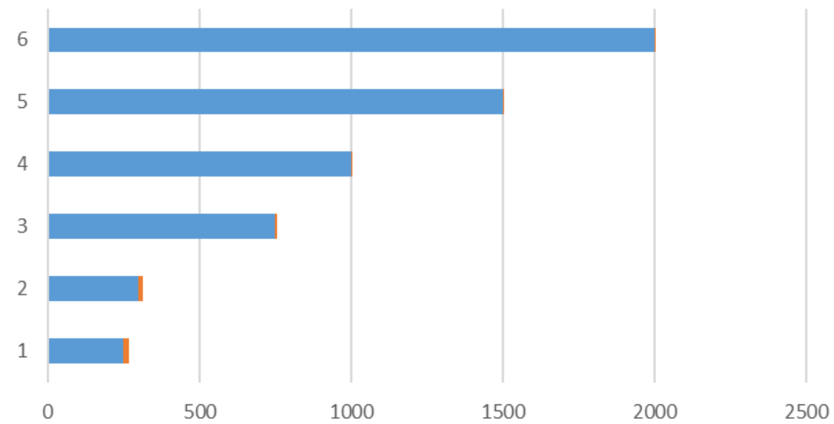
Q = Emissions at Source (mg/s)

d = Width (the smallest dimension is used for worst case scenario) (m) = 500 m

W = Average maximum wind speed (m/s)

M = Mixing Height (m)

According to the wind speed condition, wind speed during a year is about 1m / s ~ 3m / s in Myanmar. Thus, assume that average maximum wind speed will be 2 m/s in the calculation. However, the mixing height data is not available in the Meteorology Department. Therefore, the measurement of mixing height data is adopted from the atmospheric simulation models (EU) in which the default mixing height vary from very unstable stage to extremely stages in total six stages with default values of mixing height values (2000m, 1500m, 1000m, 750m, 300m, 250m).



	1	2	3	4	5	6
Mixing Height (m)	250	300	750	1000	1500	2000
Dust Concentration,C (mg/m3)	17.07	14.23	5.69	4.23	2.85	2.13

Mixing Height (m) Dust Concentration,C (mg/m3)

The above chart shows the estimated results of dust concentration at source varying mixing heights. In construction time, the whole alignment would be carried out part by part with different sub-contractors. Thus, the same whole amount of dust emission could not generate at all sections.

Significance of Impacts on Dust Generation without Mitigation Measures

The construction of traction substations and power transmission line along the railway will be very low to low without mitigation measures as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Fugitive dust emission	Construction activities	3	2	2	4	28	Low Impact (U)

Consideration of Mitigation Requirement for Dust Generation during Pre-construction Phase

The intensity requirement of mitigation measures for Dust Generation according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Fugitive dust emission	Low Impact (U)	No	Yes	Minor	Construction Service Provider

Mitigation Measures for Dust Generation during Construction Phase

The mitigation measures to protect sensitive receptors from air quality issues are:

- Stockpiles of materials such as sand must be managed to reduce dust emissions. The location of the stockpile must be downwind of sensitive receptors. The stockpile must be sprayed with water before material is moved. If the stockpile is within 300 m of dwellings the stockpile will be covered with tarpaulins and fenced in to form a high barrier and prevent wind lifting and dispersing the materials.
- Limit the transportation of vehicles to reduce dust generation.
- Water will be sprayed on construction sites and access roads to suppress dust in dry weather.
- Trucks transporting materials will be covered with automatically closing covers or tarpaulins to avoid spilling material on roads.
- During construction the contractors will immediately clean up any mud or dusty materials left on public roads. Wheel cleaning facilities will be installed at site access points to stop carryover of materials onto roads.

Significance of Impacts on Dust Generation with Mitigation Measures

The construction of traction substations and power transmission line along the railway will be very low to low without mitigation measures as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Fugitive dust emission	Construction activities	2	2	2	3	18	Low Impact (U)

Residual Impact

After mitigation measure, there will be no residual impact for fugitive dust generation.

(b) Gaseous Emission

Emissions can be generated from vehicles and running of generators.

Methodologies for Prediction of Gaseous Emission

Methodologies to Predict Gaseous Emissions during Construction Phase

Emission of pollutants will be estimated by using the simple estimation method (e.q 1). The method is to multiply relevant emission factor by activity rate.

$$Em = EF \times AR \qquad \text{(e.q 1)}$$

Where,

Em = Emission load

EF = Emission factor

AR = Activity data (can also be expressed in terms of production rate)

However, gaseous emission from the vehicular moments at the project site will be used the equation (2).

$$Em = Fc \times EF \qquad \text{(e.q 2)}$$

Where,

Em = Emission rate

Fc = Fuel consumption

EF = Emission factor

Emission Factors of Pollutants

Activity	Pollutant	Emission factor	Unit
	PM_{10}	$E = \frac{18.6\ (s)^{1.5}}{(M)^{1.4}}$	lb/hr

Bulldozing (activities include land clearing, site excavation, levelling, road and drainage construction)	CO	36[a] , 18[b]	g/kg
	CO_2	3090[a] , 3090[b]	g/kg
	NO_x	42[a], 16[b]	g/kg
Loading of excavated materials	PM_{10}	$E = k\,(0.0032)\,\frac{(\frac{U}{5})^{1.3}}{(\frac{M}{2})^{1.4}}$	lb/ton
Vehicles traveling on unpaved road	PM_{10}	$E = k\,(^{s}/_{12})^{a}\,(^{W}/_{3})^{b}$	*lb/VMT*
	CO	36[a] , 18[b]	g/kg
	CO_2	3090[a] , 3090[b]	g/kg
	NO_x	42[a], 16[b]	g/kg

Source: Adapted from USEPA

[a] Heavy Duty Vehicles-HDV that use diesel engine with moderate emission control system

[b] Light Duty Vehicles-LDV that use gasoline engine with moderate emission control system

where,

s = material silt content (%)

k = particle size multiplier (dimensionless, <10µm = 0.35),

M = material moisture content (%)

U = mean wind speed, meters per second (m/s) (miles per hour [mph])

W = mean vehicle weight (tons)

k = constant value for vehicles traveling on unpaved road (for industrial road-1.5, for public road- 1.8)

a = constant value for vehicles traveling on unpaved road (for industrial road-0.9, for public road- 1)

b = constant value for vehicles traveling on unpaved road (for industrial road-0.45, for public road- ND)

Examples of silt content of various soil types are given below (EPA, 1999).

Soil type	Silt content (%)
Silt loam	52
Sandy load	33
Sand	12
Loamy sand	12
Clay	29
Clay loam	29
Loam	40

k = particle size multiplier (dimensionless, <10µm = 0.35),

M= material moisture content (%)

U = mean wind speed, meters per second (m/s) (miles per hour [mph])

W = mean vehicle weight (tons)

Vehicle Type	Average Fuel Economy (mpg) miles-per-gallon
Passenger Cars	23.3
Motorcycles	43.5
Diesel Buses (Diesel Heavy-Duty Vehicles)	7.2
Other 2-axle, 4-Tire Vehicles	17.1
Single unit 2-Axle 6-Tire or More Trucks	7.3
Combination Trucks	5.8

Source: EPA

Assumptions for combustible emissions according to machines

Construction Equipment	No of Units	HP Rated	Hrs/day	Days/yr	Total hp-hrs
Water Truck	1	300	8	180	432000
Diesel Dump Truck	2	300	8	180	864000
Loading truck	1	300	8	150	360000
Work vehicle for electrification post	1	50	8	90	36000
Work vehicle for electrification erection	1	50	8	90	36000
Work vehicle for electrification stringing	1	50	8	90	36000
Electrification coiling car	1	3	8	90	2160
Generator	1	40	8	240	768000
Truck crane	1	300	8	90	216000
Diesel fork lift truck	1	100	8	90	72000
Concrete truck mixer	1	350	8	45	126000

Emission factors (EF) with type of construction equipment (g/hp-hr)

	Emission Factors						
Type of Construction Equipment	**VOC (g/hp-hr)**	**CO (g/hp-hr)**	**NOx (g/hp-hr)**	**PM-10 (g/hp-hr)**	**PM-2.5 (g/hp-hr)**	**SO2 (g/hp-hr)**	**CO2 (g/hp-hr)**
Water Truck	0.44	2.07	5.49	0.41	0.40	0.74	536.00
Diesel Dump Truck	0.44	2.07	5.49	0.41	0.40	0.74	536.00
Loading truck	0.44	2.07	5.49	0.41	0.40	0.74	536.00
Work vehicle for electrification post	0.44	2.07	5.49	0.41	0.40	0.74	536.00
Work Vehicle for electrification erection	0.44	2.07	5.49	0.41	0.40	0.74	536.00

Work vehicle for electrification stringing	0.44	2.07	5.49	0.41	0.40	0.74	536.00
Electrification coiling car	0.44	2.07	5.49	0.41	0.40	0.74	536.00
Generator	1.21	3.76	5.97	0.73	0.71	0.81	587.30
Truck crane	0.44	1.30	5.72	0.34	0.33	0.73	530.20
Diesel fork lift truck	1.98	7.76	8.56	1.39	1.35	0.95	690.80
Concrete truck mixer	0.61	2.32	7.28	0.48	0.47	0.73	529.70

Emission Calculations Results with type of construction equipment (tons/yr)

Emission Factors							
Type of Construction Equipment	**VOC (g/hp-hr)**	**CO (g/hp -hr)**	**NOx (g/hp-hr)**	**PM-10 (g/hp-hr)**	**PM-2.5 (g/hp-hr)**	**SO2 (g/hp-hr)**	**CO2 (g/hp-hr)**
Water Truck	0.21	0.99	2.61	0.20	0.19	0.35	255.24
Diesel Dump Truck	0.42	1.97	5.23	0.39	0.38	0.70	510.48
Loading truck	0.17	0.82	2.18	0.16	0.16	0.29	212.70
Work vehicle for electrification post	0.02	0.08	0.22	0.02	0.02	0.03	21.27
Work Vehicle for electrification erection	0.02	0.08	0.22	0.02	0.02	0.03	21.27
Work vehicle for electrification stringing	0.02	0.08	0.22	0.02	0.02	0.03	21.27
Electrification coiling car	0.00	0.00	0.01	0.00	0.00	0.00	1.28
Generator	0.10	0.32	0.51	0.06	0.06	0.07	49.72
Truck crane	0.10	0.31	1.36	0.08	0.08	0.17	126.24
Diesel fork lift truck	0.16	0.62	0.68	0.11	0.11	0.08	54.83
Concrete truck mixer	0.08	0.32	1.01	0.07	0.07	0.10	73.57
Total Emission	1.31	5.60	14.25	1.12	1.09	1.86	1347.87

Significance of Impacts of Gaseous Emissions without Mitigation Measures

The construction of traction substations and power transmission line along the railway will be very low to low without mitigation measures as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Vehicular emission	Construction activities	3	2	3	4	32	Moderate Significant (C)

Consideration of Mitigation Requirement for Gaseous Emission during Pre-construction Phase

The intensity requirement of mitigation measures for Gaseous Emission according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Vehicular emission	Moderate Significant	No	Yes	Moderate	Construction Service Provider

Mitigation Measures for Gaseous Emissions during Construction Phase

The mitigation measures to protect sensitive receptors from air quality issues are:

- Concrete batching plants to be located at least 300 m downwind or as far as practicable from the nearest dwellings in order to reduce the impact of fumes on humans.
- Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes.
- Machineries, vehicles and generator with good engine conditions and low sulphur content fuel should be used.

Significance of Impacts of Gaseous Emissions with Mitigation Measures

The construction of traction substations and power transmission line along the railway will be very low to low without mitigation measures as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Vehicular emission	Construction activities	3	2	3	3	24	Low Impact (U)

(c) Noise Impacts

The major sources of noise pollution during power supply system construction are removal of existing surface vegetation and overburden and site formation. In this site there is no pronounced slope so no site leveling will be required. Consequently, there will be no need for impact piling. No rock will be extracted other than by excavators so no blasting will take place. The general movement of construction vehicles for haulage of removed over burden and delivery of construction materials will create noise and vibration.

As regards removal of topsoil and underlying materials a mass balance "cut and fill budget" will be prepared so that cut material from an embankment can be reused on site to fill in low lying areas. This will minimize vehicle movement and save money in purchasing fill material. The cut and fill budget will be subject to approval by the materials engineer to confirm the materials are of suitable load bearing integrity.

Construction Noise Equipment

The forecast noise value of the main construction equipment is as follows:

S/N	Equipment	No. of Equipment	Noise values at 50m distance dB(A)
1.	Water Truck	1	84
2.	Diesel Dump Truck	2	84
3.	Loading Truck	1	84
4.	Work vehicle for electrification post	1	84
5.	Work vehicle for electrification erection	1	84
6.	Work vehicle for electrification stringing	1	84
7.	Electrification coiling car	1	84
8.	Generator	1	81
9.	Truck crane	1	83
10.	Diesel fork lift truck	1	85
11.	Concrete truck mixer	1	85

Calculations

$$Leq = SPL_{site} = 10\log\left(\frac{10^{8.1}+10^{8.3}+2(10^{8.5})+8(10^{8.4})}{12}\right)$$

$$= 83.93 \text{ dBA}$$

L_1 = 83.93 dBA

L_2 = 55 dBA (NEQG Standard for Noise in Residential Area)

r_1 = 15.24 m

r_2 =?

$r_2 = 15.24 \times 10^{\left(\frac{83.93-55}{20}\right)} = 426.07$ m

The village inside 426.07m will experience the noises from the construction site. Therefore, mitigation measures will have to be carried out to control the noises in the area that are below 426.07m. Although all of the predicted noise levels are based on calculations and the actual noise level may change a little bit due to the factors such as seasonal wind direction and wind speed.

Significance of Construction Noise without Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise	Noise from construction equipment	2	2	2	4	24	Low Impact (U)

Consideration of Mitigation Requirement for Noise

The intensity of mitigation required for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation required considered by EIA team	Intensity of Mitigation Required	Responsibility
1.	Noise	Low Impact (U)	Yes	Yes	Sensible	Construction service provider(s)

Mitigation Measures for Noise during Construction Phase

The potential noise impacts will be incorporated in the bid documents and construction contracts and are:

Source Control

Maintain all exhaust systems in good working order; undertake regular equipment maintenance, enclose stationary equipment such as generators where practicable and reduce vehicle speeds around sensitive receptors such as dwellings and schools.

Siting

Locate sites for concrete-mixing, batching plants and similar activities at least 500 m away from sensitive areas.

Timing

Operate between 7am-7pm only and reach an agreement with nearby residents regarding the timing of heavy machinery work, to avoid unnecessary disturbances.

Community notification

In advance of construction, representatives from religious buildings, schools and village leaders will be consulted on the timing of construction so key ceremonies, exam times, or other significant events so that impacted upon them are as little as possible.

Consultation and engagement

Set up procedure for handling of noise complaints through the Grievance Redress Mechanism and continually seek suggestions from community members to reduce noise intrusion.

Potential sensitive receptors in residential areas, businesses, religious buildings and schools may be exposed to short term impacts. With the above mitigation measures in place, potential noise impacts during the construction stage are anticipated to be acceptable. In addition, during construction, noise monitoring will be undertaken near sensitive receptors in order to identify corrective action if needed.

Significance of Construction Noise with Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise	Noise from construction equipment	2	2	2	3	18	Low Impact (U)

Residual Impact on Air Environment during Construction Phase

Dust emission and particulate matter emission from the construction of traction substations and power lines, on-site vehicles and earthworks, NOx and SOx from construction machinery and vehicles would not be a residual impact on air environment. And these can be controlled by the described mitigation during the construction phase. Noise emission caused by the earth moving, excavation equipment and constructional used machinery would not be a residual after conducting the mitigation measures. The main source of vibration is from the strong vibration construction machinery. In conclusion, there would be no residual impact on air environment during construction phase.

6.3.2.2. Anticipated Impacts on Surface Water Environment during Construction Phase

The clearing of the run of way (ROW) for construction related activities of the transmission line may include passage through riverine habitat, marshes and rivers (permanent or seasonal). The removal of riverine woodland will be inevitable in order to create the ROW. The proposed project area does not have permanent rivers but has seasonal stream valleys crossed by the proposed transmission line, water pools on seasonal rivers and water-pans on the side of the proposed ROW.

The construction activities of power station and equipment may potentially cause the soil to be susceptible to runoffs. During rainy season, downstream areas are normally affected by sediment loads from upstream areas. Erosion may occur on areas with weak soil during rainy season. Construction activities might demand water and any attempts of water extraction from the resources could probably drain water that serves an ecological role in the area. The water pools also serve livestock and domestic uses.

Water quality impacts during construction are likely to result from the following sources:

- Increased sedimentation of water courses
- Accidental spills contaminating wells with oils, lubricants, paint wastes, etc.
- Sanitation facilities such as toilets leaking into portable water source.
- Clearance of site vegetation

As regards removal of topsoil and underlying materials a mass balance “cut and fill budget” will be prepared so that cut material from an embankment can be reused on site to fill in low lying areas. This will minimize vehicle movement and save money in purchasing fill material. The cut and fill budget will be subject to approval by the materials engineer to confirm the materials are of suitable load bearing integrity.

Effluent Discharges during Construction

(i) Construction of power station, sub-stations & ROW

The construction of power station, sub-stations & ROW works will destroy the surface vegetation and produces bare surface. The soil erosion and water loss will occur in the case of rain water, and it will increase the suspended matter of the water body when entering into the water body.

(ii) Construction camp

The specific location and number of construction camps will be determined in the construction stage. The construction personnel has relatively simple lives, thus their sewage discharges are relatively less with simple pollution behavior, mainly including fecal sewage, kitchen sewage, bath wastewater and other domestic sewage.

Another impact during the construction phase is the accidental spillage of fuels and hydraulic fluids from construction plant. Therefore, storage of fuel, oils and chemicals will be on an impermeable base, away from drains and watercourses.

Hazardous Waste

Hazardous wastes from power station construction will moderately affect the surface water quality. The spillage of lead-based paint used for transmission lines coating process can cause surface water pollution. Therefore it can be **mitigated** by training workers on appropriate handling and storing of chemicals and fuels as per MSDS.

Significant of Impacts on Surface Water Environment during Construction Phase before Mitigation Measures

Impact on water environment during construction phase will not be significant due to the amount of wastewater produced during construction phase (the volume of nearest water bodies is very much greater than the volume of wastewater disposed by construction site) and the time of construction phase.

Anticipated Impacts	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Surface Water Pollution	Construction Debris	2	2	2	3	18	Low Impact (U)
	Hazardous wastes	2	2	2	2	12	No Impact (-)
	Oil and lubricants	2	2	2	2	12	No Impact (-)
	Domestic Wastes	2	2	2	3	18	Low Impact (U)

Consideration of Mitigation Requirement for Surface Water Environment during Construction Phase

The intensity requirement of mitigation measures for Surface water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Construction Debris	Low Impact (U)	No	Yes	Minor	Construction service provider(s)
2.	Hazardous wastes	No Impact (-)	No	Yes	Minor	Construction service provider(s)
3.	Oil and lubricants	No Impact (-)	No	Yes	Minor	Construction service provider(s)
4.	Domestic Wastes	Low Impact (U)	No	Yes	Minor	Construction service provider(s)

Mitigation Measures

The mitigation measures to protect from **water quality issues** for power lines are:

- Wells will be identified in advance of construction and demarcated to ensure vehicles and machinery does not encroach on them. Identification will require consultation with community members.
- Chemical and oils storage areas will be laid on a hard concrete base. Overhead protection from rain and severe weather will be provided.
- Vehicle maintenance workshops, vehicle parking areas and vehicle cleaning areas must be placed at least 300m away from the nearest water body and have surrounding drainage to ensure contaminated water does not enter a watercourse. Maintenance and cleaning activities must be on hard standing surface.
- Use zinc-based coating paint instead of lead-based coating.

The mitigation measures to protect from water quality issues for power stations are:

- No materials will be stored within 50 m of a water course, including soil, spoil, aggregates, chemicals or other materials used during construction.
- Temporary drainage provision will be made during construction to ensure that any rain storm water running off the construction areas will be controlled. It will be lead to silt traps before discharge t the natural drainage system.
- Any toilet or personal washing facilities on site will have prefabricated septic tanks installed on site which discharge to a subsurface soak away to avoid soil contamination and smell.
- Fuel storage for site vehicles must be in an elevated skid mounted tank placed on a hard area with a kerb built up around it that is capable of holding 110% of the contents of the tank volume. It may have a drainage plug to allow rain water to be discharged but this must have a tap which is Normally Closed and be kept closed at all times.
- Contingency plans for control of spills of oil and other hazardous substances will be formulated and spill collection kits kept readily available.
- Systematic waste disposal site with impermeable lining, reduce, reuse and recycle of domestic wastes.

Water quality monitoring will take place to confirm the impact of the project on water resources and identify corrective actions if needed.

The mitigation measures to protect from waste contamination issues for power lines and stations are:

- Waste removal and disposal will be subject to the waste hierarchy of reduce / reuse / recycle. Where waste materials can be reused they will be, but not if this leads to pollution.
- Vegetation will be cleared and removed to a municipal dump site approved by local authorities.
- Waste storage containers for worker’s general waste will be provided and emptied regularly
- Mud on roads will be avoided by wheel cleaning facilities at entry and exit points
- Soil and overburden will be removed, stored and reused as far as possible in accordance with a cut and fill mass balance plan
- Topsoil will be stockpiled and used for later landscaping

- Municipal type waste such as food wastes, paper, cardboard, clean wood and other materials will be collected in bins and emptied regularly to a municipal waste tip to avoid encouraging vermin and rodents.
- Temporary waste storage will be in an area kept as dry as possible with a lightweight roof to keep off rain.
- Burning of waste will be prohibited at all times.
- It has been noted on some sites that wastes are dumped by residents. The contractor will not be responsible for this in the future and this process will have to be terminated. However existing wastes on site will be removed by the contractor. Waste disposal monitoring will take place by visual inspections of the sites on a regular basis by the construction supervision inspectors.

Significant of Impacts on Surface Water Environment during Construction Phase after Mitigation Measures

Impact on water environment during construction phase will not be significant due to the amount of wastewater produced during construction phase (the volume of nearest water bodies is very much greater than the volume of wastewater disposed by construction site) and the time of construction phase.

Anticipated Impacts	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Surface Water Pollution	Construction Debris	2	2	2	2	12	No Impact (-)
	Hazardous wastes	2	2	2	2	12	No Impact (-)
	Oil and lubricants	2	2	2	2	12	No Impact (-)
	Domestic Wastes	2	2	2	2	12	No Impact (-)

Residual Impact on Surface Water Environment during Construction Phase

Construction debris and oil and grease leaked from the vehicles and construction machinery can be controlled by silt traps, and natural weirs and small lakes. So there would be no residual impact because of the construction debris and oil and grease from the construction activities. Since the intensity of mitigation for the impact on surface water environment during construction phase is minor, there would be no residual impact on surface water environment.

Impact on Watershed

As the railway route is close to Thit Ta Pin Taung Protected area which is environmental sensitive area of water resources for the local community of surrounding villages and to protect near forest areas in Pyin Oo Lwin Township. Due to the construction of railway, there will be lots of tree cutting. Due to the disappearing of forest, the quality of watershed can impact.

Significant of Impacts on watershed before mitigation measures

The nature of impact on watershed will be significance due to the railway construction near watershed as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Watershed	Cutting off trees	3	2	3	4	32	Moderate Significant (C)

Consideration of Mitigation

The intensity of mitigation required for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation required considered by EIA team	Intensity of Mitigation Required	Responsibility
1.	Watershed	Low Impact (U)	Yes	Yes	Major	Project Developer

Mitigation Measures of Impact on Watershed

The railway route close to Thit Ta Pin Taung Protected area is to be constructed as tunnel. There will be tree cutting as less as possible at the tunnel portal area. It there is need to change the alignment of railway, the protected forest for watershed is avoided as possible. Tunnel Project will be sited with utmost care so as not to disturb the forest vegetation or will not affect any forest migratory routes will not be affected.

Significant of Impacts on Watershed after mitigation measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Watershed	Cutting off trees	2	2	3	3	21	Low Impact (U)

6.3.2.3. Anticipated Impacts on Soil and Ground Water Environment during Construction Phase

Impact of soil and groundwater environment during construction phase will be leakage of fuel oil, leakage of lubricants and disposal of wastes.

(a) Impact on Soil and Ground Water Quality

Accidental Spills of Fuel Oil and Lubricants: Potential contamination of soil and groundwater during construction phase could possibly occur as a result of accidental spills of lubricants, oils, solvents and degreasers during construction can infiltrate and contaminate the soil. This can occur from poorly maintained or improperly operated on-site vehicles and construction equipment, as well as due to improper storage or handling of equipment or hazardous materials. Wastewater from repair shops and washing places contaminated with hydrocarbons (oil, lubricants and solvents) can enter the soil if spilled. Liquid contaminants that enter the soil can then percolate further and result in soil contamination and groundwater pollution.

Construction Debris and Domestic Wastes: During construction phase, construction debris such as packing materials and domestic wastes from construction workers will produce. There will have potential to soil contamination and ground water pollution if these solid wastes are not properly disposed. Moreover, seepage from construction waste dump site will also impact on soil and ground water qualities.

Impacts Significance on Soil and Ground Water Environment during Construction Phase before Mitigation Measures

Construction related impacts to soil and groundwater in project site will be as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Soil and Ground Water Pollution	Leakage of fuel oil and lubricants	3	2	1	2	12	No Impact (-)
	Construction debris and Domestic Wastes	2	2	2	3	18	Low Impact (U)

Consideration of Mitigation Requirement for Soil and Ground Water Quality

The requirement of mitigation measures for soil and ground water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
2.	Leakage of fuel oil and lubricants	No Impact (-)	No	Yes	Minor	Construction Service Provider(s)
2.	Construction debris and domestic wastes	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Impacts on Soil and Ground Water Environment during Construction Phase

(a) Mitigation Measures for Ground Water Quantity

The mitigation measure for the groundwater quality is that MR should take responsibility for the shortage of groundwater to the affected area (the nearest villages) by digging the new deep wells, tube wells and supporting water requirement to those areas if they suffer the shortage of groundwater.

(b) The Mitigation Measure for Soil and Groundwater Quality

According to the above consideration for required mitigation measures, there will be minor mitigation measures such as disposed of solid wastes according to the rules and regulations of CDCs to reduce impacts of solid wastes during construction phase. Care should be taken not to leak during the handling of fuel oil and lubricants. All of the fuel tank and lubricants container have to store over concrete floor or impermeable pad. Machineries used in construction phase have to good conditions.

Construction wastes need to be transported in an orderly manner that ensures that no material escapes from the trucks during transport, and that the waste is then deposited in MCDC approved landfill locations to ensure that the surrounding environment does not become contaminated with the waste materials generated. Wherever possible, steel scraps, metals, and other construction wastes should be recovered for re-use, recycling and reclamation after the adequacy of the physical and chemical properties of such material is ascertained and the absence of contamination is ensured.

Domestic effluent will be collected and contained in septic tanks on site. The contents will be removed for disposal as and when necessary by an MCDC licensed contractor.

During the construction phase, there will be generation of debris as a result of various construction activities. An agreement will be drafted with solid waste collectors and schedule set for demolition and construction wastes to be delivered to a CDC approved site appropriate for landfilling for:

- Contaminated and hazardous material,
- Non-hazardous material,
- Where feasible, for reclamation and reuse.

The generated materials will also be used for reclamation purposes whenever applicable on site in the project. Sorting of construction wastes will be encouraged, as well as, adoption of a re-use/recycle program on site whenever deemed feasible.

Construction wastes will also be minimized through careful planning during the design stage, whereby reducing or eliminating over-ordering of construction materials to decrease waste generation and reduce project costs (cost of surplus materials).

Chemical wastes have to be generated including containers that were used for storage of chemical wastes on site, the chemical residue as well as contaminated material. These materials have to be segregated as hazardous and non-hazardous and properly labeled, stored and disposed of. Storage be located in a separate area that has an impermeable floor, adequate ventilation and a roof to prevent rainfall from entering.

In addition all chemical wastes must be clearly labeled in Myanmar, stored in corrosion resistant containers and arranged so that incompatible materials are adequately separated. There will be a prior agreement with the MCDC for the disposal of any hazardous waste generated.

General refuse generated during project activities will be stored in enclosed bins or compaction units separate from construction and chemical wastes. An agreement will be drafted with a solid waste collector certified by the MCDC to identify collection sites and schedule the removal to minimize odor, pest infestation and litter buildup. The burning of refuse on the construction site will be strictly prohibited and penalized. General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware will be promoted if feasible. Aluminum cans will be recovered from the waste stream by individual collectors if they are segregated and made easily accessible, so separate, labeled bins for their storage should be provided if feasible.

Impacts Significance on Soil and Ground Water Environment during Construction Phase after Mitigation Measures

Construction related impacts to soil and groundwater in project site will be as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Soil and Ground Water Pollution	Leakage of fuel oil and lubricants	3	2	1	2	12	No Impact (-)
	Construction debris and Domestic Wastes	2	2	2	2	12	No Impact (-)

Residual Impact on Soil and Ground Water Environment during Construction Phase

Solid wastes and construction wastes can be disposed according to the rule and regulation of CDCs and deposited in MCDC approval landfill location and there would not be residual by conduction the described mitigation measures. Leakage of fuel oil and lubricants from vehicles and construction machinery can be stored over concrete floor or impermeable pad. So there would be no residual impact because of the construction debris and oil and grease from the construction activities. Since the intensity of mitigation for the impact on surface water environment during construction is minor, there would be no residual after conducting the mitigation measures.

6.3.2.4. Anticipated Impacts on Biodiversity Environment during Construction Phase

(a) Flora Diversity

Most of the subgrade areas are located in the areas of secondary vegetation types and artificial vegetation types (including farmland vegetation, etc.), thus, the loss of vegetation and plant resources caused by transmission line construction will not have a significant adverse impact on the integrity of local ecosystem and the diversity of plant species, and will not lead to the disappearance of any plant species.

Impacts to Wetland and Woodland

Vegetation communities in both woodland and wetland are rich and varied. Sometimes the power transmission lines may be placed in the wetland and/or woodland. Therefore the construction activities and equipment are working in that areas that may impact and dormant the wetland vegetation and woodland, forest.

Mitigation Measures for Flora Diversity

- Construction activities will not exceed the proposed construction boundaries by more than 15 m to avoid the secondary impact of construction and increasing the areas that will require clearing and rehabilitation.

- A search and rescue operation for both plants and fauna (particularly reptiles) must be initiated prior to the commencement of any construction once the required permits are in place. Applications must be submitted to the applicable authority for the removal of any protected floral or fauna species.
- Re-vegetation as part of a rehabilitation plan is always advocated, however due the nature of the vegetation, this may not be practical. It is suggested that the willow topsoil layer be stockpiled separately from the subsoil layers, will the excavation exceed 0.5 m. When the construction has been completed, then the topsoil layers, which contain seed and vegetative material, will be reinstated last thus allowing plants to rapidly re-colonise the bare soil areas.
- Alien plant regrowth will also be monitored, and any such species will be removed during the construction phase.

Mitigation Measures of Impact to Wetland

- Avoid placing transmission lines through wetlands;
- Adjust pole placements to span wetlands or limit equipment access in wetlands, wherever possible;
- Limit construction to winter months when soil and water are more likely to be frozen and vegetation is dormant;
- Use alternative construction equipment such as helicopters or marsh buggies for construction within wetlands;
- Clean construction equipment after working in areas infested by purple loosestrife or other known invasive, exotic species;
- Use mats and wide-track vehicles to spread the distribution of equipment weight when crossing wetlands during the growing season or when wetlands are not frozen.

Mitigation Measures of Impact to Woodland

- Avoiding routes that fragment major forest blocks;
- Adjusting pole placement and span length to minimize the need for tree removal and trimming along forest edges;
- Allowing tree and shrub species that reach heights of 12 to 15 feet to grow within the ROW;

(b) Fauna Diversity

(i) Analysis of the influence on mammals

The influence of engineering construction on mammals mainly occurs in the construction area along the railway: the living activities of construction personnel will cause the interference and destruction to the habitat of mammals; the noise of construction machinery will drive away the mammals; these effects will cause most mammals to migrate elsewhere, away from the construction area. As the mammals will migrate to avoid the damage caused by the project construction, the direct impact of the project construction on the mammals is not significant.

(ii) The influence on birds

Construction activities will cause disturbance and destruction to bird habitat. Construction machinery noise will directly or indirectly destroy bird habitat and bird nests, and interfere with shrub habitat of birds. Or their daily living activities will also cause interference and destruction to bird habitats. As a result of these effects, most birds will migrate elsewhere, away from the construction area; a small number of terrestrial and shrub forest birds will disappear from the construction area as a result of habitat loss; and some bird population will be reduced as a result of the destruction of nests, especially when the construction period is in the breeding season of birds (in summer). The overall result will be a reduction in the species and number of birds in the project area. As most birds will fly away and migrate in a short distance to avoid the damage caused by the project construction, the project construction has little impact on birds.

(iii) The influence on amphibians and reptiles

The influence of engineering construction on amphibians and reptiles mainly include the disturbance and destruction to their habitat, especially on the mating activities of amphibians, oviposition and hatching of eggs, and the growth of tadpoles. The noise of construction machinery will drive away amphibians and reptiles, and the excavation and filling of streams, ponds and ditches during construction will cause damage to amphibians and reptiles, especially to amphibian habitat. These effects will cause most reptiles to migrate elsewhere, away from the construction area; some amphibians and reptiles will be reduced by the destruction of their nests. The overall result is that their types and numbers within the project area will be reduced. However, as most reptiles will migrate to avoid the damage caused by project construction, the influence of project construction on reptiles will not be too great.

As noted above, the implementation of the project has little direct impact on mammals and birds and will have a certain direct impact on amphibians and reptiles. The main reason is that the construction excavation and filling of the project will destroy the natural water body necessary for amphibian reproduction activities, so that the area of natural water body will be reduced and the quality of the natural water body will be reduced. It has a certain indirect impact on mammals and birds, and has a greater indirect impact on amphibians and reptiles. The main impact on birds is that the occupation of forests will reduce the suitable habitat for birds.

Potential Noise Impact

The animals can run away by the noise of construction machines and equipment of the project. So, the habitats of fauna can be moved being shocked because of human impacts by labors and using of mining on limestone caves for creation of project purposes during construction period. The terms habitat loss and habitat reduction are also used in a wider sense, including loss of habitat from other factors, such as noise pollution.

- With the progress of construction work, noise will be generated from the construction machinery and transportation vehicles. Sufficient consideration must be given to minimize the noise impact.
- Animals are altering their natural behaviors or relocating to avoid noisy areas.
- It can also affect an animal’s ability to hear or make it difficult for it to find food, locate mates and avoid predators. It can also impair its ability to communicate and reproduce activities.
- The population and diversity of certain bird populations may be decline or change when exposed to continuous noise generated by transformer.

Potential Impacts on Fauna during Construction Phase

The following potential impacts on fauna have been identified for the construction phases of Project area. Decrease in animal populations due to:

- Killing of animals by vehicles and machinery/illegal hunting by construction workers;
- Animals moving away from the area due to the presence of humans and running vehicles and machinery.

Decrease in Animal Populations

Right-of-way construction activities along a railway alignment may adversely affect wild animal populations, including terrestrial and aerial .For terrestrial and aerial species (some birds and bats), the main deleterious effects that may reduce local wildlife populations would come from.

Terrestrial Ecosystem

With the progress of excavation work, the habitat of the plants and animals may disappear. The power plant site and its surrounding areas have already been converted into the agricultural land and are used for artificial purposes. With the progress of excavation work, the habitat of the plants and animals may disappear.

Fauna Injury or Mortality

Construction has the potential to result in injury or mortality of some individuals of less mobile fauna species, and other small terrestrial fauna that may be sheltering in vegetation within the project area. The potential injury or mortality of individuals is highly unlikely to affect an ecologically significant proportion of any local populations. More mobile native fauna, such as native birds, bats, terrestrial, and arboreal mammals are likely to be able to evade injury during construction activities.

Table - Biodiversity Impact and Activities causing to the Impact

Impact	Activities Causing to The Impact	Remark
Habitat damage, fragmentation and loss Species disturbance and loss	▪ Wildlife disturbance and relocation through increased noise, light and human ▪ Conversion of habitats providing important ecosystem services for tourism developments or supporting infrastructure ▪ Construction of access rail road and other infrastructure that open up previously inaccessible areas to development ▪ Poor construction practices leading to soil erosion	

(c) Impact on Ecosystem

The most area where the alignment passes has been heavily influenced by human activities of township building and agriculture farmland cultivation. Investigated plants are common species in this area. Due to the influence from local residents, there is no important fauna and flora resource in the alignment corridor. For this reason, proposed project has little impacts on wild animals in human habitation area. Bats have long been known as the cave-dwellers par excellence. The degree of ecological dependence on caves as shelter is highly variable for bats. Most bats species are able to use multiple kinds of roosts in caves.

From the point of view of the bats, caves must be protected to allow species most dependent on this kind of shelter to maintain viable populations. From the point of view of the cave communities, all bat species, independent of their conservation status, must be locally protected in project areas. Even in the case of bat species, the control must be carefully managed, allowing the maintenance of a minimum population size to support the cavernicoles dependent on vampire bat guano. On the other hand, bat guano is an important food source for many subterranean organisms, especially for species restricted to subterranean habitats, totally dependent on the resources present in these habitats and prone to rapid extinction following any ecological disequilibrium. Therefore, protecting bats is a fundamental part of any program or action on project by contractors for conservation of subterranean systems.

Through the field survey, it was observed that biodiversity in the project area was rich because of there are enough food sources and available conditions for wild animals in these areas.Though clearing the vegetation due to the implementation of the project, greening of the public space along and near the rail -road will help to mitigate the change of biodiversity and ecosystem. Therefore, the development of the project will be able to cause any significant impact on biodiversity and ecosystem of the region. The avoidance is essential to maintain the integrated habitat and is the most effective way to protect local resources.

The crossed territories will be directly affected both during railway construction and operation stage. Construction will change or destroy some of the habitats. Railway line will be a fragmenting object for some species' populations, since it will impose a burden to the migration. Despite the fact that construction and decommissioning works take place at different times of the project, impacts caused on the environment as a consequence of those activities are fairly similar. This is a logical statement since construction and decommissioning include analogous activities and it is just the sequence of them that is inverse.

Significance of Impact on Fauna Diversity during Construction Phase

The impact on fauna diversity will be minimal due to the site had already cleared by human activities and very little fauna species are found within the project site (direct impact zone). However, there will be a little impact on surrounding fauna diversity (indirect impact zone), due to the construction noise.

Impact assessments on the fauna of the project area

Table - Impact index value and categories of fauna in the Mandalay-Muse Railway New Project

No.	Impacts	Magnitude	Duration	Extend (area)	Probability	Total	Category
	Fauna						
1	Reduce Terrestrial Fauna	3	4	2	3	27	Low impact (U)

2	Noise Impact	3	3	2	3	24	Low impact (U)

(Source: International Association of Impact Assessment-IAIA, 2014, www.iaia.org)

Consideration of Mitigation Requirement for Fauna Diversity

The intensity of mitigation requirement for fauna diversity according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Noise	Very Low (-25)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Impact on Fauna Diversity

- Follow the WDNR guidelines for preventing the spread of exotic invasive plant species and diseases such as oak wilt.
- Avoid working at night
- Sound proof measurement will be taken at biodiversity sensitive areas

Residual Impact on Biodiversity during Construction Phase

The intensity of the impact on the biodiversity environment during construction phase is initially very low, there would be no residual impact after conducting the mitigation measures.

6.3.2.5. Anticipated Impacts on Human Environment during Construction Phase

The construction phase will last 5 years and workforces and the use of equipment will be as follow:

.	Duration	Work force for each site	Number of equipment used	Quality
Construction Phase	5 years	41 (for traction substation) 20 (for stringing transmission lines)	Water Truck Diesel Dump Truck Loading Truck Work vehicle for electrification post Work vehicle for electrification erection Work vehicle for electrification stringing Electrification coiling car	1 2 1 1 1 1 1 1 1 1

			Generator Truck crane Diesel fork lift truck Concrete truck mixer	1 1 1 1

The baseline social conditions of a community (community profiles) are the existing conditions and past trends associated with the human environment in which the proposed activity is to take place. The description of baseline conditions includes the relationship with the biophysical environment, historical background, social resources, culture, attitudes and social conditions, economic and population characteristics.

Social impact assessment (SIA) process focuses on evaluating the impacts development has on community social and economic well-being. This analysis relies on both quantitative and qualitative measures of impacts. Assessing proposed developments in a socioeconomic context will help both the developer and affected community to identify potential social equity issues, evaluate the adequacy of social services and determine whether the project may adversely affect overall social well-being.

SIA scoping intended to gain an initial understanding of the socio- economic environment of the proposed railway project area. Through scoping initial socio-economic issues that may influence project decisions were identification and these will be considered during development of the terms of reference for the impact assessment phase.

6.3.2.5.1. Positive Socio-Economic Impacts

(a) Job Creation

For the whole construction period, there will be about 1000 workers needed both for traction substation construction and stringing transmission lines. So, there will be about 500 job positions for local people during this phase. The project will create opportunities for employment and supplier business, for the duration of the project construction. These will be through increase in income generating sources. The project will bring positive benefit if the Project and Contractors give first priority when employing the displaced persons in work such as forest clearance along the ROW, road repair and maintenance, water supply work, afforestation, planting of seeds, nursery work, fencing, construction of retaining walls etc. These do not require much expertise and can easily be taken up by locals.

Another source of income may be through increase in sales of fresh vegetables, dairy products and food to workers and travellers through roadside stalls or small outlets/shops near worker camps.

The anticipated impacts are positive but limited to the construction period and to urban centers such as Muse, Lashio, and Mandalay where skilled and semi-skilled construction workforce is expected to be sourced. To a lesser extent, semiskilled construction labor may also be sourced from peri-urban areas along the transmission line route. (i.e. municipalities of Muse, Lashio, and Mandalay), and low skilled positions such as vegetation clearance, cleaning and house-keeping at accommodation camps, security guards, etc. may be sourced in the settlements of the Study Area along the line route. Employment related to demining has not been confirmed at this stage and will depend on whether the authorized demining operator selected is a private company.

According to social survey, many young people go to border city of Myanmar-China, Shweli for job seeking in Shan Region. So the job opportunities for local people will be significant as follows.

Impact Significance of Job Creation without Enhancement Measures

Anticipated Impact	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Potential to Increase in household income	3	2	3	3	24	Low Impact (U)

Consideration of Enhancement Requirement for Job Creation

The intensity of enhancement requirement for job creation according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Potential to Increase in household income	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)

Enhancement Measures for Job Creation during Construction Phase

The following mitigation measures will be done for ensuring job opportunities for local people.

(a) Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible.

(b) As the population of females is slightly higher than that of males in the township, employment opportunities for construction works will be created to ensure that the local female population also has equal chance for these opportunities (Gender Equality).

(c) It is necessary to make tendering process in every project implementation works to ensure job opportunities for local rental services, machineries rental services, local service companies and other relative businesses.

(d) Encourage construction sub-contractor to use local labor force as part of tender requirement.

Impact Significance of Job Creation after Enhancement Measures

If job creating is provided to local people, the impact will become low after enhancement actions as follow:

Anticipated Impact	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Potential to Increase in household income	3	2	3	4	32	Moderate Significant (C)

Creating job opportunities for local people is one of the most public needs according to the primary data collection and through public meeting. So, it should be intensely considered during construction phase.

(b) Skill Development for Local People

Local people hired by the proposed project would remain in communities with skills acquired during project construction such as traction substation construction techniques and stringing transmission lines techniques since it is a rare opportunity for local people to learn such techniques. Communication skills for local people will also improve in office works during construction period.

Impact Significance of Skill Development without Enhancement Measures

Components	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Local skill development	3	2	3	3	24	Low Impact (U)

Consideration of Enhancement Requirement for Skill Development

The intensity of enhancement requirement for skill development according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Local skill development	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)

Enhancement Measures for Skill Development for Local People

The following enhancement measures should be done for local skill development.

(a) Training programs will be implemented prior to and during the construction phase because majority of the local people may not be adequately skilled to qualify for positions requiring skilled labor, if required.

(b) Local construction sub-contractors will be chose as first priority during tender process.

(c) Encourage construction contractors and sub-contractors to stimulate local skill development as part of tender requirement.

Impact Significance of Skill Development after Enhancement Measure

Components	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Local skill development	3	2	3	4	32	Moderate Significant (C)

(c) Potential to Growth of Local Economy and Businesses

During the stringing of transmission lines, there will be benefit for local economy if the required food and consumer goods for construction workers are bought from nearest villages. There will be potential to growth local business and enterprise if the developer will buy construction materials from local market and helping hand construction related services from local.

Impact Significance of Growth of Local Economy and Businesses without Enhancement Measures

Since the construction period is 5 years, the required food and consumer goods are bought from the nearest villages. According to the primary data collection, there are no construction contractors and business for construction materials in nearest villages. So, this kind of impact during construction period will be considered as very low for local people in nearest villages and low for local business without enhancement measures as follow:

Components	Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Growth of local economy	Growth of economy in nearest villages	Food and consumer goods for construction workers	3	2	3	3	24	Low Impact (U)
	Growth of business in nearest villages	Supply of construction services and materials	3	2	3	2	16	Low Impact (U)

Consideration of Enhancement Requirement for Local economy and businesses

The intensity of enhancement requirement for local economy and businesses according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Growth of economy in nearest villages	Low Impact (U)	No	Yes	Minor to Moderate	Construction Service Provider(s)
2.	Growth of business in nearest villages	Low Impact (U)	No	Yes	Minor to Moderate	Construction Service Provider(s)

Enhancement Measures for Growth of Local Economy and Businesses

Any food and consumer goods that can be bought in nearest villages should be preferred as first priority. Local business for food and consumer goods in nearest villages should boost by buying required things regularly. The project developer should encourage construction contractors and sub-contractors to stimulate the emergence of local small business as part of tender requirement. The project developer should establish a policy to encourage services and materials from local in relation to construction works. Any construction services and construction materials that can be available in nearest villages should be preferred as first priority if feasible and should encourage construction contractors and sub-contractors to stimulate the emergence of local small business as part of tender requirements. But after the construction period is over, the construction site should be restored as the normal condition and make sure there would be no permanent business left in the construction site.

Impact Significance of Local Economy and Businesses after Enhancement Measures

Impact significance can be raised by enhancement measures as follow:

Components	Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Growth of local economy	Growth of economy in nearest villages	Food and consumer goods for construction workers	4	2	3	4	36	Moderate Significant (C)
	Growth of business in nearest villages	Supply of construction services and materials	3	2	3	3	24	Low Impact (U)

As some parts of the places along the proposed project are just developing, the boost in local economy will have advantage for local people during construction period. The project developer should have policy to support local businesses, especially in nearest villages.

6.3.2.5.2. Negative Socio-economic Impacts

The negative socio-economic impacts during pre-construction phase will be blockage of drainage system due to the land filling at project site. The blockage of natural drainage system will increase potential to flood in nearest farm land. There will relocation or resettlement of local people because the project site is close to some places and some local people lived here. There can be traffic congestion due to vehicles during site clearing activities which can lead to blockage of village roads.

(a) Blockage of Drainage System and Natural Spring

According to the site survey, there will potential to blockage of natural drainage system, and natural spring due to the construction of traction substations. But the location of traction substations are away from rivers and springs based on the study of topography.

Any moderate to minor changes of existing components of water balance (inflows and outflows of the system) by pre-construction activities will have negatively influence especially on function and characteristic of waterways, drainage and sub watershed as proposed project is being located in low lying flat plain. Construction of road access will somehow interfere with flow pattern of creeks and thereof it has high potential to have waterways blockage.

Potential changes in hydrological regimes of creeks due to waterways blockages by proposed project activities will have negative impact not only on flowing characteristic along the longitudinal profile of creeks but also on surface water volume area of creeks. The monsoon period when agricultural work starts, degree of negative effect on drainage system of paddy field is expected to be low in terms of physical environment. Nevertheless, significance of negative impact will turn from low to high; if waterways blockage persists till the agricultural activities in nearest paddy fields has begun. Review on outcomes of public stake holder meetings and focus group discussion reveal that nearest villages is likely to have flooding effect resulting from existing creek is essential to be utilized as drainage facilities to discharge the harvested rain water from neighboring paddy fields in the rainy season and tidal wave period.

Significance of Impacts on Blockage of Drainage System during Construction Phase before Mitigation Measures

This kind of impact can be considered as moderate due to the possibility of flash flood in nearest farm lands as shown in the following figure.

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Potential to Blockage of drainage system	Earth filling	4	2	2	4	32	Moderate Significant (C)

Consideration of Mitigation Requirement for Blockage of Drainage System during Construction Phase

The intensity requirement of mitigation measures for Blockage of Drainage System according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Potential to Blockage of drainage system	Moderate Significant (C)	Yes	Yes	Moderate	Construction service provider(s)

Mitigation Measures for Blockage of Drainage System during Construction Phase

The developer will use alternative waterway (manmade drainage system that can drain the large water volume) to avoid potential to flood due to the blockage of natural drainage system during pre-construction phase. The alternative water way will prepare to flow the water volume more than natural drainage system to reduce potential to flood. It will also prepare for cross-pass over or under public roads and village roads and culverts for natural springs.

Significance of Impacts on Blockage of Drainage System during Construction Phase after Mitigation Measures

This kind of impact can be considered as low due to the possibility of flash flood in nearest farm lands as shown in the following figure.

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Potential to Blockage of drainage system	Earth filling	4	2	2	3	24	Low Impact (U)

(b) Impact on Agricultural Lands

Due to construction of temporary base camp for workers, there will be a need to temporarily use agricultural lands. Soil material from construction site can also enter agricultural lands close to power lines.

Significance of Impacts on Agricultural Lands during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Socio-economic situation of people	Temporary Land Use	3	2	2	3	21	Low Impact (U)
	Entering of soil materials	3	2	2	2	14	No Impact (-)

Consideration of Mitigation Requirement for Agricultural Lands during Construction Phase

The intensity requirement of mitigation measures for Agricultural Lands according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Temporary Land Use	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)
2.	Entering of soil materials	No Impact (-)	Yes	Yes	Moderate	Construction Service Provider(s)

Mitigation Measures for Agricultural Lands during Construction Phase

- Avoid or minimize construction through sensitive farmland;
- Use overhead bridges where feasible;
- Find resolutions for anticipated impacts for temporary land use (*e.g.*, payments to temporarily suspend farming activities or the installation of a temporary fence).
- Use single-pole structures instead of H-frame or other multiple-pole structures so that there is less interference with farm machinery, less land impacted, and weed encroachment issues
- Locate the line along fence lines, field lines, or adjacent to roads so as to minimize field impacts
- Use transmission structures with longer spans to clear fields
- Orient the structures with the plowing pattern to make farm equipment less difficult to use
- Minimizing the use of guy wires but where necessary, keeping the guy wires out of crop and hay lands and placing highly visible shield guards on the guy wires
- Using special transmission designs to span existing irrigation systems or if necessary, reconfiguring the irrigation system at the utilities expense.
- Learnt about individual farm field activities, such as planting, tillage, and crop rotations so that construction methods and timing can be adapted to the timing of crop work;
- Surplus soil material will be used in earth filling activities as much as possible. Waste dumping site will be away from agricultural lands, plantation over the waste dumping site as soon as possible.

Installing exclusion fencing to keep livestock away from construction activities, or markers to identify where construction is occurring, in consultation with the farmer, so that field activities and construction do not overlap;

Significance of Impacts on Agricultural Lands during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Socio-economic situation of people	Temporary Land Use	3	2	2	2	14	No Impact (-)
	Entering of soil materials	3	2	2	2	14	No Impact (-)

(c) Increased in Traffic Congestion

The construction activities may lead to increase in vehicular traffic. Road traffic congestion in surrounding area during construction period can cause public anxiety. It can also lead to temporary blockage of village roads. The routes existing are narrow, permanent roads; this condition will increase traffic while reducing easy access to different places within the community and increase in dust.

Significance of Impacts on Traffic Congestion during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Traffic congestion	Construction activities	3	2	2	3	21	Low Impact (U)

Consideration of Mitigation Requirement for Traffic Congestion during Construction Phase

The intensity requirement of mitigation measures for Traffic Congestion according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Blockage of village roads	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)

Mitigation Measures for Increased in Traffic Congestion during Construction Phase

- Use alternative road that will not pressure on public road.
- Avoid hauling of construction materials at local traffic time (7-10 am during weekdays and 4-7pm during weekends along Muse-Mandalay highway road) and hauling of heavy construction materials at night.

- Use temporary construction road that does not pressure on existing public road if feasible and does not impact on forest and agricultural lands.
- Proper traffic management plan and safety sign along the transportation road.

Significance of Impacts on Traffic Congestion during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Traffic congestion	Construction activities	3	2	2	2	14	No Impact (-)

(d) Damage to Public Road

Due to frequent transportation of construction materials, the public roads can be damaged.

Significance of Impacts on Public Road during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Public road damage	Frequent transportation of construction materials	2	2	2	3	18	Low Impact (U)

Consideration of Mitigation Requirement for Damage to Public Road

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Damage to public road	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)

Mitigation Measures for Damage to Public Road during Construction Phase

- Use bypass road instead of public roads.
- Use public roads and bridges as per their respective resistance if unavoidable.
- Repair the public roads if they are damaged by construction activities.

Significance of Damage to Public Road during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Public road damage	Construction activities	2	2	2	2	12	No Impact (-)

(e) Impacts from Influx of more workers and population

During the construction phase, there will be an inclusion of external workforce who will be employed in various positions of the project that cannot be filled by the locals. The existing work opportunities may also result to increased population due to the search for jobs that result to population expansion. This may create social tension and disruptions among the construction teams and pressure will be put on the existing utilities that operate in low capacity. The social impacts will continue into the Construction Phase with more workers, increased number of work locations, more frequent transportation of construction materials as additional workers are brought in to complete the work, the risk of social conflicts, risks of spread of communicable diseases, health and safety risks, waste generation and sewage and increased pressure on resources, are all expected to increase. There are very limited social services such as health care facilities, accommodation, and food along the railway alignment according to social survey. So, the pressure on social services will be high.

The increase of population during construction phase will increase temporary pressure on existing infrastructure and services including health care, food, shelter, water, transport and recreational facilities.

Significance of Impacts Associated with Population Influx without Mitigation Measures

As proposed project is very close to urban, there will have little impact on local health care facilities and local food consumption. Impact significances related to population influx during construction period will be considered as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Increase pressure on housing, recreational facilities, and water	Increase in population	2	2	2	3	18	Low Impact (U)
Increase pressure on health care facility	Increase in population	3	2	3	4	32	Moderate Significant (C)
Increase pressure on adequate amount of local food	Increase in population	2	2	2	3	18	Low Impact (U)

Consideration of Mitigation Requirement for Impacts of Population Influx

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Increase pressure on housing, recreational facilities, and water	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)
2.	Increase pressure on health care facility	Moderate Significant (C)	Yes	Yes	Moderate	Construction Service Provider(s)
3.	Increase pressure on adequate amount of local food	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)

Mitigation Measures for Impacts Associated with Population Influx

- Appoint local construction workers
- Raise awareness amongst construction workers about local traditions and practices.
- Inform local businesses about the expected influx of construction workers so that they could plan for extra demand.
- Ensure that the local community communicates their expectations of construction workers' behavior with the construction sub-contractor, and formalise a written agreement between the community and sub-contractor.
- Partnering with the municipality to offer utility and protective services
- Include social initiatives within the Community Development plan to promote cohesion
- Support own health care facilities to workers

Significance of Impacts Associated with Population Influx after Mitigation Measures

If own health care facilities should be provided for workers during construction phase, impact due to population influx will be very low after mitigation measures as follow:

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Increase pressure on housing, recreational facilities, and water	Increase in population	2	2	2	3	18	Low Impact (U)
Increase pressure on health care facility	Increase in population	3	2	3	3	24	Low Impact (U)
Increase pressure on adequate amount of local food	Increase in population	2	2	2	3	18	Low Impact (U)

(f) Conflict between Communities

The types of violent and aggressive conflict between non-Shan communities (foreign and migrant workers) and Shan Ethnic Minority were overwhelmingly perceived to be one-off incidents between individuals from different communities and exposures that were often fuelled by alcohol and anti-social behavior, and not always related to the migrant's ethnic origin. The sporadic and "one off" nature of these incidents were reported by all the communities – both migrant and local, across urban and rural communities alike.

A higher frequency of violence and abuse could probably be among ethnic minority groups especially Shan and non-Shan migrants in the project construction area, perpetrated by individuals from both immigrants and other ethnic minority groups. A significant conflict between individual communities could be a higher frequency of incidents of name-calling, spitting, hostile attitudes, damage to property and racially motivated violence against them. This would suggest that the dynamics of race and religion negatively influence the sort of reception that the communities receive. The another significant social problems between communities may be the hostile attitudes of non-Shan migrants to local community such as sexual harassment of migrant workers to ethnic local women and hostility of that workers to low skilled local labors.

The increased population may also result to rising crime cases and social exploitation; employees from other areas may face integration challenges. An inflow of construction workers and job seekers may also be accompanied by an increase in crime. Even if specific instances of crime are not as a result of the newcomers, they may still be ascribed to them by local communities.

Significance of Impacts on conflict between communities during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Conflict between non-Shan communities and Shan community	Influx of construction workers	3	2	3	3	24	Low Impact (U)

Consideration of Mitigation Requirement for Conflict between communities during Construction Phase

The intensity requirement of mitigation measures for Land Acquisition according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Conflict between non-Shan communities and Shan community	Low Impact (U)	No	Yes	Moderate	Construction Service Provider(s)

Mitigation Measures for Conflict between Communities during Construction Phase

- Use local people as much as possible.
- Limit night out for foreign workers.
- Limit the use of foreign workers.
- When making an agreement contract with contractors and subcontractors, it must include the fact that they have to use local workers as much as possible.
- Raise awareness to respect custom of local people for foreign and migrant workers.
- Construction workers will be clearly identifiable. Overalls will have the logo of the construction company on it and construction workers will wear identification cards.
- Construction site to be fenced and access to be controlled;
- Loitering of outsiders at either the construction side or at the construction village will not be allowed.

Significance of Impacts on conflict between communities during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Conflict between non-Shan communities and Shan community	Influx of construction workers	3	2	3	2	16	Low Impact (U)

(g) Livelihood and Economic Activity

During construction stage, disruption of the livelihood and economic activities of businesses which are located along the route is expected. These businesses will get hampered because of traffic congestion, inability to park vehicles, and temporary loss and/or impedance of access to such business premises. The partially affected structures may have space to rebuild in the same land but, the fully affected structures must be relocated elsewhere. There are employees working in these commercial places. When the structures are partially affected, there will be temporary impact on the businesses and the employees may lose income temporarily. However, if the commercial places are fully affected and if they need to be relocated elsewhere, there can be permanent impact. The income of employees working in these commercial places will also be affected. They may have to find other jobs or will have to face difficulties until the businesses are re-established. There will also be an impact on paddy lands where Depot is proposed and paddy land owners and tenant farmers may permanently lose their livelihood. The Project may also impact people whose livelihood is linked with existing modes of transportation due to inaccessible roads and/or worsened traffic conditions.

Significant of Impacts on Livelihood and Economic Activity before mitigation measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Livelihood and economic	temporary loss and/or impedance of access to such business premises	3	2	2	4	28	Low Impact (U)

Consideration of Mitigation Requirement for Livelihood and Economic Activity

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Livelihood and activity	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measure

The proposed project has significant impact on livelihood and economic activities of commercial property owners, residential property owners and paddy land owners. Special attention will be paid to these affected people to mitigate the impacts on them. Compensation will be paid to the affected parties according to the stipulations of the Land Acquisition Act (LAA) and Land Acquisition and Resettlement Committee (LARC). Payments for loss of business (temporary or permanent), loss of livelihood, loss of wages employment will be provided to affected parties, as compensation. Further, there are stipulations in the LARC on an ex-gratia payment for paddy lands to be acquired. The livelihood of the persons occupying in business premises and residences will be temporarily disturbed by the construction of the proposed project and following mitigation measures in summary will be implemented.

- Provision of compensation to the Project Affected Parties (PAPs) using the compensation
- Package decided for proposed project based on LARC (Land Acquisition and Resettlement Committee) stipulations on assessing the financial and other losses of PAPs.
- Provision of alternative access to their premises as far as possible outside the construction sites to carry out their usual business activities and other domestic or related employment activities.
- Continual liaising with the Project Affected Parties (PAPs) will be undertaken to decide on the site-specific mitigation measures.
- Consultation with people whose livelihood depend on modes of transportation that may be affected by the project. They will be included in the development of the traffic management plan.

Significant of Impacts on Livelihood and Economic Activity after mitigation measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Livelihood and economic	temporary loss and/or impedance of access to such business premises	3	2	2	3	21	Low Impact (U)

Residual Impacts on Socio-economic during Construction Phase

The impact on livelihood and economic of the community is still be residual because the commercial places are fully affected and need to be relocated somewhere else and so the income will be affected. This also impact people whose livelihood is linked with existing modes of transportation. The permanent land loss will cause effects on the agricultural activity.

Mitigation Measures for Residual Impacts on Socio-economic

Land loss is not sufficiently large to result in a material effect through diminishing the quality of life as replacement could be made in locality or be compensated for. Payments for loss of business (temporary or permanent), loss of livelihood, loss of wages employment will be provided to affected parties, as compensation.

6.3.2.6. Anticipated Impacts of Utility Consumption in Power Substation and Lines Construction

(a) Water Usage

The use of water in construction sites for human needs is basically related to the essential demands of employees of the construction site and these are preserved in accordance with the labor laws. The common area, because it exists throughout the entire construction process, is responsible for significant portion of the water consumption of the whole construction work, and should receive special attention in relation to the efficiency of this feature for this purpose. The usage of water for construction site can lead to water scarcity problems. According to the social survey, Shan state is already facing water scarcity problems, so, the impact will be significant.

During construction, water is a resource that comprises several activities in a construction site. Its form of use varies according to the operations performed throughout along the construction stages. However, water is not seen or treated as a material of Civil Construction. This situation can be observed in compositions of costs of engineering services that do not include the water as an input of current activities. Some of the activities that use water are compression of landfill, manufacture of concrete, mortar, curing of concrete, testing for waterproofing, latex painting and cleaning. Several activities go on at construction sites that make use of water: mixing of concrete, wetting of dry surfaces, washing of equipment etc.

Significance of Impacts for Water Usage during Construction Phase before Construction Phase

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Water Scarcity	Usage of water for construction activities	3	2	2	3	21	Low Impact (U)

Consideration of Mitigation Requirement for Water Usage during Construction Phase

The intensity of mitigation requirement for water usage according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Water Scarcity	Low Impact (U)	Yes	Yes	Moderate	Construction Service Provider(s)

Mitigation Measures for Water Usage during Construction Phase

- Covering structure after substation construction with jute bag or sheet of plastic, so that evaporation loss may be less and if water sprinkle will not get evaporated, drainage should be proper so that water collected in pit may be used again for construction work.
- To reduce water wastage during mixing of construction materials, proper equipment should be used such as mixers with which only the required volume of water is used.
- To reduce wastage and recycling at construction sites, washing and cleaning of equipment should be done in a reservoir.
- Water storage and delivery facilities should be safe and leakage free to reduce water wastage.
- Using curing compound agent which is a material used for curing concrete instead of water.
- MR should take responsibility for the shortage of groundwater to the affected area (the nearest villages) by digging the new deep wells, tube wells and supporting water requirement to those areas if they suffer the shortage of groundwater.

Significance of Impacts for Water Usage during Construction Phase after Mitigation

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Water Scarcity	Usage of water for construction activities	3	2	2	2	14	No Impact (-)

(b) Fuel Consumption

Construction operations consume huge amounts of energy in various forms but have never been sufficiently accounted for. A significant portion of energy utilization on construction site is usually used for transportation, levelling, earthworks, lifting, compacting and mixing, including the embodied energy in materials extraction. However, electricity cannot be directly used from existing power lines since the construction process takes place where there is no electricity and generators will be mainly used as the source of energy.

The different forms of energy are used for different purposes in the construction process. For instance, diesel fuel is an important petroleum product and offers a wide range of performance, efficiency and safety features. It also offers a greater power density than other fuels, and contains between 18% and 30% more energy per litre compared to petrol. Petrol is also in used construction processes and is used for powering small petrol engines especially power tools, such as hammers and small compressors.

Electricity is used for the operation of almost all the power tools or equipment on site. Fused distribution boards are used to enable easy plugging of power tools to the electrical source.

In the substation construction, the excavating processes include both surface and deep excavation of soil and often involve the movement of excavated soil from one place to another. The machines used in this process are divided into two; excavators (such as backhoes and pile driving machines) and tractors (bulldozer). Concreting processes require a significant amount of energy. The machines used in this process are; mixers, concrete pumps, placers, vibrators and conveyors and are either mechanically or pneumatically operated. Concreting and the type of equipment used have a large embodied energy in the ingredients used and the transportation process.

Significance of Impacts for Fuel Consumption during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Fuel consumption	Use of generators for construction activities	4	2	2	4	32	Moderate Significant (C)

Consideration of Mitigation Requirement for Fuel Consumption during Construction Phase

The intensity of mitigation requirement for fuel consumption according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact on Fuel Consumption	Moderate Significant (C)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Fuel Consumption during Construction Phase

- Make minimal usage of fuel such as diesel and petrol that are used in operating machines for construction processes and transportation processes.
- Use construction machines efficiently.
- Train workers to gain the knowledge of energy conservation.
- Learn the efficient construction site management.

- Record and reduce electricity usage across the construction period.
- Turning off the equipment when it is not in use.

Significance of Impacts for Fuel Consumption during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Fuel consumption	Use of generators for construction activities	4	2	2	3	24	Low Impact (U)

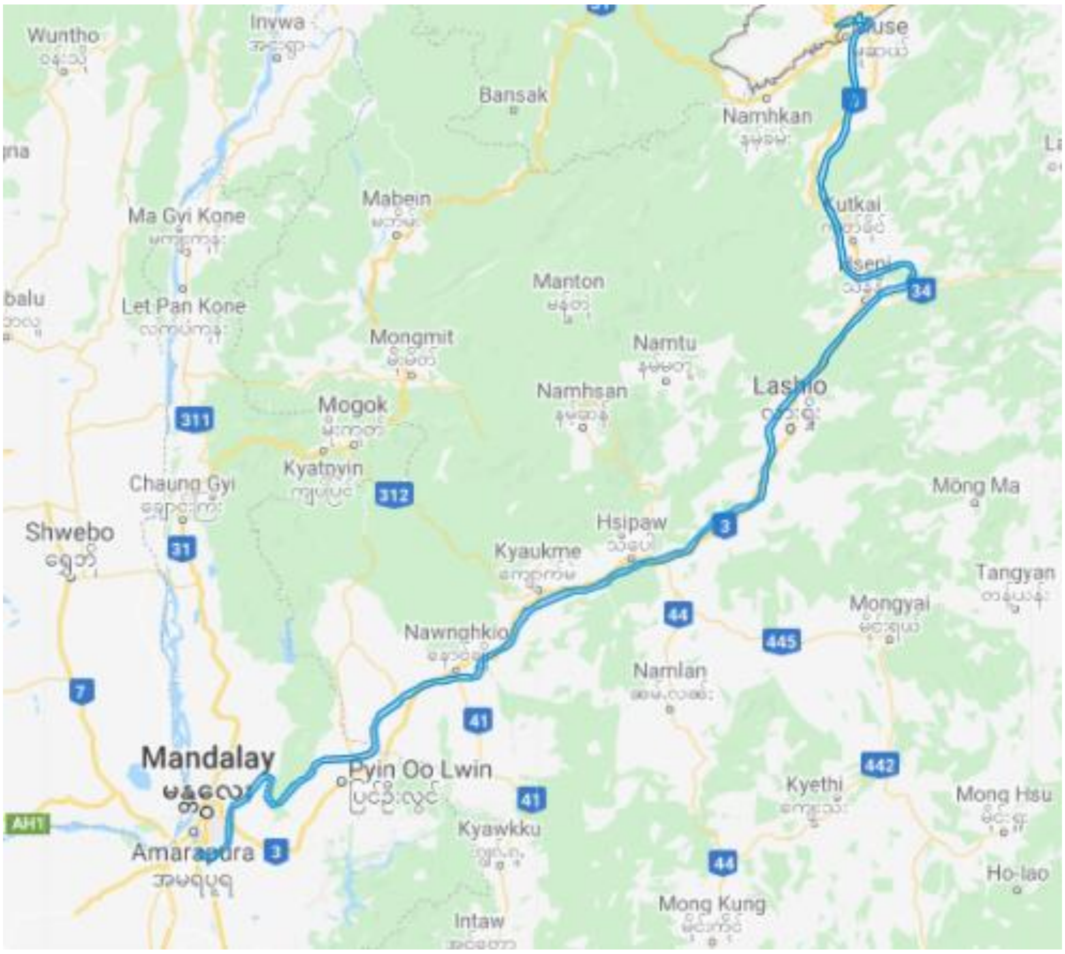
(c) The Effect of Transmission Line on Local Service

A transmission tower, also known as a power transmission tower, power tower, or electricity pylon, is a tall structure (usually a steel lattice tower) used to support an overhead power line. Transmission towers have to carry the heavy transmission conductors at a sufficient safe height from the ground. In addition to that, all towers have to sustain all kinds of natural calamities. During the detailed engineering design, the final location of the overhead electrical lines will be evaluated to avoid impacts on utility services such as sewerage, power supply, water supply and telephone.

<table>
<tr><td rowspan="2">The Minimum depth of electrical line tower from the ground</td><td rowspan="2">3 feet</td><td>The Minimum depth of the sewage line</td><td>5 feet</td><td>The alignment of the transmission line will probably affect a section of the sewer line leading to the wastewater treatment plant. Therefore, these tower locations can be realigned to avoid the sewer line.</td></tr>
<tr><td>The optimum depth of water supply pipeline (for 8-in or smaller)</td><td>3 feet</td><td>The construction of switching and transforming stations permanently occupies certain areas and jeopardizes the soil and groundwater through the potential leakage of coolants and insulants (mineral oil or other liquids possibly containing toxic polychlorinated biphenyls - PCB) in large quantities from such components as transformers, capacitors, ground-fault neutralizers and underground cables.</td></tr>
</table>

The height of the railway electrical overhead line	Around 17.39 feet above the ground	The minimum height of the telephone line	14 feet above the ground	There are also distribution lines and telephone lines that should be protected during construction phase carefully.

Electrical hazards include infringement of the load into other electrical lines during lifting of a structure (people are unable to accurately judge clearance distances of a suspended load to power lines) and shocking of a construction worker due to electrical induction onto a piece of a structure that is insulated from the ground by assembly on wooden blocks.



In case of towering the overhead lines, there is no serious negative impact to utility services which situated along the railway line. Because the optimum depth of the foundation of the overhead lines is not more than the minimum depths of water supply pipelines and sewage lines. Therefore, the location of overhead lines can be realigned to avoid the sewer lines and to protect the telephone line safely.

Significance of Impacts due to Transmission Line during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Electrical hazard	Transmission lines	2	2	4	3	24	Low Impact (U)

Consideration of Mitigation Requirement for Impact due to Transmission Line during Construction Phase

The intensity of mitigation requirement for energy consumption according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Electrical hazard	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Impact due to Power Transmission Line during Construction Phase

- Realign tower locations to avoid the sewer line.
- Avoid leakage of coolants and insulants.

Significance of Impacts for due to Electrical Tower during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Electrical hazard	Transmission lines	2	2	4	2	16	Low Impact (U)

(d) Anticipated Impacts on Archaeology and Cultural Heritage during Construction Phase

Construction of the proposed power station and transmission lines has the potential to disturb, damage or destroys features or buried remains of cultural heritage interest. Other construction activities, such as vehicle movements, soil and overburden storage and landscaping also have the potential to cause direct permanent and irreversible effects on the cultural heritage.

There are a few religious and cultural sites within the project area but it is expected that there will be no impact on Cultural and Religious sites because during design stage extra care was taken to ensure that religious structures/public property were avoided. No Transmission towers are located adjacent to such sites and the Transmission line will not in any way or manner hinder any religious or cultural practices. Moreover, the depth of transmission line will be narrow.

Significance of Impact on Archaeology and Cultural Heritage during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Damage to cultural heritage interest	Construction activities	2	2	2	2	12	No Impact (-)

Consideration of Mitigation Requirement for Archaeology and Cultural Heritage

The intensity of mitigation requirement for Archaeology and Cultural Heritage according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Damage buried remains of cultural heritage interest	No Impact (-)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Impacts on Archeology and Cultural Heritage

Mitigation measures designed to prevent, reduce or offset any potential direct adverse effects will be identified. Where artifacts of historic interest in relation to the project's previous use are identified they may be incorporated into the proposed development, avoided through design and preserved in situ unaffected by the proposed development, or recorded prior to their removal.

Environmental Team is to determine the need for and scope of a potential mitigation strategy. Potential mitigation may include a programme of archaeological works designed to identify, characterize and record buried archaeological remains. In the event of any discoveries, further mitigation through recording and publication of the results of any excavations may be required in line with the requirements of planning policy. Substations and transmission lines should be kept away from the historical and archeological sites.

(e) Visual Impacts during Construction Phase

Since the proposed project site is very close to the popular tourist attraction place: Pyin Oo Lwin, Thi Paw and other tourist attraction places along the railway line, gases pipeline, and some local community depends on the tourism business, the visual pollutants like construction materials and equipment impact on their visualization. Visual intrusions arise from the inevitable presence of construction equipment, materials, transport vehicles, and piles of soil and debris as a result of clearing, site work, and heavy equipment and vehicles on the road. If the storage, transportation and disposal of these waste materials are not managed properly, the waste will decrease visual amenity.

During construction, there will be short term landscape and visual impacts arising from the presence of plant and activities on the site. These could include:

- vegetation removal and site clearance;
- the installation of a large construction compound;
- the movement and activity of large construction machinery, usually with flashing hazard lights;
- views of cranes, if used;
- the construction/excavation of new power stations and RoW, particularly noticeable because of the speed of the changes over a short time scale, and the extent of bare earth visible;
- the presence of temporary spoil heaps and disposal areas;
- temporary traffic management and any local public right of way diversions; and
- floodlighting of areas for evening and morning working.

Significance of Visual impact during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Landscape and visual impacts	Presence of construction equipment, materials, transport vehicles, and piles of soil and debris	3	2	2	3	21	Low Impact (U)

Consideration of Mitigation Requirement for Visual Impacts

The intensity of mitigation requirement for Visual impacts according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Landscape and visual impacts	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Visual Impact

- The transmission line will be developed in linear sections, as separate phases of work, to keep all construction activity in one place and to reduce the visual impact on residents and road users during the construction phase;
- Materials and machinery will be stored tidily during the works. Tall machinery will not be left in place for longer than required for construction purposes, in order to minimize its impact in views;
- The construction area of the site will be fenced. Construction vehicles will only be allowed to use designated routes;
- Roads providing access to the site will be maintained free of dust and mud;
- The contractor's facilities and the laydown areas will be located to cause as little visual intrusion as possible; and
- On completion of construction, all remaining construction materials will be removed from the site. Any remaining spoil heaps will be graded to match existing contours.
- Routes for transmission lines will be avoided the areas considered scenic.
- Select the suitable colour for construction material.
- Proper ROW management system

Significance of Visual impact during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Landscape and visual impacts	Presence of construction equipment, materials, transport vehicles, and piles of soil and debris	3	2	2	2	14	No Impact (-)

Residual Visual Impact during Construction Phase

The main source of visual impact during the construction phase is visual pollutants lie construction materials and equipment. So there would be no residual impact on visual after conducting the mitigation measures.

(f) Community Health Impact during Construction Phase

During construction phase, the anticipated health related impacts are as follows:

(i) Increase Infection of Air-borne Diseases

An influx of construction workers from other places can lead to overcrowded conditions where air-borne diseases such as tuberculosis, influenza and meningitis can spread easily.

Impact Significance for Increase Infection of Air-borne Diseases before Mitigation Measures

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)	-	-
Construction workers	-	√	-	-	√	-	-	√ (HIR 2)	-

Mitigation Measures for Infection of Air Borne Diseases

This potential impact will be minimized by providing medical check for workers who are susceptible infection of air-borne diseases.

(ii) Fugitive Dust Emissions

Dust Generation during construction phase will be mainly resulted in nuisance impacts. Dust emissions as a result of the construction activities will include emissions from on-site heavy-duty off-road vehicles, other light-duty vehicles. Particulate matter (PMs) were released from transportation of construction materials and construction activities such as during excavation, movement of earth materials, unloading and mixing of construction materials, contact of construction machinery with bare soil, traffic movement on unpaved roads, transport of demolition waste, and exposure of bare soil and soil piles to wind. Short-term impacts will be experienced by pedestrians passing near the project site and local residents nearby.

Impact Significance for Fugitive Dust Emissions before Mitigation Measures

The impact will be little on local people in nearest villages.

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)	-	-

Mitigation Measures for Fugitive Dust Emission

Dust can be controlled by:

(a) Wetting of roads by water spraying;
(b) Seeding storage mound surfaces as soon as is practicable;
(c) Spraying exposed surfaces of mounds regularly;
(d) Restricting vehicle speeds;
(e) Watering roadways; and
(f) Wheel or body washing.

(iii) Increase Infection of Water Borne Diseases

Project activities could become sources of pollution, as a result of infiltration into the surface stream. The incidence rate of water borne diseases such as cholera and diarrhea will increase if there will be no proper sanitation practices at the construction site. Improper waste disposal of construction debris will also have potential to increase water borne diseases because the project site is very close to surface water resources. The possible negative impacts considered significant are:

- Loose soil from earthworks may be washed into river.
- Irresponsible dumping of domestic solid waste can lead to underground water contamination, due to contaminants emanating from various products into the groundwater and filtering through to the aquifers. This will be a particular problem during the rainy season.
- Potential surface water pollution can emanate from waste products generated by construction activities entering the surface drainage.

Impact Significance for Increase Infection of Water Borne Diseases before Mitigation Measures

According to the secondary data collection, infections of water borne diseases such as diarrhea are still the public healthcare problems in Upper Myanmar Region and so the impact will be considered as follow:

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	√	-	-	√ (HIR 1)	-	-

Mitigation Measures for Increase Infection of Water Borne Diseases

Avoid construction time during rainy seasons. If it is not possible to avoid rainy seasons, proper sanitation system will be provided for construction workers during construction period. Construction debris will be disposed at suitable location that does not impact on local nearest rivers. Construction activities will ensure that no loose soil is permitted into watercourses and stockpiles are located away from surface water. All mixing of cement will be carried out in a designated area away from surface water and areas of potential runoff. All areas of fuel storage will be banned to prevent hydrocarbon pollution of surface water.

(iv) Potential to Increase Infections from Mosquito

Stagnant pools of water during the construction phase will cause bleeding zone for mosquitoes and can cause potential to cause infections from mosquitoes especially in rainy season.

Impact Significance of Increased Infections from Mosquito before Mitigation Measures

The impact can be rated as medium because malaria is still a health problem in Upper Myanmar Region.

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	√	-	-	√ (HIR 1)	-	-

Mitigation Measures for Infections from Mosquito

Avoid construction time in rainy seasons as much as possible. Ensure that there are no stagnant pools of water during the construction phase. Proper temporary or permanent drainage system will be compensated if there will be the blocked of natural drainage system during construction phase.

(v) Increased Risk of Sexually Transmitted Infections

During construction phase, the improved economic status of the area and the influx of new migrant workers, living away from their families, can also lead to an increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia. Major outbreaks of infectious diseases can have a devastating effect not only on or near the project site but also on local communities.

Impact Significance of Increased Risk of Sexually Transmitted Infections before Mitigation Measures

Impact rating for sexually transmitted infection (448 people in Upper Myanmar Region in 2017) can be considered as moderate in Upper Myanmar Region.

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
Local people in Region	-	√	-	-	√	-	-	√ (HIR 2)	-

Mitigation Measures for Increased Risk of Sexually Transmitted Infections

MR will provide information and education about safe sex and implement HIV control program for migrant construction workers.

(vi) Health Impact Related to Increase in Noise Level

Construction activities normally generate a lot of noise. Noises will also arise from various construction machineries at site. Pilling operation will also produce high noise level. Both acute loud noise and chronic lower level noise have been associated with a variety of negative health effects. Hearing loss and impairment are known to occur as a result of exposure to acute, high decibel noise (greater than 85 dB). Noise annoyance can lead to stress related impacts on health such as feelings of displeasure, interference with thoughts, feelings, and activities and disturbed sleep and can have impacts on mood, performance, fatigue, and cognition.

Impact Significance of Increase in Noise Level before Mitigation Measures

The impact will be considered as low for local people due to the distance of nearest villages and medium to construction workers inside the construction site as follow:

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)		-

Mitigation Measures Health Impact Related to Increase in Noise Level

1. Reduce speed limits for trucks in the project area to reduce noise level.
2. Alert residents of anticipated noise, including time, duration, decibel levels, and machinery to be used to protect public health.
3. Avoid working at night.

(vii) Impacts due to Stringing Activities during Construction Phase

Stringing activity around the wires and other electrical units can be a potential hazard if proper planning is not followed. The assumption that local workers at times are not accustomed to using personal protective equipment (PPE) will be taken in consideration, i.e. their attitude to avoid PPE may result in accident/hazard.

As part of the project will be developed outside the existing corridor, demining hasn't happened yet for the full route. Construction activities will increase the potential interaction between communities and existing land mines. If not mitigated, both the demining activities and the land mines not deactivated but lifted to the surface during earthworks, can negatively impact the populations.

During operation, there is a possibility of lines or towers / parts of the tower failing and causing injuries and/or fatalities. Additionally, during the operation phase, contact with the transmission line can result in electrocution.

Embedded Controls

The following embedded controls are considered as part of the assessment:

- EPC Contractor team will follow the method statement for overhead stringing; the activities will be managed by experienced Supervisors.
- Implementation of design standards (built in safety), the line hardware used on the overhead transmission lines is rated or designed higher than the conductor ultimate tensile strength and the conductor is only pulled to 20% of its ultimate tensile strength.

The potential impacts are all considered unlikely in that they are not likely to occur during the lifetime of the Project.

This is considered a negative event that could lead to permanent impacts if there are injuries and fatalities. The overall impact is considered of Moderate significance.

Transmission line snapping

The negative impact is a direct impact, which while regional in its extent, could lead to permanent impacts and therefore has a large magnitude. The risk is influenced by poor foundation quality, tower member theft, material corrosion due to poor coating and poor quality or damaged fittings exposing the system to failure. The receptor sensitivity is considered high as there are households and businesses within the transmission line RoWs in the areas close to urban area. This is therefore considered as a Major significant impact, which is unlikely to occur during the lifetime of the Project.

In the rural areas, due to the fact that the transmission line routing was mostly designed far from the existing communities the receptor sensitivity is considered low but with medium significance.

Significance of Impacts on Stringing Activities during Construction Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Risks during Stringing Activities	embedded controls	3	2	2	4	28	Low Impact (U)
	transmission line snapping	3	2	2	4	28	Low Impact (U)

Consideration of Mitigation Requirement for Impacts due to Stringing Activities during Construction Phase

The intensity of mitigation requirement for Impacts due to Stringing Activities according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	embedded controls	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)
2.	transmission line snapping	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Stringing Activities

The following mitigation measures will be employed to reduce any impacts resulting from a potential unplanned event:

- Stringing activities near wires and other electrical utilities will be done after proper shutdown of the line/utilities with prior information and permission.

- Implementation of a demining campaign as per the Angolan legal framework, aligning with the demining contractor a set of control measures (e.g. safety perimeter, safety distances to maintain, equipment, tools, etc.) following the ISO9001:2008 standard.
- Making sure that temporary soil stock piles are safely stored, with controlled access.
- An Emergency Prevention and Response Plan (EPRP) will be developed according to Angolan requirements and international industry standards and best practices.
- The EPRP will be developed in consultation with the competent authorities, emergency service / civil defense and administrations along the transmission routes and around the substations.
- Based on consultations with relevant stakeholders, project proponent will investigate the capacity of statutory local emergency response providers to participate in emergency response activities.
- Personnel will be trained on how to respond to unplanned events.
- Periodic audits will be performed in order to ensure the safeguards are in place.
- Risks to general public during operation will be reduced by public awareness and education and physical measures by attaching an appropriate warning sign on all faces of the tower.
- Once the stringing work is complete, notices and permanent anti-climbing devices will be installed on the tower (in particular in lattice towers). The operational start date for electricity transmission and safety implications will be publicized locally in advance.
- In addition, the risk of the transmission line spanning or pylon collapse can be mitigated through complying with design specifications, installing antitheft devices, conducting material quality inspection and compliance and following project proponent's installation procedures.
- Project proponent will development and implement of a Demining Plan. This Plan will be communicated to the communities in the direct AOI of the project. Demining will occur along a 60m corridor along the transmission line route (as well as for any additional footprint of access roads and construction camps.

Significance of Impacts on Stringing Activities during Construction Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Risks during Stringing Activities	embedded controls	2	2	2	3	18	Low Impact (U)
	transmission line snapping	2	2	2	3	18	Low Impact (U)

Residual Impact

A residual risk of non-routine events occurring is inherent to the nature of the Project type and is likely to remain so. Provided the above mitigation measures are implemented the residual risk related to unplanned events is considered to be Minor (stringing, unplanned spillages and fires, and risk due to transmission line snapping/collapse). Demining the transmission line corridor and project footprint will result in a positive residual impact as well (as this removes this associated risk for any future developments on the land).

6.3.3. Anticipated Impacts during Operation and Maintenance Phase

The main activities which will be done in operation phase are maintenance and clearing of transmission line, maintenance and painting of substations and transformers. The affected area of the railway alignment will include the affected area of transmission lines because transmission lines will exist 15ft away from the railway alignment on each side. So, some impacts due to construction of transmission lines will not be included in this section. The main impacts considered in this phase include:

1. Impact on Air Environment
2. Impact on Surface Water Environment
3. Impact on Soil and Groundwater Environment
4. Impact on Biodiversity Environment
5. Impact on Human Environment

6.3.3.1. Anticipated Impact on Air Environment during Operation Phase

(a) Gaseous Emission and Noise

Gaseous emission due to the production of required electrical power by auxiliary generator during power outage can disturb ambient air quality. Moreover, some noise from traction substation and auxiliary diesel generator will also impact on residents nearby.

Significance of impact for Impact on Air Environment during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Gaseous Emission and Noise	Axillary Generator	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Intermittent (-2)	Probable (-3)	Low (-40)

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Gaseous Emission and Noise	Axillary Generator	2	4	2	3	24	Low Impact (U)

Consideration of Mitigation Requirement for Air Environment

The intensity of mitigation requirement for Air Environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Gaseous Emission and Noise	Low (-40)	Yes	Yes	Minor	Operators

Mitigation Measures for Impacts on Air Environmental

- Use generator with good engine condition
- Regular maintenance of generator
- Use low noise traction substation transformer

Significance of impact for Impact on Air Environment during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Gaseous Emission and Noise	Axillary Generator	2	4	2	2	16	Low Impact (U)

Residual impact on Air Environment during Operation Phase

After proper mitigation measures, the significance level will remain Very Low. So, there will be no residual impact.

Maintenance of Transmission lines and Traction Substations

The main activities included in maintenance of transmission lines and traction substations are:

- Spot painting of rusted steel
- Repairing cracked or spalled concrete of traction substations

6.3.3.2. Anticipated Impact on Surface Water Environment during Operation/ Maintenance Phase

Main sources which can impact surface water include the following:

1. Wastewater used by workers during operation phase
2. Oil and grease through light-maintenance activities of power stations
3. Paint residue for maintenance of power supply stations

But it is very unlikely to impact surface water due to oil, grease and paint residue unless maintenance activities are carried out in the rainy season.

Significance of impact for Impact on Surface Water Environment during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Surface water quality	Wastewater, oil, grease and paint	2	4	1	3	21	Low Impact (U)

Consideration of Mitigation Requirement for Surface Water Environment

The intensity of mitigation requirement for Surface Water Environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Surface water quality	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures for Surface Water Environment

- Proper treatment of waste water by installation of oil-water separator
- Training workers on appropriate handling of oil and lubricants
- Paint residues will be properly collected and disposed
- Training workers on appropriate handling of paint residues
- Proper disposal of waste according to local CDC’s instruction
- Use the zinc-based paint instead of lead-based paint
- Provide purification system for the in accidental

Significance of impact for Impact on Surface Water Environment during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Surface water quality	Wastewater, oil, grease and paint	2	4	1	2	14	No Impact (-)

Residual impact on Surface Water Environment during Operation Phase

After proper mitigation measures, the significance level will remain Very Low. So, there will be no residual impact.

6.3.3.3. Anticipated Impact on Soil and Ground Water Environment during Operation/ Maintenance Phase

Leakage of oil & grease, and paint residues during power station and transmission line maintenance may impact soil contamination.

Significance of impact for Impact on Soil and Ground Water Environment during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Soil and Groundwater quality	Leakage of oil, grease and paint	2	4	1	3	21	Low Impact (U)

Consideration of Mitigation Requirement for Impact on Soil and Groundwater Environment during Operation Phase

The intensity of mitigation requirement for Impact on Soil and Groundwater Environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Soil and Groundwater quality	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures for Impacts on Soil and Ground Water Environment

The impact on soil and groundwater quality can be mitigated by the following:

- Use zinc-based paint instead of lead-based paint
- Proper control and avoid leakage of oil or paint

Significance of impact for Impact on Soil and Ground Water Environment during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Soil and Groundwater quality	Leakage of oil, grease and paint	2	4	1	2	14	No Impact (-)

Residual impact on Soil and Groundwater Environment during Operation Phase

After proper mitigation measures, the significance level will remain Very Low. So, there will be no residual impact.

6.3.3.4. Anticipated Impact on Biodiversity Environment during Operation Phase

(a) Flora Diversity

The operational phase of the project will have limited impact on the surrounding vegetation once the plants are allowed to re-establish themselves in any remaining areas; thus the overall intensity will remain be Very Low as the species assemblages will have altered from natural. It is also anticipated that the grazing and agricultural pressure on the vegetation will also continue but will be equitable to the present state and thus similar to the No-Go option.

Some plants can suffer leaf damage if the electric field is high enough, which causes the tips of the leaves to dry out and can reduce growth.

For this to happen, the leaves have to be sharp and pointy rather than round, and normally have to be on trees, etc., to raise the height nearer to the power line. Crops at ground level would normally not be in high enough fields to impact because the intensity is very mild.

Crop	Setting of Study	Authors	Finding
Sunflower seed	5kV/m electric Field	Marino et al, 1983	Reduced germination rates in a minority of the tests
Corn	500 kV power line	Hilson et al, 1983	Lower yields, but explanation not clear (suggested that it could reflect less spraying near power line)
Cotton, soy, beans, clover	500 kV power line	Hilson et al. 1983	No effects
Various	765 kV power line	Multiple reports	No effects
Various	1200 kV power line	Multi reports	No effects
Wheat	7.7 kV power line	Endo et al, 1979	No effects
Pasture grass	1200 kV power line	Rogers et al, 1983	No effects
Wheat and conr	380 kV power line	Soja et al, 20003	No effect for corn, 7% non-significant reduction for wheat

Sources : EMFs

Significance of impact for Impact on Flora Diversity during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on Flora diversity	EMF	2	4	1	3	21	Low Impact (U)

Consideration of Mitigation Requirement for Impact on Flora Diversity during Operation Phase

The intensity of mitigation requirement for Impact on Flora Diversity Environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact on Flora diversity	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures

1. To reduce EMF, copper or brass will be used for electromagnetic shielding.

There are two basic 60-Hz magnetic field mitigation (reduction) methods: passive and active.

- Passive magnetic field mitigation includes rigid magnetic shielding with ferromagnetic and highly conductive materials, and the use of passive shield wires installed near transmission lines that generate opposing cancellation fields from electromagnetic induction.
- Active magnetic field mitigation uses electronic feedback to sense a varying 60-Hz magnetic field, then generates a proportionally opposing (nulling) cancellation field within a defined area (room or building) surrmmded by cancellation coils. Ideally, when the two opposing 180-degree out- of-phase magnetic fields of equal magnitude intersect, the resultant magnetic field is completely cancelled (nullified). This teclmology has been successfully applied in both residential and commercial environments to mitigate magnetic fields from overhead transmission and distribution lines, and tmderground residential distribution (URD) lines.

2. Providing Right of Way(R.O.W)

Overhead transmission systems required strips of land to be designed as right-of-ways (R.O.W). These strips of land are usually evaluated to decrease the effects of the energized line including magnetic and electric field effects.

Significance of impact for Impact on Flora Diversity during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on Flora diversity	EMF	2	4	1	2	14	No Impact (-)

(b) Fauna Diversity

The physical presence of transmission lines can have an effect on wildlife. These potential effects include long-term changes to habitat, impacts on herpetofauna, avian (bird and bat) strikes , noise effects , electric and magnetic fields, and electrocution

Long-Term Changes to habitat

Changes to habitat composition will also change habitat quality for plants and animals which can have a positive, negative or neutral effect depending on the species. Habitat fragmentation refers to plant communities that have become divided or isolated. Individual transmission line projects may fragment the landscape by dividing large blocks of forested habitat into smaller blocks which can result in a decline in species within the remaining forests. When a woodland animal, which require large tracts of relatively undisturbed habitat may also be negatively affected by any habbirditat fragmentation effects caused by transmission line rights-of-way. Building utility substations and transmission lines causes ecosystem fragmentation and disrupts the movement of wildlife. Animals may avoid power lines because of the UV light they emit or because the open corridors leave them exposed to predators. While some animals prefer to avoid power lines due to the flashes of UV light they perceive, others seem to be drawn to them. A power line looks like a perfect perch to a flock of birds. To a squirrel, a utility pole serves as an easy access point to get to your roof or attic. Other pests like opossums and rats may take advantage of utility poles and power lines, just as they would use a natural structure in their environment.

Impacts on Herpetofauna

Among vertebrates, amphibians are one of the groups most affected by linear infrastructures. Their dependence on aquatic habitats and seasonal migrations make amphibians particularly vulnerable to the negative impacts of these structures. In studies that show that reptiles ignore railway disturbances. Railway embankments can provide important novel habitats for reptiles, mainly in highly human-altered landscapes. Species of frogs , snakes and lizards are included in herpetofauna .

Avian Strikes

Bird mortality from collisions with lines or electrocution is biologically significant when it results in a measurable change, for example in population size. The effect of bird strike mortality can be judged biologically significant only if it results in population decline. Data on bird mortality from transmission lines is difficult to obtain. Bird mortality from transmission and distribution lines can be compared to mortality from other sources. More recent estimates suggest that vehicle strikes and building and window collisions each account for tens to hundreds of millions of bird deaths annually. Communication towers and wind turbines are two types of structures increasingly studied regarding bird mortality . In general, avian deaths due to collisions with power lines are considered an unimportant source of mortality at the population level 16. However, under certain circumstances collision losses can be biologically significant. But around this operation of the transmission line areas, avians strikes and collisions could not be happened because of the height of the transmission lines is only 10 meters and that is not enough to disturb the flight route of avians around the environment. So birds and bats can fly freely in that environment.

Noise from the operation of power station

During the operation and maintenance of power station, there may be a lot of noise on the nearest residential areas and especially on the fauna diversity near the station.

Impact due to EMF

Animals, such as birds and bats, those are strongly dependent on magnetic fields for orientation or migration. When an animals under high electrostatic field of about 30kv /m,their body acquires a charge and when they try to drink water, a spark usually jumps from their nose to the grounded pipe, like hens are unable to pick up grain because of chattering of their beaks which also affects their growth.

The main impact is avian collisions which is particularly significant in high risk areas such as wooded regions and bird migration corridors. The impact on fauna and other animal species is usually temporary.

Electrocution

Because of high voltage of power lines, animals may be electrocuted if they come in contact with them.

When animals on power lines touch the wire and certain other objects, an electrical grounding wire or a second wire carrying another voltage, they can be electrocuted.

Significance of impact for Impact on Fauna diversity during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on Fauna diversity	Noise	2	4	1	3	21	Low Impact (U)
	EMF	3	4	2	2	18	Low Impact (U)
	Electrocution	4	4	3	3	33	Moderate Significant (C)

Consideration of Mitigation Requirement for Impact on Fauna diversity during Operation Phase

The intensity of mitigation requirement for Impact due to Noise according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Noise	Low Impact (U)	No	Yes	Minor	Operators
2.	EMF	Low Impact (U)	No	Yes	Minor	Operators
3.	Electrocution	Moderate Significant (C)	No	Yes	Moderate	Operators

Mitigation Measures for Impacts on Fauna Diversity

- Usage of low noise equipment
- Avoid the activities at night
- Use barricades or fences to prevent wildlife from access to the transmission lines.
- Install rope bridges in order to create connectivity between trees nearby to give access to those animals which can climb over barricades such as monkeys.
- Bird diverters are used to prevent bird-wire collision
- To reduce EMF, copper or brass will be used for electromagnetic shielding.

  There are two basic 60-Hz magnetic field mitigation (reduction) methods: passive and active.

  1 Passive magnetic field mitigation includes rigid magnetic shielding with ferromagnetic and highly conductive materials, and the use of passive shield wires installed near transmission lines that generate opposing cancellation fields from electromagnetic induction.

  2 Active magnetic field mitigation uses electronic feedback to sense a varying 60-Hz magnetic field, then generates a proportionally opposing (nulling) cancellation field within a defined area (room or building) surrmmded by cancellation coils. Ideally, when the two opposing 180-degree out- of-phase magnetic fields of equal magnitude intersect, the resultant magnetic field is completely cancelled (nullified). This teclmology has been successfully applied in both residential and commercial

environments to mitigate magnetic fields from overhead transmission and distribution lines, and tmderground residential distribution (URD) lines.

- Use barricades or fences to prevent wildlife from access to the transmission lines.
- Build wildlife crossings or wildlife passages such as underpass tunnels, overpasses (mainly for large or herd-type animals), amphibian tunnels, fish ladders, canopy bridges (especially for monkeys and squirrels), culverts (for small mammals) and green roofs (for butterflies and birds).

Significance of impact for Impact on Fauna diversity during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on Fauna diversity	Noise	2	4	1	2	14	No Impact (-)
	EMF	2	4	2	2	16	Low Impact (U)
	Electrocution	4	4	3	2	22	Low Impact (U)

Residual impact on Biodiversity Environment during Operation Phase

After proper mitigation measures, the significance level will remain Very Low to Low. So, there will be no residual impact.

6.3.3.5. Anticipated Impacts on Human Environment during Operation Phase

6.3.3.5.1. Anticipated Socio-economic Impacts

(a) Positive Socio-economic Impacts

For operation and maintenance for each substation, the workforces required are as follows:

No.	Types of Workers	Quantity
1.	senior electrical engineer	1
2.	assistant electrical engineers	2
3.	skillful workers	4

So, a total of 77 workers will be needed altogether.

(i) Improvement in Livelihood and Economic

The proposed project will bring various employment opportunities during the operational period. The direct employment opportunities would be increased for the local people.

Significance of Impacts on Employment Generation without Enhancement Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Positive socio-economic impacts	Travel time saving	3	4	3	3	30	Low Impact (U)
	Employment generation	3	4	2	3	27	Low Impact (U)

Consideration of Enhancement Measures for Impacts on Employment Generation

The intensity of enhancement requirement for Impacts on Employment Generation according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Travel time saving	Low Impact (U)	Yes	Yes	Moderate	Operators
2.	Employment generation	Low Impact (U)	Yes	Yes	Moderate	Operators

Enhancement Measures for Employment Generation

The following measures will be done for ensuring job opportunities for local people.

(a) Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible.

(b) Encourage sub-contractor to use local labor force as part of tender requirement.

Significance of Impacts on Employment Generation with Enhancement Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Positive socio-economic impacts	Travel time saving	3	4	2	3	27	Low Impact (U)
	Employment generation	3	4	2	4	36	Moderate Significant (C)

(ii) Benefit to National Economy

There can be income from usage of electricity from local power supply system.

Significance of Impacts on Benefit to National Economy without Enhancement Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Benefit to National economy	Usage of electricity from local power supply	2	3	3	2	16	Low Impact (U)

Consideration of Enhancement Measures for Impacts on Benefit to National Economy

The intensity of enhancement requirement for Impacts on Benefit to National Economy according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Benefit to National economy	Low Impact (U)	Yes	Yes	Moderate	Operators

Enhancement Measures for Benefit to National Economy

1. Record of usage of electricity usage units systematically.
2. Encourage to pay electricity bills on time.
3. Audit electricity bills yearly with professionals.

Significance of Impacts on Benefit to National Economy with Enhancement Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Benefit to National economy	Usage of electricity from local power supply	3	4	3	3	30	Moderate Significant (C)

(b) Negative Socio-economic Impacts

(i) Impact due to Electricity Consumption

The power and electricity consumption required by the railway is listed as follows.

Table. Table of Required Power and Electricity Consumption

Design year	Country	Traction substation	Annual electricity consumption (104kW•h)		Required power (104 kW)			
					Annual average		Annual maximum	
			each substation	total	each substation	total	each substation	total
2035	Myanmar	Muse	2603.3		0.297		0.521	
		Nam hpak ka	4723.7		0.539		0.945	
		Man Peng	5235.3		0.598		1.047	
		Theinni	3650.7		0.417		0.730	
		Lashio West	5156		0.589		1.031	
		San lau	5485.2		0.626		1.097	
		Chaung Chauk	5583.1	49149.3	0.637	5.611	1.117	9.848
		Nawng hkio	5231.3		0.597		1.046	

		Pyinoolwin	5453.6		0.623		1.091	
		CK365	4359.5		0.498		0.872	
		Mandalay South	1667.6		0.190		0.334	
2045	Myanmar	Muse	3702.8	70005.8	0.423	7.992	0.741	14.001
		Nam hpak ka	6746.6		0.770		1.349	
		Man Peng	7245.6		0.827		1.449	
		Theinni	4990.5		0.570		0.998	
		Lashio West	7429.3		0.848		1.486	
		San lau	7757.7		0.886		1.552	
		Chaung Chauk	7851		0.896		1.570	
		Nawng hkio	7374		0.842		1.475	
		Pyinoolwin	7709.1		0.880		1.542	
		CK365	6927.2		0.791		1.354	
		Mandalay South	2272		0.259		0.454	

Note: In the table, the average annual load utilization is 8760 hours, and the maximum load utilization is 5000 hours.

Power supply points of the whole line will be mainly distributed in station, yard, substation and the tunnel in the sections where lighting and ventilation are required. Load will be for communication, signaling, information and infrared axle temperature detection devices, locomotive maintenance and water supply and drainage equipment, air conditioning, ventilation and indoor and outdoor lighting, etc in the stations along the line.

The usage of local power system can be disturbed if the required power load is supplied by using local power supply system.

Significance of impact for Impact due to Electricity Consumption without Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Insufficient local power supply	Use of electricity from local power supply	2	4	3	4	36	Moderate Significant (C)

Consideration of Mitigation Requirement for Impact due to Electricity Consumption

The intensity of mitigation requirement for Impact due to Electricity Consumption according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Electricity consumption	Moderate Significant (C)	Yes	Yes	Moderate	Operators

Mitigation Measures for Impact due to Electricity Consumption

- Use the source of electricity that does not pressure on local use in the current and future.
- Use alternative source of energy such as solar power where land use will available or self-generator where there have high pressure on local electrical use
- Find other alternative electrical power source such as electrical power from China near Muse and Na Phat Ka.

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Significance of impact for Impact due to Electricity Consumption with Mitigation Measures

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Insufficient local power supply	Use of electricity from local power supply	Negative (-)	Local (-3)	Long term (-4)	Low (-2)	Intermittent (-2)	Seldom (-2)	Low (-36)

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Insufficient local power supply	Use of electricity from local power supply	2	4	3	2	18	Low Impact (U)

(ii) Social Tension

Social tension can be caused since the nearby villages do not get electricity all the time while the railway lighting is always on during the night.

Significance of impact for Social Tension before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Social tension	Railway lighting through the night	2	4	3	4	36	Moderate Significant (C)

Consideration of Mitigation Requirement for Social Tension

The intensity of mitigation requirement for Impact due to Utility Consumption according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Social tension	Moderate Significant (C)	No	Yes	Moderate	Operators

Mitigation Measures for Social Tension

- Consider distributing electricity also for local people if possible before starting the project.
- Support local people by supplying solar system

Significance of impact for Social Tension after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Social tension	Railway lighting through the night	2	4	3	2	18	Low Impact (U)

6.3.3.5.2. Anticipated Visual Impacts during Operation Phase

The proposed power station and transmission lines have the potential to cause impacts on the character of the landscape of the immediate area and on the visual amenity of receptors within the vicinity of the site, and at more elevated and sensitive locations at greater distances. The main landscape and visual impacts will result from the construction of the new power station building and run of way for transmission lines. In addition to these impacts which focus on the long term, there is also the potential for short term and medium-term impacts during construction and decommissioning, and during the restoration period, as well as impacts arising from operation.

During operation, effects on views are likely to arise from:

- the presence of long new embankments and engineering infrastructure, resulting from the raising and realignment of the new transmission line, which could intrude into people's views;
- The increased visual presence of the power station and sub-station buildings in addition to the existing built-up areas, such that development forms a larger part of the view.

Specifically, for transmission line the visual impacts are not expected to be significant because the most alignment area of transmission line (TL) is aligned along in forest area. The forest itself provides a good natural screen to hide the TL from the highway.

Significance of impact for Visual Impacts during Operation phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impacts on the character of the landscape	Presence of new infrastructures	2	4	3	3	27	Low Impact (U)

Consideration of Mitigation Requirement for Visual Impacts during Operation Phase

The intensity of mitigation requirement for Visual Impacts according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impacts on the character of the landscape	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures for Visual Impacts during Operation Phase

- The power station and sub-station infrastructures (i.e. power transformer) will be designed to respond to the surrounding character of the wider area and to 'fit' with the existing vernacular of the settlement of localize areas. The design should also be local designs suitable with surrounding beautiful Shan State.
- Select the suitable transmission structure color.
- Hard landscaping and planting will be introduced to help integrate the building into its environment; and
- Development of a landscape framework strategy and planting plan is proposed to help integrate the TL and the road realignment into the landscape, and to reduce the visual impact over the long term.

Significance of impact for Visual Impacts during Operation phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impacts on the character of the landscape	Presence of new infrastructures	2	4	2	2	16	Low Impact (U)

6.3.3.5.3. Anticipated Impact due to Utility Consumption during Operation Phase

Electricity is used to provide the adequate lighting and it is also needed to provide for the safety signboards that are used in the entrances and exits. If the electricity is used from the local community, it can affect to the local power usage.

Significance of impact for Impact due to Utility Consumption without Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on local power usage	Provision of adequate lighting	2	4	1	4	28	Low Impact (U)

Consideration of Mitigation Requirement for Impact due to Utility Consumption

The intensity of mitigation requirement for Impact due to Utility Consumption according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact on local power usage	Low Impact (U)	Yes	Yes	Minor	Operators

Mitigation Measures for Impact due to Utility Consumption

- Use LED lights and/or lower wattage lamps
- Implementing good housekeeping measures such as turning off equipment and lights when not in use
- Use alternative source like solar system

Significance of impact for Impact due to Utility Consumption with Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on local power usage	Provision of adequate lighting	2	4	1	2	14	No Impact (-)

6.3.3.5.4. Anticipated Community Health Impacts during Operation Phase

(a) Noise Sources

Noise can be generated from the use of axillary generator during power outage.

The noise emitted by energized transformers consists of no-load noise, load current induced noise, cooling equipment noise and switch gear noise. In a 50 Hz transformer the current is reversing twice a cycle and the generated magnetic field causes the core to vibrate at 100Hz giving the well- known “mains hum”. The noise level varies with load and is generally constant if the load is constant. There may be harmonics of the supply frequency at 100 and 200Hz.

The transformer cooling fans generate more broadband noise, although they are not in continual operation. Fans generate a tonal component linked to the rotational speed of the fan and the air flow gives a broadband “hiss” or “white noise”. Switchgear noise is generated by the operation of circuit breakers and is “impulsive” in character and of short duration often described as a “crackle”.

Noise levels for the proposed transformers have been obtained from three sources:

- Procurement Technical Specifications
- First Principles based on the load
- Field measurements of operating substation

The results are compared below.

Transformer Specifications

The Technical Specifications as given in the BOQ follows international rules. In the EU the relevant guideline is IEC 60076-10:2001 Power transformers - Part 10: Determination of sound levels. In the USA the relevant guideline is IEEE STANDARD C57.12.90-2010 - IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers. These standards give the test procedures for establishing noise levels. Noise level, or more correctly Sound Pressure Level (SPL), must be qualified by giving the distance at which the measurement is made, or the SPL predicted. The values below are taken from section 2.20 of the BOQ and show the noise level at the IEC standard distance of 0.3 m from the face of the transformer when it is running at 105% of full rated voltage.

Table - Noise Levels of 150 MVA Transformer from BOQ

	Audible noise level		
	Voltage in percent of rated value	%	105
	ONAN rating	dB(A)	83 max
	ONAF maximum rating	dB(A)	86 max

ONAN designates an oil filled unit that has natural convection flow in the tank and utilizes natural air convection cooling externally. When fans are added for external forced air ventilation the designation is ONAF. A transformer that has natural convection cooling as a base rating and an elevated rating when fans are added is designated as ONAN/ONAF.

(b) Near Field and Far Field

The values above show that when the transformer is running at full load the noise level at 0.3 m from the face of the transformer is 86dB(A). The distance 0.3 m is the IEC standard distance at which all transformers are tested.

However, close to a sound source, the sound intensity is affected by constructive and destructive interference of the multiple waves which originate from the radiator face. This is called the "Near Field", and it is difficult to calculate the attenuation with distance of a sound level based on measurements taken in the near field. One needs to establish the distance at which the radiator starts acting as a single point source. This is known as the "Far Field" and depends on the dimension of the radiator and the frequency. If one takes a sound level measurement in the far field, then once can apply the Inverse Square Law to this measurement to extrapolate to the noise level at a set distance. The far field can be calculated from the following formula:

$$N = \frac{D^2}{4\lambda}$$

Where

N = Length of Transition from Near Field to Far Field

D = Largest dimension of transformer

λ= Wavelength, in this case 3.3m at 100hz

The dimensions of the transformer as measured in Abuja are length 7m, width 4m and height 6m. This gives a Far Field distance of 3.7m. Therefore although the IEC sound level at 0.3m is very useful for occupational noise exposure assessment, where operatives are in close proximity to the transformer, in order to calculate the possible intrusion off-site at nearby residences, one must determine noise levels at distances greater than 3.7 metres.

This is discussed further below.

(c) Noise Level Variation with Load Capacity

Noise levels are given by manufacturers. Typical noise levels of a Siemens 420 MVA transformer is shown below. As shown a 420 MVA transformer at full load with cooling fans operating gives 76.3dB (A) at 0.3 m.

Table -Typical noise levels of a Siemens 420 MVA transformer

Condition		**Standard design –dB(A)**
No-load	100% U_{rated}	65.5
Load current	100% I_{rated}	70.3
cooler	Fans, pumps	74.5
Total		76.3

Noise levels increase with load and the theoretical noise level can be calculated based on the MVA rating of the transformer assuming it is operating at full load.

The formula is SPLdB(A) @ 0.3 m = 45+12LogMVA. So, for example, as shown above, a 150 MVA transformer at full load gives 70 dB (A) at 0.3 m.

(d) Corona Discharge

One of the phenomena associated with all energized electrical devices, including high-voltage transmission lines, is corona. The localized electric field near a conductor can be sufficiently concentrated to ionize air close to the conductors. This can result in a partial discharge of electrical energy called a corona discharge, or corona.

Corona occurs on all types of transmission lines, but it becomes more noticeable at higher voltages (345 kV and higher). Under fair weather conditions, the audible noise from corona is minor and rarely noticed. During wet and humid conditions, water drops collect on the conductors and increase corona activity.

Under these conditions, a crackling or humming sound may be heard in the immediate vicinity of the line. Corona results in a power loss. Power losses like corona result in operating inefficiencies and a major concern is reduction of losses. Project proponent will take all practical steps to reduce corona discharge and the noise impacts are not considered to be significant.

Significance of impact for Impact due to Noise during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on community's health	Noise	2	4	2	3	24	Low Impact (U)

Consideration of Mitigation Requirement for Impact due to Noise

The intensity of mitigation requirement for Impacts due to noise according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact on community's health	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures for Impact due to Noise

Low noise power transformers are available. A low noise design can cut noise emission by up to 24dB (A) when compared with a standard design transformer. In this case as there are no noise sensitive receptors in the immediate vicinity, low noise transformers are not required nor economically justified. Use sound proof generator.

Significance of impact for Impact due to Noise during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on community's health	Noise	2	4	1	2	14	No Impact (-)

(b) Gaseous emission due to the production of required electrical power by generator

Gaseous emission due to the production of required electrical power by axillary generator during power outage can impact on community health.

Significance of impact for Gaseous Emission during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on community's health	Gaseous emission	2	4	2	3	24	Low Impact (U)

Consideration of Mitigation Requirement for Gaseous Emission

The intensity of mitigation requirement for Gaseous Emission according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact on community's health	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measure

- Use generator with good engines.
- Regular maintenance of generators.

Significance of impact for Gaseous Emission during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on community's health	Gaseous emission	2	4	2	2	16	Low Impact (U)

(e) Electromagnetic Fields (EMF)

The safe distance of EMF for 230kV traction substation is 40 m and that of 25kV traction substation is 30m. The local people within this distance can be affected due to EMF. The health of local people can be disturbed according to their distance from the source.

EMF Effect on Human Health

The electromagnetic field from power lines and appliances are of extremely low frequency and low energy. They are non-ionizing and are markedly different in frequency from ionizing radiation such as X-rays and gamma rays. As a comparison, transmission lines have a low frequency of 60 Hz while television transmitters have higher frequencies in the 55 to 890 MHZ range. Microwaves have even higher frequencies, 1,000 MHZ and above. Ionizing radiation , such as X-rays and gamma rays, has frequencies above 1015Hz, The energy from higher-frequency fields is absorbed by water in body tissues and cause heating which can be harmful, depending upon thr degree of heating which can be harmful, depending upon the degree of heating that occurs. X-rays have so much energy that they can ionize(form charged particles) and brake up molecules of genetic material9DNA) and no genetic material, leading to cell death or mutation. In contrast, extremely low frequency EMF does not have enough energy to heat body tissues or cause ionization. Second, all cells in the body maintain large natural electric fields across their outer membranes. These naturally occurring fields are at least 100 times more intense than those that can be induced by exposure to common power –frequency fields. However, despite the low energy of power-frequency fields and the very small perturbations that they make to the naturral fields within the body. When an external agent such as an ELF fields lightly perturbs a process in the cell, other processes may compensate for it so that there is no overall disturbance to the organism. Some perturbations may be within the ranges of disturbances that a system can experience and still function properly. During research on health effects of electric anf magnetic fields, it has come forward that electric field intensity exposure of about 1-10 mv/ m in tissue interact with cells but not proved to be harmful. But strong fields cause harmful effects when their magnitude exceeds stimulation thresholds for neutral tissues (central nervous system and brain), muscle and heart. In india it is stipulated that electric field intensity should not exceed 4.16 lV/m and magnetic field intensity should not exceed 100 ~tT in public areas. Even when effect is demonstrated consistently on the cellular level in laboratory experiments, it is hard to predict whether and how they will affect the whole organism. Processes at the individual cell level are integrated through complex mechanisms in the animals.

EMF Effects on Workers

For providing continuous and uninterrupted supply of electric power to consumers maintenance operations of power lines are often performed with systems energized or live. This is live line maintenance or hot line maintenance. The electric fields and magnetic fields associated with these power lines may affect the health of live line workers. Its electric field and current densities affect the health of humans and cause several diseases by affecting majority parts of the human body. These electric field and current densities affects humans of all stages and causes short term diseases in them and sometimes death also.

EMF Effects on Vehicles parked near Line

When a vehicle is parked under high voltage transmission line an electrostatic field is developed in it. When a person who is grounded touches it a discharge current flows through the human being. In order to avoid this parking lots are located below the transmission lines the recommended clearance is 17m for 345 kV and 20m for 400 kV lines.

EMF Effects on Pipe Line/Fence/Cables

A fence, irrigation pipe, pipeline, electrical distribution line forms a conducting loops when it is grounded at both ends. The earth forms the other portion or the loop. The magnetic field from a transmission line can induce a current to flow in such a loop if it is oriented parallel to the line. If only one end of the fence is grounded, then an induced voltage appears across the open end of the loop. The possibility for a shock exists if a person closes the loop at the open end by contacting both the ground and the conductor. For fences, buried cables, and pipe lines proper care has been taken to prevent them from charging due to Electrostatic field. When using pipelines which are more than 3 km in length & 15 cm in diameter they must be buried at least 30 laterally from the line center.

Significance of impact for Electromagnetic Fields during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Health of local people	EMF	3	4	3	2	20	Low Impact (U)

Consideration of Mitigation Requirement for Electromagnetic Fields

The intensity of mitigation requirement for Electromagnetic Fields according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Health of local people	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures

- All rooms, areas, enclosures with magnetic fields density above 0.5 mT will have a sign indicating restricted access for persons with medical implanted devices that may interfere with the magnetic field.
- Metals such as copper or brass should be used as electromagnetic shielding.
- Line shielding:

There are two basic 60-Hz magnetic field mitigation (reduction) methods: passive and active.

1. Passive magnetic field mitigation includes rigid magnetic shielding with ferromagnetic and highly conductive materials, and the use of passive shield wires installed near transmission lines that generate opposing cancellation fields from electromagnetic induction.
2. Active magnetic field mitigation uses electronic feedback to sense a varying 60-Hz magnetic field, then generates a proportionally opposing (nulling) cancellation field within a defined area (room or building) surrounded by cancellation coils. Ideally, when the two opposing 180-degree out- of-phase magnetic fields of equal magnitude intersect, the resultant magnetic field is completely cancelled (nullified). This technology has been successfully applied in both residential and commercial environments to mitigate magnetic fields from overhead transmission and distribution lines, and underground residential distribution (URD) lines.

- Overhead transmission systems required strips of land to be designed as right-of-ways (R.O.W.).
- Grounding metal objects such as fences, that are located on the right way.
- Limiting the possibility of induced currents from mobile objects such as vehicles and farm machinery that cannot be grounded permanently to persons is accomplished by maintaining proper clearances for above-ground conductors tend to limit field strengths to levels that do not represent a hazard or nuisance.
- Limiting access area by increasing conductor clearances in areas where large vehicles could be present.
- For electrocution and electromagnetic wave, use warning signs indicating high voltage area.
- Follow the National EQEG guidelines for preventing exposure to human beings.

Significance of impact for Electromagnetic Fields during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Health of local people	EMF	2	4	3	2	18	Low Impact (U)

(f) Electrocution

Due to high voltage of power lines, it can cause fatal impact on people when they come in contact with the lines.

Significance of impact for Electrocution during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Electrocution	High voltage of power source	3	4	3	2	20	Low Impact (U)

Consideration of Mitigation Requirement for Electrocution

The intensity of mitigation requirement for Chemical Hazards according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Electrocution	Low Impact (U)	No	Yes	Minor	Operators

Mitigation Measures

- Use warning signs indicating high voltage area.
- Provide barricades or fences to restrict access to high voltage area.

Significance of impact for Electrocution during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Electrocution	High voltage of power source	2	4	3	2	20	Low Impact (U)

(g) Chemical Hazards

Hazardous Materials Storage

The typical chemicals found in substations include dielectric fluid, transformer oil, capacitor oil, sulphur hexafluoride and sulphuric acid. These are used to insulate and cool electrical conductors, apart from sulphuric acid which is battery acid.

Dielectric fluid is a mineral oil used to cool and insulate underground transmission feeders. It is a Nonpolychlorinated biphenyl (Non-PCB) oil and can possibly be ignited by electric arcs which have very high temperatures, up to 5,000°C.

Transformer oil is the generic name given to the oil used to insulate and cool transformers. Its flash point is approximately 150°C. Historically; this is where PCBs have been found. Utility companies systematically remove carcinogenic PCBs from their old equipment by "retrofilling." The transformers on the project site in this project are new and the procurement specification states they must be free of PCBs.

Capacitor oil is viscous insulating oil used in capacitor banks. It is Non-PCB oil and has a flash point of 140°C. Older capacitor cans may contain PCBs but the new ones for these sites will not be allowed to do so.

Sulphuric acid is contained in the lead/acid batteries used in the backup power source. According to the technical specification the batteries will be 110 volts DC. Substations typically have two battery rooms, each containing 30 to 40 car-type batteries. Each battery can hold up to 50 Litres of acid at 40% concentration. Exposure to liquid sulphuric acid is a skin hazard, but acid mist can produce respiratory injuries. Spills must be contained and treated. The technical specification includes battery chargers. When batteries are charged hydrogen is released. In the event of a fire in a battery room Carbon Monoxide detectors are often used for safety checks. CO sensors are cross-sensitive to hydrogen and this can lead to false readings. Caution must be observed in interpreting readings as they may be false.

Sulfur hexafluoride gas is used to insulate and extinguish arcs in circuit breakers and other electrical components. For higher voltages, gas-insulated switch gear reduces the space required around live bus. Instead of bare conductors, bus and apparatus are built into pressurized tubular containers filled with sulfur hexafluoride (SF6) gas. This gas has a higher insulating value than air, allowing the dimensions of the apparatus to be reduced. In addition to air or SF6 gas, apparatus will use other insulation materials such as transformer oil, paper, porcelain, and polymer insulators. Under normal conditions, SF6 is an odorless and colorless gas that is five times heavier than air and presents an asphyxiation hazard in below-grade confined spaces. If exposed to high heat, thermal decomposition produces two hazardous by-products, hydrogen fluoride gas and metal fluorides.

Hydrogen fluoride gas (HF) gives off a rotten egg smell and desensitizes the sense of smell, so continuing exposure may make it seem as if it has dissipated. It is a respiratory hazard because in the lungs it mixes with water and produces hydrofluoric acid. Metal fluoride is a white powder which produces a sunburn type effect on the skin.

All of these materials will be stored in a Hazardous Material store with strict inventory control.

PCBs

Polychlorinated biphenyls (PCBs) were used in transformers as dielectric insulating fluids to solve the problem of high flammability for installations in and near buildings. As their negative aspects began to be fully appreciated (high toxicity), other fluids such as silicone oils, high-temperature hydrocarbons, tetrachloroethylenes, and synthetic esters started to be used in transformers located in many of the locations where PCBs were formerly used. These fluids possessed superior fire resistance properties compared to mineral oils, although they were not as fire resistant as PCBs with the exception maybe of tetrachloroethylenes. They did not, however, with the possible exception of synthetic esters, possess biodegradability characteristics that were markedly superior to mineral oils. In the late 1990s, natural esters, a new class of fully biodegradable dielectric insulating fluids, were developed for transformer applications. These vegetable-oil-based fluids meet all the requirements for a high-temperature insulating fluid with the addition of being manufactured from renewable raw materials. There are, today, a number of published industry standards and guides that cover the use of natural ester fluids in transformer applications, such as the American Society for Testing and Materials standard D6871 and the IEEE guide C57.147 in North America, and the IEC Standard 62770.

Polychlorinated biphenyl (PCB) is a concern where transformer oils are used. It is reported that some old transformers in Nigeria still contain PCBs. All transformers on these sites are new with no second hand recycling of old used transformers. All new transformers are specified as being free of PCBs.

Exposure to Environment

Once these hazardous chemicals are present in the environment, people can become exposed to them. Exposure occurs when people have contact with a chemical, either directly or through another substance contaminated with a chemical.

The place where the chemical originates is called the source. Human exposure to hazardous chemicals can occur at the source or the chemical could move to a place where people can come into contact with it. Chemicals can move through air, soil, and water. They can also be on plants or animals, and can get into the air we breathe, the food we eat and the water we drink.

The different ways a person can come into contact with hazardous chemicals are called exposure pathways. There are three basic exposure pathways: inhalation, ingestion, and skin contact. Inhalation is breathing or inhaling into the lungs. Ingestion is taking something in by mouth. Skin contact occurs when something comes in direct contact with the skin. Ingestion can be a secondary exposure pathway after skin contact has occurred, if you put your hands in your mouth and transfer the chemical from your hands to your mouth.

Adverse health effects are dependent on the factors of the exposure. Factors that play a part in whether or not adverse health effects may result from an exposure are:

- the type of chemical;
- the amount or dose (the amount or level of a chemical a person was exposed to);
- the duration (how long did exposure occur); and
- the frequency (how many times the person was exposed).

Also, the occurrence of adverse health effects can depend on the way the chemical enters your body. Some chemicals rapidly absorb through skin, others not at all. Health effects also depend on the toxicity of the chemical that entered your body. Some chemicals are very toxic in small amounts; others are only toxic in large volumes.

Also, people respond to chemical exposure in different ways. Some people may be exposed to a chemical and not get sick. Other people may be more sensitive to chemicals and get sick more rapidly or have more severe reactions than others. Certain variables play a role in a person's susceptibility to exposure and adverse health effects such as age, gender, genetics, pregnancy or other health conditions.

Significance of impact for Chemical Hazards during Operation Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on health of local people	Exposure to hazardous chemicals	2	4	2	2	16	Low Impact (U)

Consideration of Mitigation Requirement for Chemical Hazards

The intensity of mitigation requirement for Chemical Hazards according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Impact of hazardous chemicals	Low Impact (U)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures

- Handle and store hazardous chemicals and materials properly.
- Engineering control; Isolate people from the hazardous chemical substances

Significance of impact for Chemical Hazards during Operation Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Impact on health of local people	Exposure to hazardous chemicals	1	4	2	2	14	No Impact (-)

6.3.4. Anticipated Impacts during Decommissioning Phase

The main activities which will be done in decommissioning phase are demolition, decommissioning and destruction of power station and power line activities. The main impacts considered in this phase include:

1. Impact on Air Environment

2. Impact on Surface Water Environment
3. Impact on Soil and Groundwater Environment
4. Impact on Human Environment

6.3.4.1. Anticipated Impacts on Air Environment during Decommissioning Phase

(a) Dust generation

The destruction of traction substations and power lines will result in nuisance impacts in the form of dust. There have emissions from the truck vehicles and other heavy/light-duty vehicles, and dust emissions as a result of decommissioning activities. Air quality impacts during decommissioning phase are likely to result from the following;

- Dust from hauling and moving of trucks
- Dust from demolishing the building and decommissioning foundation

Significance of impact for Dust Generation during Decommissioning Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Dust generation	Hauling and moving of tracks, demolishing the building	2	1	2	3	15	Low Impact (U)

Consideration of Mitigation Requirement for Dust Generation during Decommissioning Phase

The intensity of mitigation requirement for Dust Generation according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Dust generation	Low Impact (U)	No	Yes	Minor	Decommissioning Service Providers

Mitigation measures

- Water will be sprayed on sites during destruction activities and approach roads to suppress dust in dry weather
- Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes.

Significance of impact for Dust Generation during Decommissioning Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Dust generation	Hauling and moving of tracks, demolishing the building	2	1	1	2	8	No Impact (-)

(b) Noise Impacts

The major sources of noise pollution during decommissioning phase are from removal of buildings and infrastructures.

Significance of impact for Noise during Decommissioning Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise	removal of buildings and infrastructures	3	1	1	3	15	Low Impact (U)

Consideration of Mitigation Requirement for Noise during Decommissioning Phase

The intensity of mitigation requirement for Noise according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Noise	Low Impact (U)	No	Yes	Minor	Decommissioning Service Providers

Mitigation measure

- Maintain all exhaust systems in good working order; undertake regular equipment maintenance, enclose stationary equipment such as generators where practicable and reduce vehicle speeds around sensitive receptors such as dwellings and schools.

Significance of impact for Noise during Decommissioning Phase after Mitigation Measures

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Noise	removal of buildings and infrastructures	Negative (-)	Site (-1)	Short term (-2)	Very Low (-1)	Rare (-1)	Seldom (-2)	Very Low (-12)

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Noise	removal of buildings and infrastructures	2	1	1	2	8	No Impact (-)

6.3.4.2. Anticipated Impacts on Surface Water Environment during Decommissioning Phase

The proposed project area does not have permanent rivers but has seasonal stream valleys crossed by the proposed transmission line, water pools on seasonal rivers and water-pans on the side of the proposed ROW.

Water quality impacts during decommissioning are likely to result from the following sources:

- Increased sedimentation of water courses
- Piling steel structures on the site for a long time without moving to dumping sites or to places to do recycling.

Significant of Impacts on Surface Water Environment during Construction Phase before Mitigation Measures

Anticipated Impacts	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Surface Water Pollution	Piling steel structures on site	3	1	2	2	12	No Impact (-)

Consideration of Mitigation Requirement for Surface Water Environment during Construction Phase

The intensity requirement of mitigation measures for Surface water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Surface Water Pollution	No Impact (-)	No	Yes	Minor	Decommissioning Service Providers

Mitigation Measures

- Proper Disposal of wastes according to the requirements.
- Reuse the wastes where possible.

- When reusing is impossible, recycle the wastes by giving to recyclists and secondary users can use them.

Significant of Impacts on Surface Water Environment during Construction Phase after Mitigation Measures

Anticipated Impacts	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Surface Water Pollution	Piling steel structures on site	2	1	2	2	10	No Impact (-)

6.3.4.3. Anticipated Impacts on Soil and Groundwater Environment during Decommissioning Phase

Potential contamination of soil and groundwater during decommissioning phase could occur as a result of accidents and/or improper handling of lubricants, oils, and transformer oils (PCBs). During decommissioning phase, the material wastes and domestic wastes from the workers will produce and there have potential impact to soil contamination and groundwater pollution if these wastes are not disposed systematically.

Significance of impact for Soil and Groundwater Environment during Decommissioning Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Soil and Groundwater Quality	Improper handling of lubricants, oils and transformer oils	2	1	2	3	15	Low Impact (U)

Consideration of Mitigation Requirement for Soil and Groundwater Environment during Decommissioning Phase

The intensity of mitigation requirement for Soil and Groundwater Environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Soil and Groundwater Quality	Low Impact (U)	No	Yes	Minor	Decommissioning Service Providers

Mitigation Measure

- Disposal of hazardous wastes and solid wastes according to the rules and regulations of CDCs.
- Careful removal of electrical equipment

Significance of impact for Soil and Groundwater Environment during Decommissioning Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
Soil and Groundwater Quality	Improper handling of lubricants, oils and transformer oils	2	1	2	2	10	No Impact (-)

6.3.4.4. Anticipated Impacts on Human Environment during Decommissioning Phase

Impacts on Socio-economic Environment

Generally, it tends to reverse the benefits that are got from the operation of the proposed project on closing the project. As an example, it would have to face the cases like giving up job opportunity and losing taxes for National Government.

Loss of Jobs for Local People and Revenues for the Government

In the event of the project closure, there will be potential negative impacts resulting in loss of jobs and indirect employment depending on the operation of proposed and of associated services for tourism as well as loss of revenues for the government.

Significant of Impacts on Socio-economic Environment before Mitigation measures

Being a developing country, loss of job opportunities and revenues for regional government will be greatly affected on GDP. So, impact significant will be considered as low to moderate for loss of jobs due to insignificant number of workers appointed during operation phase and moderate for loss of revenues due to important of income from industrial section.

Components	Impact Type	Magnitude	Duration	Extend (Area)	Probability	Total	Impact Rating
Loss of jobs	Negative (-)	2	5	3	4	40	Moderate Significant (C)
Loss of revenues	Negative (-)	3	5	4	5	60	High Significant (B)

Consideration of Mitigation Measures for Socio-economic Environment

The required mitigation measures for socio-economic environment are as follow:

No.	Parameters	Impact Rating	Public Concern	Mitigation Requirement	Mitigation Scale	Responsibility
1.	Loss of job	Moderate Significant (C)	No	Yes	Sensible	Project developer
2.	Loss of revenue	High Significant (B)	No	Yes	Sensible	Project developer

Mitigation Measures for Loss of Jobs and Revenues for the Government

- Extensive and comprehensive warning to employees to allow them to source alternative livelihood will be taken early.
- Project developer will prepare their employees for forced retirement by providing applicable jobs at other oil stations under the same developer, if feasible.
- If the power generation source is still usable, it will be made useful for the government.
- Prepare a plan to reuse the proposed project to other partner company to retain the revenue for the government.

Significant of Impacts on Socio-economic Environment after Mitigation measures

Components	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Loss of jobs	Negative (-)	Local (-3)	Permanent (-5)	Low (-2)	Regular (-3)	Seldom (-2)	Low (-50)
Loss of revenues	Negative (-)	Regional (-5)	Permanent (-5)	Moderate (-4)	Rare (-1)	Probable (-3)	Low to Moderate (-56)

Components	Impact Type	Magnitude	Duration	Extend (Area)	Probability	Total	Impact Rating
Loss of jobs	Negative (-)	2	5	3	2	20	Low Impact (U)
Loss of revenues	Negative (-)	2	5	4	2	33	Moderate Significant (C)

Residual Impact on Socio-economic Environment during Decommissioning Phase

After proper mitigation measures, the significance can be reduced to Low.

6.3.4.5. Anticipated Visual Impacts during Decommissioning Phase

Due to the wastes generated from decommissioning activities and piling of wastes on the site, there can be visual impacts on communities in the vicinity area.

Significance of impact for Visual Impacts during Decommissioning Phase before Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
visual impacts on communities in the vicinity area	wastes generated from decommissioning activities	2	1	2	3	15	Low Impact (U)

Consideration of Mitigation Requirement for Visual Impacts during Decommissioning Phase

The intensity of mitigation requirement for Visual Impacts according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	visual impacts on communities in the vicinity area	Low Impact (U)	No	Yes	Minor	Project developer

Mitigation Measures for Visual Impacts

- Demolish all the structures including transmission towers and transmission lines affecting the visual amenities
- Proper disposal of wastes
- Immediate disposal of wastes without piling at the site

Significance of impact for Visual Impacts during Decommissioning Phase after Mitigation Measures

Anticipated Impact	Sources	Magnitude	Duration	Extend (Area)	Probability	Total	Category
visual impacts on communities in the vicinity area	wastes generated from decommissioning activities	2	1	2	2	10	No Impact (-)

6.4. Characteristics and Assessment of Any Residual Impacts

Residual environmental effects (i.e., the environmental effects that remain after mitigation has been applied) are described during each Project phase (Construction, Operation and Decommissioning), taking into account how the proposed mitigation would alter or change the environmental effect. The analysis includes both direct and indirect interactions. The analysis considers mitigation measures to reduce adverse environmental effects or to enhance positive environmental effects, as applicable and appropriate. Once mitigation measures are applied, any remaining environmental effect is residual. The characteristics of residual environmental effects include:

Direction – the ultimate long-term trend of the environmental effect (i.e., positive or adverse);

Magnitude – the amount of change in a measurable parameter or variable relative to existing (baseline) conditions; and

Reversibility – the likelihood that a measurable parameter will recover from an environmental effect, including through active management techniques (e.g., habitat restoration).

Residual Impact on Socio-economic during Construction Phase

The impact on livelihood of the community is residual because people whose livelihood is linked with existing modes of transportation will change the route. The economic of the community is still residual because the commercial places are fully affected and need to be relocated somewhere else and so the income will be affected. According to the Myanmar Insurance Law 1993 (Law No. 15, 16) with the purpose of overcoming financial difficulties by effecting mutual agreement of insurance against social and economic losses which the people may encounter due to common perils and Land Acquisition, Resettlement and rehabilitation Law 2019 (Section 39, 41, 42, 46, 54(b and c), 58) with the purpose of preventing potential impacts on environmental and social sectors due to land use that the government stipulate the rights to take over land provided that compensation is made to the original land owner but no private ownership of land is permitted, Payments for loss of business (temporary or permanent), loss of livelihood, loss of wages employment will be provided to affected parties, as compensation. According to the Fertilizer Law 2002 (N0. 7) with the purpose of supporting the development of agricultural sector which is the basic economy of the state, the permanent land loss will cause effects on the agricultural activity but this is not sufficiently large to result in a material effect through diminishing the quality of life as replacement could be made in locality or be compensated for.

6.5. Comprehensive Monitoring Plan

Monitoring frequency will be sufficient to provide representative data for the parameter being monitored. Monitoring data will be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Monitoring will be carried out throughout all project implementation phases and the responsibilities for monitoring for construction and operation phases. The parameters to be monitored; location of the monitoring sites; frequency of monitoring, responsibilities and monitoring parameters are presented in the following tables.

Table - Environmental Monitoring Plan for Proposed Power Supply System for Railway

Project activities	Parameters to be monitored	Locations	Frequency of measurements	Responsibilities
During Pre-Construction and Construction phase				
Gaseous emission, and PM generation,	Ambient air quality (CO, CO_2, SO_2, NO_x)	Within the site and surrounding establishments	During the construction activities at different locations at least per month or every complaints or if necessary	Construction contractor(s) (as a part of contractor's financial offer)
Construction machineries	Noise complaints from the neighboring	Within the site and surrounding establishments	During the construction activities at different locations at least per month or every complaints or if necessary	Construction contractor(s) (as a part of contractor's financial offer)
Area of spillage	Soil contamination and water resource pollution	Project sites and agricultural lands nearby, nearest surface water resources	Daily	Construction contractor(s) (as a part of contractor's financial offer)
Management of construction waste and handling of hazardous waste	Amount of hazardous and nonhazardous waste generated	Project sites and agricultural lands nearby, nearest surface water resources	Weekly or monthly depending on the volume of waste	Contractor(s) during construction and power station staff during operation
Storage of the machines and construction materials of the project components	Complaints from neighboring communities and records and documentation of the temporary area for storage of materials or machineries	Project sites	monthly	Construction contractor(s)
Storage of surplus soil particle from	Complaints from neighboring communities and records and documentation of the temporary area for storage of materials or machineries	Project sites	monthly	Construction contractor(s)
Monitoring the traffic disturbance due to the vehicles	Traffic complaint	Within 500 m from the construction site	During the duration of the construction	Construction contractor(s)

and machineries movement and other related construction activities			activities	
Impacts of culture and privacy of local communities	% of local labor to total labor	Construction site	Quarterly	Construction Contractor(s)
Monitoring health and safety of the workers during the construction of the project components	Health records about occupational injuries	Clinic / hospital referred by the contractor	on received case	Construction contractor(s)
Base camp preparation for the workers	Neighbors /project' complaints	Project construction sites	Once during the preparation and prior to start the construction phase	Construction contractor(s)
Site clearance	Worker's injuries	Construction site location	Monthly	Construction contractor(s)
During Operation and Maintenance of the Power Supply System				
Noise from substations and transformers	Noise complaints from the neighboring farm/project	Every substations within the sites and surrounding establishments	Monthly or if necessary based on documentation of complaints	Monitoring team
Monitoring the electric and magnetic field (EMF)	EMF levels reading at the power station and surrounding site and neighbors farm /project' complaints	At several places including inside the power station area and along the alignment there crossing over agricultural lands	Monthly	Monitoring team
Management of the hazardous and non-hazardous waste	Amount of hazardous and nonhazardous waste generated	At the designated landfill for solid waste	Quarterly	Power station operators during operation
Management of risks during the emergency situations (fire, soil contamination, water resource contamination and smoke)	Records of emergency situations	At surrounding the transformers area	Weekly or if required	Monitoring team of Railway Project
Workers' health and safety	Workplace health and accidents record	Workplace	Monthly	Monitoring team of Railway Project

6.6. Risks Assessment

Potential Risk Assessment

Elements of Risk (ISO/IEC GUIDE 51:2014(E))

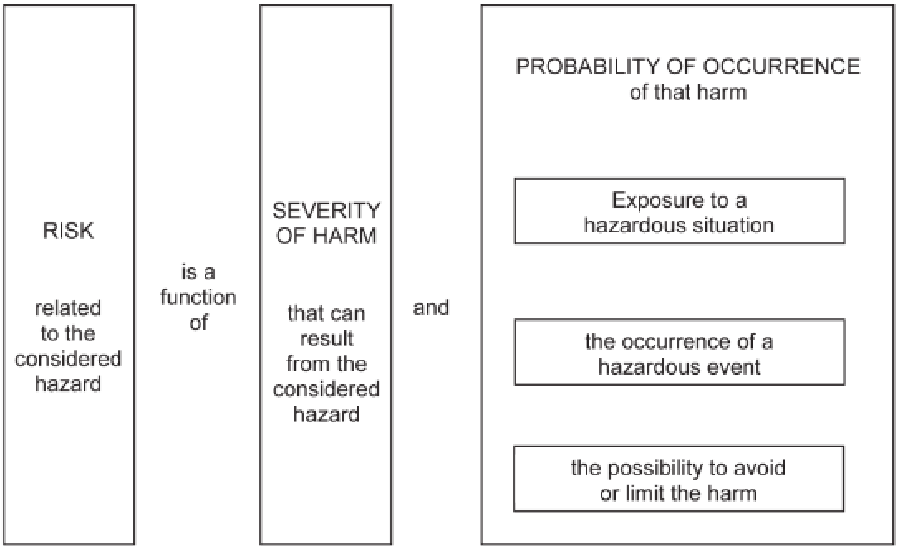


Figure - Elements of risk

The following procedure should be used to reduce risks to a tolerable level:

a. Identify the likely users for the product or system, including vulnerable consumers and others affected by the product;
b. Identify the intended use, and assess the reasonably foreseeable misuse, of the product or system;
c. Identify each hazard (including reasonably foreseeable hazardous situations and events) arising in the stages and conditions for the use of the product or system, including installation, operation, maintenance, repair and destruction/disposal;
d. Estimate and evaluate the risk to the affected user group arising from the hazard(s) identified: consideration should be given to product s or systems used by different user groups; evaluation can also be made by comparison with similar products or systems;
e. If the risk is not tolerable, reduce the risk until it becomes tolerable.

6.6.1. Occupational Health and Safety Risk

6.6.1.1. Construction Phase

Occupational health and safety risk specific to electric power supply construction primarily include:

1) Dust and Noise Generation
2) Accidents in the operation of construction machineries
3) Diseases associated with the arrival of temporary labor in the area

(1) Dust and Noise Generation

Dust emission and noise from construction machineries can impact on workers' health.

Control Measures

- Spraying of water from time to time
- Use engines with good conditions
- Limit use of noisy equipment

(2) Accidents in the operation of construction machineries

Risks will arise from a range of hazards such as the use of heavy plant and working with rotating tools. Accidents in the operation of construction machinery and other works can put damage to workers' safety and health.

Control Measures

Relevant labor laws should be strictly complied with pertaining to the health and safety of workers, employees and others.

- All workers and staff should be provided with Personal Protective Equipment (PPE) appropriate to their job on-site.
- All construction sites should be surrounded with secure tamper-proof fence, with security lighting, regular security patrols and other security measures.
- All materials and components should be stored and stacked safely in dedicated secure areas.
- Avoid use of any paints containing lead or its compounds as well as high VOCs
- Avoid roofing materials containing asbestos.
- Smoking should be prohibited near areas of fire or explosion risk.
- Sufficient supply of potable water should be ensured for all workers and employees on-site.
- Ensure that first aid kits are available in all work areas, supplied with adequate material to treat common workplace injuries.
- Dedicated transport should be provided at all work sites to take injured persons to hospitals if needed. Record of all nearest hospitals and health centers should be kept at each construction sites.

- A regular medical facility should be provided at each labor camp with suitable qualified staff and equipment to treat minor ailments and injuries.
- An effective alarm system should be established to warn track workers of approach of trains on existing IR lines in parallel route alignment.
- Protect all electric sub-stations, high-tension towers and other areas from electrocution risk by providing security fencing and lights, warning signs and security patrols.
- An Environment Health and Safety Officer (EHSO) will be appointed prepare a Health and Safety Management Plan, to implement the HSMP and ensure that the requirements of the EMP are met.
- The EHSO will ensure that the HSMP is submitted to MR prior to construction for approval, that accurate records and reports of any occupational health and safety incidents are kept, and reviewing the distribution and use of appropriate PPE.
- The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”

(3) Diseases associated with the arrival of temporary labor in the area

Stagnant water collected from rains and waste at construction sites may lead to spread of mosquitoes and flies and may increase the risk of spreading vector-borne diseases to workers and neighboring communities. Unhygienic site conditions will lead to spread of domestic pests. Communicable diseases also need significant consideration due to the involvement of migrant labor.

Various social pathologies, such as drug/alcohol misuse, abuse of woman and children and incidences of sexually transmitted diseases (STDs) may increase with the influx of job-seekers into the area. An influx of newcomers can overburden the health services and infrastructure, inadequate sewage and waste management and can increase some health risks.

Control Measures

- Awareness program for public health for workers
- Proper sewage system with septic tank for construction workers
- Proper sanitation system
- Regular medical checkup for construction workers

6.6.1.2. Operation Phase

Occupational health and safety issues specific to railway operations include the following:

- Live power lines
- Working at Height
- Electric and magnetic fields
- Electromagnetic interference
- Noise
- Fatigue

(1) Live Power Lines

Workers may be exposed to occupational risks from contact with live power lines during construction, maintenance, and operation activities.

Control Measures

Prevention and control measures associated with live power lines include:

- Only allowing trained and certified workers to install, maintain, or repair electrical equipment;
- Deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity, to the lines;
- Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following:
  - Distinguish live parts from other parts of the electrical system
  - Determine the voltage of live parts
  - Understand the minimum approach distances outlined for specific live line voltages
  - Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system
- Workers should not approach an exposed energized or conductive part even if properly trained unless:
  - The worker is properly insulated from the energized part with gloves or other approved insulation; or,

  - The energized part is properly insulated from the worker and any other conductive object; or,
  - The worker is properly isolated and insulated from any other conductive object (live-line work).
- Where maintenance and operation are required within minimum setback distances, specific training, safety measures, personal safety devices, and other precautions should be defined in a health and safety plan. (The following table provides recommended minimum safety setbacks for workers);
- Workers not directly associated with power transmission and distribution activities who are operating around power lines or power substations should adhere to local legislation, standards, and guidelines relating to minimum approach distances for excavations, tools, vehicles, pruning, and other activities;
- Minimum hot stick distances may only be reduced provided that the distance remaining is greater than the distance between the energized part and a grounded surface.

Table - Alternating Current (Minimum Working Distances for Trained Employees) (OSHA)

Voltage Range (phase to phase – Kilovolts)	Minimum Working and Clear Hot Stick Distance (meters)
2.1 to15	0.6
15.1 to 35	0.71
35.1 to 46	0.76
46.1 to 72.5	0.91
72.6 to 121	1.01
138 to 145	1.06
161 to 169	1.11
230 to 242	1.5
345 to 362	2.13[a]
500 to 552	3.35[a]
700 to 765	4.5[a]

[a] NOTE: From 345-362 kV., 500-552 kV., and 700-765 kV., the minimum working distance and the minimum clear hot stick distance may be reduced provided that such distances are not less than the shortest distance between the energized part and a grounded surface

(a) Broken or dislodged powerlines

Powerlines may be dislodged or broken by various factors, such as vehicle impact with the supporting structure, over-height vehicle loads, farm machinery or other plant contacting powerlines, high current fault conditions, high wind velocity, falling trees, storm damage from flying debris, fire damage.

Emergency services personnel must conduct a site risk assessment, including the risk of step and touch potential, if powerlines have fallen to the ground, are sagging close to the ground, fallen onto an object on the ground or are broken. Control measures for this event include:

- Stay at least 8-10m away from fallen power lines.
- Always assume powerlines are live and capable of killing anyone who comes near or into contact with the powerline, or other object/s in contact with the powerline.
- Emergency services personnel and the general public must keep clear of the site until the electricity supply company has confirmed the supply is off, and the area is safe to approach.
- Carefully examine the surroundings and ensure any vehicles are parked well clear of, and to the side of, any fallen powerlines.

(b) Unbroken powerlines

Unbroken powerlines in contact with the ground, or in contact with another object that is in contact with the ground, may burn through as a result of fault current. This may present a mechanical hazard as powerlines may recoil and cause both mechanical and electrical injury to persons standing too close. Powerlines contacting the ground, or in contact with another object that is in contact with the ground, may cause a fire and must be monitored until the supply company representatives arrive.

(2) Working at height on towers and structures

Workers may be exposed to occupational hazards when working at elevation during construction, maintenance, and operation activities.

Control Measures

Prevention and control measures for working at height include:

- Testing structures for integrity prior to undertaking work;

- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others;
- Establishment of criteria for use of 100 percent fall protection (typically when working over 2 meters above the working surface, but sometimes extended to 7 meters, depending on the activity). The fall protection system should be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point;
- Installation of fixtures on tower components to facilitate the use of fall protection systems;
- Provision of an adequate work-positioning device system for workers. Connectors on positioning systems should be compatible with the tower components to which they are attached;
- Hoisting equipment should be properly rated and maintained and hoist operators properly trained;
- Safety belts should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident;
- When operating power tools at height, workers should use a second (backup) safety strap;
- Signs and other obstructions should be removed from poles or structures prior to undertaking work;
- An approved tool bag should be used for raising or lowering tools or materials to workers on structures.

(3) Electric and Magnetic Fields

Electric and magnetic fields (EMF) are invisible lines of force emitted by and surrounding any electrical device (e.g., power lines and electrical equipment). Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of electric current and increase in strength as the current increases. Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building materials. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance. Railway workers on electric railway systems may have a higher exposure to electric and magnetic fields (EMF) than the general public due to working in proximity to electric power lines.

Power lines come in different configurations. The highest power ones (>400kV) are the long-distance lines from the generating power station to the places where the power is needed. The pylons supporting these power cables are large, metal structures, which have long strings of insulators from which the cables hang. The smallest 230 volt lines start from local substations and supply the power needs for a relatively small area. In between these two extremes are a variety of other types of lines carrying different voltages.

Induced Effects

The electromagnetic fields caused by overhead lines can induce currents and voltage in conductive objects near the line. Induction is also possible in long metal structures such as communications equipment, fences, pipes, or lines near the power lines, or in large objects such as roofs, tanks or large trucks.

Earthing

Most of the effects of induced voltage are found in metal structures and objects that are not well earthed, and every conducting part of such structures needs to be properly earthed. Long metal structures which are earthed in one or several places and stand parallel to electrical wires, must be repeatedly earthed at appropriate intervals, or interspersed with insulating elements in order to reduce the size of the possible electrical flows.

Screening

Electric fields from substation equipment are unlikely to extend beyond the equipment housing, as they are screened by practically all building materials. For all practical purposes magnetic fields cannot be stopped and will travel through walls. Buildings and some trees reduce electric fields, but magnetic fields travel through most materials.

Electrical and Magnetic Fields Safety

There are two types of EMF exposure. Low-level radiation, also called non-ionizing radiation, is mild and thought to be harmless to people. Appliances like microwave ovens, cellphones, Wi-Fi routers, as well as power lines and MRIs, send out low-level radiation. High-level radiation, called ionizing radiation, is the second type of radiation. It's sent out in the form of ultraviolet rays from the sun and X-rays from medical imaging machines. EMF exposure intensity decreases as increasing the distance from the object that's sending out waves.

Actual person exposure to EMF assessment

Electric and magnetic fields join as one field in most forms of radiation. The result is called an electromagnetic field (EMF). We are all exposed to natural electromagnetic fields, like the earth's magnetic field and the electrical fields produced by storms. Since World War Two, however, increased electricity-based technological innovation has led to the development of work equipment and domestic appliances that are sources of nonionizing radiations. Most commonly, these include mobile phones, television sets and the microwave ovens in the home, and lasers, magnetic resonance imaging for medical purposes, and welding stations in workplaces. According to Wikipedia railway electrification using 25 kV, 50 Hz AC has become an international standard. Some of worker are at especial risk, like pregnant workers and workers wearing metal medical implants. The exposure measurements include installation and maintenance of field producing equipment, rectifiers (AC/DC converters) in electrochemical processes, induction heating used in alloying smelter furnaces, welding equipment, medical applications, especially magnetic resonance imaging (MRI) equipment, broadcasting antennas and mobile phone masts. For this project, the electromagnetic field exposure to actual person can be found out around the transmission lines and substations. But for transmission line, due to the spacing of electrical equipment measured field strengths are low outside the fence line.

[a] Volts per meter; [b] Micro tesla; [c] Hertz

All rooms, areas, enclosures with magnetic fields density above 0.5 mT will have a sign indicating restricted access for persons with medical implanted devices that may interfere with the magnetic field. The safe distance of EMF for 230kV traction is 40m and that of 25kV traction substation is 30m.

The sensory effects exposure limit values and health effects exposure limit values are

For low frequency fields (1 Hz to 10 MHz)

For high frequency fields (100 kHz to 300 GHz)

For the electric field strength

• 10 kV/m on a full working shift;

• 30 kV/m, for a short exposure time (less than 2 h);

• The maximum exposure duration, calculated when the values of the field intensity are between 10 kV/m and 30 kV/m are calculated with the empiric relation $t \leq 80/E$, where t represents the duration of the recalculated working day and E is the intensity of the electric field, in kV/m.

For the magnetic field induction

• 500 µT on a full working shift (some EU countries recommend 400 µT);

• 5 mT for short time exposures (less than 2 h);

• 25 mT for a short interval of exposure of the body extremities.

Reduce Hazards of Electromagnetic Fields

According to the CEMFAW Regulations 2016 (Control of Electromagnetic Fields at Work) the management team will access the workers with the levels of EMFs to which your employees may be exposed. And the power density is ensure that exposure is below exposure limit values. The management team required to take action if the workers are exposed to EMFs in excess of the ELVs. Actual expose person to electromagnetic field also needs an appropriate, devise and implementation an action plan to ensure compliance with the exposure limits. The contractor provide information and training on the particular risks posed to employees by electromagnetic fields in the workplace and details of any action you are taking to remove or control them. This information should also be made available to their safety representatives as appropriate; and provide health surveillance or medical examinations as appropriate.

The followings are the facts to prevent the potential of electromagnetic fields exposure to person in working area

- Equipment and workplace classification
- Measuring or calculating the EMF from all relevant sources in your workplace
- Recommending specific measures to mitigate worker's exposure
- Recommending additional specific measures to protect workers at particular risk, e.g. with medical implants
- Training and education on the health and safety effects of EMF exposure
- Don't sit or linger near appliances
- Put your phone down
- Use the speaker fuction or earbuds with your phone

- Don’t carry your phone in a pocket
- Unplug accasionally from electronic devices and electricity
- Shielding with T98 shielding paint and GPA mesh which are both grounded in the process will reduce the exposure to the electric fields from the power lines.

Overhead Electrical Safety

It is common to think that one has to touch an electrical conductor to get hurt. This is not true when dealing with high voltages. Substations use a high-voltage, open-air conductor —called “bus”— which resembles a 75mm conduit pipe. The metal pipes running through the overhead areas of a substation are the conductors of electricity. There are no wires inside the pipe. The electricity is carried on the pipe’s outside skin.

Because of the high voltages involved, one need not touch an electrical conductor to be harmed. If close enough, the electricity will contact the person in the form of a high-temperature electrical arc. The potential for an electrical arc becomes greater as voltage increases. For this reason, the safety distances must be observed. The proper clearance from the overhead bus is calculated for each station, and conductors are positioned accordingly, using a conservative distance to ensure the safety of anyone walking through a station. For 333kV, a safe distance of 6m has been established. For 11kV to 132kV a safe distance of 4m has been established. To stay safe from the electric bus inside a substation, one will not climb nor carry tools above the willer.

Ground-Level Electrical Safety

The overhead bus is not the only electrical hazard present in a substation. Many electrical hazards are found at ground level also. Safety from these hazards is maintained by restricting access to them and by placing the hazard behind locked doors, cages, and fenced-in areas. Capacitor banks reside in cages, providing a buffer zone between persons and the exposed electrical conductors. Circuit breakers are housed in locked cubicles to eliminate the chance of casual entry into these areas. Lightning arrestors and various other electrical components are placed behind fences. All such areas will have warning signs.

Where a substation has a metallic fence, it must be properly grounded to protect people from high voltages that may occur during a fault in the network. Earth faults at a substation can cause a ground potential rise. Currents flowing in the Earth's surface during a fault can cause metal objects to have a significantly different voltage than the ground under a person's feet; this touch potential presents a hazard of electrocution.

Underground-Level Electrical Safety

Power cables can be undergrounded. Electric fields will be absorbed by the earth above a buried cable. Magnetic fields will be higher immediately above an underground cable than they will be below an overhead line, because one is closer, but the fields reduce much more quickly from an underground cable. It will be remembered that the cost of putting cables underground can be twenty times higher than allowing them to go overhead, although less for lower voltage lines.

In proposed railway project, the external power supply mainly provides power energy for the railway power supply system. Each traction substation supplies power for the electric locomotive by introducing two-circuit independent & reliable 132kV or 230kV power supplies from the local power system in which relative delivery distances are rated voltage 132 kV (50-150 km) & 230 kV (100-300km) and then reducing converting voltage to 132/27.5kV or 230/27.5kV by a traction transformer. Meanwhile, a step-down transformer is used to ensure 11kV three-phase power output so as to power all power consumption points such as station, work area, yard, and substation.

As per IUNIRP (International Commission on Nonionizing Radiation Protection), the exposure limits for general public exposure and occupational exposure with electric and magnetic fields are described as follows:

Table - Reference levels from ICNIRP standards

	Occupational	General Public
Frequency (Hz)	50/60	50/60
Magnetic Field (μT)	1000	200
Electric Field (kV/m)	10	5

Source: ICNIRP, 2010

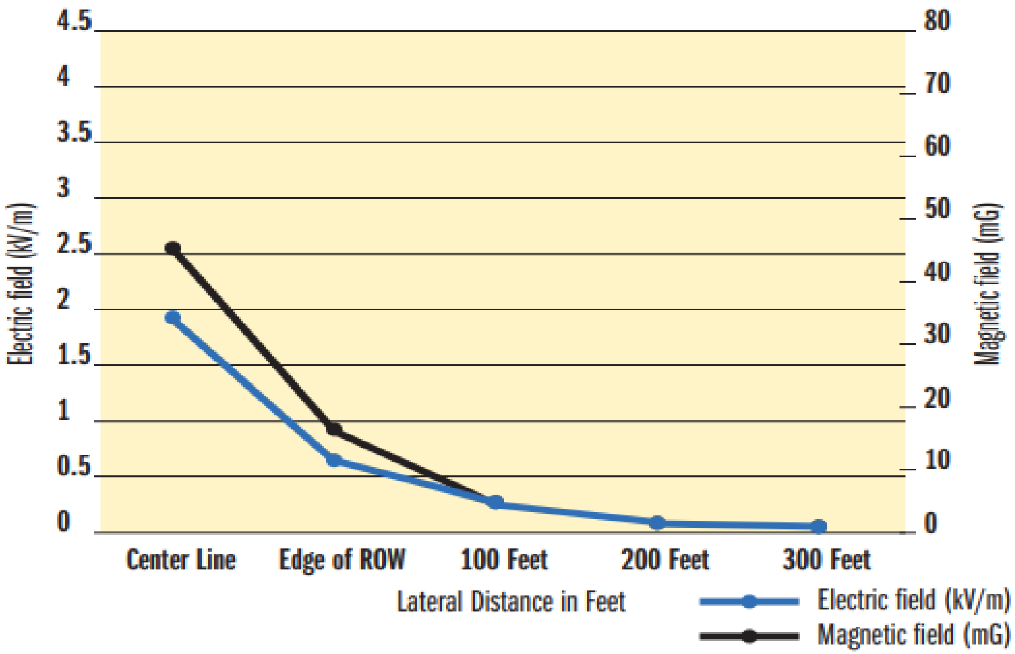
Reference levels from NEQG

Additionally, exposure limits for general public exposure to electric and magnetic fields should comply with International Commission on Non-ionized Radiation Protection guidelines for limiting general public exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 Gigahertz).

Frequency	Electric Field (V/m[a])	Magnetic Field ((μT[b])
50 Hz[c]	5000	100
60 Hz	4150	83

[a] Volts per meter; [b] Micro tesla; [c] Hertz

The following figure describes typical EMF levels for a 230-kv transmission line with electric field and magnetic field with respects to distance.



Source: CapX 2020 Certificate of Need application to the Minnesota Public Utilities Commission for three 345-kV transmission line projects

Figure - Typical EMF levels for a 230-kV transmission line

Moreover, right of way for high power lines is generally determined as follows:

Specification of line	Vertical Clearance	Horizontal Clearance
Less than 650 V AC	2.5 m	1.2 m
650 V- 11kV AC	3.7 m	1.2 m
11kV – 33 kV AC	3.7 m	2 m
More than 33 kV AC	3.7 m add to .30 meter for every additional 33Kv or part there of	2 m add to .30 meter for every additional 33Kv or part there of

Electric Field in Substations

Electric field effects in substation are of the same type as those close to transmission lines but due to the spacing of electrical equipment measured field strengths are low outside the fence line. Fields close by a substation are mainly produced by the entering power lines. Induced currents and spark discharges depend on the particular situation and on the intensity of the electric field. The electric field at one meter above ground is a useful parameter to characterize the electric field environment of a substation as well. The maximum values of the electric field for 230 kV at one meter above ground and typical geometrical characteristics of substation buses in North America are listed in below.

Table- Electric Field at One Meter above Ground in Substations

Voltage	Typical Values Off Outer Phase	Bus Height	Bus Phase Spacing	Base Height
(kV)	(kV/m)	(m)	(m)	(m)
230	5.0	5.5	3.5	3.5

Source: EPRI 3rd edition

Control Measures

Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities; Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE). Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g., 50 percent).
- Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials

Electrocution

Hazards most directly related to power transmission and distribution lines and facilities occur as a result of electrocution from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity.

Control Measures

Recommended techniques to prevent these hazards include:

- Use of signs, barriers (e.g., locks on doors, use of gates, use of steel posts surrounding transmission towers, particularly in urban areas), and education / public outreach to prevent public contact with potentially dangerous equipment;
- Grounding conducting objects (e.g., fences or other metallic structures) installed near power lines, to prevent shock. Consider installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization;
- Use of voltage sensors prior to and during workers' entrance into enclosures containing electrical components;
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them;
- Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training will include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures. Provisions will be made for periodic retraining as necessary.
- Strict procedures for de-energizing and checking of electrical equipment must be in place before any maintenance work is conducted.
- In cases where maintenance work has to be performed on energized equipment, a strict safety procedure must be in place and work must be performed under constant supervision.
- Personnel training must be conducted in revival techniques for electrocution.

(4) Electromagnetic Interference

The corona of overhead transmission line conductors and high frequency currents of overhead transmission lines may result in the creation of radio noise. Typically, transmission line rights-of-way and conductor bundles are created to ensure radio reception at the outside limits remains normal. However, periods of rain, sleet or freezing rain sharply increases the streaming corona on conductors and may affect radio reception in residential areas near transmission lines.

Process for developing Information, Education and Communication between Local Community related with Electrical Hazards

Community presentations can be done in many formats – through public speeches, informal talks, town meetings, debates, workshops, or seminars.

1. Identification of hazards and risks to be known due to transmission lines

Actions - Identification, Documentation, Validation

The hazardous of electrical shock are such as loose of motion control, respiratory arrest, pain, physical fatigue, ventricular fibrillation, cardiac arrest, and burns. Electrocution is one of the most common hazards and identifying electrical hazards can help raise awareness of the risks, their severity, and how it can harm the people. The followings are common electrical hazards and safety tips what we can do to mitigate these risks.

(a) Overhead Power Lines

Overhead powered and energized electrical lines have high voltages which can cause major burns and electrocution to whom the local villagers and workers. Remember to maintain a minimum distance of 10 feet from overhead power lines and nearby equipment. Never attempt to contact the overhead power lines. Also, safety barriers and signs must be installed to warn nearby non-electrical workers and local villagers of the hazards present in that area.

(b) Damaged Tools and Equipment

Exposure to damaged electrical tools and equipment can be very dangerous. Do not fix anything unless you are qualified to do so. Thoroughly check for cracks, cuts or abrasions on cables, wires, and cords.

(c) Exposed Electrical Parts

Examples of exposed electrical parts include temporary lighting, open power distribution units, and detached insulation parts on electrical cords. These hazards can cause potential shocks and burns. Secure these items with proper guarding mechanisms and always check for any exposed parts to be repaired immediately.

(d) Damaged Insulation

Defective or inadequate insulation is a hazard. At first, carefully inform the authorized team and then they will turn off all power sources before replacing damaged insulation and never attempt to cover them with electrical tape.

(e) Wet Conditions

Water greatly increases the risk of electrocution especially if the equipment has damaged insulation. Have a qualified electrician inspect electrical equipment that has gotten wet before energizing it.

Done by - Local Community, Traditional Leaders, Authorized Persons

2. Determination of the target audience

Consideration - In general, Myanmar language will be used and Shan if possible.

Actions - Discussion with key informants, Selection of Target Audience

Done by - Local Community, Authorized Persons (Engineers)

3. Selection of media

Consideration - The practical to develop and disseminate the information that can be complex and the capacity of the local community

Done by - Local Community, Authorized Persons (Engineers)

Media - Poster, Comic, Flipchart, Booklet, Game, etc,

4. Information development and validation

Consideration - The content information which is interesting and incite action should be clear and accurate and these information are very effective for conveying the right message.

Done by - Local Community, Authorized Persons (Engineers)

5. Printing and dissemination

Consideration - The local community can be most effectively disseminated by sharing pamphlet and calendar which have images of awareness of electrical hazards.

Done by - Local Community, Traditional Leaders, Authorized Persons

Community-based Sharing Action when someone is electrified

- If someone is electrified, call for emergency personnel. Then, remove the person from contact with the energized conductor.
- Do not try to touch the person or you may be electrified as well.
- You can turn off the power of the device that is causing the electric shock if this can be done safely (for example, turning off the circuit breaker for the outlet in which the device is plugged). Or you can obtain an insulator, such as a wooden meter stick, and break the contact between the person who is being electrified and the energized conductor.
- After the person who is suffering from electric shock has been removed from the source of the shock, check to see if this person is having breathing problems or is experiencing ventricular fibrillation.
- Artificial respiration or cardiopulmonary resuscitation should be performed on the person who experienced electric shock, if necessary.
- Also, use blankets to keep the person warm.
- Although a person who is electrified may appear unharmed, call emergency personnel because this person may have suffered internal injuries, such as burns to organs during the electric shock.

Current Range and Its Effects on human body (Average)

Current	Effect
1 mA	Barely perceptible
1-3 mA	Perception threshold (most cases)
3-9 mA	Painful sensation
9-25 mA	Muscular contraction (can't let go)
25-60 mA	Respiratory paralysis (may be fatal)
60 mA and more	Ventricular fibrillation (probably fatal)
4 A or more	Heart paralysis (probably fatal)
5 A or more	Tissue burning (fatal if vital organ)

(5) Noise

Crew members may be exposed to noise generated from generators.

Control Measures

Recommended management strategies include:

- Use of air conditioning systems to maintain cabin temperature and provide fresh air so that windows can remain closed, limiting wind and outside noise;

- Reduction of internal venting of air brakes to a level that minimizes noise without compromising the crew's ability to judge brake operation;
- Installation of active noise cancellation systems;
- Use of personal protective equipment (PPE) if engineering controls are not feasible or adequate to reduce noise levels;
- Use of dampers at the seat post to reduce the vibration experienced by the operator;
- Installation of active vibration control systems for locomotive suspension, cabs, or seat posts, as needed to comply with applicable international and national standards and guidelines.

(6) Fatigue

Locomotive engineers and other railway workers are often required to work irregular work hours which may result in fatigue. Fatigue may be affected by the length and time of the shift (e.g. long night shifts, shift start times); the nature of the changes between shifts (shift rotation); the balance in concentration and stimulation in the work activities being undertaken; insufficient rest breaks; and the time of day.

Fatigue, particularly of drivers, signalers, maintenance workers, and others whose work is critical to safe operation, can pose a serious safety risk for railway workers and the general public.

Control Measures

Railway operators will schedule rest periods at regular intervals and during night hours, to the extent feasible, to maximize the effectiveness of rest breaks, and in accordance with international standards and good practices for work time.

6.6.2. Disaster Risk

6.6.2.1. Earthquake Risk

Earthquakes cause widespread structural damage to power generation, transmission and distribution subsystems. Structural failures may result from earthquake loading or be secondary to ground failure. Structural damage results from the response of structures and equipment to strong seismic ground motion.

Buildings in electric power networks house control rooms and protect heavy equipment, such as turbines and transformers. Most buildings may be steel-frame, reinforced concrete frame or wall, masonry (reinforced or unreinforced), or mobile structures. Electricity utility buildings are relatively short, from one to three stories high, which improves their seismic performance.

The proposed Muse-Mandalay Railway line is actually located in the Shan-Thai Block and the rocks are mostly of limestone of Paleozoic age with some ragged mountain terrains. The carbonate rocks are mostly of the limestone from Maymyo Formation which has karst topography, cave and sinkhole natures. As the railway line is expected to be 431 kilometers long, it will be needed a significant number of bridges and tunnels. So, it is necessary to construct those infrastructures systematically and qualitatively. Another important thing is that as Myanmar itself falls in an earthquake prone and the strongest earthquake (Kyaukkyan Fault) happed in the railway line near Naungcho town, it should be conscious and thoroughly made any structures that must be resisted the magnitude (> R.M.8) of earthquake.

Earthquake related landslide and other natural disasters such as storms, cyclones, floods and landslide caused by heavy rains should be aware and taken into account in considering engineering designs. In addition to high cost involved, seismic, geological and natural hazardous issues are major burdens to the engineering project along Muse-Mandalay speed railway line.

The Muse-Mandalay railway line runs diagonally along the southwestern direction through Upper Myanmar. The geological structure is between two first-order geotectonic units of the mountain - nyenchen tanglha range fold system (II) and the India-Myanmar-Sumatra fold system (III).

There are six main faults near the line: Bangpaman fault (F9), branch fractures (Kyaukme fault F7-1and Kunlong fault F7-2) of Nantinghe fault (F7), Lashio fault (F8), Goteik fault (F6), and Sagaing fault (F4). In which, the faults that have been active since the Late Pleistocene to the Holocene are the Nantinghe fault (F7) and the Sagaing fault (F4), which are all regional active faults in Holocene, and where witnessed earthquakes of magnitude 7 or higher for many times in history. There is still the possibility of an earthquake of magnitude 7 or higher in the future.

A number of earthquakes have significantly affected railroads. The effects range from restriction or suspension of operations on a portion of the railroad, while earthquake effects are assessed by inspection, to extreme damage over large areas. Since earthquake intensity depends on both the distance from the fault rupture and local conditions as well as the magnitude and depth of the earthquake, the extent of railroad damage is only indirectly related to the characteristics of the earthquake.

Damage from earthquakes occurs through several mechanisms. Surface displacements across the fault rupture can directly damage facilities that cross the rupture or, if under the ocean can cause tsunamis. Shaking from seismic waves can derail cars and locomotives, can directly damage structures, can produce permanent ground movements related to liquefaction and landslides and can cause damaging floods from dam failures. Appropriate measures to minimize damage or facilitate recovery depend on the mechanism causing the damage.

Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake, Serious damage.	20
8.0 or greater	Great earthquake Can totally destroy communities near the epicenter.	One every 5 to 10 years

Earth Damage and Failure Modes

Damage State	Substation Building/Structure
Slight/Minor	- Damage to building contents - Nonstructural damage - Localized damage to load-bearing members
Moderate	- Stress of load bearing members - Failure of a limited number of load-bearing members, without loss of structural integrity
Severe	Failure of load-bearing structure members, with compromise of structural integrity
Catastrophic	Partial or complete collapse foundation/ground failure

Earthquake Magnitude Classes

Earthquakes are also classified in categories ranging from minor to great, depending on their magnitude.

Class	Magnitude
Great	8 or more
Major	7 to 7.9
Strong	6 to 6.9
Moderate	5 to 5.9
Light	4 to 4.9
Minor	3 to 3.9

Source: UPSeis

The most common effect of earthquake on railway alignment with overhead power lines is that locomotives and/or cars can be derailed or overturned and breakage of overhead power lines in which power supply linkage with traction substations. They can also cause track damage and/or embankment failures. Track damage ranged from displaced ballast without other track disturbance to broken ties, pulled apart joints, broken rails, buckled track, and lateral displacement of up to several meters and loss of vertical support for track over appreciable distances.

Effects of earthquake on railway alignment with overhead power lines also include:

- Collapse of train
- Effect on life of humans, fatalities and injuries
- Effect to economy such as cost to rebuild asset, cost to respond to and recover, cost resulting from disruption of product or service, long term costs due to environmental damage.

Earthquake Induced Liquefaction Risk

Liquefaction is a soil behavior phenomenon in which a saturated soil losses a substantial amount of strength due to high excess pore-water pressure generated by and accumulated during strong earthquake ground shaking or other rapid loading.

In Muse-Mandalay Railway alignment, it is observed that some sections of railway line is located in a high seismic intensity area, where Quaternary loose saturated sandy soil is prone to earthquake-induced liquefaction. Sand liquefaction problems exist in Lashio basin (Lashio Station) and Thazi valley in Ayeyarwady basin. Saturated sand layers within 20 m depth below the surface on the riverbed, flood plain and terrace in tributaries of Ayeyarwaddy River are prone to sand liquefaction.

Evaluation of Earthquake Induced Liquefaction Potential

It is required to determine the liquefaction level to take suitable anti-liquefaction measures for relative project items. In proposed project, evaluation of liquefaction characteristics of soils will be tested by Standard Penetration Test (SPT). The liquefaction characteristic of a soil depends on several factors, such as ground acceleration, grain size distribution, soil density, thickness of the deposits and especially the position of the ground-water table. During performing SPT in-situ test for liquefaction, it is observed that the assessments have been extended to a depth of 40 m below existing ground level. It is considered that below this depth, liquefaction is improbable and also unlikely to influence behavior of facilities founded near to the surface.

Calculation of Cyclic Stress Ratio (SR_{eq})

The cyclic shear stress ratios (SR_{eq}) induced by earthquake ground motions, at a depth z below the ground surface, using the following equation

$$SR_{eq} = 0.65 \left(\frac{\sigma_o \, a_{max}}{g \, \sigma'_o}\right) r_d$$

Where;

a_{max} = maximum horizontal acceleration at the ground surface

σ_o = total vertical stress

σ'_o = effective vertical stress at depth

r_d = stress reduction coefficient that accounts for the flexibility of the soil column

According to the above questions, the values of peak ground acceleration a_{max} of the areas that are prone to sand liquefaction along the railway line are shown in the following table:

S/N	O-D mileage	Project item	Ground motion peak acceleration (g)
1.	CK376+740～CK377+960	Bridge	0.3
2.	CK379+800～CK381+000	Subgrade	0.3
3.	CK381+400～CK383+040	Subgrade	0.3
4.	CK386+450～CK387+560	Subgrade	0.3
5.	CK387+560～CK387+880	Subgrade	0.4
6.	CK388+320～CK389+240	Subgrade	0.4
7.	CK390+320～CK394+300	Subgrade	0.4
8.	CK397+400～CK398+300	Subgrade	⩾0.4
9.	LC1K0+000 ～ LC1K4+169.87	Subgrade	⩾0.4

Calculation of Cyclic Resistance Ratio (SR)

This is estimated based on either empirical correlation with the SPT N_m value allowing for the effects of the soil fines content (FC).

Empirical charts have been prepared to determine the cyclic strength based on corrected SPT blow count, (N_1) 60 , calculated as follows:

$$(N_1)_{60} = C_n \frac{ER_m}{60} N_m$$

Where,

C_n = correction coefficient for overburden pressure

ER_m = actual energy efficiency delivered to the drill rod

Calculation of factor of Safety (FS)

The Factor of Safety against liquefaction is defined as

$$FS = \frac{(SR)}{(SR_{eq})}$$

The following figure shows the flow chart of the Seed and Idriss simplified method for liquefaction analysis.

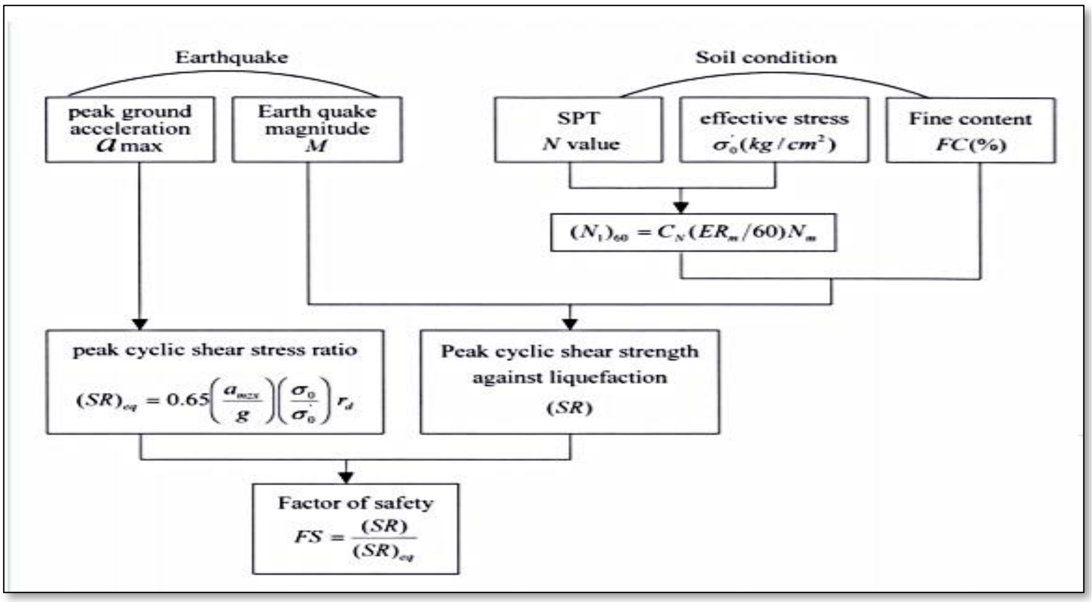


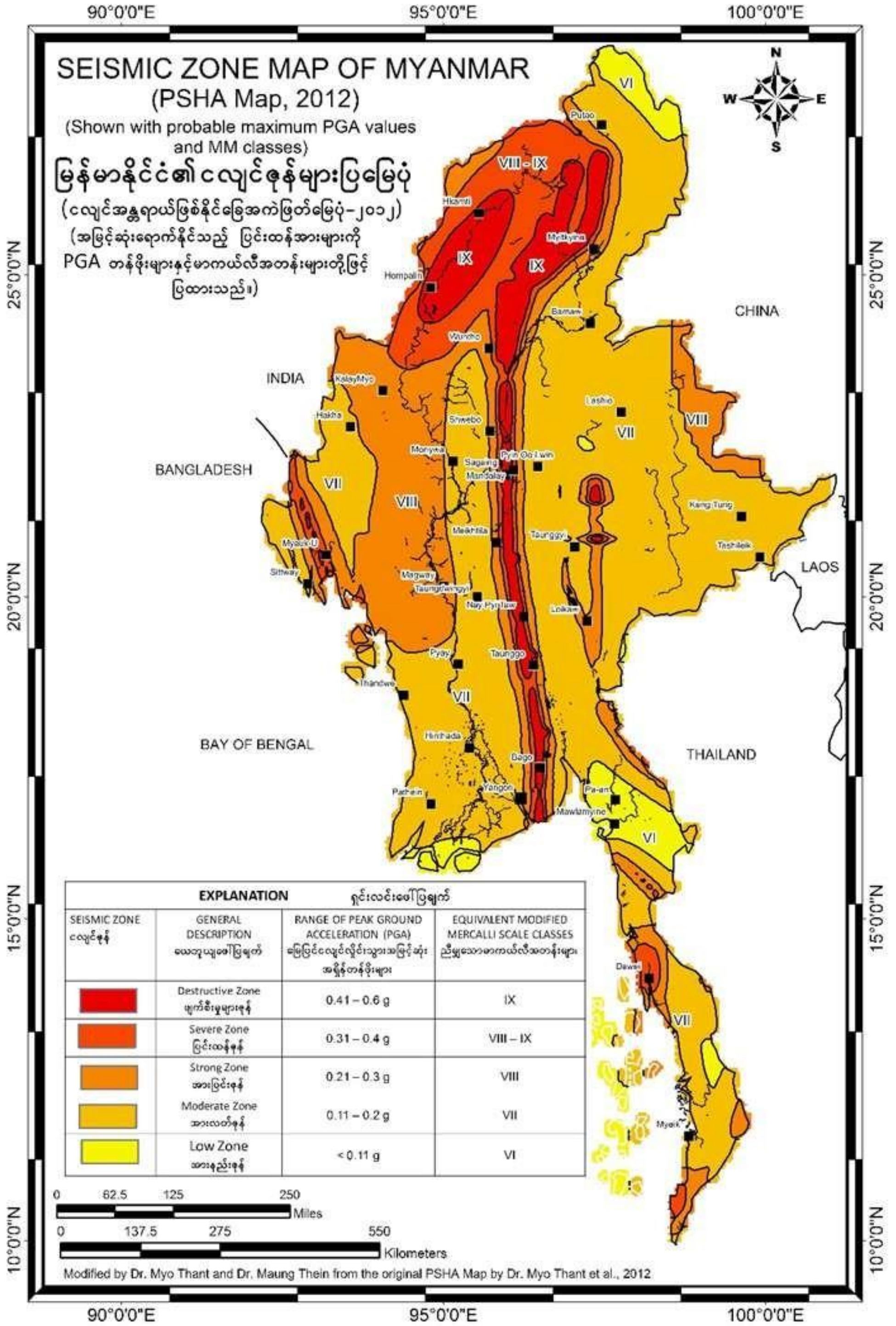
Figure - Flow Chart of Seed and Idriss Method for Liquefaction Potential Estimation

If the cyclic stress ratio caused by an earthquake is greater than the Cyclic Resistance Ratio of the in-situ soil, then liquefaction could occur during the earthquake and vice versa. Liquefaction is predicted to occur when FS ≤ 1.0, and liquefaction predicted not to occur when FS > 1. The higher the factor of safety, the more resistant against liquefaction. By observing the resulted values of FS, the relative project items can be taken corresponding anti-liquefaction measures. For example, bridges shall use pile foundations to pass through the liquefied soil layer or adopt other corresponding anti-liquefaction measures in face of the same.

Earthquakes in last 50 Years (Source: volcanodiscovery.com)

Region	Date	Magnitude (Richter Scale)	Location
Mandalay-Sagaing	11.11.2012	5.0	Pyin Oo Lwin
	30.3.2013	5.0	Pyin Oo Lwin
	9.9.2013	5.0	Mandalay
	18.1.1986	5.1	Mandalay
	1.1.1988	5.2	Mandalay
	26.6.2014	5.2	Mandalay
	28.11.2019	5.2	Pyin Oo Lwin
	11.11.2012	5.6	Pyin Oo Lwin
Shan State	1.3.2015	5.2	Lashio

	1.3.1989	5.8	Lashio
	23.4.1984	5.9	Lashio
	9.7.1995	5.9	Lashio
	23.4.1992	6.1	Lashio
	23.4.1992	6.2	Lashio



Probabilistic Seismic Hazard Assessment Map (PSHA Map) of Myanmar showing expected peak ground acceleration (PGA) values with 100% probability in 500 years. (Note: 0.21 - 0.3 g zone in the northern part of Shan State is taken from the Seismic Zone Map of Myanmar by Dr. Maung Thein et al., 2005)

Source: MIMU [Myanmar Information Management Unit]

Figure - Seismic Zone Map of Myanmar

Calculation of Probability

As stated in the above table, the probability of earthquakes, which can be slight to moderate damage (Richter scale 5-6.9), be occurred in 50 years can be taken as "Almost Certain".

An earthquake of magnitude 7.0 Richter scale occurred in Sagaing, 39km Northwest of Mandalay, on 16th July, 1956. A strong earthquake occurred on 24th July, 1485 near this location, which is also along the Sagaing fault. So, the return period of a strong earthquake to be occurred can be taken as 471 years where the probability for a strong earthquake to be occurred in 50 years can be calculated as 10.6%. It can be taken as "Likely".

Calculation of Consequences

Before Mitigation

Mandalay-Sagaing Region

Earthquakes occurred in Mandalay-Sagaing Region are generally 5.0-5.5 Richter Scale, which can be minor and slight damage to structures. However, since this region is classified as Severe to Destructive zone in Seismic Zone Map of Myanmar, the consequences can be taken as "Moderate".

However, according to records, earthquake in 1485 in Sagaing destroyed 3 well known pagodas and the one which happened in 1956 severely damaged several pagodas and 40 to 50 people were killed by this one. So, strong earthquakes of magnitude 7.0 Richter scale and above can be taken as "Catastrophic" since the region is also classified in the Severe to Destructive Zone.

Shan State

Earthquakes in this region are generally 5.5-6.5 Richter Scale, which can be moderate damage to structures, but it is classified as Moderate zone in Seismic Zone Map of Myanmar. So, the consequences can be taken as "Moderate".

After Mitigation

After Mitigation measures, consequences taken as "Moderate" can be reduced to "Insignificant" and consequences taken as "Catastrophic" can be reduced to "Moderate".

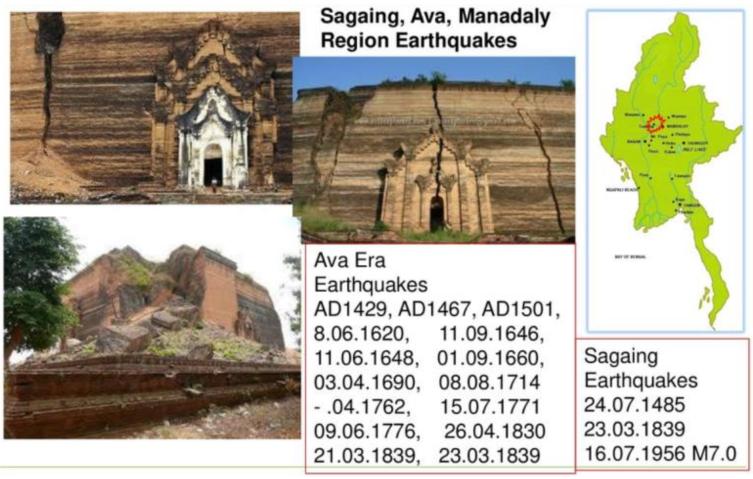


Figure - Past earthquakes in Sagaing, Ava (Innwa) and Mandalay Region

Risk Assessment Table depending on the 5X5 Risk Matrix

Region	Consequences	Probability	Initial Risk	Mitigation Measures	Consequences after mitigation	Probability after mitigation	Reduced Risk
Mandalay-Sagaing	3	5	15 (High Risk)	• Structures should be designed to withstand an earthquake of magnitude up to Richter Scale 8.0. • Selection of railway route which can have minimum impact by an earthquake. • If outdoors, find a clear spot away from buildings, trees, streetlights and power lines. Keep lying on the ground and stay there until the shaking stops. • If indoor, go below table until the shaking stops. Avoid lift and staircase.	1	5	5 (Moderate Risk)
Mandalay-Sagaing (Richter Scale 7.0 & above)	5	4	20 (Critical Risk)		3	4	12 (High Risk)
Shan State	3	5	15 (High Risk)		1	5	5 (Moderate Risk)

Residual risk even after mitigation measures cannot be mitigated more since earthquake is a natural disaster but it can be controlled by proper emergency planning after an earthquake.

- To organize search and rescue of people trapped under debris.
- Medical officer to ensure provision of proper Medical Aid to the injured.

Mitigation Measure for Earthquake Risk

Earthquakes can occur without warning and have the potential to severely affect lives and structures. Identifying potential hazards ahead of time and preparing in advance can reduce the dangers of serious injury or loss of life from an earthquake. The mitigation should include;

- Securing heavy objects to walls and floors, such as shelves, cabinets, and water heaters.
- Placing large, heavy, or breakable objects on lower shelves.
- Hanging heavy items away from areas where people sit or gather frequently.
- Bracing overhead light fixtures.
- Repairing defective electrical wiring and leaky gas connections. These are potential fire risks.

- Repairing any deep cracks in ceilings or foundations. Get expert advice if there are signs of structural defects.
- Storing flammable products and hazardous material securely on bottom shelves in cabinets that are closed with latches.
- Make sure you have a fire extinguisher, first aid kit, a battery-powered radio, a flashlight, and extra batteries at home.
- Learn first aid.
- Make up a plan of where to meet your family after an earthquake.

Risk Assessment for Liquefaction

Calculation of Probability

The probability of liquefaction is taken as "Almost Certain" as earthquakes can be occurred in 50 years and magnitude above 5.5 can trigger liquefaction.

For earthquake with magnitude 7 and above, it is taken as "Likely" since in 16th July 1956, an earthquake of magnitude 7 occurred in Sagaing and in 24th July 1485, another strong earthquake occurred along the Sagaing fault. Therefore, the return period of the strong earthquake is taken as 471 years and its probability in 50 years can be calculated as 10.6%. Liquefaction is triggered after earthquake.

Calculation of Consequences

Before Mitigation

Magnitude above 5 can trigger liquefaction and depends on its Richter scale, the damage occur to structures can be classified. The consequences of liquefaction below earthquake of magnitude 7 is moderate as it can cause minor and slight damage to the structures and its liquefaction risk depends on the impact of the earthquake.

Earthquakes with magnitude above 7.0, the liquefaction risk will be higher as in records, several pagodas and 40-50 people were killed in the earthquake occurred in 1956. Therefore, the consequences is taken as major due to multiple fatalities.

After Mitigation

After mitigation measures, consequences taken as "Moderate" can be reduced to "Minor" and consequences taken as "Major" can be reduced to "Moderate".

Region	Consequences	Probability	Initial Risk	Mitigation Measures	Consequences after mitigation	Probability after mitigation	Reduced Risk
Mandalay - Sagaing	3	5	15 (High Risk)	- structures should be supported on deep foundations such as piles - avoid construction on liquefaction susceptible soils - improve the soil by compacting and increasing its relative density	2	3	6 (Medium)
Mandalay -Sagaing (Richter Scale 7.0 & above	5	4	20 (Extreme)		3	4	12 (High)

Mitigation Measures for Liquefaction Hazards

Mitigation measures against liquefaction are

- The infrastructures should be supported on deep foundations, such as piles, that extend through the liquefiable soil to deeper strong and stable strata.
- The liquefaction of a soil can be prevented by compacting the soil and increasing its relative density by means of vibratory rollers, compaction piles, vibrio-flotation, blasting, etc.
- stabilizing soil is performed by injecting chemicals or cement grout into the soil
- By restoring to extensive ground water pumping in which the effective stress at a point increases as the water table is lowered, the liquefaction can be prevented to some extent.
- The liquefaction hazard can be reduced to some extent by providing coarse sand blankets and drains in the soil deposit.
- Applying a surcharge load to a soil deposit and construction of stone columns, the possibility of liquefaction is reduced by means of increasing the effective stress.

6.6.2.2. Flood Risk

A flood is a high flow or overflow of water from a river or similar source of water occurring over a period of time. Heavy rain spell can result in an extra volume of water in the waterways, leading to a rise in the water level of streams and rivers. A flood happens when the carrying capacity of the waterways fails to hold the total volume of increased water at any given time. Nowadays, all the countries' climate is changing - temperatures are getting hotter and the monsoon season is getting shorter. That' s why flooding cause of climate change, appear as a threat for us.

Many factors can go into the making of a flood, these are;

The main causes of floods are:

- Continuous heavy rain
- Bad drainage facilities
- Blocking of river channels by landslides
- Narrowness of the river
- Change in the course of river
- Inefficient engineering design in the construction of embankments,
- dams and canals
- Failure of hydraulic and other control measures
- Destruction of mangroves and trees which do not grow back
- Deforestation and removal of root system
- Sediment deposit or silting of the river bed
- Rapid urbanization with no proper drainage facility
- Storm surge
- Tsunami
- More and more, flooding factors are also linked to climate change.

Substation equipment flood damage and failure modes

Damage or service disruption	Description
Slight/Minor	Shut off preemptively Tripping
Moderate	Inundated, repairs economically feasible
Severe	Inundated, beyond economically feasible repair
Catastrophic	Explosion Washed away by floodwaters

Flash Flood

Flash floods are floods that rise and fall rapidly with little or no advance warning. A flash flood occurs when water overflows on or inundates land that is normally dry. Rivers can overflow their banks to cause flooding, and sea waters can be pushed towards land by massive winds, which then cause flooding. Rainfalls over an extended period can cause major rivers to overflow their banks. Rivers can overflow their banks, causing flooding during heavy rains, severe storms and dam breaks. Huge amounts of water flowing in rivers are due to incessant heavy rains and melting of snow, resulting in severe flooding. Flash flood normally happens during the monsoon season. Around this time, potholes can overflow fast, breaking and damaging the river banks. Flash floods are common in mountainous regions. Lack of vegetation and denudation of the mountain areas are the major causes of flash floods.

Flash flood damages can be reduced by establishing a proper flood control management structure to manage floods and reduce their ill effects. Taking precautionary steps, measures, and actions with the help of the government will deliver communities, agricultural land, infrastructure, and livelihoods in flash flood-prone areas to safety.

River Flood

A river flood occurs when a river overspills its banks; that is, when its flow can no longer be contained within its channel. Flooding is a natural and regular reality for many rivers, helping sculpt soil and spread nutrients in alluvial valleys and supporting many ecosystems – such as swamps and bottomland forests – adapted to occasional inundation.

River floods have also been life-giving forces for human societies dependent on them for agriculture and soil fertility. Nonetheless, humans often perceive floods negatively because of the damage and loss of life they often wreak where natural floodways have become heavily developed and populated.

Climate Change and Flooding

Connecting climate change to floods can be a tricky endeavor. Not only do myriad weather- and human-related factors play into whether or not a flood occurs, but limited data on the floods of the past make it difficult to measure them against the climate-driven trends of floods today. However, as the IPCC (Intergovernmental Panel on Climate Change) noted in its special report on extremes, it is increasingly clear that climate change "has detectably influenced" several of the water-related variables that contribute to floods, such as rainfall, extreme weather events, etc. Floods are made more likely by the more extreme weather patterns caused by long-term global climate change. Change in land cover—such as removal of vegetation—and climate change increase flood risk.

Extreme floods can be triggered by intense precipitation, longer duration, close repetition of precipitations or a combination of these. "While it is difficult to make a direct link between an individual extreme event and climate change, it is clear that we need to be prepared to face more intense and more frequent extreme hydro-meteorological events due to climate change," says Pascal Peduzzi, Director of the United Nations Environment Programme's (UNEP) Global Resource Information Database in Geneva.

Climate change endangers the railways system when subjected to flooding events. Flood events have caused property damage along with service disruptions, by the inundation of underground infrastructures (e.g., tunnels and alignment). Therefore, it is important to evaluate flood risks in railways systems to plan for flood disasters and set mitigation strategies efficiently.

General Rainfall Conditions and Flooding around Proposed Project

In Myanmar, annual rainfall in the delta region is approximately 2,500 mm (98.4 in), while average annual rainfall in the Dry Zone in central Myanmar is less than 1,000 mm (39.4 in). In specific, about 812 mm(32.0) inch of precipitation falls annually in Mandalay and around 1758 mm (69.2) inch per year in Shan State (climate-data 2020).

The floods in Myanmar, mainly occur during the monsoon months (June to October). The type of floods occur in Myanmar may be generally classified into two; the wide spread flood and flash flood. The wide spread flood mostly occurs along Ayeyarwady, Chindwin, Sittoung and Thanlwin which are major rivers and the flash flood usually occur at the small rivers and stream. The main cause of wide spread flood is heavy rainfall striking at the head water regime for considerable period (1 to 3 days), the flood wave forming at the head water started to move downward and causing flood along the river up to the deltaic area. The flash flood is caused by heavy rainfall fell on the source and the flood wave move downward swiftly. Observation shows that the percentage of occurrence of floods (exceeding danger level) in medium and large rivers of Myanmar are 6% in June, 23% in July, 49% in August, 14% in September and 8% in October. The severe floods had occurred in 2004, 1974,1997,1976,1991,1973,1988 and 1997, and order of the years are arranged with respect to their intensities. Ref; *(Department of Meteorology And Hydrology (Myanmar) 2020)*

Floods in last 50 Years

Location	Date
Wundwin, Mandalay Division	July 2001
Kyaukse District, Mandalay Division	October 2006
Along Ayeyarwaddy River	July 2004
3 places in Mogok Town	July 2008
Amarapuya Township	July 2020
Mandalay Division	June 2019
Amarapura Township	July 2016
Patheingyi	July 2016
Myit Nge , Pyin Oo Lwin, and Patheingyi, Mandalay Divison	September 2015

Flood Risk Assessment

Mandalay region

In Mandalay Region, both flash floods and river floods can occur because of its vicinity to Ayeyarwaddy River.

Calculation of Probability

Before Mitigation

Flash floods may occur at least once a year, so, the probability can be taken as “Likely”. For river floods, it is estimated that it might occur at some time, and so, the probability can be taken as “Possible”.

Calculation of Consequences

Before Mitigation

Flash floods can be low environmental damage, and so, the consequences can be taken as “Minor”. River floods can be medium damage to environment, so, it can be classified as “Moderate”.

After Mitigation

After proper mitigation measures and flood control measures, consequences of flash floods can be reduced to “Insignificant” and river floods “Minor”.

Shan State

In Shan State, only flash floods mostly occur.

Calculation of Probability

Before Mitigation

Flash floods may occur at least once a year, so, the probability can be taken as “Likely”.

Calculation of Consequences

Before Mitigation

Flash floods can be low environmental damage, and so, the consequences can be taken as “Minor”.

After Mitigation

After proper mitigation measures and flood control measures, consequences of flash floods can be reduced to “Insignificant”.

Flood Risk Assessment Table

Region & Flood Type	Consequences	Probability	Initial Risk	Mitigation Measures	Consequences after mitigation	Probability after mitigation	Reduced Risk
Mandalay (Flash Flood)	2	4	8 (Moderate Risk)	• Proper Drainage System • Re-vegetation after cutting trees in the vicinity • Avoid over cutting of trees in mountainous regions to reduce denudation	1	4	4 (Moderate Risk)
Mandalay (River Flood)	3	3	9 (High Risk)		2	3	6 (Moderate Risk)
Shan State (Flash Flood)	2	4	8 (Moderate Risk)		1	4	4 (Moderate Risk)

Preparedness Scale for Flood Risk Climate Change

Example preparedness scale for flooding and climate change;

We should prepare for unforeseen events and then identified the hazards with reactive action plans and set short-term forecast and plan. To implement long-term sustainable planning. A specific risk due to flooding and climate change, could impact on these parts on proposed project.

Control Measures for Flooding

- Introduce better Flood warning system
- Construct substation about flood level
- Tackle climate change
- Protect wetlands and introduce plant trees strategically
- Introduce water storage area
- Put up more flood barriers

Power Traction/ Electrical Power Risk due to Flooding

Floods are commonly associated with power outages. Impacts of flooding on the power supply system are;

- Flooding of power sub-station could cause electric shock.
- Loss of power could also disable other infrastructure system.
- Power shortages for traction, and stations. Widespread loss of power would affect machinery, and passengers which would stop operations.
- Moisture and dirt.
- Points and signaling equipment rely on intricate wiring and power supplies, which are extremely vulnerable to failure during flooding, and need replacing before services can run again. If the track has a live conductor rail, flooding can cause a short circuit.

6.6.2.3. Electrical Fire Risk due to Wildfire and Electrical Shock

Over the years, utilities around the nation have had to deal with wildfire-related damage to their transmission and distribution lines, especially those that traverse wilderness areas. Now, there is growing evidence that, in some instances, the power lines themselves are triggering the wildfires.

In some instances, high winds can blow nearby trees and their branches into power lines, sparking fires. In other cases, wind can snap wooden distribution line poles, causing live wires to fall onto nearby dry grass, setting it on fire.

Fire fighters performing fireground operations near downed power lines may be exposed to electrical shock hazards through the following means:

- Electrical currents that flow through the ground and extend several feet (ground gradient)
- Contact with downed power lines that are still energized
- Overhead power lines that fall onto and energize conductive equipment and materials located on the fireground
- Smoke that becomes charged and conducts electrical current

A key strategy to prevent fire

The safest way to deal with fire is to prevent it. A fire needs three elements: heat, oxygen and fuel. Without heat, oxygen and fuel, a fire will not start or spread. A key strategy to prevent fire is to remove one or more of heat, oxygen or fuel.

The goals for fire protection are universal; only the means chosen to achieve them vary. These goals can be simply stated in the following list.

Prevent the fire or retard its growth and spread.

- Control fire properties of combustible items.
- Provide adequate compartmentation.
- Provide for suppression of the fire.

Protect occupants from the fire effects.

- Provide timely notification of the emergency.
- Protect escape routes.
- Provide areas of refuge where necessary and possible.

Minimize the impact of fire.

- Provide separation by tenant, occupancy, or maximum area.
- Maintain the structural integrity of property.
- Provide for continued operation of shared properties.

Support fire service operations.

- Provide for identification of fire location.
- Provide reliable communication with areas of refuge.
- Provide for fire department access, control, communication, and water supply.

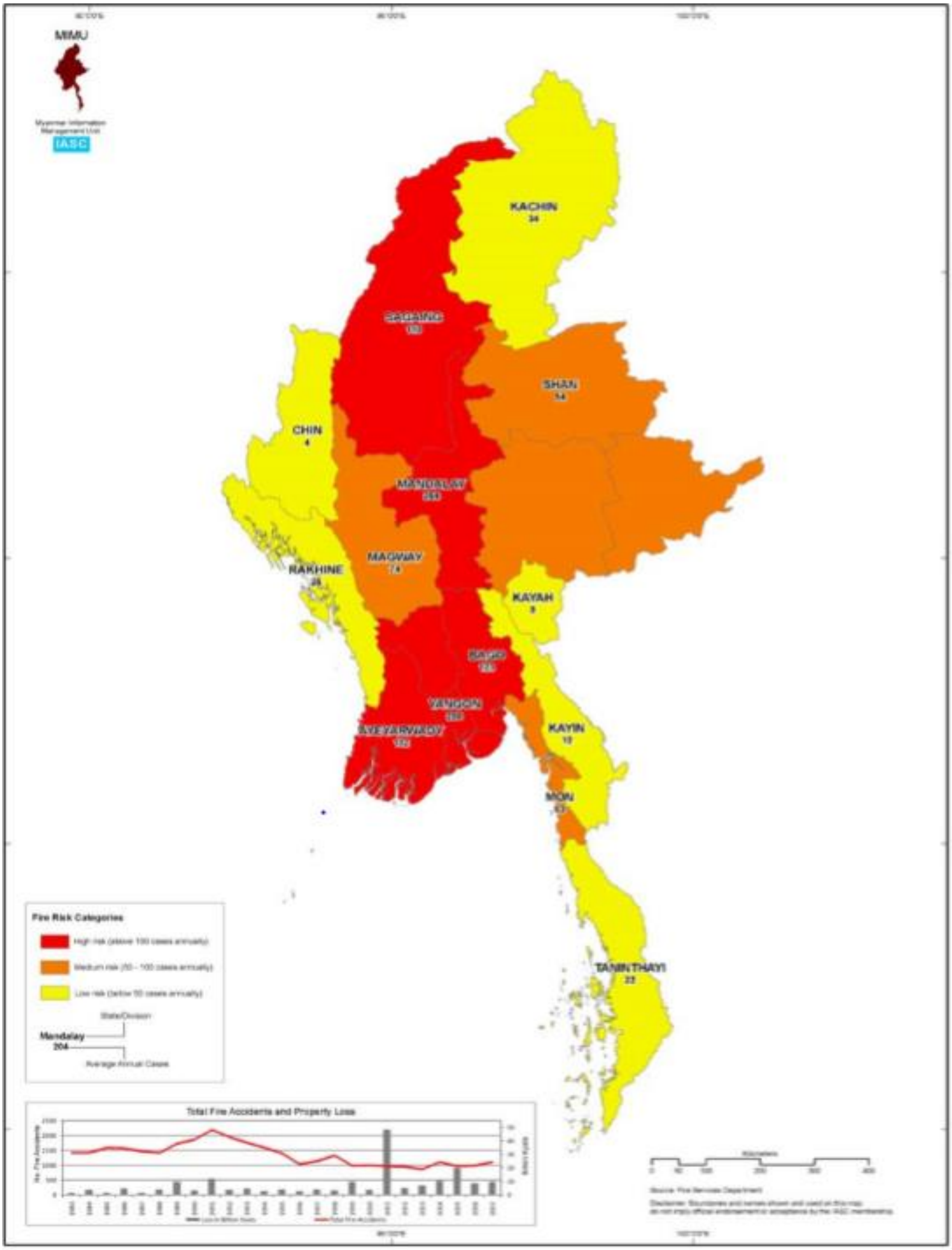


Figure: Fire Risk Map (Based on fire cases from 1983-2007)

The fire case of last 25 years (1983-2007) reflect decreasing trend at figure.

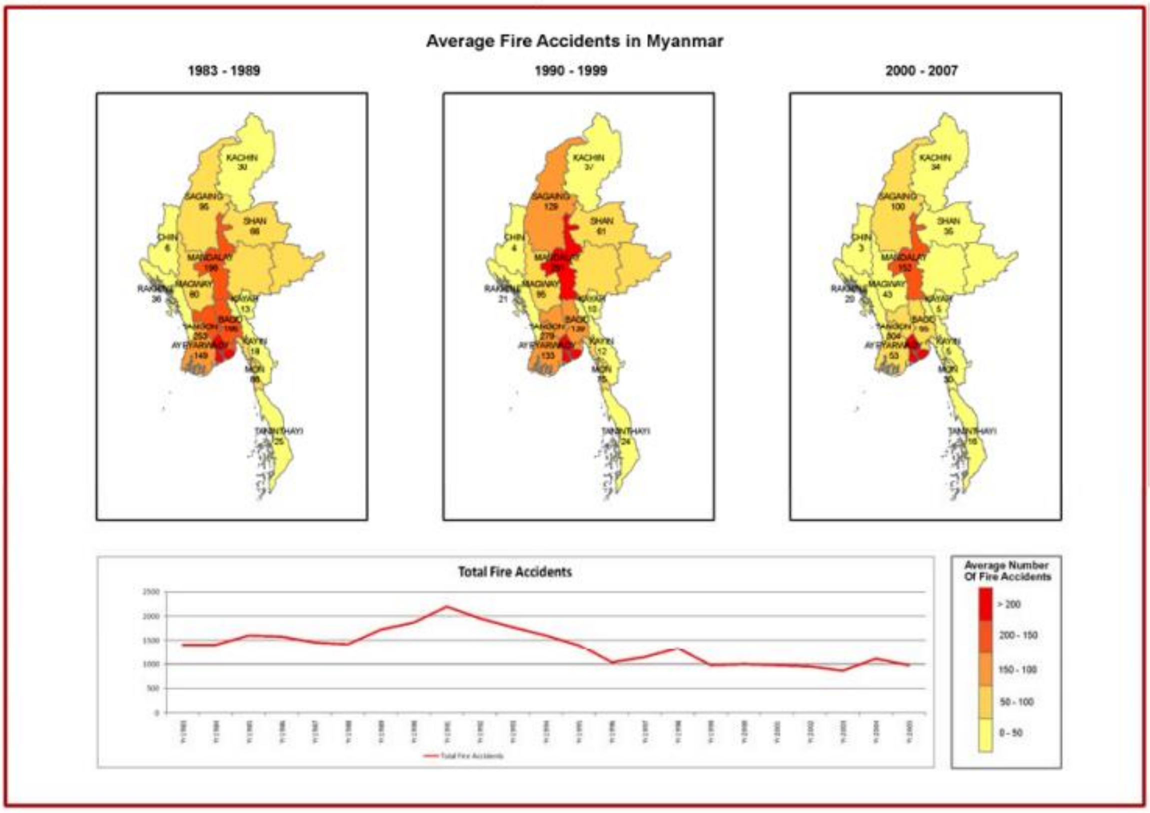


Figure: Annual Average Fire Cases

The average annual financial loss reflects increasing trend at figure.

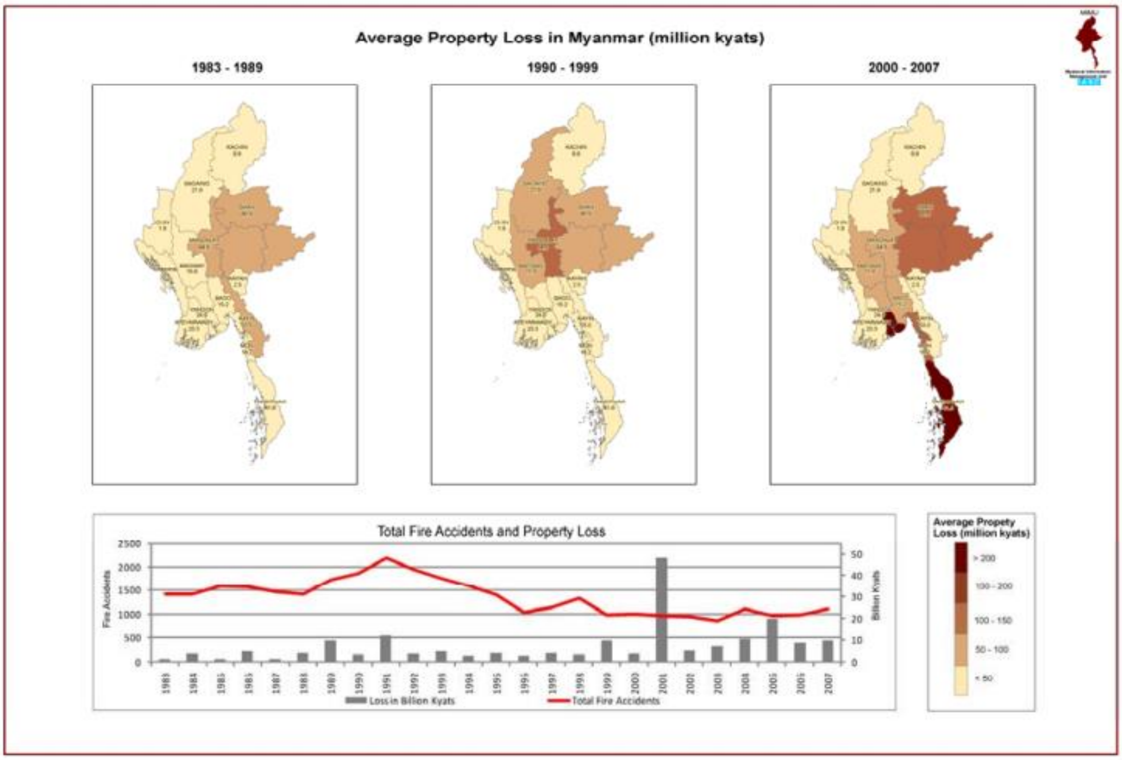


Figure: Average Annual Financial Losses due to Fire

Calculation of Probability

According to the Fire Risk Map of Myanmar, the number of annual fire cases is Mandalay Division is between 200-150 so it is considered to be high and in Shan State, it is between 50-100 which is in medium.

Calculation of Consequences

The number of financial losses from fire in Mandalay Division is less than 100 million kyats so its scale is low and for Shan State, its loss is between 100 to 200 million kyats so its scale is medium

Fire Risk Assessment Table

Region & Flood Type	Property Loss	Probability	Initial Risk	Mitigation Measures	Property loss after mitigatio	Probability after mitigatio	Reduced Risk
Mandalay	Medium	High	Medium risk	Control fire properties of combustible items Provide for suppression of the fire Do not leave the cooking unattended because cooking is the number one cause of residential fires and unattended cooking increases the chance of a stove top fire High voltage lines require much thicker insulation; therefore the condition should be made that the higher the voltage, the thicker the insulation	Medium	Medium	Medium Risk
Shan State	Medium	Medium	Medium Risk		Medium	Low	Low Risk

Prevention Measures of the risk of electrocution, electrical shock, and electricity-related burns

To minimize the risk of electrocution, electrical shock, and electricity-related burns while fighting wildland fires, fire departments and firefighters should take the following precautions:

Fire departments should do the following:

- Keep firefighters a minimum distance away from downed power lines until the line is de-energized. This minimum distance should equal the span of two poles.
- Establish, implement, and enforce standard operating procedures (SOPs) that address the safety of fire fighters when they work near downed power lines or energized electrical equipment. For example, assign one of the fireground personnel to serve as a spotter to ensure that the location of the downed line is communicated to all fireground personnel.
- Do not apply solid-stream water applications on or around energized, downed power lines or equipment.
- Ensure that protective shields, barriers, or alerting techniques are used to protect fire fighters from electrical hazards and energized areas. For example, rope off the energized area.
- Train fire fighters in safety-related work practices when working around electrical energy. For example, treat all downed power lines as energized and make fire fighters aware of hazards related to ground gradients.
- Ensure that fire fighters are equipped with proper personal protective equipment and that it is maintained in good condition.
- Ensure that rubber gloves and dielectric over-shoes and tools (insulated sticks and cable cutters) for handling energized equipment are used by properly trained and qualified personnel.

Fire fighters should do the following:

- Assume all power lines are energized and call the power provider to de-energize the line(s).
- Wear appropriate personal protective equipment for the task at hand.
- Do not stand or work in areas of dense smoke. Dense smoke can obscure energized electrical lines or equipment and can become charged and conduct electrical current.

Mitigation Measures to Wildfires

There are several measures that can be taken. First is clearing trees under and alongside power lines. Second is reducing the risk of sparking between conductors by shorter spans between poles and greater separation between the conductors. Using stronger poles and more frequent maintenance checks to remove weaker poles can reduce the risk of pole failure. Monitoring local wind-speeds and switching out lines when winds too high are another option. Of course these cost money, but it is the community as a whole that bears the costs of wildfires rather than the utilities.

Forest fires are Mother Nature's way of cleaning and renewing land. But that's not a good solution in populated areas and along the power lines. So the only real solutions are to bury the wires or clear out the fuel manually. The first is very expensive one time; the second is a continuing expense - and not really practical anyway due to the ruggedness of the terrain. The mitigation measures for forest fire are carried out according to the EHS Guideline.

Monitoring right of way vegetation according to fire risk

Removing blowdown and other high-hazard fuel accumulations

Time thinning, slashing, and other maintenance activities to avoid forest fire seasons

Disposal of maintenance slash by truck or controlled burning. Controlled burning should adhere to applicable burning regulations, fire suppression equipment requirements and typically must be monitored by a fire watcher.

Planting and managing fire resistant species (eg. Hardwoods) within and adjacent to right of way

Establishing a network of fuel breaks of less flammable materials or cleaned land to show progress of fires and allow firefighting access.

Mitigation Measures to electrical fire

However, insulating the power lines is not the cure-all, either. High voltage lines require much thicker insulation; therefore, the condition should be made that the higher the voltage, the thicker the insulation. Moreover, another real solution is to remove the fuel. We don't necessarily have to cut down the trees - but brush, especially dead brush that accumulates, is a real danger.

Fires Caused by Carelessness and Mitigation Measures

Carelessness is the most productive cause of fire and the cause of 80 per cent of fires. Its prevalence is due to the lack of personal responsibility on the part of those whose negligence permits fire to start. A man on whose premises a fire originates from avoidable causes after his failure to comply with the local fire prevention ordinances should by law be financially liable for part of or all the damage to tile adjoining property and to the city for its cost in extinguishing the fire. Neither laws or other measures can entirely overcome the failings of human nature and abolish carelessness. Nevertheless, if two-thirds of all fires have this cause as their origin it is probably not presumptions to assume that by strict enforcement of proper fire prevention regulations negligence could be checked. The ways to prevent fire incidents due to carelessness include the following.

- Educate the public, change its indifferent attitude towards fires and still more slowly change its careless habits
- Avoid unattended or careless use of candles. No open flames are allowed inside the station
- Do not smoke indoor
- Do not leave the cooking unattended because cooking is the number one cause of residential fires and unattended cooking increases the chance of a stove top fire
- Use high pressure gases, stored in huge tanks near plant buildings, to fight fire

Forest Fire

Forest fire hazard is considered a process, a phenomenon or a human activity that may cause loss of life, injury, infrastructure damage, social and economic disruption and environmental degradation. It is a fire that is burnt in trees, bushes or woodland that are uncontrolled and unwanted. Since the Muse-Mandalay railway system will be constructed through plenty of forest areas, forest fires can be caused and affect the infrastructure of the bridges.

The effects of forest fire on bridge infrastructure include:

- Immediate closure of bridges and damages to the bridge structure and infrastructure elements.
- Damage to the surrounding area that may involve loss of stability of the surrounding area leading to landslides and erosion
- Danger from falling trees and the potential for future flood risk

Fire disaster impact on bridge infrastructure could be a result of bushfires or accidents on the roads or on their adjacent environment. The impact of the elevated temperature caused by fire on material types used in construction of bridges, culverts and flood-ways could lead to degradation of structural or functional capacity of the structures and eventually failure of their elements. Responses of structures exposed to fire can vary as it could be in thermal, mechanical and deformation responses.

Reinforced Concrete	**Steel**
• Concrete spalling	• Steel distortion
• Concrete cracking	• Deflection of steel elements
• Concrete delamination	• Formation of steel elements
• Compressive strength reduction	• Buckling (web buckling)
• Steel reinforcement and prestressed strands strength reduction	• Reduction of tensile and yield strength
	• Post-fire steel toughness
	• Steel pitting & flaking
	• Paint and coating degradation

Forest fires are mostly done by arsonists and human accidents; however, they are also started by natural causes such as lighting strikes. It is common in areas with low rainfall, hot and dry summers, fire proneness and dependence of eucalypt forest. The intensity and the spread of forest fire are based on factors such as

- Vegetation type
- Wind speed
- Temperature
- Humidity
- Topography of the area

Humidity, low rainfall, increasing temperatures and wind speeds are generally favorable conditions for forest fire risk.

10-day observation of forest fire cases (January to June 2008)

The dominant type of forest in Mandalay and Shan State is residual forest that sheds leaves during dry season. As a result, the associated forest fires, which are normally surface fire, are most frequent during the dry season, starting from around December until May, as shown in following table.

Table- 10-day observation of forest fire cases (January to June 2008) (Area in Acre)

State& Division	1Jan-10Jan	11Jan-20Jan	21Jan-30 Jan	31 Jan-9 Feb	10 Feb-19 Feb	20 Feb-29 Feb	1Mar-10 Mar	11Mar-20 Mar
Mandalay	0.14	1190	1666	2619	2619	3571	5952	7380
Shan	0.00	43714	17158	35831	88538	124414	169203	35335

State& Division	21 Mar-30 Mar	31 Mar-9 Apr	10 Apr-19 Apr	20 Apr-29 Apr	30 Apr-9 May	10 May-19 May	20 May-29 May	30 May- 8 Jun
Mandalay	6428	5475	2857	714	0	0	0	0
Shan	383195	333429	306556	129390	0	0	0	0

Source-Hazard Profile of Myanmar

Forest Fire Risk Assessment

Risk	Consequences	Probability	Risk
Forest Fire	1	4	Medium

Mitigation Measures for Forest Fire Risk

- Management of combustible materials and ignition sources and including vehicles movements across grassed areas and cigarettes.
- Fuel reduction where necessary and consistent with fire regimes for native vegetation
- Fire protection and firefighting equipment.
- Thinning of trees, vegetation, and removal of highly flammable vegetation
- Elimination of fuel ladders, including shrubs near tree branches
- Integration of natural barriers such as rock outcroppings, wetlands, streams, ponds and fences
- Do not let plants touch the siding, as their flames will allow the vertical spread of flames so cut them off.
- Landscape plans that prioritize plants with high-moisture content.

7.0. CUMULATIVE IMPCT ASSESSMENT

Cumulative Impact Assessment is the process of assessing potential effects on receptors from environmental and social impacts caused by the combined influence of more than one project. Evaluation of potential cumulative impacts is an integral element of an impact assessment.

7.1. Methodology and Approach

The analysis of cumulative impacts in this section follows the processes recommended by EIA procedure (2015) and the regulations at Section 42 of the Environmental Conservation Law. Cumulative impacts in relation to an activity are defined in the EIA Regulations (Government Notice R543) as meaning "the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area". Cumulative impacts were assessed by taking into consideration of potential environmental impacts of the proposed project and other related activities that had happened in the past, currently is happening at present and likely to happen in the future. In general, the proposed project cumulative impact railway facilities depending on the resource considered. The potential cumulative impact for the proposed project encompasses the area of physical disturbance along the proposed project construction ROW and adjacent areas that could have localized impacts associated with temporary access roads and aboveground facilities. The actions considered in the cumulative impact analysis may vary from the proposed project in nature, magnitude, and duration. These actions are included based on their likelihood of occurrence, and only projects with either ongoing or reasonably foreseeable impacts are identified.

7.2. Existing and Future Private and Public Projects and Developments

The followings are the existing private and public infrastructure, factory and industrial sector related to the proposedproject…

7.2.1. Existing Private and Public Project and Developments

7.2.1.1. Existing Power Transmission Line in Northern Shan State

(a) 230 kV Mansan Primary Substation

1. Location – Nantmatu Township, Kyauk-mae District, Shan (North) State
2. Area – (70) Acre
3. Commissioning Date – (7-July-2008)
4. Install Capacity – 230/66/11kV 60 MVA (LEEEC, China)

Total – 60 MVA

5. Transmission Lines and Distribution Feeders –

(i) 230 kV Transmission Lines

(1) Shwesaryan (1) Line
(2) Shwesaryan (2) Line
(3) Shweli (1) Line
(4) Shweli (2) Line

(ii) 66 kV Transmission Lines

(1) Thi-baw Line
(2) Lashio Line
(3) Mansan Line

6. Distribution Regions – Lashio Township, Kutkai Township, Tant-yan Township, Mine-yael Township, Kyauk-mae Township, Hsipaw Township, Nant-matu Township and Nant-san Township.

Figure - Existing Power Transmission Line in Northern Shan Region

TRANSMISSION LINE	Existing	Future (Under Constructions)
500 kV	-	- - - - - - - - - -
230 kV	————	-----------------
132 kV	————	-----------------
66 kV	————	-----------------

SUBSTATION	Existing	Future (Under Constructions)
500 kV	-	△
230 kV	▲	△
132 kV	▲	△
66 kV	▲	△

POWER STATION	Existing	Future (Under Constructions)
HYDRO POWER STATION	■	□
GAS TURBINE POWER STATION	■	□
STEAM TURBINE STATION	⊕	-
SOLAR	-	■
WIND	-	■

Figure - Map of Electrification in Northern Shan State Source

(b) Shweli No. (1) Hydropower Project

1. Location – Nam Hkan Township, Shan State
2. River – Shweli
3. Construction Starting Date – 2002 - 2003
4. Commercial Running Date – 2009
5. Installed Capacity – 600 MW (6 × 100 MW)
6. Rated Head – 981 ft
7. Type of Turbine – Francis (Vertical)
8. Discharge – 6 × 1382.7 = 7972.2 ft^3/s
9. Annual Design Generation – 4022 GWh
10. Transmission Line – 230 kV Shweli-Mansan to Taung Taw Kwin Substation Shwesaryan Line (1) & (2) – (180) miles
11. Low/High Pressure Pipe Line – 3030 ft × (2) Nos (f -17ft)

Figure – Shweli No. (1) Hydropower Project

7.2.2. Future Private and Public Projects and Developments

The future project will be railway power supply system (traction substations and transmission line along the railway) and other infrastructure and developments related to the proposed project such as quarry mine sites and concrete blending plant.

Figure - Future Railway Power Traction Substation

Figure - Future Railway Transmission Line

Some Quarry Mine Site in Shan Region

Source: Frontier Myanmar

7.3. Assessment and Mitigation Measures of Potential Cumulative Impacts

Cumulative impacts for the proposed railway power supply system will be as follow:

7.3.1. Cumulative Impacts during Pre-Construction Phase

(a) Loss of Habitat as Cumulative Impact

Pre-construction activities will have too much tree cutting down along the railway line for site clearing process and include minor earth working activities that need to be used dozer and trucks. It is observed that the consequences of the deforestation effect include as follows:

Clearing vegetation for project plant is the primary cause of habitat destruction. Removing trees thins the forest canopy which is meant to block sun rays as good shelter during the day and holds in the heat at night. This damaging disruption leads to extreme temperature swings that are harmful to plants and animals. The loss of the habitats is expected to have indirect impacts on surrounding habitat areas and associated biota. Habitat destruction is currently ranked as the primary cause of species extinction worldwide. This can be a cumulative impact since people are clearing vegetation even before the project.

Mitigation Measures of Loss of Habitat

- Clearing of vegetation should be kept to a minimum;
- Keeping the width and length of earthworks to a minimum;
- Wetland habitats identified should be retained within the development footprint in its current state; and
- Replantation to balance native ecosystem

(b) Deforestation as Cumulative Impact

There will have cutting down and clearing away of trees and natural vegetation along the railway project according to the needs of ROW width for section subgrade, power supply, tunnels and bridge construction. Large amount of greenhouse gases are generated from fuel powered machinery and vehicles by the operation of generator, concrete mixer, excavator, loaders, trucks and other construction machineries into the atmosphere both on-site and the public roads. Because of the development of the area, other commercial buildings such as factories can also exist in the future. These can also release a large amount of greenhouse gases. Healthy forests absorb carbon dioxide from the atmosphere, acting as valuable carbon sinks. Deforested areas lose that ability and release more carbon. The lack of trees allows a greater amount of greenhouse gases to be released into the atmosphere. This can lead to global warming which can be considered as a cumulative impact since it is happening currently.

Mitigation Measures of Deforestation

- Protect natural carbon sinks that could be endangered by the project, such as peat soils, woodlands, wetland areas and etc.
- Clearing of vegetation should be kept to a minimum, keeping the width and length of the earth works to a minimum and the floodplain / wetlands habitats identified should be retained within the development footprint in its current state.
- Ensure there is selective clearing of the vegetation this allows future re-growth and regeneration.
- There should be initiated prior to the commencement of any construction once the required permits are in place and submitted to the authority for the removal of trees.
- Training of construction workers to raise awareness of environmental protection requirements.
- Avoid unnecessary idling of construction vehicles
- Construction machineries and vehicles will be maintained properly
- Vehicles for projects should be used energy-efficient machinery and the providers apply proper fuel oil and its suitable fuel management system.

7.3.2. Cumulative Impacts during Construction Phase

Cumulative impacts during construction phase will be as follow:

(a) Water Scarcity as Cumulative Impact

Northern Shan Region and Pyin Oo Lwin are currently facing with water scarcity problems. The proposed project will use a large amount of water since it is involving construction processes which need to use water and a large group of workers will also use water which can lead to more problems of water scarcity.

Mitigation Measures for Water Scarcity

- Sustainable water management: Improving water infrastructure must be a priority, as water conservation and efficiency are key components of sustainable water management.
- Reclaimed water: Rainwater harvesting and recycled wastewater also allows reducing scarcity and easing pressures on groundwater and other natural water bodies. Groundwater recharge, that allows water moving from surface water to groundwater, is a well-known process to prevent water scarcity.
- Awareness & Education: Education is critical to solve the water crisis. Employees must be educated about water scarcity and must be trained to get knowledge on how to save water as much as possible.
- Moreover, construction period should be started in the late rainy season in order to be able to store rainwater in storage tanks throughout the whole rainy season. Water usage of local people must not be disturbed. Besides, water from construction activities should be recycled by use of sedimentation ponds.

7.3.3. Cumulative Impacts during Operation Phase

Cumulative impacts during construction phase will be as follow:

(a) Alternation in Land Use Pattern as Cumulative Impact

There will have alternation of land use (alternation of farm lands to other industrial purposes) as cumulative impact. The proposed bypass will have a cumulative impact on the agriculture in the area. The route and the economic growth are planned to stimulate ultimately affect the way land and it can also increase the overall impact. As the development takes place, the land take area will be increased. Most versatile land will be lost and therefore there is not significant on the National or local level. In terms of the cumulative impact on agricultural practice, the impact of the proposed route on husbandry is much harder to assess.

Mitigation Measures for Alternation in Land Use Pattern

According to the primary data collection by household survey, most of the farmers are willing to handover their lands with reasonable price and want to employ with the higher salary in the proposed project. So, to reduce alternation in land use pattern and reduce income for local economy and reduce production of local crops. MR should consider to appoint local people especially people who sold their farm lands to MR.

(b) Visual Impact as Cumulative Impacts

As, Shan State has beautiful landscape and it is also famous for its scenery. When the project is finished, power lines and traction substations to supply the train with electricity can be a visual impact on the landscape since it can be an eye sore for people who enjoy sightseeing. There will have potential to visual impact as cumulative impact due to the potential to increase in industrial sector (gas pipeline, transmission line and existing railway from Mandalay to Lashio).

The cumulative impact of the proposed structures and other infrastructure and link roads will be particularly significant with the farmland and the urban edge along the road will contribute to the increasing urbanization of that area, resulting in a gradual change of character. In spite of the careful route planning, there will be a need for it to be cleared from vegetation, trees and the like; however due to its small width the extent of the work and consequently the visual changes will be negligible. In the phase of using the way, negative influences are not expected, which is why it is not necessary for any measures to be taken.

Before the Project

After the Project

Mitigation Measures for Visual Impacts

Visual impacts will be prevented through the installation of natural visual barriers such as vegetation. Landscape management and site restoration plans will be in place with recommended mitigation measures such as replacement planting, and vegetation barriers. The landscape and color of power supply facilities will be selected with consideration of architecture view.

(c) Water Scarcity as Cumulative Impact

The areas in the vicinity of the project may be developed after the construction project. Due to the development of the area, population can also increase and this can lead to water scarcity problems currently faced by the local people.

Mitigation Measures for Water Scarcity

- Sustainable water management: Improving water infrastructure must be a priority, as water conservation and efficiency are key components of sustainable water management.
- Reclaimed water: Rainwater harvesting and recycled wastewater also allows reducing scarcity and easing pressures on groundwater and other natural water bodies. Groundwater recharge, that allows water moving from surface water to groundwater, is a well-known process to prevent water scarcity.
- Awareness & Education: Education is critical to solve the water crisis. Employees must be educated about water scarcity and must be trained to get knowledge on how to save water as much as possible.
- Moreover, construction period should be started in the late rainy season in order to be able to store rainwater in storage tanks throughout the whole rainy season. Water usage of local people must not be disturbed. Besides, water from construction activities should be recycled by use of sedimentation ponds.

(d) Increase in Human Trafficking as Cumulative Impact

Since the transportation becomes easy, the increase in human trafficking rate could also occur. Regionally, Shan state registered with 37 cases, followed by Mandalay region and with 10 cases. There were 22 domestic trafficking in persons in terms of forced labor, prostitution and forced marriage during the period. In 2019, 358 people including 297 females were victimized in connection with 239 human trafficking cases across the country. During the whole 2020, 167 people including 39 young girls were victimized while 339 traffickers were charged in connection with the cases.

Mitigation Measures for Impacts of Increase in Human Trafficking

- The corporation with human trafficking team in every trip to Mandalay to Muse Permanent Immigration Inspection Team should be made. The people who smuggle women and children are sentenced to at least 10 years or up to lifetime sentence or fine while money or property received through trafficking will be confiscated by the government under the Anti-Trafficking in Persons Law.

(e) Increase in Trade off Drugs as Cumulative Impact

Since the transportation becomes easy and the profits of trade off drugs are high, the rate of trading off drugs would increase especially in Shan State.

Mitigation Measures for Trade off Drugs

Trading off the chemicals and drugs used to manufacture drugs into Shan State should be restricted. The government should redouble its drug control and anti-corruption efforts, focusing on major players in the drug trade. Education and harm reduction should replace. At the community level, the government should focus more on education and harm reduction.

(f) Illegal Trading as Cumulative Impact

During the transportation of construction materials and for maintenance of construction machineries, jade, endangered species, wood, orchid, and other natural resources can be the main objects in illegal trading.

Mitigation Measures for Illegal Trading

- Proper inspection at every gate before going out of the country
- Stop enough time for inspection
- Cooperate with respective organizations.

(g) Increased in Electricity Consumption as Cumulative Impact

Electricity is mainly used in station, along alignment and yard where lighting is required. Load will be for communication, signaling, information and infrared axle temperature detection devices, locomotive maintenance and water supply and drainage equipment, indoor and outdoor lighting, etc in the stations along the line. The usage of local power system can be disturbed if the required power load is supplied by using local power supply system.

Mitigation Measures

- Use the source of electricity that does not pressure on local use in the current and future.
- Use alternative source of energy such as solar power station or generators.

8.0. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

In order to manage the physical, biological and sociological impacts identified in the impact assessment, MR has committed to implement an environmental management plan of the project (EMP). This management plan will form the basis for the development of an integrated management system for environmental and community issues. EMP is a site-specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental impacts arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures the project implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle.

In construction & operation environmental management plan for proposed project, the following plans should be considered:

- Environmental Monitoring Plan
- Air Quality Management Plan
- Water Quality Management Plan
- Noise and Vibration Management Plan
- Soil Quality Management Plan
- Traffic Management Plan
- Occupational and Community Health & Safety Risk and Management Plan
- Disaster Risk Management Plan
- Waste Management Plan
- Watershed Management Plan
- Forest Rehabilitation Plan
- Management Plan for Minimizing Impact for Forest Cover along Transmission Line
- Wildlife Corridors Protection and Enhancement Plan
- Biodiversity Action Plan
- Avian and Bat Protection Plan
- Public Health and Safety Management Plan
- Cultural Heritage Management Plan
- Community Development Plan

8.1. Project Description by Project Phase

The following phases will be considered in conducting of EIA for the proposed project.

(i) Pre-construction Phase

Pre-construction activities will involve removal of select vegetation, if any, and the grading and excavation of soils for the installation of structural foundations for power stations, and electricity supplies system. Site clearing activities for transmission lines will be included in that of alignment.

(ii) Construction Phase

Construction activities will include installation of grounding grid, construction of temporary worker camps, access road construction, construction of command building, stringing activities and installation of electrical equipment, etc. The assembly of transformers, circuit breakers, CCTVs, circuit switchers, capacitors, and disconnect switches must be closely watched and tested to ensure proper assembly. This is especially true for transformers since their future trouble-free operation is very dependent on proper handling during assembly.

(iii) Operation Phase

Operational and maintenance activities associated with the railway power supply system include the maintenance and clearing of transmission line, maintenance and painting of substations and transformers. It will also include filling of transformer fluid.

(iv) Decommissioning Phase

This will include demolition, decommissioning and destruction of power station and power line activities. In addition to steel structures, the control building will be disassembled and removed from the site. Fencing around the substation will be broken down and removed. The gravel or aggregate surface at the substation will loaded onto trucks and removed for sale and reuse.

8.2. Environmental and Socio-economic relevant with Law and Legal Requirements

Laws and Regulations	Year	Purposes
National Environmental Quality (Emission) Guidelines (Section 2.1.9)	2015	These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem health.

Conservation of Water Resources and Rivers Law (Law No. 8, 11(a), 13, 19, 24(b), 30)	2006	To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.
Conservation of Water Resources and Rivers Rules	2013	To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.
Forest Law	1992	To implement forest policy and environmental conservation policy, to promote public cooperation in implementing these policies, to develop the economy of the State, to prevent destruction of forest and biodiversity, to carry out conservation of natural forests and establishment of forest plantations and to contribute towards the fuel requirement of the country.
The Bridges Law (Law No 16)	2019	• To systematically supervise, supervise and charge bridges on the construction of new bridges, construction of new bridges, upgrades, extensions, inspections of bridges • To ensure the safety and security of the users of the bridge and to be able to continuously carry out matters related to the maintenance and strength of the bridge • Safe and secure use of the bridge will speed up the flow of passengers and goods, improve transportation costs, improve the socio-economic life of citizens and raise living standards • To accelerate the development of the country by constructing, upgrading, expanding, inspecting, repairing and maintaining the bridge for its longevity
Land Acquisition, Resettlement and Rehabilitation Law (Section 39, 41, 42, 46, 54(b and c), 58)	2019	• In this law, it is stipulated that the government holds rights to take over land provided that compensation is made to the original land owner. No private ownership of land is permitted • To prevent potential impacts on environmental and social sectors due to land use for projects
The Freshwater Fisheries Law (Law No. 36, 40, 41)	1991	• To further develop the fisheries; • To prevent the extinction of fish; • To safeguard and prevent the destruction of freshwater fisheries waters; • To obtain duties and fees payable to the State; • To manage the fisheries and to take action in accordance with the Law.

Prevention and Control of Communicable Diseases Law (Law No. 3, 4, 9, 11)	1995	To prevent the outbreak of Communicable Diseases, by implementing following project activities; (a) immunization of children by injection or orally; (b) immunization of those who have attained majority, by injection or orally, when necessary; (c) carrying out health educative activities relating to Communicable Disease.
Myanmar Fire Force Law, (Law No. 25)	2015	• To take precautionary and preventive measure and loss of state own property, private property, cultural heritage and the lives and property of public due to fire and other natural disasters • To organize fire brigade systemically and to train the fire brigade • To prevent from fire and to conduct release work when fire disaster, natural disaster, epidemic disease or any kind of certain danger occurs • To educate, organize an inside extensively so as to achieve public corporation • To participate if in need for national security, peace for the citizens and law and order
Minimum Wages Law (Law No. 12, 13 (a to g)	2013	This Law was enacted to meet with the essential needs of the workers, and their families, who are working at the commercial, production and service, agricultural and livestock breeding businesses and with the purpose of increasing the capacity of the workers and for the development of competitiveness.
The Electricity Rule	2015	▪ the operation, maintenance and expansion of distribution systems in accordance with all applicable law and regulatory requirements, ▪ compliance with all applicable distribution codes and performance standards approved and issued by the Ministry and all environmental requirements, ▪ the distribution systems are safe, secure and operate reliably and economically.

8.3. Environmental Management and Monitoring Measures

8.3.1. Environmental Management Measures

The summary of potential environmental impacts, mitigation measures, estimated cost, and responsibility on the project during pre-construction, construction phase, operation phase and decommissioning phase are shown in table below.

Table 8.1. Environmental Management Measures

Item	Expected Environmental and Social Impacts and Sources of Impacts	Receptors	Mitigation Measures	Frequency	Cost	Responsibility
Pre-Construction Phase						
Impacts on air environment	Fugitive dust generation Fugitive dust generation due to dozers and trucks for site clearing and ground levelling	Local residents in nearest villages, Local residents near along the hauling road, Flora diversity along the hauling road	- Water will be sprayed at construction site by using handheld spray. - Wheels of vehicles will be cleaned and goods carried will be covered while delivering.	2 times/day	Total estimated costs of overall handheld spray (50000 kyats) - Estimated cost of covering (35000 kyats per cover)	Contractor
	Vehicular emissions Vehicular emissions from the operation of vehicles and machineries	Ambient Air Quality	- In loading and unloading time and idle time will be planned to reduce during working hours - Avoid local traffic time - Machineries, vehic-les and generator with good engine conditions and use low sulphur content fuel will be used. - Machineries, vehicles and generator will be maintained regularly.	-	-	Contractor
	Increase in noise Noise from heavy machineries and vehicles	Local residents nearby	- Working at night wll be limited and the operation of noisy equipment and machineries will be avoided at night if it is necessary to make operation at night - Construction activities reasonably will be arranged, especially at night - Regular maintenance of machineries will be carried out.	-	Cost of maintenance (30000 kyats/per time)	Contractor

Impacts on surface water environment	Liquid wastes Temporary water pollution due to earth working activities Sedimentation of surface drainage networks Improper handling of fuel oil and lubricants	Surface water quality	- Proper drains to prevent run off from the site to enter any water body will be provided. - Wastewater from entering the nearest water bodies will be prevented. - Any leakage of oil and lubricant from vehicles and machineries use will be avoided.	-	-	Contractor
	Solid wastes Unsuitable soil materials from site clearing activities Domestic solid wastes	Surface water quality	- Reduce, reuse and recycle of domestic wastes will be done. - Unnecessary earthworks will be limited. - Over-excavation will be prevented. - Working in a small area at a point of time will be carried out	-	-	Contractor
Impacts on soil environment	Domestic wastes from pre-construction workers Biomass site clearing and tree cutting Earth soil from earth cutting activities	Soil contamination and ground water quality	- Wastes will be disposed according to the rules and regulations of MCDC - Solid waste management plan will be provided. - Handling of diesel and lubricants will be taken with special care to avoid leakage.	-	Estimated cost for waste Management Plan – 50000kyats/ time	Contractor
Impacts on biodiversity environment	Impacts on flora diversity Tree cutting alongside the railway and for the construction of stations	Flora diversity	- Cutting of road side plants and fence plants will be avoided.	-	-	Contractor
	Impacts on fauna diversity The destruction of the vegetation cover along the strip of land May occur destroyed that individuals of some plant species are present in this strip The destruction and loss of the habitats along the land strip along the power line	Fauna diversity	- Sound proof measurement will be constructed surrounding a construction site as needed - Borrow pit will be away from fauna diversity abundance area	-	Construction of sound proof measurement (Estimated cost 300,000 kyats/one)	Contractor

Impact on human environment	***Impacts on socio-economic environment*** (a)Positive socio-economic impact Temporary employment opportunities(approximately 15 workers) for local people during about 6 months	Local people	- Policy to use local people as much as possible will be carried out.	-	-	MR
	(b) Negative socio-economic impact (i) Visual Impacts Visual pollutants like waste from site clearance and from the tree cutting alongside of railway	Local community	- Efficient and timely removal of all demolition and construction waste as per requirement will be done.	-	-	Contractor
	(b) Negative socio-economic impact (i)Land acquisition and involuntary resettlement Land use and involuntary resettlement will affect socio-economic situation of local people Resettlement or/and relocation of buildings and other assets, involving some changes Loss of income opportunity of some PAPs due to resettlement and shop owners, vendors or farmers to be affected by construction works	Local residents near the railway line	- Agricultural land, historical places, archeological places, forest area and ecologically sensitive area will be avoided as much as possible, fair compensation for land use as per compensation program in RAP - Overhead bridge will be used as much as possible - Compensation for affected structures and standing crops and assistance of livelihood restoration as per RAP will be made.	-	The cost for this cannot be identified accurately.	MR
	(ii) Visual Impacts Visual pollutants like waste from site clearance and from the tree cutting alongside of railway	Local community	- Soil materials generated from site clearing activities will be disposed of systematically to avoid impact on visual amenity of receptors	-	-	Contractor

	Impact on Indigenous and Ethnic People Related to Culture Exchange Indigenous or ethnic minority people will be affected from associated society.	Indigenous and Ethnic People	- Local cultural elements will be integrated into the hotel environment using local products, decorations, and even architecture. - A display corner or an exhibition will be created on traditional craftsmanship and sell local handicrafts. - The hiring of local staff and tour operators especially in major travel destinations will be encouraged. - Awareness-raising activities for local communities will be hosted and training to local business will be offered	-	The cost for this cannot be identified accurately.	MR
Construction Phase						
Impact on air environment	Fugitive dust generation Dust emission from on-site vehicles and construction activities Particulate matter from transportation of construction materials and demolition waste, and traffic movement on unpaved road	Local residents in nearest villages, Local residents near along the hauling road	- Use covers or control equipment on material handling sources will be done. - Properly enclosing the site through use of appropriate hoarding and screening will be carried out. -Excavated soils and demolition wastes with impervious sheeting will be covered. - Water as a dust suppressant as needed will be sprayed. - Transportation of vehicles will be avoided to reduce dust generation	No of covers depend on the amount of equipment	- Cost of covers and water suppressant have already been mentioned above. - Water can be used from nearby water resources	Contractor
	Gaseous emissions Gaseous emissions from the operation of generator, concrete mixer and vehicles	Ambient Air Quality	- Construction vehicles and machinery will be used systematically to minimize emissions of fuel fumes - Machineries, vehicles and generator with good engine conditions and low sulphur content fuel will be used.	-	Cost of one-time maintenance is already mentioned above in pre - construction phase.	Contractor
	Increased in Noise Level Noise generation from earth moving and excavation	Local residents in nearest villages	-Vehicle speeds will be reduced around sensitive receptors such as dwellings and schools	The number of warning signs cannot be identified since	Cost of installation of warning signs (2,5000 kyats)	Contractor

	equipment, generators, concrete mixer Minimize vehicle movement and save money by reused on site to fill in low lying areas cut material from an embankment		- Choosing site for concrete-mixing, batching plants and similar activities at least 500m away from sensitive areas will be done. - Noisy activities will be scheduled. - Operation of heavy machinery will be limited at night - Choosing inherently quiet equipment with mufflers will be done. - Warning signs will be installed in areas of high noise levels - Equipment speed will be kept as low as possible	the project is still in site-clearing stage.		
Impacts on surface water environment	Construction debris Waste materials such as pallets, packing crates, steel structures off-cuts and waste concretes Drainage and seepage from construction waste dumping site Unsuitable soil material from preparation of foundation	Surface water quality	- The time of exposure of any waste and erodible land exposed to stormwater runoff will be minimized. - Land clearing activities will be minimized to those of required work areas - Sediment controls will be used, with special care taken during the rainy season - Paving roads wherever possible will be carried out.	-	Cost of paving per road =1,200,000 kyats (overall)	Contractor
	Impacts on surface water environment The removal of riverine woodland will be inevitable in order to create the ROW Downstream areas normally affected by sediment loads from upside areas During rainy season, erosion may occur in weak soil Effluent Discharges (i) Increase the suspended matter of the water body	Surface water quality	- Chemical and oils storage areas will be placed on a hard concrete base to protect from rain and severe weather. - Zinc-based coating paint will be used instead of lead-based coating - Prefabricated septic tanks will be installed on site which discharge to a subsurface soak away to avoid soil contamination and smell. - Contingency plans for control of spills of oil and other hazardous substances - Waste disposal site will be placed systematically		The overall cost cannot be identified accurately.	Contractor

	when entering into the water body (ii) the accidental spillage of fuels and hydraulic fluids from construction plant Hazardous Waste Surface water pollution due to the spillage of lead-based paint used for transmission lines coating process		-Waste contamination issues for power lines and stations will be carried out.			
	Oil and grease Leakage of fuel oil from transportation of construction materials Lubricants and grease from machineries	Surface water quality	- Work areas will be restored as soon as possible once any construction is complete. - Construction works will be avoided during the rainy season. - Leakage of oil and lubricant from vehicles and machineries used in construction phase will be avoided.	-	-	Contractor
	Domestic wastes from construction workers Domestic waste generation from construction workforce Improper waste disposal from establishment of labor camps	Surface water quality	- Waste water channels from the site will be connected to septic tank -Bare areas will be replanted after the construction state - Compact soil as soon as building foundations will be formed to prevent erosion, especially during the wet season	-	-	Contractor
	Impact on Watershed – due to cutting of trees	Surface water quality	- Tunnel will be constructed close to the forest area. - limit tree cuttings	-	-	MR
Impacts on soil and ground water environment	Impact on soil and ground water quality Accidental spills of fuel oil and lubricants due to improper handling or storage of equipment Wastewater from repair shops and washing places	Soil contaminatio n	-Generated materials for reclamation purposes will be used whenever applicable on site -Construction wastes through careful planning will be minimized - All chemical wastes will be labeled and stored in corrosion and resistant containers	-	Estimated cost for sedimentation pond = 300,000kyats/ one	Contractor

	Construction debris and domestic wastes from construction workers Soil contamination and ground water pollution from improper disposal of solid wastes Seepage from waste dump site		-Collection sites and schedule will be identified for the removal of construction wastes to minimize odor and pest infestation - Sedimentation pond will be carried out with suitable drainage system around the dumping sites			
	Impacts on Soil Quality due to Hazardous Wastes Oil-based paints are consisted of VOC, so these paint cans can be hazardous to the environment if they are not properly disposed. The lead-based paints for the steel structure for the construction of the stations	Soil contaminatio n	- Water-based paint will be substituted for oil-based paints; - oil-based paint or residuals down the drain will never be discharged. - Disposal of hazardous wastes will be made according to the rules and regulations of CDC	-	-	Contractor
Impacts on biodiversity environment	Impact on flora diversity Clearing away trees and natural vegetation	Flora diversity	- The appropriate number, spacing, and location of crossing structures based on species-specific information will be determined and constructed. - Structures for obstructions will be monitored such as detritus or silt blockages, that impede movement -Human activity near crossing structures, with use of measures such as fencing and signage will be managed.	-	-	Contractor
	Impact on fauna diversity Hazards to the habitats of birds and butterflies due to clearing away trees Disturbance to the aril and wild animals due to noise from construction activities	Fauna diversity	- The WDNR guidelines for preventing the spread of exotic invasive plant species and diseases will be followed such as oak wilt - Working at night will be avoided. - Sound proof measurement will be taken at biodiversity sensitive areas	-	Cost of sound-proof measurement is already mentioned above in pre - construction phase.	Contractor

Impacts on human environment	Positive socio-economic impact Job Creation Nearly 500 employment opportunities for local people	Local residents	- Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible - The developer will encourage construction sub-contractor to use local labor force as part of tender requirement	-	-	MR
	Skill development for local people Local people hired by the proposed project would remain in communities with skills acquired during project construction	Local residents	- Training programs will be implemented prior to and during the construct- ion phase	-	Estimated cost for training programs = 700000 kyats (overall)	Contractor
	Potential to growth of local economy and business There will be benefit for local economy if the required food and consumer goods for construction workers are bought from nearest villages	Local residents	- Any food and consumer goods that can be bought in nearest villages will be preferred as first priority - The project developer will encourage construction contractors and sub-contractors to stimulate the emergence of local small business as part of tender requirement	-	-	MR
	Negative socio-economic impacts Traffic congestion Road traffic congestion in surrounding area during construction period	Local residents	- Construction hauling will be arranged reasonably, especially during local traffic time. - Alternative road will be used that will not pressure on public road.	The number of alternative roads cannot be identified since the project is still in site -clearing stage.	Cost is already mentioned above in pre -construction phase.	Contractor
	Blockage of drainage Blockage of drainage system, natural spring and village road due to land filling Increase potential to flood in nearest agricultural lands	Local people	- Alternative water way will be prepared -Drainage facilities will be utilized to discharge the harvested water	-	Estimated cost for preparing alternative waterway = 500,000 kyats (overall)	Contractor

	Agricultural Lands Soil material from construction site can also enter agricultural lands close to power lines	Local community near the proposed project	-Construction through sensitive farmland will be avoided or minimized. - Overhead bridges will be used where feasible - Transmission structures with longer spans to clear fields will be used - Exclusion fencing will be installed to keep livestock away from construction activities	-	Estimated cost for the fencing of traction substation = 150,000 kyats	
	Public road damage The transportation of workers and construction materials can damage the damage to the public road	Local community	- The roads will be repaired as soon as possible if the public roads are damaged by the construction activities - Public roads will be used as per resistance of roads if unavoidable	-	Estimated cost for repairing public roads when damaged =1,000,000 kyats (overall)	Contractor
	Impacts Influx of more worker and population Increase temporary pressure on existing infrastructure and services including health care, food, shelter, water, transport and recreational facilities	Local community near the proposed project	- Local construction workers will be appointed - Own health care facilities will be supported to workers			
	Conflicts between communities Conflict between non-Shan communities and Shan ethnic A higher frequency of incidents of name-calling, spitting, hostile attitudes, damage to property and racially motivated violence against them	Local community near the railway line	-Local people will be used as much as possible -Night out for foreign workers will be limited. - The use of foreign workers will be limited. - When making an agreement contract with contractors and subcontractors, it will include the fact that they have to use local workers as much as possible.	-	-	MR
	i) Livelihood and economic activity	Local people alongside	- Loss of business (temporary or permanent), loss of livelihood, loss of	-	The compensation for the PAPs cannot be identified	MR

	Disruption of livelihood and economic activities of business located along the route Impact on people whose livelihood is linked with existing modes of transportation		wages will be paid according to the RAP. - Provision of compensation to the Project Affected Parties (PAPs) using the compensation will be carried out. - Continual liaising with the PAPs will be undertaken to decide on the site-specific mitigation measures. - Consultation with people whose livelihood depend on modes of transportation that may be affected by the project. They will be included in the development of the traffic management plan.		accurately as it depends on the situations.	
	Impacts Socio-economic impact people whose livelihood is linked with existing modes of transportation	Local people alongside	- Result in a material effect through diminishing the quality of life as replacement will be made in locality or be compensated			
Impacts of utility consumption	Water consumption Impact on local water usage due to the water used for construction process and for domestic workers	Local community	- Water will be taken from surface water sources or underground sources where the sources are available - Residents' opinion will be considered and make agreements or contracts with the head of the village if spring water or underground water are the water sources of villages - Awareness campaign to disseminate knowledge on strategies and technologies that will be used for water conservation	-	-	Contractor
	Fuel consumption The different forms of energy are used for different purposes in the construction process. Electricity cannot be directly used from existing power	Local community	-Construction machines will be used efficiently. - Workers will be trained to gain the knowledge of energy conservation. -The efficient site management will be learned to the workers.	-	-	Contractor

	lines since the construction process takes place where there is no electricity and generators will be mainly used as the source of energy					
	The effect of transmission Line on Local services electrical induction onto a piece of a structure that is insulated from the ground by assembly on wooden blocks		- Tower locations will be realigned to avoid the sewer line - Leakage of coolants and insulants will be avoided.	-	-	Contractor
	Anticipated Impacts on Archaeology and Cultural He ritage No impact on Cultural and Religious sites because during design stage extra care was taken to ensure that religious structures/public property were avoided		- Programs for archaeological works will be designed to identify, characterize and record buried archaeological remains -The archaeological site that will be pointed out by heritage advisors, and an archaeological evaluation will be avoided.	--	-	MR
	Visual Impacts Visual intrusions arise from the inevitable presence of construction equipment, materials, transport vehicles, and piles of soil and debris as a result of clearing, site work, and heavy equipment and vehicles on the road	Local community near the project area	- The construction area of the site will be fenced - Roads providing access to the site will be maintained free of dust and mud - All remaining construction materials will be removed from the site after the construction	-	-	Contractor
	Community Health Impact (i) Increase infection of air-borne disease - Air-borne diseases such as tuberculosis, influenza and meningitis can spread easily	Construction workers and local community	- Medical check for workers will be carried out who are susceptible infection of air-borne diseases	The number of workers cannot be identified accurately.	Medical check for air-borne disease (5000 kyats/time)	EMMT

	due to an influx of construction workers from other places					
	(ii) Fugitive dust emissions - Dust emissions due to on-site heavy-duty off-road vehicles, other light-duty vehicles	Construction workers and local community	- Wetting of roads by water spraying will be carried out. - Vehicle speeds will be restricted. - Wheel or body washing	2 times/day	Overall cost is already mentioned above.	EMMT
	(iii) Increase infection of water borne diseases - Cholera and diarrhea will increase if there will be no proper sanitation practices at the construction site	Construction workers and local community	- Proper sanitation system will be provided for construction workers - Construction debris will be disposed at suitable location that does not impact on local nearest rivers - All areas of fuel storage will be banned to prevent hydrocarbon pollution of surface water	-	Estimated price of portable toilet = 70000 kyats/each	EMMT
	(iv) Increase infection from mosquito - Stagnant pools of water will cause bleeding zone for mosquitoes and infections from mosquitoes	Construction workers and local community	- Construction time will be avoided in rainy seasons as much as possible - Proper temporary or permanent drainage system will be compensated	-	-	EMMT
	(v) Increase risk of sexually transmitted infections - The influx of new migrant workers, living away from their families lead to an increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia	Construction workers and local community	- Information and education about safe sex and implement HIV control program will be provided	-	Estimated cost for HIV control program -70000 kyats (overall)	EMMT
	(vi) Health impact related to increase in noise level - Noise from construction machineries and pilling operation will produce high noise level	Construction workers and local community	-Speed limits for trucks will be reduced in the project area to reduce noise level - Working at night will be avoided.	-	-	EMMT

	(vii) Impacts due to stringing activities - Stringing activity around the wires and other electrical units can be a potential hazard if proper planning is not followed	Construction workers	- An Emergency Prevention and Response Plan (EPRP) will be developed according to Angolan requirements and international industry standards and best practices - Personnel will be trained on how to respond to unplanned events	-	-	EMMT
Operation Phase						
Impact on air environment	Impacts on air environment due to gaseous emissions Gaseous emissions from the production of required electrical power by auxiliary generator during power outage	Ambient air	- Generator with good engine condition will be used. - Regular maintenance of generator will be carried out. - Low noise traction substation transformer will be used.	The number of gas exhaust cannot be identified since there will be many vehicles during the operation.	The cost is already mentioned above.	Operation Company
	Impact of Noise – Noise and vibration due to the travelling of high- speed trains	Local residents near the proposed project	- Sound proof measurements will be taken near the public area	-	Estimated cost of sound proof measurements is already mentioned above	Operation Company
Impact on surface water environment	- Wastewater used by workers during operation phase - Paint residue for maintenance of power supply stations	Surface water quality	- Treatment of waste water will be used by installation of oil-water separator - Workers will be trained on appropriate handling of oil and lubricants and paint residues	-	Estimated cost of oil- water separator = 250000kyats/one	Operation Company
Impact on soil and ground water environment	Leakage of oil and grease from the train maintenance	Local residents near the railway line	-Zinc-based paint will be used instead of lead-based paint - Leakage of oil or paint will be controlled and avoided.	-	-	Operation Company
Impact on biodiversity environment	(a) Flora Diversity - Some plants can suffer leaf damage if the electric field is	Flora and fauna diversity	- The use of passive shield wires will be installed near transmission lines that	-	-	Operation Company

	high enough, which causes the tips of the leaves to dry out and can reduce growth		generate opposing cancellation fields from electromagnetic induction - Teleology will be successfully applied in both residential and commercial environments to mitigate magnetic fields from overhead transmission and distribution lines, and tmderground residential distribution (URD) lines			
	(b) Fauna Diversity - Transmission lines have an effect on wildlife that include long-term changes to habitat, impacts on herpetofauna, avian (bird and bat) strikes, noise effects, electric and magnetic fields, and electrocution	Flora and fauna diversity	- Low noise equipment will be used. - The activities will be avoided at night -Barricades or fences will be used to prevent wildlife from access to the transmission lines	-	The cost is already mentioned above.	Operation Company
Impact on human environment	Positive socio-economic impact Improvement in livelihood and economic The direct employment opportunities would be increased for the local people.	Local community	- Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible - Sub-contractor will encourage to use local labor force as part of tender requirement.	-	-	Operation Company
	(ii) Benefits to national economy - There can be income from usage of electricity from local power supply system	National government	- Electricity will be used systematically - Electricity bills will be audited yearly with professionals	-	-	Operation Company
	Negative socio-economic impacts (i) Impact due to electricity consumption - Power supply points of the whole line will be mainly	Local community	-The source of electricity that does not pressure on local use in the current and future will be used. - Alternative source of energy will be used such as solar power where land use will available or self-generator	-	-	Operation Company

	distributed in station, yard, substation and the tunnel in the sections where lighting and ventilation are required		where there has high pressure on local electrical use			
	(ii) Social tension The nearby villages do not get electricity all the time while the railway lighting is always on during the night	Local community	- Distributing electricity will be considered also for local people before starting the project if possible. -Local people will be supported by supplying solar system	The amount of electricity and number of solar panels cannot be identified accurately since the project is still in site clearing stage.	Estimated cost of solar panel (350000 kyats/set)	Operation Company
	Visual Impact Visual impact due to the construction of the new power station building and run of way for transmission lines	Local community for the proposed project	- The design will be local designs suitable with surrounding beautiful Shan State - Hard landscaping and planting will be introduced to help integrate the building into its environment	-	-	Operation Company
Impacts of Utility Consumption	Electricity is used to provide the adequate lighting and safety signboards	Local community	-Good housekeeping measures such as turning off equipment and lights when not in use will be implemented. - LED lights and/or lower wattage lamps will be used. - Alternative source will be used like solar system	-	Estimated cost of LED lights (5000 kyats/bulb)	Operation Company
Community Health Impacts	Noise Noise can be generated from the use of axillary generator during power outage	Local community	- Low noise power transformers will be used. - Sound proof generator will be used.	-	-	EMMT
	Gaseous Emission Gaseous emission due to the production of required electrical power by axillary generator during power outage	Local community	-generator with good engines will be used. - Generators will be maintained regularly.	-	-	EMMT

	Electromagnetic Fields (EMF) - The local people within this distance can be affected due to EMF - The health of local people can be disturbed according to their distance from the source	Local community	- Metals such as copper or brass will be used as electromagnetic shielding - For electrocution and electromagnetic wave, warning signs indicating high voltage area will be used. - The workers will be followed the National EQEG guidelines for preventing exposure to human beings	-		
	Electrocution Cause fatal impact on people when they come in contact with the lines due to high voltage of power lines	Local community	- Warning signs indicating high voltage area will be used. - Barricades or fences will be used to restrict access to high voltage area	-	Estimated cost for installation of warning signs is mentioned above.	EMMT
	Chemical Hazards - The typical chemicals found in substations include dielectric fluid, transformer oil, capacitor oil, sulphur hexafluoride and sulphuric acid	Local community	- Hazardous chemicals and materials will be handled and stored properly - People from the hazardous chemical substances will be isolated.	-	-	EMMT
Decommissioning Phase						
Impacts on air environment	Dust generation Dust emission from the truck vehicles and other heavy/light-duty vehicles	Local residents along the railway line	- Water will be sprayed on sites during destruction activities - Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes	-	Cost of water suppressant has already been mentioned above.	Contractor (Decommission ing)
	Noise Noise pollution from removal of buildings and infrastructures	Local residents along the railway line	-All exhaust systems will be maintained good working orders - Equipment will be maintained regularly.	-	The cost is already mentioned above	Contractor (Decommission ing)
Impact on surface water environment	- Increased sedimentation of water courses - Piling steel structures on the site for a long time without moving to dumping	Nearest rivers and water bodies	- Wastes will be disposed properly according to the requirements - The wastes will be recycled by giving to recyclists and secondary users can use them	-	-	Contractor (Decommission ing)

	sites or to places to do recycling					
Impacts on soil and ground water environment	Contamination of soil and groundwater occur as a result of accidents and/or improper handling of lubricants, oils, and transformer oils (PCBs)	Soil contamination	-Hazardous wastes and solid wastes will be disposed of according to the rules and regulations of CDCs - Removal of electrical equipment will be carried out carefully.	-	Overall estimated cost = 2,000,000 kyats	Contractor (Decommissioning)
Impacts on socio-economic environment	**Loss of jobs for local people and revenues for the government** Loss of jobs and indirect employment depending on the operation of proposed and of associated services for tourism as well as loss of revenues for the government	Local people	- Extensive and comprehensive warning to employees to allow them to source alternative livelihood will be taken early - A plan to reuse the proposed project to other partner company to retain the revenue for the government will be prepared.	-	-	Contractor (Decommissioning)
	Visual Impact Visual impacts on communities in the vicinity area due to the waste generated from decommissioning activities and piling of wastes on the site	Local people	-All the structures will be demolished including transmission towers and transmission lines affecting the visual amenities - Wastes will be disposed of properly.	-	-	Contractor (Decommissioning)

8.3.2. Overall Budgets for Implementation of the EMP

The summary of the parameters to be monitored, estimated cost, and responsibility on the project during pre-construction phase, construction phase and operation phase are shown in the following table.

Table 8.2. Environmental Monitoring Measures

Project activities	Parameters to be monitored and compliance standards	Locations (Coordinate Points)		Measurements (Methods and Equipment)	Frequency of measurement	Cost estimates (Kyats)**	Responsibilities
During Pre-Construction							
Gaseous emission, and PM generation	Ambient air quality (CO, CO2, SO2, NOx) **(NAAQS, WHO Guidelines)**	21°50'50.35"N	96° 7'15.96"E	Visual investigation and monitoring by handheld PM meter and CO, CO2, SO2, NOx meter	Only one time but if complaint is made, measurement has to be done.	100000 Kyats per once	Pre-construction contractor(s) (as part of contractor's financial offer)
		21°56'57.46"N	96° 9'13.07"E				
		22° 3'2.31"N	96°16'42.53"E				
		22° 6'27.01"N	96°31'59.80"E				
		22°18'53.56"N	96°48'32.81"E				
Construction machineries	Noise complaints from neighbors **(NEQG)**	22°32'27.45"N	97° 8'30.47"E	Monitoring by noise level meter	Only one time but if complaint is made, measurement has to be done.	50000 Kyats per once	Pre-construction contractor(s) (as part of contractor's financial offer)
		22°40'18.33"N	97°28'59.89"E				
Area of spillage	Soil Contamination and water resource pollution. **(NEQG)**	22°59'8.37"N	97°42'18.81"E	Visual observation; Recording and documentation of spillage	Daily	-	Pre-construction contractor(s) (as part of contractor's financial offer)
		23°17'52.57"N	97°59'10.65"E				
Water Quality	Turbidity, Oil and Grease **(NEQG)**	23°22'6.67"N	97°55'58.80"E	Taking water samples and sending to laboratory.	Only one time but if complaint is made, measurement has to be done.	20000 kyats per once	Pre-construction contractor(s) (as part of contractor's financial offer)
		23°39'19.81"N	97°50'55.84"E				
		24° 1'2.40"N	97°57'48.87"E				
Construction Phase							
Gaseous emission, and PM generation	Ambient air quality (CO, CO2, SO2, NOx)	21°50'50.35"N	96° 7'15.96"E	Visual investigation and monitoring by handheld PM meter	Only one time but if complaint is made,	100000 Kyats per once.	Construction contractor(s) (as a part of
		21°56'57.46"N	96° 9'13.07"E				

	(NAAQS, WHO Guidelines)	22° 3'2.31"N	96°16'42.53"E	and CO, CO2, SO2, NOx meter	measurement has to be done.		contractor's financial offer)
Construction machineries	Noise complaints from neighbors **(NEQG)**	22° 6'27.01"N	96°31'59.80"E	Monitoring by noise level meter	Only one time but if complaint is made, measurement has to be done.	50000 Kyats per once	Construction contractor(s) (as a part of contractor's financial offer)
		22°18'53.56"N	96°48'32.81"E				
		22°32'27.45"N	97° 8'30.47"E				
		22°40'18.33"N	97°28'59.89"E				
Water Quality	Turbidity, Oil and Grease **(NEQG)**	22°59'8.37"N	97°42'18.81"E	Taking water samples and sending to laboratory.	Only one time but if complaint is made, measurement has to be done	Only one time but if complaint is made, measurement has to be done	Pre-construction contractor(s) (as part of contractor's financial offer)
		23°17'52.57"N	97°59'10.65"E				
		23°22'6.67"N	97°55'58.80"E				
		23°39'19.81"N	97°50'55.84"E				
		24° 1'2.40"N	97°57'48.87"E				
Storage of the machines and construction materials of the project component	Complaints from Neighboring communities and records and documentation of the temporary area for storage of materials or machineries	The locations for the traction substations are mentioned above.		Recording and documentation	Monthly	-	Construction contractor(s)
Animals that can enter to the locations of traction substation	Fauna **(IUCN Red List)**	The locations for the traction substations are mentioned above.		Recording and documentation	Daily	The cost cannot be identified accurately.	Construction contractor(s)
Monitoring health and safety of the workers during the construction of the project component	Health records about occupational injuries **(WHO)**	Clinic / hospital referred by the contractor		Medical reporting cases	On received cases.	Cost cannot be identified accurately.	Construction Contractor(s)
Monitoring for the diseases for the workers during the construction of the project proponent	Health record from the sites **(WHO)**	Project sites		Medical check to construction workers and Testing works at the site	As soon as the construction start	10000 kyats/time and 7000 kyats/test kit	Contractors

Operation Phase							
Effluent from substations	BOD, COD, Oil and grease, PH, Total coliform bacteria, Total nitrogen, Total phosphorus, Total suspended solids **(NEQG)**	21°50'50.35"N 21°56'57.46"N 22° 3'2.31"N 22° 6'27.01"N 22°18'53.56"N 22°32'27.45"N 22°40'18.33"N 22°59'8.37"N 23°17'52.57"N 23°22'6.67"N 23°39'19.81"N 24° 1'2.40"N 21°50'50.35"N	96° 7'15.96"E 96° 9'13.07"E 96°16'42.53"E 96°31'59.80"E 96°48'32.81"E 97° 8'30.47"E 97°28'59.89"E 97°42'18.81"E 97°59'10.65"E 97°55'58.80"E 97°50'55.84"E 97°57'48.87"E 96° 7'15.96"E	Taking water samples and sending to laboratory.	Once a year but if complaint is made, measurement has to be done.	580000 kyats per once	Monitoring team of Railway Project
Management of risks during the emergency situations (fire, soil contamination, water resource contamination and smoke)	Records of emergency situations	The locations for the traction substations are mentioned above.		Visual monitoring for possible leak and for possible damage on the foundation and isolated area	Weekly or if required	Undefined	Monitoring team of Railway Project
EMF exposure for the workers at the traction substations	Health record from the sites **(WHO)**	The locations for the traction substations are mentioned above.		Medical check to construction workers	Once a year	12000 kyats/ one	Monitoring team of Railway Project
Replanting the trees near the project area	Flora **(IUCN Red List)**	The locations for the traction substations are mentioned above.		Recording and documentation	Daily	The cost cannot be identified accurately.	Monitoring team of Railway Project

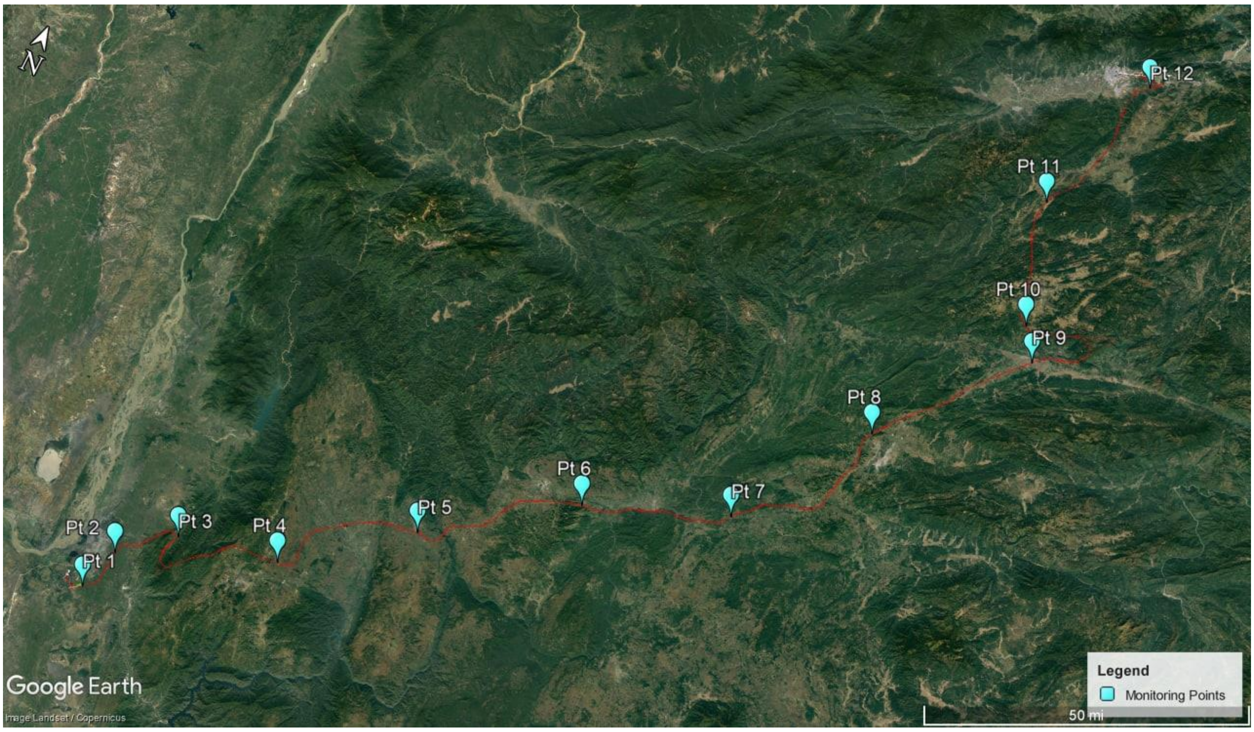


Figure 8.1 – Locations of Monitoring Points for the Proposed Project

8..3. Estimated Budget for Environmental Management and Monitoring

The specific location and number of sample points will be determined in the implementation stage. The following tables show the estimated cost and budget for environmental management and monitoring.

Table 8.3. Estimated Cost for Environmental Management

No,	Phases	Estimated Cost/Year	Total Budget
1.	Pre-construction Phase	2,150,000 kyats	2,150,000 kyats
2.	Construction Phase	12,650,000 kyats	2,0570,000kyats
3.	Operation Phase	6,180,000kyats	24,810,000 kyats
4.	Decommissioning Phase	2,180,000 kyats	2,180,000 kyats

Table 8.4. Estimated Cost for Environmental Monitoring

No,	Phases	Estimated Cost/Year	Total Budget
1.	Pre-construction Phase	2,040,000	2,040,000kyats
2.	Construction Phase	2,737,000kyats	8,211,000 kyats
3.	Operation Phase	6,972,000 kyats	348,120,000kyats
4.	Decommissioning Phase	-	-

8.4. Management and Monitoring Sub-Plans

8.4.1. Environmental Monitoring Program

8.4.1.1. Objective

The purpose of environmental monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse affects are detected and timely action can be taken. Main objectives of environment monitoring plan include:

(a) Identify all environment changes which may cause adverse effects on environment by the project implementation;

(b) Monitor discharge sources (gas emission, waste water and solid waste) and operation of environmental protection equipments in order to ensure that these activities will comply with legislative requirements;

(c) Check monitoring process and inspect installation system and equipments in respect of pollution prevention and control;

(d) Prevent potential incidents;

(e) Propose appropriate environment protection measures based on results of environmental monitoring;

(f) Overcome and repair all weak-points based on results of environment monitoring program.

8.4.1.2. Legal Requirements

(1) The Prevention of Hazard from Chemical and Related Substances Rules (Law No. 8, 15, 16, 17, 20, 22, 23, 27)

- Performing the sticking pictogram for being least the health impacts and accident injuries in the occupational area according to the prescribed standards and norms of the Globally Harmonized System GHS);
- Making the necessary arrangements to be safety of the occupational area and issuing orders and directives for preventing and decreasing the accident;
- Laying down the proliferation plans on knowledge, and safety of chemical and related substances to administrators, license holders, public and workers;
- Cooperating with local and foreign governmental departments, organizations and non-governmental organizations in respect of safety management for chemicals hazard.

(2) Protection of Biodiversity and Protected Area Law

To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological gardens and botanical gardens.

(3) Conservation of Water Resources and Rivers Law (Law No. 8, 11a, 13, 19, 24b, 30)
To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.

(4) Animal Health and Development Law (Law No.17)
- To carry out animal health and development work and promote livestock development;
- To prevent outbreak of contagious disease in animals and to control the outbreak systematically when occurs;
- To inspect imported animal, animal product and animal feed;
- To issue recommendation certificate concerning animal, animal product and animal feed for export;
- To protect animals by law from being ill-treated.

(5) The Fertilizer Law (Law No. 7)
- To enable supporting the development of agricultural sector which is the basic economy of the State;
- To enable supervision and control the fertilizer business systematically;
- To enable growers to use fertilizer of quality in conformity with the specifications;
- To support the conservation of soil and environment by utilizing suitable fertilizer;
- To enable carrying out of educative and research works extensively for the systematic utilization of fertilizer by the agriculturalist;
- To cooperate with government departments and organizations, international organizations and local and foreign non-governmental organizations regarding fertilizer business.

8.4.1.3. Overview Maps

The monitoring action will be done along the electrical power lines with the same of Railway Alignment.

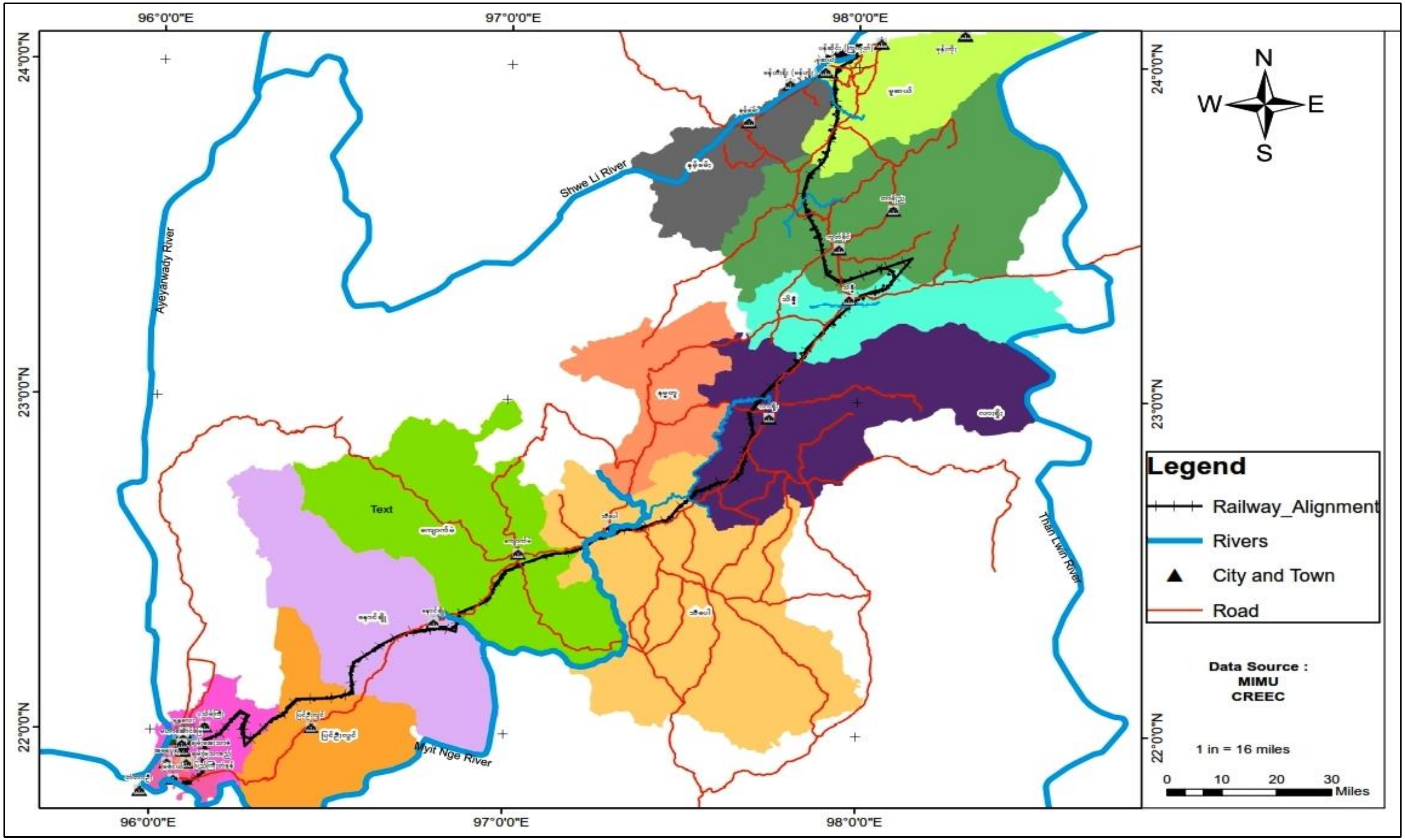


Figure 8.2 – Map of Electrical Power Lines Plan of Muse-Mandalay Railway Line

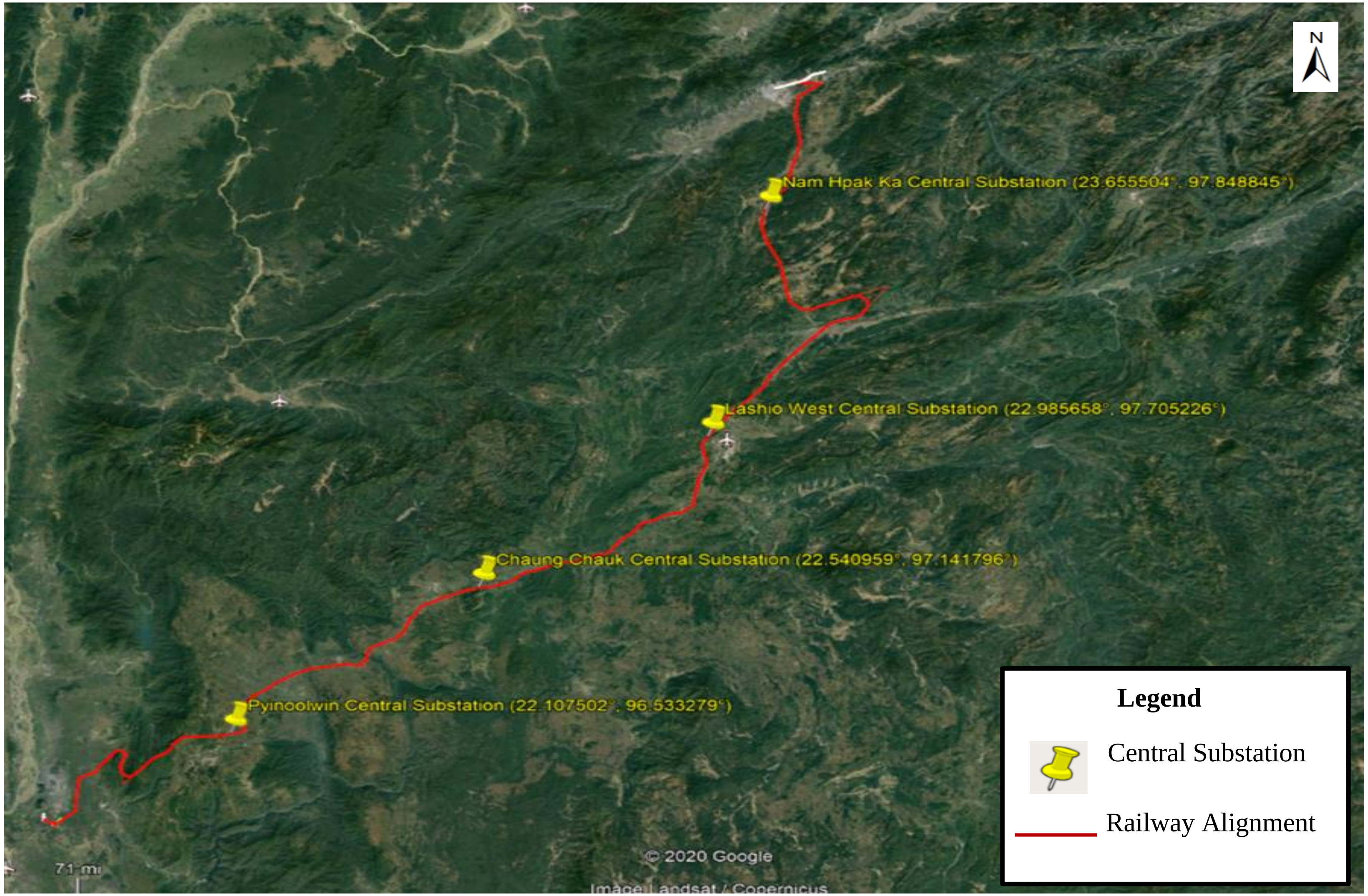


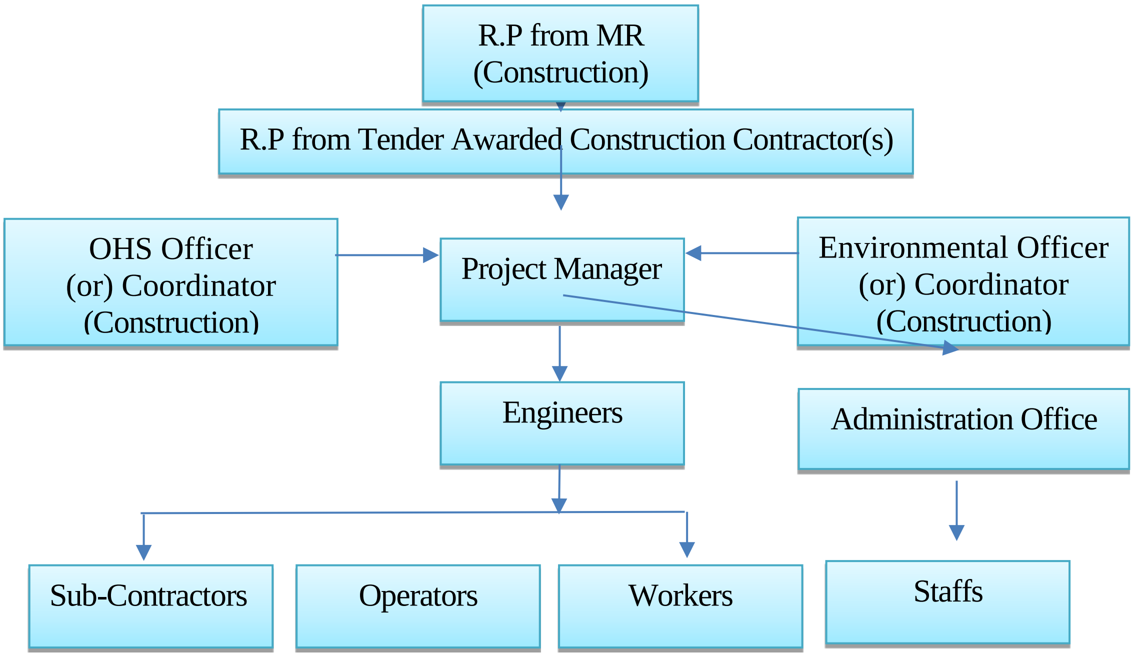
Figure 8.3 – Map of Overall Substation along the Railway Line

8.4.1.4. Management Actions

An executive agency of the Muse-Mandalay Railway Project is MR. They will be organizing a project Environmental Management and Monitoring Team (EMMT) for assist the implementation of the proposed project.

(a) For Pre-Construction and Construction Phases

The most responsible person for environmental management and monitoring during pre-construction and construction phases will be construction contractor(s). However, MR cannot assign construction contractor(s) during FS stage and will be chosen based on tender process after getting the agreement for FS. So, the organization structure for environmental management and monitoring during construction phase will be as follow:

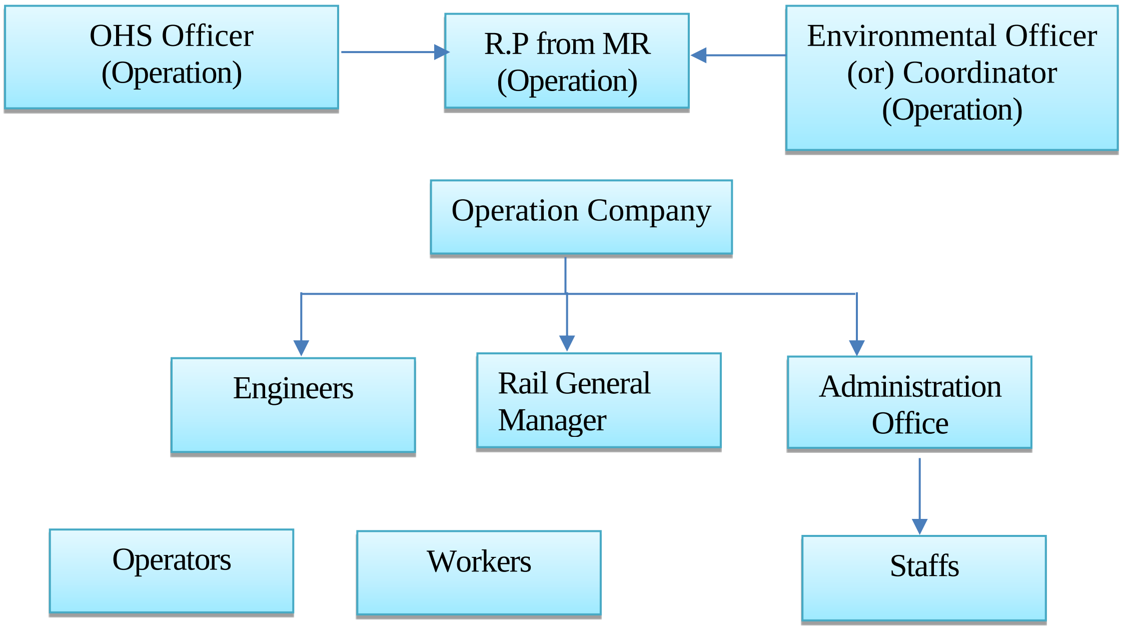


R.P – Representative Person

Figure 8.4. Environmental Management Team for Construction Phase

(b) For Operation Phase

The most responsible person for environmental management and monitoring during operation phase will be MR. MR will be So, the organization structure for environmental management and monitoring during operation phase will be as follow:



R.P – Representative Person

Figure 8.5. Environmental Management Team for Operation Phase

8.4.1.5. Staffs for Environment Management and Monitoring Team

Apart from having an EMMT, it is necessary to have a permanent staff charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. Environmental monitoring can also be done by registered third party monitoring agency. Detailed function of the environmental officer but not limited are as follow:

Environmental Officer

The major duties and responsibilities of the environmental officer or person-in-charge for environmental monitoring of proposed project will be as given below:

(a) To implement the environmental management plan,

(b) To assure regulatory compliance with all relevant rules and regulations,

(c) To ensure regular operation and maintenance of pollution control devices,

(d) To minimize environmental impacts of operations by strict adherence to the EMP.

(e) To initiate environmental monitoring as per approved schedule.

(f) Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit,

(g) Maintain documentation of good environmental practices and applicable environmental laws as ready reference,

(h) Maintain environmental related records,

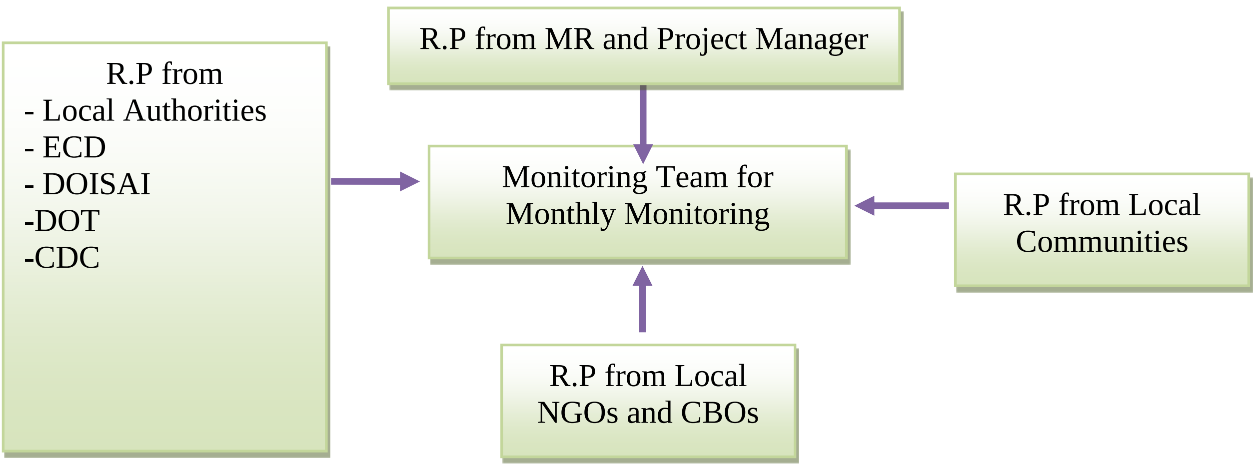
(i) Coordination with regulatory agencies, external consultants, monitoring laboratories,

(j) Maintain of log of public inconvenience and the action taken,

(k) Ready to solve any complaints from local people about environmental and social issues especially in waste water and traffic.

8.4.1.6. Environmental Monitoring Team for Monthly Monitoring

Environmental monitoring team for monthly monitoring has to organize representatives from MR, representatives from tender winning company for project construction and/or operation, representative persons from General Administrative Office (GAO), Department of Industrial Supervision and Inspection (DOISAI), Department of Transportation (DOT), Environmental Conservation Department (ECD), local communities and local NGOs & CBOs as follow:



Note: should participate, R.P = Representative Persons

Figure 8.6. Proposed Environmental Monitoring Team for Monthly Monitoring

Once the project starts implementation, construction contractors and sub-contractors will be selected by tender system. MR will open a tender system for selecting construction contractors and sub-contractors. Apart from having an Environmental Management Plan, it is necessary to have a permanent staff charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. Environmental monitoring can also be done by registered third party monitoring agency.

Role and Responsibilities of MR

MR will be the executive agency for railway project. They will conduct a contract will tender-winning contractors for implementation of EIA and EMP, with relevant rules and regulations and respective punishments and funds for not following instructions. Planning and Administrative Department of MR will closely perform monitoring and management plans and directly supervise the contractors. Thus, MR will be responsible to closely supervise tender-winning contractors for assisting the implementation of EIA and EMP for the proposed project.

Role and Responsibilities of Construction Contractors

These contractors will be responsible for assisting in implementation of EMP for proposed project by following direct instructions of MR. They will have to follow instructions, rules and regulations of MR, included in the contract. If any of the rules should they violate, there will be effective penalties for not following the instructions as follows,

No	Non-Compliance	Penalties	Specific Administrative Punishment of the Ministry
1.	Failure or delay in timely submission of reports within Period prescribed by Ministry	100 to 500 US$ or equivalent Myanmar Kyat + 10-25 US$/ day unit cured or equivalent Myanmar Kyat	-Issue Enforcement Notice
2.	Obstruction or interference with an official in the course of their duties	250 to 5,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice -Criminal prosecution
3.	Failure to provide information to the Ministry or any representative	1,000 to 5,000 US$ or equivalent Myanmar Kyat	-Suspension of Approval of EMP, EMP-CP, EMP-OP in whole or in part
4.	Failure to provide information to the Ministry Inspector or any representative when requested in regard to inspection and monitoring	250 to 5,000 US$ or equivalent Myanmar Kyat	- Issue Enforcement Notice
5.	Undertaking or allowing any preparatory or other construction works without the prior approval by the Ministry of a reserved EMP or EMP-CP	1,000 to 5,000 US$ or equivalent Myanmar Kyat +50 to 500 US$/ day until cured or equivalent Myanmar Kyat	-Criminal prosecution
6.	Operating/implementing without a permit, or approval by the Ministry of an EMP or EMP-Op	1,000 to 5,000 US$ or equivalent Myanmar Kyat +50 to 500 US$/ day unit cured or equivalent Myanmar Kyat	- Criminal prosecution

7.	Non-compliance with an Enforcement Notice or Suspension Notice issued by the Ministry	2,000 to 10,000 US$ or equivalent Myanmar Kyat +100-500 US$/day unit cured or equivalent Myanmar Kyat	-Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
8.	Failure to notify to the Ministry of any knowledge of any event of an imminent of Environmental damage	1,000 to 5,000 US$ or equivalent Myanmar Kyat	- Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
9.	Failure to take reasonable steps to prevent an imminent thread of damage to the Environment, social, human health, livelihoods, or property, where application based on the EMP, EMP-CP or EMP-OP	2,500 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
10.	Non-compliance with conditions in ‘the ECC and allowable Emission Limit Values	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
11.	Failure to take pay compensation amounts required in respected in respect of social impacts	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
12.	Failure to fully restore social conditions upon resettlement	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part

			-Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part

Role and Responsibilities of Participants

Representative from	Role and Responsibilities
MR and Tender awarded company	-Recording and reporting for monitoring plan -Participate for solving issues concerning with social, environmental and training program for workers and local people. -Cooperation with respective departments and organizations for environmental conservation and social development. Reporting any complain related to the project
General Administrative Office (GAO)	-Cooperation with respective department and organization for land compensation -Participate for issues concerning with settlement of migrant workers - Participate for issues concerning with social problems -Assist training program for local people
Department of Industrial Supervision and Inspection (DOISAI)	-Inspection for plants, equipment, use of vehicles and fuel whether project proponent follows or not according to the instructions, rules and regulations -Inspection together with respective department and organization to reduce impacts on the public health due to the wastes from the plant
Department of Transportation (DOT)	- Inspection for implementation of railway project. -Instruction for the use of public road
Environmental Conservation Department (ECD, Mandalay)	-Instruction related to environmental impact assessment -Cooperation with respective department for environmental conservation -Implementation of training program -Instruction for submission of environmental monitoring report every 6 month
Mandalay City Development Committee (CDC)	-Field inspection for consistent of reporting and implementation of engineering work -Inspection for accuracy of engineering standard and guidelines. - Field inspection for complains
Local communities	-Participate in decision for social and environmental problems -Participate for social surveying and complain their issues related to project.
Local NGOs & CBOs	- Cooperate for issue concerning human rights, social, environmental - Field inspection for complains

8.4.1.7. Considerations for Environmental Monitoring

The following factors will be considered during the environmental monitoring.

(a) Monitoring will be done by registered third party monitoring agency or proposed environmental monitoring team of the proposed team. and at least three representatives from proposed monitoring team will be participated in every monitoring process.

(b) If monitoring results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of monitoring can be reduced (IFC, World Bank, 2007).

(c) By studying the wind rose, the most dominant wind direction and wind speed for every season can be predicted and monitoring station for dust, noise and gas emissions will be carried out at that wind direction

8.4.1.8. Environmental Management Training Program

Environmental management training program is an important part in EMP. Training and human resource development is an important link to achieve sustainable operation of the facility and environmental management.

Training Program for Construction Phase

During construction phase, construction contractor must ensure that project staffs are trained on labor safety and environment protection during construction phase.

Training Program for Operation Phase

In operation phase, all staff of proposed plant will be trained on environment safety throughout training courses to be familiar with operation processes and guidelines, fire-fighting exercises and practices, etc. Project Management Board will be established and maintain training programs that are regularly updated to help staff at all levels and related functional departments are aware of their responsibility on environment protection. For successful functioning of the project, relevant EMP’s will be communicated to the following groups of people:

Employees

Employees must be made aware of the importance of safety, waste segregation and storage, and energy conservation. This awareness will be provided through leaflets and periodic in-house meetings. They will be informed about their responsibilities for successful operation of various environmental management schemes inside the premises.

Site Staff

Relevant personnel at site will be trained for:

(a) Collection, segregation and storage of the solid and waste generated during operation,
(b) Operation and maintenance of sewage treatment plant and reclamation system,
(c) Requirements of the emergency response plan in case of an emergency,
(d) Techniques for waste minimization, water conservation and energy conservation,
(e) Applicable environmental, health and safety regulations and compliance requirements,
(f) Functioning of the environmental management system including environmental monitoring, reporting and documentation needs.

8.4.1.9. Record Keeping

Record keeping and reporting of performance is an important management tool for ensuring sustainable operation. Records will be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements for the site is summarized in following table.

Table 8.5. Record Keeping Requirements

Parameter	Particulars
Resources Use	- Daily quantity of electrical power consumption through power meter - Daily quantity of water use for cooling system and domestic use through water meter
Solid Waste Handling and Disposal	- Daily quantity and management of domestic solid waste from workers' dormitory
Monitoring and Survey	-Records of all monitoring carried out as per the finalized monitoring protocol.

Complaints from Nearest Residents	- Records of all complaints about the traffic from the nearest villages
Employee Health and Safety Record	- Daily record for accidents at the workplace
Others	- Equipment inspection and calibration records, where applicable - Vehicle maintenance and inspection records

8.4.1.10. Environmental Audits and Corrective Action Plans

To assess whether the implemented EMP is adequate, MR will conduct periodic environmental audits. Environmental audit is an independent and objective oriented examination of whether the practice complies with expected standards. Broadly, environmental audit means a check on some aspects of environmental management, and implies some kind of testing and verification. There are two levels of Environmental Audits, i.e. Environmental Impact Audit and Environmental Management Audit. Environmental Impact Audit involves comparing the impacts predicted in an EIA with those that actually occur after implementation of the project while Environmental Management Audit involves checks against adherence to plans, mitigation measures and general compliance of terms and conditions. These audits will be followed by Corrective Action Plans (CAP) to correct various issues identified during the audits.

8.4.1.11. Reporting Monitoring Results

Results of recorded in files to monitor and audit monitoring will be carried out strictly as required by the related national regulations and the monitoring results of required parameters should be reported to ECD (Nay Pyi Daw) biannually.

8.4.2. Air Quality Management Plan

8.4.2.1. Objectives

The objectives of the Air Quality Management Plan are to:

- Control emissions from vehicles protecting the health and biodiversity
- Control emission dust to reduce human health impact

8.4.2.2. Legal Requirements

National Environmental Quality (Emission) Guidelines, 2015

- These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem, health.

Environmental Conservation Law, 2012

- To enable to implement the Myanmar National Environmental Policy;
- To enable to lay down the basic principles and give guidance for systematic integration of the matters of environmental conservation in the suitable development process;

Environmental Conservation Rules, 2014

- To implement correctly according to the environmental management plan

8.4.2.3. Overview Map

This plan contains the identification of impact related to air environment together with mitigation and management measures to avoid or reduce these impacts and its monitoring plan. The locations for the air quality monitoring points are shown in the following figure.

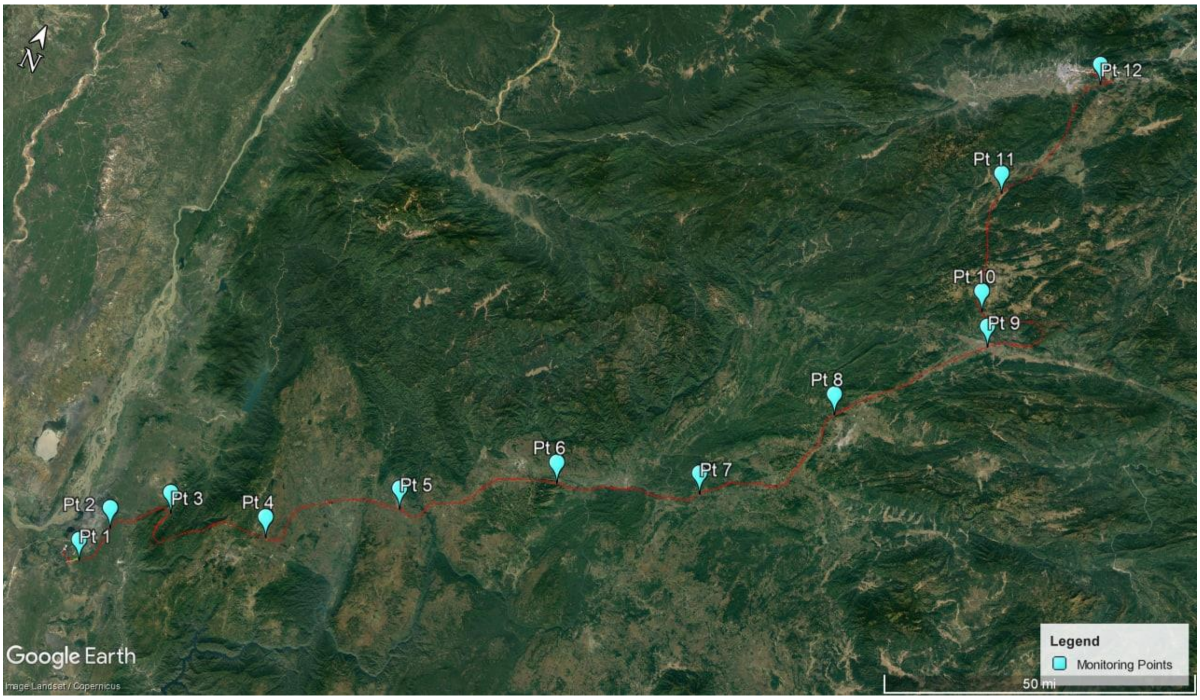


Figure 8.7. Proposed Air Quality Monitoring Points

8.4.2.4. Air Quality Management and Monitoring P

Potential Impact and Mitigation

Project Activity	Impact on Air Quality	Mitigation Measures
Site clearing and earth working for power supply system	Dust from earth working activities Dust from hauling of construction materials and earth particles	Water spraying at workplace regularly Water spraying along the hauling road Restricting vehicle speed limit
	Gaseous emissions from construction machineries	Use machineries, vehicles and generator with good engine conditions. Use low sulphur content fuel. Regular maintenance of machineries, vehicles and generator.
Construction Activities	Fugitive Dust Generation	Proper management of stockpiles. Water will be sprayed on construction sites and approach roads to suppress dust in dry weather. Trucks transporting materials will be covered with automatically closing covers or tarpaulins to avoid spilling material on roads Immediately clean up any mud or dusty materials left on public roads. Restricting vehicle speed limit
	Vehicular Emission	Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes. Machineries, vehicles and generator with good engine conditions and low sulphur content fuel should be used.
Power supply to all technologies related to railway operation and maintenance	Gaseous Emission	Use generator with good engine condition
Demolition, decommissioning, and destruction of substation and power lines activities	Dust Generation - The destruction of traction substations and power lines - emissions from the truck vehicles and other heavy/light-duty vehicles	Water will be sprayed on sites during destruction activities Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes

Air Quality Monitoring Plan

Project activities	Parameter to be monitored	Locations	Measurements (Methods and Equipment)	Frequency of measurement	Budget	Compliance Standard	Responsibilities
During Pre-Construction Phase							
Gaseous emission, and PM generation	Ambient air quality (CO, CO2, SO2, NOx)	Within the site and surrounding establishments	Visual investigation and monitoring by handheld PM meter and CO, CO2, SO2, NOx meter	During the Pre-construction activities at different locations at least per month or every complaints or if necessary	100000 Kyats per once	NAAQS	Contractor(s) (as a part of contractor's financial offer)
During Construction Phase							
Gaseous emission, and PM generation	Ambient air quality (CO, CO2, SO2, NOx)	Within the site and surrounding establishments	Visual investigation and monitoring by handheld PM meter and CO, CO_2, SO_2, NO_x meter	During the construction activities at different locations at least per month or every complaints or if necessary	100000 Kyats per once	NAAQS	Construction contractor(s) (as a part of contractor's financial offer)
Construction machineries	Noise complaints from the neighboring	Within the site and surrounding establishments	Monitoring by noise level meter	During the construction activities at different locations at least per month or every complaints or if necessary	50000 Kyats per once	NEQG	Construction contractor(s) (as a part of contractor's financial offer)

During Operation and Maintenance of the Power Supply System							
Gaseous emission,	Ambient air quality (CO, CO_2, SO_2, NO_x)	Within the site and surrounding establishments	Visual investigation and monitoring by handheld PM meter and CO, CO_2, SO_2, NO_x meter	During the activities at different locations at least per month or every complaints or if necessary	100000 Kyats per once	NAAQS	Contractor(s)
During Decommissioning Phase							
Gaseous emission, and PM generation	Ambient air quality (CO, CO_2, SO_2, NO_x)	Within the site and surrounding establishments	Visual investigation and monitoring by handheld PM meter and CO, CO_2, SO_2, NO_x meter	During the activities at different locations at least per month or every complaints or if necessary	100000 Kyats per once	NAAQS	Contractor(s)

Role and Responsibilities

Overall responsibility for the implementation of this Air Quality Management Plan rests with project developer. All employees and the contractor will meet the requirements of this management plan and associated procedures. Management actions set out in this management plan may be delegated in writing by project developer to the specific contractor.

Key project personnel including the rail project manager, rail environmental management representatives, contractor project manager and each contractor's environment/ HSE representative, will ensure that all management actions are undertaken to a satisfactory standard and that all personnel are aware of their responsibilities with respect to environmental matters. A general outline of responsibilities in relation to environmental is provided below:

Rail Project Manager

- Overall accountability for the environmental management of the project
- Implementation of the environmental Policy with respect to the project
- Overall responsibility for development, implementation, maintenance and compliance with this management plan

Rail Environmental Management Representative (EMR)

- Accountable for environmental matters on the project
- Provide support to rail personnel and the contractor as required to ensure this management plan is implemented and complied with
- Review effectiveness and implementation of this management plan
- Monitor the implementation of all required environmental management actions and compliance with legislation.
- Undertake environmental auditing as required.

All Personnel (Project Developer and the Contractor)

- Comply with the requirements of this management plan
- Report all environmental incidents as they occur
- Attend environmental inductions or any other training as required

Reporting

Construction

- Monthly reporting by the Construction Contractor to Project developer on non-conformances (including complaints), incidents and site inspections

Operation

- Monthly reporting by the Operation Manager to Project Developer on non-conformances (including complaints), incidents and site inspections
- Regular communication with community groups, councils, forums and individuals by listening to and discussing issues. Information on train-related coal dust mitigation initiatives being undertaken will be provided to the appropriate forums.

8.4.3. Water Quality Management Plan

8.4.3.1. Objective

The main objective for water quality management plan is to minimize the environmental impacts on surface water and groundwater from the project.

8.4.3.2. Legal Requirements

National Environmental Quality (Emission) Guidelines, 2015

- These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem, health.

Conservation of Water Resources and River Laws, 2006

- To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.

Conservation of Water Resources and River Rules, 2013

- To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.

8.4.3.3. Overview Map

This plan contains the summary of potential environmental impacts related to water together with mitigation measure to reduce or avoid these impacts and its monitoring plan. The locations for water quality monitoring points are shown in the following figures.

Figure 8.8. Proposed Water Quality Monitoring Points

8.4.3.4. Water Quality Management and Monitoring

Potential Impact and Mitigation

Project Activity	Impact on Water Quality	Mitigation Measures
Site clearing and earth working for power supply system	Liquid Waste 1. Improper handling of fuel oil and lubricants 2. The mobilization and transport of soil particles	Provide proper drains Avoid any leakage of oil and lubricant from vehicles and machineries used in pre-construction phase Use temporary sedimentation ponds during rainy reason
	Solid Waste 1. Earth working activities 2. Site clearing activity	Reuse suitable soil particles in earth filling activities during the construction of traction substation Limit unnecessary earthworks; Prevent over-excavation
Construction Activities	• Increased sedimentation of water courses • Accidental spills contaminating wells with oils, lubricants, paint wastes, etc. • Sanitation facilities such as toilets leaking into portable water source. • Clearance of site vegetation	Restrict materials storage within 50m of a water course. Temporary drainage provision Installation of prefabricated septic tanks on site Systematic waste disposal site Contingency plans for control of spills of oil and other hazardous substances
	Hazardous Construction Waste	Training workers on appropriate handling and storing of chemicals and fuels as per MSDS.
	Hydrological Situation	Adjust pole placements to span the resource overhead. Construct temporary bridge structures across the resource. Avoid pole placements adjacent to the resource or blockage to the resource.
Power supply to all technologies related to railway operation and maintenance	Wastewater used during operation phase Oil and grease through light-maintenance activities of power stations Paint residue for maintenance of power supply stations	Proper treatment of wastewater Train workers on appropriate handling of oil and lubricants Proper collection and disposal of paint residues Proper disposal of waste according to local CDC's instruction Use the zinc-based paint instead of lead-based paint

Demolition, decommissioning, and destruction of substation and power lines activities	Increases sedimentation of water courses Piling steel structures on the site for a long time without moving to dumping sites or to places to do recycling.	Proper Disposal of wastes according to the requirements. Reuse the wastes where possible. When reusing is impossible, recycle the wastes by giving to recyclists and secondary users can use them.

Water Quality Monitoring Plan

Project activities	Parameter to be monitored	Locations	Measurements (Methods and Equipment)	Frequency of measurement	Budget	Compliance Standard	Responsibilities
During Pre-Construction Phase							
Area of spillage	Color(TCU), turbidity, total dissolved solvents, chloride, total hardness, Iron, pH, sulphate, calcium, magnesium, electrical conductivity	nearest surface water resources	Visual observation; Recording and documentation of spillage	Monthly	12000 Kyats per once	National drinking water quality standards(2014)	Construction contractor(s) (as a part of contractor's financial offer)
During Construction Phase							
Area of spillage	Color(TCU), turbidity, total dissolved solvents, chloride, total hardness, Iron, pH, sulphate, calcium,	Project Site and nearest surface water resources	Visual observation; Recording and documentation of spillage	Daily	12000 Kyats per day	National drinking water quality standards(2014)	Construction contractor(s) (as a part of contractor's financial offer
Management of construction waste and handling of		Project Site and nearest surface water resources	Estimation of the hazardous waste and non-hazardous waste	Weekly or monthly depending on the volume of	12000 Kyats per day	National drinking water quality standards(2014)	Contractor(s) during construction and power station staff during operation

hazardous waste	magnesium, electrical conductivity		in relation to the handling and transporting to the landfill	waste			
During Decommissioning Phase							
Area of spillage	Color(TCU), turbidity, total dissolved solvents, chloride, total hardness, Iron, pH, sulphate, calcium, magnesium, electrical conductivity	Nearest surface water bodies	Visual observation; Recording and documentation of spillage	Weekly	12000 Kyats per once	National drinking water quality standards(2014)	Contractor(s)

Role and Responsibilities

Contractor shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Water Quality Management Plan.

Project developer shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of Company's responsibilities in the Water Quality Management Plan.

Reporting and Notification

Contractor shall report to Company the results of the monitoring undertaken and integrate the results, including additional mitigation and management measures as agreed with Company, into the Water Management Plan.

Contractor shall report the results of the environmental assessments undertaken in respect of the proposed water abstraction locations, and shall obtain Company approval prior to abstraction.

Contractor's monthly report to Company shall include:

• Results of all monitoring highlighting any exceedances

• Number and results of verification inspections

8.4.4. Noise and Vibration Management Plan

8.4.4.1. Objective

The objective of the Noise and Vibration Management Plan is to reduce to an acceptable level noise and vibration impacts from project activities to local residents.

8.4.4.2. Legal Requirements

National Environmental Quality (Emission) Guidelines, 2015

- These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem, health.

8.4.4.3. Overview Map

This plan contains the summary of potential environmental impacts related to noise and vibration together with mitigation measure to reduce or avoid these impacts and its monitoring plan. The following figure shows the locations of the noise and vibration monitoring points for the proposed project.

Figure 8.9. Proposed Noise Quality Monitoring Points

8.4.4.4. Monitoring Plan

Potential Impact and Mitigation Measure

Project Activity	Noise and Vibration Impact	Mitigation Measures
Site clearing and earth working for power supply system	Noise from construction machineries	Avoid operation of noisy equipment at the same time Limit the operation of noisy construction machineries at night Regular maintenance of machineries Use engines with good condition
Construction Activities	Noise from construction machineries	Source Control Locate sites at least 500m away from sensitive areas. Operate between 7am-7pm only Reach an agreement with nearby residents regarding the timing of heavy machinery work Community Notification Consultation and engagement
Removal of buildings and infrastructures.	Noise from removal of buildings and infrastructures.	Maintain all exhaust systems in good working order; Undertake regular equipment maintenance Reduce vehicle speeds around sensitive receptors such as dwellings and schools.

Noise and Vibration Monitoring Plan

Project activities	Parameter to be monitored	Locations	Measurements (Methods and Equipment)	Frequency of measurement	Budget	Compliance Standard	Responsibilities
During Pre-Construction Phase							
Construction machineries	Noise complaints from the neighboring	Within the site and surrounding establishments	Monitoring by noise level meter	During the Pre construction activities at different locations at least per month or every complaints or if necessary	50000 Kyats per once	NEQG	Contractor(s)

During Construction Phase							
Construction machineries	Noise complaints from the neighboring	Within the site and surrounding establishments	Monitoring by noise level meter	During the construction activities at different locations at least per month or every complaints or if necessary	50000 Kyats per once	NEQG	Contractor(s)
During Decommissioning Phase							
Machinery and equipment used in decommissioning phase	Noise complaints from the neighboring farm/project	Within the site and surrounding establishments	Monitoring by noise level meter	During the construction activities at different locations at least per month or every complaints or if necessary	50000 Kyats per once	NEQG	Contractor(s)

Roles and Responsibilities

Contractor shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Noise and Vibration Management Plan.

Contractor's Noise and Vibration Management Plan shall describe the resources allocated and responsible for the execution of each task and requirement contained therein, and shall describe how their roles and responsibilities are communicated to the relevant personnel.

Project developer shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of Company's responsibilities in the Noise and Vibration Management Plan.

Reporting and Notification

Contractor shall report to project developer the results of the monitoring and integrate the results, including additional mitigation and management measures as agreed with Company, with the Noise and Vibration Management Plan.

Contractor's monthly report to Company shall include:

• Number and results of verification inspections

• Results of monitoring

8.4.5. Soil Quality Management Plan

8.4.5.1. Objective

The objectives of the Soil Quality Management Plan are to contain, transport, handle and dispose of solid and liquid wastes arising from project construction activities in such a manner as to minimize impacts to the environment.

8.4.5.2. Legal Requirements

National Environmental Quality (Emission) Guidelines, 2015

- These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem, health.

Law Amending the Factories Act, 2016

- To make effective arrangements in every factory of disposal of waste and effluent, and matters on health, cleanliness and precaution against danger.

8.4.5.3. Overview Map

This plan contains summary of the potential impacts associated with wastes, together with mitigation and management measures to avoid or reduce these impacts and its monitoring. The following figures show the locations of the soil quality monitoring points for the proposed project.

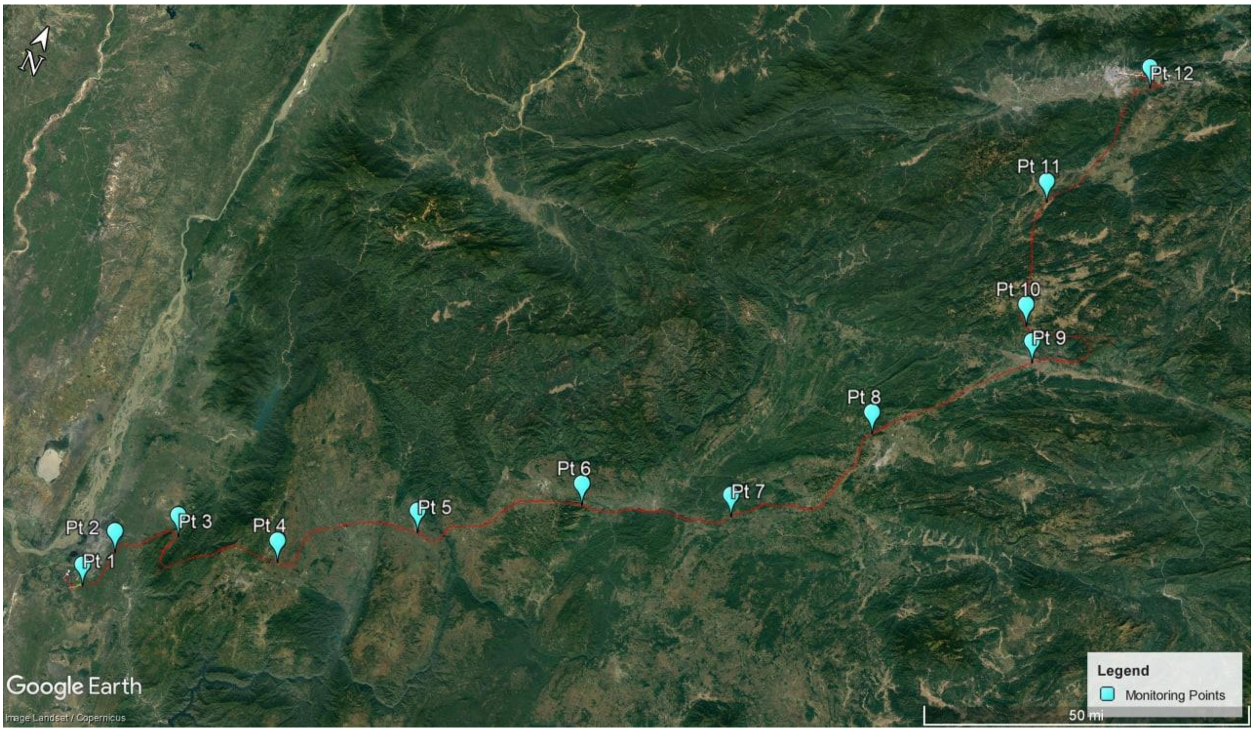


Figure 8.10. Proposed Soil Quality Monitoring Points

8.4.5.4. Monitoring Action Plan

Potential Impact and Mitigation Measure

Project Activity	Impact on Soil Quality	Mitigation Measures
Site clearing and earth working for power supply system	Domestic wastes from pre-construction workers Soil materials generated from site clearing and tree cutting activities Improper handling of diesel and lubricants	Systematically dispose solid wastes Take special care on handling of diesel and lubricants to avoid leakage.
Construction Activities	Accidental Spills of Fuel Oil and Lubricants Construction Debris and Domestic Wastes from workers	Disposal of solid wastes according to the rules and regulations of CDCs. Proper handling of fuel oil and lubricants.
Power supply to all technologies related to railway operation and maintenance	Leakage of oil, grease and paint residues	Use zinc-based paint instead of lead-based paint Proper control and avoid leakage of oil or paint
Demolition, decommissioning, and destruction of substation and power lines activities	Soil and groundwater contamination As a result of accidents and/or improper handling of lubricants, oils, and transformer oils (PCBs), and the material wastes and domestic wastes from the workers	Disposal of hazardous wastes and solid wastes according to the rules and regulations of CDCs. Careful removal of electrical equipment

Soil Quality Monitoring Plan

Project activities	Parameter to be monitored	Locations	Measurements (Methods and Equipment)	Frequency of measurement	Budget	Compliance Standard	Responsibilities
During Pre-Construction Phase							
Storage of surplus soil particle from earth working activities	pH (soil: water 1:2.5), Texture, organic carbon, Total N, CEC, available nutrients (P, K_2O), Water soluble	Project sites	Recording and documentation	Monthly	12000 Kyats per once		Contractor(s)
During Construction Phase							
Storage of the machines and construction materials of the project components	pH (soil: water 1:2.5), Texture, organic carbon, Total N, CEC, available nutrients (P, K_2O), Water soluble	Project sites	Recording and documentation	Monthly	12000 Kyats per once		Construction contractor(s)
Storage of surplus soil particle from construction activities			Recording and documentation	Monthly	12000 Kyats per once		Construction contractor(s)
During Operation Phase							
Management of the hazardous and nonhazardous waste	pH (soil: water 1:2.5),	At the designated landfill for solid waste	Recording and documentation	Quarterly	12000 Kyats per once		Power station operators during operation

	Texture, organic carbon, Total N, CEC, available nutrients (P, K_2O), Water soluble						
During Decommissioning Phase							
Storage of the machines and decommissioning materials of the project components	Complaints from neighboring communities and records and documentation of the temporary area for storage of materials or machineries	Project site	Recording and documentation	Every complaints or if necessary	12000 Kyats per once		Contractor(s)

Roles and Responsibilities

Wastes generated during construction are considered to be owned by Company, with the exception of materials to be returned to suppliers by Contractor and materials released by Contractor to third parties for reuse, recycling or disposal.

Project facilities shall be used for the management and disposal of Project wastes (including material for recycling and wastewater). Transfer of Project waste to third party facilities shall be avoided and shall be accepted by Company only as an interim measure on an exception basis. Where it is necessary to utilize a third party facility, an audit shall be undertaken of that facility and such facility may only be utilized following submission of a satisfactory audit report to Company and with Company's prior written approval.

Contractor shall be responsible for appropriate collection, segregation, treatment, and transfer of solid wastes to the Waste Management Areas, and for appropriate processing and disposal of the wastes upon acceptance to the Waste Management Areas.

Waste Management Areas shall be operated by personnel qualified by training and experience to perform the required waste management functions.

Contractor shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Waste Management Plan.

Contractor's Soil Quality Management Plan shall describe the resources allocated to and responsible for the execution of each task and requirement contained therein, and shall describe how roles and responsibilities are communicated to relevant personnel.

Company shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of Company's responsibilities in the Soil Quality Management Plan.

Reporting and Notification

Contractor's monthly report to Company shall include:

• Number and results of verification inspections

• Waste tracking reports (all wastes)

• Waste source

• Waste type

• Waste storage quantities/volumes and locations

• Waste treatment methods

• Waste disposition volumes and locations

8.4.6. Traffic Management Plan

8.4.6.1. Objective

The primary objectives of this Traffic Management Plan are:

- To ensure efficiency and safety of the movement of people, goods, or vehicles.
- To manage potential adverse impacts on traffic flows and pedestrian movements to ensure road and pedestrian network performance is maintained at an acceptable level.

'Traffic' in this sense refers to the interaction of vehicles, mobile plant (machinery) and pedestrians. Areas where pedestrians are exposed to the risk of a collision between mobile plant and vehicles should be identified, for example, in a warehouse where forklifts and workers both operate.

8.4.6.2. Legal Requirements

(1) The Highways Law (Law No.24)

- To cause easier communication and transportation among states and divisions by constructing the highways and to strengthen national solidarity and friendship and to cause all-round development in all regions and areas in economic and social sectors,
- To give support in implementing the duty for security and convenience in road and communication and quickness in flow of commodities; and to supervise systematically in respect of traffic and use of highways.
- To give support in the modernization and development of the State by constructing highways within the State or by constructing highways which connect with neighboring countries;
- To carry out systematically the works of extension, repair and maintenance for durability of highways;

(2) Law Amending Highway Act (Law No 33)

Generally, the prevention of obstruction to traffic and of annoyance, danger or injury to the public

8.4.6.3. Overview Maps

The traffic management plan consideration combined with the geographical location of the project, the railway will be dvided into 6 sections including Mandalay beyond, Mandalay, Pyinoolwin, Lashio (including Kyaukme), Muse and China, shown in the figure below.

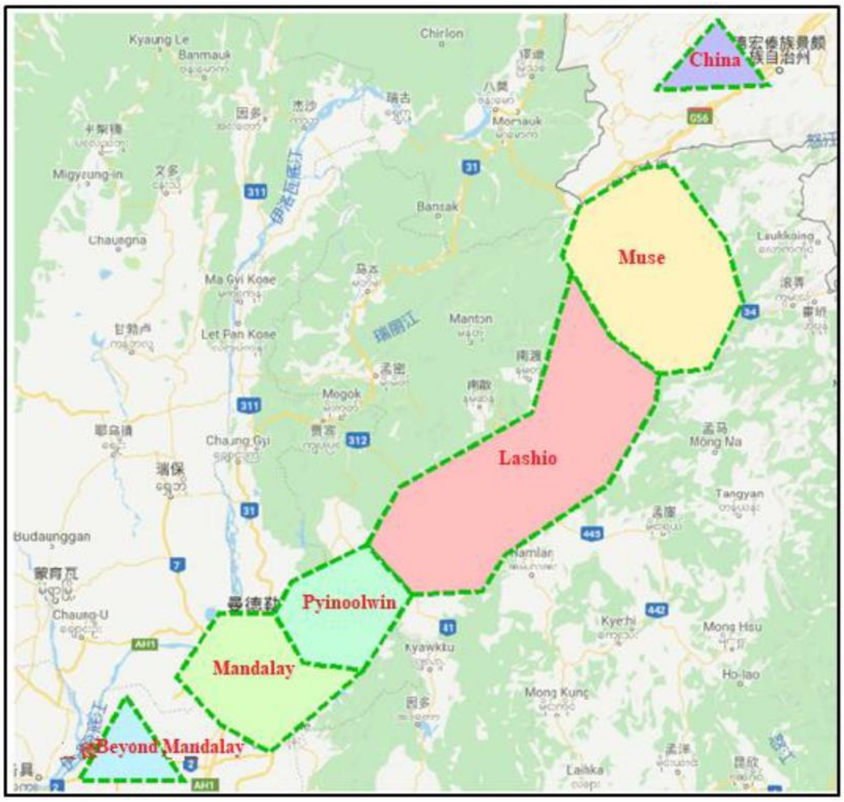


Figure 8.11 – Schematic Diagram of Selected Division

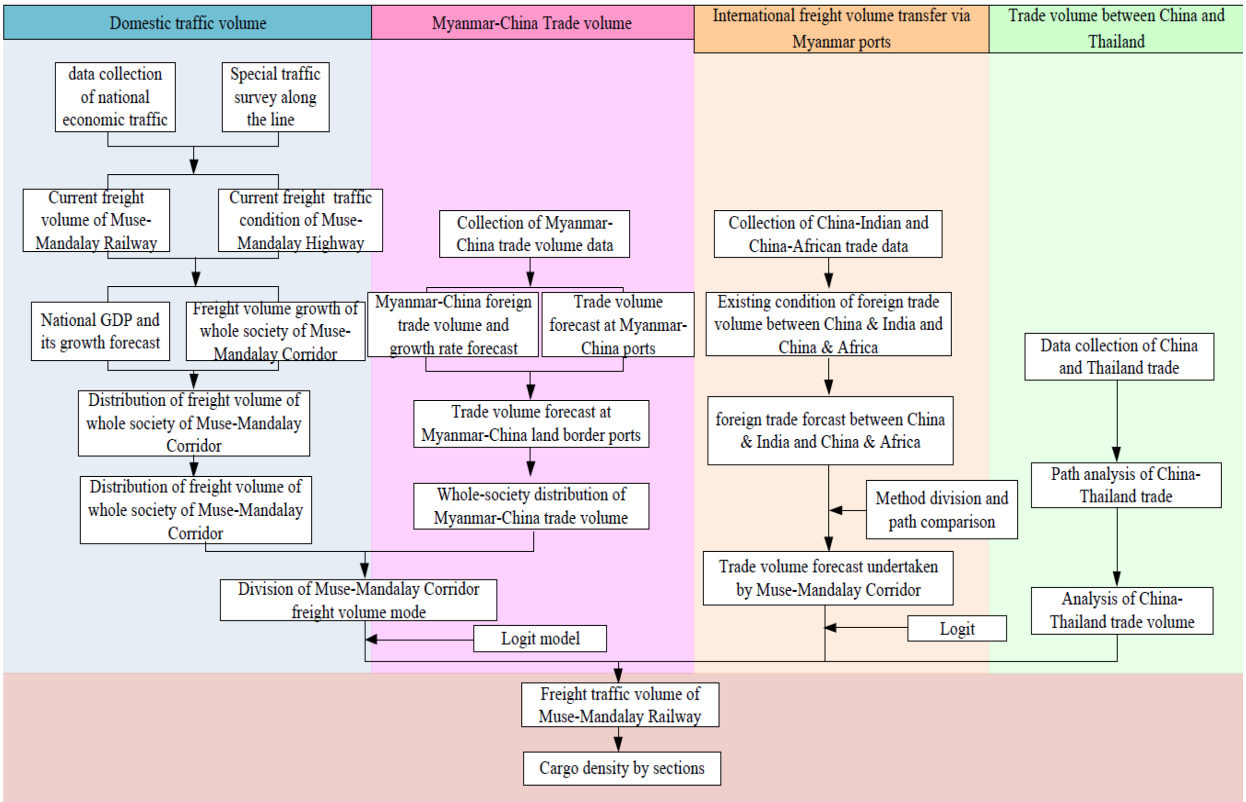


Figure 8.12 – Technical Roadmap of Freight Traffic Volume Forecasting for Muse-Mandalay Railway

8.4.6.4. Management Actions and Monitoring Plans

Management Actions and Monitoring Plans

For operation phase, traffic management will not be needed to consider. Traffic Management Plan for Construction Phase is discussed in this section.

Construction site vehicle incidents should be prevented by the effective management of transport operations throughout the construction process.

Key issues in dealing with traffic management on site are:

- Keeping pedestrians and vehicles apart
- Minimizing vehicle movements
- People on site
- Turning vehicles
- Visibility
- Signs and instructions

(a) Keeping pedestrians and vehicles apart

The majority of construction transport accidents result from the inadequate separation of pedestrians and vehicles. This can usually be avoided by careful planning, particularly at the design stage, and by controlling vehicle operations during construction work.

The following actions will help keep pedestrians and vehicles apart:

Entrances and exits – separate entry and exit gateways for pedestrians and vehicles should be provided;

Walkways – firm, level, well-drained pedestrian walkways that take a direct route should be provided where possible;

Crossings – where walkways cross roadways, a clearly signed and lit crossing point should be provided where drivers and pedestrians can see each other clearly;

Visibility – drivers driving out onto public roads should be made sure that they can see both ways along the footway before they move on to it;

Obstructions – walkways should not be blocked so that pedestrians have to step onto the vehicle route; and

Barriers – a barrier should be installed between the roadway and walkway.

(b) Minimizing vehicle movements

Good planning can help to minimize vehicle movement around a site. For example, landscaping to reduce the quantities of fill or spoil movement.

To limit the number of vehicles on site:

Car and van parking for the workforce and visitors should be provided away from the work area;

Entry to the work area should be controlled; and

Storage area should be planned so that delivery vehicles do not have to cross the site.

People on site

Employers should take step to make sure that all workers are fit and competent to operate the vehicles, machines and attachments they use on site by, for example:

Checking when recruiting drivers/ operators or hiring contractors;

Training drivers and operators;

Managing the activities of visiting drivers.

People who direct vehicle movements (signalers) must be trained and authorized to do so. Accidents can also occur when untrained or inexperienced workers drive construction vehicles without authority. Access to vehicles should be managed and people alerted to the risk.

Turning vehicles

The need for vehicles to reverse should be avoided where possible as reversing is a major cause of fatal accidents. One-way systems can reduce the risk, especially in storage areas. A turning circle could be installed so that vehicles can turn without reversing.

Visibility

If vehicles reverse in areas where pedestrians cannot be excluded, the risk is evaluated and visibility becomes a vital consideration.

The following list should be considered:

Aids for drivers – mirrors, CCTV cameras or reversing alarms that can help drivers to see movement all around the vehicle;

Lighting – so that drivers and pedestrians on shared routes can see each other easily. Lighting may be needed after sunset or in bad weather;

Clothing – pedestrians on site should wear high-visibility clothing.

Sign and instructions

All drivers and pedestrians must know and understand the routes and traffic rules on site. Standard road signs should be used where appropriate. Induction training for drivers, workers and visitors should be provided and instructions should be sent out to visitors before their visit.

Pedestrian routes should be:

- Kept clear and free of tripping hazards
- Segregated from vehicle routes
- Adequately signed
- Provided with crossing points that have a clear view

Vehicle routes should be;

- Segregated from pedestrian routes
- Designed to minimize reversing
- Suitable for the vehicles that need to use them with appropriate speed limits
- Designed to avoid steep gradients and sharp bends
- Designed with ramps, signage, and berms as required
- Designed to take into account loading and unloading areas

Hoarding, barriers, lighting and signs will be required at startup. As construction progresses, pedestrian and traffic routes will change and barriers, traffic cones, and signs will need to be moved to ensure that there is adequate pedestrian and vehicle separation. Fixed barriers should be used to separate vehicles from pedestrian walkways and to protect loading and unloading areas on site.

Injuries from construction site vehicles can be quite serious; an injured worker may be out of commission for weeks, months, or even longer.

Trucks, earth-moving equipment, and other heavy vehicles are essential on construction sites. These vehicles not only help workers with large scale projects but also make their jobs a little less strenuous. Unfortunately, these vehicles, when placed in the hands of other workers, can also be dangerous. Furthermore, dangerous vehicles that pass through construction zones can also threaten the lives of those working nearby.Distracted and inattentive drivers can easily run over or back over road construction workers or collide with other vehicles. Similarly, unsafe drivers on public roads pose their own threats while passing through construction zones.

The following are meant to control and limit the following common vehicle accident types:

- **Collisions and rollovers.** The most common type of accidents with any kind of vehicle is a collision or rollover. These occur as a result of erratic driving, failure to pay attention, and reckless driving. These types of accidents are extremely dangerous to construction workers who aren't protected inside vehicles. Also, because construction vehicles are significantly larger and heavier than normal vehicles, they can inflict even greater damage when they collide with workers or other vehicles.

- **Back-up accidents.** A back-over incident occurs when a vehicle strikes a worker who is standing, walking, or kneeling behind the vehicle. Nearly 70 workers a year die from back-over incidents that could have been avoided. These kinds of incidents can happen for a variety of reasons. Drivers may not be able to see workers in their blind spots, injured workers may fail to hear backup alarms, drivers may fail to check their surrounding properly, etc.
- **Cargo spills.** Unsecured cargo can pose an extreme threat when it spills or falls out of a vehicle. In addition to causing debris that can affect the safety of other drivers, the weight of the cargo could potentially crush nearby workers.
- **Pinning.** When drivers fail to pay attention or inadvertently leave vehicles in motion, workers on the ground can become stuck or pinned between the vehicle and other objects. This pinning can result in severe crush injuries.

According to the traffic study data done on NH_3 Road along the railway, morning peak hour occurs at 7am to 10am, midday peak at 11am to 2pm, evening peak at 4pm to 7pm and night peak at 7:30pm to 9:30pm.

According to the study, the vehicle movements in weekend day is 14.5% greater generation rate that of in working day vehicle volumes as many visitors coming to Pyin Oo Lwin, Thi Paw and Muse.

To avoid traffic accidents as much as possible, transportation vehicles to and from the construction site should not be operated during peak hours if possible.

8.4.7. Occupational and Community Health and Safety Risk and Management Plan

8.4.7.1. Objective

The primary objectives are:

- To secure the health, safety and welfare of employees and other people at work.
- To eliminate workplace risks at the source, and

- To involve employers, employees and the organization that represent them in the formulation and implementation of health, safety and welfare standards.

8.4.7.2. Legal Requirements

Occupational safety and health Law (Pyidaungsu Hluttaw Law No 8)

- The purpose to effectively implement measures related to safety and health at every industry, prevent by the workplace accidents and occupational diseases and set occupational safety and health standards

Workmen's Compensation Act

- To protect personal injury caused to a workman by accident arising out of and in the course of his employment and to compensate in accordance with the provisions of Workman Compensation Act

The Law Relating to Private Health Care Services

- Develop private health care services in accordance with the national health policy;
- To participate and carry out systematically by private health care services in the national health care system as an integral part;
- To enable utilizing effectively the resources of private sector in providing health care to the public;
- To enable the public to choose as desired in fulfilling their needs for health by establishing private health care services;
- To enable provision of quality service at fair cost and to take responsibility.

Public Health Law (Law No. 3,5)

To promote and safeguard public health and to take necessary measures in respect of environmental health.

8.4.7.3. Overview and Layout Map

The contemplation for the occupational safety and health for this sub-plan is considered as shown in the figure below.

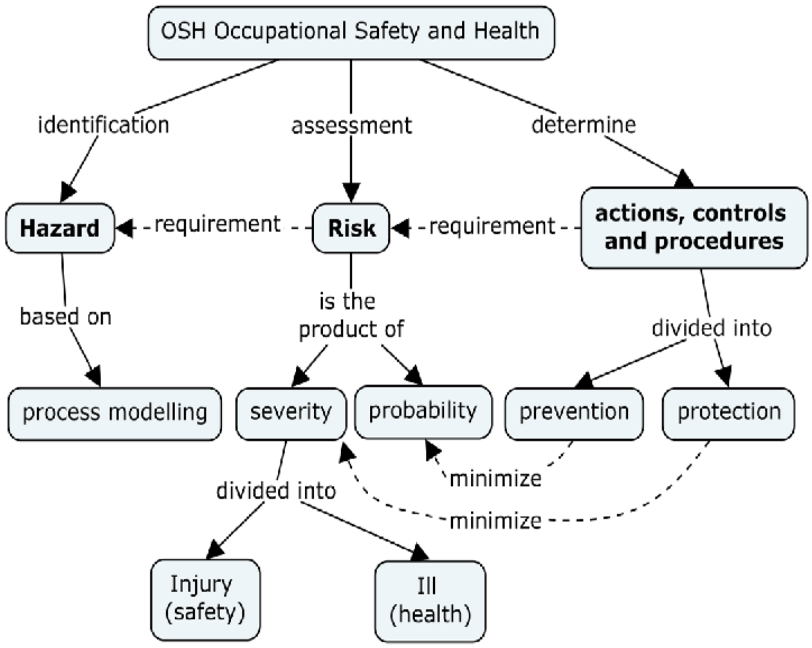


Figure 8.13 - Mind Map of Occupational Health and Safety Risk

8.4.7.4. Management Actions and Monitoring Plans

To ensure health and safety of workers, the following measures shall be implemented by the contractor:

- Prior to commencement of site works, the following plans shall be prepared by the contractor and approved by the Project Supervision Consultant:
    - Occupational and Community Health and Safety Plan consistent with international standards (e.g., the World Bank Group's Environment, Health and Safety Guidelines of 2007) and Labor Law of Myanmar. The Plan shall address health and safety hazards associated with construction activities (e.g., working at heights, excavations, etc.) establishment and operation of construction/worker's camps, casting yard, use of heavy equipment, transport of materials and other hazards associated with various construction activities.
    - Emergency Response Plan to prevent, mitigate, respond to and recover from emergency events that could occur due to project activities such as accidents, spills of hazardous substances, fire, extreme weather events, and other crises.
- Appoint an environment, health and safety manager to look after implementation of required environmental mitigation measures, and to ensure that health and safety precautions are strictly implemented for the protection of workers and the general public in the vicinity of construction areas
- Conduct orientation for construction workers regarding health and safety measures,

emergency response in case of accidents, fire, etc., and prevention of HIV/AIDS and other related diseases

- Provide first aid facilities that are readily accessible by workers.
- Provide firefighting equipment at the work areas, as appropriate, and at construction camps.
- Provide adequate drainage in workers camps to prevent water logging/accumulation of stagnant water and formation of breeding sites for mosquitoes.
- Provide adequate housing for all workers at the construction camps.
- Provide reliable supply of potable water.
- Provide separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers
- Establish clean canteen/rest area.
- Ensure proper collection and disposal of solid wastes within the construction camps consistent with local regulations.
- Provide fencing on all areas of excavation greater than 2 m deep.
- Provide appropriate personnel safety equipment such as safety boots, helmets, gloves, protective clothes, breathing mask, goggles, and ear protection
- Ensure reversing signals are installed on all construction vehicles.
- Implement precautions to ensure that objects (e.g., equipment, tool, debris, precast sections, etc.) do not fall onto or hit construction workers.
- Implement fall prevention and protection measures whenever a worker is exposed to the hazard of falling more than two meters, falling into operating machinery or through an opening in a work surface. Based on a case-specific basis, fall prevention/protection measures may include installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area, proper use of ladders and scaffolds by trained employees, use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard, fall protection devices such as full body harnesses, etc.
- Strictly impose speed limits on construction vehicles along residential areas and where other sensitive receptors such as schools, hospitals, and other populated areas are located.
- Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport

Moreover, Occupational health and safety management plan for the proposed railway bridges and culverts will also include the following:

a) Emergency and First-aid Procedures
b) Medical Precautionary Measures
c) Maintenance and Troubleshooting Precautions
d) Housekeeping
e) Safety awareness
f) Safety training

When an accident occurs at the construction site, it is essential that the proper steps are taken to secure the safety of the injured person. These steps include:

Getting medical care: The first and most important steps to follow after a work site injury is assessing and treating the damage. Even if the injury seems minor, a medical professional should diagnose and treat the injury before the injured person attempts to return to work. A minor bump on the head could mask a concussion, or a bruised abdomen could be a sign of internal injuries.

Taking note of where, when, and how the accident occurred: If the victim is physically capable, he should make sure to record the significant aspects of the accident, including time, place, and potential cause.

Reporting the injury: The injured person absolutely must inform his supervisor or superior of the accident as soon as possible. Make sure to record the name and position of the person who accepted the report and the date the report was submitted.

First-aid program should include the following elements:

- **Emergency medical services (EMS) response time**: Contact local EMS or nearest hospital to assess the response time to the facility in an emergency. This will help to determine whether or not employees should be trained in first-aid on site. If an EMS or ambulance from nearest hospital can reach workers at the site within 3 to 4 minutes in a life-threatening emergency, then the EMS is considered "in near proximity" to the workplace. If this is the case, then employees trained in first-aid are not required (but are still recommended) on site.
- **Trained personnel**: Employees who have taken first-aid training course should be assigned responsibility for providing first aid. Employers should ensure that at least one of their employees takes a first-aid course or arrange for such a program to be taught at the workplace. It is recommended that 15 to 20 percent of the workforce should be trained in first aid.

- **Written procedure**: Have a qualified medical professional provide written "standing orders" for basic first-aid treatment procedures. Have the doctor designate what is to be done in the case of a serious injury and what hospitals are to be used for emergency treatment. Local police and fire telephone numbers should be prominently displayed in enough places so that all employees can access them.
- **First-aid kit**: First-aid supplies must be easily accessible when they are required. The contents of the first-aid kit must be stored in a sealed weatherproof container with individual sealed packages for each type of item and must be checked by the employer before being sent out on each job and at least weekly to ensure that expended supplies are replaced.
- **Communications**: Let everyone in the organization know who the trained first-aid personnel are; state that these persons are the only ones who should render first-aid assistance. Be sure to keep the list up-to-date. Also, publicize the names and phone numbers of local police and fire departments, as well as others outside the organization who should be called.
- **Medical log**: Maintain a medical or first-aid log convenient to your first-aid kits; ensure that every use of the first-aid kit, even for giving out a bandage, is noted, including: date, time, person receiving treatment, person giving treatment, what injury or symptom was treated, what treatment was given, and first-aid materials used.
- **Appropriate means of transporting injured workers to medical aid**: If a worker is injured, after the first-aid procedure, choose the transportation mode to transport the injured worker to be able to arrive at a medical aid as fast as possible.

First aid is immediate, temporary treatment given in the event of accident or illness.

Eye: Contact lenses, if worn, will be removed. Irrigate the eyes immediately with large amounts of water for 15 minutes. Occasionally hold the eyelids apart to insure complete irrigation. Apply a dry protective dressing. Call for emergency medical assistance.

For "flash burns" cover the eye with cold (preferably iced) compresses for 5 to 10 minutes; then repeat. Apply a dry protective dressing. Call a physician. Don't rub the eye. Don't use ointments or drops unless prescribed by a physician.

Skin: For skin contact with irritants, flush the areas with large amounts of water, and then wash with soap and water. Remove contaminated clothing. If mucous membranes are irritated, flush with water. Wash cuts and scrapes with mild soap and water. Avoid contamination. Apply a dry sterile dressing.

For thermal bums, cold water is an effective first aid measure. If skin is not broken, immerse bum part in clean cold water or apply clean ice to relieve pain. Do not disturb or open blisters. Prevent contamination. Bandage loosely with a clean dry dressing. Call for emergency medical assistance.

Electrical Shock and Electrical Burns: Disconnect and turn off power. Remove victim from contact. Use no conducting materials if the rescuer must resort to pulling the victim from the live contact. The rescuer must first protect himself by use of insulated materials such as gloves. If not breathing, administer CPR as soon as electrical contact is broken. Call for emergency medical assistance. Continue CPR until spontaneous breathing has been restored or until a physician arrives. Administer oxygen. Keep comfortably warm. Keep horizontal until there is no further evidence of shock. Treat electrical bums as thermal bums. For electrical bums apply clean, cold (iced) compresses. Prevent contamination. Cover with a clean, dry dressing. Call for emergency medical assistance.

Developing First Aid Procedures

It is important to keep up-to-date written first aid procedures at the workplace. All workers must know where first aid kits are located and how to call for first aid personnel. To develop and keep workplace first aid procedures current, consider:

- **Drills** – Conduct a drill at least once a year. It will test the workers' awareness of how to call for first aid, how well the communication system works, and the ability of first aid attendants to respond. It will also help to determine if the first aid services are adequate to deal with injuries and illnesses most likely to happen in the workplace.
- **Maintaining the system** – A worker should be assigned to manage the first aid services at the workplace. The duties should include ensuring that required first aid attendant(s), supplies, facilities, and equipment are always available.

Medical Precautionary Measures

The following medical precautionary measures will be conducted by MR.

(a) Periodic health examinations will do with the cooperation with Public Health Office (Muse). The potential health effects of non-work related factors, such as smoking, must be considered.

(b) An effective educational, training, and industrial hygiene program will be instituted. The program will cover the following: (a) the nature and potential hazards of welding, cutting and gouging; (b) proper and safe use of equipment; and (c) emergency and first aid procedures.

(c) Medical personnel who are trained for first aid will be available on-site or by phone for advice and consultation. Emergency phone numbers will be posted near the telephones. At least one person on each shift will be trained in first aid, as well as qualified to administer oxygen and cardiopulmonary resuscitation (CPR).

(d) The following will be readily available: (a) first aid supplies approved by a physician; (b) stretchers and blankets for transportation; (c) oxygen inhalation equipment; and (d) approved instant acting eye washes and showers.

(e) For minor accident, first aid kit will be used with the help of medical personnel. For major accident, that person will be carried to the nearest clinic or hospital and for referral case, carried to the nearest hospital by stand by car. The nearest township hospital and their relative distance related to railway are described below.

Name of Hospital	Location	Number of Bed	Distance from railway
Patheingyi Hospital	Myo Ma Quarter, Pathein Gyi Township	25	1.79 miles
Pyin Oo Lwin Hospital	Pyin Oo Lwin	300	5.52 miles
Kyauk Me People Hospital	No.1 Quarter , Kyauk Me	150	1.37 miles
Naung Cho People Hospital	Bu Tar Quater , Naung Cho	25	1.44 miles
Kutkai Hospital	2nd Quarter ,Kutkai	50	2.29 miles
Thein Ni People Hospital	No.3 Quarter, Thein Ni	25	2.07 miles
Si Paw People Hospital	Si Paw	100	0.93 miles
Lashio People Hospital	Lashio	500	4.28 miles
Muse People Hospital	Muse	100	2.06 miles

(f) Good personal hygiene practices are very important. Employees will wash their face and hands before eating, and it is recommended they not be permitted to eat, drink, or smoke in the work area. Food and beverages will not be stored in the work area. Contaminated clothing will be changed.

(g) Protection against skin conditions, such as chemical burns, rashes, and dermatitis can be provided by appropriate protective clothing and equipment, as well as the use of protective creams or lotions.

Maintenance and Troubleshooting Precautions

Faulty or improperly maintained equipment can cause property damage, physical injury, or possibly death by fire or electrical shock. Here is a list of some important items to check when troubleshooting or maintaining equipment.

(a) Stop operating immediately if equipment is malfunctioning.
(b) Do not perform any maintenance unless you are qualified to perform such work.
(c) Make test readings carefully.
(d) Protect the equipment from heat, excessive wet conditions, oil or grease, corrosive atmospheres, and inclement weather.
(e) Replace parts only with manufacturer's recommended replacement parts.
(f) Keep all protective devices and covers in position.

House Keeping

The following measures will be practiced at the proposed plant.

(a) Regular cleaning of the floors with service water.
(b) Avoid dumping of wastes, damaged equipment and items anywhere inside the plant affecting aesthetics and increasing risk of fire and other hazards.
(c) Maintaining hygienic conditions in areas like canteens, near drinking water sources and toilets.
(d) Maintaining green belt along the project boundaries to suppress noise, fugitive dust and to improve the aesthetics.
(e) Developing a positive outlook in the employees for improving the working place, both in railway area and office clean and well maintained.

Safety Awareness

Safety awareness must be promoted among project managers and employees by:

(a) Imparting regular training.
(b) Installing/displaying safety caution boards and safety posters mentioning Do's & Don'ts at different vulnerable locations.
(c) Arranging safety & housekeeping competition etc.
(d) To procure and maintain personal protective equipment in good working condition.

Safety Training

Training programmes in safety and accident prevention will be organized at all levels of employees with a view to familiarize them with the general safety rules, safety procedures in various operational activities and to update their knowledge in safety and accident prevention, industrial hygiene and emergency equipment. These training programmes will be conducted periodically in a planned manner to refresh their knowledge. Training shall be imparted for:

Safe working and maintenance practices.

(a) Use of proper tools and tackles.
(b) Use of personal protective equipment.
(c) Handling emergency situation.

Development of an Environmental Health and Safety Plan

An Environmental Health and Safety Plan will be prepared for the demolition, construction, operation and decommissioning phases of the Project to ensure compliance with the Ministry of Health's Guideline for Occupational Health and Safety and the IFC guidelines.

A safety committee will be formed by LEC and regular safety meetings will be organized. General mitigation measures aimed at employees and contractors include the following:

- Provision of training about the fundamentals of occupational health and safety procedures.
- Provision of appropriate PPE (for example: latex gloves, working overalls, safety boots, safety helmets, safety glasses, hearing protection).
- Ensuring that especially sensitive or dangerous areas (like areas exposed to high noise levels, areas for especially hazardous work, etc.) are clearly marked, and barricaded if appropriate.
- Ensuring that all maintenance work necessary for keeping machines and other equipment in a good state is regularly carried out.
- Ensuring that the workers (and especially those doing hazardous work or otherwise exposed to risks) are qualified, well-trained and instructed in handling their equipment, including health protection equipment.
- Provision of adequate loading and off-loading space.
- Development of an emergency response plan.

- Provision of appropriate lighting during night-time works (if any)
- Enforcement of speed limits for vehicles entering and exiting the site.

A basic first aid program will be extended to all employees and will ensure that in the event of an accident or injury, someone with first aid knowledge will be present to render initial assistance until further medical attention can be made available. Qualified personnel will provide instruction on the necessary theoretical as well as practical skills required. The advanced first aid program will be an extension of the basic first aid program attended by selected employees, including supervisors and the Health and Safety Officer, and will train participants in the recognition and initial management of serious injuries and illnesses. Employee health and safety orientation will train all employees on the basic rules of work, safety procedures, site-specific hazards, and emergency procedures. A visitor orientation and control program will be implemented if visitors will be entering areas of the site where hazardous conditions or substances are present. Supervisory personnel and safety representatives will attend training on accident investigation and reporting procedures.

Employees and contractor personnel will be provided health and safety training prior to commencing work or a new assignment on this project. The training will consist of basic hazard awareness, identification of site-specific hazards and how they are controlled, safe work practices, potential risks to health and precautions to prevent exposure, hygiene requirements, PPE requirements and proper use, equipment labeling, accident prevention and reporting, and emergency procedures for fire, evacuation, or natural disaster.

All employees, contractors and visitors will be informed of their responsibility to participate in the creation of a healthy and safe environment by reporting unsafe and hazardous conditions when detected and performing work in a safe manner by following the correct work procedure.

Hazardous areas will be marked with appropriate signs, which identify the hazard and associated safety measures. All signs will conform to international standards and will be designed to be understood by all employees and visitors. Signs may contain both text and pictures, as necessary, to ensure that any illiterate employees or visitors would be made aware of the hazard.

Containers of hazardous materials will be labeled with the contents and associated hazards. A color coding system will be implemented to allow immediate visual identification of containers or equipment which contains hazardous substances.

Emergency personnel will be made aware of the types of fuel and of other hazardous materials and typical amounts stored onsite, and storage locations to expedite emergency response. Local emergency response personnel will be invited to inspect the site periodically to ensure familiarity with potential hazards present

8.4.8. Disaster Management Plan

Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made cause, or by accident or negligence which result in substantial loss of life or human suffering or damage to, or degradation of, environment, and is of such nature or magnitude as to be beyond the coping capacity of the community of the affected area. Disaster Management implies continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary as expedient for

- Prevention of danger or threat to any disaster.
- Mitigation or reduction of risk of any disaster or its severity or consequences.
- Capacity building.
- Preparedness to deal with any disaster.
- Prompt response to any threatening disaster situation or disaster.
- Assessing the severity of magnitude of effect of every disaster.
- Evacuation rescue & relief.
- Rehabilitation and reconstruction.

8.4.8.1. Objective

The overall objective of a disaster management plan is to make use of the combined resources created or available at the site and/or off-site services to achieve the following:

- To minimize the effects the accident on people and property;
- Affect the rescue and medical treatment of casualties;
- Safeguard other people, outside the project boundary
- Evacuate people to safe areas with utmost care and with minimum casualties;
- Inform and collaborate with statutory local and state authorities;
- Initially contain and ultimately bring the incident under control;
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;
- Investigate and take steps to prevent recurrence of similar incidents

8.4.8.2. Legal Requirements

Natural Disaster Management Law (No 21)

- To implement natural disaster management programmes systematically and expeditiously in order to reduce disaster risks;
- To form the National Committee and Local Bodies in order to implement natural disaster management programmes systematically and expeditiously
- To coordinate with national and international government departments and organizations, social organizations, other nongovernment organizations or international organizations and regional organizations in carrying out natural disaster management activities
- To conserve and restore the environment affected by natural disasters
- To provide health, education, social and livelihood programmes in order to bring about better living conditions for victims

Myanmar Fire Force Law (Law No.25)

- To take precautionary and preventive measure and loss of state own property, private property, cultural heritage and the lives and property of public due to fire and other natural disasters
- To organize fire brigade systemically and to train the fire brigade
- To prevent from fire and to conduct release work when fire disaster, natural disaster, epidemic disease or any kind of certain danger occurs
- To educate, organize an inside extensively so as to achieve public corporation
- To participate if in need for national security, peace for the citizens and law and order

National Environmental Quality (Emission) Guidelines (Section 2.1.9)

These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem health.

Prevention from Danger of Chemical and Associated Materials Law (Law No. 28)

- To prevent from damaging the environmental resources and from endangering the lively creatures due to the chemical and associated materials;

- To control systematically for the safety in carrying out in accord with the approval for chemical and associated materials business;
- To carry out the data information acquiring system and to widely do the educating and research works in order to utilize the chemical and associated materials systematically;
- To carry out continuous development for worksite safety, health and environmental conservation.

8.4.8.3. Overview Maps

The strongest earthquake (Kyaukkyan Fault) is happened in the railway line near Naungcho town, it should be conscious and thoroughly made any structures that must be resisted the magnitude (>R.M.8) of earthquake. The satellite image of Kyaukkyan Fault near Naungcho town is shown in the figure below.

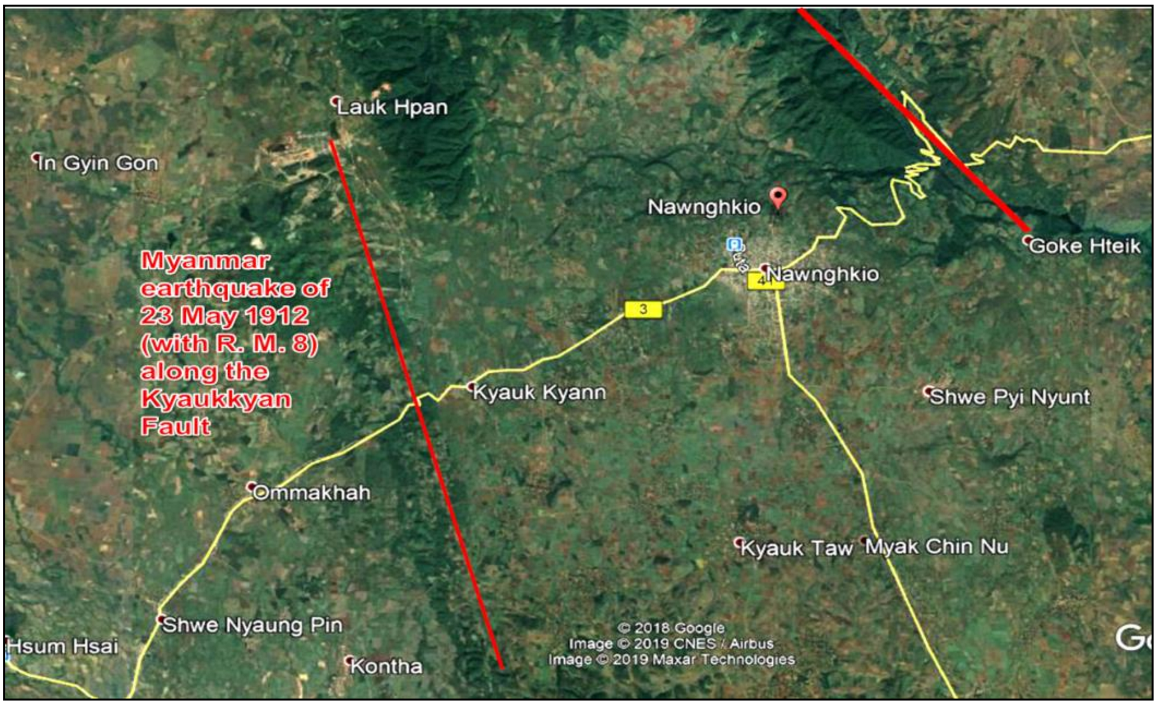


Figure 8.14. Satellite Image of Kyaukkyan Fault near Naungcho Town

8.4.8.4. Management Actions and Monitoring Plans

Dangerous conditions or events that threaten or have the potential for causing injury to life or damage to property or the environment is called hazard. Hazards can be categorized in various ways, but based on the origin, they worldwide are basically grouped in two broad headings:-

1. Natural Hazards (hazards with meteorological, geological or even biological origin) e.g. Flood, Lightning strikes, etc.

2. Manmade Hazards (hazards with human-caused or technological origin)
e.g. Fire, Structural failure etc.

Vulnerability

Vulnerability may be defined as the probability of exposure of a village, city or a community to a hazard. A society or project may be vulnerable to various hazards to different extents depending upon various reasons including environmental, geographical, social, economic etc.

Disaster

A disaster occurs when a hazard such as earthquake, flood or windstorm coincides with a vulnerable situation. It is hence the product of are two main components: Hazard and Vulnerability. A disaster seriously disrupts the normal functioning of a society, causing widespread human, material, economic or environmental losses that exceed the society's capability to cope without external relief.

8.4.8.5. Types of Disasters

The followings may be the type of disasters related to the proposed project.

1. Fire
2. Escape, intentional release or threat to release due to – oil, gas, chemicals or radioactive, biological or flammable materials
3. Accidents – Collision, grounding and sinking of ships, transport or work place accidents.
4. Natural calamities – Flood and Earth quake

Internal Department

The primary focus of the disaster management system is to mitigate the effects of disaster on port community wherever possible or practical, while preparing to respond when disaster occur. The role and responsibilities specifically for each phase being.

Specific responsibilities – Response Phase

- Activate the disaster management response team and also crisis response team.
- Activate the relevant / workplace emergency team for the first strike response including traffic and pollution

- Thereafter assist emergency services to respond to the event.
- Assist with providing relief for persons affected by disaster.

Specific responsibilities – Recovery Phase

- Satisfy immediate, essential personal and port community needs to extent of port capability.
- Maintain liaison and timely communication with District/Township Disaster Management Body.
- Contribute to the recovery function coordinated by District/Township Disaster Management Body.
- Coordinate the recovery of physical infrastructure.
- Coordinate activities with relevant Disaster district initiatives and plans.
- Participate in long term recovery, reconstruction and rehabilitation.
- Communicating regarding restoration of Plant activities.

8.4.8.6. Monitoring Plans

(a) Earthquake early-warning and monitoring system

The railway line is located in the high-intensity seismic region, and the seismic peak acceleration (g) is 0.2. In order to timely collect and release seismic information to guarantee the safe operation of trains, an earthquake early-warning and monitoring system is set up along the line.

System composition

The earthquake early-warning monitoring system is composed of the field monitoring equipment (seismic acceleration sensor), the field monitoring host (data processing and control equipment) and the central system.

The seismic acceleration sensor as a seismic geophone is installed on the device pier, and it collects seismic acceleration data transmitted to the field monitoring host.

The field monitoring host is set up in the disaster monitoring equipment room of the traction transformer station, the signal building of the station and the section base station. It is composed of the data processing module for processing the data uploaded by the seismic geophone, the control module responsible for logic judgment and alarm output, and corresponding relay equipment. The data processing module converts the analog quantity uploaded by the seismic geophone into the digital signal, and carries out threshold judgment; the alarm signal is produced when the threshold value is exceeded; the control module executes safety logic operation of the alarming signal which is generated from the data processing module, and generate the switching value alarm signal which is output to the integrated automation system of the traction transformer station, so as to realize power outage of the tractive power supply system and simultaneously reserve the interface with the train control system. At the same time, the data processing module integrates the seismic wave data and the alarm signal with the time information and transmits it to the central system, so as to provide data reference for the start of the post-disaster emergency plan.

In this design, the system equipment of the earthquake early warning monitoring center shall be provided in the control center.

System setting

1) Ground motion acceleration sensors shall be set in railway districts with peak acceleration of 0.1g or above. Seismic monitoring point shall have s-wave monitoring function and p-wave warning function, if possible;

2) The ground motion acceleration sensors should be 25 km away from each other;

3) The ground motion acceleration sensors shall be set in pairs, with a horizontal spacing of at least 40 m between two sensors and 1 sensor in 1 seismometer well;

4) The ground motion acceleration sensors should be set in the traction substation or, if not possible to be set in the traction substation, set in the power distribution station, repeater station, base station, etc., with requirements for site background noise and seismometer layout distance met.

5) The acceleration sensor should be at least 50 m away from the track center line;

6) When the site of the ground motion acceleration sensor is not affected by trains, the background vibration noise of the site should be less than 0.1 gal, and not exceed 0.5 gal at the maximum.

Installation Location

Traction substations, LTE-R base stations, stations and so on in the area within this line with a maximum earthquake acceleration ≥ 0.10 g shall be set with an earthquake monitoring system. The seismic pickup pier shall be installed in an appropriate area and the ground motion acceleration sensor shall be installed on the seismic pickup pier. The specific location is shown below:

Table 8.6. Installation Locations for Stations and Traction Substations

S/N	Mileage	Location
1	CK 8+560	Muse Traction Substation
2	CK 28+700	Man Hawng Station
3	CK50+900	Nam Hpak Ka Traction Substation
4	CK85+450	Man peng Traction Substation
5	CK100+129	Section base station
6	CK121+190	Theinni Traction Substation
7	CK133+700	Lashio West Traction Substation
8	CK157+070	Lashio North Station
9	CK183+400	SanLau Traction Substation
10	CK205+200	Hispaw Station
11	CK222+800	Chaung Chauk Traction Substation
12	CK260+550	Myin Gwin Station
13	CK283+500	Nawng Hkio Traction Substation
14	CK322+640	Pyinoolwin Traction Substation
15	CK365+000	Traction substation
16	CK395+800	Mandalay South Traction Substation

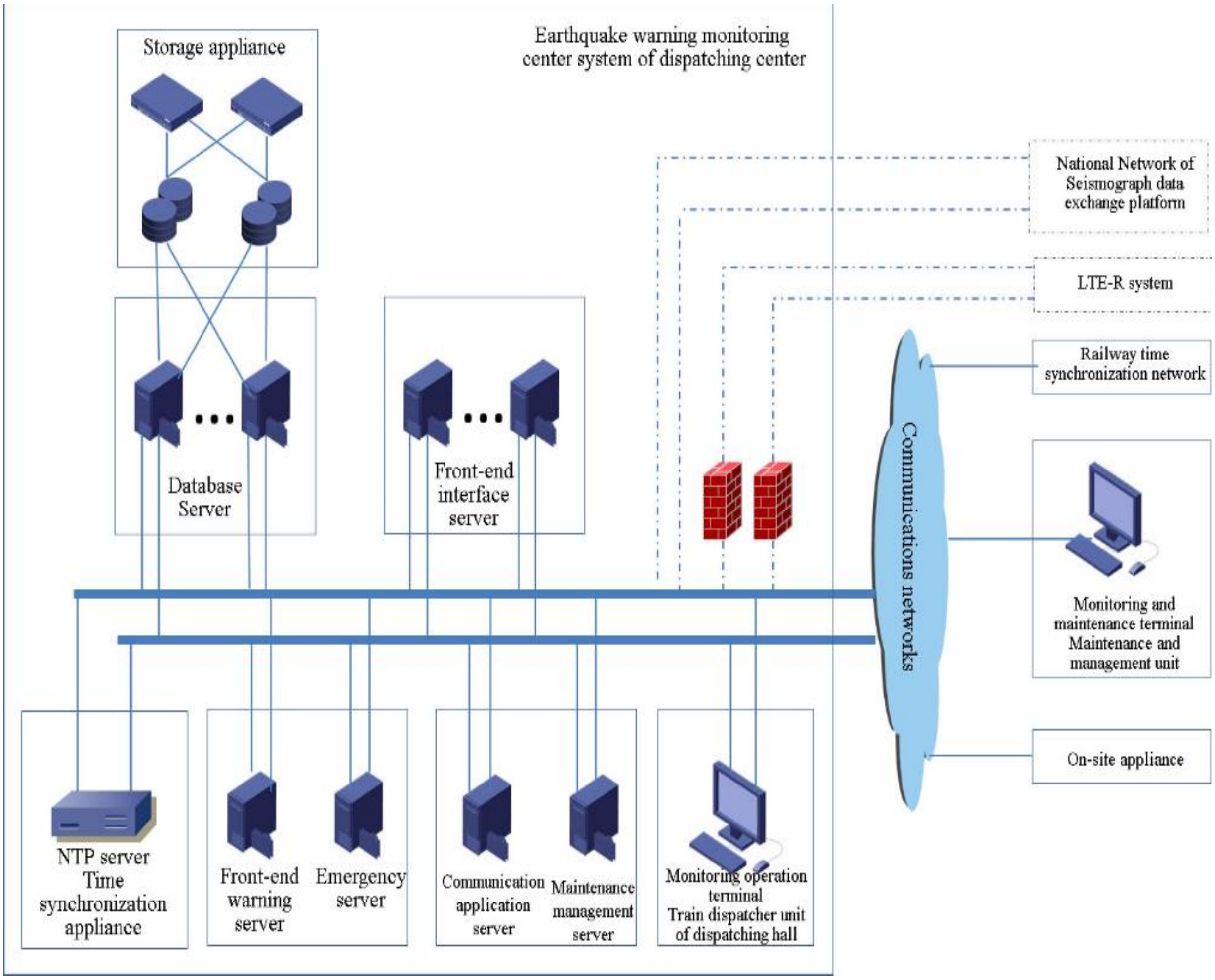


Figure 8.15. Diagram of Functional Framework of Earthquake Warning Monitoring System

(b) Rainfall monitoring system

The areas along this line are rich in rainfall, collapse, landslides and floods caused by continuous rainfall can damage roadbeds, bridges and other railway infrastructure. In order tomonitor and release the rainfall information along the railway in real time and guarantee the safe operation of trains, a rainfall monitoring system is set up along the railway.

System composition

The rainfall monitoring system consists of the field monitoring equipment (including rain gauge and field data unit), the field monitoring unit and the central system. The data collected by the field monitoring equipment is transmitted to the field monitoring unit, and then uploaded to the rainfall monitoring central system through the communication channel.

Equipment allocation

1) The field rain gauges are provided as per a single set;

2) In the key flood control sections where landslide, debris flow, dangerous rocks, rockfall and collapse are easy to occur, and the sections with high subgrade and deep cutting, the field rainfall collection equipment should be installed along the railway. In addition, the rainfall collection equipment should be installed in nearby stations, communication base stations and comprehensive maintenance work areas/workshops;

3) In the continuous subgrade section of ballast track, the interval between the field rainfall monitoring & collection equipment should be set within 15km to 20km, and the interval in the key flood control section should not be larger than 15km.

4) The field rainfall collection equipment should be installed on a separate mast; when conditions are not available, it can be installed on the catenary mast. The lower surface of the cantilever of the rain gauge mounting bracket should be 2.5m away from the top surface of the catenary mast foundation.

5) Rain gauges should be installed in open and spacious areas.

Installation Location

S/N	Mileage	Location	Remarks
1	CK8+560	Muse	Hilly land
2	CK19+000	Subgrade section	Tunnel portal of mountain valley
3	CK28+700	Man Hawng	Hilly land
4	CK40+700	Na Hpai	Hilly land
5	CK50+900	Nam Hpak Ka	Hilly land
6	CK61+250	Pang nin	Hilly land
7	CK73+300	Kutkai	Hilly land
8	CK85+450	Man peng	Hilly land
9	CK99+400	Nawng yen	Hilly land
10	CK112+400	Laban pa	Hilly land
11	CK121+190	Theinni	Hilly land

12	CK135+000	Sam lou	Hilly land
13	CK145+000	Hang lu	Hilly land
14	CK157+070	Lashio North	Hilly land
15	CK133+650	Lashio West	Hilly land
16	CK146+920	Mehan	Hilly land
17	CK162+200	Nam un	Hilly land
18	CK173+400	Sint eng	Hilly land
19	CK183+400	SanLau	Hilly land
20	CK193+100	KongTha	Hilly land
21	CK205+200	Hispaw	Hilly land
22	CK222+800	CHaung Chauk	Hilly land
23	CK236+750	Kyaukme	Hilly land
24	CK260+550	Myin Gwin	Hilly land
25	CK274+600	Nam ban ton River	Hilly land
26	CK283+020	Nawng Hkio	Hilly land
27	CK296+700	Om ma ka	Hilly land
28	CK308+100	Gan gaw	Hilly land
29	CK322+700	Pyinoolwin	Tunnel portal of mountain valley
30	CK337+300	Sin byu in	Tunnel portal of mountain valley
31	CK346+900	Sakangyi	Tunnel portal of mountain valley
32	CK358+800	Taung Kyun	Tunnel portal of mountain valley
33	CK371+600	Tok hka taung	Tunnel portal of mountain valley
34	CK385+400	Mandalay East	Hilly land

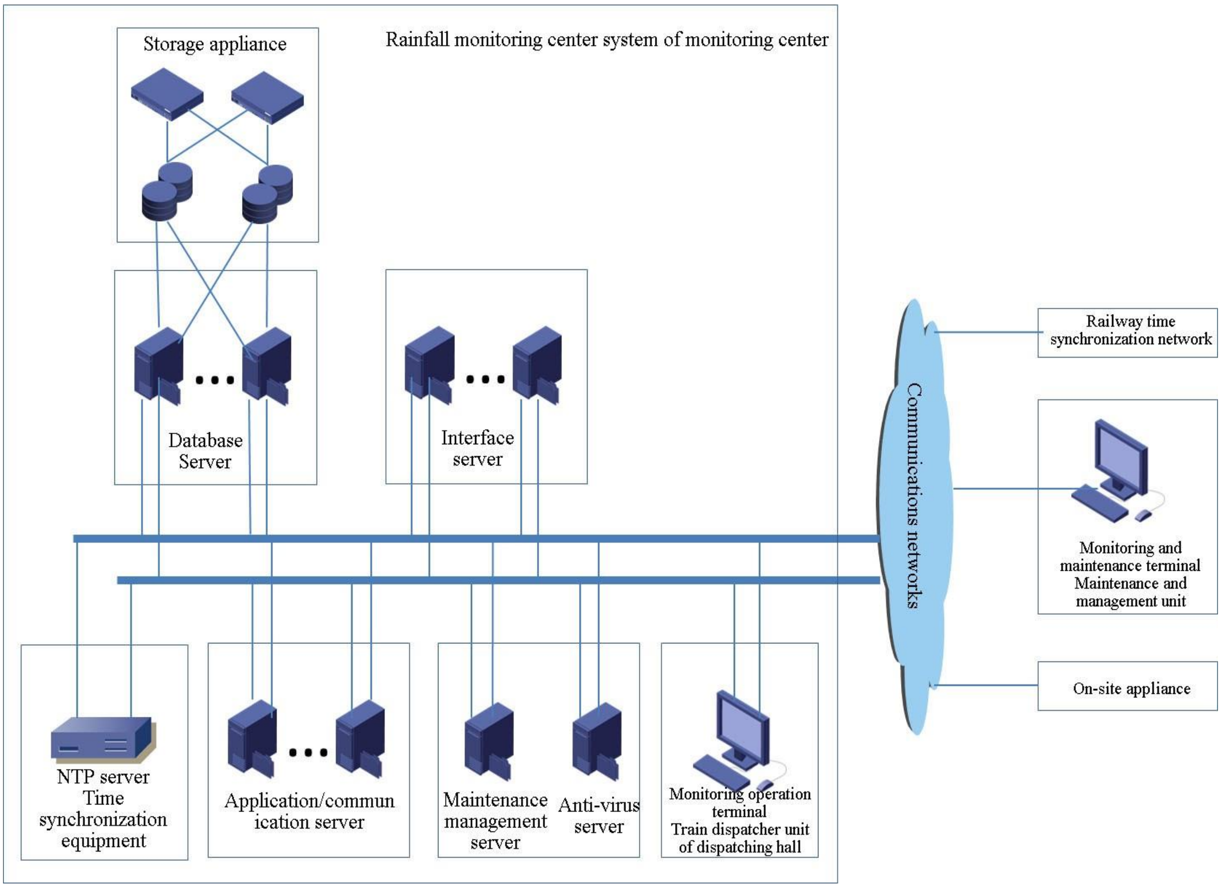


Figure 8.16. Diagram of Functional Framework of Rainfall Monitoring System

Information transmission and network structure

The primary information sources of the disaster monitoring system are distributed in stations and sections along the route. The relevant data collected by the on-site collection equipment are uploaded to the on-site monitoring unit, which, after preliminary processing, is uploaded tothe disaster monitoring center system. The policy decision information is transmitted to the integrated maintenance center by the disaster monitoring center for emergency rescue and permitted speed control of trains.

In addition to be transmitted to the integrated maintenance center through the above procedures, the earthquake information is linked with relevant systems on the site to minimizethe response time and control the train, so as avoid the disaster as soon as possible and reduce the loss.

8.4.8.7. Emergency Response Plan

A plan to deal with major emergencies is an important element of Occupational Health & Safety programs.

Besides the major benefit of providing guidance during an emergency, developing the plan has other advantages. An emergency plan promotes safety awareness and shows the organization's commitment to the safety of workers. The lack of an emergency plan could lead to severe losses such as multiple casualties and possible financial collapse of the organization.

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergency incident response plan for proposed railway project is proposed to mitigate harms on humans and environment in the project area and its vicinity in case of incident. This plan provides the management structure, key responsibilities, emergency assignments and general procedures to follow during and immediately after an emergency. Moreover, it is necessary to establish ERP to address the immediate requirements for a major disaster or emergency in which normal operations are interrupted and special measures must be taken to:

(a) Save and protect the lives of employees;
(b) Manage immediate communications and information regarding emergency operations and work site safety;
(c) Provide essential services and operations;
(d) Provide and analyze information to support decision-making and action plans; and
(e) Manage resources effectively in an emergency operation.

An emergency plan specifies procedures for handling sudden or unexpected situations. The objective is to be prepared to:

- Prevent fatalities and injuries
- Reduce damage to buildings, stock, and equipment
- Protect the environment and the community
- Accelerate the resumption of normal operations

When the organization's plan involves using outside resources, such as fire, police or ambulance, other appropriate organizations should also be consulted.

Having identified the hazards, the possible major impacts of each should be itemized, such as:

- Sequential events (e.g. a fire after an explosion)
- Evacuation
- Casualties
- Damage to plant infrastructure
- Loss of vital records/ documents
- Damage to equipment
- Disruption of work

Based on these events, the required actions such as the following are determined.

- Declare emergency.
- Sound the alert.
- Evacuate danger zone.
- Close main shutoffs.
- Call for external aid.
- Initiate rescue operations.
- Attend to casualties.
- Fight fire.

Also consider what resources are required and their location, such as:

- Medical supplies.
- Auxiliary communication equipment.
- Power generators.
- Respirators.
- Chemical and radiation detection equipment.
- Mobile equipment.
- Emergency protective clothing.

- Firefighting equipment.
- Ambulance.
- Rescue equipment.
- Trained personnel.

The emergency plan includes:

- All possible emergencies, consequences, required actions, written procedures, and the resources available.
- Detailed lists of emergency response personnel including their cell phone numbers, alternate contact details, and their duties and responsibilities.
- Floor plans.
- Large scale maps showing evacuation routes and service conduits (such as gas and water lines).

Development of an Emergency and Response Plan

The EPRP must comply with the IFC Occupational Safety Guidelines and Performance Standards. The EPRP must include:

- Roles and responsibilities of emergency personnel;
- Emergency contacts and communications systems/protocols, including procedures for interaction with local and regional emergency authorities;
- Specific emergency response procedures;
- Design and implementation of an emergency alarm system audible across the entire site;
- An evacuation plan which must be read and practiced by all employees and contractors. The evacuation plan will include emergency escape routes, procedures for accounting for employees after an evacuation, and roles and responsibilities of personnel during an evacuation;
- Identification of supplies and resources to be utilized during an emergency event, including emergency equipment, facilities, and designated areas; and
- A training plan, which includes specific training and drill schedules for personnel who are responsible for rescue operations, medical duties, spill response, and fire response.

If an emergency develops, all persons on the project site must be notified immediately and efforts must be coordinated with others in the vicinity surrounding the project area in order to reduce impacts, if applicable. If an emergency is imminent, but has not yet begun, steps must be initiated to immediately advise persons in the vicinity of the emergency to evacuate and notifications will be made to the local ECD, the County Superintendent, local police, and all other authorities which have responsibility regarding the emergency.

If there is a slowly developing emergency or unusual situation where an emergency is not imminent, but could occur if no action is taken, project personnel will notify the ECD, the County Superintendent, local police, and all other authorities of the potential problem and keep them advised of the situation. These agencies will be requested to indicate if there are any immediate actions that will be taken to reduce the risk or severity of the emergency and if necessary, what preventative actions have to be implemented. In an emergency situation, equipment and supplies have to be needed on short notice. Therefore, the LEC must maintain an accurate inventory of emergency response equipment and supplies.

The EPRP will include an evacuation plan which will be read and practiced by all employees and contractors. The evacuation plan will include emergency escape routes, procedures for accounting for employees after an evacuation, and roles and responsibilities of personnel during an evacuation. In general, the following evacuation procedures will be followed:

- Alert the Emergency Response Team to assist in the evacuation.
- Use communications tools that are appropriate for the type of incident and the time of occurrence, such as alarms or loud speakers.
- When communicating an evacuation, speak clearly and succinctly: "We have a [state the type of emergency]. Evacuate to [state the assembly point]".
- Turn equipment off, if possible.
- Take emergency supplies and staff rosters, if possible.
- Account for personnel.
- Wait at the assembly point for further instructions.

The EPRP will have specific information on fire safety and explosion response, which will provide additional details specific to these emergencies.

Elements of ERP

Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

(a) Communication systems
(b) Emergency resources
(c) Training and updating
(d) Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows:

(1) Worker Notification and Communication

Alarm bells, visual alarms, or other forms of communication will be used to reliably alert workers to an emergency. Related measures according to IFC Guidelines include:

(a) Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations; and

(b) Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency.

Community Notification

If a local community may be at risk from a potential emergency arising at the facility, the company will implement communication measures to alert the community, such as:

(a) Audible alarms, such as fire bells or sirens;

(b) Fan out telephone call lists;

(c) Vehicle mounted speakers;

(d) Communicating details of the nature of the emergency;

(e) Communicating protection options (evacuation, quarantine); and

(f) Providing advice on selecting an appropriate protection option

Media and Agency Relations

Emergency information will be communicated to the media through:

(a) A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies.

(b) Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed.

(2) Emergency Resources

(a) Fire Services

MR will consider the level of local firefighting capacity in the event of a major emergency or natural disaster. If insufficient capacity is available, firefighting capacity will be acquired that may include personal fire engine, pumps, water supplies, trucks, and training for personnel.

(b) Medical Services

MR will provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital during emergency case.

(c) Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency in Upper Myanmar region include:

(i) Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list will include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, safety, environmental science, etc., or any of the functions required to adequately respond to the identified emergency.

(ii) Providing personnel who can readily call up resources, as required.

(iii) Tracking and managing the costs associated with emergency resources.

(iv) Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies.

(v) Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site.

Note: All of these resources will have alternate facilities.

(d) Mutual Aid

Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers. Where appropriate, mutual aid agreements will be maintained with other organizations to allow for sharing of personnel and specialized equipment.

(e) Contact List

The company will develop a list of contact information for all internal and external resources and personnel in Upper Myanmar region. The list will include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained quarterly.

The contact list will include General Administrative Office (Upper Myanmar), Myanmar Police Force (Upper Myanmar), Public Health and Medical Services (Upper Myanmar), Fire Services Department (Upper Myanmar), Fire Services Department (Upper Myanmar), Department of Relief & Resettlement (Mandalay) and Department of Relief & Resettlement (Mandalay), Research and Rescue Working Committee, etc.

(3) Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs will:

(i) Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency

(ii) Develop a training plan to address needs, particularly for flood control, firefighting, spill response, and evacuation. Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated

(iii) Provide training exercises to allow personnel the opportunity to test emergency preparedness, including:

- Desktop exercises with only a few personnel, where the contact lists are tested and the facilities and communication assessed.
- Response exercises, typically involving drills that allow for testing of equipment and logistics.
- and what aspects require improvement.
- Update the plan, as required, after each exercise. Elements of the plan subject to significant change (such as contact lists) will be replaced.`
- Record training activities and the outcomes of the training.

(4) Business Continuity and Contingency

Measures to address business continuity and contingency include:

(i) Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.

(ii) Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.

(iii) Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

Proposed Organization for ERP Team

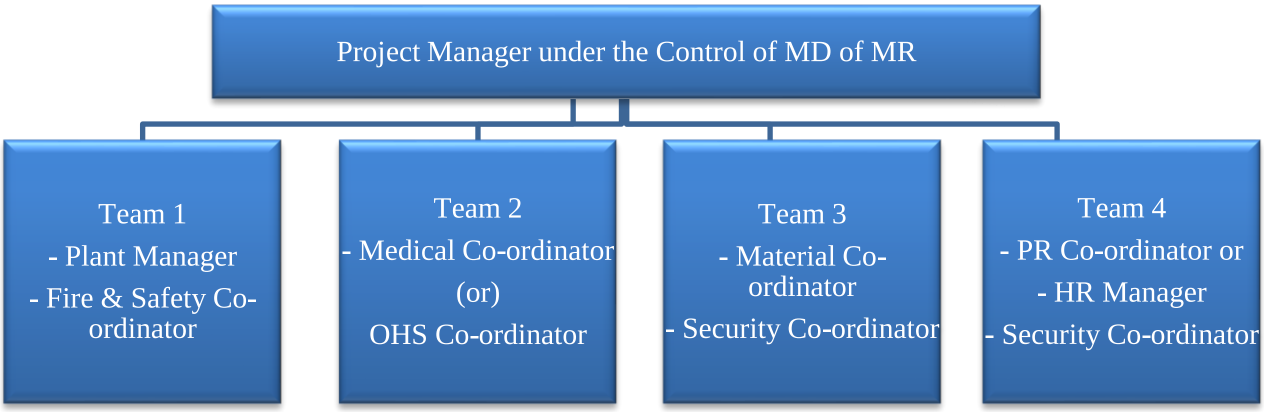


Figure 8.17. Proposed Organization for ERP Team

Proposed Duty Allocation for EPR Team

The followings are the proposed duty allocation for EPR team.

Chief Emergency Controller (General Manager)

- Take control and declare emergency.
- Focal person for all team.
- Contact Authorities.

Plant Manager

- Take steps. Make Emergency shut-down of activities. Put everything in Safe condition.
- Evacuate.
- Commence initial emergency case, till Fire Department or other agencies comes to take up.
- Identify materials requirements and call Material Manager.

Medical Coordinator

- Establish Emergency Center, Treat affected persons,
- Transfer/Remove Patients.
- Assign and Deploy staff.
- Contact Authorities.

Material Coordinator

- Dispatch necessary Supplies.
- Arrange Purchases.
- Providing equipment perform shutdown procedures, damage assessments, emergency repairs and equipment protection.

Fire & Safety Coordinator

- Be Overall in-charge for Fire and Safety.
- Coordinate with Area Coordinator and Direct the Operations.
- Coordinate with City and Other Fire-tenderers.

Public Relationship Coordinator & Security Coordinator

- Remove Crowd
- Arrange Gate security
- Contact Police
- Arrange evacuation
- Contact outside Agencies if asked.
- Handle news media
- Mobilize vehicles
- Arrange Food, clothing to Officers inside.

Emergency Control Center

- Adequate Internal phones
- Adequate external phones
- Workers Tally
- Map showing hazardous storages, Fire horns, Safety equipment, Gates and side gates, Assembly points, List of persons.

Evacuation Plan

Emergency Action Plan includes evacuation plans and procedures for implementation based on local needs. These could be:

- Demarcation/prioritization of areas to be evacuated;

- Notification procedures and evacuation instructions;
- Safe routes, transport and traffic control;
- Safe areas/shelters; and
- Functions and responsibilities of members of evacuation team.

Any precarious situation during floods will be communicated either by an alert situation or by an alert situation followed by a warning situation. An alert situation would indicate that although failure of flooding is not imminent, a more serious situation could occur unless conditions improve. A warning situation would indicate that flooding is imminent as a result of an impending failure of the dam. It would normally include an order for evacuation of delineated inundation areas. The most vulnerable/submergence area in the downstream will be demarcated with the help of flood wave travel time analysis and accordingly would be planed the evacuation plan in inundation areas.

Evacuation Team

The evacuation team will comprise of following officials/representatives:

- Chief District Officer (CDO) or designated officer to immediately relocate people to places at higher elevation;
- Engineer-in-charge of the project;
- Superintendent of Police (SP) or his designated officer to maintain law and order;
- Chief Medical Officer (CMO) of respective district hospital to tackle morbidity of affected people;
- Head of the affected village/s to execute resettlement operations with the aid of district machinery and project proponents; and
- Sub-committees at village level.

The Engineer-in-Charge will be responsible for the entire operation including prompt determination of the flood situation time to time. Once the red alert is declared, the entire local state machinery will come into full swing and start evacuating people in inundation areas delineated in the inundation map. For successful execution, mock drills and demonstration exercise will be annually conducted. CDO is expected to monitor the entire operation.

8.4.8.8. Emergency Response for Fire

Typically, railway facilities can be considered as one of the fire hazard industry and proposed plant must have fire control plan. In order to achieve this target, firefighting system have to be designed in compliance with requirements of local firefighting station or the American National Fire Fighting Association (NFPA) standards as shown in table below.

Table 8.7. American National Fire Fighting Association (NFPA) Standards

No.	Parameters	Proposed Capacity
1.	Maximum water pressure	14 bar
2.	Fire water flow	12.0 liters/m^2/min

Fire Fighting Equipment

The proposed project will be equipped with the following firefighting systems:

(a) Firewater system and posts; and

(b) Firefighting foam and

(c) Portable Fire extinguishers.

All of the firefighting facilities will be equipped according to the rules and regulations of local firefighting station (Upper Myanmar).

(a) Firewater System and Posts

Firewater posts will be equipped with the interval of 80m or according to the local firefighting station's rules and regulations. Tools and accessories will be provided in box at each post.

Fire detection and alarm system - A computerized analogue, addressable type Fire detection and Alarm system shall be provided to cover the complete power station. Following types of fire detection shall be employed.

- Multi-sensor type smoke detection system
- Photo electric type smoke detection system.
- Combination of both multi-sensor type and photo electric type smoke detection systems.
- Linear heat sensing cable detector.
- Quartzoid bulb heat detection system.
- Infrared type heat detectors (for selected coal conveyors)

(b) Firefighting Foam

Firefighting foam is foam used for fire suppression. Its role is to cool the fire and to coat the fuel, preventing its contact with oxygen, resulting in suppression of the combustion.

Types of foam are aqueous film forming foams (AFFF), film-forming fluoroprotein (FFFP), alcohol-resistant fluoroprotein foam (AR-FP), and alcohol-resistant film-forming fluoroprotein (AR-FFFP). Every type of foam has its application. High-expansion foams are used when an enclosed space, such as a basement or hangar, must be quickly filled. Low-expansion foams are used on burning spills. AFFF is best for spills of jet fuels, FFFP is better for cases where the burning fuel can form deeper pools, and AR-AFFF is suitable for burning alcohols. The most flexibility is achieved by AR-AFFF or AR-FFFP. AR-AFFF must be used in areas where gasolines are blended with oxygenates, since the alcohols prevent the formation of the film between the FFFP foam and the gasoline, breaking down the foam, rendering the FFFP foam virtually useless.

General Guidelines for the Storage and Handling of Foam Concentrates

The effective life of foam concentrates can be maximized through optimal storage conditions and proper handling. Foam concentrates have demonstrated effective firefighting performance with contents stored in the original package under proper conditions for more than 10 years. To optimize the effective life and performance of firefighting foams they will be stored in the following ways:

Do not expose to direct sunlight or any heat source. The product will be maintained within the recommended temperature range - refer to specific foam concentrate product data sheet for recommended storage temperatures. The storage area will not be susceptible to flooding.

Fire Protection Products recommends tracking of inventory batch numbers and rotating inventory to ensure older batches are used first. Foam color may differ from batch to batch, and foam color can also change during aging. Mixing firefighting foam concentrates (different types, brands, products) for long-term storage is not recommended. However, it is appropriate to use in conjunction with comparable firefighting foam type for immediate incident response. Contact the manufacturer prior to topping off existing stock with any new foam other than the original product.

Inspection

The foam concentrate will be inspected periodically in accordance with any of the following standards: NFPA 11, EN 13565 -2, or other relevant standard. A representative concentrate sample will be sent to qualified laboratory for quality analysis per the applicable standard. An annual inspection and sample analysis is typically sufficient. In case of any doubts, please contact the manufacturer.

Specific guidelines on the storage of foam concentrate

Totes/Original Packing (Optimum Storage)

The following guidelines are recommended when storing foam concentrates in totes**:**

- Totes are best stored in an environmentally controlled, indoor warehouse
- The storage area around the tote will be clean
- The tote will be stored on the floor and on a rack system rated for the volume of foam concentrate being stored
- Tote will be kept closed and sealed during storage

(c) Portable Fire Extinguishers

Fire Extinguishers of suitable type e.g. CO_2 and DCP extinguishers shall be provided in the proposed project and shall be distributed in vulnerable areas. The extinguishers shall be checked/inspected at regular intervals for replenishment according to the rules and regulations of firefighting station.

Safety Equipment and Personal Protective Appliances for Fire Fighting

Safety and personal protective appliances shall be provided in adequate numbers and shall be distributed in different sections according to requirement. A list of such appliances that must be available in the plant is given in the Table below.

Table 8.8. List of Safety Equipment for Fire Fighting

No.	Safety Equipment
1.	Gas Mask
2.	Compressed air breathing apparatus
3.	PVC hand gloves
4.	Electrical hand gloves
5.	PVC apron
6.	Face shield of different colour
7.	Goggles of different types
8.	Safety belt
9.	Safety helmet
10.	Leather hand gloves
11.	Chargeable hand set
12.	Ear muffs and ear plugs
13.	Smoke exhauster cum blower

Proposed Organization for Fire Fighting Team

Firefighting organization is proposed for MR as follow:

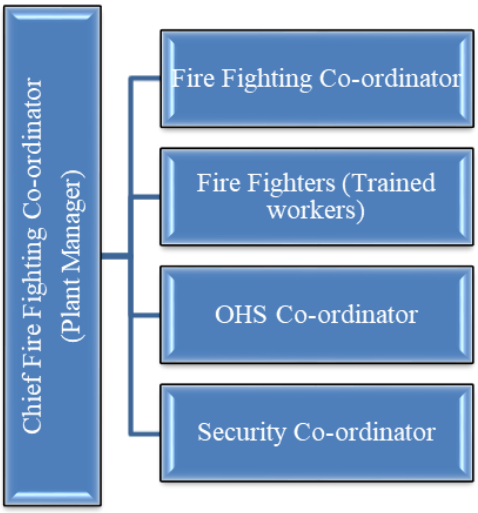


Figure 8.18. Proposed Organization for Fire Fighting Team

Role and Responsibilities of Fire Fighting Team

The following role and responsibilities for firefighting team but not limited are recommended to the project operator(s)/

Team Members	Role	Responsibilities
Plant Manager	Chief co-coordinator	• Make Emergency shut-down of activities. Put everything in Safe condition. • Commence initial emergency case, till firefighting department (Upper Myanmar) comes to take up.
Firefighting leader	Firefighting co-coordinator	• Be Overall in-charge for Fire and Safety. • Coordinate with Local firefighting station.
Trained workers and securities	Fire fighters	• Put off fire by using available equipment.
Safety officer	OHS co-coordinator	• Establish Emergency Center, Treat affected persons, Transfer/Remove Patients. • Workers Tally • Map showing hazardous storages, Fire horns, Safety equipment, Gates and side gates, Assembly points, List of persons.
Security leader	Security co-coordinator	• Remove Crowd • Arrange Gate security • Contact Police if necessary • Handle news media • Mobilize vehicles

8.4.8.9. Fire and Explosion Response Plan

The MR will operate under local Fire Fighting Service and will assisted by fire fighting teams which operates on a 8 hour shift round the clock. The location of the Main Fire Station will be at Main Gate.

Table 8.9. Methods of Dealing with Different Types of Fire and Leakages

Fires from minor oil spillage	Use dry chemical or foam extinguishers or water fog or water spray
Fire from large spillage of oil or burst hose	Use large dry chemical appliance and follow up with foam or water fog/spray. Cool surrounding area/risks with water spray
Fires from spillage of oil on surrounding waters	Emulsification of oil with water jets or apply foam coverage as appropriate
Ammonia Gas	Use dry chemical, carbon dioxide, water spray or alcohol-resistant foam from upwind position
Phosphoric/Sulphuric Acid	Dry powder, carbon dioxide (CO_2), water fog or spray
Electrical fires and/or fire in buildings-canteen	Switch off power-use CO_2 or dry chemical extinguishers
Fire in office involving combustible material	Use dry powder fire extinguishers-water spray, use breathing apparatus
LPG and LNG Fires	Should not be extinguished until source of leakage is under control. Dry chemical is the most effective. Cover affected area with water spray to reduce radiant heat.
Fire in cargo tanks	Use foam or steam smothering

Emergency Response for Electrical Fire Hazard due to Lightning Strike

When lightning strikes near a power line, the power will run through the lines, and it can increase the amount of electrical current flowing to the outlet and this extra burst of electricity can lead to electrical fire hazard.

- Collect, evaluate and share information on energy system damage and estimations on the impact of energy systems outages within affected areas;
- Provide information concerning the energy restoration process such as projected schedules, percentage completion of restoration and geographic information on the restoration;
- Facilitate the restoration of energy systems through legal authorities such as fire and police department support;

- Provide technical expertise to the utilities, conduct field assessment, and assist government and private-sector stakeholders to overcome challenges in restoring the energy system.
- If the power line falls on the ground, locate the wire ends and supervise the public to prevent any contact with energized object.
- Douse the fire with a mist/fog spray. Do not shoot a steady stream of water on an electrical fire, conductor or apparatus.

Emergency Response Plan Electrical emergency

There are typically 4 types of electrical emergency:

1. Power Outages
2. Electrical Fire
3. Electrical Shocks
4. Fallen power lines

Power Outages

Power outages are the most common emergency also known as power failures or breakouts. Power outages can occur due to a range of reasons such as a downed power line, a storm, shortage of energy, etc. and cannot only be irritating but also highly dangerous. Things to do in case of a power outage are:

i. Turn off the Main Power Source
ii. Check the Source
iii. Check for Damaged Wiring or Breaker
iv. Contact the Distributor
v. Reset Safely

Electrical Fire

Electrical fires are caused by overloading, faulty or exposed wiring or when flammable objects are placed near a light bulb. In case of an electrical fire, follow these 4 steps:

i. Cut the Power Supply
ii. Use a Fire Extinguisher to put out the fire
iii. Call the Fire Department Immediately
iv. Evacuate the Site

Electrical Shocks

i. Turn off the Power Supply
ii. Don’t Touch the Person who has received an Electric Shock

iii. Call Local Emergency Service

iv. Unplug the Appliance Immediately

Fallen Power Lines

Fallen power lines pose a serious threat to life and property and so they should be dealt with extreme caution. If you are in close proximity to a fallen power line, follow these 3 steps:

i. Stay at least 40 feet away

ii. Don't touch any object or tree that is in contact with the fallen power line

iii. Contact the Local Authorities Immediately

Emergency Response to Earthquake

Get an emergency kit

If earthquakes are prone to happening in your area, make sure your emergency kit includes the following:

- Non-perishable and high-energy food items.
- Water in bottles or other sealed containers.
- Medications (must be properly safeguarded).
- First aid kit.
- Comfortable shoes and socks.
- Flashlight and batteries.
- Battery-operated radio and batteries.
- Cash

Develop a plan

Determine an emergency plan for disasters with family, colleagues, and friends. Topics should include:

- How to contact each other after an emergency.
- How to find each other and assemble after an emergency. This includes determining assembly points and considering dependents.
- Determining emergency contacts. Make sure everyone has an emergency contact card that is easily accessible in wallets and bags and an I.C.E. (In Case of Emergencies) contact programmed into cell phones.

Internal Department

The primary focus of MR disaster management system is to mitigate the effects of disaster on port community wherever possible or practical, while preparing to respond when disaster occur. The role and responsibilities specifically for each phase being

Specific responsibilities – Response Phase

- Activate the disaster management response team and also crisis response team.
- Activate the relevant / workplace emergency team for the first strike response including traffic and pollution
- Thereafter assist emergency services to respond to the event.
- Assist with providing relief for persons affected by disaster.
- Satisfy immediate, essential personal and port community needs to extent of port capability.
- Maintain liaison and timely communication with district disaster coordinator.
- Contribute to the recovery function coordinated by District Disaster coordinating authority.
- Coordinate the recovery of physical infrastructure.
- Coordinate activities with relevant Disaster district initiatives and plans.
- Participate in long term recovery, reconstruction and rehabilitation
- Communicating regarding restoration of Plant activities.
- If outdoors, find a clear spot away from buildings, trees, streetlights, and power lines. Keep lying on the ground and stay there until the shaking stops. Injuries can occur from falling trees, street-lights and power lines, or building debris.
- If on vehicle, pull over to a clear location, stop and stay with your seatbelt fastened until the shaking has stopped. Trees, power lines, poles, street signs, and other overhead items may fall during earthquakes. Stopping will help reduce your risk. Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that might have been damaged by the quake.

Self-Awareness during an earthquake

The instant you feel the ground or building start to shake, move quickly to protect yourself. Be aware that some tremors are actually foreshocks and a larger earthquake might follow.

Indoors

- Drop to the ground and take cover by getting under a sturdy table or a piece of furniture.
- If there isn't a table or desk near you, cover your face and head with your arms and

crouch in an inside corner of the building.

- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or heavy bookcases.
- Use a doorway for shelter only if it is nearby and if you know it is a strongly supported.
- Stay inside until the shaking stops and it is safe to move about. Injuries most often occur when people inside buildings attempt to move during the earthquake. Beware of aftershocks.
- Be aware that the electricity may go out, sprinkler systems may turn on, and fire alarms may be activated.
- DO NOT use the elevators.

Outdoors

- Stay outside. Do not try to enter any buildings to help others.
- Move away from buildings, streetlights, and utility wires.
- Once in an open, safer location, stay there until the shaking stops. The greatest danger exists directly outside buildings, at building entrances/exits, and alongside exterior walls where there may be falling debris.

Recovery Actions after earthquake

- Remain calm.
- Treat any injuries or seek professional medical care. Small wounds should be washed with soap and water and then bandaged to reduce the risk of infection. Replace bandages as needed.
- Dial 191 to report major injuries to emergency personnel.
- Assist others as trained.
- Take emergency supplies and evacuate carefully and calmly.
- Do not use elevators.
- Be alert for aftershocks.
- Meet at your designated assembly point, as determined in your department's Emergency Action Plan (EAP).
- Do not enter buildings until they are examined and considered safe by emergency personnel. If a structure bears a color-coded sign, do not enter it until you get official information about what the sign means and advice about the safety of entering.
- Await instructions from supervisors and emergency personnel.

8.4.9. Waste Management Plan

8.4.9.1. Objective

The purpose of the waste management plan is the following:

- To develop action plans for achieving the objectives of the waste management plan;
- Monitor discharge sources (waste water and solid waste) and operation of environmental protection equipment in order to ensure that these activities will comply with legislative requirements; and
- To provide guidance on how to minimize, handle, contain, control, re-use, recycle and dispose of all waste generated.

8.4.9.2. Legal Requirements

1) The Prevention of Hazard from Chemicals and Related Substances Rules (Law No. 8, 15, 16, 17, 20, 22, 23, 27)

- Performing the sticking pictogram for being least the health impacts and accident injuries in the occupational area according to the prescribed standards and norms of the Globally Harmonized System GHS);
- Making the necessary arrangements to be safety of the occupational area and issuing orders and directives for preventing and decreasing the accident;
- Laying down the proliferation plans on knowledge, and safety of chemical and related substances to administrators, license holders, public and workers;
- Cooperating with local and foreign governmental departments, organizations and non-governmental organizations in respect of safety management for chemicals hazard.

(2) Prevention of Danger of Chemical and Associated Materials Law (Law No. 28)

- To prevent from damaging the environmental resources and from endangering the lively creatures due to the chemical and associated materials;
- To control systematically for the safety in carrying out in accord with the approval for chemical and associated materials business;
- To carry out the data information acquiring system and to widely do the educating and research works in order to utilize the chemical and associated materials systematically;
- To carry out continuous development for worksite safety, health and environmental conservation.

(3) Conservation of Water Resources and Rivers Law (Law No. 8, 11a, 13, 19, 24b, 30)

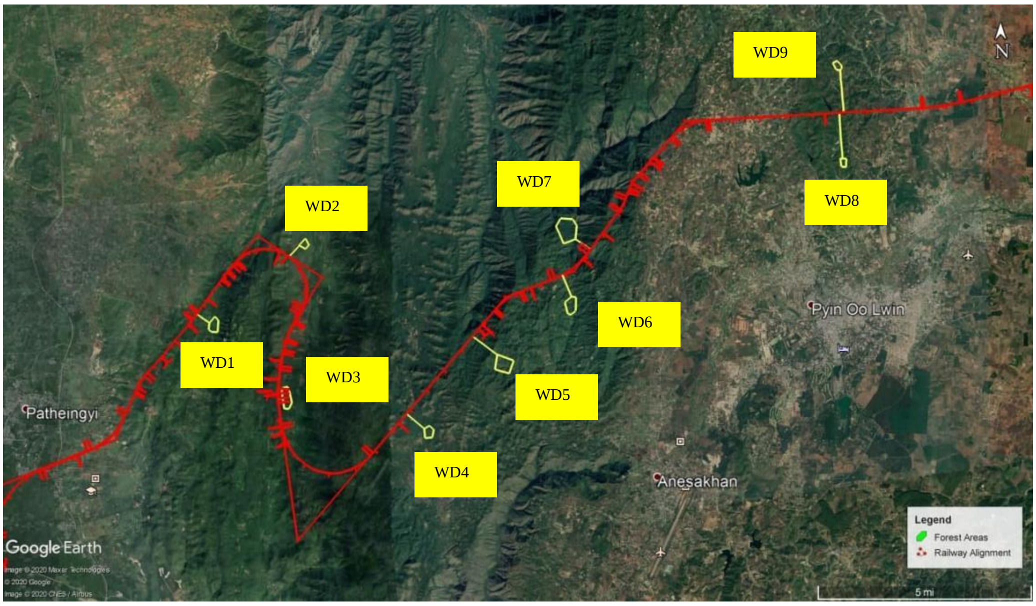
To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.

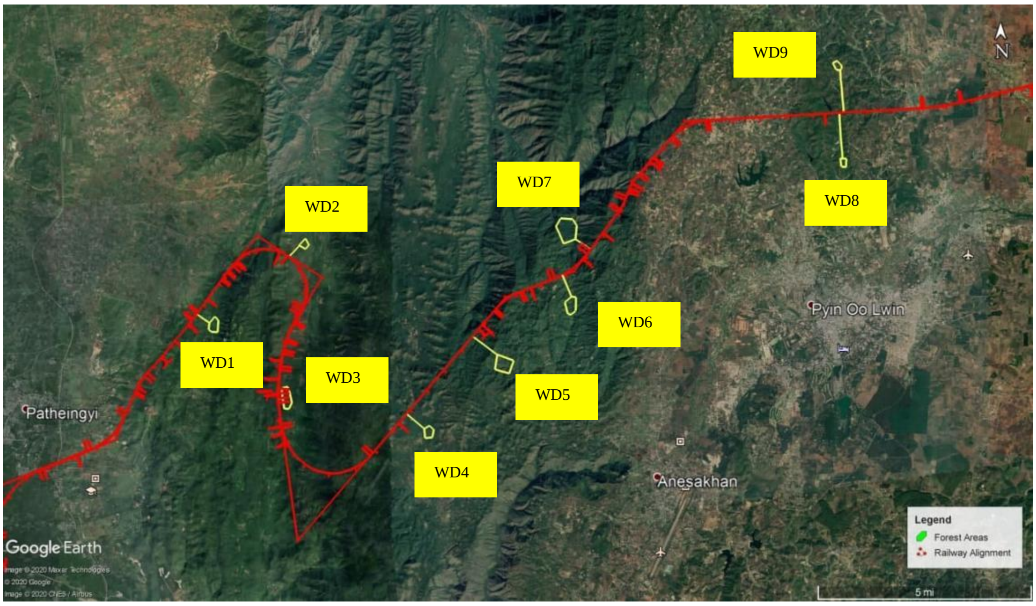
(4) Land Acquisation, Resettlement and Rehabilitation Law (Section 39, 41, 42, 46, 54b and c, 58)

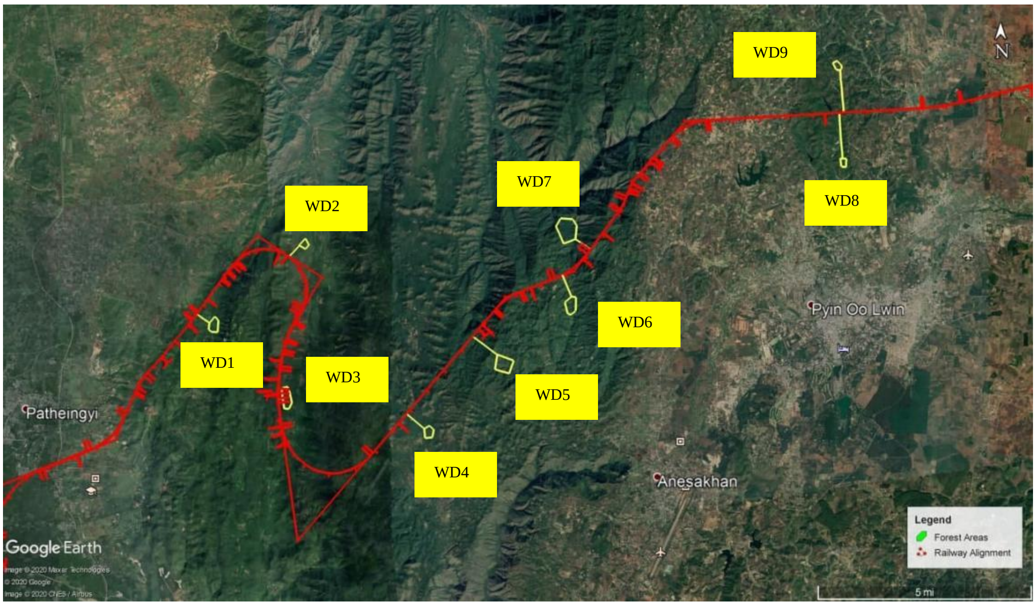
- In this law, it is stipulated that the government holds rights to take over land provided that compensation is made to the original land owner. No private ownership of land is permitted
- To prevent potential impacts on environmental and social sectors due to land use for projects

8.4.9.3. Overview Maps and Site Layout Maps

The proposed waste dumping sites along the railway electrical power lines for the waste management plan are shown in the following figures.



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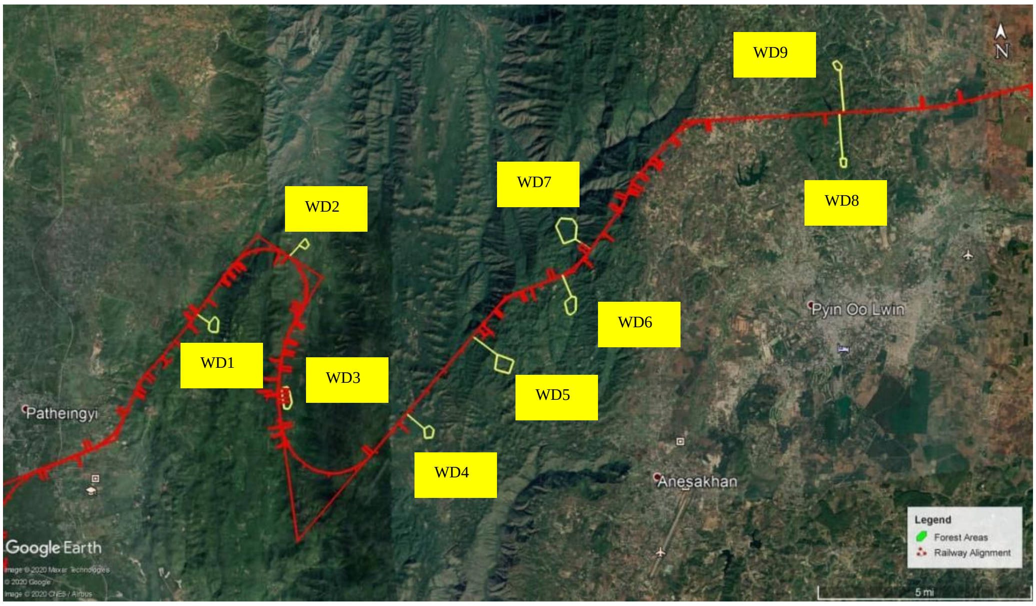
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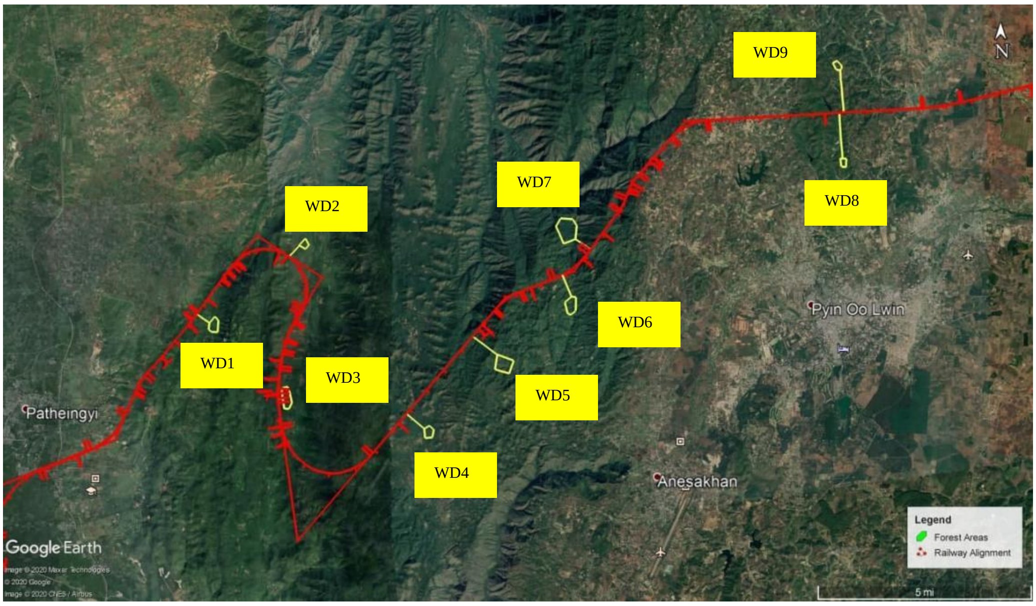
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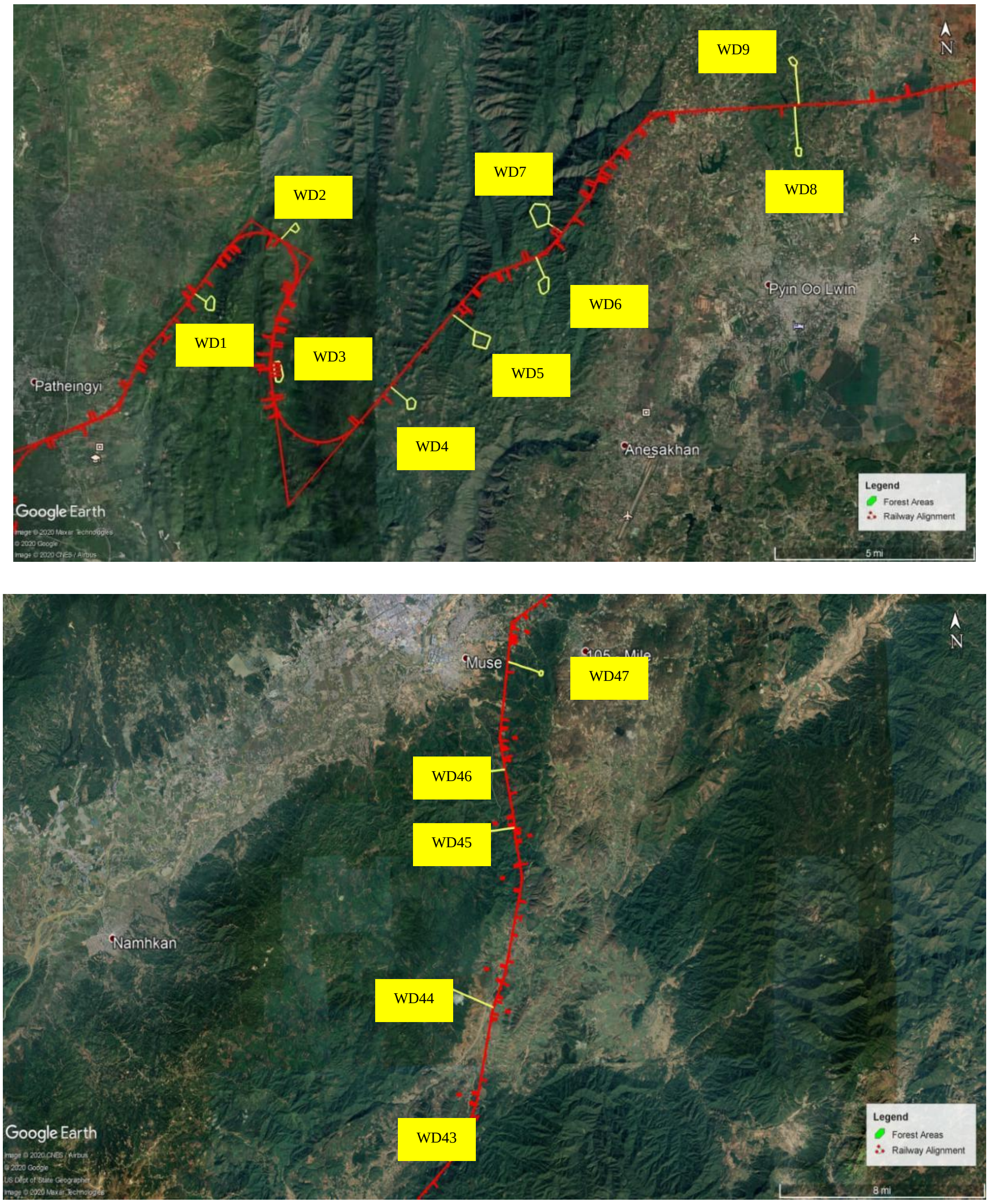


Figure 8.19. Waste dumping sites along the railway electrical power lines

Table 8.10. The Locations and Capacity of Proposed Waste Dump Areas

Proposed Waste Dump Area			Name of Tunnel	Area of dump area (m^2)	Distance from Alignment (m)	Surrounding Environment (within 1km radius)
ID	Coordinate					
	Latitude	Longitude				
WD-1	22° 1'44.51"N	96°14'20.99"E	Taung Kyun 2, 3 Tunnels & Tok Hka Taung Tunnels	178,800	646.89	Forest Area Monastery(0.95km)

WD-2	22° 3'23.68"N	96°16'21.39"E	Taung Kyun 1 Tunnel	77,236	574.70	Forest Area
WD-3	22° 0'14.34"N	96°15'56.05"E	Sakangyi 1 & 2 Tunnels	227,209	173.22	Forest Area
WD-4	21°59'31.60"N	96°19'8.06"E	Sakangyi 1 Tunnel	127,860	914.25	Forest Area Cropland (0.21km)
WD-5	22° 0'54.56"N	96°20'48.49"E	Sakangyi 1 Tunnel, Sin Byu In 3 Tunnel	328,268	1,162.62	Forest Area
WD-6	22° 4'56.30"N	96°28'13.66"E	Pyinoolwin Tunnel	62,071	892.14	Forest Area Cropland (0.47km)
WD-7	22° 2'5.45"N	96°22'16.21"E	Pyinoolwin Tunnel	213,713	762.55	Forest Area
WD-8	22° 3'37.43"N	96°22'12.03"E	Sin Byu In 1 & 2 Tunnels Pyinoolwin Tunnel	551,353	1,654	Forest Area
WD-9	22° 6'53.70"N	96°28'6.03"E	Pyinoolwin Tunnel	71,366	1,532.68	Forest Area
WD-10	22°19'23.13"N	96°49'18.64"E	Ko San 2 Tunnel	31,067	560.46	Vacant Land Cropland (0.16 km) Nearest Local Residence (0.38 km)
WD-11	22°16'36.81"N	96°51'36.35"E	Ko San 1 Tunnel	79,869	4,292.30	Vacant Land Cropland (0.38 km) Monastery (0.22 km)
WD-12	22°24'17.81"N	96°53'27.99"E	Kyaung Gone Tunnel	206,667	3,160.35	Forest Area Cropland (0.57km
WD-13	22°20'35.78"N	97° 0'8.43"E	Kyaung Gone Tunnel & Myin Gwin Tunnel	258,047	8,234.56	Vacant Land
WD-14	22°24'46.77"N	97° 0'34.28"E	Myin Gwin Tunnel	52,098	4,767.70	Vacant Land
WD-15	22°26'50.84"N	96°59'49.06"E	Man Loi 1, 2, 3 & Long Wai Tunnels	57,118	1,849.24	Vacant Land Cropland (0.45 km)
WD-16	22°31'3.03"N	97° 6'34.64"E	Kyaukme & Chaung Chauk Tunnels	160,794	3,060.14	Forest Area Cropland (0.84 km)
WD-17	22°29'26.17"N	97° 4'42.71"E	Kyaukme Tunnel	46,783	1,216.50	Forest Area Cropland (0.26 km)
WD-18	22°32'19.05"N	97°10'4.77"E	Kyang Yin 1 & 2 Tunnels	20,657	593.90	Vacant Land Cropland (0.34 km) Nearest Local Residence (0.76 km)
WD-19	22°34'27.88"N	97°14'45.20"E	Baw Gyo 2 Tunnel	12,876	473.38	Forest Area Farmland (0.68 km)
WD-20	22°34'58.61"N	97°16'33.19"E	Baw Gyo 1 & Nalin 2 Tunnels	26,950	845.84	Forest Area
WD-21	22°35'9.38"N	97°17'13.94"E	Nalin 1 Tunnel	30,899	737.19	Forest Area
WD-22	22°35'41.86"N	97°18'31.30"E	Teng Sam 2	26,970	744.05	Forest Area

						Farm Land (0.35km) Nearest Local Residence (0.82 km)
WD-23	22°35'56.46"N	97°19'13.43"E	Teng Sam 1 & Hsipaw	116,576	858.15	Forest Area Monastery (0.7 km)
WD-24	22°36'9.01"N	97°21'8.91"E	Hsipaw, Hsup Lang, Pang Hsauk 2, 1 & Kong Tha 2 Tunnels	433,763	1,404.22	Forest Area
WD-25	22°35'20.74"N	97°25'46.53"E	Kong Tha 1	27,069	4,875.25	Forest Area Cropland (0.61 km)
WD-26	22°42'3.44"N	97°30'6.19"E	Kong Mon	69,250	613.43	Forest Area Cropland (0.82 km)
WD-27	22°43'21.58"N	97°31'46.72"E	Nam Um & Sint Eng 2	40,054	254.15	Forest Area Cropland (0.37 km) Stream (0.66 km)
WD-28	22°44'54.68"N	97°34'39.69"E	Sint Eng 1	74,285	361.22	Forest Area Cropland (0.9 km)
WD-29	23° 5'8.68"N	97°46'8.72"E	Hang Lu	129,096	1.477.89	Vacant Land
WD-30	23° 6'55.23"N	97°51'27.52"E	Hang Lu	136,470	2,405.28	Vacant Land
WD-31	97°51'27.52"E	97°59'21.80"E	Laban Pa	20,272	2,763.98	Vacant Land Cropland (0.56 km)
WD-32	23°19'38.12"N	98° 3'55.84"E	Nawng Yen 3 & 2	60,087	965.09	Vacant Land Cropland (0.4 km) Nearest Local Residence (0.76 km)
WD-33	23°21'53.49"N	98° 4'39.70"E	Nawng Yen 2 & 1	230,834	1,586.95	Forest Area Nearest Local Residence (0.91 km)
WD-34	23°22'54.10"N	98° 4'43.24"E	Nawng Yen 1 & Man Peng 2	282,422	1,674.56	Forest Area Nearest Local Residence (0.89 km)
WD-35	23°23'21.95"N	97°59'28.18"E	Man Peng 2 & 1	278,026	1,498.39	Forest Area Cropland (0.38 km)
WD-36	23°21'20.37"N	97°55'59.96"E	Man Peng 1	90,647	921.66	Vacant Land Cropland (0.3 km)
WD-37	23°22'37.28"N	97°54'22.62"E	Kutkai 3	59,748	719.29	Forest Area
WD-38	23°25'33.51"N	97°52'2.54"E	Kutkai 2	44,590	3,135.47	Forest Area Cropland (0.55 km)
WD-39	23°30'31.06"N	97°54'19.24"E	Kutkai 1, Peng Nin 3 & 2	92,740	2,149.45	Forest Area Lashio-Muse Road (0.89 km) Nearest Local Residence (0.76 km)
WD-40	23°31'28.18"N	97°52'14.49"E	Pang Nin 2 & 1	124,261	89.41	Forest Area Nearest Local Residence (0.9 km)
WD-41	23°34'25.20"N	97°50'13.87"E	Nam Hpak Ka 2	44,636	925.05	Forest Area Cropland (0.43 km) Stream (0.83 km)
WD-42	23°36'18.69"N	97°49'43.54"E	Nam Hpak Ka 2 & 1	41,660	1,132.07	Forest Area Cropland (0.91 km)
WD-43	23°43'14.72"N	97°52'49.96"E	Na Hpai	100,314	1,200.62	Vacant Land Cropland (0.44 km)

WD-44	23°48'20.42"N	97°53'12.50"E	Pang Hkam 2	73,880	3,364.99	Forest Area
WD-45	23°53'8.60"N	97°54'21.58"E	Pang Hkam 2 & 1	159,443	2,498.14	Forest Area
WD-46	23°55'3.39"N	97°54'22.02"E	Pang Hkam 1, Muse 4, 3 & 2	190,667	1,960.45	Forest Area
WD-47	23°58'11.90"N	97°57'3.12"E	Muse 2 & 1	56,607	2,061.70	Vacant Land Cropland (0.4 km)

The above proposed waste dumping sites are selected based on less environmental impacts (away from water resources, agricultural land and residential areas) and available space for waste

8.4.9.4. Management Actions and Monitoring Plans

The waste management plan will thus have a positive contribution in reducing disposal costs, minimizing waste going to landfill sites, and an overall contribution to integrated waste management according to the rules and regulations of CDC. Adherence to the waste management plan should be exercised by all employees, contractors and service providers to ensure proper waste management is applied. This will be undertaken when appointed and through regular auditing. Service providers and contractors are required to furnish evidence of proper waste management (i.e. classification, quantities and disposal).

To help manage waste effectively, the Project has committed to implementing the "hierarchy of waste management" with a focus on waste prevention; and then a decreasing focus on waste reuse; recycling; recovery and elimination. Only when waste prevention cannot be achieved will the waste be reused, recycled or used as a source of energy.

- Waste avoidance
- Re-use
- Recycling
- Energy recovery
- Treatment
- Disposal

General Solid Waste

In construction of traction power substations and transmission lines, following solid wastes can be produced:

- Material and equipment wrappings
- Electrical materials
- Unusable cement/ grouting mixes

- Damaged or contaminated construction material
- Debris from digging or excavation works
- Wood from removing trees, and
- Other wastes from site clearing works

We should try to reduce source of waste because when source of waste is reduced, the life-cycle of material use, energy use, and waste generation can also be reduced. Source reduction prevents waste from being generated, e.g., designing power stations for adaptability to prolong their life, use of methods that allow disassembly and facilitate reuse of materials, and employing alternative framing techniques. It can also conserve landfill space, reduces the environmental impact of producing new materials, and can cut down the overall project expenses through avoided purposes.

Raw construction and demolition debris can be diverted and used as a resource. Some materials that can be diverted include:

- Landscape and land clearing debris
- Gravel and aggregate products
- Concrete
- Plastics
- Insulation materials
- Electrical cables

Valuable construction and demolition materials for further use is an effective way to save money and conserve natural resources. Much construction debris can be recycled. Concrete and rubble can be recycled into aggregate and concrete products. Metals like steel, copper, and brass are also valuable resources to recycle.

The following methods can be used to recycle waste:

1. **Site-separated**: This uses multiple boxes for each type of waste. Separating waste on the job site gives immediate feedback to everyone on the job and can help to ensure that the project's recycling goals are met. Site separation also promotes a responsible atmosphere on the job site and is the best method for diversion goals. It does, however, take up more space and requires a high level of supervision.
2. **Commingled recycling**: This type of recycling uses one container. The hauler sorts everything off-site. This makes it easier for the field staff to manage waste on-site. Commingled recycling requires little storage space and is the best option for sites that are tight on space.

3. **Hybrid recycling**: This type of recycling combines site-separation and commingled recycling. For instance, one box for wood, one box for concrete, and one box for non-recyclable waste. It optimizes the weight vs. sorting effort. The total number of boxes can be reduced by working in phases. It reduces work for sorting haulers, which reduces hauling fee.

Benefits of reducing disposal of construction and demolition waste include:

1. Reduction in overall building project expenses through avoided purchase costs and donation of recovered materials to qualified charities, which offers a tax benefit. Transportation costs also come down with onsite material reuse.
2. Fewer disposal facilities which educe associated environmental issues.
3. Conserve landfill space.
4. The environmental impact associated with the extraction and consumption of virgin resources and the production of new materials is offset.

Wastes which cannot be reused or recycled, such as debris from excavation works which cannot be reused in foundation works, will be disposed of in a permitted disposal facility. Excavated soil, sediment, or tailings can be disposed of either on site, in an approved repository constructed for this purpose or another location where the exposure pathways allow the material to be beneficially reused, or off site in a permitted disposal facility. Solid wastes will be removed and transported to dumping site or landfill on a daily basis.

Selection of Landfill

An ideal sanitary landfill:

1. Will meet local zoning and land use criteria, including local road weight limits and other limitations;
2. Is easily accessible by solid waste vehicles in all weather conditions;
3. Safely protects surface and groundwater quality;
4. Controls landfill gas;
5. Has access to earth cover material that can be easily handled and compacted;
6. Is located where the landfill's operation will not affect external environmentally sensitive areas;
7. Should not be very close to significant water bodies (water courses or dams);
8. Will be that no major power transmission or other infrastructure like sewers, water supply lines should be crossing through landfill developmental area;

9. Comprises enough land and internal capacity to provide a buffer zone from neighboring properties and is able to be expanded; and
10. Will be the most economic site available given haul distances to user communities and other economic considerations.

Domestic Waste

A certain amount of domestic waste will be generated from construction workforce. The establishment of labor camps will also effect on environment through improper waste (solid & garbage /sewage) disposal. Management of domestic waste can be done by as follows:

- Domestic waste generated during construction period shall be cleaned up in time and collected every day.
- Food waste can be reused as farmyard manure.
- The rest of the waste should be transported to the garbage dump for disposal.
- The stacking position of construction materials should be far away from the water body.

Sewage and Domestic Wastewater

Wastewater comes from ordinary living processes: bathing, toilet flushing, laundry, dishwashing, etc. from temporary facilities.

Wastewater is broken into two categories, depending upon the source.

- Gray water: Gray water is from showers, laundry, dishwashing and sinks other than the kitchen sinks.
- Black water: Black water is from toilets and kitchen sinks.

Wastewater also includes rainwater that has accumulated pollutants as it runs into oceans, lakes, and rivers. Pollutants are unwanted chemicals or materials that contaminate air, soil, and water. Sewage treatment involves three stages: primary treatment, secondary treatment, and tertiary treatment.

Primary treatment physically separates solids and liquids. The wastewater passes through a grating that strains out large particles. The remaining water is left to stand in a tank, where smaller sediments (particles of sand, clay, and other materials) settle to the bottom. These sediments are called sludge. At this point, this liquid part of the wastewater still contains many pollutants and is not safe for exposure to humans or the environment.

In secondary treatment, the liquid part of the wastewater passes through a trickling filter or an aeration tank. A trickling filter is a set of pipes with small holes in it that dribbles water over a bed of stones or corrugated plastic. Bacteria in the stones or plastic absorb pollutants from water and break them down into substances that are not harmful. An aeration tank is a tank that contains bacteria that break down pollutants. The liquid part of the wastewater from primary treatment is pumped into the tank and mixed with the bacteria. Air is bubbled through the tank to help the bacteria grow. As bacteria accumulate, they settle to the bottom of the tank and form sludge. The sludge is removed from the bottom of the tank and buried in landfills.

After secondary treatment, the water is generally free from the majority of pathogens and heavy metals. It still contains high concentrations of nitrate and phosphate, minerals that can over-stimulate the growth of algae and plants in natural waters, which can ultimately cause them and the surrounding organisms to die. Tertiary treatment removes these nutrients from the wastewater. One method of tertiary treatment involves using biological, chemical, and physical processes to remove these nutrients. Another method is to pass the water through a wetland or lagoon.

Wastewater should be treated before discharging to the land, or to surface or groundwater. At least secondary treatment should be done before discharging.

Hazardous Waste

In traction substations construction and maintenance works, most common hazardous waste includes transformer oil from substation maintenance, fuel oils from transportation and lubricants from lubricating works.

Waste Oil

- Engine oil or fuel filters will be crushed and evacuated of oil. Filters will be stored in clearly labeled bunded filter ponds for collection and recycling by a licensed contractor There will be a prior agreement with the MCDC for the disposal of any hazardous waste generated.
- Temporary sedimentation pond on the waterway to nearest water courses
- Hydrocarbon wastes such as waste oils, fuels, lubricants and hydraulic fluids generated from the maintenance of light vehicles, plant and equipment will be stored in approved containers and conditions onsite prior to removal offsite for treatment and disposal by a licensed waste management contractor at a licensed waste management facility.
- Pump all of the remaining fuel oil inside the tanks and pipe lines. Care has to be taken the remaining oil are not disposed to nearest water bodies directly.

- Other miscellaneous oil/hydrocarbon wastes will be stored in designated bins for collection by a licensed contractor for energy recovery and/or disposal. Coolants will be stored in a separate tank for collection and reconditioning by suppliers.

Transformer oil

Loading PCB Contaminated Waste

It is not appropriate to use a short-side flat-bed trailer or vehicle to transport a transformer that may contain fluid contaminated with PCBs. At a minimum for all PCB-contaminated wastes and for transformers:

- Liquid-proof containers or trailers with a drip tray capable of storage of the fluid contents of the equipment being transported must be used. The sides of the trailer and container must be higher than the shipped materials, to ensure full coverage;
- There must be internal fixing points with adequate load bearing to fasten the equipment securely;
- There should be a completely open loading platform for unloading operations;
- Adequate weather-proofing must be provided, such as a tarpaulin (cover), to prevent water infiltration during transportation;

Unloading PCB Contaminated Waste

- In a manner similar to the loading requirements, an inspection of the vehicle should take place before unloading commences and the same loading precautions, such as vehicle stability and warning signs, should be applied at unloading also.
- The unloading of the vehicle shall not take place if the inspection reveals deficiencies that may affect the safe unloading of the PCB-contaminated waste.
- If any substances have leaked and been spilled in a vehicle or container, it may not be reused until after it has been thoroughly cleaned and, if necessary, decontaminated.
- Any other goods and articles carried in the same vehicle or container shall be examined for possible contamination.

Handling

- Do not wear contaminated clothing or shoes. Use good personal hygiene practices.
- Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty oil containers to heat, flame, sparks, or other sources of ignition.

- Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Storage

- Keep container(s) tightly closed.
- Use and store this material in cool, dry, well-ventilated areas away from heat and all sources of ignition.
- Storage temperatures above 113°F may lead to thermal decomposition, resulting in the generation of hydrogen sulfide and other sulfur containing gases.
- Store only in approved containers.
- Keep away from any incompatible material.
- Protect container(s) against physical damage.
- Store in accordance with all current regulations and standards.
- The storage floor must be impermeable and form a collecting basin so that, in the event of an accident spillage, the liquid cannot spread beyond the storage area.

Spill Management

- Stop the source of the release if it can be done without risk.
- Contain release to prevent further contamination of soil, surface water or groundwater.
- Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection.
- Use appropriate techniques such as applying noncombustible absorbent materials or pumping.
- Where feasible and appropriate, remove contaminated soil.
- Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
- Contain spillage with sand or earth.
- Collect spillage for reclamation or disposal in sealed containers.
- Avoid water contacting spilled material or leaking containers.
- Spillages or uncontrolled discharges into watercourses must be reported immediately to the Environmental Agency or other appropriate regulatory body. In case of spillage on water prevent the spread by use of suitable barrier equipment.

Land Spill: Shut off source taking normal safety precautions. Take measures to minimize the effects on ground water. Recover by pumping using explosion-proof equipment or contain spilled liquid with sand or other suitable absorbent and remove mechanically into containers.

Water Spill: Notify port and relevant authorities. Confine with booms if skimming equipment is available to recover the spill for later recycling or disposal.

Disposal Considerations

- Use material for its intended purpose or recycle if possible.
- Oil collection services are available for used oil recycling or disposal.
- Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations.
- Do not discharge into lakes, streams, ponds and ground water supply.
- Contact sales representative or local environmental or health authorities for approved disposal or recycling methods.

Lubricants

Handling

- Prevent small spills and leakage to avoid slip hazard.
- Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source).
- When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations).
- Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation.
- Consult local applicable standards for guidance.

Storage

- Do not store in open or unlabeled containers.
- Store in cool, dry, ventilated area, away from heat and ignition sources. Use good personal hygiene. Always keep the container close and the type of container used to store the material may affect static accumulation and dissipation.

Spill Management

Land Spill: Stop leak. Recover by pumping or with suitable absorbent.

Water Spill: Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants. Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted.

Disposal Considerations

- Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal.
- Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

Diesel Oil

Handling

- Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk. DO NOT reuse empty containers without commercial cleaning or reconditioning. Ground/bond line and equipment during pumping or transfer to avoid accumulation of static charge. Do not breathe gas/vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment.
- If ingested, seek medical advice immediately. Avoid contact with skin and eyes. Practice good personal hygiene. Wash hands after handling and before eating. Launder work clothes frequently. Discard saturated leather goods.
- Diesel is a flammable liquid and is dangerous unless handled and stored properly. Children and pets should have no access to the storage tanks to avoid accidents. Adult access to the tanks should be limited to only those who need access for refueling or maintenance of the tanks.
- The fuel should be stored in an isolated area away from residences. An above-ground container may be installed in a building or under a lean-to. This location helps prevent water from harming the tank and prevents radiant heat from evaporating the diesel.

Storage

- Store at cool, ventilated and specified place.
- Store in tightly closed containers in cool, dry, isolated, well-ventilated area, and away from incompatibles. Ground all equipment containing material.
- Keeping the fuel away from ignition sources is important. While diesel has a higher ignition point than gasoline, it is still flammable. Any electrical outlets nearby should be rated for explosions. No smoking should be allowed within 50 to 100 feet of the storage area.
- If a small amount of diesel fuel needs to be restored, keep it in portable 5-gallon gas cans that can take to the gas station. For larger amounts, store in special storage containers, such as 55-gallon drums or a stand-alone tank.
- Larger diesel tanks, made of metal or specially formulated polyethylene, can be installed above ground or below ground, depending on the site and local regulations. These tanks can also be mounted on the back of trucks when necessary. The exact size of the tank is, of course, dependent on how much fuel needs to be stored.

Disposal Considerations

- Preferred waste management priorities are: (1) recycle or reprocess; (2) incineration with energy recovery; (3) disposal at licensed waste disposal facility. Ensure that disposal or reprocessing is in compliance with government requirements and local disposal regulations. Consult local or regional authorities.
- On large scale absorb and landfill , allow for atmospheric evaporation.

Fuel Oil

Handling

- Precautions for safe handling: Provide adequate ventilation. Use personal protective equipment as required.
- Do not breathe vapor/aerosol. Avoid contact with skin, eyes and clothing. Take any precaution to avoid mixing with combustibles. Ensure proper process control to avoid excess waste discharge (temperature, concentration, pH, time).
- Do not allow to enter into surface water or drains. Obtain special instructions before use. (Do not handle until all safety precautions have been read and understood.).
- Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Ensure equipment is adequately earthed. Use explosion-proof equipment. Use only non-sparking tools.

- Product may release Hydrogen Sulphide: A specific assessment of inhalation risks from the presence of hydrogen sulphide in tank head spaces, confined spaces, product residue, tank waste and waste water, and unintentional releases should be made to help determine controls appropriate to local circumstances.
- Hygiene measures: Keep good industrial hygiene. Wash hands immediately after handling the product. When using do not eat, drink or smoke. Keep away from food, drink and animal feeding stuffs. Separate working clothes from town clothes. Take off contaminated clothing. Wash contaminated clothing before reuse.

Storage

- Conditions for safe storage, including any incompatibilities
- Technical measures: Store in a dry, cool and well-ventilated place. Bund storage facilities to prevent soil and water pollution in the event of spillage.
- Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
- Product may release Hydrogen Sulphide: A specific assessment of inhalation risks from the presence of hydrogen sulphide in tank head spaces, confined spaces, product residue, tank waste and waste water, and unintentional releases should be made to help determine controls appropriate to local circumstances.
- Packaging materials: Keep only in the original container. Suitable material: Carbon steel. Stainless steel.
- Unsuitable material: synthetic material.

Disposal Considerations

- Do not allow to enter into surface water or drains. Dispose of empty containers and wastes safely. Refer to manufacturer/supplier for information on recovery/recycling. Recycling is preferred to disposal or incineration.
- If recycling is not possible, eliminate in accordance with local valid waste disposal regulations.
- Additional information: Handle contaminated packages in the same way as the substance itself. Dispose of contaminated materials in accordance with current regulations. Do not pierce or burn, even after use. Never use pressure to empty container.

Treatment of Hydrocarbon-Containing Wastewater

Concentrations of petroleum hydrocarbons in wastewater may decrease due to natural processes of decomposition and chemical oxidation, evaporation and biological degradation by native microflora. In natural environments, however, these processes are relatively slow. To enhance the oil contaminant removal from wastewater, the mechanical, chemical, physicochemical and biological methods, as well as their combinations, are employed, providing the required purification rate at reasonable costs. Importantly, the choice of a treatment method in each case is determined by the source of wastewater, the diversity and levels of contaminants, and the subsequent intended use of treated effluents.

Treatment of petroleum wastewater usually involves two stages, firstly, physical (mechanical) pre-treatment to remove free oil & grease fractions and suspended particles. Secondly, an advanced treatment, usually involving a combination of different physicochemical and biological methods, to decrease the pollutant level to acceptable discharge values

a) The sedimentation treatment, which is used to separate bulk free oil from water, is mechanically achieved by gravity in API (American Petroleum Institute) or CPI (Corrugated Plate Interceptor) separators and dissolved air floatation (DAF) units. During wastewater sedimentation, insoluble solids are also removed, which prevents clogging and wearing of devices used in subsequent treatment stages.

b) Mechanical treatment techniques, while allowing the reuse of roughly purified water in the operation cycle, are inefficient in the recovery of finely dispersed oil, dissolved organics, metals and colloids. The mechanical step is followed by the physiochemical step, in which small-sized suspended solids and dispersed oil are further reduced by agglomeration into large-sized particles to ease the removal by filtration, sedimentation or floatation.

All hazardous waste areas should be inspected weekly. Any concerns should be documented and fixed. If there are any spills, clean up and disposed of properly. Waste analysis and waste determination records should be kept.

Among several options available for hazardous waste management, the most desirable method is to reduce the quantity of waste at its source or to recycle the materials for some other productive use. However, some amount of hazardous waste need to be treated, or disposed.

Hazardous wastes must be deposited in secure landfills, which provide at least 3 metres (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table.

8.4.10. Watershed Management Plan

8.4.10.1. Objectives

The main goal of Watershed Management – sustainable management of natural resources to improve the quality of living for the population- is to be accomplished by the following objectives:

- Supply and securing of clean and sufficient drinking water for the population;
- Provision and securing of access to sanitation;
- Improvement and restoration of soil quality and thus, raising productivity rates;
- Reducing the impact of natural hazards (especially of the climate change);
- Improvement of the income of the population with simultaneous regeneration of natural re-sources;
- Improvement of infrastructure for storage, transport and agricultural marketing;
- Improvement of physical health (supported by clean drinking water, access to sanitation)
- Reduce the amount of sediment by: stabilizing eroding road-stream crossings, restricting livestock from the stream and stabilizing eroding stream banks
- Reduce the amount of nutrients by: reducing fertilizer use on residential lawns, restricting livestock from the stream and identifying and correcting falling septic systems
- Reduce hydrologic impacts from fluctuating flows by: retrofitting and modifying existing infrastructure in the watershed to reduce high water (peak) flows and identifying ways to manage urban storm water

8.4.10.2. Legal Requirements

Conservation of Water Resources and Rivers Law, 2006

- To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.

Conservation of Water Resources and Rivers Rules, 2013

- To conserve and protect the water resources and rivers system for beneficial utilization by the public; to prevent environmental impact.

8.4.10.3. Overview Map

As the railway route is close to Thit Ta Pin Taung forest area, which is environmental sensitive area of water resources for the local community of surrounding villages and to protect near forest areas in Pyin Oo Lwin Township. The location map of Thit Ta Pin Taung Forest and the proposed railway alignment is shown in the following figure.

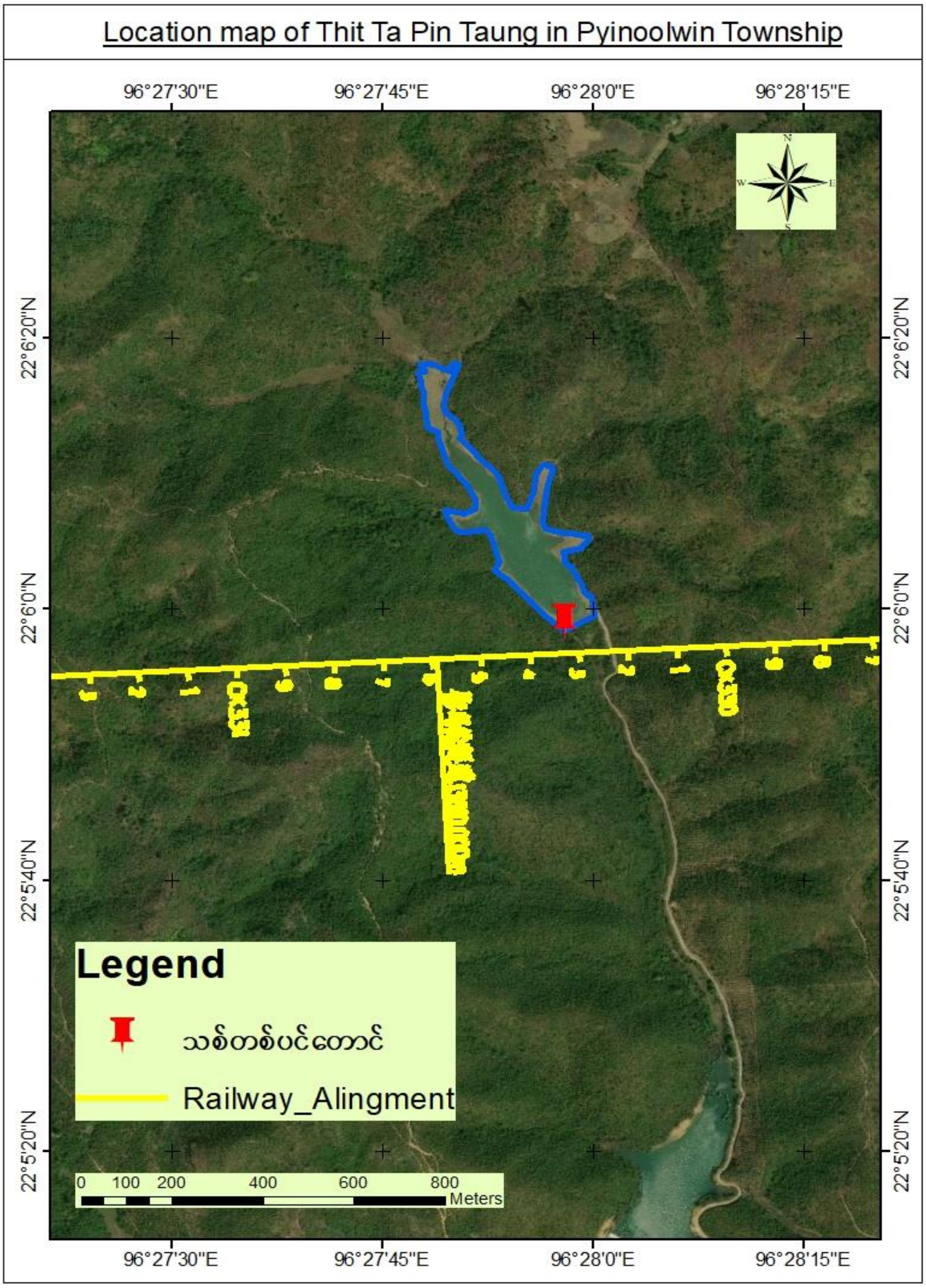


Figure 8.20. Location Map of Thit Ta Pin Taung Forest and Proposed Railway Alignment

8.4.10.4. Management and Monitoring Plan

The Watershed Management Plan provides a watershed-based management approach for improving water quality and preserving the ecological integrity of the water resources, they are located near and along the proposed project. Water quality concerns in the watershed include nutrient pollution, excessive sedimentation, high bacteria concentrations, and elevated water temperatures. The stream ecosystem is also under threat from aquatic invasive species and habitat loss. Stressors affecting the watershed ecosystem include: agricultural operations, residential land use, road-stream crossings, and beaver dams. A watershed management approach to protecting the water resources (stream, lake etc.) and addressing problems is not only important for the health of water resources (steam, lake, etc.), but for the receiving waters of them as well.

The recommended Watershed Management Plan consists of the following:

- a project overview with goals and objectives
- general watershed information
- water quality monitoring
- inventories and surveys
- watershed issues and concerns, and
- watershed management recommendations for addressing problems

Successful implementation of the Plan's recommendations will result in improved water quality conditions in related water resources, as well as restoration and maintenance of the stream ecosystem.

Management and Monitoring

Potential Impact and Relevant Management Plan	Mitigation and Management (Design Feature/ Specific Measure)	Monitoring	Monitoring Frequency	Responsibility
Impacts to water quality with consequent adverse impacts on downstream beneficial uses	Discharge of waters will be at a sufficient distance from water bodies so as to prevent pollution by turbid water and comply with relevant discharge criteria. Discharge will be performed to discharge	Verification	Prior to/ during discharge to land	Contractor

	structures so as to prevent erosion of the surrounding land and to maintain the discharge quality required.			
	Perform controlled discharge of hydrotest water in order to control erosion and use erosion protection measures.	Verification	Prior to/ during discharge to land	Contractor
	Utilise runoff controls to maintain stable landforms.	Verification	Prior to/ during discharge to land	Contractor
	Reinstatement of disturbed lands at both abstraction and discharge points.	Verification	Upon completion of test	Contractor

Roles and Responsibilities

Contractor shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Watershed Management Plan. Contractor's Watershed Management Plan shall describe the resources allocated to and responsible for the execution of each task and requirement contained therein, and shall describe how roles and responsibilities are communicated to relevant personnel. Project Developer shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of Project Developer's responsibilities in the Watershed Management Plan.

Training, Awareness and Competency

Contractor shall ensure that all personnel responsible for the execution of the tasks and requirements contained within the Watershed Management Plan are competent on the basis of education, training and experience. Contractor's Watershed Management Plan shall describe the training and awareness requirements necessary for its effective implementation. Contractor's training activity associated with the Watershed Management Plan shall be appropriately documented by means of a training needs assessment, training matrix/plan and records of training undertaken. Company shall ensure that all Company personnel responsible for the execution of Company's tasks and requirements in the Watershed Management Plan are competent on the basis of education, training and experience. Company's training activity associated with the Watershed Management Plan shall be appropriately documented by means of a training needs assessment, training matrix/plan and records of training undertaken.

Reporting and Notification

Contractor shall report to Project Developer the results of the surveys undertaken in accordance with monitoring and management and integrate the results, including additional mitigation and management measures as agreed with project developer, with the Watershed Management Plan. Contractor's monthly report Project Developer to shall include:

- Results of the surveys
- Results of all water sampling undertaken in accordance with monitoring and management
- Number and results of verification inspections prescribed in monitoring and management
- Performance Indicators as applicable in the reporting period.

8.4.11. Forest Rehabilitation Plan

Restoration of forest landscapes through tree planting, seed collection and propagation, agroforestry, and many other restoration methods offers a way to recover some of the essential forest functions that have been lost through degradation. It can also offer a route to spiritual recovery and renewal as we work with nature to rebuild our bond with forest ecosystems. Restoration of forest landscapes can help mitigate forest losses, even as we continue the work to achieve zero deforestation. Large-scale forest restoration is needed to attain the Sustainable Development Goals, meet international climate goals, and reverse the loss of biodiversity. (FAO/UNEPa, 2020, p.25). Forest restoration is a broad term that includes a spectrum of different activities, ranging from minimal to more intensive interventions. I would like to recommend these step to implement along with the guidance of forest department

- Allowing natural forest regeneration to take place in harvested or disturbed areas (often called passive restoration);
- Augmenting natural regrowth in harvested or degraded forests with additional tree planting and care;
- Actively re-establishing forests on lands where forests have been cleared (such as croplands and shrublands); and
- Improving existing landscapes with trees, such as in agroforestry systems, where forestry and agricultural activities are combined in a modified forest setting.

Reforested areas span a range of sites and uses from protected forests and wildlife reserves, to production forests where tree harvesting continues, to farmlands incorporating trees. Not surprisingly, the blend of ecological, economic, and social benefits of these different forms of restoration can differ widely.

In this primer, we consider mostly small-scale restoration projects undertaken at the local community level with the goal of restoring a range of forest ecosystem functions.

8.4.11.1. Objective

The objective of forest rehabilitation plan is to restore forest cover that degraded due to railway construction activities.

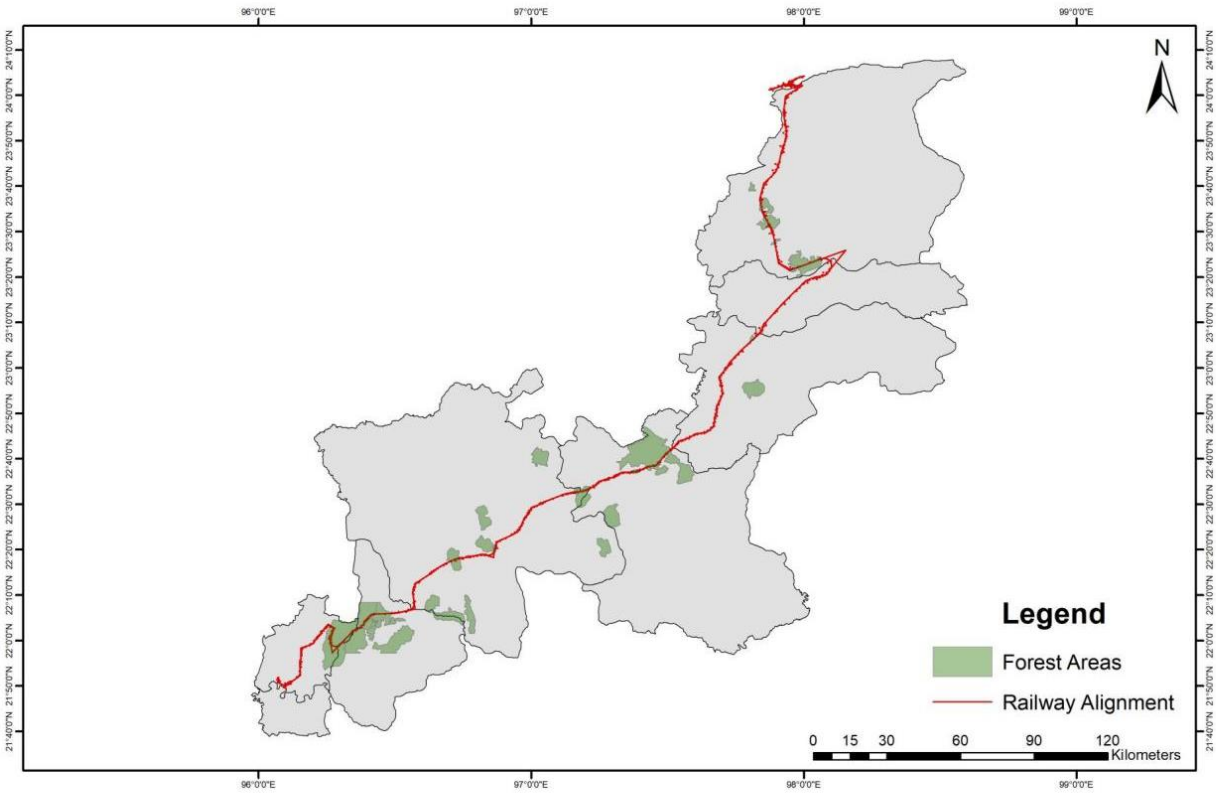
8.4.11.2. Legal Requirements

Forest Law, 2012

- To implement forest policy and environmental conservation policy, to promote public cooperation in implementing these policies, to develop the economy of the State, to prevent destruction of forest and biodiversity, to carry out conservation of natural forests and establishment of forest plantations and to contribute towards the fuel requirement of the country.

8.4.11.3. Overview Map

The locations of the forest area along the railway alignment is shown in the following figures.



Overview

This plan contains identifying degraded forest due to construction of railway, selection of suitable tree species for restoration and their implementation plan.

Identification of degraded forest area

The area of degraded forest is estimated according to the railway alignment. In the Mandalay Region, the estimated degraded forest is about 5.54 acres, in Pyin Oo Lwin 0.1 arces, in Naung Cho 3.37 acres, in Thipaw 14.62 acres, in Lashio 8.35 acres, in Theinni 5.25 acres, in Muse 22.44 acres. The total area of degraded forest is about 60 acres.

Selection of suitable tree species for restoration

The selection of suitable tree species is based on the plant list extracted from survey data. Teak, Pyinkadoe, Padauk, Pine, Yemane, Mezali, Bamboo, Ingyin, etc are commonly found along Mandalay Muse Railway. Therefore, these tree species are selected for the forest rehabilitation.

Tree Species (Common Name)	**Scientific Name**
Teak	Tectona garndis
Pyinkadoe	Xylia xylocarpus
Pakdauk	Pterocarpus macrocarpus
Pine	Pinus kesiya
Yemane	Gmelina arborea
Mezali	Cassia mimosoides
Bamboo (Tin-wa)	Cephalostachyum pergracile
Ingyin	Shorea siamensis

8.4.11.4. Implementation Plan

Forest rehabilitation area is determined with the help of Ministry of Forest. The startup time of forest rehabilitation plan is during the rainy season of startup year.

All land preparation activities will be conducted by field coordinator with the assistance field assistants and hired local workers from the local communities. In order to prepare the land for restoration, an initial soil analysis would need to be conducted to assess the soil quality. Poor quality soil that are compacted and low in organic matter will require more time, money, water and fertilizer to maintain plants. Poor soil conditions also contribute to water quality issues by shedding runoff during rainfall events.

Production of planting lines and holes will be conducted by engaged technical workers from the community, led by the field assistant and it will involve the following activities:

- Information signs will be constructed, and the area will be marked out with bamboo poles along with planting lines for holes to be dug
- Weeding of land and digging of planting holes
- Water barriers will be built along sloping grounds to prevent over-drainage
- The land will be fertilized with a chemical organic treatment

Role and Responsibility

Field Coordinator

Field coordinator has direct responsibility for the field assistants who will report to them. Field coordinator is responsible for undertaking the following aspects of implementation.

- Lead field works (planting)

- Make routine field visits into the restoration sites for ongoing monitoring
- Produce a report for rail general manager

Field assistant

Field assistants will be responsible for managing inputs from the local workers, and will report to the field coordinators. Field assistants may be recruited from the local workforce but are expected to have experience of managing a nursery and managing a restoration planting plan. Specific responsibilities of the field assistants include:

Organizing nursery management by local workers

Organizing tree planting by local workers

Inputs to the field coordinators' reports

Local workers

Local workers will be recruited from local communities. These local residents already have typically high levels of knowledge about the forest, native species, and tree planting. The local workers will be guided and supervised by field assistant. Core responsibilities of the local workers will be:

- Seedlings and tree sapling production
- Watering and weeding saplings
- Preparation of restoration sites including making planting holes
- Tree sapling planting
- Identification and replacement of dead saplings as required

Monitoring and Evaluation

Monitoring of the implementation is planned and organized in two phases:

- Short-term monitoring – year one to five after planting
- Long-term monitoring – year five onwards to year fifteen after planting

Short-term Monitoring

Short-term monitoring will be undertaken over a minimum of five years. The aim of the monitoring is to assess the survival rate of the plants.

Monitoring Focus	**Target**	**Monitoring Location**	**Frequency**	**Responsibility**
Planting survival rate	Plant survival rate >90%	At areas undergoing rehabilitation	For periods after planting:	Field coordinator to be appointed by

			First six months –daily Six to 18 months after planting - monthly Second to fifth year - quarterly	project developer

Long term Monitoring

The long-term monitoring should be undertaken over a minimum period of fifteen years. The objectives of long-term monitoring are similar to short-term monitoring. The monitoring frequency is quarterly.

8.4.12. Management Plan for Minimizing Impact for Forest Cover along Transmission Line

8.4.12.1. Objective

The objective of this plan is to reduce deforestation and forest degradation for construction of railway.

8.4.12.2. Legal Requirements

Forest Law, 2012

- To implement forest policy and environmental conservation policy, to promote public cooperation in implementing these policies, to develop the economy of the State, to prevent destruction of forest and biodiversity, to carry out conservation of natural forests and establishment of forest plantations and to contribute towards the fuel requirement of the country.

Protection of Biodiversity and Protected Area Law, 2018

- To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological and botanical

8.4.12.3. Overview Map

This plan contains the impact on forest due to the construction of railway together with mitigation measures to reduce it and its monitoring plan.

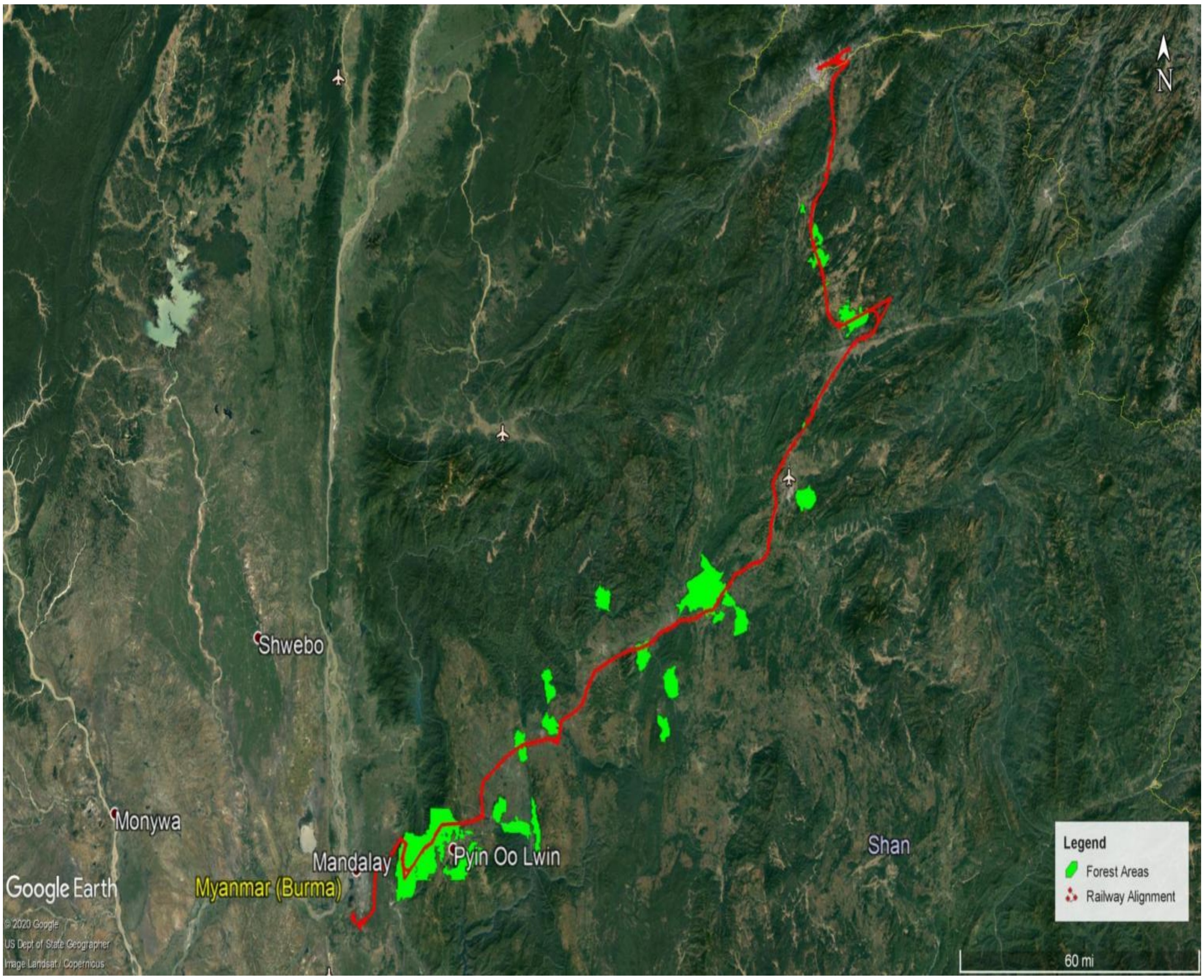


Figure 8.21. Location of Forest Plantation along the Railway Alignment

8.4.12.4. Monitoring Plan

Potential Impact on forest

During the preconstruction phase, site clearing activities are implemented to meet the project requirements. Due to the site clearing activities, the loss of native plants, trees and forest can occur.

Mitigation Measures for Impact on Forest Cover

Mitigation Measures	**Responsibilities**	**Timing**
Review clearing requirements for the construction of railway and identify opportunities to reduce clearing trees and utilize	Design Manager	During detailed design

existing cleared area wherever possible.		
Clearly delineate areas for trees clearing and ensure that all personnel involved are aware of the clearing limits.	Construction Manager/ Environmental Manager	Prior to site clearing and subgrade work
Forest rehabilitation is undertaken in accordance with the forest rehabilitation plan	Construction Manager/ Environmental Manager	Ongoing

Monitoring Plan

Monitoring Action	Responsibilities	Monitoring Frequency
Conduct audit for clearing of trees not to exceed the clearing requirement.	Environmental Manager	Ongoing

Reporting

In the event of cutting tree exceeding the clearing requirement for the stealing of wood, the environmental manager will immediately take appropriate action and promptly report details to the authorized representatives.

Corrective action

Rehabilitation of degraded forest due to the construction of railway is implemented according to the forest rehabilitation plan.

8.4.13. Wildlife Corridors Protection and Enhancement Plan

8.4.13.1. Objectives

The goal of this action plan is to improve wildlife movement throughout the proposed project. Eliminating gaps by restoring natural cover in the corridors, and removing barriers by improving the effectiveness of wildlife passages beneath roads will result in higher quality wildlife habitat in all of the habitats and will lessen the overall impacts of project development. Protecting, restoring and enhancing wildlife corridors does not only serve to improve wildlife habitat and biodiversity though, it also supports many of other ecosystem health targets, such as increasing natural cover, reducing impervious surfaces, enhancing water quality, and others.

8.4.13.2. Legal Requirements

Protection of Biodiversity and Protected Area Law, 2018

- To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological and botanical.

8.4.13.3. Overview Map

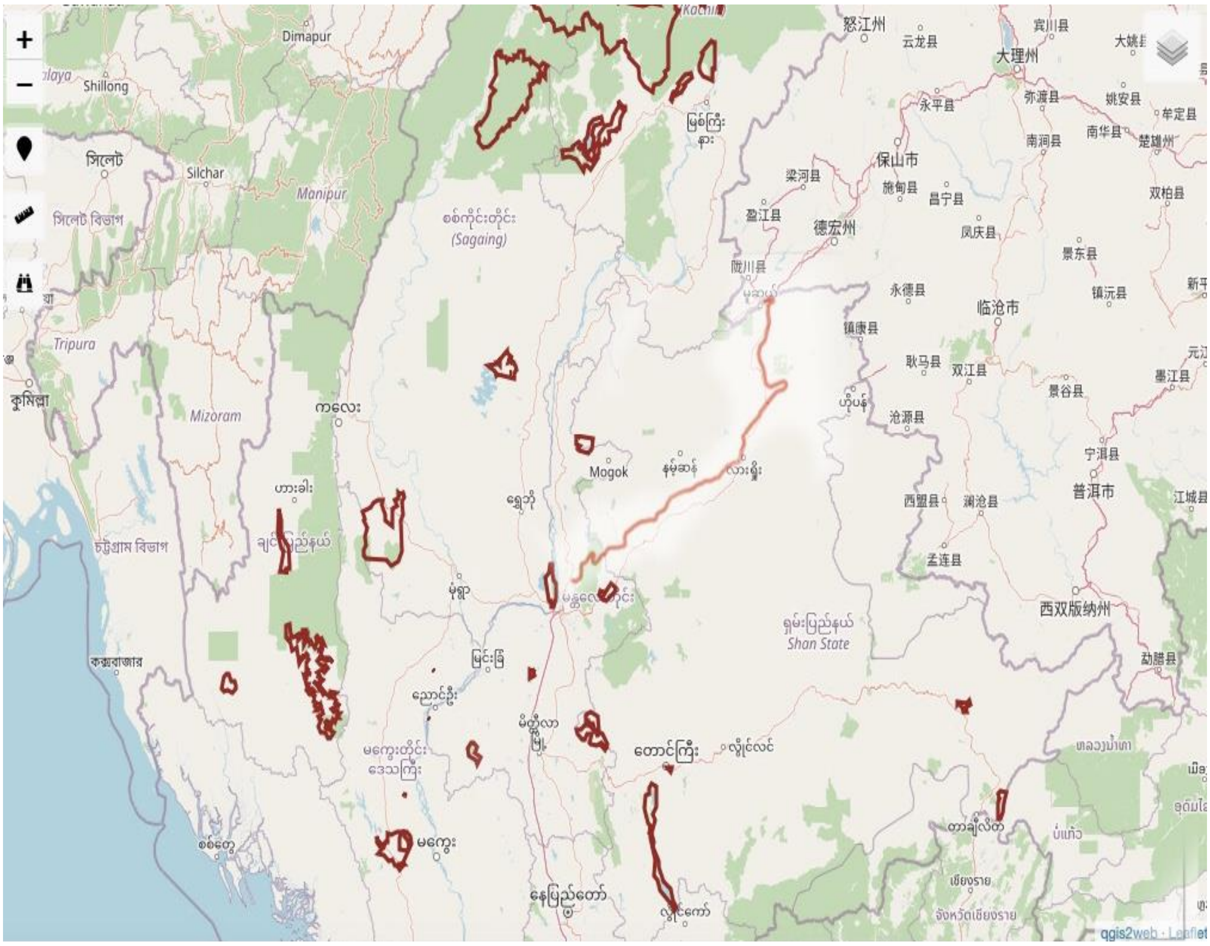
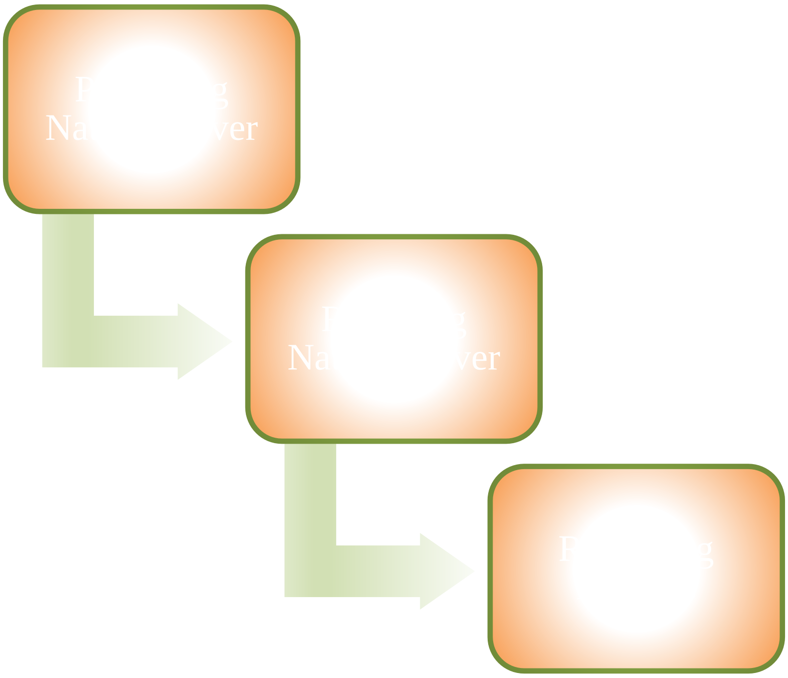


Figure – Wildlife Sanctuary and Transmission Corridors

8.4.13.4. Implementation Plan

As such, implementing the recommendations of this Action Plan should not be viewed as being solely beneficial to wildlife. Recommendations for Wildlife Corridor Protection & Enhancement Plan are listed below,



Benefits of Animal Crossings

The wildlife animal crossing offers loads of advantages, primarily to help avoid collisions of animals and vehicles. These bridges not only help in reducing collisions but additionally, it aids wildlife species to find resources like food, shelter, mates that are specifically found on the other side. In absence of these wildlife crossings, animals will be left without sufficient food, reduced reproductivity, or possible extinction. This could be more cost but that is the way to conserve biological resource and a good management plan.

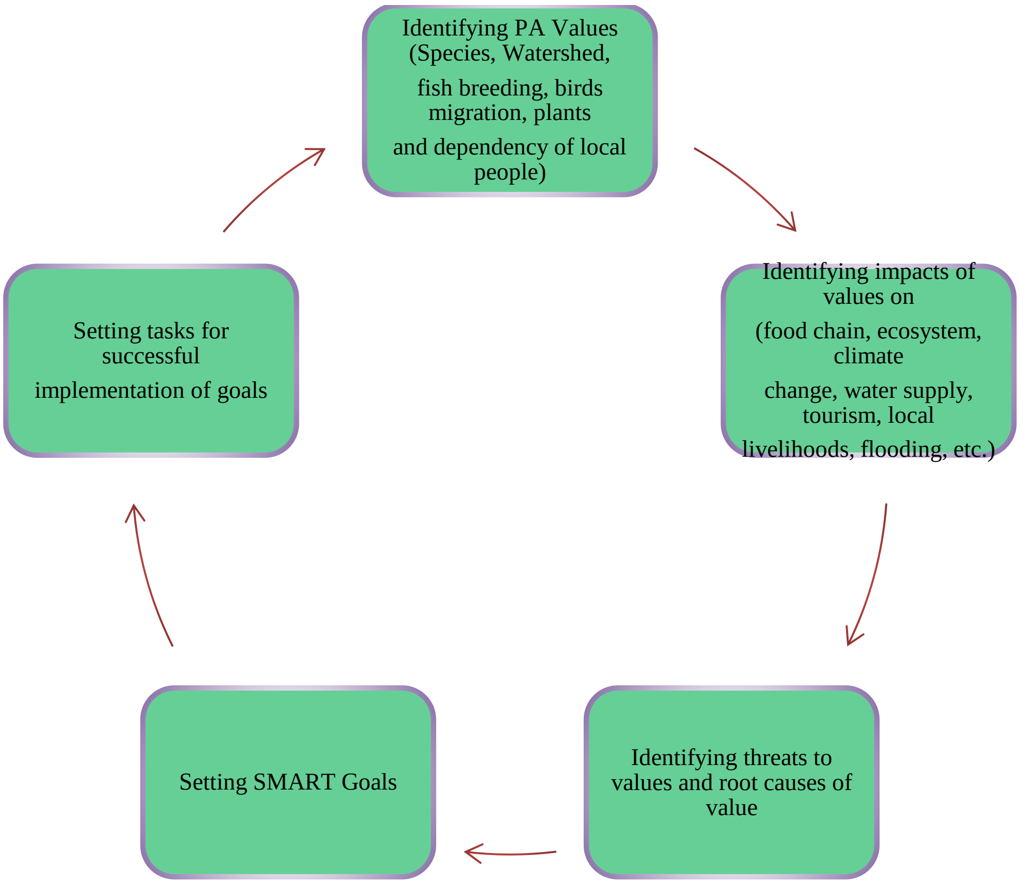
Attractive animal bridges that cross Railways

Photo Source: Animal Fact 2009

The Re-establishing Natural Habitats Programmes (RNH)

The project is institutionalized, legalized and supported community and stakeholder participation. According to the notification 690/2020 (see the appendix) the project will protect them. In recent years, ecosystem Re-establishing has become priority to ensure the sustained flow of the ecosystem services. According to the forest department Myanmar has national target to cover 10% of the country's area by the PAs. For the time being, there are 44 Pas, representing 5.85%of the country's area. The Re-establishing Natural Habitats Programmes (RNH) recommendations are listed below. The lists of the migratory birds' species are shown in the Appendix.

Re-establishing Natural Habitats Programme for the Railway Project



Habitat and Wildlife Population Management

Lower numbers of wildlife species near railways can be achieved by controlling populations (e.g., selective hunting, trapping), or by habitat modification. Changes in habitat structure along railway verges may also increase animals' capability to detect and evade the train.

Population control of a particular species may sometimes be used to reduce its numbers near railways. This method should only be applied on very common species, or those that can compromise human safety due to collisions. This method has been used to prevent collision with vehicles on roads (Glista et al. 2009), but its use in railways may not be as necessary since most animals will not affect trains' movements.

8.4.14. Biodiversity Action Plan

The Critical role that biological resources play in sustaining human life has in the last two decades received considerable if belated attention. In 1992 a board framework for the conservation and use of the world's biological resources – The Convention on Biological Diversity (CBD) – was agreed by the United Nations Conference on Environment and Development (the Earth Summit). Despite increasing recognition, however, the worlds' biological resource continues to be lost at an alarming rate, and particularly so in developing countries where many of the remaining resources are concentrated. (World Bank 2002)

8.4.14.1. Objectives

The overarching objective of "Biological Resource Management Plan" is to provides strategies and management actions necessary to sustain the country's biological resources.

Recommended biological resource management objectives for proposed railway project are to:

- Protect species and habitats of along the railway project
- Maintain and preserve native biological diversity
- Reduce the spread of invasive species and provide integrated controls of noxious weeds
- Where and when feasible, improve degraded habitats in a strategic manner to increase landscape connectivity and native diversity
- Reduce and minimize fragmentation of habitats
- Maintain landscape that provide regional connectivity to habitats surrounding railway project.
- To meet these objectives, BRMP provides a set of generally directives for proposed railway project operation.
- Develop a flora replantation plan particularly for native species
- Educated employees of environmental responsibilities during inductions including treating all native fauna species as protected.

8.4.14.2. Legal Requirements

Forest Law, 2012

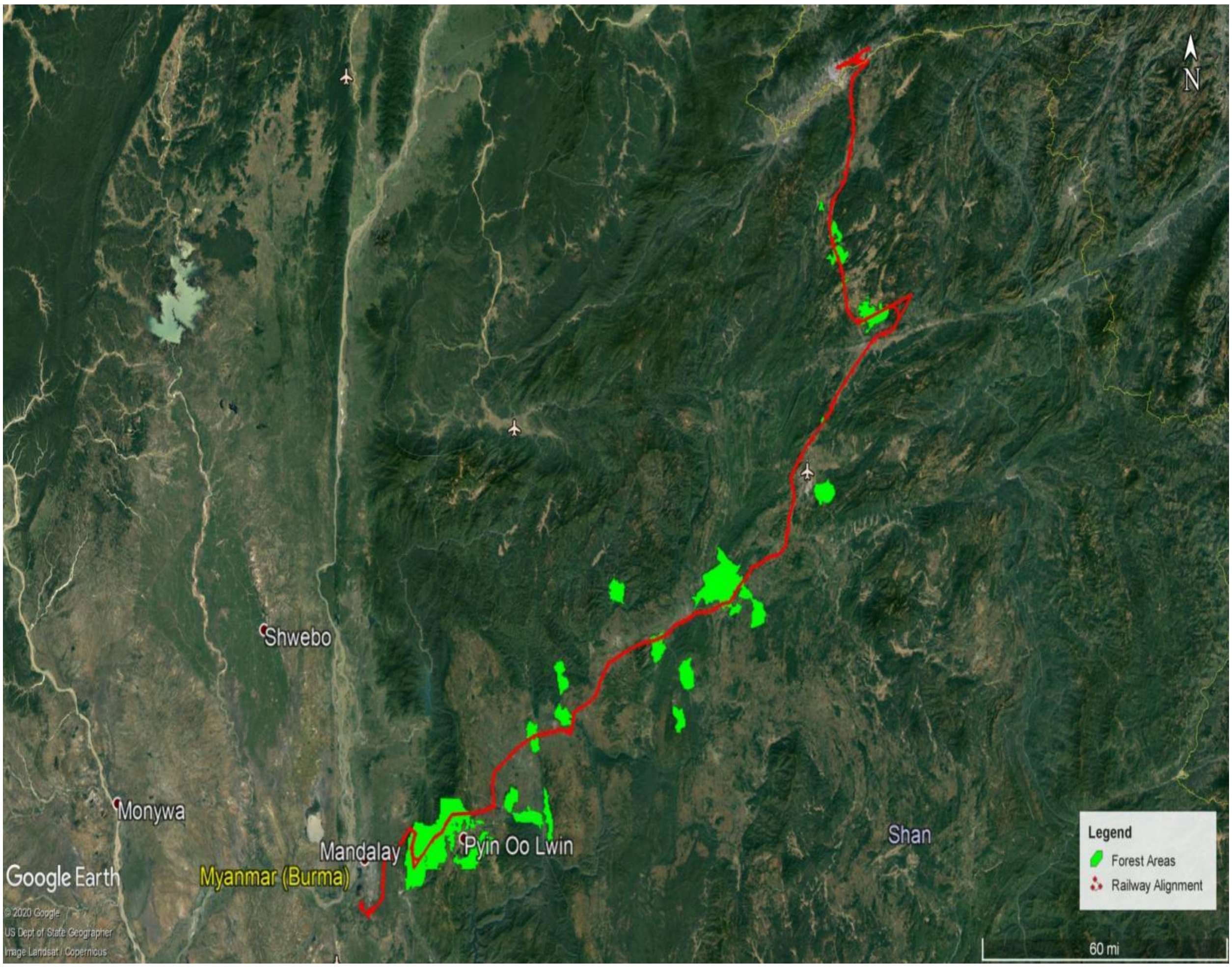
- To implement forest policy and environmental conservation policy, to promote public coorperation in implementing these policies, to develop the economy of the State, to prevent destruction of forest and biodiversity, to carry out conservation of natural forests and establishment of forest plantations and to contribute towards the fuel requirement of the country

Protection of Biodiversity and Protected Area Law, 2018

- To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological gardens and botanical gardens.

8.4.14.3. Overview Map

The location map for the forest plantation along the railway transmission lines is shown in the following figure.



8.4.14.4. Monitoring Plan

Construction and Operation

- Incidents of fauna strike and mortality will be monitored during construction and operation.
- The condition of all fencing will be inspected regularly to determine maintenance requirements.
- A monitoring program will be developed and implemented to examine the success of crossings for fauna species.

Construction

Work areas will be inspected daily prior to commencement and fauna present will be relocated or moved.

Operation

A monitoring program will be developed and implemented for the rehabilitated aquatic habitats and riparian areas to check the success of the rehabilitation.

Reporting

Construction and Operation

- Incidents involving animal strike or injury will be managed and reported as an incident in accordance with the incident management procedure mentioned below.
- In the event of an incident, the Construction Contractor and Project Developer will immediately take appropriate action to minimise any adverse environmental impact and promptly report details of the incident to relevant agencies. The Construction Contractor and Project Developer must carry out any lawful instruction received from the authorised representatives of relevant agencies.
- The investigation of incidents will include a process for identifying all the contributing factors of the incident. The investigations will be carried out by competent persons with the appropriate involvement of relevant personnel and their representatives. The level of detail of these investigations will be appropriate to the actual or potential seriousness of the event.
- Prioritised corrective or preventative actions, aimed at preventing recurrence of similar events, will be implemented. Procedures will be established and maintained to ensure the

follow-up and completion of corrective actions. Corrective actions following incidents will be communicated to all staff as applicable.

- An Incident Register will be developed and maintained, recording all environmental near-misses and incidents.
- Additional procedures will be developed for specific environmental incidents, such as spills of hazardous substances and injury or death of native wildlife.
- The incident management procedure will be communicated to all staff and contractors during
- environmental inductions and displayed at all site offices/crib rooms. Contact names and numbers will be updated as required.

Construction

Monthly reporting by the Construction Contractor to Project Developer on non-conformances, incidents (including deaths and injury of wildlife) and site inspections

Operation

Monthly reporting by the Operation Manager to Project Developer on non-conformances, incidents (including deaths and injury of wildlife) and site inspections

Corrective Actions

Operation and Construction

- Additional watering, fertilising or replanting of rehabilitated areas will be considered in areas where rehabilitation planting has not been successful.
- Fauna crossings will be modified or enhanced as necessary to improve effectiveness.

8.4.15. Avian and Bat Protection Plan

8.4.15.1. Objectives

The objectives of the avian and bat protection plan are to:

- Reduce the potential for avian and bat mortality by implementing specific mortality reduction actions;
- Identify and isolate where avian and bat mortality has occurred or has the potential to occur to minimize future incidents;

- Establish an avian and bat reporting system to document incidents of mortality caused by electrocution, collision and other plant-related features;
- Assist MR in compliance with state and federal laws regarding avian and bat species to avoid the threat of penalties and fines; and
- Improve MR's reliability and services by reducing power outages due to avian and bat interactions and by reducing repair costs due to electrocution of the animals.

8.4.15.2. Legal Requirements

Protection of Biodiversity and Protected Area Law, 2018

- To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological gardens and botanical gardens

8.4.15.3. Overview Map

The overview map and layout map for the avian and bat protection plan is shown in the following figure.

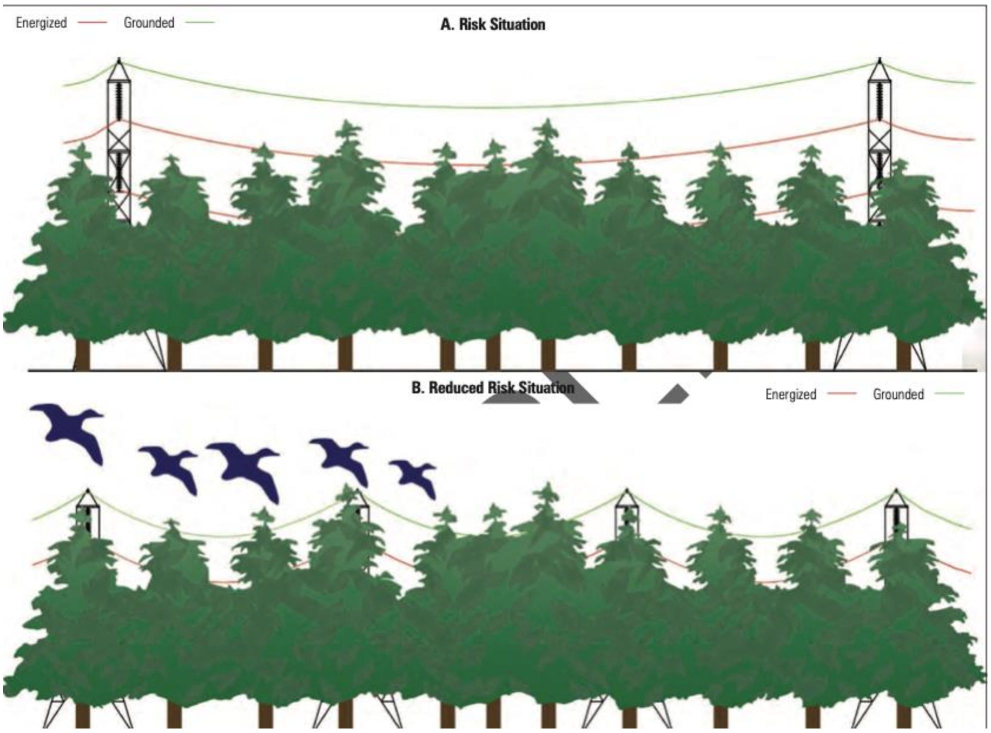


Figure 8.22. Reducing collisions in wooded areas.

A tree line or other obvious obstacle at the appropriate height warns birds to gain altitude, which results in birds flying over the power line screened by the trees (after Thompson 1978). Source: waterboards 2012

8.4.15.4. Implementation of the Avian and Bat Protection Plan

MR would do the following to implement the avian and bat protection plan and thus accomplish the identified goals. Specifically, MR would:

- Verify avian and bat mortalities, update mapped data and develop additional data on concentrations of avian and bat species which may be impacted by the project facility;
- Identify the environmental and behavioral factors that lead to areas of high avian and bats use and potentially higher numbers of electrocutions, collisions, and outages;
- Assist in refining criteria and protocols to further avian and bat conservation; and
- Ensure the accuracy and detail of incident reporting.

Monitoring Plan

Integrating an avian protection plan into an electric utility's operations will help the utility meet demands for reliable, cost-efficient, and environmentally compatible power delivery. Thus, avian protection plan implementation and operation is a long-term commitment and a process of continual evaluation and improvement. Depending on the condition, the rate of adoption may vary. An avian protection plan may be the first species-oriented environmental compliance initiative to which utility employees are exposed. High-profile endorsements by corporate officers and managers can facilitate a program's implementation. Creating and implementing an avian protection plan will be more successful if all the affected departments within the utility also support it. An effective way to build a broad consensus during avian protection plan preparation is to form a team within the utility that includes representatives from standards, engineering, environmental services, vegetation management, construction, operations and maintenance, public relations, customer service, and other departments that will be impacted by the avian protection plan.

Engineers and biologists can reduce collisions for the modifying existing power lines by this recommend list.

Evaluation studies include:

Collision monitoring to examine the causes and conditions associated with the risk and to help determine the type and effectiveness of modifications.

Avian risk assessment and spatial analysis to prioritize line segments for modification

Risk reduction options include:

- Line marking to increase the visibility of the line.
- Managing surrounding land to influence bird use.
- Removing the shield wire if lightning is not an issue or if lightning arresters can be used instead.
- Increasing the diameter or changing the configuration of wires when a line is being rebuilt.
- Rerouting the line if all other attempts have been exhausted and populations are significantly impacted.
- Burying the lines if feasible and warranted.

Planting Trees

Where climate and location will allow, planting native trees that will grow to or above the height of nearby power lines, without interfering with line operations, may prevent collisions by forcing birds to gain enough altitude to clear the more visible tree line (Thompson 1978; Raevel and Tombal 1991). For mitigation purposes, tree planting is a long-term strategy because of the time it takes for trees to grow to the desired height; thus, short-term mitigation would likely be necessary in the interim. Because trees can potentially cause operational and reliability problems with lines, a design engineer and a forester should be consulted concerning minimum clearances and line maintenance requirements so appropriate tree species and planting locations can be determined.

Personnel Training

In order to effectively implement the avian and bat protection plan, the project developer would ensure that all appropriate personnel (facilities maintenance department, etc.) undergo training on the issues and protocols outlined in the avian and bat protection plan. This training would ensure that all appropriate personnel have a thorough understanding of the avian and bat protection plan and their responsibility to avian and bat protection and regulatory compliance.

Reporting

MR's Environmental Representative would complete and submit an avian incident form during, or immediately following the site investigation for further risk assessment. Although this form would be for internal submittal, ii would be used for mortality monitoring studied at the site and would be available to regulatory agencies should data be requested. The intent of the data is to gain information that can be used to prevent future avian mortality.

8.4.16. Public Health and Safety Management Plan

8.4.16.1. Objective

The objectives of this Plan are to:

- Describe actions required to implement the construction-related management and mitigation measures
- Facilitate monitoring activities, medical clinic and community-based sources
- Outline the roles and responsibilities of the organization in charge of implementing the plan, including monitoring and evaluation
- Describe the process for recording and reporting non-conformances, as well as measurement and reporting of performance indicators.

8.4.16.2. Legal Requirements

Public Health Law, 1972

- To promote and safeguard public health and to take necessary measures in respect of environmental health

The Law Relating to Private Health Care Services, 2007

- Develop private health care services in accordance with the national health policy
- To participate and carry out systematically by private health care services in the national health care system as an integral part;
- To enable utilizing effectively the resources of private sector in providing health care to the public
- To enable the public to choose as desired in fulfilling their needs for health by

establishing private health care services

- To enable provision of quality service at fair cost and to take responsibility

8.4.16.3. Layout Map

This Plan applies to project activities and the associated risks and potential impacts that these activities may have on community health and safety.

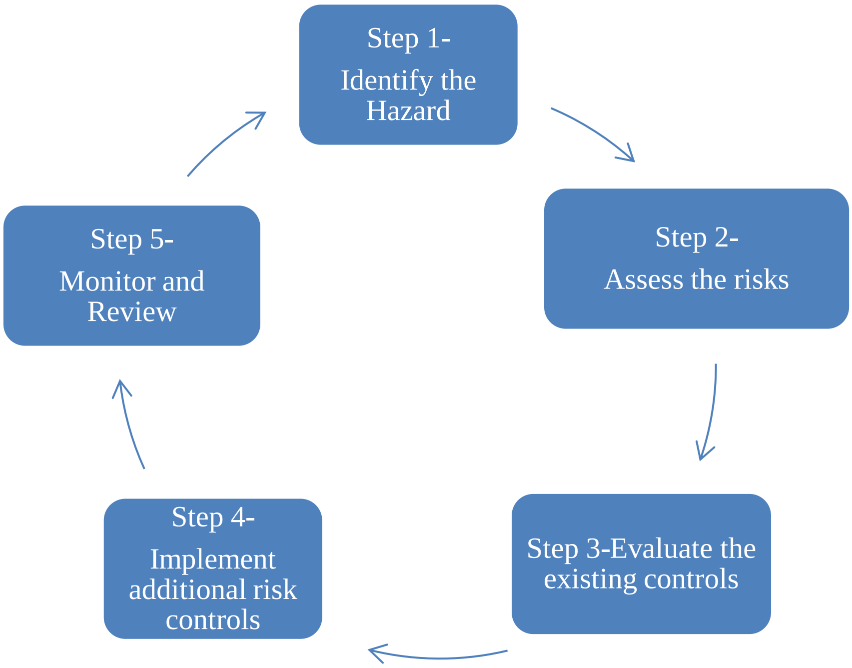


Figure 8.23. 5 Steps process for Health and Safety Management Plan

8.4.16.4. Implementation and Monitoring Plan

This plan includes identification of risk and potential impacts related to community health and safety and its related mitigation measures. These are based on the public consultation and desk-top literature reviews from standard sources and peer-reviewed articles and reports. The strategy adopted by this Plan is based on a combination of key elements: primary prevention, health/ education promotion.

Identification of Public Health and Safety Value

The community values for public health and safety that may be affected by the Project (Rail) are listed in Table and subsequently assessed.

Aspects	Community Health and Safety Values
Air environment	Air quality that is conducive to human health and well-being. Air quality that supports agricultural activities.

	Absence of dust and odour.
Noise environment	The qualities of the acoustic environment are those conducive to human health and wellbeing. This includes provision of a suitable acoustic environment for individuals to sleep, study, learn or be involved in recreation, including relaxation and conversation. The qualities of the acoustic environment are those conducive to protecting the amenity of the community.
Water	Biological integrity of an aquatic ecosystem in moderately disturbed waters. Stock watering and Irrigation. Cultural and spiritual values of the water.
Public Safety	Safe from sagging power lines and electrocution
Disease Vectors	Construction activities not leading to increases in local populations or spread of biting insects or pests that are known disease vectors.

Potential Impact and Mitigation

Public Health and Safety related risks	**Potential Risk**	**Mitigation**	**Responsibility**
Air Quality			
Fugitive Dust Emissions during Construction Activities	Potential bronchial and other respiratory tract diseases	Wetting of roads by water spraying; Restricting vehicle speeds; Cement Silo with the dust collector equipment will be installed.	Contractor
Gaseous Emission from construction activities	Potential bronchial and other respiratory tract diseases	Regularly service vehicles, plant and equipment such that exhaust systems and fuel consumption comply with manufacturers' specifications.	Contractor
Noise environment			
Noise from construction activities	Disturbance (noise) to sleep, social activities, work activities	Construction activities generating noise above ambient levels within the vicinity of the nearest noise	Contractor

		sensitive places wherever possible and practicable, be confined to general work hours of 6:30 am – 6:30 pm. Regularly service vehicles, plant and equipment such that noise emissions comply with manufacturers' specifications.	
Noise from rail operation	Disturbance to sleep, social activities and/or work activities	Noise barrier will be constructed at sensitive point. Train operators are to be trained in the appropriate use of horns and warning devices. Regularly service vehicles to facilitate operation within acceptable sound and vibration.	Project Developer
Water			
Storage, handling and use of environmentally hazardous substances	Spills and leaks and subsequent degradation of water quality.	Spills and leaks are to be cleaned up as soon as practicable. All the wastewater from concrete batching plant will be treated.	Contractor
Public Safety			
Low sagging power lines	Public electrocutions, risk of fire.	The proposed line should be constructed according best practice in the energy sector to guarantee structural strength, adequate ground clearance, and safety of other existing power infrastructure. Education/ public outreach to prevent public contact with potentially dangerous equipment.	Project Developer
Electrocution from Live Power Lines	Public electrocutions, risk of fire.	Installation of anti-climbing devices. Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding transmission	Contractor

		towers, particularly in urban areas). Signboards (Danger Warning Signs) need to put on every tower as well as on the conductors where crossing community centers, roads and rivers. Education/ public outreach to prevent public contact with potentially dangerous equipment. Education/ public outreach to prevent public contact with potentially dangerous equipment;	
Disease Vectors			
Increase Infection of Air-borne Diseases	Potential for infection of diseases	Information and education about air transmitted disease will be provided.	Project Developer
Increase Infection of Water Borne Diseases	Potential for infection of diseases	Proper sanitation system will be provided for construction workers and rail staffs. Information and education about disease will be provided.	Project Developer
Potential to Increase Infections from Mosquito	Potential for infection of diseases	Proper temporary or permanent drainage system will be provided to avoid ponding water. Mosquito-proof screens will be installed for water tanks. Information and education about disease will be provided.	Project Developer
Increase Risk of Sexually Transmitted Infections	Potential for infection of diseases	Information and education about safe sex and implement HIV control program will be provided.	Project Developer
COVID-19	Potential for infection of diseases	Restrict or control employee travel Planning site activities to facilitate social distancing Virtual meetings or where meetings are essential, restricting numbers so	Contractor

		social distancing can be actively practiced. Reduce camp densities and redistribute workers within worker camps to facilitate social distancing (e.g. reducing the number of people occupying a dormitory)	

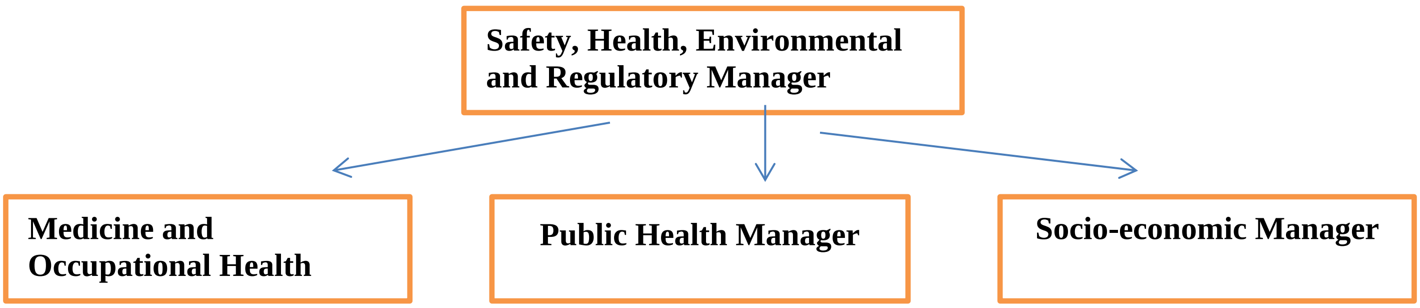
Monitoring

Performance indicators which will be monitored to determine the effectiveness of the public health and safety impact and mitigation measures include;

- Rates of communicable disease in project workforce,
- Rates of communicable disease in the community,
- Project related safety in the community and
- Numbers of grievances or claims of project related impacts on the community

Organization, Roles, and Responsibilities

The requirements of this Plan will be stewarded and implemented by the Project. The Safety, Health, Environmental and Regulatory Manager will own this Plan.



Public Health and Safety Organization

The following roles and responsibilities are examples of the type of roles that will apply during the construction phase. As the needs of the Project change over time, some roles may be replaced and or combined with others that are more appropriate to the Project's needs at the time.

Safety, Health, Environmental and Regulatory Manager

- Responsible for overall implementation
- Responsible for ensuring safe behaviors by Project personnel such that community safety is protected
- Investigates and analyses community safety events when/if they occur and escalates findings and required remedial actions to Management as required
- Responsible for notification of community safety incidents

Medicine and Occupational Health Manager

- Responsible for health support coordination, delivery and implementation of health services to the production workforce
- Ensure health specifications and programs/procedures
- Develops and coordinates the implementation of health inspection and audit programs to monitor compliance with health requirements
- Provides review of disease prevalence data and recommends changes to address disease prevalence and severity.

Public Health Manager

- Identifies and evaluates community health risks
- Identifies mitigation steps to address community health issues affected by production activities
- Conducts inspections and audits for effective implementation of community health programs
- Budgetary stewardship
- Collects, analyses data, reports on and provides recommendations on initiatives for continuous improvement in the community health program performance and compliance.

Socio-economic Manager

- Overall responsibility for the interface between the Project and community members
- Manages the team who facilitate access to community members for community health and safety issues/topics
- Supports MOHS Manager in the identification and implementation of community health projects which can deliver community development benefits.

Where the Contractor is undertaking scopes of work related to this Plan, the Contractor will ensure sufficient resources are allocated on an ongoing basis for effective implementation.

Training

Training will include:

Sanitation and nutrition awareness and education for all employees, with a focus on messages which can be taken home to families to encourage good sanitation and nutrition practices in village environments

Training/knowledge about electrical hazard and warning signs and for public and basic first aid

Transmitted diseases and HIV/AIDS prevention and awareness training for all employees, with extension to communities through education and awareness campaigns as appropriate

Respiratory illness and infectious disease management including TB

Vector-borne disease awareness including malaria and dengue

Reporting and Notification

Contractor is required to provide a monthly report that provides a descriptive summary of all Community Health and Safety activities that it has undertaken in that month, including the number of participants in each activity, the objective(s) of each activity and applicable photographs.

Contractor's information will be submitted to Project Health and Safety Department.

The Project will review Contractor's community health and safety reports to ensure actions and feedback are tracked and recorded appropriately.

Any community health and safety grievances submitted by community members will be directed to the Project Health and Safety Department within 24 hours and captured in the Project community grievance management mechanism.

8.4.17. Cultural Heritage Management Plan

8.4.17.1. Objective

A cultural heritage management plan aims to:

- Safeguard the cultural heritage values of a place;
- Develop and ensure attractive, competitive and multifunctional historic urban areas;

- Manage and balance conflicting uses/ functions and the different demands of “users” of an historic urgan area: local ecomony, citizens, tourists, property owners, conservators, etc.

8.4.17.2. Legal Requirements

(1) The Protection of Rights of National Race Law (Law No. 5)

Consists of four bills, as submitted to the legislature; Buddhist Women’s Special Marriage Bill, Religious Conversion Bill, Monogamy Bill and Population Control Bill.

(2) Protection and Preservation of Antique Objects Law (Law No. 12, 15, 20)

- To implement the policy of protection and preservation for the perpetuation of antique objects;
- To protect and preserve antique objects so as not to deteriorate due to natural disaster or man-made destruction;
- To uplift hereditary pride and to cause dynamism of patriotic spirit by protection and preservation of antique objectives;
- To have public awareness of the high value of antique objectives;
- To carry out in respect of protection and preservation of antique monuments in conformity with the International Convention and Regional Agreement ratified by the State.

(3) Law on the Perservation and Protection of Ancient Buildings

- To implement the policy of protection and preservation for the perpetuation of ancient monuments
- To protect and preserve ancient monuments so as not to deteriorate due to natural disaster or man-made destruction
- To uplift hereditary pride and to cause dynamism of patriotic spirit by protecting and preserving ancient monuments
- To have public awareness of the high value of ancient monuments
- To protect and preserve ancient monuments from destruction
- To search and maintain ancient monuments
- To carry out in respect of protection and preservation of ancient monuments in conformity with the International Convention and Regional Agreement ratified by the State.

(4) Law Concerning Religious Conversion (Law No. 48)

To move freely from own religion to another religion, from one religion to atheism, from atheism to one religion.

8.4.17.3. Management Actions and Monitoring Plans

During Construction Phase of proposed project***, a***ny heritage resources, located in close proximity to the project may be impacted through:

- Direct impact to historical (e.g. demolition) and sites of terrestrial archaeological potential (e.g. excavation); and
- Indirect vibration impact on historical buildings due to drilling and piling activities during construction phase that may lead to the structural damage or interference of normal activities;

General cultural heritage management measures should include:

- provision by the nominated undertaker to its contractors of locations and descriptions of all known cultural heritage assets within and adjacent to construction works, including restrictions to construction methods to protect cultural heritage assets;
- an historic environment investigation programme detailing the implementation of archaeological and heritage investigation and recording works prior to and during construction;
- the nominated undertaker will require its lead contractors to monitor compliance against the programme of historic environment investigation and recording works using appropriately qualified environmental management staff;
- during all stages, the nominated undertaker will require its lead contractors to facilitate archaeological and built heritage specialists undertaking the works as specified as an appropriate mitigation measure (including purposive investigation); and
- All archaeological, built heritage and historic landscape intervention, recording, analysis, dissemination and archiving will be undertaken by a suitably qualified and demonstrably experienced organization.
- The lead contractor will carry out works in such a way as to ensure that disturbance to all heritage assets is managed in accordance with accepted historic environment practice and, where disturbance cannot reasonably be avoided, is controlled and limited as far as reasonably practicable.
- implementation of controls on the movement of construction vehicles and machinery in areas of heritage interest (e.g. archaeological remains and historic buildings);
- The development and implementation of a procedure for soil stripping and excavation before commencement of such works. This procedure will identify the interface of those works with areas of identified archaeological investigations;

- procedures adopted to preserve archaeological remains in situ beneath earthworks; and
- Procedures for the recording, dismantling, storage and re-erection of buildings of heritage significance.

Metal Detectors

During site preparation and construction, the use of metal detectors will be prohibited within areas of identified/defined archaeological interest unless deployed by archaeological specialists or other appointed persons in the execution of their activities.

Human remains

Should human remains be discovered during construction, either during archaeological works or as part of construction activity, the nominated undertaker and its lead contractors will comply with all relevant legislative and project-specific requirements.

Treasure Act

During the course of construction, if artifacts are located that are deemed by their material content or context to be treasure, then all necessary measures to comply with the requirements of the Act and any project-specific requirements will be implemented.

Measures in relation to unexpected discoveries of heritage assets

Should, during the course of construction works, artifacts and / or remains of archaeological interest or expected interest be located unexpectedly, these will immediately be reported to the lead contractor's project manager. The project manager will obtain specialist archaeological advice to undertake and prepare an appropriate response.

If that advice indicates that there is potential for the finds to be of national importance, then the Procedure for the unexpected discovery of archaeological remains of national importance procedure will be followed .

Measures in relation to unexpected discovery of archaeological remains of national importance

When heritage assets of potential national importance are unexpectedly revealed during construction, the unexpected discovery of archaeological remains of national importance will be implemented. Mitigation or investigation and recording may include the following, as appropriate:

- investigation and assessment of discoveries to determine their significance if this cannot be determined from the asset as found;

- assessment of potential project impacts to inform the design of appropriate mitigation or investigation and recording measures;
- preparation of a written scheme of investigation for any stage of archaeological work required;
- excavation, recording and reporting on any discoveries; and
- Recording and implementing measures to preserve any discoveries in situ, if required or if appropriate.

Monitoring

The nominated undertaker will require its lead contractors to implement appropriate monitoring of the consequences of construction work, as required, on all cultural heritage assets (designated and non-designated) to ensure the effectiveness of management measures and compliance with agreed approaches to construction activities and cultural heritage assets.

Risk assessments identifying appropriate surveys, for example, structural or condition surveys and vibration monitoring will be undertaken at locations of archaeological or built heritage interest adjacent to the construction site prior to, during and following construction works.

Noise and Vibration Management

Best practicable means will be applied during construction works to minimize noise (including vibration) at nearby cultural heritage properties and other sensitive receptors arising from construction activities

Measures to reduce potential noise and vibration impacts

To reduce potential noise and vibration impacts, the following measures should be taken:

- Noise and vibration control at source – for example, the selection of quiet and low vibration equipment, review of construction programme and methodology to consider quieter methods, location of equipment on site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings;
- Screening – for example, local screening of equipment, perimeter hoarding or the use of temporary stockpiles

8.4.18. Community Development Plan

8.4.18.1. Objective

A community development and rehabilitation plan aim to:

- supporting people with disabilities to maximize their physical and mental abilities, to access regular services and opportunities, and to become active contributors to the community and society at large;
- activating communities to promote and protect the human rights of people with disabilities for example by removing barriers to participation;
- Facilitating capacity building, empowerment and community mobilization of people with disabilities and their families.

8.4.18.2. Legal Requirements

(1) Village Regional Development Law (Law No. 39)

- To ensure that people in rural areas have access to personal hygiene and home pollution prevention activities by working together with the relevant government departments, government agencies, and non-governmental organizations
- To ensure the continuity of the development of rural areas and the social development of the rural population.
- To maximize the efficiency of human resources and finances that can be achieved in rural development activities, including the participation of the people

(2) Law Regarding Population Control & Health (Law No. 28)

- To improve living standards while alleviating poverty in the country;
- To ensure sufficient quality healthcare; and
- To develop maternal and child health

8.4.18.3. Overview Map

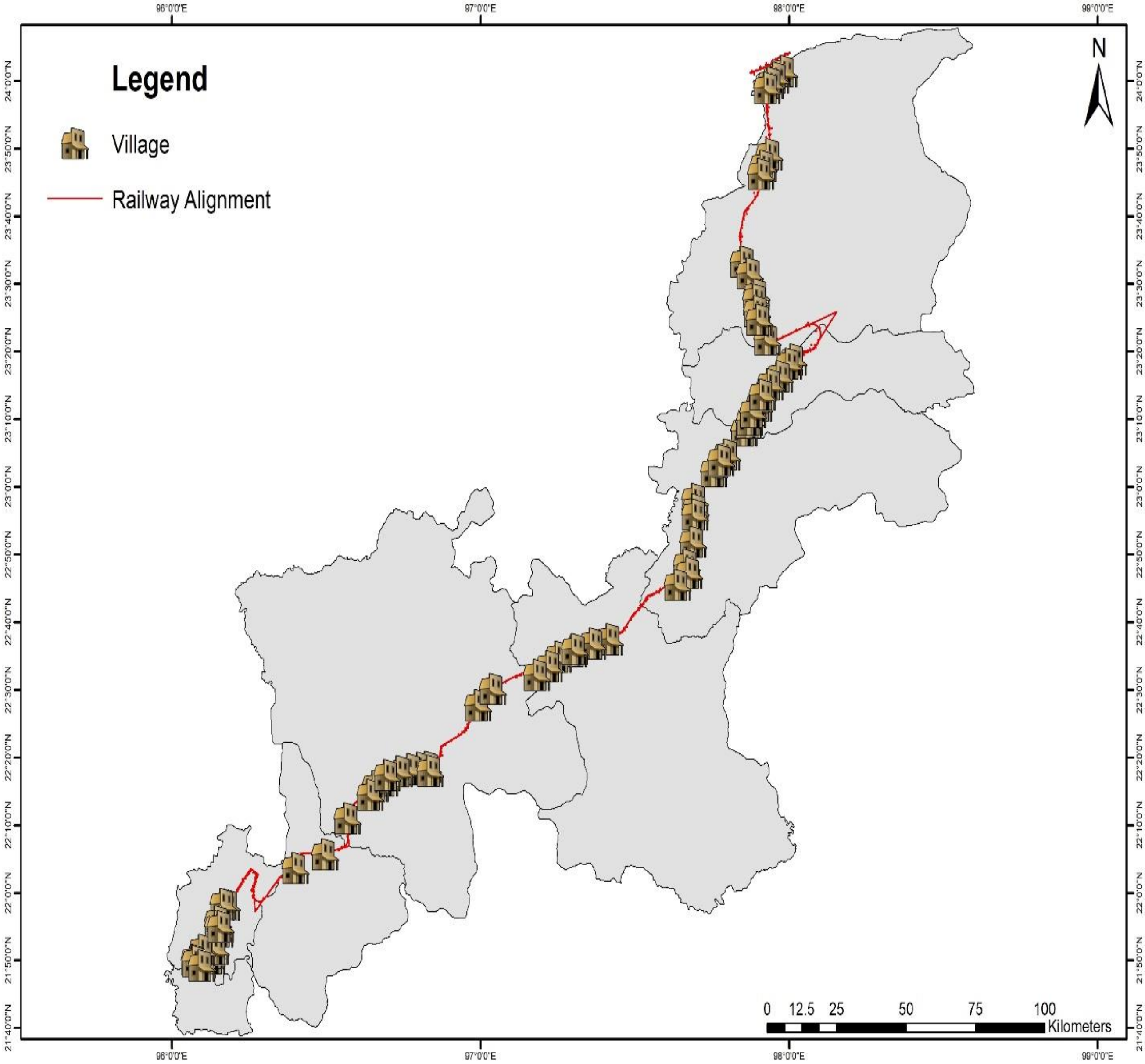


Figure 8.24 – Residential Areas along the Railway

8.4.18.4 Management Actions and Monitoring Plans

Building Trust – Mobilizing Community

Community mobilization is done by bringing together as many stakeholders as possible to raise people's awareness of and demand for a particular programme, to assist in the delivery of resources and services, and to strengthen community participation for sustainability and self-reliance. A lot can be achieved when people from different parts of the community share a common goal and actively participate in both identifying needs and being part of the solution. Community mobilization helps to empower communities and enable them to initiate and control their own development.

Community Implementation Agreement (Ownership and Sustainability)

Ownership and sustainability is dependent on community involvement through all phases of the project from project start up, through project implementation and until project handover. The ambitions for community involvement depend on the role of community expected to play in the project if they are expected to take an active part in project implementation and take over the project activities once the project is finalized. Therefore the level of ambitions is ranging from community awareness raising and community consultations to community commitment, community investment through money, materials or human resources and community ownership of the project in the long run.

Providing Job Opportunity (Road Construction, Handicraft training, etc,.)

The community roads give a direct impact on improvement of livelihood and living environment; for instance, transportation of products and purchase of commodities. The implemented projects are High Labor Intensive Work and Hybrid Method with both mechanical and manual. The road constructions improve the awareness of unemployment of the local people during the project life cycle.

Townships along the railway	Kyaukme	Lashio	Hsipaw	Muse	Theinni	Naungkhio	Kutkai	Pyin Oo Lwin
Unemployed Persons	1500	9700	1900	2350	1000	1800	6200	5600

In the awareness of unemployment for local people, the training associated with construction techniques and heavy machinery driving should be done before the actual construction phase because the lack of the experience can be substituted by the other experienced labor workers. The villagers will be given more job opportunities mainly work on construction site. However, women in the villages will not be suitable for construction works. So, job opportunities will also be created for women.

Unskilled or semi-skilled men and women are hired from nearby villages and are trained to handle day-to-day work procedures. To become a certified heavy machine operator, there should be at least 12 weeks training program and 2 week practical work. If villagers are not trained beforehand, they will not be certified for such works and only get manual labor works. When they are certified, they can also work in large construction sites in the future as well.

The special training program such as making handicrafts, sewing clothes, broom making, etc. will be given to women. For these training programs, the trainers will be Shan and Burmese language speaking volunteers from the villages who will be trained beforehand for the program. Since some of the villagers are unable to speak Burmese, Shan Language will be needed at some time. After the training program, they will be capable of making handicrafts, clothes and broom which can be sold in the market. A souvenir shop will be opened at the subway stations so that villagers can sell their products. This way, women will be given job opportunities in the future as well.

Agriculture

Villages in Northern Shan State mainly cultivate betel, seasonal crops, flower, paddy and fruits. Proper cultivating techniques will be presented to the farmers.

To achieve higher yields, however, hybrid rice, heavily reliant on fertilizers and pesticides, needs more water and often requires mechanized farming equipment, all of which are either in short supply or beyond the financial reach of most Shan farmers, whose traditional rice-growing methods entailed few if any imported goods or equipment. According to researcher Hkun Seng, there have been no government programs to train the farmers how to grow the new rice or how to use the fertilizers and pesticides. The Lashio Township government put out a pamphlet on how to grow the rice - but only in English. To make matters worse, the instructions for the fertilizers and pesticides are all in Chinese, unreadable to most in Shan state. The lack of information has made it nearly impossible for farmers to know the proper concentrations to use or what precautions to take when handling the pesticides and fertilizers. All most farmers are told is that they have to spray six kinds of pesticides at least six times within 120 days. Farmers have reportedly become ill, and a few reportedly have died, after improperly using the pesticides.

So, proper usage of pesticides and insecticides will be introduced and instructions to use them will be written to Burmese language and labeled on the bottles. The disadvantages of using them will also be informed to the farmers and usage of manure as much as possible will be suggested. Techniques for sustainable production of rice and application of resource conserving techniques (RCTs) will be introduced and recommended to the farmers.

During construction phase, for the source of food for employees on site, the agricultural products will be bought from the villagers.

Animal Husbandry

Villages in Northern Shan State mostly raise chicken for eggs and meat.

Modern animal husbandry will be introduced to the villagers. Modern animal husbandry can produce more and earn much more.

- Well-fed animals grow more quickly, they become bigger, yield more meat. They can be sold at a better price.
- Animals produce manure. Your soil will become richer and better. Your harvests will be better. You will make more money.
- Animals that are well fed and looked after are healthy. They have more young ones and your herd will be better and bigger. You can sell animals and earn more money. Animal husbandry is a capital that can produce a lot.

How to improve animal husbandry

If animal husbandry is to produce more, the animals must be raised in a different way.

- A farmer who wants to earn more money must look after his animals himself.
- He must both grow crops and look after his animals.
- The farmer must learn to look after animals.
- Chicken must be raised in a stress-free environment so that they can produce larger eggs and higher quality meat.
- There should be enough space for them to roam so that they can forage for bugs and other critter.

He must:

- Feed them better: especially the young animals; he must lay in reserves for the dry season; give the animals enough to drink.

- look after them better:
- Build a shelter for them, protect the animals against parasites and diseases, and look after them if they are hurt.

Improving Rural Transportation

Rural transport is the movement of people and goods in rural areas by any conceivable means, for any conceivable purpose along any conceivable route and plays as an important role in the local economy. The transportation fare of using the train will be subjected to a reasonable price which is convenient for the villagers so that they can use the train to transport conveniently. They can also reduce transportation fees when they go and sell their agricultural products at a large city like Mandalay.

Improving Water Resource

To promote community health an easily accessible water supply should be available that provides sufficient safe water to meet community needs. There are many types of water resources such as protected spring, dug well, borehole, piped water supply, rainwater harvesting, and ponds and lakes. The water supply such as wells and boreholes should be done for accomplishing the basic healthy life of individual indigenous people. Sometimes the best option for improving water quality is to treat water in the home by boiling. Bringing water to a rolling boil will destroy pathogens in the water and make it safe to drink. Therefore the knowledge sharing should be done for improving the local people's hygiene and for avoiding the diarrhea especially in the children.

Providing Renewable Energy Supply for Rural Area

Providing access to electricity in rural areas is a major challenge. The fuel is generally of poor quality, and energy is used inefficiently; the power supply is unreliable and access to it limited. This not only has an adverse effect on economic productivity; more importantly, it also affects people's quality of life and is having a strong impact on the environment. The unsustainable use of locally sourced biomass and an increasing dependence on fossil fuels are causing environmental degradation at local (land degradation), regional (air, water and soil pollution) and global levels (greenhouse gas – GHG emissions contributing to climate change). Providing solar energy make an improvement of rural economies with new sources of revenue, employment and business opportunities, product and policy innovation, capacity building, and, most notably, affordable energy. But the use of candles is surprisingly high. Given the high cost of candles, there is likely to be a strong economic case for switching to lower-cost and higher-quality alternatives in local community. Therefore there is large potential for using solar PV to meet the demand for lighting in rural areas, particularly the sunny dry zone. If battery systems are used and energy management is already practiced, solar PV systems can offer a safe and increasingly inexpensive alternative to using candles for lighting.

Community Health Improvement Process

The main objective is to avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine. This is done by providing the local clinics, supporting the facility requirements and improving the district hospitals.

Preceed-Proceed is a health promotion assessment and planning process. Communities precede by defining their desired outcome and conduction social, epidemiological, educational, ecological, adminstrative, and policy assessements to identify causes of health issues. Then, the proceed with intervention and evaluation.

Proceed – 1. Social Assessment (defining end result)
2. Epidemiological Assessment (identifies community health priorities)
3. Educational and ecological Assessment
4. Adminstrative and policy Assessement

Proceed – 5. Implementation
6. Process Evaluation
7. Impact Evaluation
8. Outcome Evaluation

Corporate Social Responsibility (CSR) Fund

It promises to set up some fixed amount as CSR fund after negotiation with local authorities and local communities along the railway alignment. They also promise environmental mitigation and monitoring costs will not take account as CSR fund. The company's policies for local socio-economic development are shown in the following table.

No.	Description	Company's Policy
1.	Local Community Development Policy	Appoint local people with relevant skills as much as possible and at least 50% of local people will be appointed during operation phase.
2.	Corporate Social Responsibility (CSR) Policy	Contribute at least 2 percent of the annual net profit after tax as CSR fund

(i) CSR Fund

The company will set up fixed CSR fund for local community development. CSR activities will be accomplished not only by financial assistance but also by technical assistance and manpower in some donations to retain good relationship with local communities.

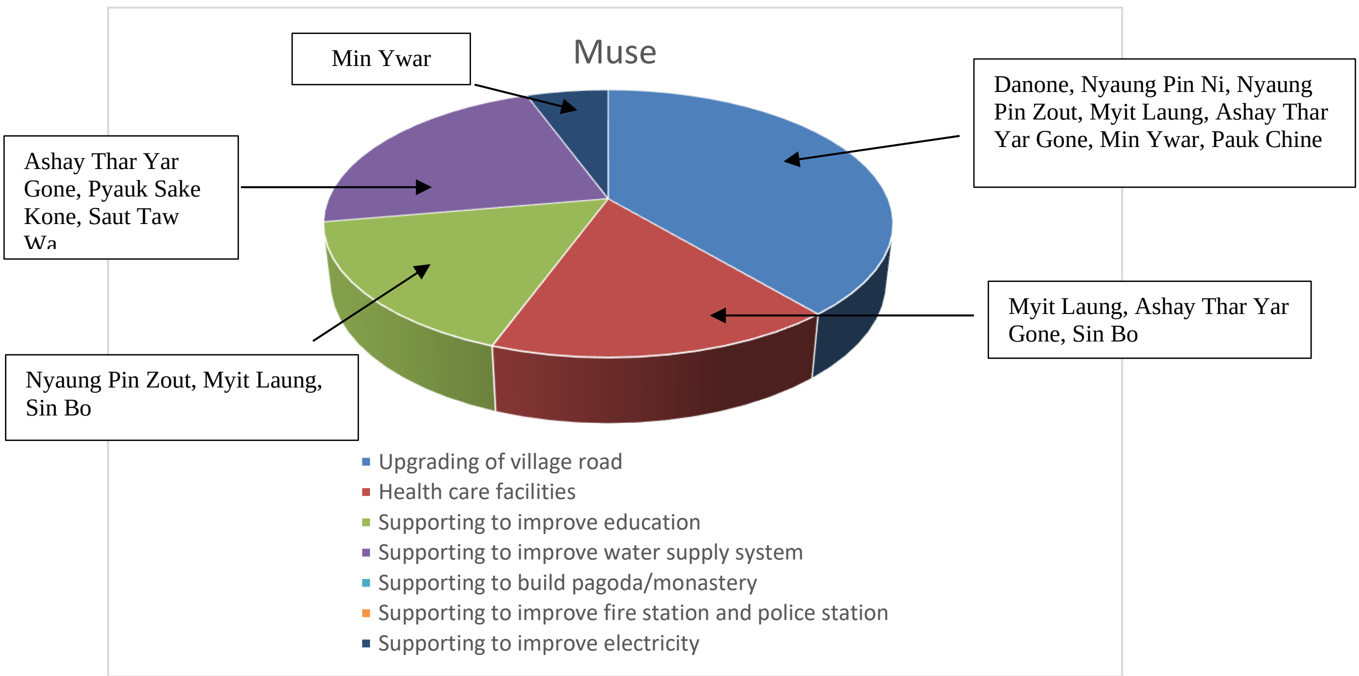
(ii) CSR Officer (or) Coordinator

The company will assign CSR officer who is closely communicate with local people in order to manage the contributions of CSR fund effectively. CSR officer is not only intended for the proposed soft-shell crab farming but also for the whole factories in Pathaw-Pahtet Island. HR manager may be assigned as CSR officer. CSR officer will donate CSR fund after the discussion with representative people from nearest villages, local authorities not only for Kyunsu but also for Myeik, local CBOs and NGOs. Allocated percent of CSR fund is based on local community needs according to the public survey as follow:

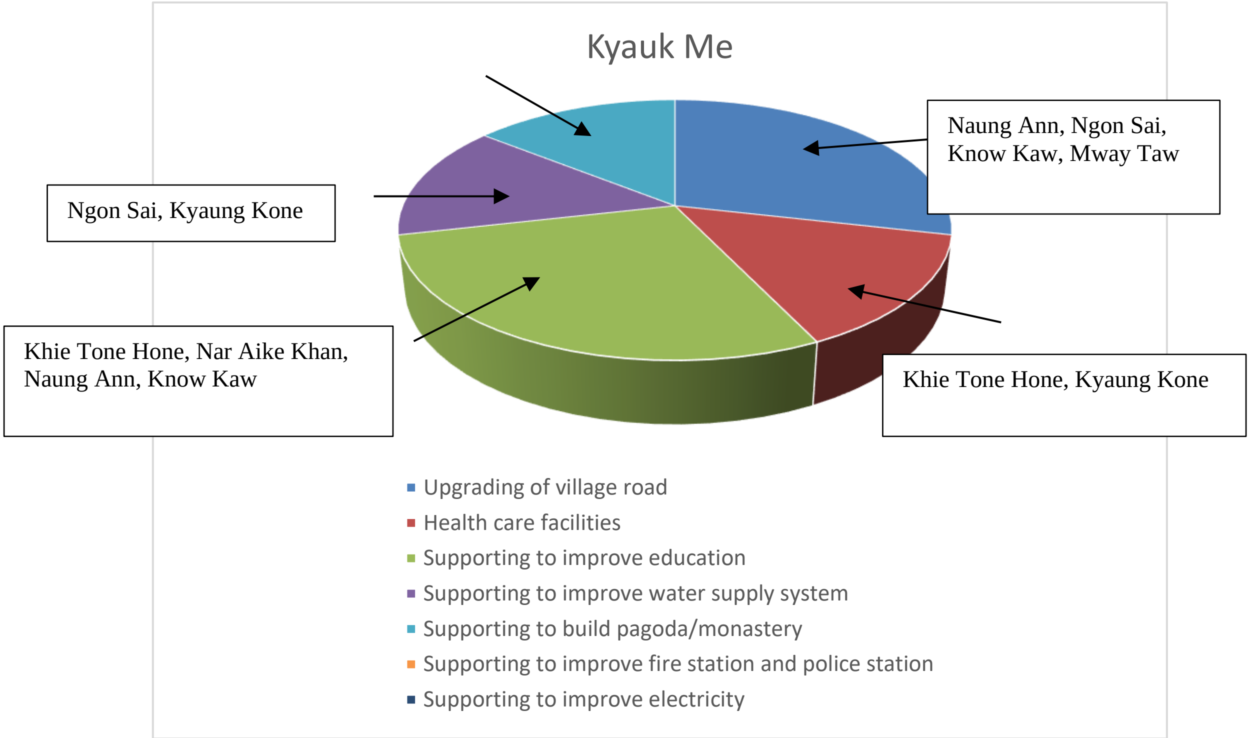
(iii) Allocated CSR Budget

The following development activities are based on the needs of the local people for the socio-economic development during the public consultation meetings. The proposed development activities will be beneficial to the nearby areas. The following development activities are as follow:

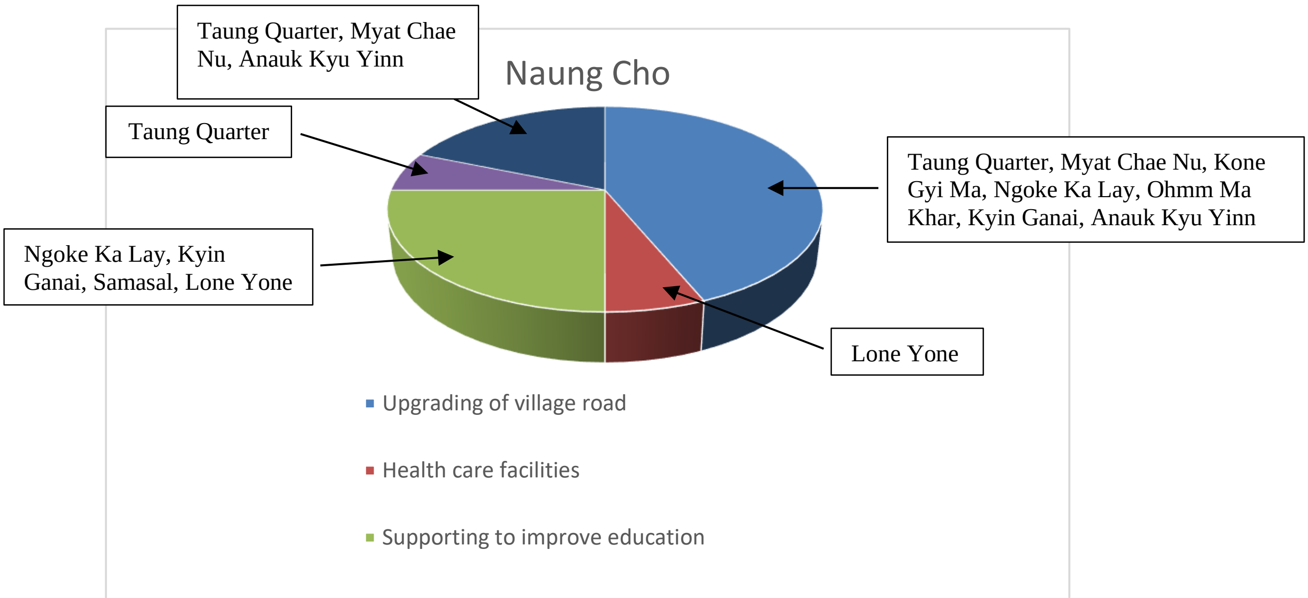
Muse Township



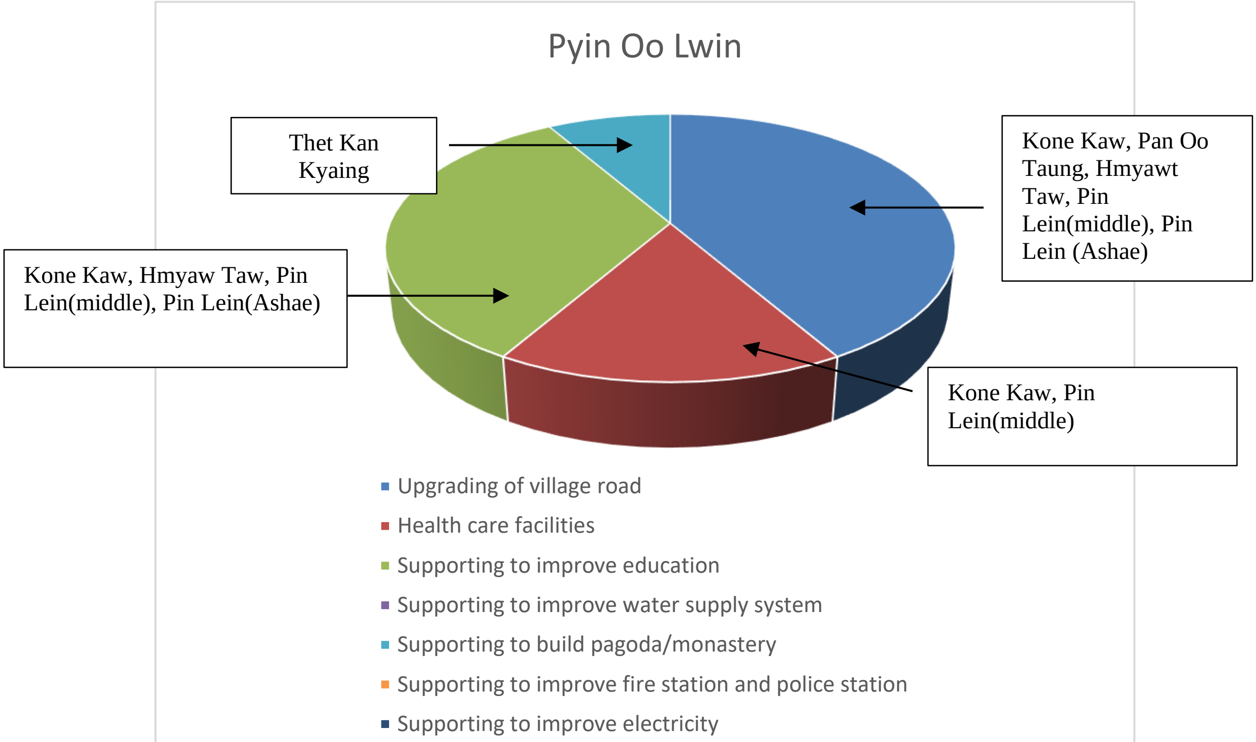
Kyaukme Township



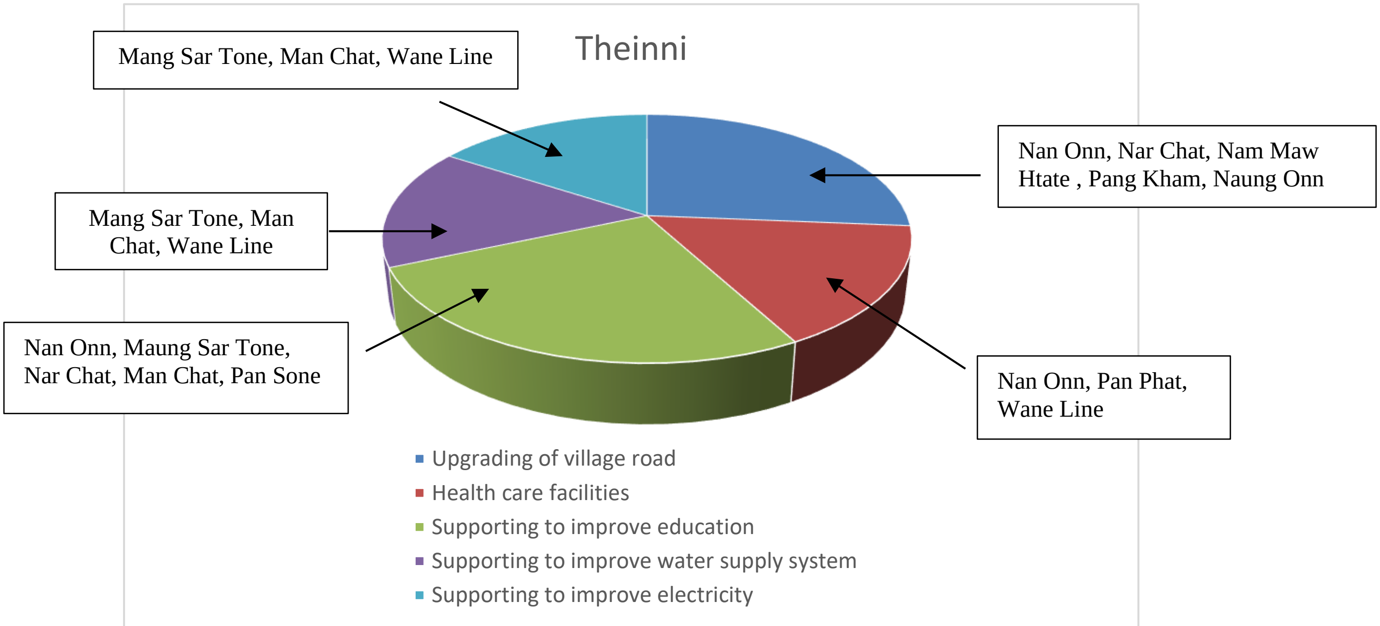
Nwang Hkio Township



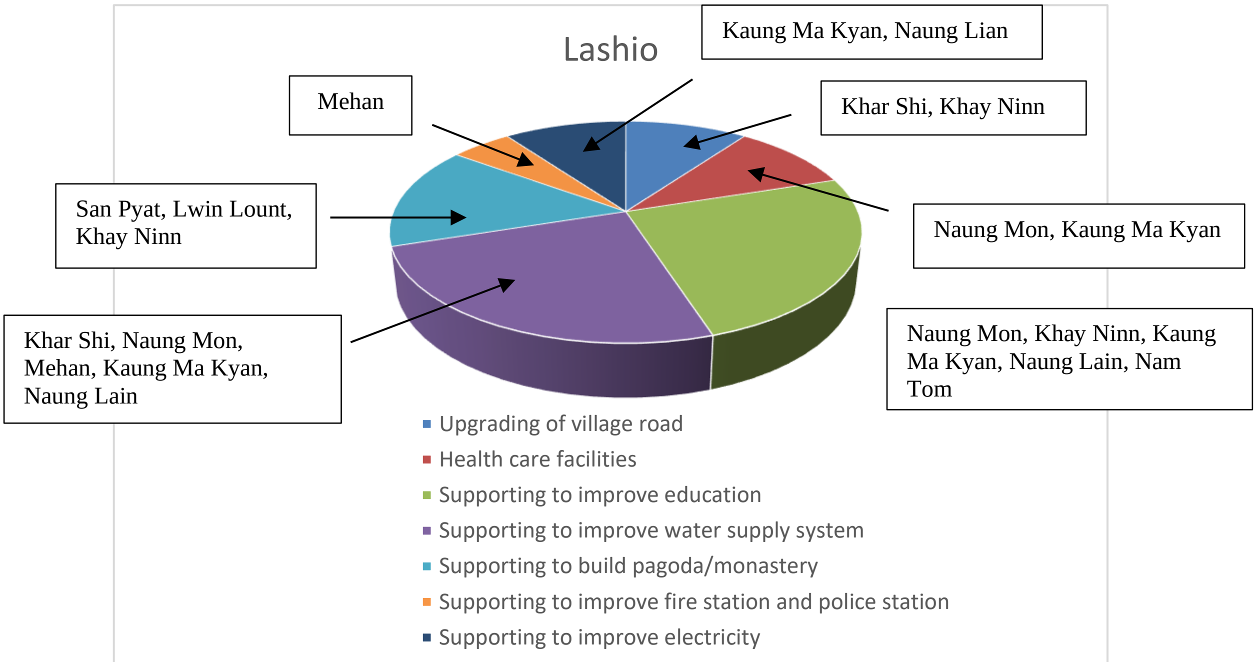
Pyin Oo Lwin Township



Theinni Township



Lashio Township



Hsipaw Township

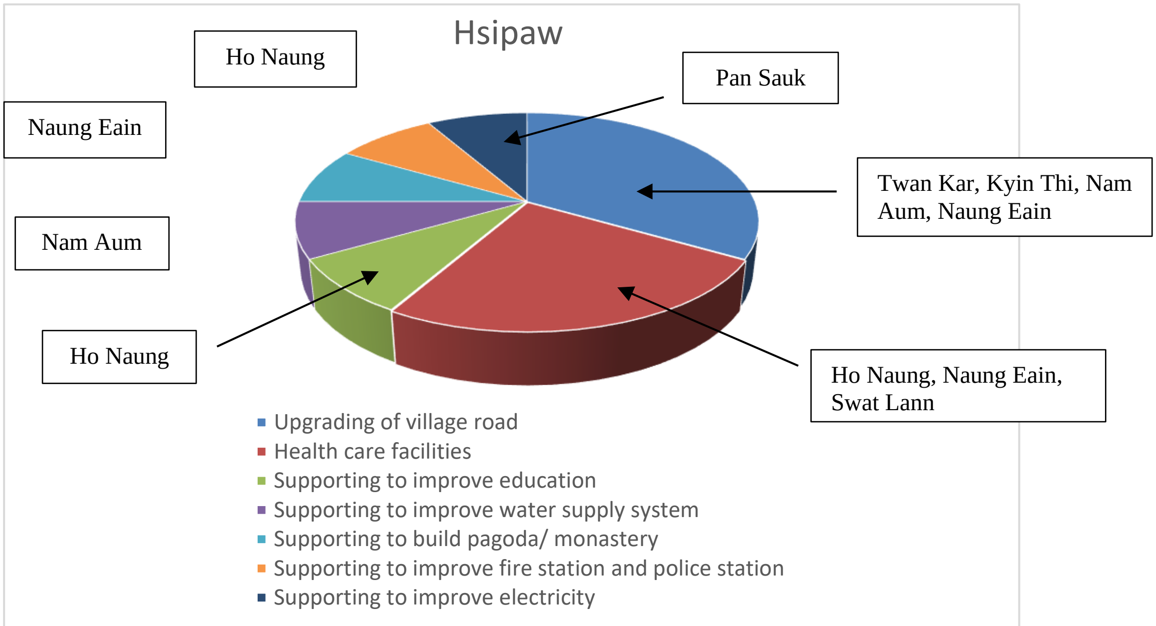


Table 8.11. Allocated CSR Budget

No.	Activities	Proposed allocated percent of CSR budget	CSR Activities
1.	Supporting to upgrading of village road	15%	.A good transportation route is one of important task during the community development as transportation plays a huge role in every towns and villages. The company will help in maintaining the roads and bridges for the locals in order for them to travel conveniently and will also take part in constructing new roads and bridges. Moreover, the company will help in upgrading the village roads which are close to the proposed project area.
2.	Supporting to improve water supply system to nearest villages	15%	To promote community health an easily accessible water supply will be provided by water pond sufficient safe water to meet community needs. Sometimes the best option for improving water quality is to treat water in the home by boiling. Bringing water to a rolling boil will destroy pathogens in the water and make it safe to drink. Therefore, the knowledge sharing will be done for improving the local people's hygiene and for avoiding the diarrhea especially in the children.
3.	Supporting to get full time electrical power to nearest villages	15%	The fuel is generally of poor quality, and energy is used inefficiently; the power supply is unreliable and access to it limited. This not only has an adverse effect on economic productivity; more importantly, it also affects people's quality of life and is having a strong impact on the environment. The unsustainable use of locally sourced biomass and an increasing dependence on fossil fuels are causing environmental degradation at local (land degradation), regional (air, water and soil pollution) and global levels (greenhouse gas – GHG emissions contributing to climate change). Providing solar energy make an improvement of rural economies with new sources of revenue, employment and business opportunities, product and policy innovation, capacity building, and, most notably, affordable energy.
4.	Supporting to improve education in nearest villages	15%	Distribution of education materials and financial aid or scholar grants to the students who are economically deprived in the nearest villages in this region will have a great benefit for students. All of the school in villages which is closed to the railway alignment will prepare as free of charge and will provide required stationery for all students at the beginning of the school day. CSR will provide 15% of the funds for educational purposes as the nearby areas have plenty of children who are willing to attend schools. Educational facilities such as books, pencil case, bags and many more will be provided to the children and the remaining funds will go to the schools for its development and also support for the teachers for their living.

5.	Donation to health care facilities in nearest villages	15%	Health care facilities of proposed project will be assessed to nearest local people with lowest price or free of charge as part of CSR program. Ambulance for emergency case will be provided for local people in nearest villages. CREEC will hold health education program for locals to raise awareness in the community. Particularly, health issues related to population growth such as sexually infected diseases, covid and so on will be included in the program along with the ways to take precautions against those diseases. With the help of CREEC and local authorities, the program will not only be beneficial to the community wellness but also create a safe environment to the community. The main objective is to avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine. This is done by providing the local clinics, and supporting the facility requirements.
6.	Contribution to local NGOs and CBOs	5%	CREEC will cooperate with local NGOs and CBOs not only in nearest villages but also in Mandalay and Shan Regions in the activities to improve regional, religious, and all-round developments. Some percentage of CSR fund will provide regularly to NGOs and CBOs in local communities as deposit. CSR program will contribute 5% of the funds to NGOs and CBOs as those organizations are helping and doing good deeds in rural areas which are facing financial problems to carry out development for its community. NGOs and CBOs help in every corner to the locals who are in needs of help so CREEC will contribute to those organizations as a helping hand to the those in needs.
7.	Supporting to free funeral service and social welfare society's aid	5%	10% of the CSR funds will go to social welfare society's aid such as free funeral services, healthcare ambulance and so on. Those services have been aiding the locals who could not afford or when they face emergency health cases.
8.	Supporting to law enforcement	5%	5% of the CSR funds will go to the law enforcement such as Police department and Fire department for their development. For the fire department, the CREEC will provide some equipment used for the fire cases and for the police department, the CREEC will upgrade the station buildings and maintain for the buildings such as painting, repairing and so on especially in Muse, Kyaukme, Pyin Oo Lwin, Lashio and Hsipaw Townships.
8.	Participating Government Schemes of Welfare	10%	CREEC will actively participate in implementation of government schemes for welfare of the society of the villages not only in Mandalay region but also for Shan region.

Note: Budget allocation can be changed according to the public needs and allocation will be made after the discussion with local communities.

Declare the Contribution of CSR Fund

All of the CSR activities and contribution programs will be declared to public by means of local media, company annual report or company's website on a regular basis. Audit on contribution of CSR fund will be carried out together with environmental and social audits through independent external audit team for transparency.

8.5. Implementation Schedule and Projected Budgets of Sub-Plan Table

Sub-plan	Implementation Schedule	Projected budgets	Responsibilities
Environmental monitoring program	During the duration of the construction activities at different locations	-	Monitoring team of Railway Project and construction contractor(s)
Traffic management plan	During the duration of the construction activities	-	Construction Contractor(s)
Risk management plan	During the duration of the construction activities and operation phase	-	Monitoring team of Railway Project
Occupational health and safety plan	During the duration of construction activities and operation	The cost is undefined, depending on the cases	MR and Construction Contractor(s)
Disaster risk and management plan	During the operation	Depending on the cases	MR
Emergency planning and response procedures	During the construction activities and operation	Depending on cases	MR and Construction Contractor(s)
Waste management plan	During the construction activities	For area of spillage – 12000kyats per day For management of construction wastes and handling of hazardous waste – 12000kyats per day	Construction Contractor(s)
Water intake management plan	During the construction activities	-	Construction Contractor(s)
Storm water management plan	During the construction activities	-	Construction Contractor(s)
Cultural heritage management plan	During the construction activities	-	Construction Contractor(s)
Community development and rehabilitation plan	Prior to operation phase	Undefined	MR and Construction Contractor(s)

9.0. PUBLIC CONSULTATION AND PARTICIPATION PROCESS

Public participation is a process that is designed to enable all interested and affected parties (I&APs) to voice their opinion and/ or concerns which enables the practitioner to evaluate all aspects of the proposed development, with the objective of improving the project by maximizing its benefits while minimizing its adverse effects. I&APs include all interested stakeholders, technical specialists, and the various relevant organs of state who work together to produce better decisions. Public participation empowers local people so that they regard the development projects as their own. Public participation (community involvement) also reduces the impact of uncertainties and stress caused by the proposed project.

9.1 Methodology and Approach

9.1.1. Objectives of Public Participation in an ESIA

Public participation is an essential and regulatory requirement for EIA process according to the EIA Procedure, 2015. The public participation process will be designed to provide sufficient and accessible information to I&APs in an objective manner to assist them to:

During the Scoping Phase:

- Raise issues of concern and suggestions for enhanced benefits;
- Verify that their issues have been recorded;
- Assist in identifying reasonable alternatives; and
- Contribute relevant local information and traditional knowledge to the environmental assessment.

During the Impact Assessment Phase:

- Contribute relevant information and local and traditional knowledge to the Environmental assessment;
- Verify that their issues have been considered in the Environmental studies; and
- Comment on the findings of the Environmental assessments.

So, public participation is a process that is designed to enable all interested and affected parties (I&APs) to voice their opinion and/ or concerns which enables the practitioner to evaluate all aspects of the proposed development, with the objective of improving the project by maximizing its benefits while minimizing its adverse effects. I&APs include all interested stakeholders, technical specialists, and the various relevant organs of state who work together.

to produce better decisions. Public participation empowers local people so that they regard the development projects as their own. Public participation (community involvement) also reduces the impact of uncertainties and stress caused by the proposed project.

In this study, effective public consultation and participation approaches in the form of stakeholder identification, focus group discussions, public meetings and public disclosure process will be conducted.

9.1.2. Methodology for Public Consultation and Participation Process

Public participation will be conducted by the following procedures:

(a) Stakeholder Engagement and Identification;
(b) Focus group discussion;
(c) Household survey;
(d) Public meetings; and
(e) Public disclosure process.

The EIA includes the activities undertaken during detailed design stage to engage the stakeholders, and planned information disclosure measures and processes for carrying out consultation with affected people and facilitating their participation during implementation stage. Five rounds of engagements have been undertaken as follow:

Table 9.1 - Public Consultation and Stakeholder Engagement Process

Round	Method	Stakeholders
Round 1. Stakeholders Identification	Conduct discussion with local authorities, by studying GIS Map and social specialists' study	Head of general administrative offices and Villages Heads
Round 2: Information sharing and issues identification	Conduct house hold survey in local residents which the railway pass through or cross nearby	Village leaders and local people in project affected areas (nearest villages)
Round 3: Public meeting for Scoping Proposal	(a) Invitation letters, handout, and report for current situation were distributed. (b) Posters and presentations were used during the meeting.	Regional Government, Key stakeholders in civil society, government officials and local authorities of Mandalay Region & Shan State, NGO's, INGO and CBO's, community leaders, and local communities

Round 4: Public meetings	(a) Invitation letters, handout, and report for current situation were distributed. (b) Posters and presentations were used during the meeting.	Regional Government, Key stakeholders in civil society, government officials and local authorities of Mandalay Region & Shan State, NGO's, INGO and CBO's, community leaders, and local communities
Round 5: Public disclosure process	Distribution of executive summary, announcement of EIA Report in website	Regional Government, Key stakeholders in civil society, government officials and local authorities of Mandalay Region & Shan State, NGO's, INGO and CBO's, community leaders, and local communities

9.1.2.1. Round 1: Stakeholder Engagement and Identification

It will develop a Stakeholder Engagement Plan (SEP) which will follow the framework provided by the International Finance Corporation (IFC) in Guidance Note (GN) 1, Annex B, in terms of Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts (www.ifc.org).

The purpose of stakeholder engagement is to:

"Establish and maintain a constructive relationship with a variety of external stakeholders over the life of the project .... An effective engagement process allows the views, interests and concerns of different stakeholders, particularly of the local communities directly affected by the project (Affected Communities), to be heard, understood, and taken into account in project decisions and creation of development benefits (GN6). Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts (GN 90)."

The involvement of the following groups or organizations in the stakeholder engagement process will be considered to be particularly important:

- Relevant Government Departments at the National, Provincial and Local level;
- Directly affected communities in the project area;
- Representatives of the local industries;
- Environmental groups and Non-Governmental Organisations (NGO)s;

- Community Based Organisations;
- Academic/research Organisations;
- International donors/funders active in the project area;
- Local communities; and
- The media.

The following communities, authorities and NGOs will be considered as key stakeholders who are directly or indirectly related to the proposed project according to the above consideration.

(a) Myanma Railways (MR) and CREEC;
(b) Local People (around the proposed railway project area);
(c) Village Administrative Offices (around the proposed railway project area)
(d) Environmental Conservation Departments in Lashio, Pyin Oo Lwin, Mandalay
(e) Head of Local Administration Offices (around the proposed railway project area);
(f) City Development Committee (Muse, Kuit Kai, Thein Ni, Lashio, Thi Paw, Kyuke Mae, Mandalay);
(g) Department of Public Health (Muse, Kuit Kai, Thein Ni, Lashio, Thi Paw, Kyuke Mae, Mandalay);
(h) Planning and Statistics Department (Muse, Kuit Kai, Thein Ni, Lashio, Thi Paw, Kyuke Mae, Mandalay);
(i) Department of Settlement and Land Record (Muse, Kuit Kai, Thein Ni, Lashio, Thi Paw, Kyuke Mae, Mandalay);
(j) Department of Archaeology and National Museum (Mandaly)
(k) Department of Water Resources Utilization Department (Mandalay, Lashio, Muse);
(l) Department of Labour (Muse, Kuit Kai, Thein Ni, Lashio, Thi Paw, Kyuke Mae, Mandalay);
(m) Myanmar Police Force (Muse, Kuit Kai, Thein Ni, Lashio, Thi Paw, Kyuke Mae, Mandalay);
(n) Local Media,
(o) NGOs and CBOs and
(p) Forest Department

Stakeholder Analysis

Stakeholder	Key Concern	Communication Method	Correlation
Myanma Railways (MR) & CREEC	- Operational safety. - Solutions and mitigation measures to long term management of the impacts. - Emergency preparedness. - Benefits from the project. - Complying with Standards.	- Public Meetings - Presentations - Educational activities - Written Communication	- RAP - Mitigation and Monitoring. - EIA - HIA - CSR - Legislative Framework
Local People	- Safety of operation - Health and Environmental impacts. - Land Compensation.	- Surveying households alongside of the project. - Public Meetings.	- RAP - Mitigation and Monitoring
Village Administrative Offices, Environmental Conservation Departments, Head of Local Administration Offices, City Development Committee, Forest Department, Department of Settlement and Land Record, Department of Public Health, Planning and Statistics Department, Department of Archaeology and National Museum, Department of Water Resources Utilization Department, Department of	- Legislative Framework, Environmental impacts - Health and Safety - Cultural Heritages - Solutions and mitigation measures to long term management of the impacts. - Regional Development - Job opportunities. - Local Socio-economic development.	- Meetings - Written Communications	- EIA - RAP - HIA - CSR - Legislative Framework

Labor, Myanmar Police Force			
Media	- Public Concerns. - Accurate information. - Transparency of the project.	- Public Meetings - Written Communication - Social Media	- Public Disclosure Process.
NGOs and CBOs	- Environmental Issues. - Labor Issues. - Transparency of the project. - Health and Safety.	- Public Presentation and Meetings. - Written Communication. - Social Media.	- Suggestion and Discussion.

9.1.2.2. Round 2: Information Sharing and Issues Identification

(a) Focus Group Discussions

Focus group discussions were carried out with heads of village administration office and elders from almost all of the nearest villages. Through these discussions, information will collect for consideration of PAPs (Project Affected Persons) and potential environmental and socio-economic impacts. Some recorded photos for example of group discussions are as follow:

Sar Toe

Nyaung Pin Zout

Anauk Kyu Yinn Village

Taung Quarter

Myo Pyin Gyi

Sat Kway

Pan Kham Village

Ngon Sai Village

Min Ywar

Khie Tone Hone Village

Khar Shi Village

Mal Han Village

Nan Onn Village

Kaung Khan Village

(b) Household Surveys

Household sample survey was conducted to evaluate primary socio-economic conditions of the project area and to understand the mood, perceptions and extent of preparedness of the people towards the proposed project. The household survey was carried out to tap the baseline socio-economic conditions of project area and to assess project perceptions and attitudes of the local people over a period of twenty days. To get the accurate data, primary data collection will be conducted by social specialist, social consultants, local authorities and local people.

Sample Size Determination

i. Sample size

The sample size was determined using Yamane's formula. The sampling error was considered as 4 % as the confident level was set at 96%.

$$\mathbf{n} = \frac{N}{1+Ne^2}$$

Where,

n = sample size

N =total number of households in the study area

e = desired margin error

In order to have a clear understanding about the sampling error "e" value, the correlation between sample size and "e" value were presented in the following table.

Table: Correlation between Sample Size and Sampling Error

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99

Source: Updated from Glenn D. Israel, 2003

This formula is not applicable for small population below 500 sizes of population, so the small size population was calculated 30% of each population's size. Then sample size was distributed according to the number of households in each village. However, the selection was done by the number of households located in the project affected part of the village. Thus, the sampled households were more or less differed from village to village. The following presented the sample households distributed in the survey.

ii. Sampling Method

The sampling unit was individual household in the study area. The sampling was carried out by stratified random sampling with the following steps.

- ***Step-1***, Households information were preliminary accessed during the pilot survey. The information includes baseline information of socio-economic activities and their concerns about the proposed projects.

- ***Step-2***, The households in each ward will be geographically classified sub-groups such as

  - households located nearby water sources by the proposed project
  - households located along the accessed roads to the proposed project site
  - households located beside the railway alignment of the proposed project
  - households located near the cultural and heritage site

- Step-3, The respondent households were randomly selected from each group according to the sample size.

The following table shows the list of household survey for proposed project.

Table 9.2. List of Household Survey for Proposed Project

Township	Village and Village Tract
Mandalay (Myit Nge)	Sar Toe Village Grouop (Sar Toe, Sat Kway, Myo Pyin Gyi) Danone Village, Nyaung Pin Ni Village, Nyaung Pin Zout Village, Myit Laung Village, Ashay Thar Yar Gone Village, Min Ywar Village, Pyauk Sake Kone Village, Sin Bo Village, Pauk Chine Village, Min Su Village, Saut Taw Wa Village
Mandalay (Pathein Gyi)	Than Ma Taw Village, Thansin Kone Village, Let Kaung Village, Tha le Kone Village, Yan Kin Taung Village, Lane Pin (Ashay and Anauk) Village
Pyin Oo Lwin	Thet Kan Kone (Hmyawt Taw) Village, Kone Kaw Village, Pin Lein (Middle) Village, Ashay Pin Lein Village, Pan U Taung Village
Naung Cho	Taung Quarter, Myat Chae Nu Village, Kone Gyi Ma Village, Ngoke Ka Lay Village, Ohmm Ma Khar Village, Kyin Ganai Village, Ban Bway Village, Samasal Village, Lone Yone Village, Anauk Kyu Yinn Village
Kyauk Me	Khie Tone Hone Village, Nar Kite Khan Village, Naung Ann Village, Ngon Sai Village, Know Kaw Village, Kyaung Kone Village, Mway Taw Village
Hsipaw	Kyin Thi Village, Twan Kar Village, Naung Eain Village, Swat Lann Village, Ho Naung Village, Pan Sauk Village, Nam Aun Village
Lashio	Khar Shi Village, Naung Mon Village, San Pyat Village, Lwin Lount Village, Khay Ninn Village, Mal Han Village, Kaung Ma Kyan Village, Naung Laing Village Nam Tom Village, Ho Pate Village, Pan Hat Village
Theinni	Nan Onn Village, Man Sar Tone Village, Nar Chat Village, Nan Maw Hate Village, Pan Kham Village, Man Chat Village, Pan Sone Village, Pan Phat Village, Naung On Village, Wane Line Village
Kutkai	Nam Hpat Kar Village, Pang Sa Lorp Village, Ho Nar Village, Nan Khone Village, Nam Hpat Lun Village, Kawng Lein Village, Mhan Lone Village, Pa Gyo Village
Muse	Nan Pann Village, Nan Kon Village, Nan Sonn Village,

	Kaung Khan Village, Wane Mine Village, Nan Onn Village, Mhan Haunn Village, Phat Mhan Village, Mine Mine Village, Yaw Han Par Village

Methodology Use in Household Survey

As there are a lot of villages in 10 townships (2 townships in Mandalay Region and 8 townships in Shan State), four SIA teams were composed with various team members as follow:

Table 9.3. Four SIA Team

Team No.	Team Leader	Degree
Team 1	Ma Nander Nwe	M.S. in EIA/EMS; Dip. in Applied Psychology
Team 2	Ma Thazin Htwe	M.S. in EIA/EMS; Dip. in Applied Psychology
Team 3	Mg Yaw Ma Nar	B.Sc. (Forestry); Dip. in ELA/EMS
Team 4	Mg Zaw Min Htwe	B.Sc. (Forestry)
Team 5	Mg Moe Pyi Kyaw	B.Sc. (Forestry)

Survey teams were organized by team leaders from social consultants and team members from local communities.

Table 9.4. Date and Period of Household Survey in Each Township

List of household	**Survey Team**	**Date of survey**
Kyauk Me Township	**Survey Team 1+Team 4**	**26.6.2019**
• Khie Tone Hone Village		26.6.2019
• Nar Kite Khan Village		26.6.2019
• Naung Ann Village		26.6.2019
• Ngon Sai Village		26.6.2019
• Know Kaw Village		26.6.2019
• Kyaung Kone Village		26.6.2019
• Mway Taw Village		26.6.2019
Lashio Township	**Survey Team 2+Team 5**	**27.6.2019 – 28.6.2019**
• Naung Mon Village		27.6.2019
• Naung Lang Village		27.6.2019
• Lwai Lount Village		27.6.2019
• Khay Ninn Village		27.6.2019
• San Pyat Village		27.6.2019
• Khar Shi Village		27.6.2019
• Kaung Ma Kyan Village		27.6.2019
• Mal Han Village		27.6.2019
• Nam Hu Village		28.6.2019
• Ho Phate Village		28.6.2019
• Pan Hat Village		28.6.2019
		28.6.2019

• Naung Laing Village		
Muse Township • Nan Pann Village • Nan Kon Village • Nan Sonn Village • Kaung Khan Village • Wane Mine Village • Nan Onn Village • Mhan Haunn Village • Phat Mhan Village • Mine Mine Village • Yaw Han Par Village	**Survey Team 3+Team 4**	**29.6.2019** 29.6.2019 29.6.2019 29.6.2019 29.6.2019 29.6.2019 29.6.2019 29.6.2019 29.6.2019 29.6.2019 29.6.2019
Naung Cho Township • Taung Quarter • Myat Chae Nu Village • Kone Gyi Ma Village • Anauk Kyu Yinn Village • Ngoke Ka Lay Village • Ohmm Ma Khar Village • Kyin Ganai Village • Ban Bway Village • Samasal Village • Lone Yone Village	**Survey Team 1+Team 5**	**24.6.2019 - 25.6.2019** 24.6.2019 24.6.2019 24.6.2019 24.6.2019 25.6.2019 25.6.2019 24.6.2019 25.6.2019 25.6.2019 25.6.2019
Pyin Oo Lwin • Thet Kan Kone Village • Kone Kaw Village • Pin Lein (Middle) Village • Ashay Pin Lein Village • Pan U Taung Village	**Survey Team 2+Team 4**	**31.8.2019 – 1.9.2019** 31.8.2019 31.8.2019 1.9.2019 1.9.2019 1.9.2019
Hsipaw Township • Kyin Thi Village • Twan Kar Village • Naung Eain Village • Swat Lann Village • Ho Naung Village • Pan Sauk Village • Nam Aun Village	**Survey Team 3+Team 5**	**4.9.2019 – 6.9.2019** 4.9.2019 4.9.2019 4.9.2019 5.9.2019 5.9.2019 5.9.2019 6.9.2019
Theinni Township • Pan Phat Village • Nan Onn Village • Man Sar Tone Village • Nar Chat Village • Nan Maw Hate Village • Pan Kham Village • Man Chat Village • Pan Sone Village • Naung On Village • Wane Line Village	**Survey Team 1+Team 4**	**27.6.2019 – 28.6.2019** 27.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019 28.6.2019
Kutkai Township • Nan Khone Village	**Survey Team 2+Team 5**	**22.10.2019** 22.10.2019 22.10.2019

• Nam Hpat Lun Village • Mhan Lone Village • Pa Gyo Village		22.10.2019 22.10.2019
Mandalay (Pathein Gyi) • Than Ma Taw Village • Thansin Kone Village • Let Kaung Village • Tha le Kone Village • Lane Pin (east) Village • Lane Pin (west) Village • Yan Kin Taung Village	**Survey Team 3+Team 4**	**13.8.2019 – 15.8.2019** 13.8.2019 13.8.2019 14.8.2019 14.8..2019 14.8.2019 15.8.2019 15.8.2019
Mandalay (Myit Nge) • Sar Toe Village • Sat Kway • Myo Pyin Gyi • Danone Village • Nyaung Pin Ni Village • Nyaung Pin Zout Village • Myit Laung Village • Ashay Thar Yar Gone Village • Min Ywar Village • Pyauk Sake Kone Village • Sin Bo Village • Pauk Chine Village • Min Su Village • Saut Taw Wa Village	**Survey Team 1+Team 2 + Team 3**	**22.6.2019 – 23.6.2019** 22.6.2019 22.6.2019 22.6.2019 22.6.2019 22.6.2019 22.6.2019 22.6.2019 23.6.2019 23.6.2019 23.6.2019 23.6.2019 23.6.2019 23.6.2019 23.6.2019 23.6.2019

Table 9.5. Sample Size Determination of sample size for each township

1.Mandalay (Myit Nge) Township	**Households**	**Sample Size**
Sar Toe Village Group (Sar Toe, Sat Kway, Myo Pyin Gyi)	1319	426
Da None Village	969	380
Nyaung Ni Pin Village	180	140
Nyaung Pin Zout Village	267	188
Myit Laung Village	404	246
Ashay Thar Yar Gone Village	217	162
Pyauk Sake Kone Village	215	160
Sin Boe Village	325	214
Pauk Chine Village	86	76
Min Su Village	95	83
Saut Taw Wa Village Group (Min Ywar Village, War Yone Pin Village)	917	372
2.Mandalay (Pathein Gyi)Township	**Households**	**Sample Size**
Than Ma Taw Village	1541	445

Thansin Kone Village	597	306
Let Kaung Village	250	179
Tha le Kone Village	601	307
Yan Kin Taung Village	1594	449
Lane Pin Village	406	247
3.Pyin Oo Lwin Township	**Households**	**Sample Size**
Thet Kan Kone (Hmyawt Taw) Village	126	105
Kone Kaw Village	150	121
Pin Lein (Middle) Village	159	127
Ashay Pin Lein Village	382	238
Pan U Taung Village	714	334
4.Naung Cho Township	**Households**	**Sample Size**
Taung Quarter Village	1121	402
Mak Hki Nu Village	1032	390
Kone Gyi Ma Village	904	370
Ngoke Ka Lay Village	580	301
Ong Ma Hkar Village	822	356
Kyein Ga Naing Village,	1515	443
Bant Bway Village	1643	453
Hsan Ma Hse Village	1478	440
Long Yon Village	1315	424
Ah Nauk Kyu Inn Village	537	289
5.Kyaukmae Township	**Households**	**Sample Size**
Nar Aik HkantVillage Group (Khie Tone Hone Village, Kone Kaw Village)	288	198
Naung Ann Village	109	93
Ngon Sai Village	80	71
Sai Khawng Village	36	35
Kyaung Kone Village	171	135
Mway Taw Village	108	93
6.Hsipaw Township	**Households**	**Sample Size**
Kyin Thi Village	423	253
Twan Kar Village	124	104
Naung Eain Village	90	79
Swat Lann Village	120	101
Ho Naung Village	156	125
Pan Sauk Village	55	51
Nam Aun Village	253	181

7.Lashio Township	**Households**	**Sample Size**
Hkar Shi Village	462	266
Nawng Mun Village	1982	476
San Pyat Village	137	113
Lwin Lount Village	410	248
Hkay Nin Village	514	283
Mae Han Village	1218	414
Kaung Ma Kyan Village	80	71
Naung Laing Village	290	199
Ho Peik Village & Pan Hat Village	839	359
8.Theinni Township	**Households**	**Sample Size**
Nar Chat Village	30	29
Nan Maw Hate Village	114	97
Pan Kham Village	95	83
Pan Sone Village	325	214
Pan Phat Village	354	226
Nam On Village	107	92
Pan Lawt Village Group (Man Chat Village, Wane Line Village, Man Sar Tone Village, Naung Onn Village)	505	280
9.Kutkai Township	**Households**	**Sample Size**
Nam Hpat Kar Village	1667	455
Pang Sa Lorp Village	245	177
Ho Nar Village	12	12
Nan Khone Village	40	38
Nam Hpat Lun Village	192	147
Kawng Lein Village	212	159
Mhan Lone Village	28	27
Pa Gyo Village	25	25
10.Muse Township	**Households**	**Sample Size**
Nam Pang Village	448	261
Nan Sonn Village	86	76
Kaung Khan Village	198	151
Wane Mine Village	181	141
Nam Aun Village Group (Phat Man Village, Man Haung Village)	717	334
Man Hai Village	576	300
Man Mai Village	63	58

Recorded Photo during Household Survey

Figure 9.1 - Recorded photos for household survey in Mandalay (Myit Nge)

Sar Toe Village

Nyaung Pin Ni Village


Nyaung Pin Zout Village

Myit Laung Village


Danone Village


Myo Pyin Gyi

Sat Kway

Min Ywar Village

PyaukSake Kone Village

Ashay Thar Yar Gone Village


Saut Taw Wa Village


Pauk Chine Village


Min Su Village


Sin Bo Village

Figure 9.2 -Recorded photos for household survey in Naung Cho Township

Taung Quarter


Myat Chae Nu


Anauk Kyu Yinn


Kone Gyi Ma


Lone Yone

Kyin Ganai

Ohmm Ma Khar

Ngoke Ka Lay

Ban Bway

Samasal

Figure 9.3 - Recorded photos for household survey in Kyauk Me Township

Khie Tone Hone

Nar Kite Khan

Naung Ann

Ngon Sai


Know Kaw


Kyaung Kone


Mway Taw

Figure 9.4 - Recorded photos for household survey in Lashio Township

Khar Shi


Naung Mon


San Pyat


Lwin Lount


Khay Ninn


Mal Han


Kaung Ma Kyan


Nam Tom


Pan Hat

Figure 9.5 - Recorded photos for household survey in Theinni Township


Nan Onn


Man Sar Tone


Nar Chat


Nan Maw Hate


Pan Kham


Man Chat


Pan Sone


Pan Phat


Naung On


Wane Line

Figure 9.6 - Some Recorded photos for household survey in Muse

Nan Pann

Nan Kon


Nan Sonn Kaung Khan


Wane Mine Nan Onn


Mhan Haunn Yaw Han Par


Phat Mhan Mine Mine

Table 9.6. Summary of Affected Households Concerns and Public Needs

Location	Concerns	Public Needs
Hsipaw		
Twan Kar Village	- affecting the field and vegetation - transportation difficulties - vibration from operation of trains	- compensate properly according to its current price - discuss with the villagers before starting the project - compensate for vegetation - fix roads inside the village - want the project to construct the railway by avoiding the village's farming land
Kyin Thi Village	- affecting the field and vegetation - blockage of field's drainage system and streams	- discuss properly with the victims till satisfaction - prepare the project openly - fix the roads inside the village
Ho Naung Village	- affecting the vegetation field and forest area	- discussions should be made with villagers and compensate properly according to its current price - prepare the project by avoiding the village 's farming land -upgrade the schools from primary to secondary - fix the fire station and police station - build clinics
Nam Aun Village	- affecting the field, houses, yards and vegetation	- compensate the victims properly - carry out according to their preference - do the project away from houses and farming land - build wells and connect the water to the village - improve the roads
Pan Sauk Village	- affecting the agricultural field	- construct the railway by avoiding the village - help in getting electricity and jobs
Swat Lann Village	- affecting the houses and agricultural field - noises from the proposed project disturbing the environment	- carry out the project in accordance with environmental rules and regulations - build clinics
Naung Eain Village	- affecting the agricultural field and houses - concerning about the accidents that can occur from speed of the train	- compensate the affected people properly - build pagoda, clinics and station - improve the roads

Lashio		
Khar Shi Village	- affecting the agricultural field - concerning if the villagers will get injured from the proposed project	- discussions should be made with villagers and compensate properly according to its current price - help with the drinking water supply - improve the transportation system
Naung Mon Village	- concerning about losing the land and forest - affecting the source of water - concerning about car accidents	- discuss with the affected villagers or victims till satisfaction - when the land is used, it should be compensated according to the current price - help with the development of the village - fix the water ponds
San Pyat Village	- affecting the pagodas and agricultural field	- discuss with the villagers before starting the project - build monastery
Lwin Lount Village	- affecting the houses and land	
Khay Ninn Village	- affecting the agricultural field, vegetation and villagers	- discuss with the affected victims and compensate them properly according to its current price - build monastery, bridges and schools - help in improving the transportation system
Mal Han Village	- affecting the land and houses	- discuss with the affected victims and compensate them properly according to its current price - help with the drinking water - need fire station and police station
Kaung Ma Kyan Village	- affecting the land and vegetation - causing damage to the buildings - affecting the long-life trees and plants - affecting the livestock farming	- discuss with the affected victims and compensate them properly according to its current price - help with the drinking water - help in developing the village and its transportation system - help in getting electricity
Naung Laing Village	- affecting the land, houses and forest	- discuss with the affected victims and compensate them properly according to its current price - help with the drinking water - help in increasing its economy and getting electricity - build schools
Nam Tom Village	- affecting the land, houses and drainage system	- discuss with the affected victims and compensate them properly according to its current price - build houses for teachers and workers

Theinni		
Nan Onn Village	- losing agricultural land - need to protect the source of water since there can be a shortage of water that could be a difficulty for farming	- discuss properly with the victims till satisfaction - when the land is used, it should be compensated according to the current price - help with the development of the village - build new schools
Man Sar Tone Village	- affecting the houses, yard - concerning that the project will be constructed across the village	- do not want the project to be constructed across the village - when the land is used, it should be compensated according to the current price - build shan literature school - want water supply in the village and electricity
Nar Chat Village	- losing land, forest and sources of water	- compensate properly according to its current price - discussions should be made with villagers before the start of the project - compensation for vegetation - build roads that connect with nearby villages - need schools
Nan Maw Hate Village	- affecting the land and vegetation - road traffic due to the project	- carry out the project openly - compensate properly for the affected cases or victims - improve the road along from the main road to the monastery
Pan Kham Village	- concerning about injuring the villagers - road traffic	- compensate properly - improve the transportation system
Man Chat Village	- affecting the houses and yards - concerning that the project will be constructed across the village	- when the land is used, it should be compensated according to the current price - build shan literature school - want water supply in the village and electricity
Pan Sone Village	- affecting the land and sources of water	- want the project to be carried out outside the village - build schools
Pan Phat Village	- affecting the houses, yard - concerning that the project will be constructed across the village	- do not want the project to be constructed across the village - build clinics
Naung On Village	- affecting the houses and yard	- compensate properly to the affected cases or victims - improve bridges and roads
Wane Line Village	- affecting the houses and yards	- do not want the project to be constructed across the village

	- concerning that the project will be constructed across the village	- when the land is used, it should be compensated according to the current price - build shan literature school - want water supply in the village and electricity
Pyin Oo Lwin		
Kone Kaw Village	- losing garden land - want the workers from the proposed project to go back home after the project is done	- when the houses and yards are affected, a replacement should be made - discuss carefully with the owners for the compensation - improve the roads within the village - build clinics and schools
Pan U Taung Village	- losing garden land - concerning that the project will be constructed across the village	- when the land is used, it should be compensated according to the current price (or) a replacement should be made instead - fix roads within the village
Hmyawt Taw Village	- affecting agricultural land and yard - concerning about the compensation since the past project about gas pipe line do not cover full compensation to the affected people	- compensation should be made according to the current price - discussion should be made openly - reconstruct the road - build asphalt roads for the entrance and inside the village - upgrade schools
Pin Lein (Middle) Village	- affecting the agricultural land - concerning that the income from the agricultural works would be affected before the compensation period - concerning about the compensation since the past project about gas pipe line do not cover full compensation to the affected people - concerning about the safety of villagers and animals while passing due to the speed of the train	- compensate properly according to its current price - while passing through the village, do not cross over the village's agricultural land - build highway overcrossing railway or pedestrian overpass - reconstruct the village road with asphalt - build houses for teachers - want medical care
Pin Lein (Ashae) Village	- affecting agricultural field - concerning about affecting the village's pagodas - since the electric train project is the first one in Myanmar, there are some	- compensate properly according to its current price - explain the villagers carefully with proofs that the proposed project will have no harm to them - improve the transportation and education system

	concerns that the project might affect the village - affecting the grazing land of cows and buffalos	
Thet Kan Kyaing Village	- affecting the agricultural land - concerning that the traffic of the village will be complex due to the project	- compensate properly according to its current price and provide replacement for the land - build highway crossing railway or pedestrian overpass - when the train crosses through the village, warning signs should be placed nearby - build a village hall and fix monastery
Naung Cho		
Taung Quarter	- losing farming land - road traffic due to the project	- when the land is used, it should be compensated according to the current price - fix road and build drainage system properly - want every houses in the village to get electricity
Myat Chae Nu Village	- affecting the houses and farm	- implement the project openly - when the land is used, it should be compensated according to the current price - improve the transportation system - prioritize to get electricity - build housing for workers
Kone Gyi Ma Village	- affecting the agricultural land	- when the land is used, it should be compensated according to the current price (or) a replacement should be made instead - fix and upgrade the village road
Ngoke Ka Lay Village	- affecting the farming land	- when the land is used, it should be compensated according to the current price - improve transportation system of the road - build new schools
Ohmm Ma Khar Village	- affecting the farming land	- compensate the farming land according to its current price - build new roads within the village and also build village hall
Kyin Ganai Village	- affecting the houses and yard - concerning that the vibration from the project will damage the houses	- when the houses and yards are affected, a replacement should be made - discussions should be carried out to solve for the effected cases - when the land is used, it should be compensated according to the current price

		- build a station, support schools and construct new roads
Ban Bway Village	- affecting the farming land and houses - concerning about the transportation difficulty due to the project	- want the project to carry out outside the village - prepare everything in advance - victims should be compensated properly - build a station, help with the electricity and improve the transportation system
Samasal Village	- affecting the farming land and houses - noise pollution from the project	- affected cases or places or victims should be relocated - perform safely throughout the project - build a station and schools
Lone Yone Village	- affecting the farming land and houses - road traffic due to the project	- when the land is used, it should be compensated according to the current price (or) a replacement should be made instead - build schools and clinics
Anauk Kyu Yinn Village	- affecting the houses and farming land - concerning that the pagodas will be affected	- when the land is used, it should be compensated according to the current price (or) a replacement should be made instead - construct roads - help with getting electricity
Kyauk Me		
Khie Tone Hone Village	- losing farming land - affecting farming land and vegetation	- compensate properly according to the current price - discuss with the villagers before starting the project - compensation for vegetation should be made - help with the development of the village - build new schools and station - fix monastery and support education and health of the village
Nar Aike Khan Village	- losing farming land - difficulty of water for farming	- discuss with the affected villagers until satisfaction - when the land is used, it should be compensated according to the current price - help with the development of the village with their needs - build new schools since there is no enough schools in the villages
Naung Ann Village	- concerning that the water surfaces near the village will be affecting due to the project	- discuss with the villagers closely while performing the work - fix the schools and improve the village's roads
Ngon Sai Village	- concerning that the villagers will be injured	- help with the difficulty of water - improve the transportation system of the village

Know Kaw Village	- affecting the farming land and source of water	- compensate properly according to the current price - improve the roads of the village - fix the schools and monasteries
Kyaung Kone Village	- affecting the houses and yards - concerning that the project will be constructed across the village - affecting the source of water	- when the houses and yards are affected, a replacement should be made - discussions should be carried out to solve for the effected cases - build clinics and a storage for drinking water
Mway Taw Village	- affecting the farming land and houses	- affected cases should be compensated properly - improve the roads of the village
Muse		
Nan Pann Village	- affecting the houses and yards	- want the proposed project to be constructed away from houses and yards
Nan Kon Village		
Nan Sonn Village	- concerning that the garden yard (rubber, sugar cane) will be affected	- the affected cases should be discussed with the villagers and compensate properly
Kaung Khan Village		
Wane Mine Village		
Nan Onn Village	- affecting the farming land and grazing land	
Mhan Haunn Village		
Phat Mhan Village		
Mine Mine Village	- affecting the garden land, tea leaves farm	
Yaw Han Par Village		
Mandalaly (Myit Nge)		
Sar Toe Village	- affecting houses and agricultural land - concerning that the trees will be cut down due to the project	- when the land is used, it should be compensated according to the current price
Danone Village	- affecting farming land and houses	- when the land is used, it should be compensated according to the current price - improve the transportation system of the village
Nyaung Pin Ni Village		- when the land is used, it should be compensated according to the current price (or) a replacement should be made instead - improve the transportation system of the village
Nyaung Pin Zout Village	- affecting farming land, houses and concerning about the noise pollution	- when the land is used, it should be compensated according to the current price - improve the transportation system of the village

	and also worries if the station will be near	- build new schools
Myit Laung Village	- affecting houses and land - concerning about the air pollution from the project	- build railway parallel to the road - when the land is used, it should be compensated according to the current price - improve the transportation system of the village - build new schools, library and clinics
Ashay Thar Yar Gone Village	- affecting houses	- when the houses and yards are affected, a replacement should be made - discussions should be carried out to solve for the effected cases - when the land is used, it should be compensated according to the current price - build a drinking water pool for the village - build clinics and fix the roads
Min Ywar Village	- affecting the farming land and houses - concerning about the transportation difficulty due to the project	- want the project to be carried out in a place away from the agricultural land - compensate properly to the victims - help with the electricity - improve the transportation system
Pyauk Sake Kone Village	- affecting houses and land	- compensate properly to the victims - fix the drainage system
Sin Bo Village	- affecting the farming land and houses - road traffic due to the project	- when the land is used, it should be compensated according to the current price (or) a replacement should be made instead - build schools and clinics
Pauk Chine Village	- affecting the farming land and houses - concerning that accidents might occur due to railway operation	- when the land is used, it should be compensated according to the current price - improve the transportation system
Min Su Village	- affecting the farming land and houses	
Saut Taw Wa Village	- affecting the houses and land	- when the houses and yards are affected, a replacement should be made - discussions should be carried out to solve for the effected cases - when the land is used, it should be compensated according to the current price - build drainage system - help with the development of the village

Kuitkai		
Nan Khone Village Nam Hpat Lun Village Mhan Lone Village Pa Gyo Village	- cutting trees - blockage of natural water sources - road traffic due to project - affecting farming land and grazing land for cows and buffalos - accidents along the operation of railway	- compensate properly according to its current price - build highway overpassing or pedestrian overpass - hold up warning signs along the main roads - write the warning signs with the local language - guarantee the jobs for the villagers
Mandalay (Pathein Gyi)		
Than Ma Taw Village Thansin Kone Village Let Kaung Village Tha Le Kone Village Yan Kin Taung Village Lane Pin (Ashay and Anauk) Village	- affecting land and houses - concerning that the pagodas will be affected - accidents along the operation of railway - blockage of natural water sources - road traffic due to project - affecting farming and grazing land for cows and buffalos	- build highway overpass or pedestrian overpass - hold up warning signs along the main roads with the local shan language - discuss with the villagers in every important cases - compensate properly to affected area or people - sell the train ticket with a reasonable price

Most Public Concerns Resulted by Household Survey

During household survey, the most important positive outcomes from the project expected by the local people and most of their concerns about proposed project were described. As household were made at least 70 villages and so public concerns were summarized e as follow:

No.	Most Important Public Concern	% concerned
1	Worry about the damage of agricultural land, forest area, historical places and archeological sites	27.5%
2	Proper compensation to land use whether they don't have land permit or not	21.56%
3	The blockage of rivers and water pollution	5.6%
4	Noise & vibration	1.56%
5	Discuss openly and transparency before starting any stage of project	12.81%
6	Ensure job opportunities for local people	8.4%

9.1.2.3. Round 3: Public Consultation Meetings (PCMs)

The aim of PCMs are to:

(a) To announce the process and procedure of EIA;
(b) To discuss about the possible environmental and social impacts;
(c) To discuss about the alternative ways to avoid the possible impacts; and
(d) To discuss effective mitigation measures most public concerns about the proposed project.

Public meetings will be held as follow:

(a) Public Meeting for Scoping Proposal

Public meeting for scoping proposal were made six times from the date of (25.6.2019) to (2.7.2019) in six townships, namely, Mandalay (Myit Nge), Naung Cho, Kyauk Mae, Lashio, Thein Ni and Muse as follow:

Table 9.7. Public Consultation Meetings for Scoping Proposal

No.	Meeting	Location	Date
1	Public Meeting for Scoping Proposal	Zaytawon Monastery, Myit Nga Mandalay	(25.6.2019)
2	Public Meeting for Scoping Proposal	Township Hall, Naung Cho	(26.6.2019)
3	Public Meeting for Scoping Proposal	Meeting Hall (GAO), Kyauk Me	(27.6.2019)

4	Public Meeting for Scoping Proposal	Meeting Hall (GAO), Lashio	(29.6.2019)
5	Public Meeting for Scoping Proposal	Township Hall, Thein Ni	(1.7.2019)
6	Public Meeting for Scoping Proposal	City Hall, Muse	(2.7.2019)

These townships will place railway stations and so public meetings are held at these townships initially. The following are the summary of discussions about the project and their exceptions from participants during the meeting.

(b) Summary of PCMs for EIA Stage

Public meeting for EIA Stage were made 13 times from the date of (17.8.2019) to (23.10.2019) in 11 townships, namely, Pyin Oo Lwin, Mandalay (Pathein Gyi), Hsipaw, Kuikai, Naung Cho, Theinni, Lashio, Kyauk Me and Muse as follow:

Table 9.8. Public Consultation Meetings for EIA Stage

No.	Meeting	Location	Date
1	Public Meeting for EIA Stage	Pyin Oo Lwin (City Hall)	(31.8.2019)
2	Public Meeting for EIA Stage	Mandalay (Pathein Gyi) (Township Hall)	(17.8.2019)
3	Public Meeting for EIA Stage	Hsipaw (Township Hall)	(7.9.2019)
4	Public Meeting for EIA Stage	Kuitkai (Meeting Hall, GAO)	(22.10.2019)
5	Public Meeting for EIA Stage	Mandalay (Pathein Gyi) (Township Hall)	(10.10.2019)
6	Public Meeting for EIA Stage	Pyin Oo Lwin (City Hall)	(11.10.2019)
7	Public Meeting for EIA Stage	Naung Cho (Township Hall)	(1.9.2019)
8	Public Meeting for EIA Stage	Hsipaw (Township Hall)	(21.10.2019)
9	Public Meeting for EIA Stage	Theinni (Township Hall)	(25.10.2019)
10	Public Meeting for EIA Stage	Lashio (Meeting Hall, GAO)	(8.9.2019)
11	Public Meeting for EIA Stage	Muse (City Hall)	(24.10.2019)
12	Public Meeting for EIA Stage	Kyauk Me (City Hall)	(6.9.2019)
13	Public Meeting for EIA Stage	Kuitkai (NantphatKha) (Church)	(23.10.2019)

Process of inviting locals for Public Consultation Meetings

The meetings were held in 10 townships for both scoping and EIA stage where 13 meetings were held for EIA stage and 6 meetings were held for scoping stage. The method for the locals to engage in the PCMS were by going to their townships and villages; sent out invitation letters to every households. For remote villages that had difficulties with travelling or transportation, invitation letters were sent directly to their villages' administrative offices and from there, those invitations were delivered to them 3 days ahead before the meeting. Cars were provided.

Locals from remote villages

For locals who were living in remote villages, cars were prepared to use for transportation to pick them up and send them back so that they would be able to attend the public consultation meetings. If there are some locals who do not attend the meeting, print out the power point as handouts and send it to the villages' administrative offices to deliver back to the locals who miss the public consultation meeting. Through the administrative offices, they can send back their concerns and opinions about the proposed project after reading the handouts.

9.2. Summary of Consultations and Activities Undertaken

Summary of Public Meeting Mandalay (Myit Nga Township)

Firstly, public consultation meeting for scoping proposal was held at the Zaytawon Monastery, Myit Nge Township, Mandalay in June 25, 2019. Over 200 people from local authorities, local people and other social communities' groups from Myitnge region and other stakeholder are attended. The key discussion about this PCM is the compensation about land use and the not to use historical areas and places.

Recorded Photos from Public Meeting Mandalay (Myit Nga Township)

Summary of Public Meeting (Naung Cho Township)

Then, public consultation meeting for scoping proposal was held at the Naung Cho Township Hall in June 26, 2019. Over 100 people from local authorities, local people and other social communities' groups from Naung Cho Township region and other stakeholders who are interest the project are attended. The key discussions are the land acquisition and compensation, announce the precise railway alignment and the impact on natural water spring.

Recorded Photos from Public Meeting Naung Cho

Summary of Public Meeting (Kyauk Mae Township)

Public consultation meeting for scoping proposal was held at the Kyauk Me General Administrative Office Meeting Hall in June 27, 2019. Over 120 people from local authorities, local people and other social communities' groups from Kyauk Me Township region and other stakeholders who are interest the project are attended. The key discussion during public meeting are about the environmental baseline study, land acquisition and proper compensation, impact on national level security and impact on water resources.

Recorded Photos from Public Meeting Kyauk Mae

Summary of Public Meeting for Scoping Report (Lashio Township)

Public consultation meeting for scoping proposal was held at the Lashio General Administrative Office Meeting Hall in June 29, 2019. Over 120 people from local authorities, local people and social communities' groups from Lashio Township region and other stakeholders who are interest the project are attended. The key discussions during public meeting are about the registration of third party, proper land compensation, proper fair price, impacts on natural spring and national level security.




Recorded Photos from Public Meeting Lashio

Summary of Public Meeting for Scoping Report (Thein Ni Township)

Public consultation meeting for Thein Ni Township was held at Theinni Township Hall in 1st July, 2019. Over 120 people from local authorities, local people and other social communities' groups from Thein Ni Township are attended. The key discussions during public meeting are land aquisation and proper compensation to land use, impact on natural water resources, impact on agricultural lands, impact on public safety.




Recorded Photos from First Public Meeting Thein Ni

Summary of Public Meeting for Scoping Report (Muse Township)

We held the 6th Public Consultation Meeting at the Muse City Hall in 2nd July, 2019. Over 100 people from local authorities, local people and other participants from Muse Township are attended. The key discussion during public meeting are the compensation to tree cutting, impact to national security, impact to religious and national security.

Recorded Photos from First Public Meeting Muse

Summary of Public Conservation Meeting for EIA

Ever Green Tech and MR hold 19 PCM in 9 townships along the MMR both for scoping and EIA reports. 6 PCMs for scoping phase and 13 PCMs for EIA stage. Detailed discussions during the PCMs cannot be described as there were 19 PCMs and a lot of pages will have to use to describe detailed discussions. The list of attendances, suggestion letter and PCMs photos can be seen in Appendix D and E.

First PCM

Time	Location	Participant		Key Discussion	Recorded Photo
		Composition	Number		
25.6.19 1:00 pm to 4:00 pm	Mandalay Myit Nge)	Local authorities	20	• Proper compensation for land used; • No or Less impact to monastery and pagoda; • Not to pass railway through villages; • Beware increase in human trafficking; • Not to cause accidental cases to local people due to high speed train	   
		NGOs	12		
		local people	180		
26.6.19 1:00 pm to 4:00 pm	Naung Cho	Local authorities	15	• Transparence for the project information in every stage; • Not to use agricultural land or proper compensation for land use; • Railway accidents when crossing with village road; • Not to damage natural spring along the railway; • Ensure job opportunities for local people.	
		NGOs	12		
		local people	120		

First PCM					
27.6.19 1:00 pm to 4:00 pm	Kyauk Mae	Local authorities	20	• Proper compensation measures for land used; • Proper arrangement for sustainable livelihood for project affected persons; • Keep the alignment away from village and forest areas; • Blockage of natural drainage system and natural spring; • Prepare warning signs along the railway line in local language; • Need to care for natural springs along the project area	- 
		NGOs	12		
		local people	115		
First PCM					
29.6.19 1:00 pm to 4:00 pm	Lashio	Participant		• Damage to agricultural lands along the railway; • Need sufficient compensation for every land used; • Damage to water resources by the project; • Worry for road accidents along the railway; • Need detailed assessment for socio-economic impacts;	
		Local authorities	22		
		NGOs	10		
		local people	110		

1.7.2019 1:00 pm to 4:00 pm	Thein Ni	Local authorities	12	• Blockage of village roads along the railway line; • Need to construct over pass, when the railway and road cross point • Use warning signs in local languages along the railway line; • Avoid or less impact to agricultural lands. • Appropriate compensations are required for affected farmers. • Need to care for natural springs along the project area	
		NGOs	6		
		local people	102		
First PCM					
2.7.2019 1:00 pm to 4:00 pm	Muse	Local authorities	22	• Appropriate compensations are required for affected persons. • Tree plantation for cutting of trees • Need transparency for the project. • Want to care for road safety. • Need to care for natural springs along the project area • Keep away the alignment from the village • Need to protect illegal trades due to project development	
		NGOs	4		
		local people	60		

Second PCM					
31.8.2019 1:00 pm to 4:00 pm	Pyin Oo Lwin	Local authorities	22	• Noise and vibration from the train; • Replantation of trees for cutting of trees; • Choose electrical power not to pressure on local electricity use; • Compensate the farm and agricultural land of local people fairly and transparently- • To protect the local people for their right with existing laws and regulation • Not allow cross over the natural spring which are the main water source of local people • Not to reduce the water catchment area due to railway line (in Pyin Oo Lwin) region • To control natural resources that can be damage during construction and operation phases • Not to take surplus soil and rock from tunnel construction	
		NGOs	10		
		local people	125		
Second PCM					
17.8.2019 1:00 pm to 4:00 pm	Mandalay (Pathin Gyi)	Local authorities	16	• To reduce the damage of natural resources, trees and forest and the responsible agency have to undertake the compensation of damage • To emphasize the public concerns • To ensure job opportunities for local people, experts and engineers • To make RAP for proper compensation for land use • To prepare comprehensive assessment for implementation phase • Surface water pollution due to bridge construction	
		NGOs	13		
		local people	150		
		...			

<table>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="3">7.9.2019
1:00 pm
to 4:00 pm</td><td rowspan="3">Hsipaw</td><td>Local authorities</td><td>20</td><td rowspan="3">• Not to damage natural spring
• Compensate, rebuild and relocate the local residents which are removed for the railroad before the project are started
• Proper and sufficient compensation to local people without delay
• Worry to relocate the place of local people who are poor and to protect them by the laws
• Build overpass and underpass where the joint with the road which the local people are using it</td><td rowspan="3"></td></tr>
<tr><td>NGOs</td><td>12</td></tr>
<tr><td>local people
...</td><td>180</td></tr>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="3">22.10.2019
1:00 pm
to 4:00 pm</td><td rowspan="3">Kuitkai</td><td>Local authorities</td><td>20</td><td rowspan="3">• To reduce house demolishing and land acquisition as much as possible
• Policy to control human trafficking
• Control migrant workers who can be settlement near the project area after construction phase
• If possible, the railway alignment is away far from the village
• Worry to disturb the local electricity use
• Do not allow soil and other material getting from project construction to carry the other place
• Appropriate compensations are required for affected farmers and land owners
• Not allow to destroy natural springs along the project area</td><td rowspan="3"></td></tr>
<tr><td>NGOs</td><td>8</td></tr>
<tr><td>local people
...</td><td>180</td></tr>
</table>

Second PCM					
Time	Location	Participant Composition	Participant Number	Key Discussion	Recorded Photo
10.10.2019 1:00 pm to 4:00 pm	Mandalay Pathein Gyi	Local authorities	15	• To provide compensation for house demolishing and land acquisition according to laws and regulations • To control noise during operation phase • To provide sidewall along the railway • To make comprehensive assessment for implementation phase • To provide job opportunities • To make open tender system for all implementation process • To prevent human trafficking and drug handling	
		NGOs	10		
		local people	60		
		...			
Second PCM					
11.10.2019 1:00 pm to 4:00 pm	Pyin Oo Lwin	Local authorities	16	• To emphasize on the public voices and concern • To publish the project related issues through media and make the meeting with media for the announcement. • To avoid the blockage of natural springs • To avoid the damage of religious and archeological places • To provide resettlement action or compensation for house demolishing and land acquisition; • To provide support for the basic infrastructure (such as, school, hospitals, road) of project related places and nearby areas; • To make compensation for tree cutting; • Not to damage the natural resources buried under the ground; • Not to damage the buried archeological resources; • To prevent the settlement of migrant workers near the project sites	
		NGOs	12		
		local people	90		

<table>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="3">1.9.2019
1:00 pm
to 4:00 pm</td><td rowspan="3">Naung Cho</td><td>Local authorities</td><td>18</td><td rowspan="3">
• They want very less amount of damage size on their garden land and farm land.
• If any damage, they would like to get appropriate compensation;
• The use of electricity from local resources;
• Need to care for natural springs along the project area
• How the railway alignment pass through the natural springs and farm lands
• Want to care about the railway pass for accidents and dangerous
• When the alignment in detail design, local people want to care the roads and bridge that already exits
• Secure job opportunities for local people
• The illegal trade of unhealthy food from China
• Prevent zero dollar tourism from other place</td><td rowspan="3"></td></tr>
<tr><td>NGOs</td><td>9</td></tr>
<tr><td>local people</td><td>200</td></tr>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="4">21.10.2019
1:00 pm to 4:00 pm</td><td rowspan="4">Hispaw</td><td colspan="2">Participant</td><td rowspan="4">
• To avoid the blockage of natural springs
• Having anxious to get damage on the religious buildings and historical places or buildings
• Worry for water resources are damaged by the project.
• To provide resettlement action or compensation for house demolishing and land acquisition
• Want job opportunity favor for local peoples
• Noise from blasting process
• To emphasize the public concerns and their livelihood changes
• Not to dispose soil material and other waste from construction near the agricultural lands
• Control foreign and migrant workers</td><td rowspan="4"></td></tr>
<tr><td>Local authorities</td><td>22</td></tr>
<tr><td>NGOs</td><td>10</td></tr>
<tr><td>local people</td><td>110</td></tr>
</table>

<table>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="3">25.10.2019
1:00 pm to 4:00 pm</td><td rowspan="3">Thein Ni</td><td>Local authorities</td><td>12</td><td rowspan="3">
• Need transparency for the project, when the project is being started to build.
• Keep away the railway from the village area (limited area for relocation)
• Want job opportunity favor for local peoples
• Worry to disturb the local electrical power source
• Don't want to destroy the roads that are connecting village to village by the project
• Want over pass, when the railway and road meet points.
• Noise and vibration
• Warning signs should be in local languages (Shan, Burmese, and other native languages)
• Want to avoid grazing ground and agricultural land if possible
• Appropriate and definite compensations are required for affected farmers.
• Need to care for natural springs along the project area</td><td rowspan="3"></td></tr>
<tr><td>NGOs</td><td>6</td></tr>
<tr><td>local people</td><td>102</td></tr>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="2">8.9.2019
1:00 pm to 4:00 pm</td><td rowspan="2">Lashio</td><td>Local authorities</td><td>22</td><td rowspan="2">
• To avoid the agricultural land and provide compensation for any damages
• To avoid the damage of water resources
• To improve the security to protect Myanmar national with laws as a lot of foreigners can ether into the country from this railway.
• To consider the national security
• To provide electricity and job opportunities
• To reduce the adverse impacts on environment, culture and socio-economic conditions
• To prioritize the safety on road crossing
• To provide compensation for house demolishing and land acquisition with current prices.</td><td rowspan="2"></td></tr>
<tr><td>NGOs</td><td>10</td></tr>
</table>

		local people	200	• To implement the project after compensation process. • To replant the trees the railway • To make sure that the railway is readily accessible by local people. • To discuss with Ministry of Construction before choosing the railway alignment- • Ground water alternative due to blasting process	
Second PCM					
24.10.2019 1:00 pm to 4:00 pm	Muse	Local authorities	22	• To make sure that the project activities would not harm to the socioeconomic conditions • Need to care for natural springs along the project area • Want warning signs along the railway and both side. • To make sure that the implementation agency compensate to the affected person directly • Compensation should be done before the project beginning and paid transparently • Replanting trees as compensation for tree cutting • Limit tree cutting outside the project area	
		NGOs	10		
		local people	85		
		...			
Second PCM					
6.9.2019 1:00 pm to 4:00 pm	Kyuk Mae	Local authorities	16	• To provide sidewall along the railway • Impact to fauna diversity due to noise • To build underpass and overpass for the local people and animals • To compensate transparently for losing lands and household • Replant trees along the railroad • Worrying of human traffic and drugs • Suggest to build railroad after getting peace • Declare the width of the railway line and land use of other facilities openly	
		NGOs	13		
		local people	180		
		...			

<table>
<tr><td colspan="6">Second PCM</td></tr>
<tr><td rowspan="4">23.10.2019
1:00 pm
to 4:00 pm</td><td rowspan="4">Kuikhai
(Nantphat
kha)</td><td>Local Authorities</td><td>14</td><td rowspan="4">Minimize or avoid the farmland and agricultural land
Compensation will pay for affected farmers and land owners as soon as possible
To provide job opportunities
Want to avoid grazing ground
If possible, the railway alignment is away far from the village
Reasonable railway fee that can be affordable to local people</td><td rowspan="4"></td></tr>
<tr><td>NGOs</td><td>6</td></tr>
<tr><td>local
people</td><td>100</td></tr>
<tr><td>...</td><td></td></tr>
</table>

This table shows the key discussions of public consultation meetings as it will take a lot of papers since there were 19 PCMs so far. The discussions about EIA were answered by EIA teams and discussion about the concerns during scoping stage (both oral discussions during PCMs and suggestion letters) were presented with a power point and discussed during PCMs for EIA Study and discussed as follow:

First PCM (Scoping)

Key Concern	How to Manage this Concern in EIA Report
1st PCM for Scoping Report	
Proper compensation for land used;	Cannot discuss during FS stage and RAP will be developed.
No or Less impact to monastery and pagoda	Alternative Analysis for Alignment based on Socio-economic Consideration is implemented.
Not to pass railway through villages;	Alternative Analysis for Alignment based on Socio-economic Consideration is implemented.
Beware for increase in human trafficking;	It is considered during assessment of negative socio economic impacts during operation phase. The corporation with human trafficking team in every trip to Mandalay to Muse Permanent Immigration Inspection Team will be made.
Not to cause accidental cases to local people due to high speed train	Public Health and Safety Management Plan is Developed. Routine inspection and maintenance of signaling equipment. The Project will install either passive or active controls at level crossings.
2nd PCM for Scoping Report	
Transparence for the project information in every stage;	It is described in submission of EIA Report. (i) by means of national media (i.e. newspapers) (ii) the website(s) of the Project or Project Proponent; (iii) at public meeting places (e.g. libraries, community halls); and (iv) at the offices of the Project Proponent
Not to use agricultural land or proper compensation for land use	Alternative Analysis for Alignment based on Socio-economic Consideration is Implemented. RAP is developed.
Railway accidents when crossing with village road;	Public Health and Safety Management Plan is Developed. Routine inspection and maintenance of signaling equipment. The Project will install either passive or active controls at level crossings.
Not to damage natural spring along the railway	It is considered during assessment of negative socio-economic impact during construction phase and its mitigation measures are described.
Ensure job opportunities for local people.	It is described in Project Developer Commitment. At least 50% of local people will be used as worker required for the construction phase.

3rd PCM for Scoping Report	
Proper compensation measures for land used;	Cannot discuss during FS stage and RAP will be developed.
Proper arrangement for sustainable livelihood for project affected persons;	Cannot discuss during FS stage and RAP will be developed.
Keep the alignment away from village and forest areas;	Alternative Analysis for Alignment based on Socio-economic Consideration is implemented.
Blockage of natural drainage system and natural spring;	Blockage of drainage system is considered in assessment of negative socio-economic impact during construction phase and its mitigation measures are developed. The project will use alternative waterway (manmade drainage system that can drain the large water volume) to avoid potential to flood due to the blockage of natural drainage system
Prepare warning signs along the railway line in local language;	Public Health and Safety Management Plan is developed use of warning signs in local language is prioritized.
Need to care for natural springs along the project area	Blockage of drainage system is considered in assessment of negative socio-economic impact during construction phase and its mitigation measures are developed. The project will use alternative waterway (manmade drainage system that can drain the large water volume) to avoid potential to flood due to the blockage of natural drainage system
4th PCM for Scoping Report	
Damage to agricultural lands along the railway;	Land Compensation Plan is developed.
Need sufficient compensation for every land used;	Land Compensation Plan is developed.
Damage to water resources by the project;	Blockage of drainage system is considered in assessment of negative socio-economic impact during construction phase and its mitigation measures are developed. The project will use alternative waterway (manmade drainage system that can drain the large water volume) to avoid potential to flood due to the blockage of natural drainage system
Worry for road accidents along the railway;	Public Health and Safety Management Plan is Developed.
Need detailed assessment for socio-economic impacts;	Socio-economic impact assessment is implemented.
5th PCM for Scoping Report	
Blockage of village roads along the railway line;	Overpass bridges, underpass bridge and platform bridges are planned to be constructed.
Need to construct over pass, when the railway and road cross point	Overpass bridges, underpass bridge and platform bridges are planned to be constructed.
Use warning signs in local languages along the railway line;	Public Health and Safety Management Plan is developed and use of warning signs in local language is prioritized.
Avoid or less impact to agricultural lands.	Alternative Analysis for Alignment based on Socio-economic Consideration is Implemented.

Appropriate compensations are required for affected farmers	Cannot discuss during FS stage and RAP will be developed.
Need to care for natural springs along the project area	Blockage of drainage system is considered in assessment of negative socio-economic impact during construction phase and its mitigation measures are developed. The project will use alternative waterway (manmade drainage system that can drain the large water volume) to avoid potential to flood due to the blockage of natural drainage system
6th PCM for Scoping Report	
Appropriate compensations are required for affected persons.	Cannot discuss during FS stage and RAP will be developed.
Tree plantation for cutting of trees	Forest Rehabilitation Plan will be developed.
Need transparency for the project.	It is described in submission of EIA Report. (i) by means of national media (i.e. newspapers) (ii) the website(s) of the Project or Project Proponent; (iii) at public meeting places (e.g. libraries, community halls); and (iv) at the offices of the Project Proponent.
Want to care for road safety	Traffic Management Plan will be developed.
Need to care for natural springs along the project area	Blockage of drainage system is considered in assessment of negative socio-economic impact during construction phase and its mitigation measures are developed. The project will use alternative waterway (manmade drainage system that can drain the large water volume) to avoid potential to flood due to the blockage of natural drainage system.
Keep away the alignment from the village	Alternative Analysis for Alignment based on Socio-economic Consideration is Implemented.
Need to protect illegal trades due to project development	It is considered in assessment of negative socio-economic impact during operation phase.

Second PCM (EIA)

For public meetings for EIA Stage, the discussions are based on the scoping stage public meeting and experiences.

Key Concern	How to Manage this Concern in EIA Report
1st PCM for EIA Study	
Noise and vibration from the train	Sound barriers are planned to be constructed at the sensitive points and vibration monitoring is implemented.
Replantation of trees for cutting of trees	Forest Rehabilitation Plan is developed.
Choose electrical power not to pressure on local electricity use;	Will be discussed with Ministry of Electrical Power.
Compensate the farm and agricultural land of local people fairly and transparently-	Land compensation plan is developed.
Not allow cross over the natural spring which are the main water source of local people	Alternative Analysis for Alignment based on Socio-economic Consideration is Implemented.
Not to reduce the water catchment area due to railway line (in Pyin Oo Lwin) region	Watershed Management Plan is developed.

2nd PCM for EIA Study	
To reduce the damage of natural resources, trees and forest and the responsible agency have to undertake the compensation of damage	Alternative Analysis for Alignment based on Environmental Consideration and Socio Economic Consideration is implemented.
To emphasize the public concerns	Public consultation and participation are undertaken.
To ensure job opportunities for local people, experts and engineers	It is described in Project Developer Commitment. At least 50% of local people will be used as worker required for the construction phase.
To make RAP for proper compensation for land use	Resettlement Action Plan is developed.
Damage to natural spring during tunneling	Tunnel construction wastewater treatment is implemented.
Surface water pollution due to bridge construction	Impacts on Water Environment during Construction Phase are assessed.
3 rd PCM for EIA Study	
Not to damage natural spring	Alternative Analysis for Alignment based on Environmental Consideration is implemented.
Compensate, rebuild and relocate the local residents which are removed for the railroad before the project are started	Land compensation plan and resettlement action plan are developed.
Proper and sufficient compensation to local people without delay	Land compensation plan is developed and Grievance Redress Mechanism (GRM) is appointed for complaints.
Worry to relocate the place of local people who are poor and to protect them by the laws	Resettlement action plan is developed.
Build overpass and underpass where the joint with the road which the local people are using it	Overpass bridges, underpass bridge and platform bridges are planned to be constructed.
4 th PCM for EIA Study	
To reduce house demolishing and land acquisition as much as possible	Alternative Analysis for Alignment based on Socio Economic Consideration is implemented.
If possible, the railway alignment is away far from the village	Alternative Analysis for Alignment based on Socio Economic Consideration is implemented.
Worry to disturb the local electricity use	
Do not allow soil and other material getting from project construction to carry the other place	The proposed waste dumping sites along the railway alignment for the waste management plan are indicated.
Appropriate compensations are required for affected farmers and land owners	Land Compensation Plan is developed.
Not allow to destroy natural springs along the project area	Tunnel construction wastewater treatment is implemented.
5 th PCM for EIA Study	
To provide compensation for house demolishing and land acquisition according to laws and regulations	Land Compensation Plan is developed according to laws and regulations.
To control noise during operation phase	Sound barriers are planned to be constructed at the sensitive points and vibration monitoring is implemented.
To provide sidewall along the railway	Railway-road parallel-run protections (rail protective barriers or concrete collision walls) are planned to be constructed.
To provide job opportunities	It is described in Project Developer Commitment. At least 50% of local people will be used as worker required for the construction phase.

To make open tender system for all implementation process	It is described in Project Developer Commitment.
To prevent human trafficking and drug handling	It is described in impact assessment of Negative Socio-economic Impacts during Operation Phase.
6 th PCM for EIA Study	
To emphasize on the public voices and concern	Public consultation and participation are undertaken. Grievance Redress Mechanism (GRM) is appointed for complaints.
To avoid the blockage of natural springs	Tunnel construction wastewater treatment is implemented.
To avoid the damage of religious and archeological places	Alternative Analysis for Alignment based on Environmental Consideration is implemented.
To provide resettlement action or compensation for house demolishing and land acquisition;	Land compensation and resettlement action plan is developed.
To provide support for the basic infrastructure (such as, school, hospitals, road) of project related places and nearby areas	It is set up at least 2% of annual profit as CSR fund.
To make compensation for tree cutting;	Forest rehabilitation plan is developed.
Not to damage the natural resources buried under the ground;	It is described in mitigation measures of impact on geology of tunnel construction.
Not to damage the buried archeological resources;	It is described in mitigation measures of impact on geology of tunnel construction.
To prevent the settlement of migrant workers near the project sites	
7 th PCM for EIA Study	
They want very less amount of damage size on their garden land and farm land.	Alternative Analysis for Alignment based on Socio Economic Consideration is implemented.
If any damage, they would like to get appropriate compensation;	Land Compensation Plan is developed.
Need to care for natural springs along the project area	Tunnel construction wastewater treatment is implemented.
How the railway alignment pass through the natural springs and farm lands	Alternative Analysis for Alignment based on Environmental Consideration and Socio Economic Consideration is implemented.
Want to care about the railway pass for accidents and dangerous	Risk Assessment is implemented. Assessment of Accidents on Railway Alignment is described in Negative socioeconomic Impacts during Operation Phase.
Secure job opportunities for local people	It is described in Project Developer Commitment. At least 50% of local people will be used as worker required for the construction phase.
8 th PCM for EIA Study	
To avoid the blockage of natural springs	Tunnel construction wastewater treatment is implemented.
Having anxious to get damage on the religious buildings and historical places or buildings	Alternative analysis for alignment based on environmental consideration is implemented.
Worry for water resources are damaged by the project	Tunnel construction wastewater treatment is implemented.
To provide resettlement action or compensation for house demolishing and land acquisition	Land Compensation Plan is developed.
Want job opportunity favor for local peoples	It is described in Project Developer Commitment. At least 50% of local people will be used as worker required for the construction phase.

Noise from blasting process	It is considered in impact during tunnel construction phase.
To emphasize the public concerns and their livelihood changes	Public consultation and participation process is implemented.
Not to dispose soil material and other waste from construction near the agricultural lands	Waste dumping site along the railway alignment is planned.
Control foreign and migrant workers	It is considered in mitigation measures for increase in crime and security during construction phase of the railway alignment.
9 th PCM for EIA Study	
Need transparency for the project, when the project is being started to build.	It is described in submission of EIA Report. (i) by means of national media (i.e. newspapers) (ii) the website(s) of the Project or Project Proponent; (iii) at public meeting places (e.g. libraries, community halls); and (iv) at the offices of the Project Proponent.
Keep away the railway from the village area (limited area for relocation)	Alternative analysis for alignment based on environmental consideration and based on socioeconomic consideration are conducted.
Want job opportunity favor for local peoples	It is described in Project Developer Commitment. At least 50% of local people will be used as worker required for the construction phase.
Don't want to destroy the roads that are connecting village to village by the project	Damage to public road is considered during identification of negative socioeconomic impacts during construction phase.
Want over pass, when the railway and road meet points.	Overpass bridges, underpass bridge and platform bridges are planned to be constructed.
Noise and vibration	Noise level is predicted during construction and operation phase of the railway and vibration is predicted and their mitigation measures are described.
Warning signs should be in local languages (Shan, Burmese, and other native languages)	Public Health and Safety Management Plan is developed and use of warning signs in local language is prioritized.
Want to avoid grazing ground and agricultural land if possible	Alternative analysis for alignment based on socioeconomic consideration is implemented.
Appropriate and definite compensations are required for affected farmers.	Land compensation plan is developed.
Need to care for natural springs along the project area	Tunnel construction wastewater treatment is implemented and waste dumping site along the railway alignment is planned.
10 th PCM for EIA Study	
To avoid the agricultural land and provide compensation for any damages	Alternative analysis for alignment based on socioeconomic consideration is implemented and land compensation plan is developed.
To avoid the damage of water resources	Tunnel construction wastewater treatment is implemented and waste dumping site along the railway alignment is planned.
To provide electricity and job opportunities	Job opportunity for local people is described in project developer commitment and providing renewable energy supply for rural area is considered in CSR plan.
To reduce the adverse impacts on environment, cultural and socio-economic conditions	Thee respective mitigation measures are described.

To prioritize the safety on road crossing	Overpass bridges, underpass bridge and platform bridges are planned to be constructed.
To provide compensation for house demolishing and land acquisition with current prices.	Land compensation plan is developed.
To replant the trees the railway	Forest rehabilitation plan is developed.
Ground water alternation due to blasting process	It is considered in negative socioeconomic impact on water resource during tunnel construction.
11 th PCM for EIA Study	
To make sure that the project activities would not harm to the socioeconomic conditions	Impacts on socioeconomic are considered.
Need to care for natural springs along the project area	Tunnel construction wastewater treatment is implemented and waste dumping site along the railway alignment is planned.
Want warning signs along the railway and both side.	Public Health and Safety Management Plan is developed and use of warning signs in local language is prioritized.
Replanting trees as compensation for tree cutting	Forest rehabilitation plan is developed.
Limit tree cutting outside the project area	It is considered in mitigation measure for flora diversity during construction phase.
12 th PCM for EIA Study	
Impact to fauna diversity due to noise	It is considered in impact on fauna diversity during construction phase.
To build underpass and overpass for the local people and animals	For local people, overpass bridges, underpass bridge and platform bridges are planned to be constructed. For animal passing, tunnel, bridges, culverts, are planned to be constructed to avoid all wildlife along the line.
Replant trees along the railroad	Forest rehabilitation plan is developed.
Worrying of human traffic and drugs	It is considered in negative socioeconomic impacts of alignment during operation phase of the project.
Declare the width of the railway line and land use of other facilities openly	Project proponent discloses the EIA report (that contained width of the railway line and land use) to civil society, PAPs (project affected persons), local community and other concerned stakeholder by means of national media, website of project proponent, at public meeting places and at the office of project proponent.
13 th PCM for EIA Study	
Minimize or avoid the farmland and agricultural land	Alternative analysis based on environmental and socioeconomic consideration is implemented.
Compensation will pay for affected farmers and land owners as soon as possible	Proper compensation will be made by organizing compensation team with local authorities during implementation phase. Compensation will be paid according to the Land Acquisition Act (LAA) and Land Acquisition Resettlement Committee (LARC).
To provide job opportunities	It is described in Project Developer Commitment.

	At least 50% of local people will be used as worker required for the construction phase.
Want to avoid grazing ground	Alternative analysis based on environmental and socioeconomic consideration is implemented.
If possible, the railway alignment is away far from the village	Alternative analysis based on environmental consideration is implemented.

Review

Due to large number of events since 6 PCMs for scoping and 13 PCMs for EIA were held, detailed information concerning with the PCMs could not be provided precisely. For information about EIA, Dr. Kyaw Swar Tint and his members of EIA team responded to the questions and for information about the project, those in charge from MR Team responded. The following table shows the key challenges and responses that were made during PCMs. During PCMs, the major discussion and challenges are as follows:

No.	Challenges	Response
1.	The detailed railway alignment that pass the exact location	During FS stage, precise railway alignment cannot be got and proposed alignment can be changed during implementation stage
2.	Compensation for land use	Proper compensation will be made by organizing compensation team with local authorities during implementation phase
3.	Not believe all of the Chinese Project	International official tender will be made for selection of project developer(s)
4.	Commitments for compensation	Compensation will be made by organizing compensation
5.	The blockage of village roads, seasonal streams and natural springs	Will use adequate bridges and culverts along the railway line not to block any public worry
6.	Noise during operation phase	Will made sound barrier in some environmentally and socially sensitive areas
7.	Trees cutting outside of the project corridor	Limit tree cutting and replanting as per local forestry department if cutting No tree cutting outside of the project corridor
8.	The use of electricity in local	Power supply will be sourced that no pressure on local electricity use Source electricity from China if possible Will not construct power supply system in local for this purpose
9.	Quarry mine for extraction of road stone	Will not extract lime stone for railway subgrade without permission from Government
10.	Secure job opportunities for local people	Tender will be made transparency for every project development stage
11.	Take other natural resources (logs, metals and wild animals) during construction of railway and tunnels	Strictly control construction contractor(s) not to take other resources during construction phase

12	Blockage of spring water due to blasting process in tunneling	Beware the alternation of waterway during tunneling
13.	Avoid pagoda and monastery areas	Will avoid pagoda and monastery areas
14.	Avoid forest area to reduce tree cutting	Will avoid forest area as much as possible and will replant if cutting is made.

9.3. Results of Consultations

Key Findings from the PCMs about the Proposed Project

The followings are the summary of key findings from public meetings for scoping proposal:

1. Less damage to agricultural land, forest area and histological places;
2. Not to damage to uncover natural resources; (keep away alignment from natural resources existing area);
3. Proper compensation to land use with or without ground gram;
4. Declare the width of the railway line and land use of other facilities openly;
5. Limit tree cutting outside of the project area;
6. Less damage to wildlife along the railway line;
7. Control foreign and migrant workers;
8. Policy to prevent the settlement of migrant workers near the project sites;
9. Policy to ensure job opportunities to local people;
10. Tender system for every project implementation works;
11. Not to separate the agricultural lands by the railway;
12. Not to increase in traffic during construction phase;
13. Road damage during transportation of construction materials;
14. Create job opportunities for local people at Muse-Mandalay Railway road where the economic conditions can be reduced due to the development of railway line;Not to produce the electricity for railway in Myanmar;
15. Not to use the require electricity for rails in local source.

Public concerns and public needs for transmission lines will be considered in those of railway alignment. Public concerns and public needs for power stations for each township are as follows:

No.	Township Names	Village Names	Public Concerns					Public Needs		Remarks
			Traffic and Road Damage	Land Acquisition	Pressure on Power Distribution System	Damage to Agricultural Lands	Proper Compensation for Land Use	Job Opportunities	Electrical Power Supply	
1.	Mandalay (Myit Nge, Pathein Gyi, Pyin Oo Lwin	Sar Toe, Sat Kway, Myo Pyin Gyi, Da None, Nyaung Ni Pin, Nyaung Pin Zout, Myit Laung, Ashay Thar Yar Gone, Pyauk Sake Gone, Sin Boe, Pauk Chine, Min Su, Min Ywar, War Yone Pin, Than Ma Taw, Thansin Kone, Let Kaung, Tha Le Kone, Yan Kin Taung, Lane Pin, Thet Kan Kone, Kone Kaw, Pin Lein (Middle), Ashay Pin Lein, Pan U Taung	√	√	-	-	√	√	-	3 nos. of traction substation
2.	Naung Cho	Taung Quarter, Mak Hki Nu, Kone Gyi Ma, Ngoke Ka Lay, Ong Ma Hkar, Kyein Ga Naing, Bant Bway, Hsan Ma Hse, Long Yon, Ah Nauk Kyu Inn	-	√	-	√	√	√	√	1 no. of traction substation
3.	Kyaukmae	Khie Tone Hone, Kone Kaw, Naung Ann, Ngon Sai, Sai Khawng, Kyaung Kone, Mway Taw	-	-	√	√	-	√	√	No traction substation
4.	Hsipaw	Kyin Thi, Twan Kar, Naung Eain, Swat Lann, Ho Naung, Pan Sauk, Nam Aun	-	√	√	√	√	√	√	1 no. of traction substation

5.	Lashio	Hkar Shi, Nawng Mun, San Pyat, Lwin Lount, Hkay Nin, Mae Han, Kaung Ma Kyan, Naung Laing, Ho Peik, Pan Hat	√	√	√	√	√	√	√	2 nos. of traction substati on
6.	Theinni	Nar Chat, Nan Maw Hate, Pan Kham, Pan Sone, Pan Phat, Nam On, Man Chat, Wane Line, Man Sar Tone, Naung Onn	-	√	√	√	√	√	√	1 no. of traction substati on
7.	Kutkai	Nam Hpat Kar, Pang Sa Lorp, Ho Nar, Nan Khone, Nam Hpat Lun, Kawng Lein, Mhan Lone, Pa Gyo	√	√	√	√	√	√	√	2 nos. of traction substati on
8.	Muse	Nam Pang, Nan Sonn, Kaung Khan, Wane Mine, Phat Man, Man Haung, Man Hai, Man Mai	-	√	√	-	√	√	√	1 no. of traction substati on

0 to 10 % of respondents

10 to 30 % of respondents

31 to 60 % of respondents

61 to 90 % of respondent

9.4. Further Public Consultation Meetings

During the Public Consultation Meetings, it didn't explain about the detail discussion about the compensation for the land use of the proposed project. Therefore, the compensation for the land use will be performed according to the Resettlement Action Plan for the Power Supply System and the developer will make public consultation meeting at least two times per year. Moreover, intermittent consultation meeting will also make according to the necessarily. MR will do the future public meetings shows in the following table.

SN	PCM	Responsibilities	Remarks
1.	Land Compensation	MR	Places where every affected people can attend
2.	Before starting key project development	MR	Places where every affected people can attend
3.	Once for any conflict between communities	MR	Places where every affected people can attend
4.	Job Opportunities (Plan for jobless local people)	MR	Places where every affected people can attend
5.	The use of CSR fund	MR	Places where every affected people can attend

9.5. Public Disclosure Process

EIA investigation

The EIA procedure of Myanmar (2015) requires that the Project Proponent shall undertake: timely disclosure of all relevant information about the proposed Project and its likely Adverse Impacts to the public and civil society through local and national media, the website(s) of the Project or Project Proponent, at public places such as libraries and community halls, and on sign boards at the Project site visible to the public, and provide appropriate and timely explanations in press conferences and media interviews.

In accordance with the guideline,

1. Sharing of relevant information about the proposed project was done by focus group discussions which was carried out with heads of village administration office and elders from almost all of the nearest villages.

2. Information regarding the proposed project was disseminated to the local community by sharing pamphlet and brochure which have images related to the project.
3. During Public Meeting, facts regarding the proposed project and potential impacts were presented in a transparent behavior using Power Point presentation and posters.

Submission of EIA Report

The EIA procedure of Myanmar (2015) requires that not later than fifteen (15) days after submission of the EIA Report to the Department, the Project Proponent shall disclose the EIA Report to civil society, PAPs (project affected persons) , local communities and other concerned stakeholders: (i) by means of national media (i.e. newspapers); (ii) the website(s) of the Project or Project Proponent; (iii) at public meeting places (e.g. libraries, community halls); and (iv) at the offices of the Project Proponent.

In accordance with the guideline, draft EIA report will be made publicity on MR website.

9.6. Grievance Redress Mechanism (GRM)

A grievance redress mechanism (GRM) must be made available to parties who have grievances or are not satisfied with any part of the development of proposed project and compensation process. A grievance redress mechanism (GRM), will be established to prevent and address community concerns, and reduce risks. The GRM is also an integral part of the monitoring and information system. It aims to ensure that feedback is received, that the voices from the poor and marginalized groups are heard, and that the issues raised are resolved effectively and expeditiously. It helps ensure that vulnerable households are treated equitably.

The GRM will be accessible to diverse members of the community and stakeholders. Multiple types of media, including face-to-face meetings, written forms, telephone conversations, or e-mail, will be available for raising issues, concerns and grievances.

The GRM aims to resolve concerns promptly, in an impartial and transparent process tailored to the specific community, and at no cost and without retribution to the complainant/s. The GRM will be communicated to different stakeholders. It is intended that information about the GRM be disseminated widely in meetings and through pamphlets and brochures in Myanmar language, and ethnic languages as needed/relevant. Specifically, information will be provided about how and where to lodge complaints/grievances. Villagers will be encouraged to seek clarification or remediation through the mechanism if they have any questions or complaints/ grievances.

Grievance Redress Monitoring Indicators

Grievance redress monitoring indicators will include:

- Number of complaints/ grievances registered.
- Percentage of grievances resolved.
- Percentage of grievances resolved within stipulated time period.
- Time required to resolve complaints.
- Percentage of complainants satisfied with response and grievance redress.
- Percentage of project beneficiaries that have access to the GRM.

9.6.1. Grievance Redress Committee (GRC)

In order to address grievances, a Grievance Redress Committee (GRM) will be formed for dealing with any grievances as they arise. This will include representatives from MMQ, representatives from Village Administrative Office of nearest project sites, representatives from Land Use Department (if necessary), representatives from Township Administrative Office, and representative from Village Administrative Office and PAPs.

9.6.2. Role and Responsibility of GRM Team

The GRM

The proposed GRM follows the existing approach taken for managing complaints about local issues by members of the public in Myanmar. Residents' complaints or concerns are generally taken to local government (village and township level) representatives for resolution; therefore this system is integrated into the GRM.

In their capacity as implementing agencies, the MR will establish a Public Complaints Unit (PCU) within the PMU early during project implementation prior to the start of planning and design of sub-projects and prior to negotiations for public complains. The PCU will deal with complaints from affected people and stakeholders throughout implementation of the project. This will include nearby residents, construction workers, and will involve village and township level government.

The PMU will be the key contact point for local government representatives who may require information about the project or who have an issue they would like to discuss. The PMU will issue public notices and leaflets in local languages early in the subproject design process to inform people and organizations within the project area of the GRM. The PCU's phone number, fax, address, email address will be disseminated.

The PMU will maintain a complaints database which indicates the household making the grievance, the nature of the issue, the date the report was received and also dealt with and the result. Dispute receipt and resolution will be reported regularly in project quarterly reports.

9.6.3. Grievance Mechanism Procedures

The procedure for handling grievances should be as follows.

(i) The affected person will file his grievance in writing, to the Village Leader. The grievance note will be signed and dated by the aggrieved person. Where the affected person is unable to write, he will obtain assistance to write the note and emboss the letter with his/her thumbprint.

(ii) The Head of Village Administrative Office or Village Leader will notify the Grievance Committee and respond within 14 days during which any meetings and discussions to be held with the aggrieved person will be conducted. If the grievance relates to valuation of assets, an independent value will be requested to revalue the assets, and this may necessitate a longer period of time. In this case, the aggrieved person will be notified by the VOC's head or Village Leader that his/her complaint is being considered.

(iii)If the aggrieved person does not receive a response or is not satisfied with the outcome within the agreed time, he/she may lodge his/her grievance to the Local General Administration Department.

Table 9.9. Township, district and state level committees for the grievance redress mechanism

No	Committee Member	Member Role
Township Level Redress Committee (TRC)		
	A person elected from citizen	Chairperson
	A person elected from experts	Member
	A person elected from CSOs	Member
	Deputy admin officer – township level (General Administrative Department)	Member
	Township level officer	Member

District Level Redress Committee (DRC)		
	A person elected from citizen	Chairperson
	A person elected from experts	Member
	A person elected from CSOs	Member
	Deputy admin officer – district level (General Administrative Department)	Member
	District level officer	Member
State Level Redress Committee (SRC)		
	The president appointed mayor as a minister	Chairperson
	In Yangon, there are four districts and each district can elect one representative	4 Members
	Appointed from government	4 Members

9.6.4. GRM Steps and Time Frame

Procedures and time frames for the grievance redress process are as follows:

Stage 1: Access to GRM. If a concern arises, the affected person will resolve the issue of concern directly with the contractor, or make his/her complaint known to either the PCU directly, or through the local village or township government, whichever level of authority he/she is most comfortable with;

Stage 2: Official Complaint to PCU. If a complaint is filed at local government level, the government representative will submit an oral or written complaint to the PCU. For an oral complaint the PCU must make a written record. For each complaint, the PCU must assess its eligibility. If the complaint is not eligible, for instance it is determined that the issue is outside the scope of the project, PCU will provide a clear reply within five working days to the affected person;

Stage 3: PCU Complaint Resolution. The PCU will register the complaints informing the respective local and district government, the PMU and contractors. The PCU, with support of the social specialist and other PICs depending on the issue will take steps to investigate and resolve the issue. This may involve instructing the contractor to take corrective actions. Within seven days of the redress solution being agreed upon, the contractor should implement the redress solution and convey the outcome to the PMU;

Stage 4: Stakeholder Meeting. If no solution can be identified by the PCU or if the affected person is not satisfied with the suggested solution under Stage 3, within two weeks of the end of Stage 3, the PCU will organize a multi-stakeholder meeting under the auspices of the head of local government, where all relevant stakeholders will be invited. The meeting will result in a solution acceptable to all, and identify responsibilities and an action plan. MMQ will implement the agreed redress solution and convey the outcome to the PMU within seven working days. The invitees to this meeting will depend on the nature of the complaint. For example, if the complaints relate to health, land disputes, or labor issues, the appropriate specialist in this field will be invited to the stakeholder meeting. This may include officers from the Department of Agricultural Land Management and Statistics (land rights issues), Myanmar Chamber of Commerce (business/commercial issues), various non-government organizations (NGOs) (gender or equity issues), Ministry for Ethnic Affairs (if ethnic group household involved), Ministry of Health (health issues), Ministry of Environmental Conservation and Forestry (environmental issues), and Ministry of Labor (labor issues); and

Stage 5: District Administration Officer Resolution. If the multi-stakeholder meeting cannot resolve the problem, and the affected person remains unsatisfied, the PMU will set up a meeting with the District Administration Officer to identify a solution.

10.0. CONCLUSION

This EIA study for railway power supply system will cover the traction substations and power transmission line for railway power supply system. This study will not cover for high voltage power transmission line where traction substations will use electrical power from this source. Moreover, EIA study will focus mainly on environmental and social impacts due to traction substations because the adverse impacts of transmission line will be included in railway subgrade construction. Typically, operation phase of transmission line will be considered. According to the impact assessment for the feasibility study for the railway power supply system, the most possible impacts will be land use, increase in traffic, soil contamination and noise during construction phase and the use of electrical power and EMF during operation phase. The most possible socio-economic impacts will be impact on agricultural lands, increase in traffic, and impacts due to population influx and pressure on electricity consumption. According to the nature of the environmental and social impacts for railway power supply system, the impact due to construction phase will be more than operation and decommissioning phase.

This EIA report will only consider the environmental, socio-economic and health impacts of the project related impacts and will not cover the political and economic issues correlated to the proposed project. According to the nature of the environmental and social impacts for railway construction, the impact due to construction phase will have high impact than operation phase. So, the MR will pay attention for construction phase. As for conclusion, all the environmental and social impacts can be mitigated to proper mitigation measures to acceptable level described in this report.

The construction and operation of Muse-Mandalay Railway will provide improved transport service, and will serve as one of the import-export corridors of the country. During the railway project development, there will be socio economic impacts, such as loss of farmland, house and income. It will also contribute to the improvement of the livelihood of the local populations that are crossed by the road project, contribute to the growth and development of trade and urban centers, improvement of crop and livestock production and its marketing network.

According to the EIA study, the most public concerns is land acquisition of the railway as the construction of the railway transmission line will displace some households that are located along the route. So, EIA report for Railway Power Supply System will be reported together with Resettlement Action Plan (RAP) for Railway Power Supply System. The objective of this RAP report is to minimize the socio-economic risks from the construction of railway bridges and culverts project by avoiding displacement of (especially for land acquisition and resettlement). The RAP designs compensation procedures and relocation, establishes compensation measures for losses incurred and it also establishes income restoration measures and resettlement assistance. The preparation of this report is based on the World Bank policies on involuntary resettlement.

In implementation phase, the most important thing is to involve the right PAPs in compensation process because most of the agricultural lands in rural areas in southern part of Myanmar does not have legal permit for land use and can cause dispute about the land ownership. Compensation for land that does not have legal permit is also one of the most public concerns during public consultation meetings. The developer also needs to draw up some portions of RAP after the project has been granted and getting the detailed design for railway power supply system & related facilities. The other essential things are who will make the compensation during implementation phase and it is also necessary to make clear cut for the responsible party for compensation. So, it is necessary to clear cut who will make the compensation and implement the RAP Framework and RAP before any start of the project implementation. The participation of local leaders and PAPs in disseminating information and resolving disputes will be important once RAP implementation starts. As for conclusion, all of the environmental and social impacts can be mitigated to proper mitigation measures to acceptable level described in these EIA Report and impacts related land acquisition and resettlement will be minimized by RAP reports.