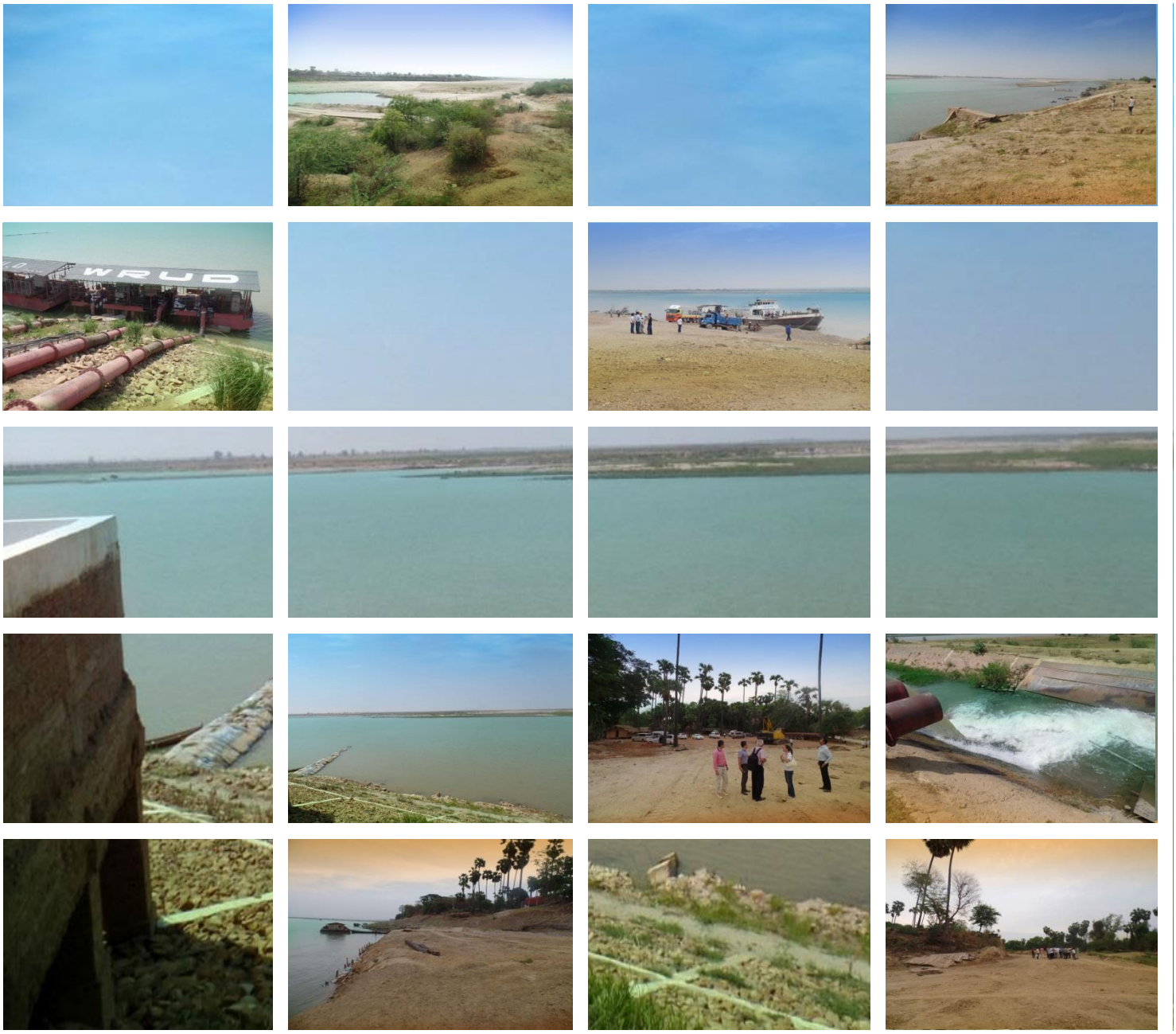


ESIA Report for Myingyan IPP Project – 225 MW Gas-fired Combined Cycle Power Station, Myanmar

September 2015

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REPORT

Sembcorp Utilities Pte. Ltd.

Environmental and Social Impact Assessment (ESIA) Report for Myingyan IPP Project – 225 MW Gas-fired Combined Cycle Power Station, Myanmar

September 2015

Prepared by: ERM-Siam Co Ltd

For and on behalf of ERM-Siam Co Ltd

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Signed:



Position: IAP Partner

Date: 15 September 2015

This report has been prepared by ERM-Siam Co Ltd with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

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ABBREVIATIONS

ADB	Asian Development Bank
AIDS	Acquired Immune Deficiency Syndrome
ALARP	As Low As Reasonably Practicable
AoI	Area of Influence
API	American Petroleum Institute
ASEAN	Association of Southeast Asian Nations
ASRs	Air sensitive Receivers
AZE	Alliance for Zero Extinction
BOD	Biochemical Oxygen Demand
BOT	Build, Operate and Transfer
CBP	Concrete Batching Plant
CCCW	Closed Cycle Cooling Water system
CCGT	Combined Cycle Gas Turbine
CCW	Closed Circuit Water system
CDP	Community Development Plan
CEDAW	Convention on Elimination of All Forms of Discrimination against Women
CEO	Chief Executive Officer
CEMS	Continuous Emission Monitoring System
CH	Critical Habitat
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLO	Community Liaison Officer
CO_2e	Carbon dioxide equivalent
COC	Cycles of Concentration
COD	Commercial Operation Date
COD	Chemical Oxygen Demand
CR	Critically Endangered
DC	Direct Current
DD	Data Deficient
DICA	Directorate of Investment and Company Administration
DLN	Dry Low NOx burners
ECC	Environmental Compliance Certificate
EHS Guidelines	Environmental Health and Safety (EHS) Guidelines
EIA	Environmental Impact Assessments
EM&A	Environmental Monitoring and Audit
EPC contractor	Engineering, Procurement and Construction contractor
EPs	Equator Principles
EQS	Environmental Quality Standards
ERM	Environmental Resources Management
ESHIA	Environmental Social and Health Impact Assessments
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
FDS	Fire Detection System
FID	Foreign Investment Department

ABBREVIATIONS

GAD	General Administration Department
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GISD	Global Invasive Species Database
GLCs	Ground Level Concentrations
GOM	Government of Myanmar
GT	Gas Turbine
GTG	Gas Turbine Generator
GWh	Gigawatt-hours
GWP	Global Warming Potential
Ha	Hectares
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HEMP	Hazard and Effects Management Process
HIV	Human Immunodeficiency Virus
HP	High Pressure
HPGE	Hydropower Generation Enterprise
HRSG	Heat Recovery System Generator
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IP	Intermediate Pressure
IPIECA	International Petroleum Industry Environment Conservation Association
IPP	Independent Power Producer
ITTA	International Tropical Timber Agreement
IWTS	Industrial Wastewater Treatment System
KBAs	Key Biodiversity Areas
Km	Kilometer
kWh	Kilowatt-hours
LC	Least Concern
LCU	Landscape Character Unit
LNG	Liquefied Natural Gas
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LSD	Low Sulphur Diesel
LTSA	Long Term Service Agreement
MEPE	Myanmar Electric Power Enterprise
MIC	Myanmar Investment Commission
MMIP	Mandalay Myotha Industrial Park
MNPED	Ministry of National Planning and Economic Development
MOAI	Ministry of Agriculture and Irrigation
MOECAF	Ministry of Environmental Conservation and Forestry
MOEP	Ministry of Electric Power
MOGE	Myanmar Oil and Gas Enterprise
MOI	Ministry of Industry
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level

ABBREVIATIONS

$MtCO_2e$	million tons of CO_2 equivalent
MTE	Myanmar Timber Enterprise
MW	Megawatt
NCEA	National Commission for Environmental Affairs
NEMC	National Energy Management Committee
NEP	National Environment Policy
NGOs	Non-Government Organizations
NO_2	Nitrogen dioxide
NSDS	National Sustainable Development Strategy
NSRs	Noise Sensitive Receivers
NT	Near Threatened
O&M	Operation and Maintenance
OECD	Organization for Economic Cooperation and Development
OH&S	Occupational Health and Safety
PAs	Protected Areas
PCP	Public Communications Policy
PEECC	Packaged Electrical and Electronic Control Compartment
PM	Particulate Matters
PM_{10}	Particles less than 10 micrometers in diameter (or respirable suspended particulates)
$PM_{2.5}$	Particles less than 2.5 micrometers in diameter (or fine suspended particulates)
PME	Powered Mechanical Equipment
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PS	Performance Standard
QRA	Quantitative Risk Assessment
RDMP	Risk and Disaster Management Plan
REM	Resource and Environment Myanmar Ltd
RH	Reheat
RoW	Right of Way
SEP	Stakeholder Engagement Plan
SEZ	Special Economic Zone
SIA	Social Impact Assessment
SO_2	Sulphur dioxide
SPLs	Sound pressure levels
SS	Suspended Solids
STG	Steam Turbine Generator
STP	Sewage Treatment Plant
SWL	Sound Power Level
TAR	Third Assessment Report
TB	Tuberculosis
TCB	Total Coliform Bacteria
TDS	Total Dissolved Solids
TJ	Terajoules
TSS	Total Suspended Solids
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development

ABBREVIATIONS

UNDHR	Universal Declaration of Human Rights
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
VSR	Visually Sensitive Receptors
VU	Vulnerable
WBCSD	World Business Council for Sustainable Development
WBG	World Bank Group
WHO	World Health Organization
WRI	World Resources Institute
WWF	World Wide Fund for Nature
YESB	Yangon City Electricity Supply Board

EXECUTIVE SUMMARY

0.1 INTRODUCTION

This Environmental and Social Impact Assessment (ESIA) report presents an assessment of the potential environmental and social impacts associated with the proposed 225MW Combined Cycle Gas Turbine (CCGT) power plant and Project facilities in Myingyan Township, Mandalay Region, Myanmar ('the Project').

This report has been prepared for **Sembcorp Utilities Pte. Ltd.** (hereinafter referred to as **'the Sponsor'** or **'Sembcorp'**) by **Environmental Resources Management** (hereinafter referred to as **'ERM'**) and presents the objectives, methodology and outcomes of the ESIA study.

0.2 PROJECT BACKGROUND AND OVERVIEW

The Sponsor has been selected by the Ministry of Electric Power (MOEP) of the Government of Myanmar (GOM) as a private sector Independent Power Producer (IPP) to develop the Project on a Build, Operate and Transfer (BOT) basis in Myingyan Township, in the Mandalay region in Myanmar. The Project comprises of the following Project facilities:

- 225MW CCGT Power Plant;
- Gas Supply Pipeline;
- 230kV Overhead Transmission Line; and
- Water Supply Pipeline, Wastewater Discharge Pipeline and Water Intake Pumping Station.

The Project will proceed to invest and establish a CCGT power plant with international financing provided by Asian Development Bank (ADB), International Finance Corporation (IFC), and other banks which have adopted the Equator Principles (EPs) as syndicates.

The technology of the Project is an efficient form of CCGT power generation which was designed for high reliability and efficiency operation with lower environmental impact. The Project will operate on natural gas as its only fuel.

The electrical capacity and electricity generated will be sold under a 22 year Power Purchase Agreement ("PPA"), as agreed with MEPE.

0.3 PROJECT NEED

Parallel to growth in GDP, electricity demand in Myanmar has increased dramatically in recent years. ADB released a report on Myanmar's energy sector in October 2012 in which the future power demand was estimated to be doubling from 12,459 million kWh in 2012-2013 to 25,683 million kWh in 2018-2019 (ADB, 2012).

As of July 2013, Myanmar's power is predominantly generated from hydropower, gas and coal, representing over 70%, 22% and 3% of the total power generation

respectively. [1] Out of the 3,735 MW of total installed capacity, approximately 835 MW is of gas-fired power generation. Due to the lack of water during dry season, hydropower generation has not been able to operate at full capacity and therefore electricity supply has been unstable during that time.

To reduce the country's reliance on hydropower, MOEP in its five year plan (2011/2012 to 2015-2016) has set an ambitious target to add 1,740MW of gas-fired generation capacity by 2015-2016, which will increase the gas-fired capacity to over 50% of the total generation mix. [2]

In addition, given that the new gas supply will become available from the Shwe Gas Supply pipeline, the proposed development of a combined cycle gas turbine power plant in Myingyan Township, Myanmar will contribute towards a power source for adding capacity required to cover the shortfall in Myanmar.

0.4 THE PROJECT

The Project Sponsor is planning to develop a 225MW Combined Cycle Gas Turbine (CCGT) power plant in Myingyan Township, Mandalay region in the Union Republic of Myanmar.

0.4.1 Project Location

The Project site is located approximately 8km, south of Myingyan Township, Mandalay region in Myanmar.

The Power Plant will be located on a predominately green field site. The Project site is located adjacent to an existing steel mill (Myingyan Steel Mill No.4), owned by Ministry of Industry (MOI).

The following 5 villages are located in close proximity (3km radius from the Project site boundary):

- Sa Khar village;
- Hnan Ywa village;
- Hpet Taw village;
- Nyaung Kan village; and
- Gyoke Pin village.

The Ayeyarwady River is located approximately 14km west of the Project site boundary, where the water intake pumping station will be installed. In addition, there is 1 village located in close proximity to the proposed water intake pumping station: Tha Pyay Thar village.

0.4.2 Land

The Project site was acquired by the GOM, up to 18 years ago, and the registered land owner is MOI. The majority of this MOI-owned land is occupied by the existing

[1] MEPE (2013). http://www.ubifrance.com/medias/press/mepe_9_7_2013_29_31.pdf Accessed 8 June 2015.

[2] Sharma, Vikas (2013). An Overview of Electricity Market in Myanmar. http://www.slideshare.net/VikasSharma128/myanmar-electricity-industrydec2013 Accessed 8 June 2015.

steel mill infrastructure which was commissioned in 2007. The northern part was allocated for the Power Plant. The Project site was cultivated farmland prior to acquisition of the land by the GOM and is currently dominated by sparse shrubby vegetation.

A total area of approximately 16 hectares (ha) is allocated for the core Project Facilities.

0.4.3 Project Facilities

The Project Facilities and Associated Facilities are described below.

- ***225MW Combined Cycle Gas Turbine Power Plant*** (approx. 9 ha) comprising of the following main components:
  - 2 sets of Gas Turbine (GT) units;
  - 2 sets of Heat Recovery System Generator (HRSG);
  - 1 steam turbine generating unit with associated auxiliary equipment;
  - Switchyard area;
  - Cooling Water System;
  - Demineralised Water System; and
  - Wastewater Treatment Facility.

- ***Gas Supply Pipeline*** (approx. 0.2 ha) connecting the new MOGE gas receiving station to the Power Plant (approximately 1km in length). MEPE/MOGE will build the new MOGE gas receiving station and the Sponsor will build new gas supply pipeline from delivery point at the outlet of the MOGE gas skid to the Power Plant.

- ***230kV Overhead Transmission Line*** (approx. 5 ha) connecting the Power Plant to the upgraded Myingyan Steel Mill sub-station located within the steel mill complex (approximately 2.5km in length).

- ***Water Supply Pipeline and Wastewater Discharge Pipeline*** (approx. 2 ha) connecting the Power Plant to the water intake point and new Pumping Station at the Ayeyarwady River. The water supply pipeline will be approximately 14km in length. The wastewater discharge pipeline will connect the Power Plant to the existing irrigation canal (approximately 3km in length). The wastewater pipeline will be run in parallel with the water supply pipeline. Both pipelines will share the 2m easement.

The key Project components including the proposed emission embedded controls are described in the below sections.

<u>225MW CCGT Power Plant</u>

The main power block of the Plant consists of 2 sets of gas turbine (GT), 1 set of steam turbine (ST), 2 sets of heat recovery steam generator (HRSG) and bypass and exhaust stacks. The Power Plant is designed to operate continuously, either in simple cycle mode or in combined cycle mode. During simple cycle operation, the flue gas from the gas turbine will exit via the bypass stack to the atmosphere. During normal combined cycle operation, the heat of exhaust gas will be admitted to the HRSG

where superheated steam will be produced which will drive the steam turbine to generate electrical power. The exhaust gas from the HRSG will be released from the main stack of the HRSG to the atmosphere.

Cooling Water System

The mechanical draft cooling tower cooling water systems is selected for this Project. The cooling water from the cooling tower will be mainly supplied to the steam turbine condenser and other auxiliary cooling requirements.

Raw Water System

The raw water system includes the make-up water system, raw water storage pond and the pre-treatment system.

The raw water will be taken from Ayeyarwady River, using the water intake pumping station at the flow rate of approximately 405 m^3/hour, via a 14km water pipeline and will be stored in the raw water storage pond.

The capacity of raw water storage pond is approximately 20,000 m^3, which can satisfy the water consumption of the plant for 2 days.

Emission Controls

The Project will be equipped with the following equipment:

- Dry Low NOx burners will be installed to achieve low NOx emissions; and
- Continuous Emissions Monitoring Systems (CEMS) will be installed with a CEMS which shall monitor the concentrations of SO_2, NOx, CO, O_2 and dust as well as temperature and flow.

0.4.4 Associated Facilities

The new MOGE gas receiving station will be installed by MEPE/MOEP for connection of the gas supply pipeline to the Power Plant is regarded as an associated facility.

In addition, the transmission connection beyond the upgraded Myingyan Steel Mill sub-station will be GOM's responsibility and therefore is classified as associated facility. The connection beyond the Myingyan Steel Mill sub-station transmission line is not known at this stage.

0.4.5 Project Life Cycle Overview

For the purposes of this report, the Project is divided into 3 phases: Construction Phase, Operation Phase and Decommissioning Phase.

Construction Phase

Construction is expected to start in the first quarter of 2016 and be completed in approximately 22.5 months, with commercial operation targeted at the first quarter of 2018.

Construction activities of the Project will include: mobilisation, site clearance, onshore construction of all Project components, Nyaung Hla jetty reinforcement and commissioning. Heavy equipment such as bulldozers, excavators, dump trucks, compactors, etc. will be used at the Project site.

The EPC Contractor will be appointed to undertake the engineering, procurement and construction activities of the Project. The EPC Contractor will be responsible for implementation of the mitigation, management measures and monitoring programme defined in this report under the Sponsor's supervision.

Operation Phase

The Project will be owned and operated by the Sponsor. The Operation and Maintenance (O&M) of the Project will be undertaken by the Sponsor with the support of a long term service agreement (LTSA) for the GT with the manufacturer. The LTSA will cover the supply of spare parts, supervision and specialized labour for inspections, major and minor overhauls.

O&M staff with relevant experience of operating similar plants and with adequate knowledge of comparable technology will be deployed prior to Simple Cycle commercial operation date (COD) to commission and take over the Project from the EPC Contractor.

Decommissioning Phase

The design life of the power plant is estimated to be 25 years. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided the required retrofits and new emission rates meet the applicable standards and guidelines.

If retrofitting is not feasible and the operational life of the Power Plant expires, the Power Plant will be decommissioned according to the requirements of the authorities at that time according to best industry practices.

0.5 ALTERNATIVE ANALYSIS

The main design criteria and project type were determined by MOEP to develop the competitive tender process and are therefore beyond the remit of this report.

However, the alternative analysis was conducted for the following aspects:

- Alternatives of the Project Location;
- Alternatives of Configuration on Site;
- Alternatives of Technological Options; and
- Alternatives of Temporary Landing for Heavy Cargo.

0.6 ADMINISTRATIVE FRAMEWORK

The Project will conform to the legal and administrative requirements of the Union Republic of Myanmar. The Project will also conform to international treaties to which

Myanmar is signatory, and to standards and safeguard policies of the Asian Development Bank (ADB) (2009), the International Finance Corporation (IFC) Performance Standards (IFC PS) (2012) and other associated guidelines.

0.6.1 Overview of Myanmar Legislation

The latest enacted Constitution (May 2008) provides information on governing laws and regulations in Myanmar. The Constitution takes precedence over any other national legislation or international agreements.

Myanmar is divided into twenty-one (21) main administrative subdivisions, which include:

- Seven states;
- Seven regions (Note that regions were previously referred to as “divisions”, prior to August 2010);
- Five self-administered zones;
- One self-administered division; and
- One union territory

States and regions are divided into districts. Districts consist of townships, which are composed of towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is defined in the Constitution.

Each region and state has a Regional/State Government, consisting of a Chief Minister, Ministers and an Advocate General. Legislative authority resides with the State/Regional “Hluttaw” (a parliament or legislative body), which are made up of elected civilian members and representatives of the military.

0.6.2 ESHIA Requirements in Myanmar

Myanmar currently does not have effectively implemented regulatory requirements for environmental, social and health impact assessments (ESHIA). However, a number of environmental laws are either pending or in the final stages of government approval, and the situation with respect to ESHIA requirements in Myanmar is expected to undergo significant imminent changes. As such, this section will highlight both the current and pending legislation with respect to ESHIAs.

The Myanmar Government has had plans to install new laws on ESHIA requirements since at least 2009. Laws related to ESHIA requirements (including those that are currently pending) are as follows:

- Environmental Policy, 1994, Myanmar Agenda 21, 1997, and National Sustainable Development Strategy, 2009;
- The Environmental Conservation Law, 2012;
- Environmental Conservation Rules (2013);
- Foreign Investment Law, 2012, Foreign Investment Rules, 2013, and Notifications for Investment, 2013; and
- Draft – Environmental Impact Assessment Procedure (Pending, currently on 8th Draft as of January 2015).

0.6.3 *International Standards and Applicable Guidelines*

In addition to national legislation, the Project will be undertaken to comply with a range of international standards, including the Asian Development Bank Safeguard Policy Statement, IFC Performance Standards (IFC PS), and the World Bank Guidelines. These standards are set to complement and reinforce national legislation and ensure the Project is conducted under best practices in a way that minimizes risks, impacts and ensures compliance and fair practices. The international performance standards and guidelines provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

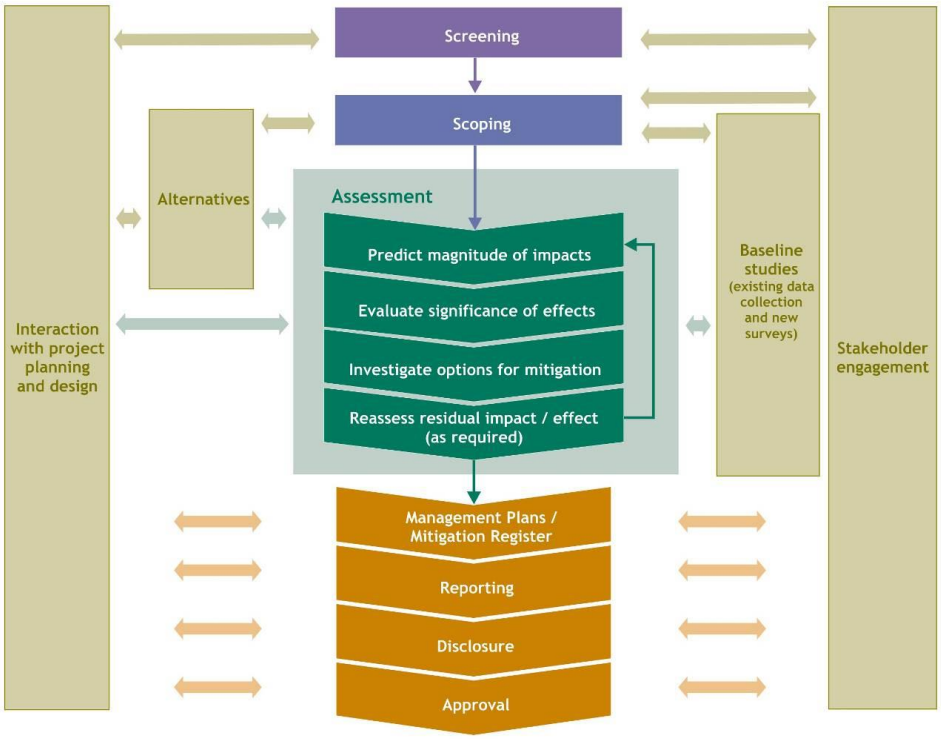
The applicable guidelines and standards for the Project are as follows:

- Asian Development Bank (ADB) Safeguard Policy Statement (2010);
- ADB's Social Protection Strategy (2001), ADB's Gender and Development Policy (2003) and ADB's Public Communication Policy (2003);
- The IFC's Performance Standards (IFC's PSs) (2012);
- IFC/World Bank Group (WBG) EHS Guidelines and WBG EHS Guidelines for Thermal Power (2007 and 2008);
- IFC's Stakeholder engagement handbook and other relevant Good Practice Notes;
- IFC's Handbook for Preparing a Resettlement Action Plan (if applicable)
- Kyoto Protocol to the UNFCC on Climate Change (1997);
- United Nations Convention on Biological Diversity (1992);
- Basel Convention (1989);
- Ramsar Convention on Wetland (1971); and
- International Union for Conservation of Nature and Natural Resources, Red List of Threatened Species (1964).

0.7 *IMPACT ASSESSMENT METHODOLOGY*

The ESIA methodology follows the overall approach illustrated in ***Figure 0.1***. The ESIA has been undertaken following a systematic process that evaluates the potential impacts the Project could have on aspects of the physical, biological, social/ socio-economic and cultural environment; identifies preliminary measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for potential adverse impacts; and identifies measures to enhance potential positive impacts where practicable.

Figure 0.1 Overall Impact Assessment Process



The stages of the ESHIA process are described below.

Screening

At the initial stage of the ESIA, preliminary information was provided to aid in the determination of what legal and other requirements apply to the Project. This step was conducted utilising a high level description of the Project and its associated facilities.

Scoping

It is to be noted that the IFC, with their role in providing MOEP with technical, legal, environmental and financial due diligence advisory services, has undertaken the scoping exercise and the Scoping Study was issued in May 2015.

During the scoping study, potential interactions between the Project, environmental and human resources/receptors were identified, and prioritised in terms of their potential to cause impacts of concern.

Project Description

In order to set out the scope of the Project features and activities, with particular reference to the aspects which have the potential to impact the environment, a Project Description has been prepared.

Baseline Conditions

To provide a context within which the impacts of the Project can be assessed, a description of physical, biological, social / socio-economic and cultural conditions that would be expected to prevail in the absence of the Project is presented. The

baseline includes information on all receptors and resources that were identified as having the potential to be significantly affected by the proposed Project.

It is to be noted that the IFC has undertaken the baseline study including the primary data collection for ambient air quality, noise level and surface water quality during July to December 2014.

Stakeholder Engagement

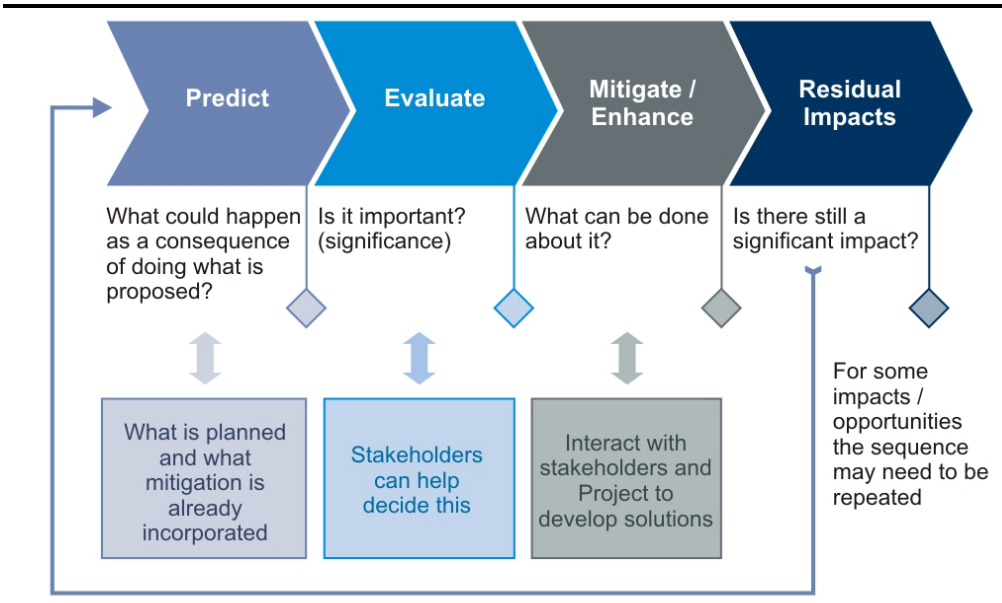
An effective ESIA Process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

Impact Assessment

Impact identification and assessment starts with scoping and continues through the remainder of the ESIA Process. The principal ESIA steps are summarized in ***Figure 0.2*** and comprise:

- **Impact prediction:** to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities;
- **Impact evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;
- **Mitigation and enhancement:** to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts; and
- **Residual impact evaluation:** to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure 0.2 ***Impact Assessment Process***



Identification of Mitigation and Enhancement Measures

Once the significance of a potential impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this ESIA, ERM has adopted the following Mitigation Hierarchy:

- Avoid at Source, Reduce at Source;
- Abate on Site;
- Abate at Receptor;
- Repair or Remedy; and
- Compensate in Kind, Compensate Through Other Means.

Management, Monitoring and Audit

The final stage in the ESHIA Process is definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

The Environmental and Social Management Plan (ESMP) has been developed as part of the ESIA report. The ESMP generally refers to the Project specific plan which will set out how the requirements, management and mitigation measures, and any other commitments will be implemented, managed and monitored. It will lay out information such as the responsible parties for implementing the Project commitment, any monitoring requirements and associated standards or thresholds, the timing of monitoring, check methods and corrective actions, and any training requirements.

0.8 DESCRIPTION OF THE ENVIRONMENT

The biophysical environmental baseline conditions within the Project Study Area are based on secondary data from published sources as well as primary data collected to fill data gaps.

The Project Study Area refers to the area that needs to be studied in order to adequately understand and describe the baseline conditions likely to be affected by the Project. The Project Area of Influence (AoI) varies according to the potential impacts on a resource or receptor (influenced by spatial and temporal dimensions). The AoI with respect to the biophysical baseline covers the Project Study Area. However, for air quality the AoI was extended to 10km from the Complex to consider stack emissions.

The baseline studies were carried out as part of the IFC Scoping Study (July to December 2014) and also as part of this report (January to June 2015).

0.8.1 *Climate and Meteorology*

Most of Myanmar belongs to the tropical region. The climate of Myanmar is roughly divided into three (3) seasons: Summer, Rainy Season, and Winter Season. Summer months are from March to Mid-May; the rain falls from Mid-May to the end of October and the Winter Season starts in November up to the end of February.

The Project Site is located in the central plain of Myanmar, and is primarily located in the Dry Zone of Myanmar, which includes the western and middle part of the Mandalay region; this region is the most susceptible to drought in Myanmar [(1)]. The region is characterised by low annual rainfall, with mean temperature of 27°C.

Dominant wind patterns in the Project Study Area are driven primarily by regular southwest (SW) monsoon wind in the rainy season and northeast (NE) monsoon wind in the winter or cold-dry season. These wind patterns are mediated by more mountainous terrain to the west and east. Localized meteorological conditions are also influenced by diurnal thermal cycles and cloud cover.

0.8.2 Ambient Air Quality

Ambient air quality monitoring was undertaken at 5 selected baseline air sampling locations, located in the vicinity of the Project Site. NO_2, SO_2, PM_{10} and $PM_{2.5}$ were measured at the selected baseline air sampling locations for 7 consecutive days each month from July 2014 to June 2015.

The baseline results show that SO_2 levels at Myingyan Project site were considered low (typical of rural area with low emission sources) whilst NO_2 levels were above the WHO annual ambient air quality standard. Tailpipe emissions on the adjacent roads (in particular motorcycle), the operation of the steel mill and the general background are the potential sources of the relatively high measured NO_2 concentration. Background PM levels also showed higher concentrations during winter months (October to March) compared to summer months (July to September). Higher PM_{10} and $PM_{2.5}$ concentrations measured is likely due to local activities, especially burning of wood for cooking by nearby residents and unpaved road dust.

0.8.3 Noise

Baseline noise monitoring was conducted at 4 existing noise sensitive receivers (NSRs) located near the Project Site from July to September 2014 and from February to June 2015. Hourly A-weighted equivalent continuous sound pressure levels (LAeq, 1 hour) were recorded continuously over 24 hours at each location during both weekday and weekend. At each location, daytime and night-time LAeq were calculated by averaging the hourly sound pressure levels measured between 0700 and 2200 hours and between 2200 to 0700 hours, respectively.

Daytime background noise levels at 2 NSRs exceeded the IFC guideline values; while night-time background noise levels at all NSRs exceeded the IFC guideline values.

0.8.4 Surface Water Quality

The Project Study Area is characterised by a flat terrain, with gentle undulating slopes towards the inlands. The Project Site is located approximately 14km from the Ayeyarwady River bank. During the low water season (December through May), riverine morphology alternates between single and multiple channel reaches, the latter created by sand island deposits that emerge near the mouths of convergent tributaries and above and below channel constrictions.

(1) http://lift-fund.net/downloads/Component%203%20Final_19Aug13.pdf

Flow measurements in the southern channel of the Ayeyarwady River were conducted at the surface, mid-depth and bottom of the water column twice a month from July to December 2014 during preparation of the Scoping Report and during February to April 2015, as part of this ESIA study. Flow rates at the sampling location have been estimated to be in the range of 64 m^3 /s (measured on March 28, 2015) to 660 m^3 /s (measured on August 8, 2014).

Water quality monitoring was conducted near the Project's planned cooling water intake in the Ayeyarwady River between July 2014 and December 2014 and February 2015 and April 2015 and also in June 2015. Parameters that were sampled and analyzed include pH, DO, COD, BOD5, Oil and Grease, TN, TP, TSS, Total Coliform, water temperature, channel depth and flow velocity. With the exception of TSS, total coliform bacteria, and iron, all other monitored parameters were found to be below the WBG/IFC guideline values.

0.8.5 Soils

Soils in the Project Study Area are classified as Vertisol Soils. The soils are deep and mostly composed of clayey materials. Their low fertility and declining organic matter level make them difficult for farming, especially under excessively dry or wet conditions.

Soil samples were taken using the standard agricultural sampler (Soil Auger), at 8 locations within the Project Site. Top soil was collected from 10 - 30 cm in depth and sub soil from 2.7 - 3.0 m in depth.

The results show that heavy metals and hydrocarbons were found to be well below the relevant WBG/IFC/WHO guideline values.

0.8.6 Groundwater

Groundwater in the Myingyan region is dependent upon natural recharge from Ayeyarwady River and the upper watershed. Declining groundwater levels in the region have occurred due to associated environmental degradation of water sources, as well as uncontrolled excessive pumping of wells. Siltation, accumulation of waste, and encroachment on the channel areas contribute to reduced drainage capacity.

Groundwater samples were taken at 8 locations around the Project Site, from 16th to 20th June, 2015. For a range of commonly measured and reported parameters including (but not limited to) BOD, TSS, Total Hardness, metals, arsenic, cyanide and fluoride, all were noted to be within the appropriate WBG/IFC/WHO guidelines for drinking water. However, Chemical Oxygen Demand (COD), Total Coliform and Sulfates exceeded the established guidelines.

0.8.7 Landscape and Visual

The Project AOI is characterized by flat terrain, with gentle undulating slopes towards the inlands. The Project AOI is also regarded as predominately rural comprising of agricultural land and scattered village settlements.

The Project site also comprises the Aggreko 95 MW temporary gas-fired power plant which began operation in April 2015. The temporary gas-fired power plant will be decommissioned once the Power Plant is in operation. The existing steel mill, transmission lines and transmission towers are the most dominant features in the landscape. The construction activities associated with Phase 2 of the steel mill are also dominant features.

0.8.8 Waste

The Mandalay City Development Committee is the responsible agency for waste management in the Mandalay region. Currently, there are existing problems in the Municipal Waste Management system due to a lack of equipment (e.g. vehicles) and personnel, improper collection and management of disposal sites, which are mostly run as semi-landfill systems, lack of awareness and cooperation from the public, and lack of awareness in solid waste management. There are currently no recycling facilities in Myanmar.

The feature of solid waste collection in Myanmar is essentially labour-intensive work and mainly relies on manual labour and non-specialized vehicles. Waste collection systems include block collection, communal depot collection, house-to-house collection, limited collection, and street sweeping. Currently, recycling of municipal waste is not fully and systematically developed as the budget allocation covers only routine works. Also, a framework for hazardous waste management has yet to be developed in Myanmar.

0.8.9 Terrestrial and Marine Biodiversity

The Project area resides within the dry zone of central Myanmar. According to the World Wide Fund for Nature (WWF) Wildfinder database, it is located in the Ecoregion known as the Irrawaddy Dry Forests, which have been under intensive conversion pressure to agriculture. In recent years the larger mammal fauna have been hunted to the brink of extinction. The conversion of forests to agricultural land and illegal cutting of timber causes loss and fragmentation of the habitat, while intense poaching of protected animals and the lack of political will to conserve this and other ecoregions in Myanmar leaves the remaining forests devoid of wildlife.

In Myanmar, Key Biodiversity Areas (KBAs) fall in different land management categories including protected areas, public protected forests, community-conserved forests, community forests, reserve forests and other resource and land use areas. The KBAs closest to the Project Site include the Ayeyarwady River (Bagan Section), Minsontaung Wildlife Sanctuary (W.S.), and Popa Mountain Park (Critical Ecosystem Partnership Fund, 2012). The Ayeyarwady River is the country's largest river and home to a large diversity of animals, including about 43 fish species. The Bagan Section of the river is recognized as a high priority KBA and is about 60 km away from the Project Site.

Flora Survey was conducted in June 2015. A Global Positioning System was used to navigate and mark coordinates between sample plots around the proposed Project area.

A total of 10 sample plots (3mx3m in size) were set up and observed during the study period. Care has been taken to cover overall spectrum of species diversity.

In order to obtain essential ecological data for flora, habitat types were classified. Three habitat types were identified in the project area: cultivated land; developed area; and the area of vegetation with grass, shrubs and small trees. All are considered as modified habitat as defined by IFC PS6.

Fauna Survey was also conducted during the same period as Flora Survey on birds, mammal, reptile and amphibian, butterfly, fish and plankton. No threatened species were found in the Project area.

0.9 DESCRIPTION OF THE SOCIO-ECONOMIC BASELINE

Myanmar is divided into a number of States and Regions (sometimes also referred to as Divisions), which are further divided into Townships for governance purposes. The Project site is located in the Myingyan Township in the Mandalay region.

Receptors that may be impacted or influenced by the Project due to their proximity to the Project site and/ or Project associated facilities includes:

- Sa Khar village;
- Hnan Ywa village;
- Hpet Taw village;
- Nyaung Kan village;
- Gyoke Pin village;
- Thien Ywa;
- Tha Pyay Thar village; and
- The temporary accommodation located adjacent to the Project site, which is home to approximately 30 people.

A desktop review of publicly available information was conducted, and primary data was collected through a visit to the Project site. Primary data were collected through a variety of methods so that the data could be triangulated. This included:

- Key informant interviews with village leaders.
- Focus groups with key sectors within each of the villages.
- Household surveys (total of 300 household surveys).

0.9.1 *Demographic Profile*

As of 2013, it was estimated that the population of Myanmar was approximately 53 million, with an annual growth rate of approximately 1% (CIA 2015). The population in the Mandalay region is approximately 6.2 million, making it the second largest region in the country in terms of population, behind Yangon, which has a population of approximately 7.3 million.

Much of the population in Myanmar lives in rural areas. As of 2014, it was estimated that approximately 65.7% of the population lives in rural areas, while 34.3% of the population resides in urban areas. Myingyan township has a population of

approximately 1 million people, most of whom (approximately 888,006 people) live in rural areas.

The largest ethnic group in Myanmar is the Burmans, which make up more than half of the population (68%). This is followed by Shan (9%), Karen (7%), Rakhine (4%), Chinese (3%), Indian (2%), Mon (2%) and other (5%).

0.9.2 Community Health

The life expectancy in Myanmar is 64 years of age for men and 68 years of age for women. The leading causes of morbidity are largely associated with communicable diseases and pregnancy/ child birth. In terms of mortality, again the leading causes are largely associated with communicable diseases i.e. human immunodeficiency virus (HIV)/ acquired immune deficiency syndrome (AIDS).

The prevalence of communicable diseases can be exacerbated by availability of and access to clean drinking water and sanitation facilities. For the Mandalay region, there is better access to sanitary latrines when compared to the broader population, with coverage of 96.7% for urban areas and 78.9% for rural areas. Access to improved drinking water in the Mandalay region was available to 87.7% of the population (Public Health Statistics 2012; Ministry of Health 2014).

According to the Ministry of Health, in 2012, Myanmar had 987 public hospitals with a total of 54,503 beds. In addition to existing health facilities, the use of traditional medicine is widespread and forms an integral part of the country's health services.

0.9.3 Economy and Livelihood

In 2013/2014, Myanmar's gross domestic product (GDP) was estimated to be $56.8 billion. This means that the per capita GDP is approximately $1,505 - one of the lowest in Southeast Asia (World Bank 2015). In fact, nearly one-third of the country's population lives in poverty.

The key sectors of the economy include agriculture, forestry and fishing.

Agriculture

Traditionally, Myanmar has been reliant on the agriculture sector (and to a lesser extent forestry and fishing). Approximately half of all agricultural land in Myanmar is devoted to cereal crops, such as rice. Other agricultural products include beans, sesame, groundnuts, sugarcane, and hardwood. Cereals appear to be the most prominent crop in the Project area.

Forestry

The Myanmar Timber Enterprise (MTE), a government-owned company, manages the timber within the country. The focus is largely on teak and other hardwoods.

The dragging of logs is done mainly by elephants and, to a lesser extent, water buffalo. This process is referred to as skidding. The use of animals in log extraction is considered to have a lower impact on the environment than other methods.

Fisheries

The fishing industry contributes approximately 8% to GDP. The industry is separated into three components – inland fisheries, marine fisheries and aquaculture. The marine sector makes up approximately 52% of the industry, followed by inland fisheries (27%) and aquaculture (20%).

0.9.4 Community Infrastructure and Public Services

The limited access to and the poor state of existing infrastructure and services have been identified as impediments to development in Myanmar. This includes the provision of basic health and education services, as well as other infrastructure such as roads, telecommunications, drinking water and waste management (World Bank 2015).

Access to Electricity

In terms of lighting, a range of sources are available. The most commonly used are electricity, candle, and batteries.

The access to electricity is likely to change in the future given the investment that the Myanmar government is making in the power sector. A number of new power plants are being developed in order to provide an increasing number of people with electricity.

Transportation

A variety of transport methods are used in Myanmar, including roads, rail, air and water. In some areas the various modes of transport are well developed, while in other areas they are quite limited.

Central Myanmar, where the Project is located, has a relatively well developed transport system compared to other parts of Myanmar, including road, air, rail, and water. Due to its geography, central Myanmar, particularly Mandalay acts as the central hub for transport of people and goods with destinations further north, east and west in the country, as well as to China and India.

0.9.5 Cultural Heritage

Desktop study supplemented by field survey conducted between 7 and 16 July 2015 identified no known archaeological resources; three items of ancient above ground resources and 20 items of living heritage sites within the cultural heritage study area. All the identified items are pagoda complexes and monasteries. Most of these items are located within or in close proximity to human settlements. The villages located within the cultural heritage study area include Tha Pyay Thar, Nyaung Kan, Hpet Taw, Hnan Ywa, Thein Ywa and Gyoke Pin. No tangible cultural heritage resources were identified within the project's footprint (i.e. the CCGT plant site boundary and proposed water intake pipeline).

No significant intangible cultural heritage (e.g. tradition, ritual and religious practice, ceremonies) was identified through interview with villagers and stakeholder's meeting.

0.10 STAKEHOLDER ENGAGEMENT

Project stakeholders have been engaged at a number of points during development of the ESIA. The focus of the engagement activities has been to:

- Introduce the Project and provide ongoing updates as the design of the Project is further refined;
- Provide an overview of the likely impacts and proposed management measures and corresponding monitoring activities;
- Gather stakeholder insights and input, including feedback on the identified impacts, proposed management measures and monitoring activities; and
- Respond to key issues raised by stakeholders.

Stakeholders were encouraged to ask questions and raise concerns throughout the engagement process. A range of issues and concerns were raised by stakeholders. Key issues included:

- Employment. Most of the villages indicated that they would like to benefit from the employment opportunities that will be created by the Project;
- Availability and quality of surface and ground water. Stakeholders expressed concern that Project activities (e.g. discharge of waste water, use of water from the Ayeyarwady River) may impact the quality of water and/ or reduce the amount of water available for use by local villagers;
- Access to electricity. Many of the Project area villages do not have access to reliable electricity. There is a keen interest from villagers to be address this issue through the Project;
- Health implications. Stakeholders indicated that they were concerned about the health implications associated with air emissions that will be generated by the Project during construction and operation, and the potential for an increase in the transmission of communicable diseases; and
- Noise. Stakeholders expressed concern about the noise that will be generated by the Project, as it may disrupt local village activities.

The issues and concerns captured during the stakeholder engagement activities have been incorporated into development of the ESIA. The information has been used to inform the impact identification and assessment process as well as the identification of management measures and monitoring activities.

Engagement will continue to occur throughout construction and operation of the Project, in line with Sembcorp's Stakeholder and Community Engagement Policy, the IFC performance standards and ABD safeguards.

0.11 KEY ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

All construction and operation activities that were likely to cause environmental and social impacts were identified, and evaluated to assess their magnitude, duration, and potential receptors.

0.11.1 Construction Phase

The activities which have the potential to cause impacts on surrounding environment and receptors during the construction phase are identified as:

- Site preparation;
- Transportation of construction material and machinery for the power plant by road/ rail and heavy machinery/ equipment by barges up to temporary jetty location;
- Dredging of water channel up to the temporary jetty depending on available water depth during the heavy lift transportation;
- Construction of a temporary jetty, water pipeline, gas pipeline and transmission line;
- Excavation of equipment foundations and installation of power plant components;
- Laydown areas for temporary use during construction phase;
- Storage and handling of hazardous materials, waste and wastewater; and
- Accommodation and transportation for the construction workforce and the Sponsor personnel.

Air Quality

The construction activities of the Project that may potentially generate air quality impacts involves site clearance, site formation and levelling, as well as construction of substructure and superstructure of the power plant facilities. It is anticipated that the dust arising from the dust generating activities and air emissions from construction vehicles and non-road machinery within the construction site boundary are the key concerns during construction of the Project.

With the implementation of the recommended control measures (namely, the dust suppression measures and good site practices at the construction worksites), the magnitude of the air quality impact is considered to be minor.

Greenhouse Gas

During construction, the Project will involve Scope 1 and Scope 2 emissions as follows;

- Scope 1 direct emission mainly from construction site equipment and site vehicles and vessel transportation; and
- Scope 2 indirect emission from purchased electricity from external provider in Myanmar.

Based on the calculated GHG emissions, the emissions from the construction phase (22.5 months) are estimated to be 9,126.94 tonnes CO_2e (Scope 1 and Scope 2). This is considered insignificant emissions according to IFC. GHG emissions are global pollutants. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Although overall the atmosphere is sensitive to impacts from GHG emissions, the local atmosphere is not expected to be any more or less sensitive to potential impacts to GHG.

Surface Water Quality

During the construction phase, potential water quality impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, and sedimentation.

Potential impacts to surface water quality are expected to be short-term and localised in nature, and can be controlled with the implementation of good construction practices and adequate wastewater treatment systems on-site. Therefore, the residual impact is considered to be minor.

Noise

The construction activities of particular importance for potential noise impacts are: Site preparation, pile driving and foundation works, Installation of equipment and Construction of the infrastructure such as internal access roads, storm water drains and security fence.

The construction contractor will ensure that construction noise is adequately controlled to avoid nuisance and not normally exceed the applicable Guidelines. Work will not be carried out at night without notification to the local communities and the local authorities. Further mitigation measures as regular maintenance of construction equipment, noise barriers/enclosures etc. are proposed to further reduce noise level. With the implementation of these measures, the residual noise impact from construction is expected to be minor.

Landscape and Visual

Construction of the Project will result in a change to the visual character of the landscape. However, the Project is located within Industrial Complex (with existing steel mill) which has a low sensitivity. The initial construction will directly impact the character of this area and resulting in a significant contrast with the existing nature of the site. In order to reduce all impacts, the proposed mitigation measures (refer to Chapter 17) will be implemented, together with specific consultation with people from the surrounding villages to obtain their suggestion in terms of additional mitigation measures (if required). The residual impact is considered to be minor.

Soil and Groundwater

During construction phase, the following impacts to soil and groundwater may occur:

- Loss of soil structure, quantity and quality due to improper management during site clearance activities;
- Changes to groundwater levels during development due to abstraction/dewatering (if necessary);
- Soil and groundwater contamination due to potential leaks, spills and contaminated fill materials during all phases of Project construction;
- Soil and groundwater contamination due to improper construction waste storage and disposal; and
- Soil and groundwater contamination due to improper discharge of waste water discharges and runoff.

Construction of the Project will be carried out by the EPC Contractor appointed by the Sponsor. The EPC Contractor will handle, store and dispose of all waste in accordance with applicable guidelines to prevent soil and ground water contamination. With other mitigation measures such as proper storage of chemicals and fuel, drip or spill trays for spills and leaks, site specific emergency response plan for soil clean –up and training by contractors, demarcating routes for heavy vehicle movement, retaining top soil for reuse, the impact to soil and groundwater would be mostly negligible or minor.

Waste

During the construction phase, a range of waste materials will be generated either due to the daily activities of the construction workforce (e.g. generation of putrescible waste) as well as a range of general construction waste such as concrete, steel pipes, plastic pipes, steel plates, structural steel and wooden crates during the civil works phase of construction. Whilst most of these are likely to be non-hazardous, some of these may be hazardous include used paint, engine oils, hydraulic fluids, spent solvents, spent batteries etc. Improper waste management may result in indirect impacts to community and work health and safety due to contamination of drinking water or food; accidental leaks or spills of oil, fuel or other hazardous materials could potentially pollute surface waters; and soil may be contaminated by pollution from spills or leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored. Implementation of proper mitigation measures including waste management plan (both non-hazardous and hazardous) will minimise the impacts. With implementation of the mitigation measures, the residual impact is expected to be minor.

Terrestrial and Marine Biodiversity

Construction activities such as clearance of vegetation at the Project site, jetty location, transportation route near jetty and excavation of gas pipeline laying will create disturbance to habitat in modified and natural habitat areas, which has the potential to impact the local and downstream biodiversity as well as impacts to priority biodiversity values.

Mitigation measures can be implemented to manage the disturbance during construction such that biodiversity values are not significantly impacted or impacts are reduced by the application of the mitigation hierarchy.

Community Health and Safety

The community health and safety impacts, as those associated with changes in environmental conditions, increased prevalence of diseases and heavy traffic movement are assessed as minor. Impacts due to construction workers camp, laydown areas and logistics on the community health and safety will be temporary and can be considered as minor to moderate.

Social Impacts

In terms of overall social impact, the construction phase in one hand will generate employment, benefit local enterprises, while on the flipside will cause labour influx,

cause some displacement/disruption of communities, and will have noise and dust impacts to some extent. The Project benefits will either reduce or disappear at the end of construction phase. Mitigation measures include maximising local procurement and employment to reduce and manage influx, labour management measures, ensuring no local resources are indiscriminately used by the Project, developing resettlement and livelihood restoration plan, developing compensation plan, consultation with stakeholders, review of land acquisition/procurement, health interventions etc. The residual impact is expected to remain, however, it is considered to be minor.

Cultural Heritage

There are no potential ancient above ground resources. There is also no indication that a large, complex archaeological site is located within the Project site. However, Pagoda complexes were identified in close proximity to the site. Also, based on the number and diversity of known archaeological sites in northern Mandalay state there is the potential for subsurface archaeological resources to be present within the Project area. A cultural heritage baseline survey was conducted and found no archaeological resources within the Project footprint, and no significant intangible cultural heritage. A Chance Find Procedure will be developed for the Project.

0.11.2 Operation Phase

Air Quality

The key emission source associated with the operation of the Project is stack emissions from the combustion of natural gas during combined cycle and simple cycle operation.

With the built-in dry low NOx burners to reduce NOx emission at stack to below 25ppm at all times, the impacts from the stack emissions at identified ASRs, during normal combined cycle operation or simple cycle operation, the impact is considered small as the maximum Project contribution is between 10% and 15% of relevant air quality standards for degraded airshed.

Greenhouse Gas

During operation phase, electricity for the Power Plant will be supplied by the Plant itself, so there would be no Scope 2 emissions to consider. Scope 1 emissions of GHG from the plant operation will mainly come from the gas turbine generators.

The estimated GHG emissions from the Power Plant during operation will exceed the threshold that defines significant emitters of GHGs by the ADB SPS and EP III (100,000 tonnes CO_2e per year) and IFC PS3 (25,000 tonnes CO_2e per year). Therefore, the Project is required to implement measures for GHG reduction, and report annual GHG emissions as per the applicable reference framework.

Surface Water Quality

During the operation phase, potential surface water impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal,

contaminated surface water runoff, cooling water withdrawal and discharge, impacts to surface water hydrology, erosion, and sedimentation.

As the wastewater generated at various areas of the plant will be collected and treated at the wastewater treatment plant, meeting the discharge standards of the World Bank/ EHS guidelines, the impact is considered to be minor.

Noise

The sources of noise associated with the operation of the power plant are expected to include the heat recovery steam generators (HRSG), gas turbines, steam turbine and cooling tower.

With the proposed plant inventory and its corresponding source level (i.e. 85 dB(A) at 1m from the plant items) to be used during operational phase, results of the assessment indicate the noise associated with the operation of the Project will comply with the IFC guideline with no more than 3 dB(A) increase in background noise during operation. It is therefore not anticipated that adverse noise impacts will occur during the operational phase of the Project.

Landscape and Visual

The long term presence of the Project is anticipated to have impacts upon both the landscape and visual amenity. However, the presence of the Project will add another industrial component into the Industrial Complex area, which already contains an existing steel mill (undergoing expansion). The effect of introducing this into the area will likely have minimal impacts.

Soil and Groundwater

During the operation phase, potential soil and groundwater impacts may arise from:

- Loss of soil due to increased erosion potential during operations;
- Soil and groundwater contamination due to potential leaks, spills and leaks;
- Soil and groundwater contamination due to improper construction waste storage and disposal; and
- Soil and groundwater contamination due to improper discharge of waste water discharges and run-off.

It is noted that soil and groundwater contamination due to improper waste storage and disposal would be the result of contaminated surface water run-off being discharged from waste storage and disposal areas. Therefore, the impacts and mitigation measures are also discussed in surface water quality and waste management sections. With the implementation of good site practices and controls, the residual impacts are considered to be minor.

Waste

The impacts on surface water, soil and groundwater contamination from generation of hazardous and non-hazardous wastes are assessed as minor. The operations of the proposed Project would result in generation of various types of non-hazardous and

hazardous wastes from office and canteens; gas turbine; laboratories; compressors; lube oil systems; DG sets; and power house and workshop area.

The solid and non-hazardous wastes generated from the various areas during operations will be collected and segregated at the point of generation and stored in proper designated areas and disposed of through waste disposal contractors. It is planned that hazardous wastes generated from the proposed Project will be collected and stored in designated roofed-areas and/or barrels with concrete flooring and secondary containment and disposed of/ sold through contractors or treated prior to discharge. Further mitigation measures as proper labelling of hazardous wastes, periodic audits, spill response and emergency plans and manifest records will be maintained. With implementation of the recommended mitigation measures, residual impact significance would be negligible.

Terrestrial and Marine Biodiversity

Operational activities that have potential to disturb native fauna include the use of night lighting at infrastructure and facility locations. Lighting required for operation and safety at the facilities can influence nocturnal foraging behaviours as well as disrupt sleep patterns of crepuscular species. In addition, mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during transmission line maintenance vegetation clearing activities. However, the impact significance is considered to be negligible. There are also no residual impacts to biodiversity values identified that require be offsetting or compensating.

Community Health and Safety

During the operation phase of the Project, Community health and safety issues as hazardous material handling and storage and traffic movement was considered for impact. Impact on traffic in the operational phase of the Project is assessed as negligible as the total manpower will be limited to 80, their transportation will not lead to any impact on road safety of the nearby communities using the access road.

A Quantitative Risk Assessment (QRA) for gas leakage from the Fuel Gas Pipeline from the MOGE Gas Station was conducted. It was concluded that the Individual Risk and the Societal Risk associated with the Fuel Gas Pipeline is compliant with the risk criteria determined in UK HSE Risk Guidelines and BS PD 8010 Part 3 respectively.

Social Impacts

Some of the social impacts predicted due to the operations of the Project are Employment Generation and In-Migration of Skilled workforce, Demand for lodging, housing and civic services, Increments in cost of living, Opportunity for local transporters and Risks of industrial accidents and fatalities to workers. The impacts as employment generation, demand lodging, housing and opportunity for local transporters would be positive where as other would be creating negligible impacts.

Cultural Heritage

There are no potential ancient above ground resources. There is also no indication that a large, complex archaeological site is located within the Project site. However, Pagoda complexes were identified in close proximity to the site. Also, based on the

number and diversity of known archaeological sites in northern Mandalay state there is the potential for subsurface archaeological resources to be present within the Project area. A cultural heritage baseline survey was conducted and found no archaeological resources within the Project footprint, and no significant intangible cultural heritage. A Chance Find Procedure will be developed for the Project.

0.12 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

0.12.1 Mitigation Measures

Many of the mitigation measures suggested during the construction phase of the Project associated with good construction and housekeeping practices and are included in the Environmental and Social Management Plan (ESMP).

Mitigation measures for the operation phase (such as those for air emissions and noise generation) of the Project are part of the design and will be incorporated into the Project design specifications.

The construction phase of the Project is anticipated to be 22.5 months, whereas the operation phase of the Project is 22 years, as per the Power Purchase Agreement.

A summary of mitigation measures identified for the construction and operation phases of the Project is presented in the ESMP. This also identifies lead responsibility for implementing of the mitigation measures and its verification along with reporting requirements and sources of funds for such implementation.

The Sponsor will ensure that the mitigation measures stated in the ESMP are implemented throughout the life span of the Project.

0.12.2 Monitoring Programme

Key roles and responsibilities of the Sponsor and the appointed EPC contractor have been defined for implementation and monitoring of environmental and social impacts. For environmental monitoring, physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator will be prepared for all phases of the Project which gives parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

0.12.3 TRAINING PROGRAMME

Prior to commencement of construction activities at site, a suitably qualified in-house/ external expert will be appointed by the EPC contractor in consultation with the Sponsor to develop and deliver a training programme on implementation of the ESMP. Environmental and social monitoring programme and reporting will be implemented in line with the applicable reference framework for the Project.

Prior to the commencement of the Plant operation, a suitably qualified in-house/ external environmental expert will be engaged by the Sponsor to develop and deliver a training programme on operation phase environmental monitoring and reporting. The topics will be mostly same as that during the construction phase. The reporting

and verification will be semi-annual during construction phase and annual during operation phase and the reports will be submitted to the relevant authorities (i.e. MOEP) and the Lenders.

0.13 CONCLUSIONS

The environmental assessment of the Project ascertains that the Project is unlikely to cause any major environmental impacts. Many of the impacts are localised and short-term or temporary in nature and can be readily addressed based on the built-in mitigation measures in the engineering design of the Project.

It is to be noted that the results from baseline air quality monitoring shows that the existing conditions are considered as degraded airshed, this is possibly due to the operation of the existing Steel Mill. However, the built-in dry low NOx burners will be installed in order to reduce NOx emission at stack to below 25ppm at all times. Therefore, the impacts from the stack emissions at identified ASRs, during normal combined cycle operation or simple cycle operation, is considered small as the maximum Project contribution is between 10% and 15% of relevant air quality standards for degraded airshed.

In terms of social aspect, the results from stakeholder engagement indicate that the Project has received favourable support from local people and other stakeholders. Stakeholders appreciated that in addition to providing a reliable power supply to the region, the Project will have several other benefits such as supporting economic growth in the region, potential employment (direct and indirect) and improving local infrastructure.

In addition, the Environmental and Social Management Plan (ESMP) has been prepared as part of this report to manage and mitigate such impacts, a range of measures have been developed to reduce the overall impacts to acceptable levels and as low as reasonably practicable.

The effective implementation of the ESMP and adherence with the ADB SPS and IFC guidelines will assist in minimising the environmental impacts to acceptable levels..

1 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This Environmental and Social Impact Assessment (ESIA) report presents an assessment of the potential environmental and social impacts associated with the proposed 225MW Combined Cycle Gas Turbine (CCGT) power plant and Project facilities in Myingyan Township, Mandalay Region, Myanmar ('the Project').

This report has been prepared for **Sembcorp Utilities Pte. Ltd.** (hereinafter referred to as **'the Sponsor'** or **'Sembcorp'**) by **Environmental Resources Management** (hereinafter referred to as **'ERM'**) and presents the objectives, methodology and outcomes of the ESIA study.

1.2 PROJECT BACKGROUND AND OVERVIEW

The Sponsor has been selected by the Ministry of Electric Power (MOEP) of the Government of Myanmar (GOM) as a private sector Independent Power Producer (IPP) to develop the Project on a Build, Operate and Transfer (BOT) basis in Myingyan Township, in the Mandalay region in Myanmar. The Project comprises of the following Project facilities:

- 225MW CCGT Power Plant;
- Gas Supply Pipeline;
- 230kV Overhead Transmission Line; and
- Water Supply Pipeline, Wastewater Discharge Pipeline and Water Intake Pumping Station.

The Project will proceed to invest and establish a CCGT power plant with international financing provided by Asian Development Bank (ADB), International Finance Corporation (IFC), and other banks which have adopted the Equator Principles (EPs) as syndicates.

The technology of the Project is an efficient form of CCGT power generation which was designed for high reliability and efficiency operation with lower environmental impact. The Project will operate on natural gas as its only fuel. Complete details on the Project description are provided in ***Chapter 2***.

The electrical capacity and electricity generated will be sold under a 22 year Power Purchase Agreement ("PPA"), as agreed with MEPE.

ERM has been commissioned by the Sponsor to prepare this ESIA report in order to align the Project with Myanmar's regulations, and international standards/guidelines, as described in ***Chapter 3***. The report incorporates the findings and recommendations from the Scoping Report[(1)] and provides additional studies and assessment work in a wider scoped Environmental and Social Impact Assessment.

(1) Myingyan IPP Project – Environmental & Social Consultancy Services in support of Transaction Advisory Services for Private Sector Participation – Scoping Report – Revision 4 – 18th May 2015

As part of the ESIA development process, field surveys, consultation, air quality modelling, noise modelling and Quantitative Risk Assessment (QRA) for the gas pipeline were undertaken in conjunction with extensive social studies, to develop the ESIA and outline the ESMP.

It shall be acknowledged that not all aspects of the Project are considered "detailed design". Design is ongoing and some layout logistic components will only be finalised once the EPC contractor is appointed. This phased-approach is common practice in large projects, i.e. a phased assessment commensurate with the design details available.

1.3 PROJECT NEED

Parallel to growth in GDP, electricity demand in Myanmar has increased dramatically in recent years. ADB released a report on Myanmar's energy sector in October 2012 in which the future power demand was estimated to be doubling from 12,459 million kWh in 2012-2013 to 25,683 million kWh in 2018-2019 (ADB, 2012).

As at July 2013, Myanmar's power is predominantly generated from hydropower, gas and coal, representing over 70%, 22% and 3% of the total power generation respectively. [1] Out of the 3,735 MW of total installed capacity, approximately 835 MW is of gas-fired power generation. Due to the lack of water during dry season, hydropower generation has not been able to operate at full capacity and therefore electricity supply has been unstable during that time.

To reduce the country's reliance on hydropower, MOEP in its five year plan (2011/2012 to 2015-2016) has set an ambitious target to add 1,740MW of gas-fired generation capacity by 2015-2016, which will increase the gas-fired capacity to over 50% of the total generation mix. [2]

In addition, given that the new gas supply will become available from the Shwe Gas Supply pipeline, the proposed development of a combined cycle gas turbine power plant in Myingyan Township, Myanmar will contribute towards a power source for adding capacity required to cover the shortfall in Myanmar.

1.4 PROJECT SPONSOR / PROJECT DEVELOPER

Sembcorp Utilities Pte. Ltd., a subsidiary of Sembcorp Industries (SCI), is the main Project Sponsor for the Project. SCI is a leading energy, water and marine group operating across six continents worldwide. With facilities with over 8,200 megawatts of gross power capacity and over 9.5 million cubic metres of water per day in operation and under development, SCI is a trusted provider of essential energy and water solutions to both industrial and municipal customers. It is also a world leader

(1) MEPE (2013). http://www.ubifrance.com/medias/press/mepe_9_7_2013_29_31.pdf Accessed 8 June 2015.

(2) Sharma, Vikas (2013). An Overvoew of Electricity Market in Myanmar. http://www.slideshare.net/VikasSharma128/myanmar-electricity-industrydec2013 Accessed 8 June 2015.

in marine and offshore engineering as well as an established brand in urban development.

The SCI Group has total assets of over S$17.2 billion and employs more than 8,000 employees. Listed on the main board of the Singapore Exchange, it is a component stock of the Straits Times Index and several MSCI and FTSE indices. SCI's key facts are highlighted in ***Table 1.1***.

Table 1.1 Key Facts of SCI

Key Facts	Descriptions
Year of Incorporation	1998
Listing	Singapore Exchange (SGX)
Market Capitalisation	S$8.0 billion
Shareholders	Temasek Holdings – 49.5% Public – 50.5%
Number of Employees	Over 8,000
FY2014 Turnover	S$10.9 billion
FY2014 Net Profit	S$ 801 million
Key Business	Sembcorp Utilities – 100% Sembcorp Marine – 61% Sembcorp Development – 100%
Global Presence	Singapore, China, India, Indonesia, Philippines, Vietnam, Myanmar, Australia, Oman, UAE, South Africa, Norway, UK, Panama and the Caribbean, Brazil, Chile

Source: (Sembcorp 2015)

1.5 ENVIRONMENTAL, SOCIAL AND HEALTH EXPERTS

Environmental Resources Management (ERM) has been contracted by the Sponsor to prepare an ESIA report for the Project. This report presents the objectives, methodology and outcomes of the impact assessment.

ERM is the world's leading provider of environmental, health and safety, risk and social consulting services. As a global organization with an unparalleled pool of expertise, ERM is uniquely able to leverage prior project experience to efficiently deliver projects of any size in a responsive and flexible manner.

ERM has high international standing, and an unrivalled track record in preparing successful Environmental and Social Impact Assessments (ESIAs) for high profile and often controversial development projects. ERM has over 20 years' experience undertaking ESIAs for the power sector worldwide, including many high profile power projects.

For this Project, ERM has selected the qualified sub-consultant, **Resource and Environment Myanmar Co., Ltd (REM)**, who has experience in carrying out the baseline survey and public consultation meetings in the local context. Note that all the works provided by REM are under ERM supervision.

REM is a leading resource and environmental consultancy firm based in Myanmar, consisting of former and current university faculty members of various disciplines relating to environmental and social management.

They have worked extensively across Myanmar undertaking Environmental Impact Assessment related works including terrestrial biodiversity surveys, habitat and land use mapping, health and social impact surveys and development of post project monitoring surveys.

1.6 ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT OBJECTIVES

The specific objectives of this ESIA are as follows:

- Facilitate an understanding of the elements of the existing baseline conditions that are relevant to resources/receptors that could be potentially impacted by the Project;
- Identify the aspects of the Project that could potentially result in significant environmental and social impacts on resources/receptors;
- Document how stakeholders have been engaged during the ESIA Process, and how stakeholder feedback has been considered in the ESIA;
- Predict and evaluate the significance of the potential environmental and social impacts of the Project;
- Identify the aspects of the Project that need to be managed, and recommend appropriate and justified mitigation and enhancement measures;
- Determine the significance of residual impacts, taking into account the implementation of mitigation measures;
- Generate plans for the management and monitoring of impacts, including plans for ongoing stakeholder engagement; and
- To meet international environmental and social requirements.

1.7 IMPACT ASSESSMENT SCOPE

It is noted that the IFC launched a scoping study to obtain environmental baseline data and to determine the Terms of Reference (ToR) for the ESIA study.

This report has been prepared to cover the proposed ToR stated in the IFC Scoping study and to ensure compliance with ADB and IFC requirements. It identifies the potential environmental and social impacts that could be associated with the proposed Project activities and its associated facilities including those of an indirect and cumulative nature.

The study area for environmental and social impact assessment covers all Project operational areas, including where supporting activities take place.

The scope of the impact assessment includes Project activities that may affect the existing environment and social setting. Details of the Project include location, Project overview and components, schedule, Project facilities and activities, associated facilities, construction and operational process, as described in ***Chapter 2***.

The scope does not provide an assessment for any other/future developments or activities, either at the site location or anywhere else within the Project, unless these activities are specifically identified in ***Chapter 2*** of this report.

Should any further development be planned, either as result of this Project or other related work, additional planning and assessment must be carried out specifically in relation to that proposed development.

ERM does not endorse or take responsibility for any use of this report outside of or inconsistent with the scope of the Project as defined in ***Chapter 2*** of this ESIA report.

1.8 STRUCTURE OF THIS REPORT

An outline of the ESIA report is provided in ***Table 1.2***.

Table 1.2 ESIA Report Structure

Chapter	Title	Description
0	Executive Summary	Summary of entire ESIA report
1	Introduction	This *Chapter* will outline the development and structure of the ESIA report including the Project background, objectives, Impact Assessment scope and the report structure.
2	Project Description and Alternatives	This *Chapter* will provide a concise description of the Project and its geographical and temporal context. It will include a site description, an overview of the Project Facility design and details of Project inputs and outputs. This *Chapter* will also include discussion of the Project background, objectives, need for the Project, value of the Project, envisioned sustainability, alternatives considered, development options considered and site selection. The *Chapter* will also include a description of best available technologies.
3	Administrative Framework	The policy, legal and institutional framework in which the ESIA study has been conducted will be discussed in this *Chapter*. National regulations will be summarized along with relevant international agreements, as well as applicable international best practice guidelines and standards.
4	Impact Assessment Methodology	This *Chapter* outlines the impact assessment methodology and approach used for this ESIA report.
5	Description of the Environment – Biophysical Baseline	This *Chapter* will summarize the available baseline data on the environmental and biological resources and receptors within the Project Study Area. It will be based on both primary and secondary data sources and will consider changes in the baseline condition without the development in place. It will focus on the description of the biological environment and physical environment.
6	Description of the Socio-Economic Baseline	This *Chapter* will summarize the available baseline data on the socio-economic within the Project Study Area. It will be based on both primary and secondary data sources and will consider changes in the baseline condition without the development in place. It will focus on the description of the human environment.
7	Air Quality	This *Chapter* will summarize the predicted impacts of the Project in terms of Air Quality.
8	Greenhouse Gases	This *Chapter* will summarize the predicted impacts of the Project in terms of Greenhouse Gas.
9	Surface Water Quality	This *Chapter* will summarize the predicted impacts of the Project in terms of Surface Water Quality.
10	Noise and Vibration	This *Chapter* will summarize the predicted impacts of the

Chapter	Title	Description
		Project in terms of Noise and Vibration.
11	Landscape and Visual	This *Chapter* will summarize the predicted impacts of the Project in terms of Landscape and Visual.
12	Soils and Groundwater	This *Chapter* will summarize the predicted impacts of the Project in terms of Soil and Groundwater.
13	Waste	This *Chapter* will summarize the predicted impacts of the Project in terms of Waste Management.
14	Terrestrial and Marine Biodiversity	This *Chapter* will summarize the predicted impacts of the Project in terms of Terrestrial and Marine Biodiversity.
15	Social Impact Assessment	This *Chapter* will summarize the current socio-economic status and the identification of potential negative and positive impacts.
16	Stakeholder Engagement and Public Disclosure	This *Chapter* will summarize the stakeholder engagement and public disclosure activities undertaken for the Project.
17	Cumulative Impact Assessment	Cumulative impacts will be assessed as appropriate.
18	Environmental and Social Management Plan (ESMP)	The ESMP will draw together the possible mitigation measures; group them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation; develop a monitoring program and estimate the costs of the measures.
19	Disaster Risk Plan	This *Chapter* provides a summary of the Risk and Disaster Management Plan prepared for the Project.
20	Conclusion and Recommendation	This *Chapter* will summarize conclusions that are made based on the assessment as well as outline any further recommendations.
21	References	
	Annexes	

2 PROJECT DESCRIPTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter provides a description of the Sembcorp Utilities Pte. Ltd (the Sponsor or Sembcorp) Combined Cycle Gas Turbine (CCGT) Power Plant, including the facilities, equipment required and the associated activities to be undertaken throughout the Project cycle, including construction, operation and decommission phases. This chapter also provides an analysis of alternatives to the Project in ***Section 2.8***.

The Sponsor has been selected by the Ministry of Electric Power (MOEP) of the Government of Myanmar (GOM) as a private sector independent power producer (IPP) to develop a 225MW CCGT power plant on a Build, Operate and Transfer (BOT) basis in Myingyan Township, in the Mandalay region in Myanmar. The Project comprises of the following Project facilities:

- 225MW CCGT Power Plant;
- Gas Supply Pipeline;
- 230kV Overhead Transmission Line; and
- Water Supply Pipeline, Wastewater Discharge Pipeline and Water Intake Pumping Station.

The Project will proceed to invest and establish a CCGT power plant with international financing provided by Asian Development Bank (ADB), International Finance Corporation (IFC), and other banks which have adopted the Equator Principles (EPs) as syndicates.

The technology of the Project is an efficient form of CCGT power generation which was designed for high reliability and efficiency operation with lower environmental impact. The Project will operate on natural gas as its only fuel.

The electrical capacity and electricity generated will be sold under a 22 year Power Purchase Agreement ("PPA"), as agreed with MEPE.

2.2 NAME OF PROJECT

Myingyan IPP Project – 225MW Gas-fired Combined Cycle Power Station.

2.3 PROJECT SPONSOR

Details of the main Project Sponsor are as follows:

Company Name: Sembcorp Utilities Pte. Ltd

Address: 30 Hill Street, #05-04

Singapore 179360

2.4 PROJECT LOCATION

The Project site is located approximately 8km, south of Myingyan Township, Mandalay region in the Union Republic of Myanmar as shown in ***Figure 2.1.***

The Power Plant will be located on a predominately green field site. The Project site is located adjacent to an existing steel mill (Myingyan Steel Mill No.4), owned by Ministry of Industry (MOI).

The Project site was acquired by the GOM, up to 18 years ago, and the registered land owner is MOI. The majority of this MOI-owned land is occupied by the existing steel mill infrastructure which was commissioned in 2007. The northern part was allocated for the Power Plant as shown in ***Figure 2.2***. The Project site was cultivated farmland prior to acquisition of the land by the GOM and is currently dominated by sparse shrubby vegetation.

The following 5 villages are located in close proximity (3km radius from the Project site boundary), as shown in ***Figure 2.2***:

- Sa Khar village;
- Hnan Ywa village;
- Hpet Taw village;
- Nyaung Kan village; and
- Gyoke Pin village.

In addition, there is 1 village located in close proximity to the proposed water intake pumping station, which is Tha Pyay Thar village.

The Ayeyarwady River is located approximately 14km west of the Project site boundary. There is an existing gas pipeline (Shwe Gas Supply Pipeline), approximately 18km in length which runs from the Taung Thar offtake point to an existing MOGE gas receiving station within the Project site boundary. The location of the Ayeyarwady River and Shwe Gas Supply Pipeline is shown in ***Figure 2.2***. To the north, south and west of the Project site boundary is the agricultural area, to the east is an existing dirt road.

2.4.1 *Existing Steel Mill Facilities*

The existing Steel Mill produces approximately 200,000 tonnes per year of billets and slabs from recycled material such as scrapped metals and cars. It is currently undergoing expansion (Steel Mill Phase 2) to increase capacity with upgraded sub-station (to be connected to both the steel mill and the Power Plant), melt shop, direct reducing plant and rolling mill.

There are 913 workers at the steel mill, and their accommodation is as follows:

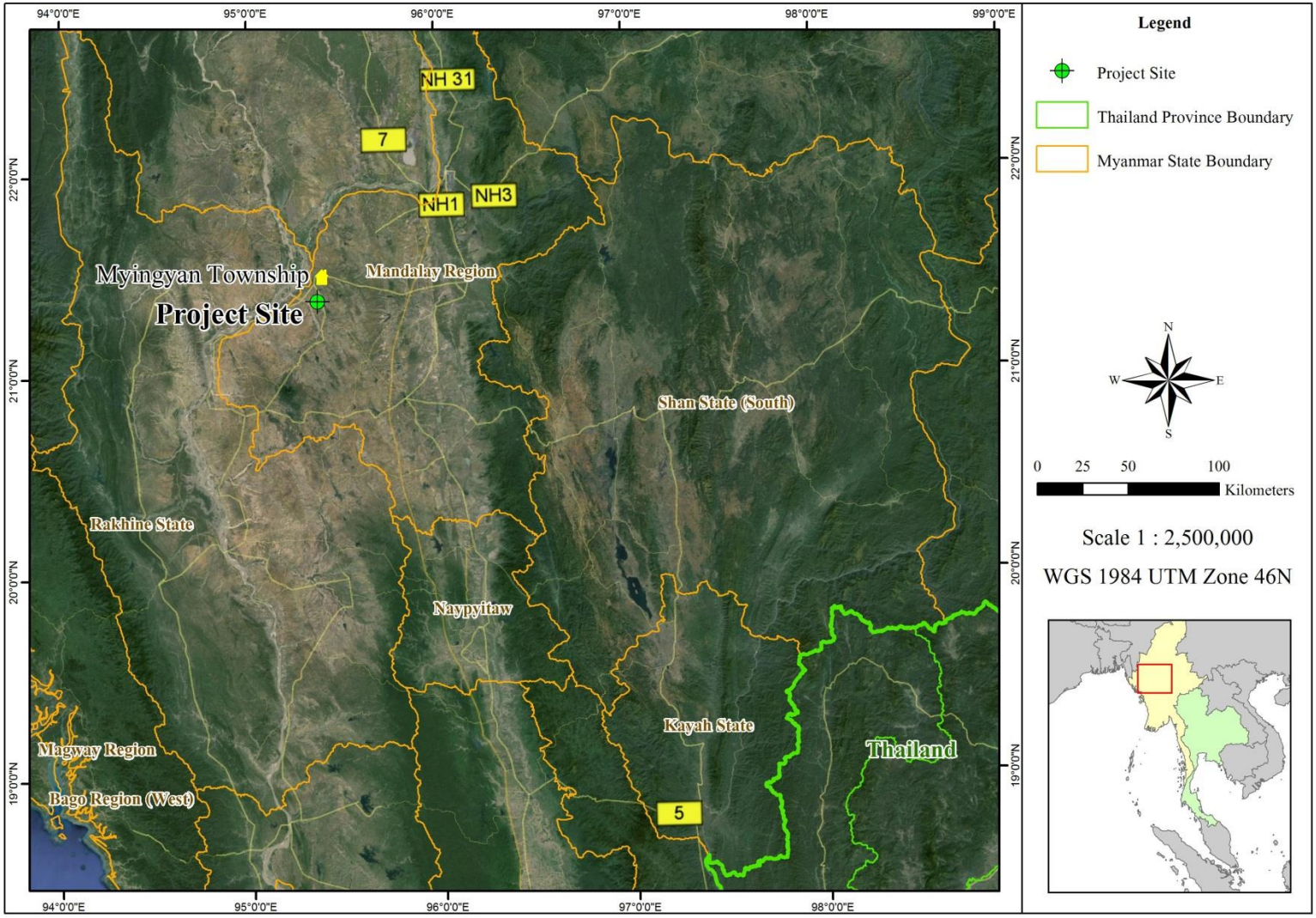
- Permanent worker's camp, housing approximately 880-900 workers. The permanent camp is located within the steel mill boundary, but is not near the Project site.
- Temporary worker's housing, for the remaining workers due to exceeded capacity at the permanent camp. The temporary accommodation consists of 15 households, and approximately 30 people in total. The temporary

accommodation is located outside the steel mill boundary, near the project site. Further details are provided in ***Chapter 6***.

2.4.2 Aggreko Temporary Gas-Fired Power Plant

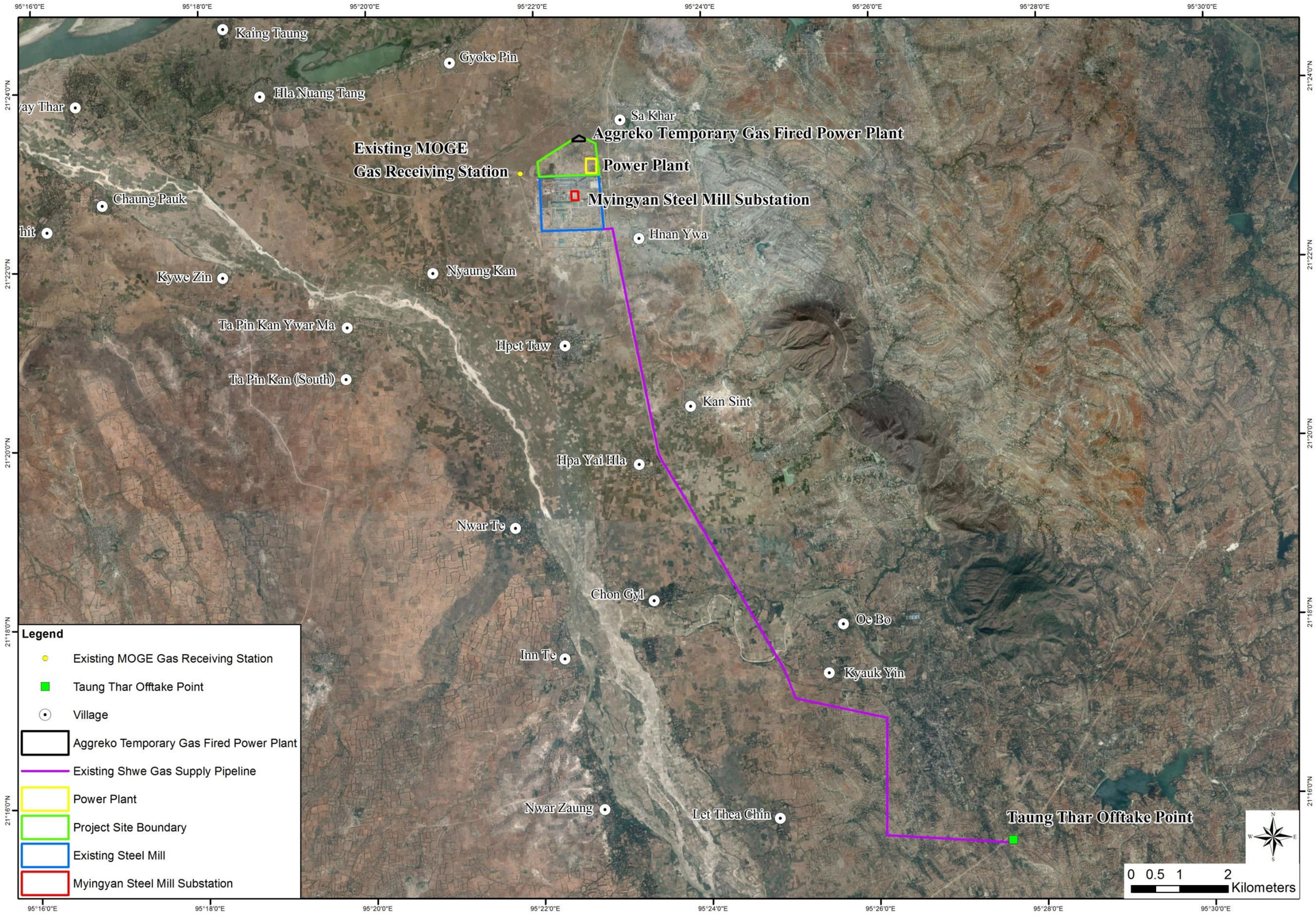
In addition, there is an existing 95MW temporary gas-fired power plant located within the Project site boundary (see ***Figure 2.2***) operated by Aggreko. The temporary gas-fired power plant began operation in April 2015 and comprises 92 gas engines rated at 1.3MW each (119MW total). The generated power is supplied to Myingyan town substation via the existing 132kV overhead transmission line. The temporary gas-fired power plant will be decommissioned once the CCGT Power Plant is in operation.

Figure 2.1 Location of the Project Site within Myanmar



Source: Sembcorp, 2015 (modified by ERM)

Figure 2.2 Project Site Location



Source: Sembcorp, 2015 (modified by ERM)

2.5 PROJECT FACILITIES

The Project components are presented below and include Project Facilities (shown in ***Figure 2.3***) and Associated Facilities. *A* total area of approximately 16 hectares (ha) is allocated for the Project facilities.

2.5.1 Project Facilities

- ***225MW Combined Cycle Gas Turbine Power Plant*** (approx. 9 ha) comprising of the following main components:
  - 2 sets of Gas Turbine (GT) units;
  - 2 sets of Heat Recovery System Generator (HRSG);
  - 1 steam turbine generating unit with associated auxiliary equipment;
  - Switchyard area;
  - Cooling Water System;
  - Demineralised Water System; and
  - Wastewater Treatment Facility.

- ***Gas Supply Pipeline*** (approx. 0.2 ha) connecting the new MOGE gas receiving station to the Power Plant (approximately 1km in length). MEPE/MOGE will build the new MOGE gas receiving station and the Sponsor will build new gas supply pipeline from delivery point at the outlet of the MOGE gas skid to the Power Plant.

- ***230kV Overhead Transmission Line*** (approx. 5 ha) connecting the Power Plant to the upgraded Myingyan Steel Mill sub-station located within the steel mill complex (approximately 2.5km in length).

- ***Water Supply Pipeline and Wastewater Discharge Pipeline*** (approx. 2 ha) connecting the Power Plant to the water intake point and new Pumping Station at the Ayeyarwady River. The water supply pipeline will be approximately 14km in length. The wastewater discharge pipeline will connect the Power Plant to the existing irrigation canal (approximately 3km in length). The wastewater pipeline will be run in parallel with the water supply pipeline. Both pipelines will share the 2m easement.

2.5.2 Associated Facilities

The new MOGE gas receiving station (see ***Figure 2.7***) to be installed by MEPE/MOEP for connection of the gas supply pipeline to the Power Plant is regarded as an associated facility.

In addition, the transmission connection beyond the upgraded Myingyan Steel Mill sub-station will be GOM's responsibility and therefore is classified as associated facility. The connection beyond the Myingyan Steel Mill sub-station transmission line is not known at this stage.

The Project components are described in the below sections.

2.5.3 225 MW CCGT Power Plant

The Power Plant is designed to operate continuously, either in simple cycle mode or in combined cycle mode. During simple cycle operation, the flue gas from the gas turbine will exit via the bypass stack to the atmosphere. During normal combined cycle operation, the heat of exhaust gas will be admitted to the Heat Recovery Steam Generator (HRSG) where superheated steam will be produced which will drive the steam turbine to generate electrical power. The exhaust gas from the HRSG will be released from the main stack of the HRSG to the atmosphere.

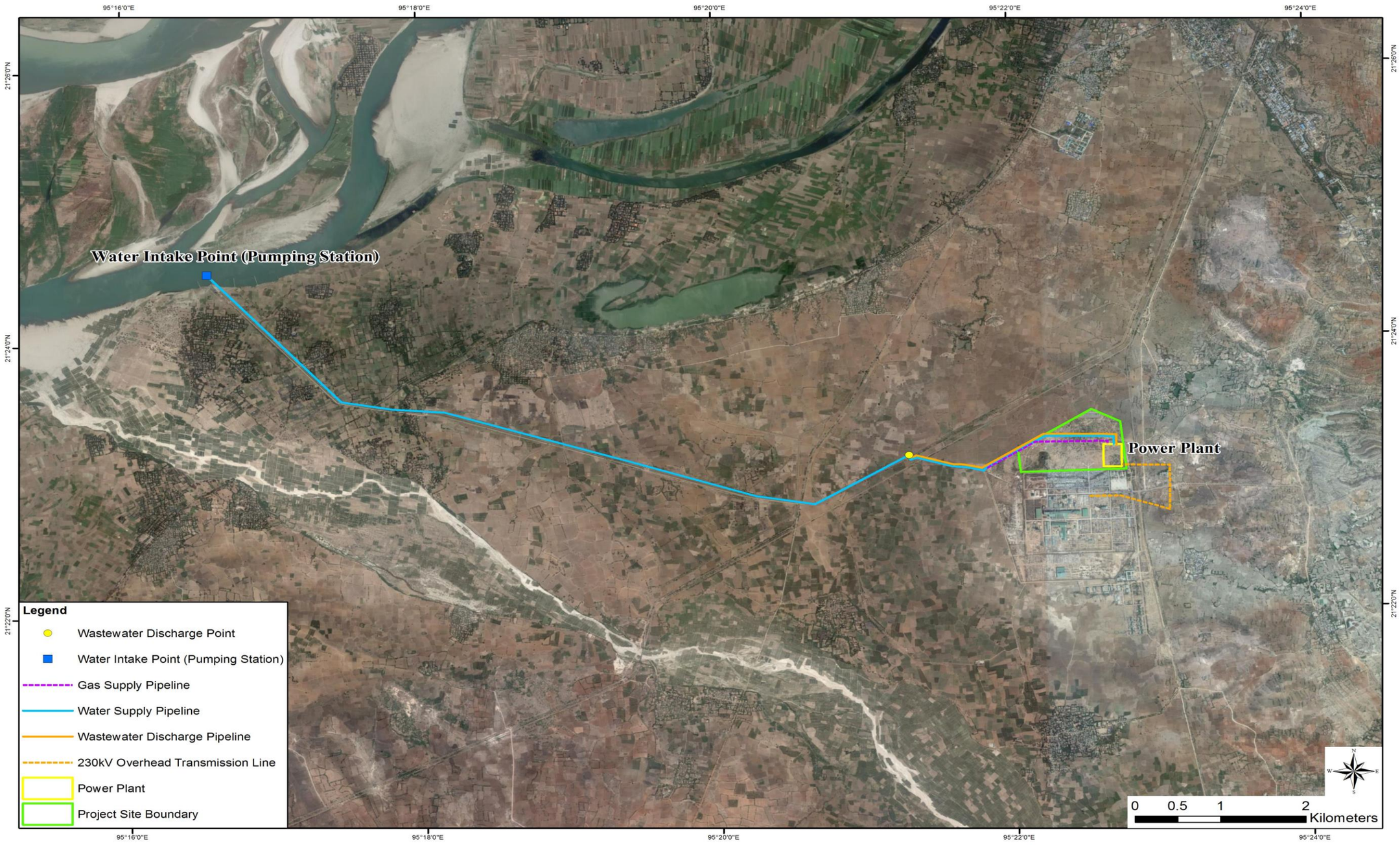
It is anticipated that the Power Plant will operate at full load for the majority of the time. Only one unit (either steam turbine or one gas turbine unit) will be down for maintenance. If the steam turbine in under maintenance, the gas turbines will be running in simple cycle mode, bypassing the HRSG. If one gas turbine is under maintenance, the other gas turbine will still be running.

The HRSG is designed for 3 pressures with reheat steam generation (High Pressure (HP), Intermediate Pressure (IP), Reheat (RH) and Low Pressure (LP)) used to maximize energy transfer from the exhaust gas of the gas turbine. The HP steam generated by the HRSG will be fed to the HP steam turbine and the reheat and LP steam will be fed to the LP steam turbine.

The power output is approximately 143MW during simple cycle and 225MW during combined cycle operation. The Power Plant will use natural gas as the only fuel.

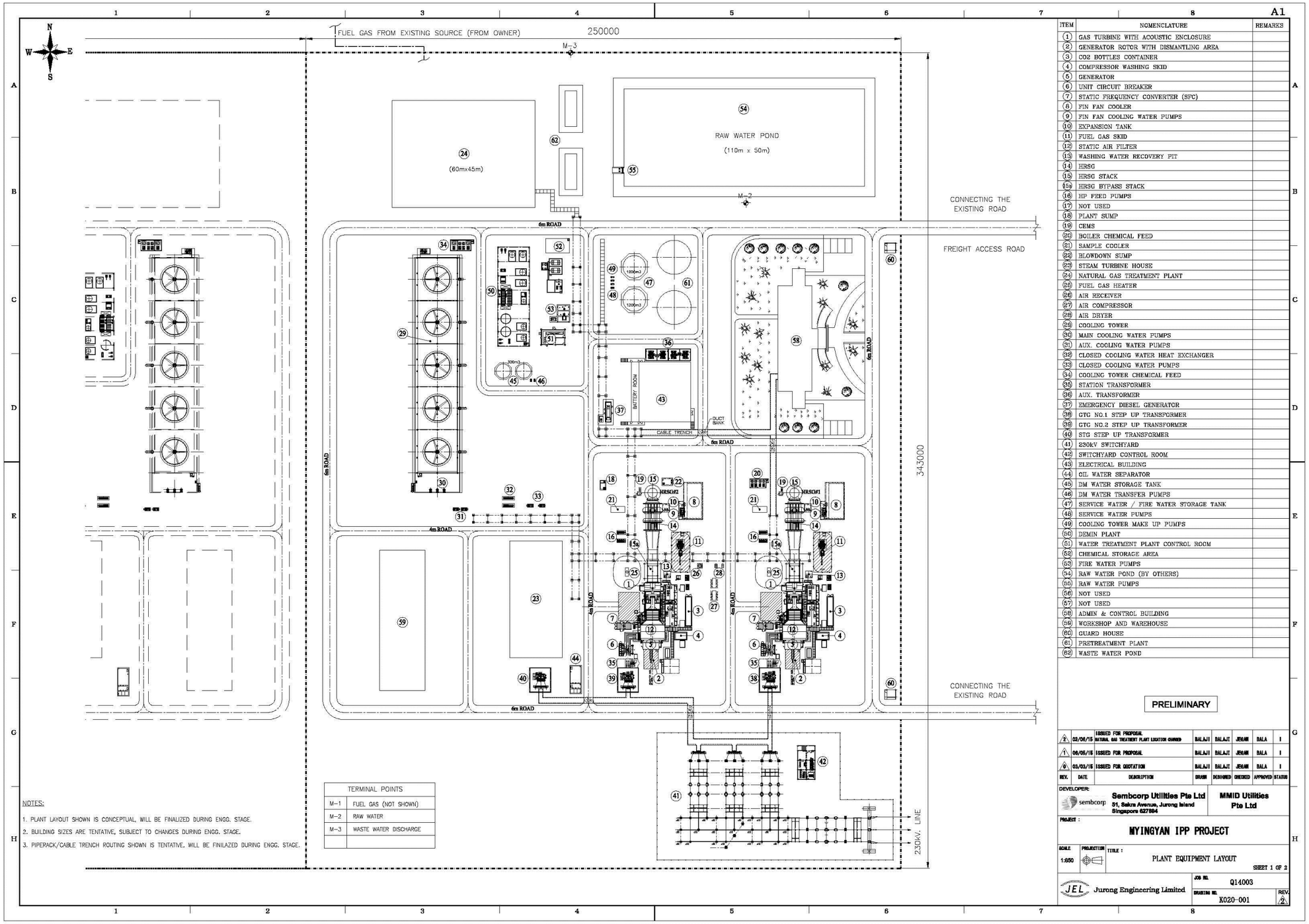
The indicative layout of the Power Plant is shown in ***Figure 2.3***. In addition, the Process Flow Diagram of the Power Plant is shown in ***Figure 2.5***.

Figure 2.3 Project Facilities



Source: Sembcorp, 2015

Figure 2.4 CCGT Power Plant Layout Plan

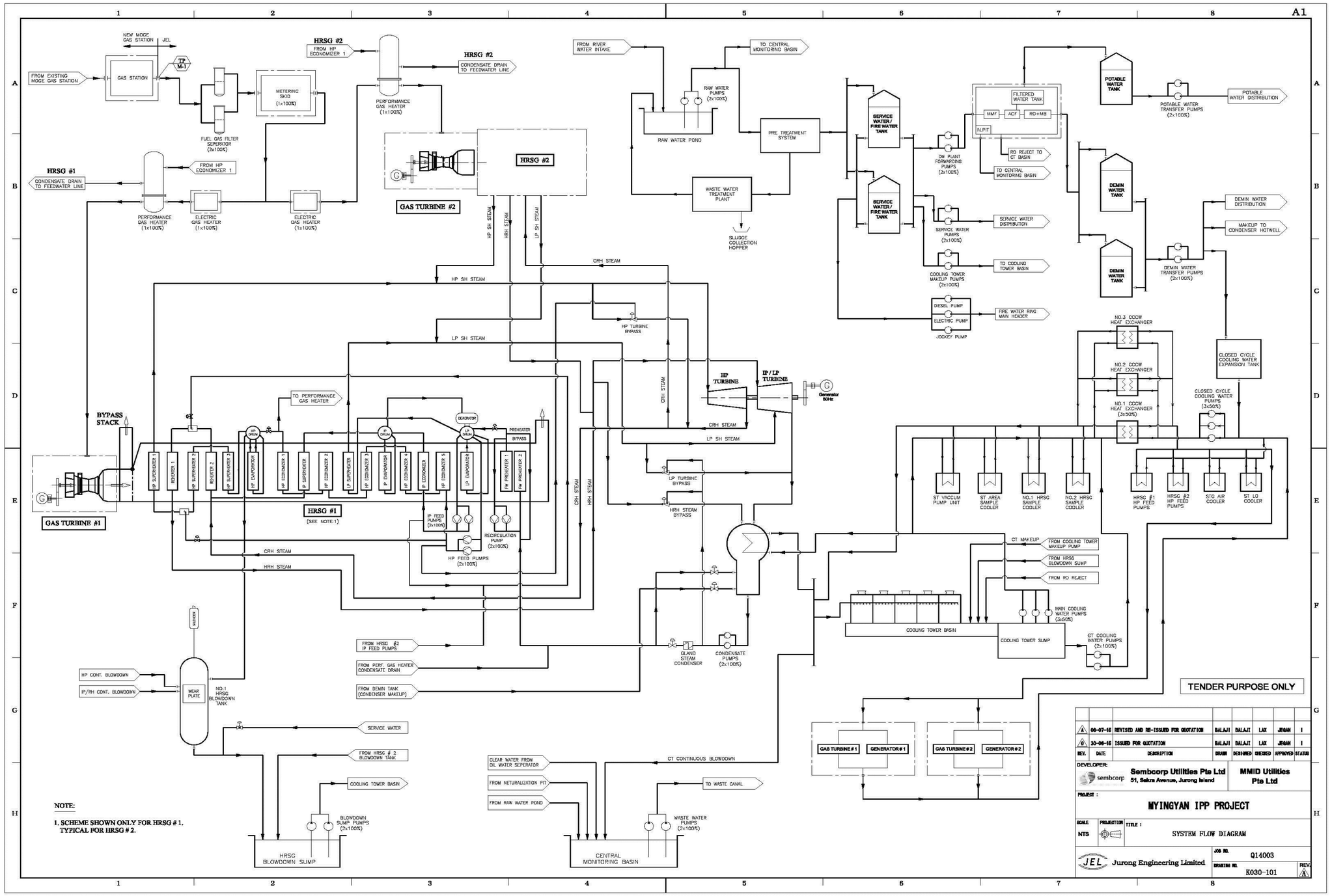


ITEM	NOMENCLATURE	REMARKS
1	GAS TURBINE WITH ACOUSTIC ENCLOSURE	
2	GENERATOR ROTOR WITH DISMANTLING AREA	
3	CO2 BOTTLES CONTAINER	
4	COMPRESSOR WASHING SKID	
5	GENERATOR	
6	UNIT CIRCUIT BREAKER	
7	STATIC FREQUENCY CONVERTER (SFC)	
8	FIN FAN COOLER	
9	FIN FAN COOLING WATER PUMPS	
10	EXPANSION TANK	
11	FUEL GAS SKID	
12	STATIC AIR FILTER	
13	WASHING WATER RECOVERY PIT	
14	HRSG	
15	HRSG STACK	
15a	HRSG BYPASS STACK	
16	HP FEED PUMPS	
17	NOT USED	
18	PLANT SUMP	
19	CEMS	
20	BOILER CHEMICAL FEED	
21	SAMPLE COOLER	
22	BLOWDOWN SUMP	
23	STEAM TURBINE HOUSE	
24	NATURAL GAS TREATMENT PLANT	
25	FUEL GAS HEATER	
26	AIR RECEIVER	
27	AIR COMPRESSOR	
28	AIR DRYER	
29	COOLING TOWER	
30	MAIN COOLING WATER PUMPS	
31	AUX. COOLING WATER PUMPS	
32	CLOSED COOLING WATER HEAT EXCHANGER	
33	CLOSED COOLING WATER PUMPS	
34	COOLING TOWER CHEMICAL FEED	
35	STATION TRANSFORMER	
36	AUX. TRANSFORMER	
37	EMERGENCY DIESEL GENERATOR	
38	GTG NO.1 STEP UP TRANSFORMER	
39	GTG NO.2 STEP UP TRANSFORMER	
40	STG STEP UP TRANSFORMER	
41	230kV SWITCHYARD	
42	SWITCHYARD CONTROL ROOM	
43	ELECTRICAL BUILDING	
44	OIL WATER SEPARATOR	
45	DM WATER STORAGE TANK	
46	DM WATER TRANSFER PUMPS	
47	SERVICE WATER / FIRE WATER STORAGE TANK	
48	SERVICE WATER PUMPS	
49	COOLING TOWER MAKE UP PUMPS	
50	DEMIN PLANT	
51	WATER TREATMENT PLANT CONTROL ROOM	
52	CHEMICAL STORAGE AREA	
53	FIRE WATER PUMPS	
54	RAW WATER POND (BY OTHERS)	
55	RAW WATER PUMPS	
56	NOT USED	
57	NOT USED	
58	ADMIN & CONTROL BUILDING	
59	WORKSHOP AND WAREHOUSE	
60	GUARD HOUSE	
61	PRETREATMENT PLANT	
62	WASTE WATER POND	

REV.	DATE	DESCRIPTION	DRAWN	DESIGNED	CHECKED	APPROVED	STATUS
2	03/08/15	ISSUED FOR PROPOSAL NATURAL GAS TREATMENT PLANT LOCATION CHANGED	BALAJI	BALAJI	JEHAN	BALA	I
1	06/05/15	ISSUED FOR PROPOSAL	BALAJI	BALAJI	JEHAN	BALA	I
0	03/03/15	ISSUED FOR QUOTATION	BALAJI	BALAJI	JEHAN	BALA	I

Source: Sembcorp, 2015

Figure 2.5 Process Flow Diagram of the CCGT Power Plant



Gas Turbine

The GE 6F.03 heavy duty, multi-shaft gas turbine is selected for this Project. The configuration of this selected gas turbine is a multi-shaft, bolted rotor with the generator connected to the gas turbine through a speed reduction gear at the compressor or "cold" end. This feature provides for an axial exhaust to optimize the plant arrangement for combined cycle application.

The Power Plant will be operated based on grid dispatch instructions. The Power Plant will be declared available for full load in normal case. If one gas turbine is offline the other gas turbine in full load and steam turbine (50%) will be declared available. The Power Plant is capable for house load operation. In case of any trip, the Power Plant could be started within 2 hours any one of the gas turbines.

Two gas turbine units will be installed for the Project. The gas turbines will be installed within an acoustic, ventilated enclosure with fire detection and protection systems. The gas turbines will have all associated ancillary equipment and systems required for the safe, efficient and reliable operation of the unit under simple and combined cycle operation.

The gas turbine generator (GTG) specification for each unit is shown in ***Table 2.1***.

Table 2.1 Gas Turbine Generator Specification

Feature	Specifications
Model/Type	GE 6F.03
Fuel system	Gas only
Starting Means	Static Frequency Converter
Air filtration	Static type
Compressor/Turbine Cleaning	On and Off-line Compressor Water Wash
Exhaust System	Axial
Emissions Control	Gas – Dry Low NOx
Fire Detection	Heat Detectors
Gas Leak Detection	Gas detectors
Fire Protection	High pressure CO2 System
Off-Base Acoustic Enclosure	Turbine and Load Gear Compartments
On-Base Acoustic Enclosure	Lube oil and Gas module Compartments

Source: Sembcorp, 2015

The GTG's will be installed outdoors as shown in ***Figure 2.3.*** The GTG's will be capable of operation with their exhaust gases passing into the associated heat recovery steam generator, or as simple open cycle turbine generators, exhausting directly to atmosphere via an exhaust gas damper and the bypass stacks associated with each gas turbine (30m in height), located on the exhaust ducting upstream of the heat recovery boiler.

All cooling requirements for the turbine shall be met using heat exchangers, fed from the Closed Circuit Water (CCW) system.

Control of emissions of NOx will be achieved by Dry Low NOx (DLN) burners. The detailed of embedded emission controls are described in ***Section 2.5.1***.

Audible and visual alarms will be located in the supervised areas in the Local Packaged Electrical and Electronic Control Compartment (PEECC). In addition, a Fire Detection System (FDS) will be installed at each gas turbine.

Heat Recovery Steam Generator (HRSG)

As one of the main units in a CCGT power plant, the two HRSG's (boilers) will be a natural circulation horizontal type HRSG with a three pressure with reheat system and an integral deaerator with no duct burners. The HRSG's will be combined with the gas turbines. The HRSG's are designed for exhaust gas conditions of the gas turbines fueled with natural gas.

Steam generated by the HRSG's will enter the steam turbine. The High Pressure (HP), Reheat (RH) and Intermediate Pressure (IP) steam from the HRSG's is sent to the steam turbine. Exhaust steam from the steam turbine will then enter into the condenser. The exhaust gas leaving the HRSG's will be routed to the HRSG stacks (40m in height).

The HRSGs will be sized to operate over the full range of ambient temperatures specified. The HRSGs consists of an economizer, evaporator, and super-heater tube bank section(s) with finned tubing, as appropriate, to maximize heat transfer. No supplemental firing facilities will be installed.

All pressure parts will be designed, manufactured and will be tested in accordance with "ASME Boiler and Pressure Vessel Code, Section 1, Power Boilers" or equivalent standards.

The HRSG specification is provided in ***Table 2.2***.

Table 2.2 HRSG Specification (at design condition)

Feature	Specifications
HP steam rating	85.0 t/h
HP steam pressure	14.4 MPa(a)
HP steam temperature	568 °C
IP steam rating	17.0 t/h
IP steam pressure	2.27 MPa(a)
IP steam temperature	300°C
LP steam rating	10.4t/h
LP steam pressure	0.4 MPa(a)
LP steam temperature	290°C

Source: Sembcorp, 2015

Steam Turbine

The steam turbine is a separate High Pressure (HP) and Low Pressure (LP) cylinder structure. The selected steam turbines are:

- HP: multistage/bleeding/backpressure type; and
- LP: multistage/bleeding/condensing type.

Each rotor is composed with groups (drums) of reaction stages. Both turbines are equipped with 2 (two) inlet flanges positioned in the head. The live steam flows

through the emergency stop valves and the mass flow is regulated by control valves, which throttle all the steam flow; such valves are directly bolted to, and installed inside, the inlet section of turbine external casing for HP turbine, or installed separately on steam piping for LP turbine.

HP steam turbine has a downward radial exhaust flange, and LP steam turbine has an axial exhaust discharge flange. The steam turbine exhaust and condenser configuration will be in accordance to manufacturer's standard design.

The Steam Turbine Generator (STG) will be of proven design and complete with all auxiliary oil and steam systems. The STG will be installed indoors for environmental protection (e.g., dust and rains) and to provide acoustic attenuation. The STG building will include an overhead travelling crane suitable for lifting the maximum heavy load for normal maintenance activities and suitable indoor laydown areas for plant maintenance. The STG specifications are outlined in ***Table 2.3.***

Table 2.3 Steam Turbine Generator Specifications

Feature	Specifications
Rated out power	90 MW (to be determined)
Rated power factor	0.8 (lagging)
Rated rotation	3000 r/min
Rated frequency	50 Hz
Phase number	3
Cooling mode	TEWAC (Totally Enclosed Water-To-Air Cooled)
Insulation class	Class F (temperature rise as per Class B)
Exciting mode	Static Excitation System

Source: Sembcorp, 2015

Condensers and Auxiliaries

The condensate system is provided with a recirculation system to ensure there is a minimum condensate flow through the pump and gland steam condenser. The minimum flow protection is accomplished by recirculating the condensate back to the condenser via the Condensate Pump Recirculation Control Valve, based on the flow rate measured at the pump discharge header.

Feed Water System

The feed water system will provide sufficient and reliable feed water to the HRSG from the demineralization plant. The HP Feed water flow rate shall be approximately 29m^3/sec and the quality shall be in accordance with STG and HRSG Original Equipment Manufacturer recommendations.

The feed water system will include necessary feed water heaters, de-aerators, feed water pumps, control valves and auxiliaries.

Cooling Water System

The mechanical draft cooling tower cooling water systems is selected for this Project. The main cooling water system will provide cooling water to the steam turbine condenser by means of cooling water pumps installed in the cooling tower basin. The warm water from the condenser is returned to the multi-cell mechanical draft cooling

tower, where it is cooled and collected in the cooling tower basin for return to cool the condenser. The induced draft cooling tower will be provided with the capacity for maximum heat rejection duty under all steam turbine operation conditions for the design conditions specified. The cooling tower shall have sufficient cells to allow for one cell to remain in standby under reference operating conditions.

The cooling tower will contain clarified raw water. A cooling tower chemical injection system will be provided to maintain the appropriate cooling tower chemistry. The Cooling water chemistry will be maintained at approximately 5 cycles of concentration (COC).

Closed Circuit Cooling Water (CCCW) System

The CCCW is a closed loop which provides cooling water flow to small duty plant heat removal and large duty plant heat removal devices which requires low fouling quality water during all modes of plant operation.

The CCCW system includes pumps, heat exchangers (plate-heat exchanger type), and a series of pipe runs complete with valves and controls necessary for the efficient distribution of cooling water from the pumps and heat exchanger to the various components of the cycle.

The CCCW system expansion tank maintains the required system head pressure and system water reserve storage. The tank is vented to the atmosphere and has a combined overflow and drain line. The tank also serves as a surge tank, accommodating flow variations in the system or thermal expansion of the water.

The chemical make-up water is a source of initial fill and make-up water for the CCCW system. The chemical composition of the CCCW will be constantly controlled.

A water sampling provision is located in the CCCW pump discharge line to periodically collect and sample the water and to monitor the water quality.

Cooling water from the CCCW pumps flows through a main header and then various small sub-headers and distribution lines to the heat removal devices picking up heat.

After passing through the heat removal devices, hot water flows from the individual equipment return lines to the main return header. At this point, hot water flow is directed through the CCCW heat exchanger. These heat exchangers reduce the coolant temperature approximately to 38°C. The CCCW heat exchangers utilize colder open cycle cooling water passing through the tubes as the cooling medium.

Raw Water System

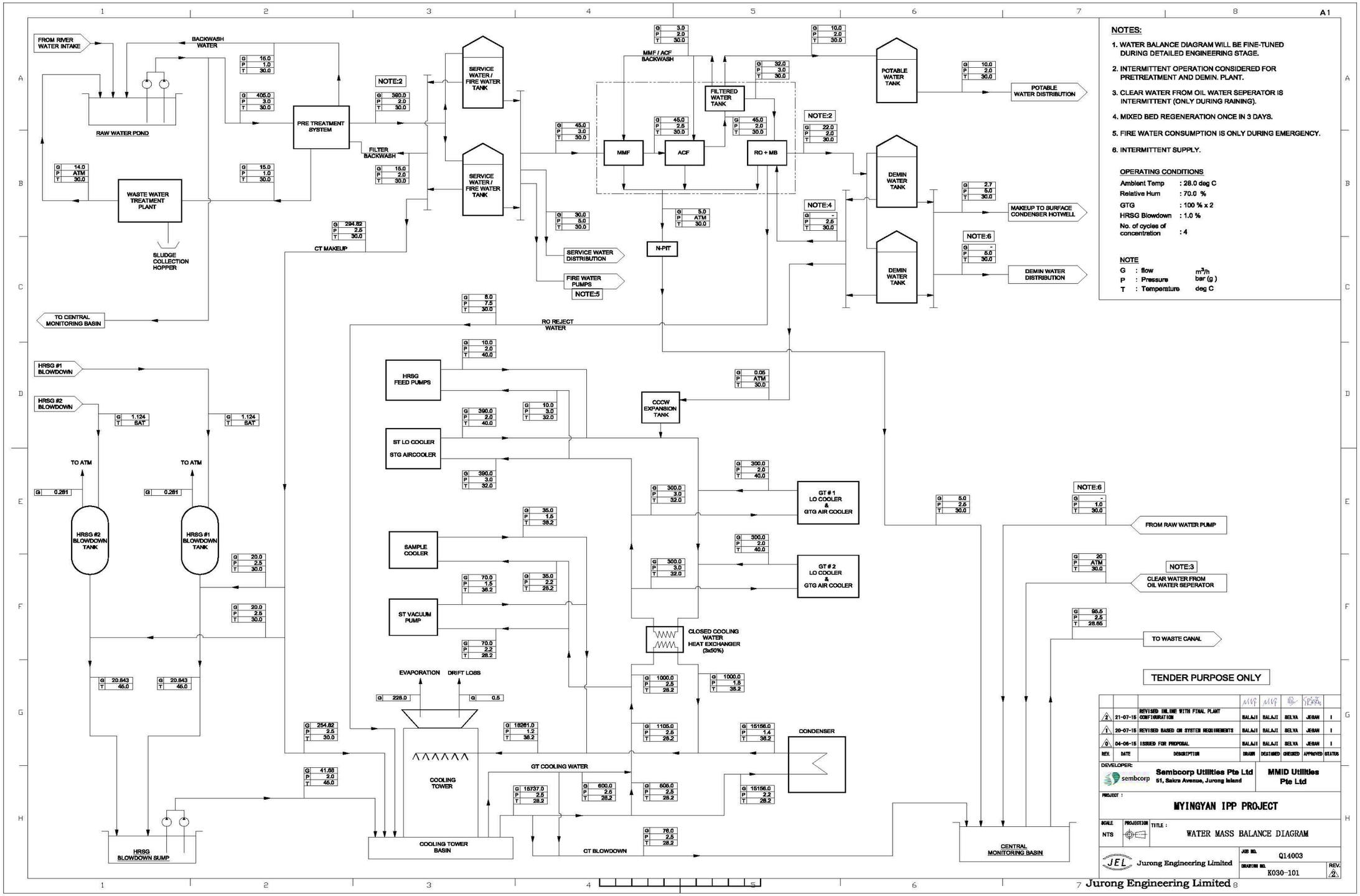
The raw water system includes the make-up water system, raw water storage pond and the pre-treatment system.

The raw water will be taken from Ayeyarwady River, using the water intake pumping station at the flow rate of approximately 405 m^3/hour, via a 14km water pipeline and will be stored in the raw water storage pond. The water balance for the Power Project is shown in ***Figure 2.6***.

The capacity of raw water storage pond is approximately 20,000m^3, which can satisfy the water consumption of the plant for 2 days.

The pre-treatment system consists of 2 clarifier tank. The capacity of each clarifier is estimated at 240m^3/hour approximately (2x60% capacity).

Figure 2.6 Power Plant Water Balance



Wastewater Treatment System

The wastewater system will collect and neutralize chemical wastes from the water treatment plant (regeneration waste) and the drainage from chemical containment areas.

Drains from all equipment containment drainage, spills, floor wash downs and fire protection discharges will be led to oil-water separator. One oil/water separator will be designed for outdoor, underground in RCC construction.

Plant Wastewater Monitoring System

The Central Monitoring Basin will collect all the neutralized wastes, separated water from oil-water separator, and cooling tower blow down water for monitoring to ensure compliance to wastewater effluent quality before discharge. The wastewater will be discharged to the irrigation canal outside of the Power Plant shown in ***Figure 2.3***.

Sewage Water System

Sanitary waste water collection and a package sewage treatment plant will be provided. The treated water will be discharged to the Central Monitoring Basin.

Rain Water Drainage System

The rain water drainage system will consist of buried pipelines. Rain water from the roofs and the ground will be collected to the rain gravity drainage pipe, and then sent to the Central Monitoring Basin.

Oily Water Treatment System

Drains from all equipment containment drainage, spills, floor wash downs and fire protection discharges will be led to oil-water separator.

The oily waste water treatment is designed to treat the oily water from the Power Plant. The treated water shall drain to the Central Monitoring Basin.

Emission Control

The Project will include emission control technologies to reduce air pollutant emissions to comply with applicable standards.

Dry Low NOx burners

The proposed power plant will be equipped with Dry Low NO_x burners developed to achieve low NO_x emissions.

The Project will provide Dry Low NOx burners which are Best Available Technology (BAT) for CCGT power plants to guarantee NO_x emission levels at the exhaust chimney of 25ppm by volume (dry) at 15% O_2 levels.

Continuous Emissions Monitoring Systems (CEMS)

In addition to the emission reduction technologies, the proposed power plant will be installed with a CEMS which shall monitor the concentrations of SO_2, NO_x, CO, O_2 and dust as well as temperature and flow; as summarised below:

- SO_x Analysers (0 – 25ppm)
  - Non Dispersive Infrared/UV technique;
  - Extractive type, microprocessor based; and
  - Analyser shall have features such as auto temperature compensation, auto zero and span calibration etc.
- NOx Analysers (0 – 100ppm)
  - Non Dispersive Infrared detection technique;
  - Extractive type, microprocessor based; and
  - Analyser shall have features such as auto temperature compensation, auto zero and span calibration etc.
- O2 Analysers (0 – 25%)
  - Extractive type, using paramagnetic detection technique.
- Dust Analysers /Particulate matter (0 – 20mg/m3)
  - In situ type, optical transmission meter type (electro optical type), microprocessor based;
  - Extractive type, microprocessor based; and
  - Analyser shall have features such as auto temperature compensation, auto zero and span calibration etc.
- CO Analysers (0 – 200ppm)
  - Extractive type; and
  - Non dispersive infrared detection technique.

The sample handling system shall be based on the Extraction technique, with complete sample transportation and condition unit, heat tracing (if required), sample probes and pressure regulators etc. The system shall provide the facilities for local data acquisition and transmission of system parameters and off-normal alarms to the central control room.

2.5.4 Gas Supply Pipeline

Currently, the existing Steel Mill facility offtakes the gas from the Shwe gas pipeline, which is a Government-built gas supply pipeline. The gas supply pipeline from Taung Thar offtake point (on Shwe gas supply pipeline) is approximately 18km in length and connects to an existing MOGE gas receiving station located to the northwest of the steel mill built by the Government. This existing MOGE gas receiving station has been used to receive and supply gas to the steel mill and the existing onsite Aggreko temporary gas-fired power plant.

MOGE will install a new gas receiving station adjacent to the existing MOGE gas receiving station to supply gas to the Power Plant. The Project will build a new gas supply pipeline approximately 1km in length from the outlet of the new MOGE gas receiving station to the Power Plant (see ***Figure 2.7***).

Design of the gas supply pipeline will be as per ANSI B 31.8: Gas Transmission and Distribution Systems. The class rating will be as per the final discharge pressure from

MOGE new gas receiving station and will be either ANSI Class 300 or Class 600. Welding of pipeline will be as per API Standard 1104. The gas supply pipeline will be buried and have a minimum cover of 1.0m on top of it. Cathodic protection will be in place for the buried section of the pipeline and the design will be based on soil resistivity. A Quantitative Risk Assessment (QRA) has been prepared for the gas supply pipeline (refer to ***Annex A***).

It is noted that the gas supply from the Shwe gas supply pipeline will be sufficient to meet the Project's requirements, and there is no need to expand or seek additional gas supply. The gas supply agreement between MOGE and MEPE states that there will be a gas supply of 47.546 mmscfd from January 2015 onwards. This gas supply infrastructure is already in place and awaiting offtake.

A natural gas supply and treatment system will be installed at the Power Plant to meet the required gas quality and pressure specified by the gas turbine manufacturer. The natural gas system will include backup metering equipment and all necessary, gas filter-separators, isolation and control valves, safety valves, and other equipment. The gas analysis is provided in ***Table 2.4.***

Table 2.4 Shwe Gas (natural gas) Composition

Component	Mole Percent	BTU Gross	Relative Density
C6 + 47/35/17	0.0199	1.05	0.0007
Propane	0.0297	0.75	0.0005
i-Butane	0.0109	0.36	0.0002
n-Butane	32.2 ppm	0.11	0.0001
i-Pentane	49.7 ppm	0.20	0.0001
n-Pentane	0.0000	0.00	0.0000
Nitrogen	0.2218	0.00	0.0021
Methane	99.5529	1007.81	0.5514
Carbon Dioxide	0.0491	0.00	0.0007
Ethane	0.1073	0.00	0.0011
TOTAL	100.0000	1012.18	0.5570

Source: Sembcorp, 2015

2.5.5 230kV Overhead Transmission Line

The proposed 230kV overhead transmission line alignment is approximately 2.5km in length and will be located between the generator transformer at the Power Plant and the upgraded Myingyan Steel Mill sub-station located within the steel mill complex. The proposed alignment is to the east of the Project boundary shown in ***Figure 2.8***.

Connection beyond the upgraded Myingyan Steel Mill sub-station is GOM's responsibility. The connection beyond the upgraded Myingyan Steel Mill is not known at this stage.

2.5.6 Water Supply Pipeline and Wastewater Discharge Pipeline

The proposed water supply pipeline alignment is approximately 14km in length and will run from the Power Plant along an existing irrigation canal connecting to the Ayeyarwady River for water intake (see ***Figure 2.9***). The proposed alignment is surrounded by predominantly agricultural/modified land and some shrubs. The

proposed alignment is expected to go underneath several existing dirt paths and roads including the Nyaung U-Myingyan highway.

Land required for the water supply pipeline would be minimal as the majority of the water supply pipeline will be located along the existing irrigation canal.

There is an existing floating pump house for supply of water for irrigation, located at the irrigation canal intake on the Ayeyarwady River. Due to capacity requirements, this pump house is considered to be unsuitable insufficient for supplying water to the proposed Project and a new pump house will be constructed by the Sponsor. The pumps will be located on a floating pontoon with shed.

In terms of social features, the proposed alignment avoids crossing existing villages. Near the outlets on the Ayeyarwady River the water supply pipeline is expected to have several communities of the Tha Pyay Thar village on either side of the proposed alignment and pass through the south of Hla Naung Taung village (*see* ***Figure 2.2***).

The proposed wastewater discharge alignment is approximately 3km in length and will run alongside the water supply pipeline from the Power Plant to the irrigation canal (see ***Figure 2.9****)*. The wastewater discharge is anticipated to be approximately 70 to 100 m^3/h.

Figure 2.7 Proposed Alignment of Gas Supply Pipeline from New MOGE Gas Receiving Station to the Power Plant

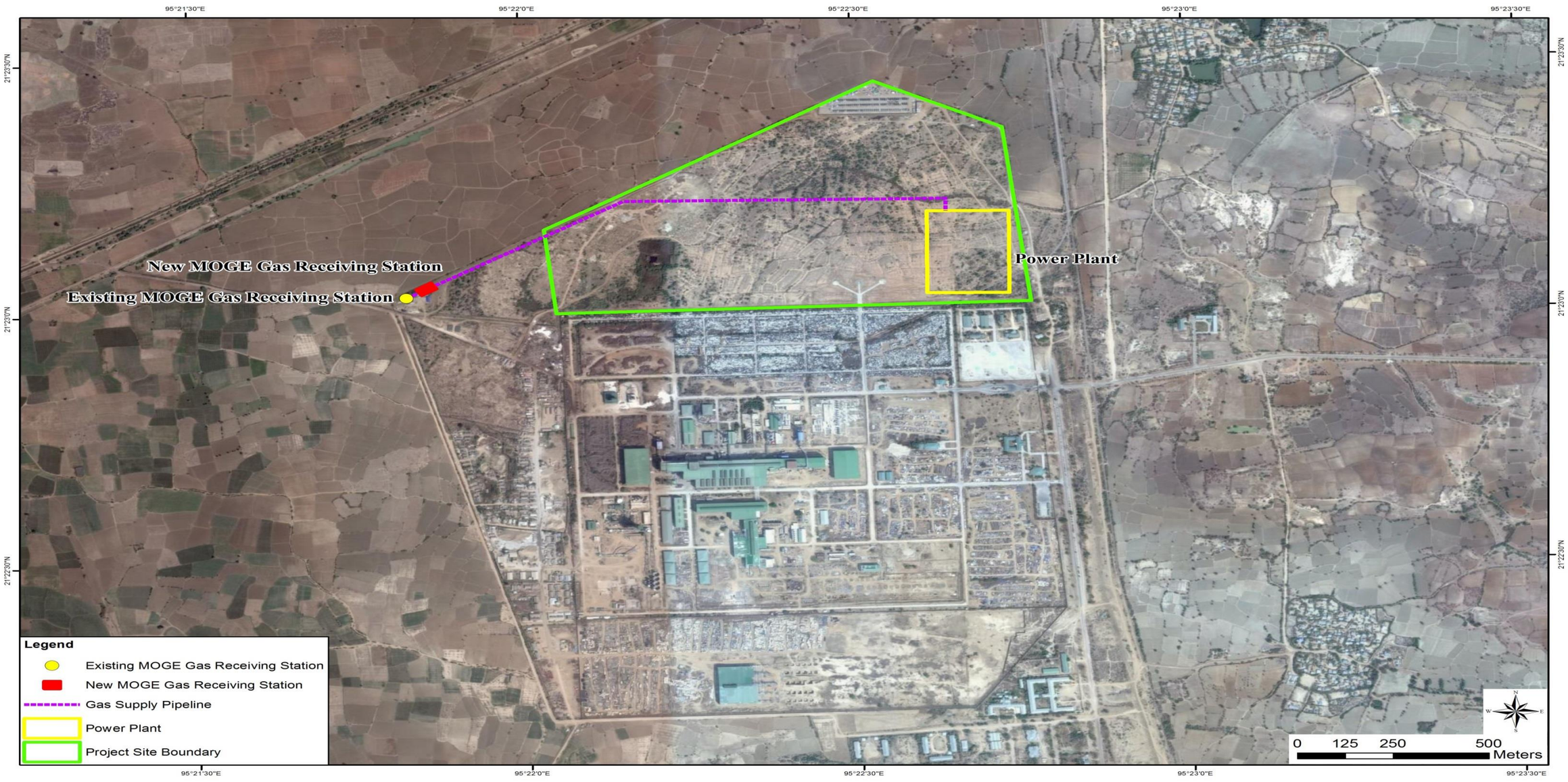
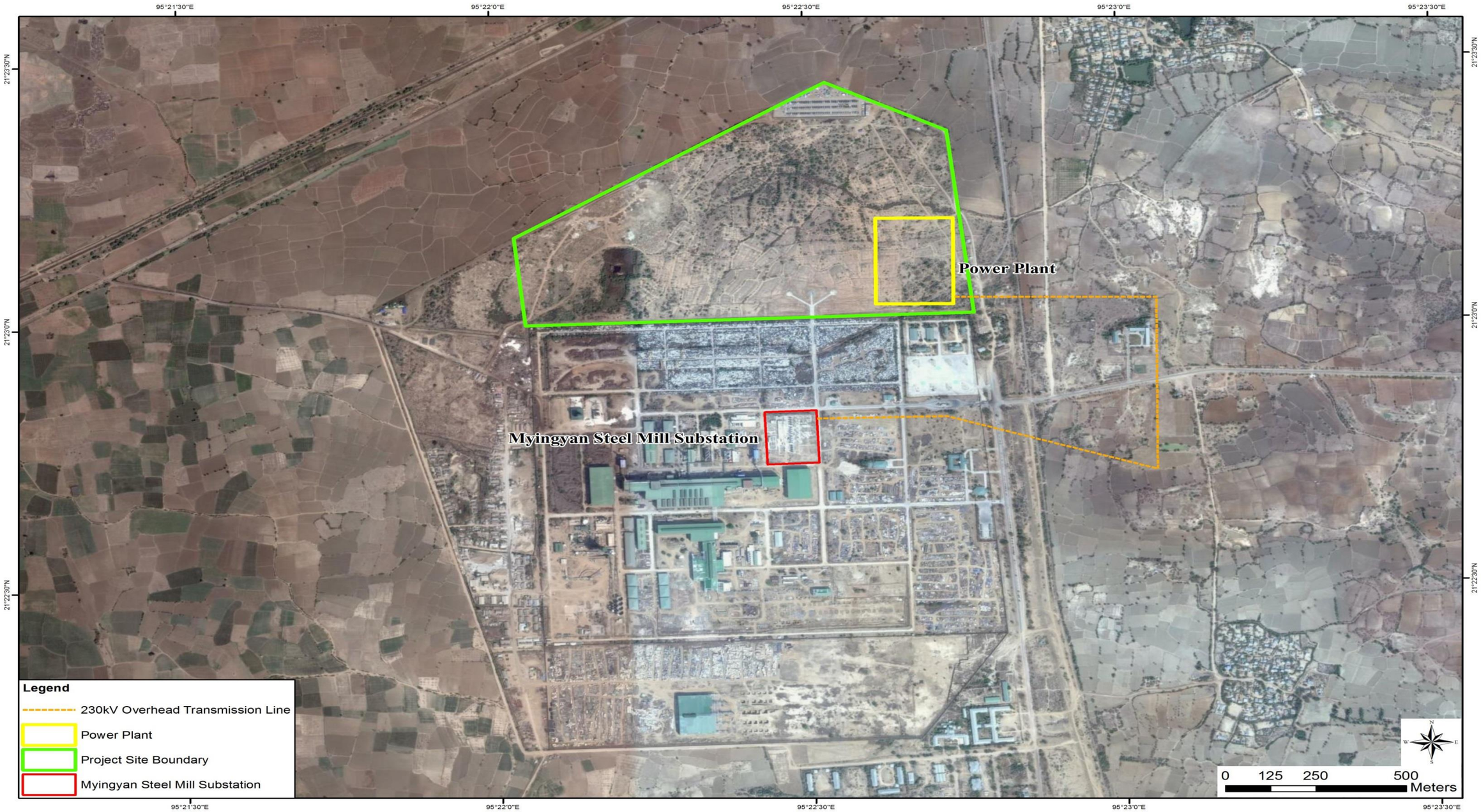


Figure 2.8 Proposed Alignment 230kV Overhead Transmission Line Route from Power Plant to Upgraded Myingyan Steel Mill sub-station



Source: Sembcorp, 2015 (modified by ERM)

Figure 2.9 Proposed Alignment of Water Supply Pipeline from the Power Plant to the Ayeyarwady River Water Intake Point and Wastewater Discharge Pipeline



Source: Sembcorp, 2015 (modified by ERM)

2.6 PROJECT LIFE CYCLE OVERVIEW

Project life cycle analysis identifies the key issues and concerns that are likely to evolve over the entire lifespan of a project.

In the case of the proposed Project, these issues may arise during the construction, operation and maintenance, and decommissioning. These issues have been considered in this ESIA, prior to any irreversible actions being undertaken by the Sponsor, Contractors and other Project associates. The following sub-sections identify the key activities to be completed and facilities to be constructed and operated over the lifetime of the Project.

2.6.1 *Construction Phase*

Construction Schedule

Construction is expected to start in the first quarter of 2016 and be complete in the region of 22.5 months with commercial operation targeted at the first quarter of 2018.

Construction activities of the Project will include: mobilisation, site clearance, onshore construction of all Project components, Nyaung Hla jetty reinforcement and commissioning. Heavy equipment such as bulldozers, excavators, dump trucks, compactors, etc. will be used at the Project site.

The normal construction hours are anticipated to be 10 hours per day, 6 days per week.

Mobilisation

Site construction work will start once civil design of site preparation is finalised. All work will be conducted in accordance with the detailed master construction schedule, provided by the EPC Contractor. Prior to commencement of work, all Contractors will be required to provide detailed site specific plans related to:

- Equipment use;
- Excavation and backfilling management;
- Soil erosion management;
- Traffic management;
- Storm water pollution prevention plan;
- Dust prevention plan;
- Environmental and Social Management Plan;
- Waste Management Plan; and
- Plan drawings of laydown, traffic flow, parking, trash storage, and recycling areas.

Earth Works

Earth works will include clearing of vegetation and grading of the Project site. It is anticipated that the subsoil, which will be stripped and removed from the Project site, will be utilised for levelling/ backfilling. It is anticipated that approximately 20,000m^3 of soil will be removed due to excavation activities of the water supply pipeline and then backfilled.

Site Foundation

The foundation concept design for the Project has been prepared considering geotechnical information. It is proposed that lightly loaded structures with equipment not sensitive to settlement may be supported on spread footings and/or mat foundations, provided the sub grade is adequately compacted. Other structures and/or settlement sensitive equipment shall be supported on piles.

Power Plant Construction

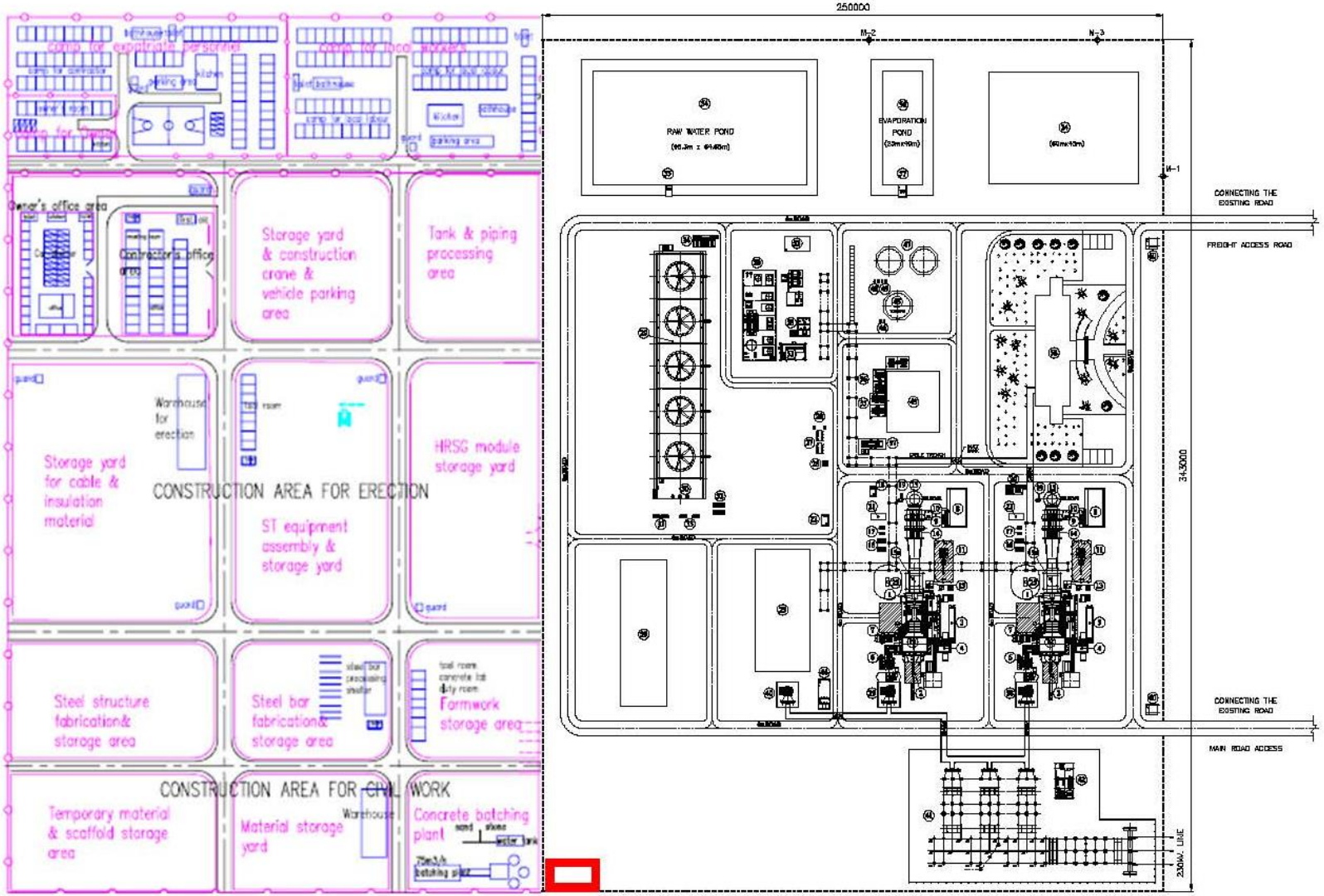
Table 2.5 presents the key structures which will be constructed for the Power Plant. It is expected as a part of the mobilisation phase the Project site will be fenced. The construction area for the Power Plant will be adjacent to the Power Plant site as shown in ***Figure 2.10***.

Table 2.5 Power Plant Key Structures

Item	Description
Steam Turbine Building	The Steam Turbine Building will consist of the following: • Steam Turbine Hall • Turbine Operation Platform • Crane Girder • Turbine Hall Gable Structure • Turbine Generator Pedestals
Main Control & Electrical System Buildings & Structures	The Control & Electrical System Buildings & Structures will consist of the following: • Central Control Room • Plant electrical room • Transformer oil pit • Outdoor power distribution equipment • Emergency diesel generator room / container • Switchyard control building
Main Chemical Water Treatment System Structures	The Main Chemical Water Treatment System Structures will consist of the following: • Boiler Make up Water Treatment Plant • Industrial Waste Water Treatment Plant
Auxiliary Buildings & Structures	The Auxiliary Buildings & Structures will consist of the following: • Administration building • Maintenance & Warehouse • Guard house • Air compressor house shelter • Cooling water pump house and associated equipment (outdoor) • Mechanical draft flow cooling tower (5 cells) • Water basin of cooling tower (1 set) • Mechanical acceleration clarifier（2 sets）(outdoor) • Foundation of service water cum firefighting watertank (2 sets) • Sewage water equalization tank • Oil water separator
Main HRSG Stacks (2 stacks)	• 40m height with a diameter of 3.7m
Bypass Stacks (2 stacks)	• 30m height with a diameter of 4.0m

Source: Sembcorp, 2015

Figure 2.10 Power Plant Construction Area



The construction of the buildings and structures in ***Table 2.5*** will typically be reinforced concrete structures or steel frame structures. Reinforced concrete shall be used for primary plant facilities and facilities exposed to an aggressive environment. These facilities are primarily low-rise buildings/structures that have a large footprint area relative to their height. Conversely, steel is used for large expansive structures.

A concrete batching plant will be located onsite during construction. The location of the concrete batching plant is located near the material storage yard and is shown in ***Figure 2.10***. The concrete batching plant will produce 500m^3 of concrete per day and will be operational for 12 hours per day. The loading/unloading areas during construction will also take place in the construction area shown in ***Figure 2.10.***

Gas Supply Pipeline Construction

Construction of the gas supply pipeline will take approximately 4 months.

The site clearance activities for the gas supply pipeline will involve the clearance of shrubs and vegetation. The construction activities for the gas supply pipeline will require the use of crane truck, excavator, compactor and generator set. The machinery associated with the construction of the gas supply pipeline will be operated during daytime only (10 hours per day).

The waste associated with construction of the gas supply pipeline will comprise of steel pipes, steel plates, structural steel and wooden crates. Excavated soil will be used for backfilling and will be compacted and levelled. Opportunities for the disposal sale of the steel pipes and structural steel will be explored. The wooden crates will be disposed of by a licenced waste contractor.

230kV Overhead Transmission Line Construction

Construction of the 230kV overhead transmission line from the generator transformer at the Power Plant to the upgraded Myingyan Steel Mill sub-station located within the steel mill complex will take approximately 7 months.

The site clearance activities for the 230kV overhead transmission line will involve the clearance of shrubs and vegetation. The construction activities for the 230kV overhead transmission line will require the use of cranes, soil compactor, concrete truck, generator set and trucks. The machinery associated with the construction of the 230kV overhead transmission line will be operated during daytime only (10 hours per day).

The waste associated with construction of the gas supply pipeline will comprise of steel pipes, steel plates, structural steel and wooden crates. Opportunities for the disposal sale of the steel pipes and structural steel will be explored. The wooden crates will be disposed of by a licenced waste contractor.

Water Supply Pipeline Construction

Construction of the water supply pipeline from the Ayeyarwady River to the Project site will take approximately 11 months.

The water pipeline shall be led with floating barge water intake concept. The intake floating pontoon located on the river bed. A steel approach bridge will be adopted to connect the pontoon with the land. The bridge pier will be constructed on the bank of the river. Around the bridge, dry masonry will be used to protect the river bank, and the scope of slop protection will be approximately 40m.

The site clearance activities for the water supply pipeline will involve the clearance of shrubs and vegetation. The construction activities for the water supply pipeline will require the use of cranes, soil compactor, concrete truck, generator set and trucks. The machinery associated with the construction of the water supply pipeline will be operated during daytime only (10 hours per day). For the crossing of roads and the railway pipe jacking will be used.

The waste associated with construction of the water supply pipeline will comprise of steel pipes, steel plates, structural steel and wooden crates. Opportunities for the disposal sale of the steel pipes and structural steel will be explored. The wooden crates will be disposed of by a licenced waste contractor

Commissioning

After 75 to 80%, completion of the construction phase, priorities shall be shifted from the overall geographic area to that dictated by utilities and process completion. All major equipment will be installed, tested and commissioned under the supervision of the respective representatives.

Commissioning activities would involve the following activities:

Simple Cycle:

- First Fire;
- GTG Short-circuit and AVR testing;
- Synchronizing; and
- Dry Low NOx tuning.

Combined Cycle:

- Steam Blowing;
- STG no-load tests;
- STG Load Tests;
- Plant Fine-Tuning;
- Performance Test; and
- Reliability Run.

Transportation of Construction Material

Heavy Cargo

Heavy cargo will be transported by barge from Thilawa Port in Yangon to Nyaung Hla Jetty on the Ayeyarwady River. ***Table 2.6*** shows the heavy cargo to be transported.

Table 2.6 Heavy Cargo to be transported from Thilawa Port in Yangon to Nyaung Hla Jetty

Description	Quantity
Gas Turbine	2
Gas Turbine Generator	2
LP steam turbine	1
Steam Turbine Generator	1
HP steam turbine skid (with gearbox)	1
Main condenser	1
HRSG Module	12

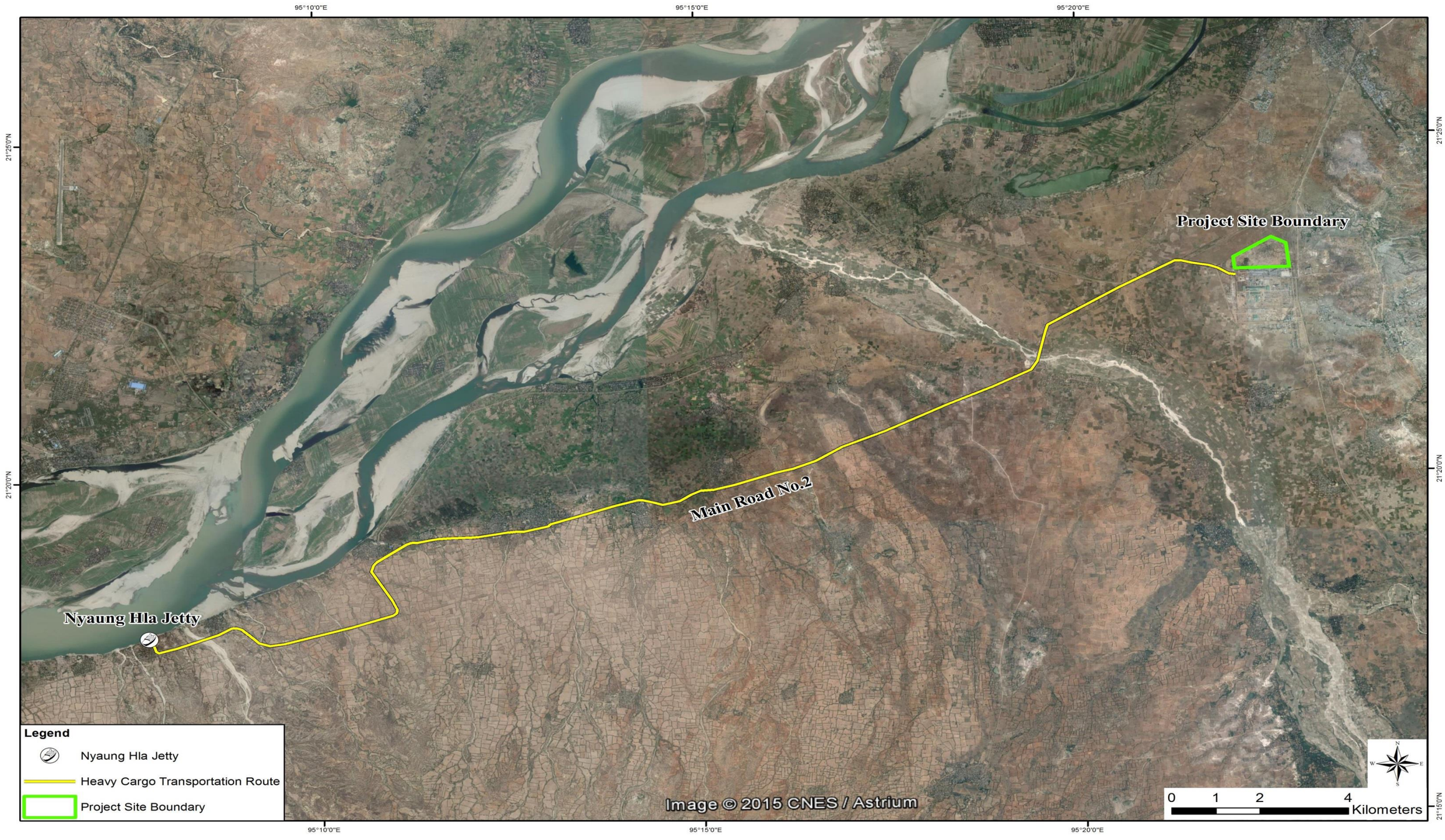
The inland transportation for the heavy cargo will start from Nyaung Hla Jetty place to the Project site using the Nyaung U-Myingyan Road. With approval from the Transport Superintendent, the cargo will be transported from the jetty to the Project site with necessary traffic escorts. The proposed transportation route from Nyaung Hla Jetty to the Project site is approximately 25km and is shown in ***Figure 2.11***. On route to the Project site the heavy cargo will use the existing road to cross the Sintelwa River. This road will require reinforcement and backfilling underneath the existing I-beams.

The temporary landing place at the Nyaung Hla Jetty will require reinforcement for the roll off operation. The ground conditions will be prepared, levelled and compacted/strengthened appropriately.

Construction Materials

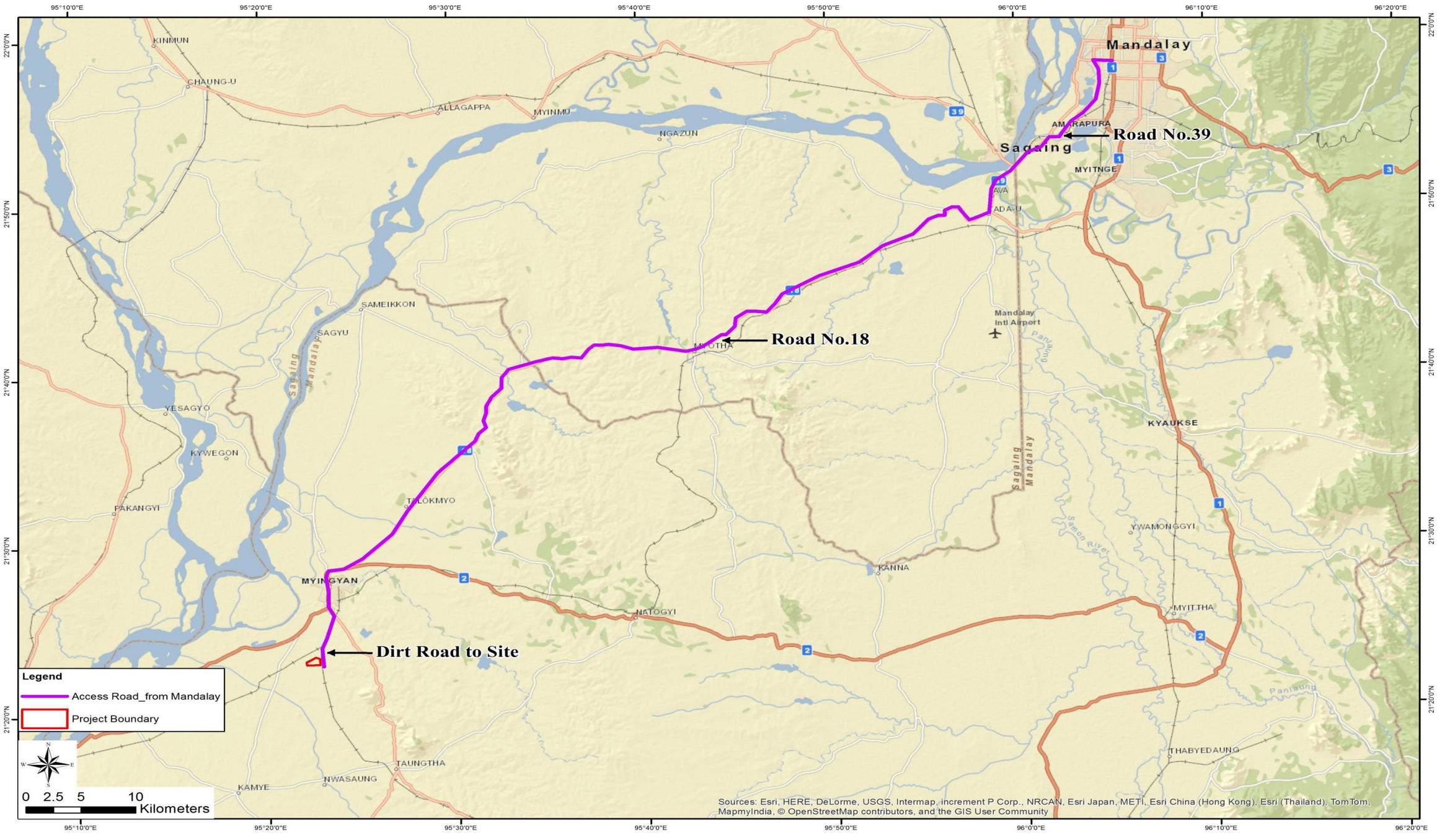
For other construction materials the proposed ground transportation route is from Mandalay to the Project site using existing roads no. 39 and road no. 18. Construction materials such as structure steel, piping, plant mechanical equipment, electrical and instrumentation equipment and other construction consumables will be used for this route. It is anticipated 2 to 10 trucks will use this route during the construction period. The ground transportation route is shown in ***Figure 2.12***.

Figure 2.11 Proposed Transportation Route of Heavy Cargo from Nyanung Hla Jetty to the Project Site



Source: Sembcorp, 2015 (modified by ERM)

Figure 2.12 Proposed Transportation Route of Construction Materials to the Project Site Transportation Route



Source: ERM, 2015

Power and Water Supply

Approximately 16,000kW of electricity will be required during the peak construction period, with an average consumption rate of 800kwh/mth. The electricity will be sourced from the 11kV transmission line which is 2km from the Project site. The route of the transmission line is currently not known. The Contractor shall provide 11kV/380V box-type transformer and 300kW diesel generator for emergency.

During construction, water is required for construction worker activities and prefabricated concrete activities. The maximum number of workers onsite during construction is anticipated to be 900 persons and each worker is estimated to consume approximately 50 litres of water per day[(1)]. Prefabricated concrete activities are estimated to consume 40m^3 of water per day.

The average water consumption rate during construction is anticipated to be 700m^3 per month (approximately 24m^3 per day).

At the early stage, the raw water required during construction will be transported from underground tube wells. The final location of the tube wells are not known at this stage. The water from the tube wells will be treated and purified to supply for construction. At a later stage, when the water supply pipeline from the Ayeyarwady River is connected, the construction will change over to this water supply for construction purposes.

Construction Waste

Solid Waste during Construction

The solid waste generated during construction will include steel pipes, steel plates, structural steel and wooden crates. Opportunities will be explored for selling the steel plates and structural steel. The wooden crates will be disposed of by a licenced waste contractor.

There will also be biomass waste associated with the clearance of tree, shrubs and grass. Approximately 800m^3 of biomass waste is anticipated during construction. Opportunities for providing biomass waste to the local community will be explored or biomass waste will be disposed of by a licenced waste contractor.

All excavated material will be backfilled with no surplus.

Hazardous Wastewater during Construction

Hazardous wastewater will be generated from chemical cleaning of the equipment during the precommissioning process. The hazardous wastewater from chemical cleaning will be treated in the neutralisation system.

(1) Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

Non Hazardous Wastewater during Construction

Non-Hazardous wastewater will be generated from the toilet facilities and workers accommodation (sewage). Non-hazardous wastewater will also be generated from the canteen. The sewage generated onsite will be collected through underground pipes into a holding tank, from where the sewage will be routed to an onsite sewage treatment plant or alternatively transported periodically by vacuum trucks and transferred to a septic tank or discharge to common drain.

Construction Workforce

The anticipated workforce during construction is shown in ***Table 2.7***. The workers accommodation will be located to the north of the construction area shown in ***Figure 2.11.***

Table 2.7 Anticipated Workforce during Construction

Workforce Origin	No. of Skilled Workers	No. of Semi-Skilled Workers	No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
Local Workforce	**140**	**210**	**250**	600	900
Migrant Workforce	**50**	**10**	**0**		

Source: Sembcorp, 2015

2.6.2 Operational Phase

The main features of the Project have been described in ***Section 2.5.1***.

There will be no Operation and Maintenance (O&M) contract with any third party operator, as the Project will be owned and operated by the Sponsor. The O&M of the Project will be undertaken by the Sponsor with the support of a long term service agreement (LTSA) for the GT with the manufacturer. The LTSA will cover the supply of spare parts, supervision and specialized labour for inspections, major and minor overhauls.

O&M staff with relevant experience of operating similar plants and with adequate knowledge of comparable technology will be deployed prior to Simple Cycle commercial operation date (COD) to commission and take over the Project from the EPC Contractor.

The below sections will discuss further the key activities during Operation Phase.

Operational Schedule

The start of operation is anticipated for the first quarter of 2018. Simple cycle operation will occur during the first five months of operation before the combined cycle plant is complete.

Fresh Water Supply

The main freshwater supply source will be taken from Ayeyarwady River via the water supply pipeline which will be retained in the raw water pond.

The raw water will be passed through the pre-water treatment. The majority of the water will be supplied to meet the plant service water / cooling tower make-up and the balance will be taken to meet the plant potable water and demineralized water requirement.

Table 2.8 presents the water requirements and their volumes during operation.

Table 2.8 Water Requirements during Operation

Water Requirement	Volume
Cooling water system	405 m^3/h (circulating)
Demineralised water system	22 m^3/h
Domestic water	4m^3/h

Source: Sembcorp, 2015

Operational Wastewater

As presented in ***Section 2.5.1*** the Project will be equipped treat all wastewater to comply with the discharge specification before discharge to the irrigation canal shown in ***Figure 2.9***. A sewage treatment plant will also be installed.

Table 2.9 presents details of the wastewater and approximate capacities which will be generated during operation.

Table 2.9 Wastewater during Operation

Item	Timing of Wastewater Generation	Capacity
Wastewater from Power Plant		
Sludge from river water pre-treatment	Normal Operation	1 m^3/ hour
DM plant neutralized water	Normal Operation	5 m^3/ hour
Cooling tower blowdown	Normal Operation	70.5 m^3/ hour (continuous)
Stormwater	Normal Operation	Intermittent
Washing water from Main Block	Normal Operation	Intermittent
Fire protection system	Emergency	
Domestic Wastewater		
Kitchen	Normal operation	
Wash room	Normal operation	
Plant control room	Normal operation	
Condensate polisher / safety shower	Emergency	
Battery room/eye wash	Emergency	
Water treatment plant/safety shower	Emergency	
Sanitary/ Sewage Wastewater	Normal Operation	4 m^3/ hour

Wastewater from the plant process will be treated with pH control within a pH range 6 to 9 in the neutralisation treatment system and oil-water separator system. The treated wastewater will be stored in the Central Monitoring Basin before discharge to the existing irrigation canal shown in ***Figure 2.9***. Sewage will be treated in a package sewage treatment and discharged into the wastewater discharge system. The sludge will be dewatered and disposed off-site by a licensed waste contractor.

Stormwater

The Power Plant perimeter drain for stormwater will be connected to an oil and grease pit (interceptor). The contaminants will be captured in the pit and removed manually.

Operational Solid Waste

Table 2.10 presents details of the solid waste and approximate capacities anticipated during operation.

Table 2.10 Solid Waste during Operation

Waste Type	Anticipated Quantity
Domestic Solid Waste	1.65kg per employee per week

The solid waste generated during the operation phase will be collected and segregated for recycle and non-recycle waste (i.e. paper, plastic). Solid waste will be disposed of and handled by Myingyan Municipality.

There will also be minimal other waste such as wood crates from maintenance activities which will be provided to the local community as fire wood.

Operational Hazardous Materials

The hazardous materials to be stored on site during operation are presented in ***Table 2.11***. The chemicals will be transported appropriately to the Project site and Material Safety Data Sheets (MSDS) will be prepared from chemical suppliers in Myanmar.

Table 2.11 Hazardous Materials during Operation

Hazardous Material	Use of Hazardous Materials	Storage Location Onsite	Quantities to be Stored Onsite
Oxygen Scavenger	Chemical Dosing System	Chemical Storage House	$1m^3$
Phosphates	Chemical Dosing System	Chemical Storage House	$1m^3$
Fouling Agent	Chemical Dosing System	Chemical Storage House	$1m^3$
Anti-corrosion	Chemical Dosing System	Chemical Storage House	$1m^3$
Biocides	Chemical Dosing System	Chemical Storage House	$1m^3$
Hydrochloric Acid	Chemical Dosing System	Chemical Storage House	$3m^3$
Sodium Hydroxide	Chemical Dosing System	Chemical Storage House	$3m^3$
Sodium Hydroxide	Water Treatment System and Demineralised Water System	Chemical Storage House	$10m^3$
Hydrogen Chloride	Water Treatment System and Demineralised Water System	Chemical Storage House	$10m^3$
Diesel oil	Liquid fuel for emergency diesel engine generator, emergency diesel generator	Storage Tank	4,000 l/month

Operational Workforce

The anticipated workforce during operation is shown in ***Table 2.12***.

Table 2.12 Anticipated Workforce during Operation

Description	Staff Number
Permanent Staff	48
Security (external)	12
Contract staff: Cleaners, Gardeners and helpers	10
Contract staff: Technical hands	10
Maintenance (once every 3 years)	90 for 30 days

Source: Sembcorp, 2015

The operational working hours / shift structures will be as follows:

- 12 hours per shift with 4 shift teams;
- 2 days shift 1 day off, 2 nights shift 3 days off (including sleeping off);
- 1 shift charge, 1 unit controller and 2 field technicians per shift; and
- 18 staffs will be in the shift roaster.

Ancillary Structures

In addition to the main infrastructure on site, and as described above, the following ancillary buildings will be constructed:

- Administration building (incorporated of the Central Control Room);
- Gatehouse at the main gate of the site;
- Staff canteen; and
- Fire fighting pump house.

Emergency Diesel Generators

The Power Plant will have one emergency diesel generator with a capacity 800kWh that will only be used during plant safe shutdown. The diesel will be transported appropriately to the Project site from diesel suppliers in Myanmar. Material Safety Data Sheets (MSDS) will be completed for the diesel to ensure appropriate transportation. The diesel generator will be the stationary emergency type and will consist of control gear, lubricating oil system, fuel day tank, cooling system, direct current (DC) starting power and synchronizing equipment, and electrical protection system equipment. Following an emergency shutdown at the power plant, the diesel generators will provide electrical power to maintain the turbine generator unit and its auxiliaries in safe conditions. The diesel generator will not exceed operation for more than 2 hours which is considered to be sufficient.

Fire Protection System

The Power Plants fire protection system will provide personnel safety and plant protection through prompt detection, alarm and suppression of a fire. The system will be designed for any single design basis fire and will be in accordance with all local applicable codes and standards. The primary source of water for the system shall be from the plant's water system.

Power Plant Maintenance

During operation, maintenance will be associated with the following:

- Breakdown Maintenance;
- Planned Preventive Maintenance;
- Routine Maintenance; and
- Scheduled Preventive Maintenance.

2.6.3 Decommissioning Phase

The design life of the power plant is estimated to be 25 years. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided the required retrofits and new emission rates meet the applicable standards and guidelines.

If retrofitting is not feasible and the operational life of the Power Plant expires, the Power Plant will be decommissioned according to the requirements of the authorities at that time according to best industry practices.

2.7 PROJECT ALTERNATIVES

IFC Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) ("PS1") and the ADB Safeguard Policy Statement requires an assessment process that identifies the risk and potential impacts associated with a project. Specifically, "the process may comprise a full scale environmental and social impact assessment, a limited or focused environmental assessment or straight forward application of environmental siting, pollution standards, design criteria or construction standards". PS1 states that for greenfield developments or large expansions with specifically identified physical elements, aspects and facilities that are likely to generate potential environmental or social impacts, the client will conduct a comprehensive ESIA, including an examination of alternatives, where appropriate.

This section presents an overview of the alternatives considered as part of the ESIA study. The main design criteria, plant technology, configuration and Project type were determined by MOEP and the selected IPP will have to comply with MOEP requirements and are therefore beyond the remit of this ESIA study and are not included in this review.

However, the decision on the final Project location has been considered and therefore this section presents a summary of the anticipated environmental and social impacts associated with each option.

In addition, 3 cooling options were initially explored by the MOEP, comprising once through cooling, cooling towers and dry/air cooling technologies. These alternatives are discussed further below.

2.7.1 *Project Need*

Myanmar adopted political and economic reforms in 2011 which resulted in a significant growth in Myanmar's gross domestic product (GDP) to 6.3% in 2012 compared with an average of 5% in the previous 5 years (Asian Development Bank, 2013). According to a 2012 Asian Development Bank (ADB) study, Myanmar could follow Asia's fast growing economies and expand at 7% to 8% per year and Myanmar's economic growth is forecast to rise gradually to 6.7% in 2014.

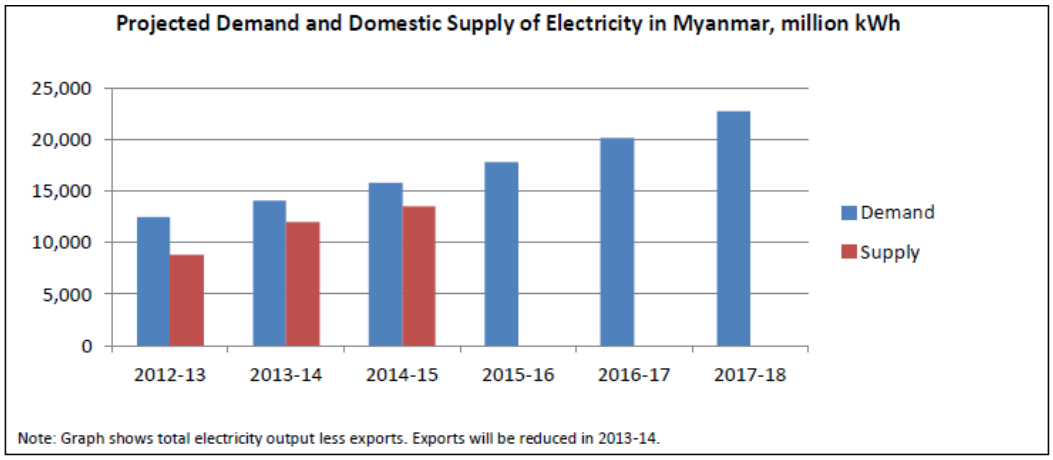
Parallel to the growth in GDP, electricity demand in Myanmar has increased dramatically. ADB released a report on Myanmar's energy sector in October 2012 in which the future power demand was estimated to be doubling from 12,459 million kWh in 2012-2013 to 25,683 million kWh in 2018-2019 (ADB, 2012). Total system installed capacity in 2012 consists of 76.1% hydropower capacity, 20.5% gas-fired capacity, and 3.4% coal-fired capacity (ADB, 2013).

However, the actual power production in 2012 appears to be approximately 10,000 gigawatt-hours (GWh) with only 3,659 GWh available for domestic use (David Dapice,

2012). In 2012, total electricity consumption was 8,434 GWh. With a population of approximately 60 million, Myanmar per capita electricity consumption was only 140 kilowatt-hours (kWh) per year, which was the lowest among the 10 Association of Southeast Asian Nations (ASEAN) countries. The low national average per capita electricity consumption is due to the low electrification rate, low industrial development and lack of investment.

Figure 2.13 shows the estimated electricity demand and supply in Myanmar (ADB, 2012).

Figure 2.13 Estimate of Electricity Demand and Supply in Myanmar, million kWh



Source: David Dapice, 2012

There is a big medium-term problem with electricity supply in Myanmar. There will be only modest additions to hydroelectric capacity in the period from 2014 to 2019 and very little net new natural gas for domestic use will come on line.

Meanwhile, some hydro that is now exported may be switched to domestic use and some old gas-fired units will get more efficient new equipment and so be able to produce more electricity from the same amount of gas. However, these additions will fall short of new demand growth during 2014-2019. The more than 1,400MW of new gas units officially projected to be come on line in 2015-2016 will be forced to use, in part, LPG or even expensive liquid fuels if the official reports of limited additional supplies of natural gas for domestic use are correct. If world wholesale diesel or kerosene prices continue at their recently lower levels, the cost of electricity would be higher than current prices charged but much less than diesel electricity has cost in the past – over 400 kyat per kWh.

ADB (2012) estimated that demand in 2012 was 12.5 million kilowatt-hours, while supply available for consumption in that year was only 8.3 million kWh. In addition, a growing economy at this low development stage has a high growth of electricity relative to real output growth. The ADB growth cited from the MEP was 12.8% a year for electricity consumption. Therefore, even if supplies doubled every five to six years it would still not fully allow for closing the gap between demand and available supply that existed in 2012 or for increasing the coverage of households with grid connected power. Increasing thermal capacity to balance the dry season hydroelectric shortfalls would help to reduce blackouts.

Given that the new gas supply will become available from the Shwe Gas Supply pipeline, the proposed development of a combined cycle gas turbine power plant in Myingyan Township, Myanmar will contribute towards a power source for adding capacity required to cover the shortfall.

The 'No Project Scenario' is likely to have a negative effect on opportunities for employment, both directly from the Project and its dependent sectors such as agriculture, industries and manufacturing that require stable power supply in order to operate and be competitive.

2.7.2 *Alternatives of Different Power Generation Options*

Overview

Electricity generation may be achieved from renewable and non-renewable sources. Renewable sources include solar, wind, hydroelectric sources, and biomass while non-renewable sources include fossil fuels such as coal and natural gas. The following section describes the energy mix in Myanmar.

Hydroelectric

Myanmar has 20 grid-connected hydroelectric power plants; all operated by Hydropower Generation Enterprise (HPGE). Their installed capacity is 2,780MW accounts for 76.1% of national capacity. Off-grid supply from mini hydropower stations is provided by ESE and IPPs and contributes 33MW.

Table 2.13 shows the existing hydroelectric power plant in Myanmar (> 50MW).

Table 2.13 Existing Hydroelectric Power Plant in Myanmar (> 50 MW)

Station	Installed Capacity (MW)
Yeywa	790
Shweli-1	600
Paunglaung	280
Dapein-1	240
Baluchaung-2	168
Thauk-ye-khat	120
Mone	75
Shwegyin	75
Kyee on Kyee wa	74
Kun	60
Kinda	56
Keng Taung	54
All Others	188
Total	**2,780**

Source: Vikas Sharma, 2013

During the wet season (June-September), the power plants are able to generate at optimum capacity. However, in the dry season, insufficient water storage leads to production drops that necessitate significant load-shedding.

The exploitation of hydroelectric sites has been a top-down affair with little consultation with local communities. This is changing and affected communities,

especially in ethnic areas, now expect and should get a role in planning or even investing in their projects. Because this is tied into the peace negotiations, this participation often slows down the pace of investment. For example, an investor will often prefer a high dam as this has a better rate of return, but a high dam will displace more area and people with its reservoir. It is also more of a risk downstream if the dam fails. Local groups often prefer dams of medium height or even run of the river dams that do not store large amounts of water.

In addition, hydrology studies (how much water flows through the proposed dam site – not just on average, but maximum and minimum flows over many years) and environmental assessments can take several years. This is required to ensure that the maximum flow of the dam is not underestimated. This could lead to large releases of water and poor management of the reservoir level. These assessments can take 3 to 5 years to complete. Even then, the influence of water pressure on rock formations causing earthquakes in the region or of downstream sediment deposition may not be fully understood.

Once the design and studies and assessments are completed, large dams can take 5 to 10 years to come online. While hydroelectricity is a low cost source of power with no ongoing carbon or particulate emissions, it is not costless and without risks.

There are significant amounts of potential hydroelectric capacity and some estimates exceed 40,000MW. This is ten times the current capacity of Myanmar from all sources. Alternatively, if demand needs to double every six years for eighteen years, the capacity in 2032 would need to be 32,000MW. This suggests a significant amount and is above the high estimate of the MEP, however it would amount to approximately 2,000kWh per capita, less than the current Thai usage and equal Vietnam's per capita generation in a few years. Given the long lags in building these dams, it is important to negotiate the ability to purchase significant amounts of power for domestic use, even from dams invested with foreign capital and initially destined for export.

Currently, the MEP is developing 20 hydroelectric power projects, 14 of which involve investments from China and Japan. The MEP also estimates the hydroelectric power plant projects to be completed during 2013-2016 with the total installed capacity of 472MW as shown in ***Table 2.14***.

Table 2.14 Expected Hydroelectric Power Plant Projects to be completed during 2013-2016

Station	Installed Capacity (MW)
Thaukyekhat-2	120
Phyu	40
Namcho	40
Upper Paunglaung	140
Baluchaung No.3	52
Kyaukphyu	50
Upper Baluchaung	30
Total	**472**

Source: MEPE, 2013.

Gas-fired

Myanmar has 10 gas-fired power plants; all operated by Myanmar Electric Power Enterprise (MEPE). Their installed capacities of 996MW account for 20.5% of national grid capacity. Ahlone is the biggest plant with a capacity of 275MW. These plants use gas produced in the offshore fields of Yadana and Yetagun, and onshore fields operated by the Ministry of Energy. The output from these plants has been below expectations owing to low calorific value of local gas (high Nitrogen content) and low pressure without compression.

Table 2.15 shows the existing gas-fired power plants in Myanmar.

Table 2.15 Existing Gas-fired Power Plants in Myanmar

Station	Installed Capacity (MW)
Kyungchaung	54.3
Mann	36.9
Shwedaung	55.3
Mawlamyaing	12.0
Myanaung	34.7
Hilawga	208.7
Ywama	122.3
Ahlone	275.2
Thaketa	145.6
Thaton	51.0
Total	**996**

Source: Vikas Sharma, 2013

The gas-fired power plants in Myanmar use both liquefied petroleum gas (LPG) and liquefied natural gas (LNG) as fuels, however, the differences between LPG and LNG are not always clear. LPG is propane or butane gas under slight pressure which turns into a liquid at normal temperatures. It is often used for household cooking and delivered in small cylinders, but can be used in place of natural gas in many generators. It currently sells for 15 to 16 USD per million BTU (import price) and can be delivered in small ships of 10-30 thousand tons. It does not require elaborate or costly ports or handling equipment. LPG is a plausible transition fuel for gas-fired generators that will be commissioned in 2015-2018 but not able to use domestic natural gas until a few years later when extra domestic gas supplies should become available. LPG is also cheaper than kerosene or diesel alternatives.

LNG is super-cold natural gas which has turned into a liquid. It is typically delivered in specialized ships which are essentially floating thermos bottles, specially designed to handle the very cold liquid. Recently, most LNG tankers have been very large – up to 12 meters (39 feet) in draft and require costly specialised storage facilities on shore, which take several years to build. Due to the cost of the ships and the onshore facilities that need to be repaid over an extended period, most LNG contracts are for many years, usually at least twenty. If Myanmar will produce more domestic natural gas for its own use starting in 2020, the cost of domestic natural gas would be less than that of LNG. This would make the large onshore investment in equipment unattractive. Besides this, there are not deep water ports capable of handling large LNG ships close to population centers where electricity is needed.

However, MEP intends to focus on gas-fired power plant to reduce reliance on hydroelectric power plant projects. In its official five-year-plan, MEP has set an ambitious target to increase capacity to 2,500MW capacity by 2015-2016. One key upcoming development is a 500 MW plant set for completion by the end of 2014. It will supply power to Thilawa Special Economic Zone (SEZ) that is jointly developed by Myanmar and Japan. In addition, the World Bank lent 140 million USD in September 2013 to upgrade and add 125MW capacity to Thaton station. The MEP estimates the gas-fired power plant projects to be completed during 2013 to 2016 with a total installed capacity of 1,720MW as shown in ***Table 2.16***.

Table 2.16 Expected Gas-fired Power Plant Projects to be completed during 2013 to 2016

Station	Installed Capacity (MW)
Hlawga (Zeya Co., Ltd.)	50
Ywama (MyanShwePyay Co., Ltd.)	50
Thaketa (CIC Co., Ltd.)	50
Ahlone (Toyo Thai Co., Ltd.)	100
Ywama (Transferred from Thailand)	240
Thaketa (BKB Co., Ltd. Korea)	500
Hlawga (Hydrolancang Co., Ltd. China)	530
Mawlamyaing (Myanmar Lighting Co., Ltd.)	50
Kyunchaung (Extension)	70
Shwedaung (Extension)	80
Total	**1,720**

Source: MEP, 2013.

Coal-fired

Currently, Myanmar has one coal-fired power plant named Tigyit with an installed capacity of 120MW. Efficiency of the power plant is low, generating power at an average capacity factor of approximately 30%.

There has been public skepticism concerning new coal generating plants. Historically, coal-fired power plants in the emitted significant amounts of soot and sulfur. Sulfur led to acid rain downwind. In addition, certain specifications of coal are also high in mercury, a toxic metal that can pollute watercourses. However, technology has evolved considerably and new coal-fired power plants can be designed to use low-sulfur coal and catch almost all of the ash particles generated from burning. Processing of coal before burning can also remove over half of the mercury.

A single coal unit has a usual capacity of 400 to 600MW and most coal stations have at least two units. A typical station has a capacity of 1,000MW (1 million kilowatts) and operates for 6,000 hours a year, producing six billion kWh a year. Since a ton of good steam coal produces approximately 3,000kWh, the annual coal consumption of one station is in the order of two million tons a year or 5-6 thousand tons a day. If the coal is of lower thermal quality, even larger amounts must be used. Handling such large amounts of coal requires ocean transport on large ships that need deep channels and ports with specialised unloading facilities. These are major investments and there is the potential for significant impact on the area in which they operate.

MEPE aims to add 300MW capacity by 2015-2016. In a key development, World Bank sanctioned a 165 million USD loan in early 2013 to develop coal-fired power plants.

It should be noted that coal-fired plants in general have higher CO2 emissions compared to gas turbines. Gas turbines have relatively low CO2 compared with other fossil fuel energy generation technologies. The Project has employed a CCGT technology which was designed for high reliability and efficiency operation with lower environmental impact. CCGT plant offer half as much CO_2 per kWh compared to other power generation technology. Natural gas provides more efficiency than coal because of higher operating temperatures, and when used together with the more efficient combined-cycle results in even higher efficiencies (IEA, 2006)[1].

Non-hydro Renewable Sources

Using non-hydro renewable sources for power generation is still in its infancy in Myanmar and constitutes a small percentage of total installed capacity and generation. While Myanmar is rich in renewable resources, the development remains severely limited by availability of funds to support the research and development, lack of a clear renewable energy policy and lack of talented manpower.

The following provides a brief summary of the limited publically available information concerning non-hydro renewable projects in Myanmar.

Biomass

There are 174MW of biogas power projects in operation.

Geothermal

Approximately 90 geothermal locations have been identified to date. Of these, 43 are being tested by the MEP along with Electrical Power Development Company of Japan, as well as Union Oil Company of California.

Wind Energy

Wind power projects are either in experimental phase or undergoing feasibility studies. There are some very small operational projects off the grid (Dattaw Mountain in Kyauske, and Government Technical High School in Ahmar, Ayeyarwaddy). Gunkul Engineering Public Company Limited and China Three Gorges Corporation, both foreign, signed a MOU with the MEP in 2011 to conduct feasibility studies for the development of 4,032MW of wind energy in Myanmar.

Solar Energy

Some pilot PV cell projects financed by the MEP and university research departments are underway in rural areas; being used to charge batteries and pump water for irrigation. Another example is the installation of 3KW PV systems in remote schools by Mandalay Technological University. Overall, however, at current costs, solar energy is unaffordable.

[1] IEA, 2006a: Energy Technology Perspectives 2006: Scenarios and strategies to 2050. International Energy Agency, Paris, 484 pp.

2.7.3 *Alternatives of the Project Location*

Three (3) power plant locations were considered by MOEP; location 1 – adjacent to the steel mill in Taung Thar Township (preferred location); location 2 – Thi Gon Site and location 3 – Taung Thar Site. The three (3) locations are shown in ***Figure 2.14***.

Location 1 (adjacent to the steel mill in Taung Thar Township)

The preferred site is located adjacent to the existing steel mill on a plot of MOI-owned land which is approximately 27 hectares in size. An electricity sub-station is currently being constructed on the steel mill site to accommodate the capacity expansion of the steel mill and the Project. The 230 kV bay in use at present by the transmission line from ThPyaWa, will be made available for the Project once the existing 230kV transmission line termination is relocated to one of the new bays under construction. River water is currently being abstracted for the steel mill by tube wells, expected to increase from 4 to 12 tube wells to accommodate the expansion of the steel mill (currently under construction). This site would require abstraction of freshwater from the Ayeyarwady River for cooling water system. It is also noted that there is currently no municipal sewage discharge connection to the steel mill site, and septic tanks are used instead.

The construction of the connecting gas pipeline from the interconnection point to the Project is in progress, with completion expected in 2015. Exact details of the gas reception area are not yet available and it is not yet confirmed whether the gas pipeline will access the receiving station from the east or west of the site.

There are at least 5 villages within 5km of the steel mill and Project site. The nearest villages are:

- Sa Ka Village 0.7km to the north;
- Hnan Ywa village 1.7km to the south east;
- Pet Taw village 3.7km to the south;
- Nyaung Gan village 3.8km to the south west; and
- Gyo bin village 3.2km to the north west.

Note that each village has its own pagoda. There is also a pagoda complex (i.e. shrines, courtyards and garden) located approximately 2km to the north. Some of these villages are considered as sensitive receivers for potential air and noise impacts.

A key reason for selecting Location 1 as the preferred site is that the site is located adjacent to the steel mill, which is already in operation, and therefore the proposed Project is in keeping with the existing industrial use. This would minimise the significance of the potential visual and aesthetic impact of the development of the Project. The infrastructure is also in place, or in the process of being installed, at this site and thus has advantages in relation to land availability, gas supply pipeline and connection to the national grid. The availability of cooling water is also an important factor, with the site at Location 1 being the closest of the three sites to the Ayeyarwady River. However, a disadvantage of the site being in close proximity to the steel mill is the potential for cumulative air quality and noise impacts on the existing Air and Noise Sensitive Receivers (ASRs and NSRs). It is also located quite far

(about 10km) away from cooling water source from the Ayeyarwady River, meaning construction of long pipelines are required for cooling water intake.

Location 2 (Thi Gon Site)

Location 2 is located approximately 5km south west of the preferred site at Location 1 (i.e. the steel mill site). GOM owns 8 hectares of land at this location, but this is not considered to be sufficient for the CCPP Project (which requires a minimum of 16 hectares). The connecting gas pipeline would need to be extended from the steel mill gas reception area for a further 5 km; however, at this early stage, the RoW for the gas pipeline is not considered to pose a constraint (although there would be additional costs in extending the gas connecting pipeline to the electricity substation).

The discussions have not been held with the Ministry of Gas (MOG) who would be responsible for the construction of the gas pipeline extension. Initial findings indicated that an electrical connection to the 230kV system is possible, but an additional 230kV substation would be required, in addition to the 5 km transmission line, to be constructed by the IPP developer.

Cooling water could also be extracted from the Ayeyarwady River, but the RoW from the river to the Project site would be considered a constraint as the RoW would traverse agricultural land (which could involve multiple owners) to connect to this location. Hence, this location would have additional land acquisition consideration. For once through cooling, the water pipelines are expected to be approximately 1.5m in diameter and the land for the RoW corridor would be sizeable (8-10m in width).

There are at least 8 village settlements within a 5km radius of the site at Location 2. Those closest would be considered as sensitive receivers for potential air quality and noise impacts. The nearest villages adjacent to Location 2 are Ta Pin Kan Ywar (0.3 km from Location 2) and Ta Pin Kan (South) within 1.1km of Location 2.

Location 3 – Taung Thar Site

The site at Location 3 is located on the opposite side of the road to the Taung Tha gas offtake station. The site is currently vacant and is bound by the railway line to the north west. A 230kV electrical interconnection would be available within 6.5km, but a new 230kV interconnection sub-station would need to be constructed by the IPP developer as well as the additional 6.5km transmission line. At the time of undertaking this ESIA study, there was no information available on the size of the land available at Location 3.

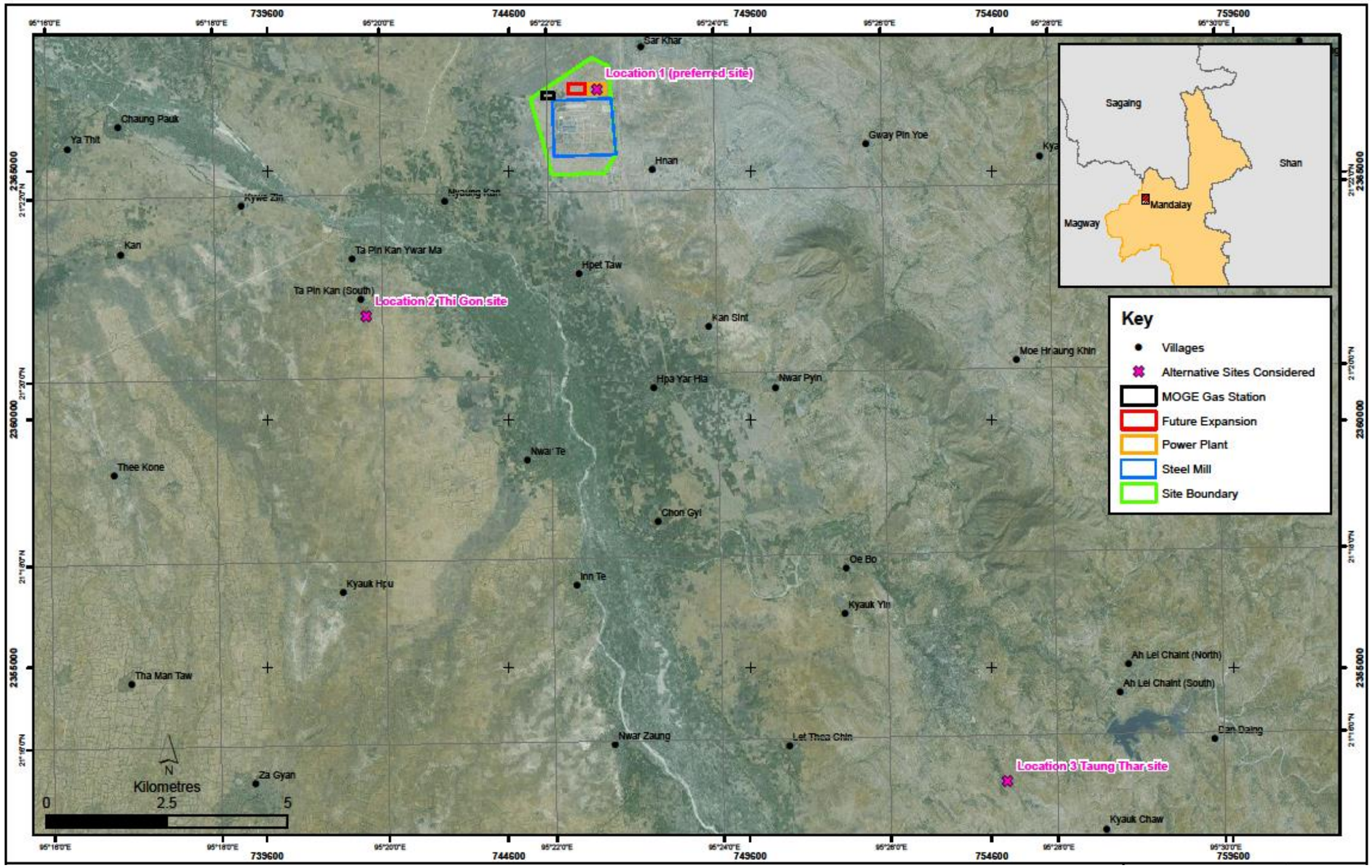
Given the inland location and distance from the Ayeyarwady River, the use of cooling water (i.e. cooling towers) is not considered feasible at this site.

There are at least 10 villages located within 5km of the site at Location 3, with the town of Taung Thar being the closest.

Location 3 is advantageous as the site is located directly opposite the Taung Thar gas offtake point; however, there is no information available at present regarding the availability of connection points. There is no water available within vicinity of the site

and so the plant would need to be air cooled, which has an associated penalty on the plant heat rate through decreased efficiency as well as potential visual and aesthetic impacts.

Figure 2.14 Alternatives of the Project Location



Source: ERM, 2015

2.7.4 *Alternatives of Configuration on Site*

As Location 1 is the preferred site for the Project, the following discussion refers to the options being considered regarding the plant configuration at Location 1.

MOGE has indicated that the new gas receiving station would be constructed adjacent to the existing one within the existing steel mill site and therefore no additional land take is required. The connecting Taung Thar gas offtake line may connect to the gas receiving station either from the west.

Sembcorp as the selected IPP developer will connect the power plant to the existing electricity substation within the steel mill site only.

Two (2) routes were considered for overhead transmission, either directly through the steel mill or adjacent to the Project Site in the steel mill complex. The route running alongside the Project Site is preferred as this would avoid the need to pass through the scrap yard. No additional land to be acquired and therefore there are no additional land acquisition issues to be considered.

2.7.5 *Alternatives of Technological Options*

The power plant technology was determined as part of the competitive tender process, by MOEP. However, the cooling mechanism for the Project; with open loop cooling water intake, closed loop with cooling towers and dry/air cooled condenser options are considered by the IPP developer. The main considerations for these options are outlined below.

Open Loop / Once Through Cooling

This system will take water from the Ayeyarwady River, circulate it through the pipes to absorb heat from the steam in the condensers and then discharge the water back to the river. This option is considered fairly simple and low cost to maintain, however it also requires a large reliable source of withdrawal water, which in turn can have potential water availability impacts on the river ecology and downstream river users (e.g. for irrigation and domestic users). It has been estimated that for once through cooling, a flow of approximately 4.5m^3/s would be required and that this would be piped to the Project through pipelines, assumed to be subsurface, 1.5m in diameter.

The total RoW corridor would be between 8 to 10m in width to allow for maintenance access. Initial designs indicate that the RoW for the cooling water pipe would run alongside the existing irrigation canal, although this may pose issues in some locations regarding land rights/availability. There will also be pipeline crossings across the irrigation canal which would need to be considered for construction activities and long term stability of the pipeline.

Due to capacity limitations, the existing pumping station, maintained by the MOAI would not be suitable for the Project and new infrastructure would need to be developed or the existing pumping station upgraded to support the Project. Should piling or dredging works be required, this has the potential to impact on existing water quality and the freshwater ecology.

In addition to water availability, once through cooling can have significant negative impacts on the aquatic ecosystem and river users caused by the discharge of water which has absorbed the excess heat from the power plant. The continuous discharge creates a thermal plume, which gradually mixes with the river water.

Closed Loop System

The closed loop system uses cooling towers to expose water to ambient air to cool the water. As some of the water would evaporate, make-up water would be taken from the Ayeyarwady River to replace the evaporated water. These systems have lower water withdrawal requirements than once through systems. Water pipeline would also be required to supply water to the Project Site; however, these would likely be narrow in diameter (less than 30cm) and can be buried. Therefore, the RoW corridor will be narrower in comparison to the once through cooling system RoW.

The closed loop system has been selected for this Project.

Dry/ Air Cooling

The dry/air cooling system uses ambient air to cool the steam instead of water and thus the water withdrawal requirements are negligible on comparison with open loop and closed loop systems. There is an associated penalty on the plant heat rate through decreased efficiency and this will be an important consideration for the Project given the high ambient air temperatures experienced in the Mandalay region.

2.7.6 Alternatives of Temporary Landing for Heavy Cargo

The following temporary landing locations for heavy cargo were surveyed during the initial pre-development stage.

- Semeikhon Port at Mandalay Myotha Industrial Park (MMIP);
- Let Htode at the Ayeyarwady River; and
- Nyaung Hla at the Ayeyarwady River.

Semeikhon Port

The survey determined that the slipway jetty at Semiekhon Port is not suitable for roll off operation as the water level is too low and the slope level is very steep. The road conditions from the MMIP gate to the Project site is in good condition, however there is a suspension bridge that is not passable. There is no alternative road to avoid the suspension bridge.

Let Hrode Riverbank

The ground conditions at the Let Hrode Riverbank are considered suitable for heavy cargo. There is a steep slope at this location which would require levelling. This location is also accessible to the public.

Nyaung Hla Riverbank

The ground conditions at the Nyaung Hla Riverbank would require reinforcement. There is no steep slope onsite and the landing location is owned by a private company. Following reinforcement of the ground conditions the Nyaung Hla Riverbank is considered as the appropriate location.

3 ADMINISTRATIVE FRAMEWORK

3.1 INTRODUCTION

This chapter summarises the Administrative Framework for the Project, covering national requirements as well as applicable international treaties and conventions, and internal guidelines and standards voluntarily committed to by the Project Sponsors. The intent of this chapter is to lay out the regulatory and non-regulatory performance requirements for all stages of the Project.

3.2 NATIONAL ADMINISTRATIVE REQUIREMENTS

3.2.1 Overview of Myanmar Legislation

The Constitution

The latest enacted Constitution (May 2008) provides information on governing laws and regulations in Myanmar. The Constitution takes precedence over any other national legislation or international agreements. The general provisions of the Constitution that relate to the Project are the requirement for Myanmar citizens to assist in:

- Preservation and safeguarding of cultural heritage;
- Environmental conservation;
- Striving for development of human resources; and
- Protection and preservation of public property.

Administrative Divisions of Myanmar

Myanmar is divided into twenty-one (21) main administrative subdivisions, which include:

- Seven states;
- Seven regions (Note that regions were previously referred to as “divisions”, prior to August 2010);
- Five self-administered zones;
- One self-administered division; and
- One union territory.

The administrative subdivisions are detailed in ***Table 3.1***, and an administrative map is presented in ***Figure 3.1***.

Table 3.1 Administrative Regions of Myanmar

Name	Capital	Population	Area
Ayeyarwady Region	Pathein	6,663,000	35,138
Bago Region	Bago	5,099,000	39,404
Chin State	Hakha	480,000	36,019
Kachin State	Myitkyina	1,270,000	89,041
Kayah State	Loikaw	259,000	11,670
Kayin State	Pa-an	1,431,377	30,383
Magway Region	Magwe	4,464,000	44,819
Mandalay Region	Mandalay	7,627,000	37,021
Mon State	Mawlamyaing	2,466,000	12,155
Rakhine State	Sittwe	2,744,000	36,780
Sagaing Region	Sagaing	5,300,000	93,527
Shan State	Taunggyi	4,851,000	155,801
Tanintharyi Region	Dawei	1,356,000	43,328
Yangon Region	Yangon	5,560,000	10,170
Naypyidaw Union Territory	Naypyidaw	925,000	N/A
Danu Self-Administered Zone	Pindaya	N/A	N/A
Kokang Self-Administered Zone	Laukkai	N/A	N/A
Naga Self-Administered Zone	Lahe	N/A	N/A
Pa-O Self-Administered Zone	Hopong	N/A	N/A
Pa Laung Self-Administered Zone	Namhsan	N/A	N/A
Wa Self-Administered Division	Hopang	N/A	N/A

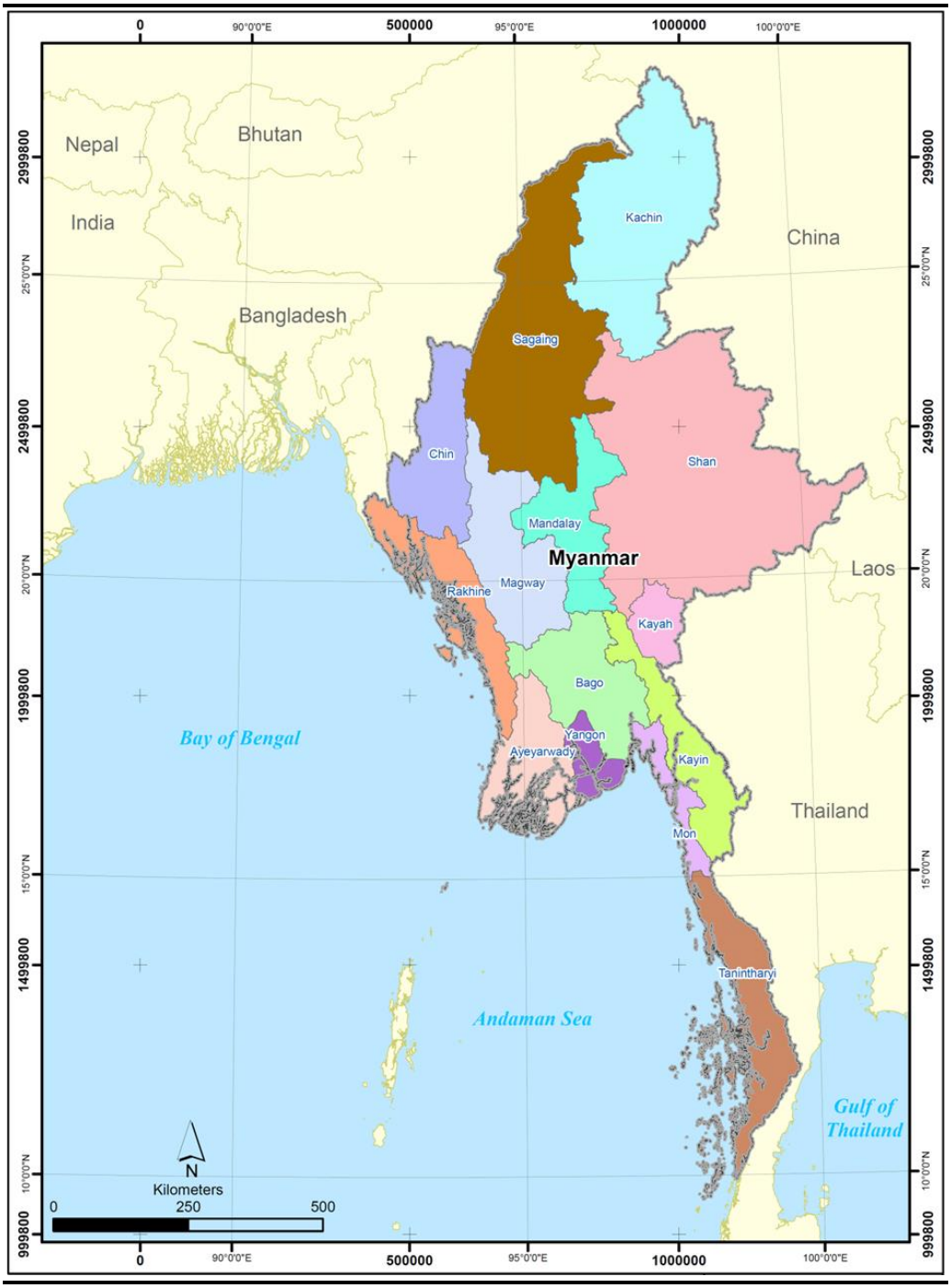
States and regions are divided into districts. Districts consist of townships, which are composed of towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is defined in the Constitution.

Each region and state has a Regional/State Government, consisting of a Chief Minister, Ministers and an Advocate General. Legislative authority resides with the State/Regional "Hluttaw" (a parliament or legislative body), which are made up of elected civilian members and representatives of the military.

The Constitution states that Naypyidaw is a Union Territory under the direct administration of the President. The Naypyidaw Council, led by a Chairperson, carries out general functions on behalf of the President. The Chairpersons of the Naypyidaw Council are appointed by the President, and include civilians and representatives of the military.

Self-Administered Zones and Self-Administered Divisions are administered by a Leading Body, which is headed by a Chairperson, and has executive and legislative powers. The Leading Body consists of elected State/Regional Hlutttaw members and military personnel.

Figure 3.1 Myanmar States/Regions and Townships



ESHIA Requirements in Myanmar

Myanmar currently does not have effectively implemented regulatory requirements for environmental, social and health impact assessments (ESHIA). However, a number of environmental laws are either pending or in the final stages of government approval, and the situation with respect to ESHIA requirements in Myanmar is expected to undergo significant imminent changes. As such, this section will highlight both the current and pending legislation with respect to ESHIAs.

The Myanmar Government has had plans to install new laws on ESHIA requirements since at least 2009. Laws related to ESHIA requirements (including those that are currently pending) are as follows:

Environmental Policy, 1994, Myanmar Agenda 21, 1997, and National Sustainable Development Strategy, 2009

Myanmar issued an Environmental Policy in 1994, which was as follows:

"…. The wealth of the nation is its people, its cultural heritage, its environment and its natural resources. The objective of Myanmar's Environment Policy is aimed at achieving harmony and balance between these, through the integration of environmental considerations into the development process to enhance the quality of life of all its citizens. Every nation has the sovereign right to utilize its natural resources in accordance with its environmental policies, but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interest of present and future generations. Environmental protection should always be the primary objective in seeking development".

With a view to implementing a National Environment Policy (NEP), the National Commission for Environmental Affairs (NCEA) formulated Myanmar Agenda 21 in 1997 under the guiding principles established at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The Agenda 21 provided the first framework for integrating environmental considerations into national development plans in Myanmar. The purpose of Agenda 21 is to mobilize and focus national efforts to achieve sustainable development, and is intended to have the following functions:

a) To define the choices, set the goals and targets, and establish the standards for sustainable development in Myanmar;

b) To illuminate the environmental and ethical dimensions underlying the choices to be made and goals to be achieved in sustainable development;

c) To analyze the ecological, economic and social issues in the country in a comprehensive and integrated fashion, clarifying the links between them, identifying the policy gaps, and showing how to reduce conflicts between environment and development;

d) To identify and evaluate options for addressing priority issues, problems and opportunities, including the identification of appropriate programmes for legal reform, development of economic instruments, institutional development, capacity-building and other measures;

e) To set out sectoral and cross-sectoral policies and plans which rationalize the responsibilities for sustainable development, reduce duplication, close gaps, prevent or reduce conflicts, and take advantage of compatibilities and synergies among sectors and interest groups;

f) To improve decision-making and policy formulation through better information and analytical techniques, and by enabling those most affected by decisions to participate in the decision-making process;

g) To develop understanding and build consensus so that decisions have strong support;

h) To identify, promote and support actions leading to sustainable development and to reduce, abate and put a stop to actions impeding sustainable development;

i) To identify and apply practices which sustain the resource base of the economy, achieve sustainable levels of resource use, restore degraded natural resources, make use of unused or under-used resource potential, improve the efficiency of existing resource use, and diversify the use or seek substitution of existing resources;

j) To determine priorities for action, evaluating costs and benefits and the trade-offs between the different concerns affecting all levels of society;

k) To provide a basis for the allocation and optimal use of limited resources;

l) To develop and strengthen institutions for sustainable development; and

m) To build up the capacity of institutions and the population of the country to handle complex and inter-related issues through frameworks which integrate environmental concerns with planning.

Subsequently in 2007, the NCEA developed the National Sustainable Development Strategy (NSDS) for Myanmar. It incorporated the aspirations of the Agenda 21 as well as Myanmar's Millennium Development Goals. The NSDS was approved in 2009 and served as the main guiding principal on environmental protection in the country.

Specific strategies are outlined under each goal. For example, the goal for Sustainable Management of Natural Resources suggests strategies for forest resource management, sustainable energy production and consumption, biodiversity conservation, sustainable freshwater resources management, sustainable management of land resources, sustainable management for mineral resources utilization, etc.

The aim of NSDS is to achieve sustainable development through three sectors, focused on natural resource management, economic development, and social

development. Relevant government ministries are expected to institutionalize NSDS principles into their sectoral development through short-term, medium-term and long-term actions.

Although much of the NSDS guidelines are for adoption and integration into the government legislation and regulation body, some are targeted at the private sector, such as the polluter pay principle, and reduction of energy consumption and greenhouse gas emission from industries.

The Environmental Conservation Law, 2012

The legal mechanism for ESHIA has been put in place with the 2012 Environmental Conservation Law. The law was enacted on April 1, 2012, based on a draft written in 1998.

According to the text of The Environmental Conservation Law, the main objectives of the Law are as follows:

a) to enable to implement the Myanmar National Environmental Policy;
b) to enable to lay down the basic principles and give guidance for systematic integration of the matters of environmental conservation in the sustainable development process;
c) to enable to emerge a healthy and clean environment and to enable to conserve natural and cultural heritage for the benefit of present and future generations;
d) to reclaim ecosystems as may be possible which are starting to degenerate and disappear;
e) to enable to manage and implement for decrease and loss of natural resources and for enabling the sustainable use beneficially;
f) to enable to implement for promoting public awareness and cooperation in educational programmes for dissemination of environmental perception;
g) to enable to promote international, regional and bilateral cooperation in the matters of environmental conservation;
h) to enable to cooperate with Government departments, Government organizations, international organizations, non-government organizations and individuals in matters of environmental conservation.

The following articles are particularly relevant to ESHIA requirements and this project:

"7. The duties and powers relating to the environmental conservation of the Ministry are as follows:

…

(m) causing to lay down and carry out a system of environmental impact assessment and social impact assessment as to whether or not a project or activity to be undertaken by any Government department, organization or person may cause a significant impact on the environment;"

Also in this law, Article 14 and Article 15 are related with waste disposal in accordance with environmental standards:

"14. A person causing a point source of pollution shall treat, emit, discharge and deposit the substances which cause pollution in the environment in accord with stipulated environmental quality standards.

15. The owner or occupier of any business, material or place which causes a point source of pollution shall install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If it is impracticable, it shall be arranged to dispose the wastes in accord with environmentally sound methods."

Article 19 is related to maintenance of cultural heritage:

"19. The Ministry shall cooperate with the relevant Government departments and Government organizations in the matters of environmental conservation for perpetual existence of cultural heritage sites and natural heritage sites, cultural monuments and natural areas stipulated under any existing law."

For violations of bylaws, regulations and directives issued under this law, punishment is not more than one year or fine (unspecified amount), or both, under Article 32.

Environmental Conservation Rules (2013)

The Environmental Conservation Rules were approved by cabinet in 2013, and The Ministry of Environmental Conservation and Forestry passed the Environmental Conservation Rules on 5 June 2014.

The Environmental Conservation Rules detail the environmental policy and implementation framework of the 2012 Environmental Conservation Law. According to the Rules, the Ministry of Environmental Conservation and Forestry (the "Ministry") with the approval of the Environmental Conservation Committee (the "Committee") is authorized to prescribe: (a) the amount of liability owing from a person or entity causing environmental damage; and (b) the amounts of contribution to be made to the Environmental Management Funds by persons or entities engaged in environmental services and extraction of natural resources.

The Ministry is also authorized to specify: (a) the projects, businesses, services, or investments for which environmental impact assessments ("EIA") must be conducted; and (b) the businesses, work sites, or factories that can potentially damage the environment for which prior permission from the Ministry must be sought. The second list must be approved by the Union Government and confirmed by the Committee. However, it is important to note that even if a project, business, service, or investment does not fall under those for which EIA must be conducted, the Ministry may still require an Initial Environmental Examination in order to determine whether an EIA is in fact necessary. Additionally, companies must seek the confirmation of the Ministry before appointing an EIA service provider.

In addition, the Environmental Conservation Rules stipulate the following relevant articles under Chapter (XI) Environmental Impact Assessment:

"54. The business, department, organization or person who would carry out categories of plan, business or activity stipulated under rule 52:

(a) shall carry out environmental impact assessment for his plan, business or activity;

(b) submit to the Ministry in advance by which organization or person, the environmental impact assessment is intended to be carried out;

(c) submit the environmental impact assessment report to the Ministry.

55. The plan, business or activity which is established before the issue of these rules and responsible to carry out the environmental impact assessment or initial environmental examination shall prepare the environmental management plan in accord with the environmental impact assessment procedure to be issued under the Law and submit to the Ministry. The Ministry shall scrutinize the environmental management plan for approving it. The person who carries out the project, business or activity shall implement the environmental management plan approved by the Ministry and matters stipulated by the Ministry within the time stipulated by the Ministry.

56. The person who carries out any project, business or activity shall arrange and carry out for conducting the environmental impact assessment for any project, business or activity by a qualified third person or organization accepted by the Ministry.

57. The Ministry shall, on submission to the Ministry in advance by which organization or person, the environmental impact assessment is intended to be carried out under sub-rule (b) of rule 54, determine and decide, after making scrutiny, whether or not it is suitable level of international organization or person to carry out the environmental impact assessment. The decision of the Ministry relating to such matter is final and conclusive.

58. The Ministry shall form the Environmental Impact Assessment Report Review Body with the experts from the relevant Government departments, Government organizations.

59. If the private persons are included in the Environmental Impact Assessment Report Review Body, honorariums, allowances and aids for them may be borne from the environmental management fund.

60. The Ministry may assign duty to the Department to scrutinize the report of environmental impact assessment prepared and submitted by a third person or organization relating to environment impact assessment and report through the Environmental Impact Assessment Report Review Body.

61. The Ministry may approve and reply on the environmental impact assessment report or environmental management plan with the approval of the Committee."

Foreign Investment Law, 2012, Foreign Investment Rules, 2013, and Notifications for Investment, 2013

Myanmar passed a new Foreign Investment Law on November 2, 2012, which replaced the Myanmar Foreign Investment Law of 1988. The recently enacted rules require ESIA for large projects according to the rules of the Ministry of Environmental Conservation and Forestry.

Although the law does not specifically define legislation for EIAs, Notification 1/2013 provides a categorization of the business activities in which foreigners will be allowed to engage. Under this, "Electrical power production" projects fall under "Category 3.3: activities allowed only following an Environmental Impact Assessment". Specifically, electrical power production projects "must conduct Environmental Impact Assessment and obtain and follow MOECAF's terms and conditions".

Draft – Environmental Impact Assessment Procedure (Pending, currently on 8th Draft as of January 2015)

An Environmental Impact Assessment Procedure is currently being drafted by the Ministry of Environmental Conservation and Forestry. This is currently in a preliminary draft form, but states that:

"…all Projects undertaken in the Republic of the Union of Myanmar by any ministry, government department, organization, corporation, board, development committee, local government or authority, company, cooperative, institution, enterprise, firm, partnership or individual having the potential to cause significant Adverse Impacts, are required to undertake IEE or EIA and to obtain an ECC in accordance with this Procedure."

According to the Draft EIA Procedure, based on the criteria indicated in Annex 1 'Categorization of Economic Activities for Assessment Purposes', coal-fired power plants greater than 10 MW require an EIA.

The EIA Procedure also outlines requirements for Scoping for all EIA Projects, which are required to be undertaken according to Article 40 and 41, as follows:

"*40. The Scoping shall, in respect of the proposed Project:*

a) define the study area, area of influence, time boundaries, project phases, and potential stakeholders;

b) start the process of understanding the applicable regulations and standards, and their context for Project design and completion of the EIA;

c) make a provisional identification of Environmental, Social and, if any, Health Impacts, focusing in particular on the environmental, social and health issues that need to be addressed in subsequent EIA studies;

d) provide an indication of what baseline data and information are required, and how it is proposed to obtain it (although there is no need to actually collect any data at this stage);

e) provide an opportunity for consultants, relevant authorities, project developers, interested and affected parties to express their views and concerns regarding the proposal before an EIA proceeds;

f) enable an efficient and comprehensive assessment process that saves time, resources, costs and delays; and

g) identify potentially affected communities and other stakeholders with an interest in the Project.

41. As part of the Scoping, the Project Proponent shall ensure that the following public consultation and participation process is carried out:

a) disclose information about the proposed Project to the public and civil society through local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project site which are visible to the public; and

b) arrange the required complement of consultation meetings as advised by the Ministry, with local communities, potentially PAPs, local authorities, community based organizations, and civil society."

Furthermore, EIA Investigation shall encompass the requirements of Article 47 through 52:

"47. An EIA investigation shall consider all biological, physical, social, economic, health, cultural and visual components of the environment, together with all pertinent legal matters relating to the environment (including land use, resources use, and ownership of and rights to land and other resources) that may be affected by the Project during all project phases including pre-construction, construction, operation, decommissioning, closure, and post-closure; and shall identify and assess all Adverse Impacts and risks for environment, social and, if relevant, health that potentially could arise from the Project.

48. The investigations shall include all necessary data collection, technical studies, modelling, field surveys, field sampling, laboratory analysis, engineering designs and calculations, and consultations to determine and document that all feasible measures are taken to ensure that all Residual Impacts are within standards and are acceptable to the Ministry and interested and affected persons.

49. The investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives.

50. The Project Proponent is obliged to use, comply with and refer to applicable national standards, international standards adopted by the Government and/or the Ministry, or, in the absence of relevant national or adopted international standards, such standards as may be agreed with the Ministry.

51. The EIA shall consider the views, concerns, and perceptions of stakeholders, communities and individuals that could be affected by the Project or who otherwise have an interest in the Project. The EIA should include the results of public consultations and negotiations with the affected populations on the environmental and social issues. Public concerns should also be taken into account in assessing impacts, designing mitigation measures, and selecting monitoring parameters.

52. As part of the EIA investigations, the Project Proponent shall undertake the following consultation process:

a) 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 of the Project Proponent, at public places such as libraries and community halls and sign boards at the Project site visible to the public

b) arrange consultation meetings at national, state and local level with PAPs, authorities, community based organizations, and civil society;

c) consultations with concerned government organizations including the Ministry, the concerned sector ministry, regional government authorities, and others; and

d) field visits for the Ministry and concerned government organizations."

Pending (Draft) Approval Process

According to the Draft EIA Procedure, depending on project type and scale, location and the potential environmental impact, one of three levels of assessment will be allocated to a proposed development project:

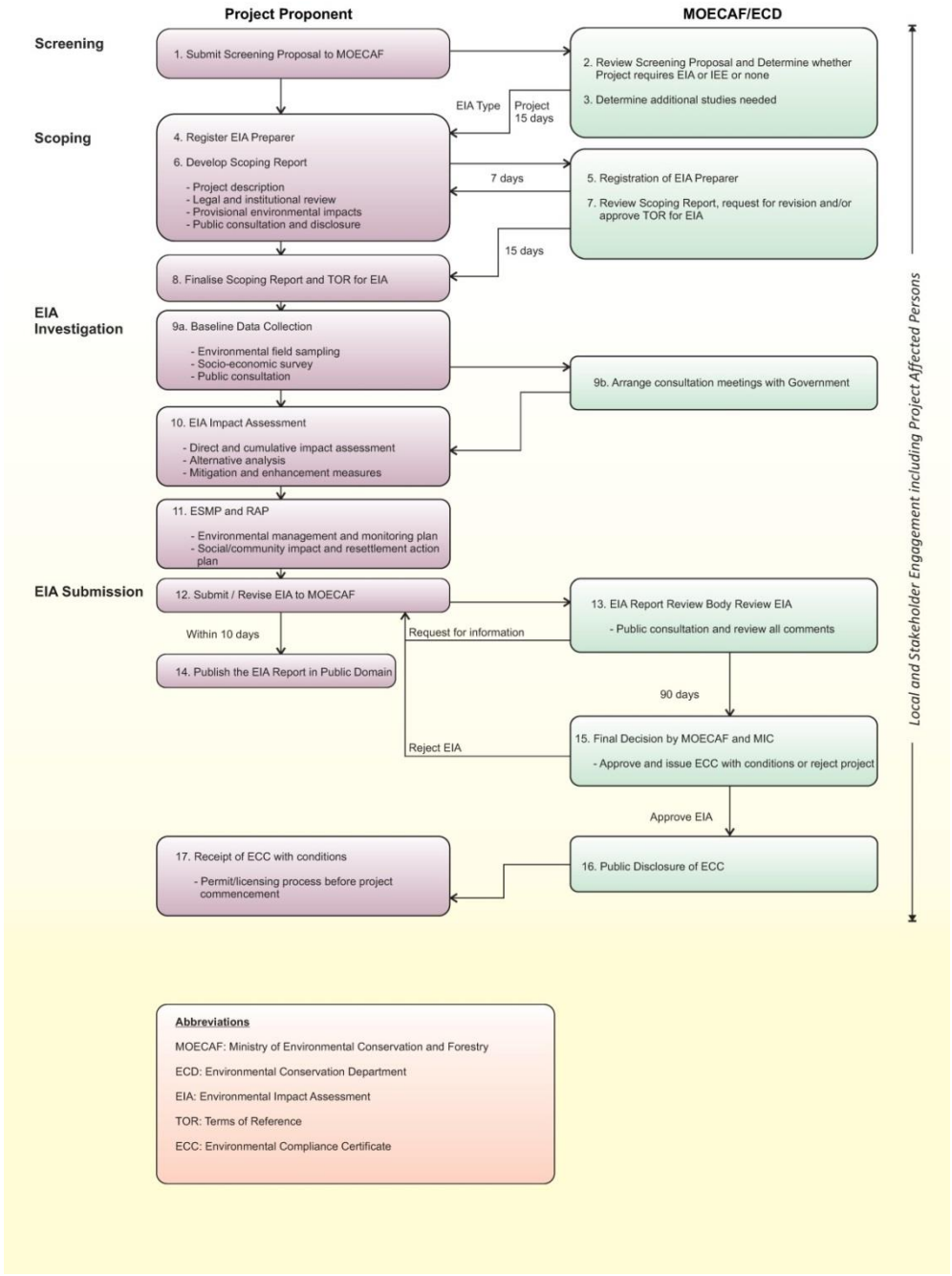
Environmental Impact Assessment (EIA);

Initial Environmental Examination (IEE); or

Neither an EIA nor an IEE - an environmental assessment is not required.

According to the current Draft of the EIA Procedures, thermal power projects require an EIA. The Draft EIA Procedures stipulate that the Project is therefore required to submit the EIA to MOECAF for review and obtain an Environmental Compliance Certificate (ECC). If the EIA is satisfactory, MOECAF will approve the EIA Report, and issue an ECC. The procedure is shown in ***Figure 3.2***.

Figure 3.2 EIA Review and Approval Process (According to Draft EIA Procedure, 2014)



Myanmar Protected Areas

The first legal instrument related to protected areas, which designated a wildlife sanctuary in the environs of the Royal Mandalay City, was promulgated in 1859. The first piece of wildlife legislation to be enacted was the Wild Elephant Protection Act of 1879. The Forest Act of 1902 gave responsibility for wildlife management to the Forest Department. Legislation specific to wild animals followed in 1927, and broader legislation followed nine years later with the Wildlife Protection Act of 1936. This provided for designation of wildlife sanctuaries with species-specific conservation objectives. Legislation was revised in 1994 with issue of the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law. The 1994 Law, which was issued by the State Law and Order Restoration Council, provides for:

- A Committee for the Protection of Wildlife and Wild Plants and Conservation of Natural Areas, which is to serve as an advisory body to the Minister of Forestry; supervise implementation of the Law; give guidance in matters of research, conserving species in danger of extinction and international cooperation;
- Categories of 'natural areas' and zoological and botanical gardens, their declaration and uses;
- Categories of protected wild animals (almost the same as provided for under earlier law): completely protected, normally protected and seasonally protected;
- Hunting licences;
- Establishment of zoological and botanical gardens;
- Registration of ownership of completely protected animals or trophies thereof;
- Administrative actions;
- Appeals; and
- Offences and penalties.

The categories of so-called 'natural areas' are defined in the Law described above as:

- Scientific Nature Reserve;
- National Park;
- Marine National Park;
- Nature Reserve;
- Wildlife Sanctuary;
- Geo-Physically Significant Reserve; and
- Other Nature Reserve Determined by the Minister.

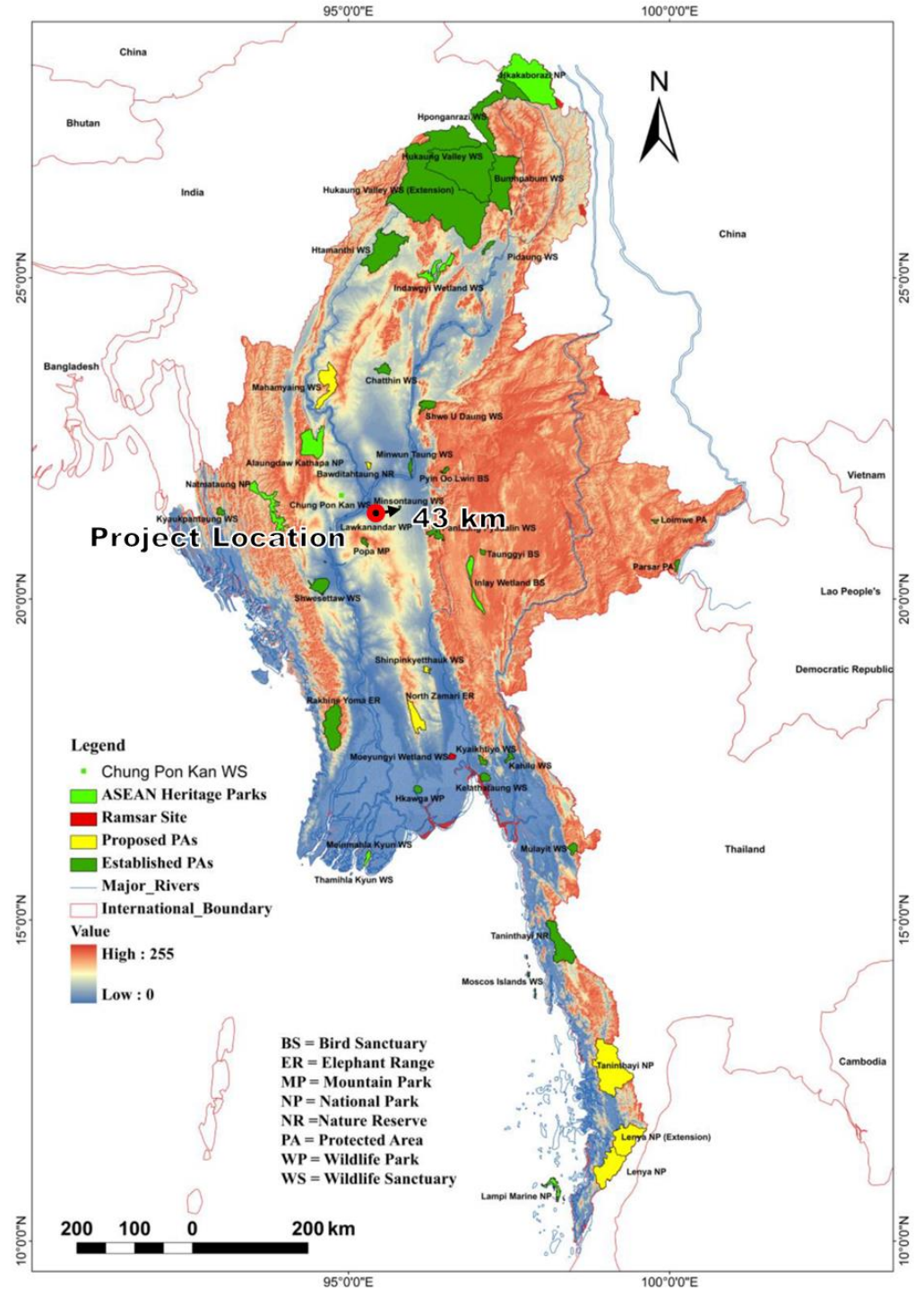
A total of 43 protected areas have been established or proposed in Myanmar, and are shown in ***Figure 3.3.*** The nearest protected area to the Project is Minsontaung Wildlife Sanctuary, which is located 43 km northeast of the Project, and the details of which are shown in ***Table 3.2.***

Table 3.2 Protected Areas in Myanmar

No	Name	National Designation	Year Established	Location and Coordinates	Area (km^2)	Key Species Protected
1	Minsontaung W.S	Wildlife Sanctuary	2001	Mandalay Region, Nwahtogyi Township, 21°25'N, 95°47'E	23	Burmese Star Tortoise

Source: Myanmar Protected Areas: Context, Current Status and Challenges, 2011

Figure 3.3 Protected Areas in Myanmar and Project Location



Source: Fifth National Report to the United Nations Convention on Biological Diversity, Ministry of Environmental Convention and Forestry, March 2014

Myanmar Legislation Specific to the Power Sector

Existing legislation governing the power in Myanmar is mainly contained in the 1984 Electricity Law and the accompanying 1985 Electricity Rules.

The Electricity Law distinguishes between generation, transmission, distribution and use of electricity. It establishes permissions required by the relevant authorities for installation, generation, transmission, distribution and inspection activities. The law does not address environmental issues, ownership, financing, tariffs, land use, or other environmental, social and health issues relevant to power projects.

A new draft electricity law is currently being prepared by the Ministry of Electric Power (MOEP). The draft law will establish an electricity regulatory commission within the MOEP, to formulate policy, prepare tariffs, advise the MOEP, set standards and form inspection bodies. The draft law divides projects into "small" (up to 10MW), "medium" (between 10MW to 30MW) and "large" (upwards of 30MW) projects. States and regions can issue permits for small and medium power plants, while the MOEP will approve permits for large-scale power plants or plants connected to the national power grid.

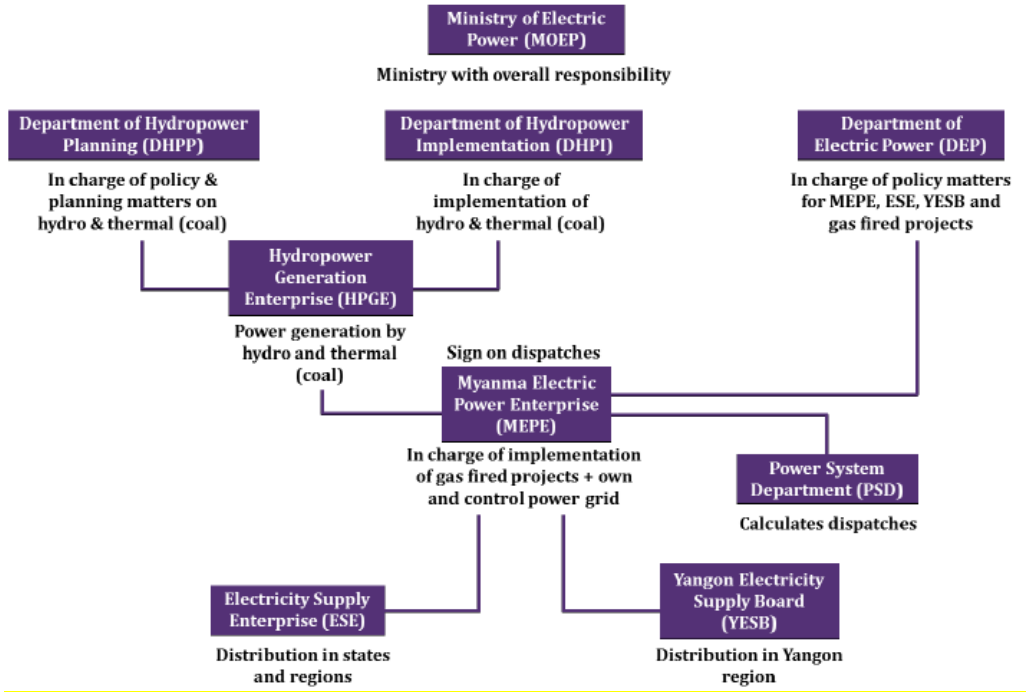
Government Administration of Myanmar Power Sector

The power sector in Myanmar is governed primarily by the Ministry of Electric Power (MOEP), as shown in ***Figure 3.4***. MOEP supervises the sector and governs power generation, transmission and distribution. Various other ministries play a role, as follows:

- **Ministry of Electric Power (MOEP)** - primary responsibility for electricity planning, generating and transportation. It is also the sole supplier of natural gas for power generation and is responsible for issuing regulations on the generation, transmission and delivery of electric power in Myanmar. It consists of three main departments, the Department of Electricity Planning (DEP), the Department of Hydropower Implementation (DHPI) and the Department of Hydropower Planning (DHPP).
- **Myanmar Electric Power Enterprise (MEPE)** - solely responsible for purchasing power from public and private power producers, including Build, Operate Transfer (BOT) project companies, and reselling that power on to the ESE and the YESB. In addition, the MEPE controls all transmission lines and substations.
- **Hydropower Generation Enterprise The Hydropower Generation Enterprise (HPGE)** - government partner for all hydro-generation BOT projects, and operates and maintains all large-scale public sector hydro-generation facilities.
- **Yangon City Electricity Supply Board (YESB)** - plans, develops and maintains the Yangon electricity distribution system.
- **National Energy Management Committee (NEMC**) – recently implemented body that will, among other duties, coordinate with the Privatization Commission and the Myanmar Investment Commission in order to facilitate development of the energy and electricity sectors through private investments.

- **Ministry of National Planning and Economic Development (MNPED)** - oversees the Directorate of Investment and Company Administration (DICA) and its sub-agency, the Myanmar Investment Commission (MIC). DICA oversees the process of company registration in Myanmar, and oversees the Foreign Investment Department (FID), who has a role in reviewing applications and is responsible for issuing the relevant licenses and permits after MIC and DICA approval. MIC is responsible for interfacing with foreign investors incorporated under the FIL.

Figure 3.4 Ministry of Electric Power Organizational Chart



Source: VDB Loi, 2014

3.2.1.1 Other Project-Relevant Legislation in Myanmar

Table 3.3 provides a list of major environmental laws relevant to the Project.

Given that additional guidelines associated with the Environmental Conservation Law (2012) are relatively new, the MOECAF typically recommends that internationally accepted environmental standards, such as Asian Development Bank (ADB) Safeguard standards, International Finance Corporation (IFC) standards / guidelines and Equator Principles to be adopted for any environmental issues/assessment. As part of the recent revision and issuing of the bill it is understood there are plans for further rules and regulations of environmental conservation to be drafted[1]. Additional project-relevant legislation is discussed below.

Public Health Law

Section 3 of the Public Health Law includes a general provision that empowers the Government of the Union of Myanmar to "carry out measures" relating to

(1) Government to approve new conservation law, Feb 2014, Eleven Media Group Myanmar, accessed 17 June 2014

environmental health, such as garbage disposal, use of water for drinking and other purposes, radioactivity, protection of air from pollution, sanitation works and food and drug safety. However, detailed provisions do not exist.

Union of Myanmar Marine Fisheries Law, 25 April 1990

There are several restrictions relating to marine fisheries contained within the Fisheries Law. Those found guilty of violating any of the prohibitions may be liable to heavy fines and/or imprisonment. The relevance of this law to the offshore component of the project is that it places a general restriction on pollution, as follows: *"No person shall dispose of living aquatic creatures or any polluting material into the Union of Myanmar Marine Fisheries"*.

Territorial Sea and Maritime Zones Law, 1977

The Union of Myanmar has exclusive jurisdiction for the construction, maintenance and operation of offshore terminals. It also has exclusive jurisdiction to preserve and protect the marine environment, and to prevent and control marine pollution.

The Underground Water Act, 1930

The Underground Water Act, 1930 provides measures for systematic and sustainable use of underground water.

Forest Law, 1992

The Forest Law, 1992 is one of the environmental related laws in the forestry sector. The offences for extracting, moving, keeping in possession unlawfully any forest produce, including fauna and flora are liable to be punished with fine or imprisonment, or for both. For offences relating to teak trees the punishment is heavier. The Courts are empowered to confiscate all forest produce, vehicles, vessels, animals, machinery, tool and equipment in addition to the punishment for the related offence. Forest Officers are also empowered to take administrative actions in respect of forest produce seized.

Penal Code, 1961 (and extended in Public Health Law, 1972)

The Penal Code has some relevance to public health. It is considered an offence to "voluntarily corrupt or foul the water of any public spring or reservoir so as to render it less fit for the purpose for which it is ordinarily used", or to pollute the atmosphere from smoke, fumes, noxious odours, dust particles, noise and radioactive substances.

Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, 1994

Under the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, 1994, the following are considered crimes: hunting without license, breeding protected animals without permission, causing water and air pollution, poisoning water, possessing, selling, transporting or transferring wildlife or any part thereof without permission.

Conservation of Water Resources and Rivers Law, 2006

The Conservation of Water Resources and Rivers Law (2006) prohibits carrying out any actions with the aim to ruin water resources, including rivers, and causing intentional water wastage, and pollution of water resources.

Antiquities Act, 1957 (Revised 1962)

The Antiquities Act is a law that governs movable and immovable cultural heritage that have archaeological and historical value.

The Antiquities section provides stipulations for the movement of antiquities inside and outside the country, the protection and management of antiquities, the protection and restoration obligation and the compulsory acquisition right of the Director of the Burma Archaeological Survey, and penalties for violations of the above.

The Protection and Preservation of Cultural Heritage Region Law, 1998 (Revised in 2009 and Supplemented in 2011)

The Protection and Preservation of Cultural Heritage Region Law mainly supplements the Antiquities Act with provisions that more widely cover cultural heritage. Relevant excerpts are as follows:

"20. No person shall carry out any of the following in the cultural heritage region:-

- *(a) destroying an ancient monument;*
- *(b) wilfully altering the original ancient form and structure or original ancient workmanship of an ancient monument;*
- *(c) excavating to search for antiquities;*
- *(d) exploring for petroleum, natural gas, precious stones or minerals.*

21. No person shall, without prior permission granted under this Law, carry out any of the following in the cultural heritage region:-

- *(a) carry out renovation and maintenance work on an ancient monument;*
- *(b) carrying out archaeological excavation;*
- *(c) building road, constructing bridge, irrigation canal, embankment or extending the same;*
- *(d) digging well, pond, fish-breeding pond or extending the same."*

Table 3.3 Project-Relevant Legislation in Myanmar

Sector	Relevant Laws in Myanmar
Administrative	The Territorial Sea and Maritime Zones Law, 1977
	The Emergency Provisions Act, 1950
	The Essential Supplies and Services Act, 1947
	The Police Act, 1945
	The Poisons Act, 1919
	The Explosive Substances Act, 1908
	The Yangon Police Act, 1899
	The Explosives Act, 1887
	The Penal Code, 1861 of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals
	Foreign Investment Law, 2012
	The Child Law (Law No. 9/93)
	Myanmar Maternal and Child Welfare Association Law (No. 21/90).
	Myanmar Investment Commission Notification (1994)
	The Private Industrial Enterprise Law - SLORC Law No. 22/90
Agriculture and Irrigation	The Fertilizer Law, 2002
	The Plant Pest Quarantine Law, 1993, and amended in 2011
	The Pesticide Law, 1990
	The Embankment Act, 1909
	Underground Water Act, 1930
	Farmland Rules - Notification No 62/2012 (English)
	Vacant, Fallow and Virgin Lands Management Rules - Notification No. 1/2012
	Vacant, Fallow and Virgin Land Management Act - Pyidaungsu Hluttaw Law No. 10/2012
Culture	The Protection and Preservation of Cultural Heritage Region law, 1998 (Revised in 2009 and Supplemented in 2011)
	Antiquities Act, 1957 (Revised 1962)
Forestry, Environment and Natural Resources	The Protection of Wild Life, Wild Plants and Conservation of Natural Areas Law, 1994
	The Forest Law, 1992
	The Conservation of Water Resources and Rivers Law, 2006
	Burma Wild Life Protection Rules, 1941
	The Forest Department Notification No. 583/94
	ENVIRONMENTAL IMPACT ASSESSMENT RULES – DRAFT
	Environmental Conservation Law (March 2012)
	Myanmar Agenda 21
	National Environmental Policy (1994)
Public Health	The National Food Law, 1997
	The Traditional Drug Law, 1996
	The Prevention and Control of Communicable Disease Law, 1995
	The Narcotics Law, 1993
	The National Drug Law, 1992
	The Union of Myanmar Public Health Law, 1972
	Private Health Act, 2007
	The Penal Code of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals (1861)
Occupational Health and Safety	Factory Act, 1951 (safe and healthy workplaces)
	Employment and Training Act 1950
Tourism	The Myanmar Hotel and Tourism Law, 1993

Sector	Relevant Laws in Myanmar
Industrial	Myanmar Special Economic Zone Law, 2011
	Dawei Special Economic Zone Law, 2011
	The Private Industrial Enterprise Law, 1990
	The Factories Act, 1951
	The Oilfield (Workers and Welfare) Act, 1951
	The Petroleum Act, 1934
	The Oilfield Act, 1918
	Employment Restriction Act (1959)
	Workmen's Compensation Act
	Shops and Establishment Act, 1951
	Leave and Holidays Act, 1951
	Minimum Wage Act 1949
	Payment of Wages Act 1936
	Social Security Act 1954
	Trade Dispute Act 1929
	Settlement of Labour Dispute Law (2012)
	Employment and Skill Development Law
	Employment Statistics Act (1948)
	Water Power Act (1927)
Fisheries, Aquaculture, and Water	The Freshwater Fisheries Law, 1991
	The Myanmar Marine Fisheries Law, 1990, amended in 1993
	The Law Relating to Aquaculture, 1989
	The Law Relating to the Fishing Rights of Foreign Fishing Vessels, 1989
	The Law Amending the Law Relating to the Fishing Rights of Foreign Fishing Vessels, 1993
	The Law Amending the Myanmar Marine Fisheries Law, 1993
	The Conservation of Water Resources and Rivers Law - SPDC Law No. 8/2006
	Territorial Sea and Maritime Zone Law-1977
	The Underground Water Act (1931)
Science and Technology	The Atomic Energy Law, 1998
	Science and Technology Development Law (Law No. 5/94, 1994)
Transportation	The Highways Law, 2000
	The Motor Vehicles Law, 1964
	The Law Amending the Motor Vehicles Law of 1964 enacted in 1989
	The Myanmar Aircraft Act, 1934
	The Inland Steam Vessels Act, 1917
	The Ports Act, 1907
	The Defile Traffic Act, 1908
	The Yangon Port Act, 1905
	The Canal Act, 1905
	The Obstruction in Fairways Act, 1881
Land Use	Land Acquisition Act, 1894
	The Towns Act, 1907
	The Village Act, 1907

3.2.2 *Summary of Applicable Standards*

National Environmental Quality (Emission) Guidelines (Drafting)

The Ministry of Environmental Conservation and Forestry (MOECAF) is currently in the process of formulating new procedures and rules on environmental conservation and environmental quality standards (EQS). The Guidelines are largely based on International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines, and provide the basis for regulation and control of various environmental parameters, including noise and vibration, air emissions, and effluent discharges, from various sources.

Relevant excerpts from the guidelines are as follows:

"*6. Provisions of the general and applicable industry-specific Guidelines shall be reflected in project EMP and ECC and together constitute a project's commitment to take necessary measures to avoid, minimize and control adverse impacts to human health, safety, and the environment through reducing the total amount of emissions generation; adopting process modifications, including waste minimization to lower the load of pollutants requiring treatment; and as necessary, application of treatment techniques to further reduce the load of contaminants prior to release or discharge.*

7. These Guidelines supersede any existing national guideline or standard provision relating to regulation and control of noise, air, and water emissions from activities and projects subject to the EIA Procedure.

8. As specified in Article 56 of the EIA Procedure, all projects are obliged to use, comply with and refer to applicable national guidelines or standards or international standards adopted by the Ministry. These Guidelines will henceforth be applied by the Ministry in satisfying this requirement until otherwise modified or succeeded by other guidelines or standards.

…

11. As specified in Article 95 of the EIA Procedure, projects shall engage in continuous, proactive and comprehensive self monitoring of the project and comply with applicable guidelines and standards. For purposes of these Guidelines, projects shall be responsible for the monitoring of their compliance with general and applicable industry-specific Guidelines. Projects shall be responsible for ensuring compliance at the point of compliance specified in the applicable Guidelines.

12. To demonstrate compliance with these monitoring requirements as specified in articles 97 and 98 of the EIA Procedure, projects shall submit monitoring reports to the Ministry at least every six months or more frequently as provided in the EMP and ECC. Monitoring reports shall inter alia document compliance, difficulties encountered in complying with EMP and ECC conditions, number and type of non-compliance with EMP and ECC, and monitoring data of prescribed environmental parameters as detailed in the EMP and ECC. "

A summary of environmental standards that are relevant to the Project are shown below. These standards will be used for comparison of baseline data and predicted impacts in this ESHIA.

General

Air Emissions

"*Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that: (i) emissions do not result in pollutant concentrations that reach or exceed ambient quality guidelines and standards, or in their absence the current World Health Organization (WHO) Air Quality Guidelines; and emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards (i.e. not exceeding 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.*"

Wastewater

General wastewater guidelines are presented in ***Table 3.4***.

Table 3.4 Indicative Guideline for Treated Sanitary Sewage Discharges

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.	6-9
Total coliform bacteria	MPNa/100 ml	400b
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

Noise Levels

General noise guidelines are presented in ***Table 3.5***.

Table 3.5 General Noise Level Standards

Receptor	One Hour LAeq (dBA)	
	Daytime (07:00 – 22:00)	Nighttime (22:00 – 07:00)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Industry-Specific Standards for Thermal Power Projects

A list of standards specific to thermal power projects is shown in ***Table 3.6*** and ***Table 3.7***.

Table 3.6 Effluent Standards for Thermal Power

Parameter	Unit	Guideline Value
Arsenic	mg/L	0.5
Cadmium	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Iron	mg/L	1
Lead	mg/L	0.5
Mercury	mg/L	0.005
Oil and grease	mg/L	10
pH	S.U.	6-9
Temperature increasea	°C	<3
Total residual chlorine	mg/L	0.2
Total suspended solids	mg/L	50
Zinc		1

Note: [a] Heavy metals include: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, Vanadium and Zinc

Table 3.7 Air Emission Standards for Thermal Power (applicable to non-degraded airsheds)

Combustion Technology/Fuel	Paramter/Guideline Values		
	Particulate Matter	Sulfur Dioxide	Nitrogen Oxides
Combustion Turbine			
Fuels other than natural gas (unit > 50 MW)	50 mg/Nm^3	Use of ≤ 1% Sulfur fuel	152 ppm
Natural gas (all turbine types; unit > 50 MW)	N/A	N/A	51 ppm
Boiler			
Liquid fuels (plant > 600 MW)	50 mg/Nm^3	200 mg/Nm^3	400 mg/Nm^3
Liquid fuels (plant 50-600 MW)	50 mg/Nm^3	900 mg/Nm^3	400 mg/Nm^3
Natural gas	N/A	N/A	240 mg/Nm^3
Other gaseous fuels	50 mg/Nm^3	400 mg/Nm^3	240 mg/Nm^3
Solid fuels (plant > 600 MW)	50 mg/Nm^3	200 mg/Nm^3	510 mg/Nm^3
Solid fuels (plant 50-600 MW)	50 mg/Nm^3	900 mg/Nm^3	510 mg/Nm^3
Reciprocating Engine			
Biofuels / gaseous fuels other than natural gas	50 mg/Nm^3	N/A	30% higher than for other fuels
Liquid fuels (plant > 300 MW)	50 mg/Nm^3	585 mg/Nm3	740 mg/Nm^3
Liquid fuels (plant 50-300 MW)	50 mg/Nm^3	1170 mg/Nm3	1460 mg/Nm^3
Natural gas	N/A	N/A	200 mg/Nm^3

3.3 INTERNATIONAL STANDARDS AND GUIDELINES

In addition to national legislation, the Project will be undertaken to comply with a range of international standards, including the Asian Development Bank Safeguard Policy Statement, IFC Performance Standards (IFC PS), and the World Bank Guidelines. These standards are set to complement and reinforce national legislation and ensure the Project is conducted under best practices in a way that minimizes risks, impacts and ensures compliance and fair practices. The international performance standards and guidelines provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

In the case of its direct investments (including project and corporate finance provided through financial intermediaries), the IFC PS require its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced.

The applicable guidelines and standards for the Project are as follows:

- Asian Development Bank (ADB) Safeguard Policy Statement (2010);
- ADB's Social Protection Strategy (2001), ADB's Gender and Development Policy (2003) and ADB's Public Communication Policy (2003);
- The IFC's Performance Standards (IFC's PSs) (2012);
- IFC/World Bank Group (WBG) EHS Guidelines and WBG EHS Guidelines for Thermal Power (2007 and 2008);
- IFC's Stakeholder engagement handbook and other relevant Good Practice Notes;
- IFC's Handbook for Preparing a Resettlement Action Plan (if applicable)
- Kyoto Protocol to the UNFCC on Climate Change (1997);
- United Nations Convention on Biological Diversity (1992);
- Basel Convention (1989);
- Ramsar Convention on Wetland (1971);
- International Union for Conservation of Nature and Natural Resources, Red List of Threatened Species (1964).

3.3.1 *International Finance Corporation (IFC) and World Bank Performance Standards*

The IFC updated its Sustainability Framework in January 2012. This included revising the Performance Standards; which replace the previous safeguard policies and will be used to evaluate any project seeking funding through the IFC.

The Performance Standards represent the 'policy framework' for the ESIA and sustainable social and environmental management for the Project, whereas the IFC EHS Guidelines provide guidance on general and industry best practice as well as recommended numerical limits for emissions to the atmosphere, noise, liquid and solid wastes, hazardous wastes, health and safety, and other aspects of industrial facilities and other types of development projects. The relevant IFC Performance Standards are listed in ***Table 3.8*** and the EHS Guidelines are discussed further in ***Section 3.3.2***.

Table 3.8 IFC Performance Standards

Performance Standards	Objectives
Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts underscores the importance of managing social and environmental performance throughout the life of a project (any business activity that is subject to assessment and management).	• *Impact identification and assessment.* To identify and assess social and environmental impacts, both adverse and beneficial, in the project's area of influence • *Mitigation.* To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment • *Stakeholder engagement.* To ensure that affected communities are appropriately engaged on issues that could potentially affect them • *Effective management.* To promote improved social and environment performance of companies through the effective use of management systems.
Performance Standard 2 - Labour and Working Conditions recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers.	• To promote fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labor and employment laws • To establish, maintain and improve the worker management relationship. • To promote compliance with national employment and labour laws. • To protect the workforce by addressing child labor and forced labor. • To promote safe and healthy working conditions, and to protect and promote the health of workers.
Performance Standard 3 - Resource Efficiency and Pollution Prevention recognizes that increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level.	• To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities • To promote more sustainable use of resources, including energy and water. • To reduce project –related GHG emissions.
Performance Standard 4 - **Community Health, Safety and Security** recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development.	• To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non routine circumstances • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.
Performance Standard 5 - **Land Acquisition and Involuntary Resettlement** outlines that involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition	• To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. • To avoid forced eviction • To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected. • To improve, or restore, the livelihoods and standards of living of displaced persons. • To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

Performance Standards	Objectives
Performance Standard 6 - **Biodiversity Conservation and Sustainable Management of Living Natural Resources** recognizes that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve, is fundamental to sustainable development	• To protect and conserve biodiversity • To maintain the benefits from ecosystem services • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities
Performance Standard 7 - Indigenous People recognizes that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable segments of the population.	• To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner • To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. • To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the life of the project • To ensure the Free, Prior and Informed Consent (FPIC) of the Affected Communities of the IPs when the circumstances described in this Performance Standard are present. • To respect and preserve the culture, knowledge and practices of Indigenous Peoples
Performance Standard 8 - Cultural Heritage recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities.	• PS 8 aims to protect the irreplaceable cultural heritage and to guide clients on protecting cultural heritage in the course of their business operations. In addition, the requirements of this PS on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity. PS 8 recognizes the importance of cultural heritage with an objective to: • Protect cultural heritage from the adverse impacts of project activities and support its preservation; and • Promote the equitable sharing of benefits from the use of cultural heritage in business activities. • The PS requires the project proponent to comply with relevant national law on the protection of cultural heritage, including national law implementing the host country's obligations under the Convention Concerning the Protection of the World Cultural and Natural Heritage and other relevant international law.

3.3.2 *Gap Analysis between Myanmar Legislation and IFC Performance Standards*

A Gap Analysis of the existing and forthcoming Myanmar national legislation has been undertaken against the IFC Performance Standards. The review is presented below in ***Table 3.9*** and highlights the key gaps and the actions required in order for the Project Proponent to comply with the international guidelines [1].

[1] Note that whilst it was the intention of this Gap Analysis to provide an estimate of costs associated with the additional actions that may be required to close out the identified gaps, it is ERM's recommendation that compliance with the applicable standards are included in the terms of reference for the forthcoming ESIA and therefore no separate additional costs will be required by the Project Proponent should these be followed. Therefore the following table excludes cost estimates at this stage

Table 3.9 Gap Analysis International Standards and Myanmar Legislation Relevant to the Project

IFC Performance Standards PS1-PS8	Myanmar Legislative & EIA Requirements (including agreed scope from EIA Scoping)	Commentary/Discussion	Gaps	Further Action/Recommendations
Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts	*ENVIRONMENTAL IMPACT ASSESSMENT RULES – DRAFT* *Environmental Conservation Law 2012* *National Environmental Policy (1994)* *Myanmar Agenda 21* *Land Acquisition Act, 1894* *The Forest Law, 1992* *The Plant Pest Quarantine Law, 1993* *The Pesticide Law, 1990* *The Fertilizer Law, 2002* *The Underground Water Act (1931)* *The Protection of Wild Life, Wild Plants and Conservation of Natural Areas Law, 1994* *Factory Act, 1951 (safe and healthy workplaces)* *Workmen's Compensation Act* *Minimum Wage Act 1949* *Payment of Wages Act 1936* *Social Security Act 1954* *The Freshwater Fisheries Law, 1991* *The Myanmar Marine Fisheries Law, 1990* *The Conservation of Water Resources and Rivers Law - SPDC Law No. 8/2006*	With the *Environmental Conservation Law only recently enacted*, there is the potential that assessment of environmental risks are not being comprehensively regulated under Myanmar local legislation. This is further compounded by the fact that the EIA Rules are currently in draft form and therefore there is no enforceable legislation for undertaking assessment of development projects. Several separate pieces of legislation regulate management of environmental and social risks though do not specifically require proper assessment. For example, *The Forest Law 1992* has incorporated Indigenous Peoples into its management policies and is a step towards recognition. Under *The Protection of Wild Life, Wild Plants and Conservation of Natural Areas Law, 1994* conservation of in-situ wild flora and fauna is implemented. This piece of legislation aims to protect endangered species and their natural habitats. In doing so, it provides for some national legislation addressing environmental impacts but not the assessment process. The majority of legislation current legislation is concerned with 'management' of environmental impacts and does not specifically cover requirements regarding assessment of impacts prior to operating and does not yet include quantitative values for assessment. Similarly, social impacts are not specifically addressed in implemented legislation. However, local legislation does exist to regulate working conditions, wages, OH&S and social security etc. Though given the social and governance framework the regulation of such legislation is an area for concern. The EIA processes for public consultation is at the discretion of those parties identified/advised by MOECAF and as such may fail to include the entirety of social discourse for identification of social issues. The Myanmar Agenda 21 derived from the Kyoto Protocol aims to facilitate the incorporation of environmental considerations in the development process of the economic and social sectors and as such incorporates aspects of the EIA phase and should be promoted to encourage sustainable development of projects and encouraging best practice in Myanmar's industry.	1. Gaps exist in enforceable local legislation requiring EIA as per the administering law *Environmental Conservation Law 2012*, due to the *EIA Rules* regulations being still in draft. This will be rectified when the draft regulations are enacted/approved; however there is no date set for enactment/approval of the draft regulations. 2. Gaps exist in enforceable local legislation for assessment of social impacts for projects at an EIA stage. Primarily due to EIA assessment rules still in draft form and as per Article 7 the *EIA Rules (Draft)* do not prescriptively cover social impacts/assessment 3. Current legislation also does not recognize indigenous peoples and therefore does not provide additional measures to protect or consider impacts and assessments on their livelihood. The Ministry of Forestry does have a history of including indigenous parties in stakeholder engagement and has included in its Forest Policy public awareness an imperative, in which it includes participation with indigenous parties.	The Equator Principles aligned with the IFC Performance Standards provide comprehensive requirements for the assessment of environmental and social impacts and should be used as standard guide for social impact assessment. The Project Proponent should use a combination of local and international standards where gaps exist, as EIA rules are still in draft form. Social legislation and engagement/consultation activities present the largest gaps; recommend thorough use of international standards over local obligations.

IFC Performance Standards PS1-PS8	Myanmar Legislative & EIA Requirements (including agreed scope from EIA Scoping)	Commentary/Discussion	Gaps	Further Action/Recommendations
Performance Standard 2: Labour and Working Conditions	*Factories Act, 1951* *Employment Restriction Act (1959)* *Employment Statistics Act (1948)* *Employment and Skill Development Law (2013)* *Workmen's Compensation Act (1923)* *Labour Organisation Law (2011)* *Leave and Holidays Act, 1951* *Minimum Wage Law (2013)* *Payment of Wages Act (1936)* *Workmen's Compensation Act (1923)* *Social Security Law (2012)* *Settlement of Labour Dispute Law (2012)*	Significant national legislation exists in coverage of labour and working conditions within the Myanmar legal framework. Occupational Health and Safety (OH&S) and endorsement of working conditions and terms of employment are addressed in legislation from the *Workman's Compensation Act, Leave and Holidays Act, Payment of Wages Act, Social Security Act* and the *Factory Act* providing for safe and healthy workplaces. Current legislation however has limited mechanisms to address child labour specifically along with non-discrimination and equal opportunity.	1. Main gaps exist in legislation addressing child labour, non-discrimination and equal opportunity. Child labour is not specifically prohibited, provisions set out the 'right to work' of a child - person of the age of 16. Equal opportunity and other legislation were repealed under the Law *Defining the Fundamental Rights and Responsibilities of the People's Workers (Revolutionary Council Law No. 6 of 1964).* 2. Possible gaps with the regulation and enforcement of existing legislation.	Labour conditions under legislation provide basic principles; though do not include much protection and rights afforded to the worker, including gaps regarding child labour. Recommend employing IFC PS and Equator Principles to fill the gaps in national legislation. The most stringent standards should be applied.
Performance Standard 3: Resource Efficiency and Pollution Prevention	*Water Power Act (1927)* *The Conservation of Water Resources and Rivers Law - SPDC Law No. 8/2006* *The Underground Water Act (1931)* *The Motor Vehicles Law, 1964*	Legislation relevant to resource efficiency and pollution prevention is limited to management of water and management of pollution within the transport industry. Air pollution is regulated under the *Motor Vehicle Law* and *Motor Vehicle Rules*, with a Practicing Standard of Road Standards. However pollution control in a more general sense, encompassing reduction and management strategies has primarily fallen under the jurisdiction of the *Environmental Policy 1994* which is still in its infancy. The Myanmar Agenda 21 operates such that it aims to facilitate the incorporation of environmental considerations in the development process of the economic and social sectors and as such incorporates aspects of an EIA process; though the enforcement of this is uncertain. Energy efficiency is addressed in the National Strategy for Sustainable Development (NSDS) through one of its primary goals of '*Sustainable Management of Natural Resources.*'	1. Gaps exist in specific levels or quantitative limits set in legislation for pollution control, waste and inclusion of pollution and waste reduction standards for industry. 2. Energy efficiency gaps exist due to a lack of enforceable legislation committing to energy efficiency standards. 3. Gaps exist in wastewater treatment and waste management or control standards, as well as legislation and greenhouse gas emissions.	Several high level strategies exist, though the legal requirements of these are undetermined to be enforceable or obligatory. Specific limits on pollution control or waste standards (including wastewater/sewage/effluent etc.) are not enforced, recommend complying with IFC EHS guidelines for specific limits.
Performance Standard 4: Community Health and Safety	*The National Food Law, 1997* *The Traditional Drug Law, 1996* *The Prevention and Control of Communicable Disease Law, 1995* *The Narcotics Law, 1993* *The National Drug Law, 1992* *The Union of Myanmar Public Health Law, 1972* *Private Health Act, 2007* *The Penal Code of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals (1861)* *The Conservation of Water Resources and Rivers Law - SPDC Law No. 8/2006* *The Highways Law, 2000* *The Motor Vehicles Law, 1964* *(The Law Amending the Motor Vehicles Law of 1964 enacted in 1989)* *The Ports Act, 1907* *The Defile Traffic Act, 1908* *The Underground Water Act (1931)* *The Protection of Wild Life, Wild Plants and Conservation of Natural Areas Law, 1994* *The Forest Law, 1992*	Community Health and Safety is administered under a wide range of legislation, with specific emphasis on food & drug legislation, transport, unsafe material and negative environmental/agriculture practices. Gaps exist with design safety and hazardous materials management.	1. Gaps in hazardous material/waste legislation 2. Design and wider community health legislation exist, posing possible implications with impact assessment and design/project planning	Legislation governing waste in Myanmar is limited, as are requirements for consideration of wider community health and safety. IFC EHS, PS, Equator Principles provide greater consideration for community health assessment and management. Recommend waste management principles of IFC and limits in IFS EHS Guidelines adopted for specific standards/targets.

IFC Performance Standards PS1-PS8	Myanmar Legislative & EIA Requirements (including agreed scope from EIA Scoping)	Commentary/Discussion	Gaps	Further Action/Recommendations
	The Plant Pest Quarantine Law, 1993 *The Pesticide Law, 1990* *The Fertilizer Law, 2002* *The Explosives Act, 1887* *The Explosive Substances Act, 1908* *The Emergency Provisions Act, 1950*			
Performance Standard 5: Land Acquisition and Involuntary Resettlement	*Land Acquisition Act (1894)* *Towns Act (1907) (as amended)* *Village Act (1908) (as amended)* *Protection of the Right of Cultivation Act (1963)* *Tenancy Law (1963) and Tenancy (Amendment) Law (1965)*	Currently the Myanmar Land Acquisition Act provides for state involvement and acquisition of land and provides little to facilitate prior ownership or indigenous peoples. Compensation provides for acquisition of property (market value plus 15%), though provides little for resettlement and economic displacement. Project design and pre-planning consultation is not administered under the associated acts and will, when finalized, be administered under the EIA legislation. Current legislation does not include resettlement costs, including physical, cultural and economic considerations.	1. Gaps exist in compensation for physical and economic displacement 2. Gaps exist in requirement for resettlement planning, assessment or compensation on a resettlement basis.	Compensation scheme provides for physically displacement only. Recommend complying with IFC/ Equator Principles standards for inclusion of economic displacement. Resettlement impacts and costs are not legally regulated. recommend complying with IFC/WBG resettlement handbook and IFC/ Equator Principles guides
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	*The Forest Law, 1992* *The Protection of Wild Life, Wild Plants and Conservation of Natural Areas Law, 1994* *Burma Wild Life Protection Rules, 1941* *The Protection of Wildlife and Conservation of Natural Areas Law - SLORC Law No. 6/94* *The Forest Department Notification No. 583/94* *Environmental Conservation Law, 2012* *Myanmar Agenda 21* *National Environmental Policy (1994)* *The Conservation of Water Resources and Rivers Law, 2006* *The Plant Pest Quarantine Law, 1993* *The Freshwater Fisheries Law, 1991* *The Myanmar Marine Fisheries Law, 1990* *The Conservation of Water Resources and Rivers Law - SPDC Law No. 8/2006*	With the recently enacted *Environmental Conservation Law 2012* Myanmar has implemented an overruling legislative framework for biodiversity conservation in Myanmar. Myanmar has a long history of conservation and wildlife protection and has a total of 58 protected areas, however the regulation and management of these areas is at times inadequate. As with many developing nations, Myanmar has specific legislation covering conservation of fishing resources, Myanmar's legislation also includes the protection of riverine areas. Current legislation does not differentiate between natural and modified habitat, though it does include critical and legally protected areas. Myanmar has a specific invasive alien species bill. Current legislation does not outwardly enforce supply chain management, through a lack of standards. *Environmental Conservation Law* and the EIA Rules do categorize projects into determining severity through requiring an IEE or EIA.	1. Gaps exist in specific environmental and social standards. 2. EIA rules are still in draft and therefore prescribed management plans are restricted to specific commitments in various separate legislation until it is enacted. 3. Gaps in supply chain management & requirements in legislation.	Specific standards and requirements of management plans are not legislated. Recommend compliance with IFC/EP standards as well as local legislation. Supply chain management to be in compliance with IFC performance standards.

IFC Performance Standards PS1-PS8	Myanmar Legislative & EIA Requirements (including agreed scope from EIA Scoping)	Commentary/Discussion	Gaps	Further Action/Recommendations
Performance Standard 7: Indigenous Peoples	*Land Acquisition Act (1894)* *Towns Act (1907) (as amended)* *Village Act (1908) (as amended)* *Protection of the Right of Cultivation Act (1963)* *Tenancy Law (1963) and Tenancy (Amendment) Law (1965)*	The aforementioned acts do not provide for allowances of Indigenous Peoples or traditional ownership claims, nor recognize or provide regulation of peoples who fall outside the jurisdiction of these acts. However it should be noted that some more recent acts and ministries have included consideration for IPs. Furthermore, EIA processes for public consultation is at the discretion of those parties identified/advised by MOECAF, as well as not mentioning IPs. Drafted EIA laws do not include provision for IPs or impacts on traditional ownership and relocation. The *Lands Acquisition Act* does provide a basic framework for compensation of land and property. *The Protection and Preservation of Cultural Heritage Region law, 1998* includes requirements of cultural heritage protection which will include cultural heritage sensitive to indigenous peoples.	1. Gaps exist in legislation protecting IPs 2. Gaps exist in public participation and consultation under drafted EIA laws 3. Gaps exist in mitigation and relocation/resettlement legislation *The EIA procedure does not address specific matters in relation to resettlement or in relation to Projects that may have an Adverse Impact on Indigenous People. Projects involving resettlement or potentially affecting Indigenous People shall additionally comply with separate procedures issued by responsible ministries, and in the absence of such procedures all such Projects shall adhere to international best practice on Involuntary Resettlement and Indigenous People.*	Recommend compliance with IFC/ Equator Principles standards for IPs and consultation process as a lack of meaningful local legislation or obligations currently exist.
Performance Standard 8: Cultural Heritage	*The Protection and Preservation of Cultural Heritage Region law, 1998*	Cultural heritage legislation is administered under *The Protection and Preservation of Cultural Heritage Region law, 1998*. This primarily covers protection of existing sites and does not provide requirements for assessment or surveying of potential sites prior to activity nor are there specific requirements for 'chance find' procedures. Similarly cultural heritage legislation does not include consultation services though it does prescribe prohibitions against the removal of cultural heritage items.	1. Gaps exist in legislation requiring inspections and surveys to identify potential undocumented cultural heritage sites and chance find procedures 2. Current legislation does not define requirements for consultation and project design around cultural heritage sites and sensitivities.	No requirement for pre-survey under local legislation. Recommend adoption of IFC/ Equator Principles for impact assessment of cultural heritage. Local legislation does administer management of existing sites, if identified to be of relevance to project.

This review has demonstrated that there are several gaps between the existing national regulatory framework and the applicable international standards. These include:

1. Assessment and Management of Environmental and Social Risks and Impacts

   ii. Gaps exist in enforceable local legislation requiring EIA as per the administering law *Environmental Conservation Law 2012*, due to the Environmental Impact Assessment Rules regulations being still in draft. This should be rectified when the draft regulations are enacted/ approved.

   iii. Gaps exist in enforceable local legislation for assessment of social impacts for projects at an EIA stage, as EIA assessment rules are draft. Furthermore, the EIA assessment rules do not prescriptively cover social impacts/assessment.

   iv. Current legislation also does not recognize Indigenous Peoples and therefore does not provide additional measures to protect or consider impacts and assessments on their livelihood.

2. Labour and Working Conditions

   i. The main gaps exist in legislation addressing child labour, non-discrimination and equal opportunity. Child labour is not specifically prohibited, provisions set out the 'right to work' of a child - person of the age of 16. Equal opportunity and other legislation were repealed under the Law Defining the Fundamental Rights and Responsibilities of the People's Workers (Revolutionary Council Law No. 6 of 1964).

   ii. Possible gaps present with the regulation and enforcement of existing legislation.

3. Resource Efficiency and Pollution Prevention

   i. Gaps exist in specific levels or quantitative limits set in legislation for pollution control, waste and inclusion of pollution and waste reduction standards for industry.

   ii. Energy efficiency gaps exist due to a lack of enforceable legislation committing to energy efficiency standards.

   iii. Gaps exist in wastewater treatment and waste management or control standards, as well as legislation and greenhouse gas emissions.

4. Community Health and Safety

   i. Gaps in hazardous material/waste legislation.

   ii. Design and wider community health legislation exist, posing possible implications with impact assessment and design/project planning.

5. Land Acquisition and Involuntary Resettlement

   i. Gaps exist in compensation for physical and economic displacement.

   ii. Gaps exist in requirement for resettlement planning, assessment or compensation on a resettlement basis.

6. Biodiversity Conservation and Sustainable Management of Living Natural Resources

   i. Gaps exist in specific environmental and social standards.

   ii. EIA rules are still in draft and therefore prescribed management plans are restricted to specific commitments in various separate pieces of legislation until it is enacted.

   iii. Gaps in supply chain management & requirements in legislation.

7. Indigenous Peoples

   i. Gaps exist in legislation protecting IPs.

   ii. Gaps exist in public participation and consultation under drafted EIA laws.

   iii. Gaps exist in mitigation and relocation/resettlement legislation.

8. Cultural Heritage

   i. Gaps exist in legislation requiring inspections and surveys to identify potential undocumented cultural heritage sites and chance find procedures.

   ii. Current legislation does not define requirements for consultation and project design around cultural heritage sites and sensitivities.

3.3.3 International Finance Corporation (IFC)/World Bank Environmental, Health, and Safety (EHS) Guidelines

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent.

Due to the technical nature of the standards, the limits and levels are not included here in the regulatory review. However the standards, where applicable, will be assessed and complied with as per the technical requirements set out in the original document.

Applicable IFC General EHS Guidelines are shown in ***Table 3.10*** and IFC/World Bank EHS Guidelines for Thermal Plants are shown in ***Table 3.11***.

Table 3.10 Applicable IFC General EHS Guidelines

Applicable IFC EHS Guidelines
General Environmental Guidelines
1. Environment
1.1 Air Emissions and Ambient Air Quality
1.2 Energy Conservation
1.3 Wastewater and Ambient Water Quality
1.4 Water Conservation
1.5 Hazardous Materials Management
1.6 Waste Management
1.7 Noise
1.8 Contaminated Land
General Occupational Health and Safety Guidelines
2. Occupational Health and Safety
2.1 General Facility and Design and Operation
2.2 Communications and Training
2.3 Physical Hazards
2.4 Chemical Hazards
2.5 Biological Hazards
2.6 Radiological Hazards
2.7 Personal Protective Equipment (PPE)
2.8 Special Hazards Environments
2.9 Monitoring
General Community Health and Safety
3.1 Water Quality and Availability
3.2 Structural Safety and Project Infrastructure
3.3 Life and Fire Safety (L&FS)
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response
General Construction and Demolition Guidelines
4.1 Environment
4.2 Occupational Health and Safety
4.3 Community Health and Safety
Sectors Specific EHS Guidelines
EHS Guidelines for Thermal Power Plants

Where different standards are prescribed by the different agencies, the most stringent of the national and international standards will apply to the Project:

"When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment." (IFC General EHS Guidelines, page 1).

In general, the IFC's EHS Guidelines are the more comprehensive and stringent. Compliance with national standards is always required. It should be noted that the IFC's EHS Guidelines are now under revision and the first batch of revised guidelines (including the General EHS Guidelines), will tentatively be finalised in 2016.

3.3.4 Projects Located in Degraded Airsheds

The IFC's General EHS Guidelines state that '*Facilities or projects located within poor quality airsheds should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed. Specific provisions for minimizing emissions and their impacts in poor air quality airsheds should be established on a project-by-project or industry-specific basis. Offset provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project.'* (IFC General EHS Guidelines, page 5).

Table 3.11 IFC/World Bank EHS Guidelines for Thermal Power Plants

EHS Guidelines for Thermal Power Plants	
1.0	**Industry-Specific Impacts and Management**
1.1	**Environment**
	- Air emissions
	- Effluents
	- Solid wastes
	- Hazardous Materials and Oil
	- Noise
1.2	**Occupational Health and Safety (OH&S)**
	- Non-ionizing radiation
	- Heat
	- Noise
	- Confined Spaces
	- Electrical Hazards
	- Fire and Explosion Hazards
	- Chemical Hazards
	- Dust
1.3	**Community Health and Safety**
	- Water consumption
	- Traffic Safety
2.0	**Performance Indicators and Monitoring**
2.1	**Environment**
	- Emission and Effluent Guidelines
	- Environmental Monitoring
2.2	**Occupational Health and Safety (OH&S)**
	- OH&S Guidelines
	- Accident and Fatality Rates
	- OH&S Monitoring

Source: Environmental, Health and Safety Guidelines for Thermal Power Plants [(1)]

3.3.5 *Asian Development Bank Safeguard Policy Statement (2010)*

The ADB's Safeguard Policy Framework are operational policies that seek to avoid, minimize or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process. ADB's safeguard policy framework consists of three (3) operational policies on the environment, 9 (nine) polices on Indigenous Peoples, and involuntary resettlement (***Table 3.12***). All three safeguard policies involve a structured process of impact assessment, planning, and mitigation to address the adverse effects of projects throughout the project cycle. The safeguard policies require that *(i)* impacts are identified and assessed early in the project cycle; *(ii)* plans to avoid, minimize, mitigate, or compensate for the potential adverse impacts are developed and implemented; and *(iii)* affected people are informed and consulted during project preparation and implementation. The policies apply to all ADB-financed projects, including private sector operations, and to all project components.

(1) Environmental, Health and Safety Guidelines for Thermal Power Plants, 2008, International Finance Corporation, World Bank Group

A basic principle of the three (3) existing safeguard policies is that implementation of the provisions of the policies is the responsibility of the borrower/client. Borrowers/clients are required to undertake social and environmental assessments, carry out consultations with affected people and communities, prepare and implement safeguard plans, monitor the implementation of these plans, and prepare and submit monitoring reports.

Table 3.12 Safeguard Policy Statement (Safeguards Requirements 1-3)

Applicable ADB Safeguard Policy Statement	
Safeguard Requirements 1: Environment *Outlines the requirements that borrowers/clients are required to meet when delivering environmental safeguards for projects supported by the Asian Development Bank (ADB). It discusses the objectives and scope of application, and underscores the requirements for undertaking the environmental assessment process. The applicability of particular requirements is established through the environmental assessment process and compliance with the requirements is achieved through implementation of environmental management plans agreed to by ADB and the borrower/client.*	
1. Environmental Assessment	The borrower/client will identify potential direct, indirect, cumulative and induced environmental impacts on and risks to physical, biological, socioeconomic, and physical cultural resources and determine their significance and scope, in consultation with stakeholders, including affected people and concerned NGOs. If potentially adverse environmental impacts and risks are identified, the borrower/client will undertake an environmental assessment as early as possible in the project cycle. The assessment process will be based on current information, including an accurate project description, and appropriate environmental and social baseline data. Impacts and risks will be analyzed in the context of the project's area of influence.
2. Environmental Planning and Management	The borrower/client will prepare an environmental management plan (EMP) that addresses the potential impacts and risks identified by the environmental assessment. The EMP will include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Where impacts and risks cannot be avoided or prevented, mitigation measures and actions will be identified so that the project is designed, constructed, and operated in compliance with applicable laws and regulations and meets the requirements specified in these standards.
3. Information Disclosure	The borrower/client will submit to ADB the following documents for disclosure on ADB's website: *(i)* a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration, and/or environmental assessment and review frameworks before project appraisal, where applicable; *(ii)* the final EIA/IEE; *(iii)* a new or updated EIA/IEE and corrective action plan prepared during project implementation, if any; and *(iv)* the environmental monitoring reports.
4. Consultation and Participation	The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report.
5. Grievances Redress Mechanism	The borrower/client will establish a mechanism to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project.
6. Monitoring and Reporting	The borrower/client will monitor and measure the progress of implementation of the EMP. The extent of monitoring activities will be commensurate with the project's risks and impacts. In addition to recording information to track performance, the borrower/client will undertake inspections to verify compliance with the EMP and progress toward the expected outcomes. The borrower/client will document monitoring results, identify the necessary corrective actions, and reflect them in a corrective action plan. The borrower/client will submit at least semi-annual monitoring reports during construction for projects likely to have significant adverse environmental impacts, and quarterly monitoring reports for highly complex and sensitive projects. For projects likely to have significant adverse environmental impacts during operation, reporting will continue at the minimum on an annual basis.

Applicable ADB Safeguard Policy Statement		
7. Unanticipated Environmental Impacts	Where unanticipated environmental impacts become apparent during project implementation, the borrower/client will update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.	
8. Biodiversity Conservation and Sustainable Natural Resource Management	The borrower/client will assess the significance of project impacts and risks on biodiversity and natural resources as an integral part of the environmental assessment process. The assessment will focus on the major threats to biodiversity, which include destruction of habitat and introduction of invasive alien species, and on the use of natural resources in an unsustainable manner. The borrower/client will need to identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity. The standards include specific guidelines for assessment of the following habitats:	
	a. Modified Habitats *b. Natural Habitats* *c. Critical Habitats*	*d. Legally Protected Areas* *e. Invasive Alien Species* *f. Management and Use of Renewable Natural Resources*
9. Pollution Prevention and Abatement	During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines; as mentioned in (Table 5.2). The borrower/client will avoid, or where avoidance is impossible, will minimize or control the intensity or load of pollutant emission and discharge. In addition the borrower/client will examine and incorporate in its operations resource conservation and energy efficiency measures consistent with the principles of cleaner production. Pollution prevention includes assessment of the following:	
	a. Pollution Prevention, Resource Conservation and Energy Efficiency *b. Wastes* *c. Hazardous Materials*	*d. Pesticide Use and Management* *e. Greenhouse Gas Emissions*
10. Health and Safety	The borrower/client will provide workers with a safe and healthy working environment, taking into account risks inherent to the particular sector and specific classes of hazards in the borrower's/client's work areas, including physical, chemical, biological, and radiological hazards. The borrower/client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work. These include specific assessment of; a) OH&S and, b) Community Health and Safety. The borrower/client will apply preventive and protective measures consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. The borrower/client will identify and assess the risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the project, and will establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts.	
11. Physical Cultural Resources	The borrower/client is responsible for siting and designing the project to avoid significant damage to physical cultural resources. When a project may affect physical cultural resources, the borrower/client will consult with affected communities who use, or have used them within living memory, for long-standing cultural purposes to identify physical cultural resources of importance and to incorporate the views of the affected communities on such resources into the borrower's/client's decision making process.	

Applicable ADB Safeguard Policy Statement	
Safeguard Requirements 2: Involuntary Resettlement *Safeguard Requirements 2 outlines the requirements that borrowers/clients are required to meet in delivering involuntary resettlement safeguards to projects supported by the Asian Development Bank (ADB). The objectives are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons1 in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. The requirements apply to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees (hereafter broadly referred to as projects).*	
1. Compensations, Assistance and Benefits for Displaced Persons	The borrower/client will provide adequate and appropriate replacement land and structures or cash compensation at full replacement cost for lost land and structures, adequate compensation for partially damaged structures, and relocation assistance, if applicable. Preference will be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. These strategies may include resettlement on public land, or on private land acquired or purchased for resettlement. Whenever replacement land is offered, displaced persons are provided with land for which a combination of productive potential, locational advantages, and other factors is at least equivalent to the advantages of the land taken. The rate of compensation for acquired housing, land and other assets will be calculated at full replacement costs. In the case of economically displaced persons, regardless of whether or not they are physically displaced, the borrower/client will promptly compensate for the loss of income or livelihood sources at full replacement cost.
2. Social Impact Assessment	The borrower/client will conduct socioeconomic survey(s) and a census, with appropriate socioeconomic baseline data to identify all persons who will be displaced by the project and to assess the project's socioeconomic impacts on them. For this purpose, normally a cut-off date will be established by the host government procedures. In the absence of such procedures, the borrower/client will establish a cut-off date for eligibility. Information regarding the cut-off date will be documented and disseminated throughout the project area.
3. Resettlement Planning	The borrower/client will prepare a resettlement plan, if the proposed project will have involuntary resettlement impacts. The objective of a resettlement plan is to ensure that livelihoods and standard s of living of displaced persons are improved, or at least restored to pre-project (physical and/or economic) levels and that the standards of living of the displaced poor and other vulnerable groups are improved, not merely restored, by providing adequate housing, security of land tenure and steady income and livelihood sources.
4. Negotiated Land Acquisition	Safeguard Requirements 2 does not apply to negotiated settlements, unless expropriation would result upon the failure of negotiations. Negotiated settlements help avoid expropriation and eliminate the need to use governmental authority to remove people forcibly. The borrower/client is encouraged to acquire land and other assets through a negotiated settlement wherever possible, based on meaningful consultation with affected persons, including those without legal title to assets.
5. Information Disclosure	The borrower/client will submit the following documents to ADB for disclosure on ADB's website: *(i)* a draft resettlement plan and/or resettlement framework endorsed by the borrower/client before project appraisal; *(ii)* the final resettlement plan endorsed by the borrower/client after the census of affected persons has been completed; *(iii)* a new resettlement plan or an updated resettlement plan, and a corrective action plan prepared during project implementation, if any; and *(iv)* the resettlement monitoring reports.
6. Consultation and Participation	The borrower/client will conduct meaningful consultation with affected persons, their host communities, and civil society for every project and subproject identified as having involuntary resettlement impacts.
7. Grievance Redress Mechanism	The borrower/client will establish a mechanism to receive and facilitate the resolution of affected persons' concerns and grievances about physical and economic displacement and other project impacts, paying particular attention to the impacts on vulnerable groups. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected persons' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the affected persons at no costs and without retribution.

Applicable ADB Safeguard Policy Statement	
8. Monitoring and Reporting	The borrower/client will monitor and measure the progress of implementation of the resettlement plan. The extent of monitoring activities will be commensurate with the project's risks and impacts. The borrower/client will prepare semi-annual monitoring reports that describe the progress of the implementation of resettlement activities and any compliance issues and corrective actions. These reports will closely follow the involuntary resettlement monitoring indicators agreed at the time of resettlement plan approval.
9. Unanticipated Impacts	If unanticipated involuntary resettlement impacts are found during project implementation, the borrower/client will conduct a social impact assessment and update the resettlement plan or formulate a new resettlement plan covering all applicable requirements specified in this document.
10. Special Considerations for Indigenous Peoples	The borrower/client will explore to the maximum extent possible alternative project designs to avoid physical relocation of Indigenous Peoples that will result in adverse impacts on their identity, culture, and customary livelihoods. If avoidance is impossible, in consultation with ADB, a combined Indigenous Peoples plan and resettlement plan could be formulated to address both involuntary resettlement and Indigenous Peoples issues. Such a combined plan will also meet all relevant requirements specified under Safeguard Requirements 3.
Safeguard Requirements 3: Indigenous Peoples *Safeguard Requirements 3 outlines the requirements that borrowers/clients are required to meet in delivering Indigenous Peoples safeguards to projects supported by ADB. The objective is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they (i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them. The requirements apply to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees (hereafter broadly referred to as projects). The requirements also cover actions conducted by the borrower/client in anticipation of ADB projects.*	
1. Consultation and Participation	The borrower/client will undertake meaningful consultation with affected Indigenous Peoples to ensure their informed participation. To carry out meaningful consultation with affected Indigenous Peoples, the borrower/client will establish a context-specific strategy for inclusive and participatory consultation, including approaches of identifying appropriate Indigenous Peoples representatives, and consultation methods appropriate to the social and cultural values of the affected Indigenous Peoples communities. The borrower/client will pay special attention to the concerns of indigenous women and youth.
2. Social Impact Assessment	The level of detail and comprehensiveness of the SIA will be proportional to the complexity of the proposed project and commensurate with the nature and scale of the proposed project's potential effects on Indigenous Peoples, whether positive or negative.
3. Indigenous Peoples Planning	If the screening and SIA indicate that the proposed project will have impacts, positive and/or negative, on Indigenous Peoples, the borrower/client will prepare an IPP in the context of the SIA and through meaningful consultation with the affected Indigenous Peoples communities.
4. Information Disclosure	The borrower/client will submit to ADB the following documents to disclose on ADB's website: *(i)* a draft IPP and/or Indigenous Peoples planning framework, including the social impact assessment, endorsed by the borrower/client, before appraisal; *(ii)* the final IPP upon completion; *(iii)* a new or updated IPP and a corrective action plan prepared during implementation, if any; and *(iv)* the monitoring reports.
5. Grievance Redress Mechanism	The borrower/client will establish a mechanism to receive and facilitate resolution of the affected Indigenous Peoples communities' concerns, complaints, and grievances. The grievance mechanism will be scaled to the impacts of the project. It should address concerns and complaints promptly, using an understandable and transparent process that is culturally appropriate, gender responsive, and accessible to the affected Indigenous Peoples communities at no cost and without retribution. The mechanism should not impede access to the country's judicial or administrative remedies. The affected Indigenous Peoples communities will be appropriately informed about the mechanism.
6. Monitoring and Reporting	The borrower/client will monitor and measure the progress of implementation of the IPP. The extent of monitoring activities will be commensurate with the project's risks and impacts. The borrower/client will prepare periodic monitoring reports on the progress of IPP implementation, highlighting compliance issues and corrective actions, if any.
7. Unanticipated Impacts	If unanticipated impacts on Indigenous Peoples become apparent during project implementation, such as a change in the project's footprint, the borrower/client will carry out a social impact assessment and update the IPP or formulate a new IPP covering all applicable requirements specified in the SPS document.

Applicable ADB Safeguard Policy Statement	
Special Requirements	Special Requirements exist for the following categories. Specific guidance is detailed in the SPS document in reference to these, if applicable. *1. Ancestral Domains and lands and Related Natural Resources* *2. Consent of Affected Indigenous Peoples Communities* *3. Indigenous Peoples and Development*

Source: ADB Safeguard Policy Statement (2010) [1]

The above standards are to be applied in conjunction with the *ADB's Handbook on Resettlement and Environmental Assessment Guidelines (2003)*; which provide information on good practice approaches to implementing the above safeguard

[1] ADB Safeguard Policy Statement (2010); ADB administration and governance; Environment; Social development and protection, paragraph 15

3.3.6 *ADB's Social Protection Strategy (2001)*

In addition to the standard ADB Safeguard Policies to regulate the proper implementation of an ESIA and responsible management of the project, the Kyaiklat Project will implement measures to comply with the ADB's Social Protection Strategy (2001). This strategy defines social protection as a set of policies and programs designed to reduce poverty and vulnerability by promoting efficient labour markets, diminishing people's exposure to risks, and enhancing their capacity to protect themselves against hazards and interruption/loss of income.

One key component of the policy is to adequately assess social risks, through the strategy's Social Risks-Risk Assessment and Risk Reduction Measures tool. This includes assessing risks in, lifecycle, economics, environmental and social or governance. The tool also incorporates levels of reduction measures to be considered, including options for public and private intervention and mechanisms.

Specifically the strategy also seeks to address the following aspects of social protection:

a) labour market policies and programs designed to facilitate employment and promote the efficient operation of labour markets;

b) social insurance programs to cushion the risks associated with unemployment, health, disability, work injury, and old age;

c) social assistance and welfare service programs for the most vulnerable groups with no other means of adequate support;

d) micro and area-based schemes to address vulnerability at the community level; and

e) child protection to ensure the healthy and productive development of the future Asian workforce [(1)].

3.3.7 *ADB Gender and Development Policy (2003)*

Following from the above section, the Kyaiklat Project will address and comply with the ADB's Policy on Gender and Development 2003. This policy introduces emerging areas of concern for women and gender issues and provides recommendations to development and finance institutions to provide a platform for action, as endorsed by the United Nations amongst this issue. This includes institutional mechanisms and strategic objectives of improving the status of women. Primarily the policy includes a key strategy for promoting gender equity, the key elements being:

a) Gender sensitivity: to observe how ADB operations affect women and men, and to take into account women's needs and perspectives in planning its operations.

(1) Social Protection Strategy, 2001, Asian Development Bank

b) Gender analysis: to assess systematically the impact of a project on men and women, and on the economic and social relationship between them.

c) Gender planning: to formulate specific strategies that aim to bring about equal opportunities for men and women.

d) Mainstreaming: to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision-making process in development activities.

e) Agenda setting: to assist DMC governments in formulating strategies to reduce gender disparities and in developing plans and targets for women's and girls' education, health, legal rights, employment, and income-earning opportunities.[1]

3.3.8 *ADB's Public Communications Policy (2011)*

With any ESIA, public communication and stakeholder participation is key. In following with the requirements of compliance with ADB Standards, the Kyaiklat Project will address and comply with the ADB's Public Communications Policy (PCP) 2011. This policy promotes proactive external relations and improved access to information about ADB operations for better development effectiveness. The policy promotes greater transparency and accountability by enabling ADB's stakeholders—especially people affected by development activities—to better participate in the decisions that affect them.[2]

The policy aims to enhance stakeholders' trust and ability to engage, through the fundamental policy elements of:

a) Proactive disclosure
b) Presumption in favor of discourse
c) Right to access and impart information and ideas
d) Country ownership
e) Limited exceptions
f) Right of appeal[3]

3.4 INTERNATIONAL CONVENTIONS

Myanmar has ratified several international conventions. Highlights of key conventions are provided below.

3.4.1 *The Kyoto Protocol on Climate Change (UNFCC)*

Myanmar achieved full accession to the UNFCC in 2003. This obligates Myanmar to assure that future development in the country meets the conditions of the Convention. Relevant to this Project are the requirements associated with the

[1] Gender and Development Strategy, 2003, Asian Development Bank

[2],[3] Public Communications Policy 2011 – Disclosure and Exchange of Information, 2011, Asian Development Bank

potential generation of greenhouse gas from the operation of the coal fired power plant; further conditions of relevance include:

- Enhancement of energy efficiency in relevant sectors;
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forest management practices, afforestation and reforestation;
- Promotion of sustainable forms of agriculture;
- Implementation of measures to limit and/ or reduce emissions of greenhouse gases; and
- Limitation and/ or reduction in methane emissions.

3.4.2 The United Nations Convention on Biodiversity 1992

This Convention seeks to conserve biodiversity and promote its sustainable use. It requires the identification and monitoring of the biodiversity in an area and adopting the necessary conservation measure. Myanmar became party to this Convention in 1994.

3.4.3 The Basel Convention 1989

This was developed under the auspices of the United Nations Environmental Programme (UNEP) in response to the growing worldwide awareness of the problem of international traffic in hazardous waste. The *Basel Convention 1989* is the first and foremost global environmental treaty that strictly regulates the trans-boundary movement of hazardous wastes. It obligates parties to ensure environmentally sound management, especially during the disposal process.

The objectives of the Convention are to:

- Ensure that waste is disposed of as near as possible to the place or source of its generation;
- Reduce trans-boundary waste and where it cannot be avoided, to be disposed of in an environmentally sound and efficient manner; and
- Provide assistance to developing countries in the management of hazardous waste and the generation.

The Convention places a ban on the export of hazardous waste from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries.

A list of Project-relevant international treaties of which Myanmar is a signatory are provided in ***Table 3.13***.

Table 3.13 International Conventions Ratified by Myanmar

No.	Conventions	Year (Ratified/Acceded/Accepted)
Environment		
1	Plant Protection Agreement for the Southeast Asia and Pacific Region, Rome 1956	1959 (Ratified)
2	MARPOL: International Convention for the Prevention of Pollution from Ships 1973 and MARPOL Protocol of 1978	1988 (Accession)
3	ICAO: ANNEX 16 to the Convention on International Civil Aviation Environmental Protection Vol. I and II, Aircraft Noise and Aircraft Engine Emission	Accession
4	Agreement on the Networks of Aquaculture Centres in Asia and the Pacific, Bangkok 1988	1990 (Accession)
5	Vienna Convention for the Protection of the Ozone Layer, Vienna 1985	1993 (Ratification)
6	Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987	1993 (Ratification)
7	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London 1990	1993 (Ratification)
8	United Nations Framework Convention on Climate Change (UNFCCC), New York 1992	1994 (Ratification)
9	Convention on Biological Diversity, Rio de Janeiro 1992	1994 (Ratification)
10	The Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris 1972	1994 (Acceptance)
11	International Tropical Timber Agreement (ITTA), Geneva 1994	1996 (Ratification)
12	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought, Paris 1994	1997 (Accession)
13	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington DC 1973; and as amended in Bonn, Germany 1979	1997 (Accession)
14	ASEAN Agreement on Conservation of Nature and Nature Resources, Kuala Lumpur, 1985	1997 (Signatory)
15	Kyoto Protocol to the Convention on Climate Change, Kyoto 1997	2003 (Accession)
16	ASEAN Agreement on Trans-boundary Haze Pollution	2003 (Ratification)
17	Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	2004 (Accession)
18	Ramsar Convention on Wetlands of International Importance	2005 (Accession)
19	Establishment of ASEAN Regional Centre for Biodiversity	2005 (Signatory)
20	Declaration on ASEAN Heritage Parks	2003 (Signatory)
21	International Treaty on Plant Genetic Resources for Food and Agriculture, 2001	2004 (Ratification)
22	Catagena Protocol on Biosafety, Cartagena, 2000	2001 (Signatory)
23	Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, Rome, 1973	1994 (Acceptance)
24	United Nations Convention on the Law of the Sea, Montego Bay, 1982	1996 (Ratified)
25	Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, New York, 1994	1996 (Accession)
26	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and their Destruction, Paris, 1993	1993 (Signatory)

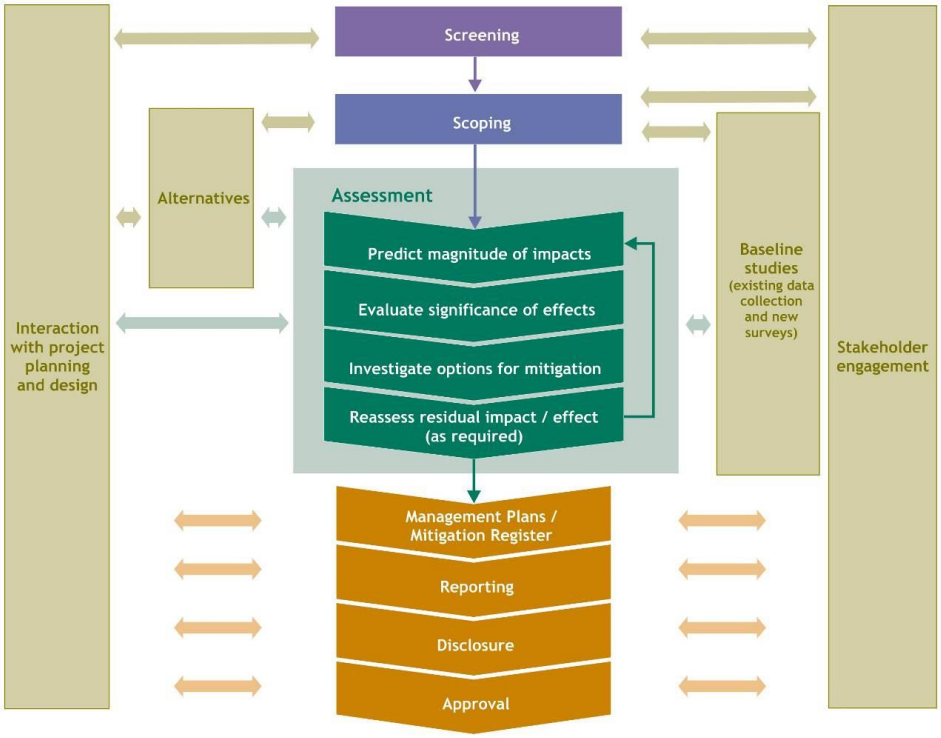
No.	Conventions	Year (Ratified/Acceded/Accepted)
27	Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction on the Sea Bed and Ocean Floor and in the Subsoil there of, London, Moscow, Washington, 1971	1971 (Signatory)
Social, Labour and Health		
28	Universal Declaration of Human Rights (UNDHR)	signed
29	Convention on the Rights of the Child	1991 (acceded)
30	Convention on Elimination of All Forms of Discrimination against Women (CEDAW)	1997 (acceded)
31	Relevant ILO Conventions in force in Myanmar • C1 Hours of Work (Industry) • C14 Weekly Rest (Industry) • 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 • C87 Freedom of Association and Protection of the Right to Organize	

4 IMPACT ASSESSMENT METHODOLOGY

4.1 INTRODUCTION

This Chapter presents the methodology used to conduct the ESIA. The ESIA methodology follows the overall approach illustrated in ***Figure 4.1***. The ESIA has been undertaken following a systematic process that evaluates the potential impacts the Project could have on aspects of the physical, biological, social/ socio-economic and cultural environment; identifies preliminary measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for potential adverse impacts; and identifies measures to enhance potential positive impacts where practicable.

Figure 4.1 Overall Impact Assessment Process



This section also details the methodology applied in the collection and analysis of primary and secondary data used in this report. Primary and secondary information from Sembcorp, government sources, non-government organizations (NGOs) and other Project-related stakeholders have been collected to support the preparation of this report.

4.2 SCREENING

At the initial stage of the ESIA, preliminary information was provided to aid in the determination of what legal and other requirements apply to the Project. This step was conducted utilising a high level description of the Project and its associated facilities.

4.3 SCOPING

Scoping has been undertaken by IFC in 2015[1] to delineate the potential Area of Influence for the Project (and thus the appropriate Study Area), and to identify potential interactions between the Project and resources/receptors in the Area of Influence (i.e. identifying the potential impacts that could result from these interactions). It also helps in developing and selecting alternatives to the proposed action and in identifying the issues to be considered in an ESIA.

The Scoping study was undertook as a means to ensure that there is a focus on the issues that are most important for Project planning, decision-making and stakeholder interests. During the scoping study, potential interactions between the Project, environmental and human resources/receptors were identified, and prioritised in terms of their potential to cause impacts of concern. ***Table 4.1*** presents the resources/receptors considered in the scoping stage, together with the changes that might indicate a potential Project-related impact.

Table 4.1 Resources/Receptors and Potential Impacts Considered in Scoping

Resources/Receptors	Changes that May Indicate Potential Impacts
Environmental	
Geology	Changes to geology, geomorphology, topography
Soil	Changes to physical and chemical properties and soil ecology
Surface Water	Changes to physical, chemical or biological quality of rivers, lakes, seas and other surface water bodies; Introduction of exotic species, changes in habitat quality, abundance, diversity; Effluent discharge
Groundwater	Contamination of shallow or deep groundwater resources, change in ground water resources
Sediments	River/waterbed morphology, physical and chemical properties, benthic organisms
Fisheries	Changes in fisheries productivity
Vegetation	Changes to vegetation population, health, species abundance and diversity and impact on endangered and economic species, food chain effects
Wildlife	Changes to wildlife assemblages, impact on endangered and economic species, food chain effects
Air	Emissions of NOx, SOx, PM, CO, VOC, greenhouse gases (CO_2, CH_4, and N_2O), ozone, TSP etc.
Noise and Vibration	Change in noise or vibration levels
Aesthetics	Physical presence of facilities, increased night time light
Waste	Generation of wastes – hazardous and non-hazardous
Social / Socio-economic	
Population and physical displacement	Changes in total population, gender ratio, age distribution. Physical displacement from residence as a result of Project land take, or activities
Social and Cultural Structure	Disruption in local authority and governance structure; change in social behaviours; alterations to social and cultural networks; intra and inter-ethnic conflict
Economy and employment	Change in national/local economy, employment, standard of living, occupation

[1] Myingyan IPP Project – Environmental & Social Consultancy Services in Support of Transaction Advisory Service's for Private Sector Participation Scoping Report – Rev 4, 18th May 2015

Resources/Receptors	Changes that May Indicate Potential Impacts
Resource ownership and use	Temporary or permanent restriction for accessing or using land or water, changes in livelihood activities based on natural resources; changes in ownership of such resources.
Cultural Resources	Physical disturbance of shrines, burial grounds, archaeological resources or other desecration or change in access to cultural resources, rituals or celebrations carried out in their premise.
Education and skills	Change in availability or quality of education or skills provision, supply and demand in certain skill sets etc.
Infrastructure and public services	Improvement or pressure on existing urban/rural infrastructure or services including: transportation; power, water, sanitation, security, waste handling facilities etc.
Community Health and Safety	
Mortality and Key Health Indicators	Change in the mortality profile of the community; changes in life expectancy, birth rates, death rates, maternal mortality rates etc.
Environmental Change	Decreased air quality (e.g. NOx, SOx, VOC, CO, PM), contamination of surface waters and potable ground water, increased vibration and noise, increased night time light beyond acceptable limits, changes to the visual environment.
Communicable and Non Communicable Diseases	Change in incidence and /or prevalence of communicable and non-communicable diseases or disease causing factors
Vector Borne Diseases	Changes in the incidence and or prevalence of vector borne diseases, the density of these vectors and their breeding grounds.
Sexually Transmitted Diseases	Changes in the incidence and /or prevalence of sexually transmitted diseases and the factors that contribute to this (external workforce, transport routes etc.)
Nutritional Status	Changes to nutritional status and food security
Health Care/ Recreational Facilities	Changes in availability of and access to health care and recreational facilities including green space
Psychosocial /Lifestyle Factors	Drug use/abuse, prostitution, communal violence, crime, suicide and depression; changing expectations of quality of life
Community Safety	Risk to community safety from gas leaks from the gas supply pipeline

4.4 PROJECT DESCRIPTION

In order to set out the scope of the Project features and activities, with particular reference to the aspects which have the potential to impact the environment, a Project Description has been prepared. Details of the Project facilities' design characteristics, as well as planned and possible unplanned Project activities, are provided in ***Chapter 2*** of this ESIA Report.

4.5 BASELINE CONDITIONS

To provide a context within which the impacts of the Project can be assessed, a description of physical, biological, social / socio-economic and cultural conditions that would be expected to prevail in the absence of the Project is presented. The Baseline includes information on all resources/receptors that were identified during scoping as having the potential to be significantly affected by the Project.

The baseline characterization is reported in ***Chapter 5*** and ***Chapter 6*** of this Report.

4.6 STAKEHOLDER ENGAGEMENT

An effective ESIA Process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

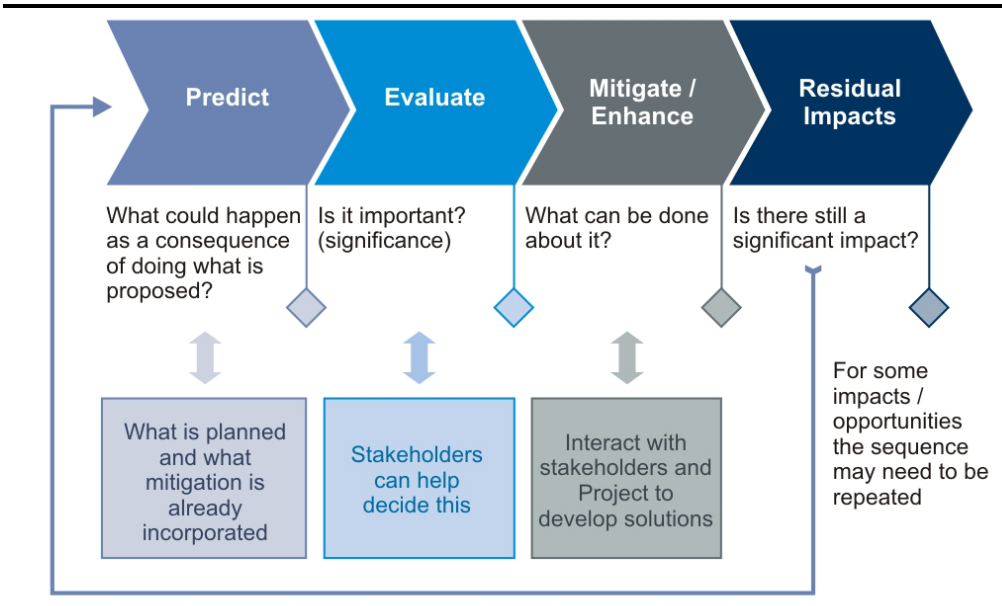
Stakeholder Engagement activities are being undertaken for this Project and these will be presented in the final ESIA at later stage.

4.7 IMPACT ASSESSMENT

Impact identification and assessment starts with scoping and continues through the remainder of the ESIA Process. The principal ESIA steps are summarized in ***Figure 4.2*** and comprise:

- **Impact Prediction:** to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities;
- **Impact Evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;
- **Mitigation and Enhancement:** to identify appropriate and justified measures to mitigate potential negative impacts and enhance potential positive impacts; and
- **Residual Impact Evaluation:** to evaluate the significance of potential impacts assuming effective implementation of mitigation and enhancement measures.

Figure 4.2 ***Impact Assessment Process***



4.7.1 *Prediction of Impacts*

Prediction of impacts is essentially an objective exercise to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in Scoping, the impacts to the various resources/receptors are elaborated and evaluated. The diverse range of potential impacts considered in the ESIA process typically results in a wide range of prediction methods being used, including quantitative, semi-quantitative and qualitative techniques.

4.7.2 *Evaluation of Impacts*

Once the prediction of potential impacts is complete, each potential impact is described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology and designations used to describe impact characteristics are shown in ***Table 4.2.***

Table 4.2 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The "reach" of the potential impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is potentially affected.	Temporary Short-term Long-term
Scale	The size of the potential impact (e.g., the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.).	[no fixed designations; intended to be a numerical value or a qualitative description of "intensity"]
Frequency	A measure of the constancy or periodicity of the potential impact.	[no fixed designations; intended to be a numerical value or a qualitative description]

The definitions for the *type* designations are shown in ***Table 4.3.*** Definitions for the other designations are resource/receptor-specific, and are discussed in the resource/receptor-specific impact assessment chapters presented later in this Report.

Table 4.3 Impact Type Definitions

Type	Definition
Direct	Potential impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Potential impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Potential impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is *likelihood*. The *likelihood* of an unplanned event occurring is designated using a qualitative scale, as described in ***Table 4.4.***

Table 4.4 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Once impact characteristics are defined, the next step in the impact assessment phase is to assign each potential impact a 'magnitude'. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood (for unplanned event).

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the potential impact. The magnitude designations themselves are universally consistent, but the definitions for these designations vary depending on the resource/receptor. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large.

In the case of a potential *positive* impact, no magnitude designation (aside from 'positive') is assigned. It is considered sufficient for the purpose of the ESIA to indicate that the Project is expected to result in a potential *positive* impact, without characterizing the exact degree of positive change likely to occur.

In the case of potential impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilized. However, the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterizing the magnitude of impact, the other principal impact evaluation step is definition of the sensitivity/vulnerability/importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity/vulnerability/importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors may also be considered, such as legal protection, government policy, stakeholder views and economic value. As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis.

The sensitivity/vulnerability/importance designations used herein for all resources/ receptors are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterized, the significance can be assigned for each impact. Impact significance is designated using the matrix shown in ***Table 4.5.***

Table 4.5 ***Impact Significance***

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/importance designations that enter into the matrix. ***Box A*** provides a context for what the various impact significance ratings signify.

It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the ESIA Process). This avoids the situation where an impact is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

Box A ***Context of Impact Significances***

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/vulnerability/importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its' effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of ESIA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholder to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

4.7.3 Identification of Mitigation and Enhancement Measures

Once the significance of a potential impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this ESIA, ERM has adopted the following Mitigation Hierarchy:

- **Avoid at Source, Reduce at Source:** avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity);
- **Abate on Site:** add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping);
- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site);

- **Repair or Remedy:** some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures; and
- **Compensate in Kind, Compensate Through Other Means**: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

The priority in mitigation is to first apply mitigation measures to the source of the potential impact (i.e., to avoid or reduce the magnitude of the potential impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

4.7.4 Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the ESIA Process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the implementation of the proposed mitigation and enhancement measures.

4.8 MANAGEMENT, MONITORING AND AUDIT

The final stage in the ESIA Process is definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

A Register of Commitments, which is a summary of all actions which the Project Proponent has committed to executing with respect to environmental/social/health performance for the Project, is also included as part of this Report. The Register of Commitments includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

5 DESCRIPTION OF THE ENVIRONMENT – BIOPHYSICAL BASELINE

5.1 INTRODUCTION

This Chapter provides an overview of the environment-biophysical baseline conditions within the Project Study Area based on secondary data from published sources as well as primary data collected to fill data gaps. This section of the ESIA report is organized by different biophysical parameters and also includes a discussion of the baseline conditions and any additional methods used to fill in the gaps during primary data gathering at the Project Study Area.

5.1.1 Project Study Area

The Project Study Area refers to the area that needs to be studied in order to adequately understand and describe the baseline conditions likely to be affected by the Project. The Project Study Area (see ***Figure 5.1)*** comprises a 3km radius of the Project site and existing Steel Mill (shown as the Complex in ***Figure 5.1***). The Project Study Area also comprises a 500m buffer of the water supply pipeline route presented in the Scoping Study undertaken by IFC in 2015[1].

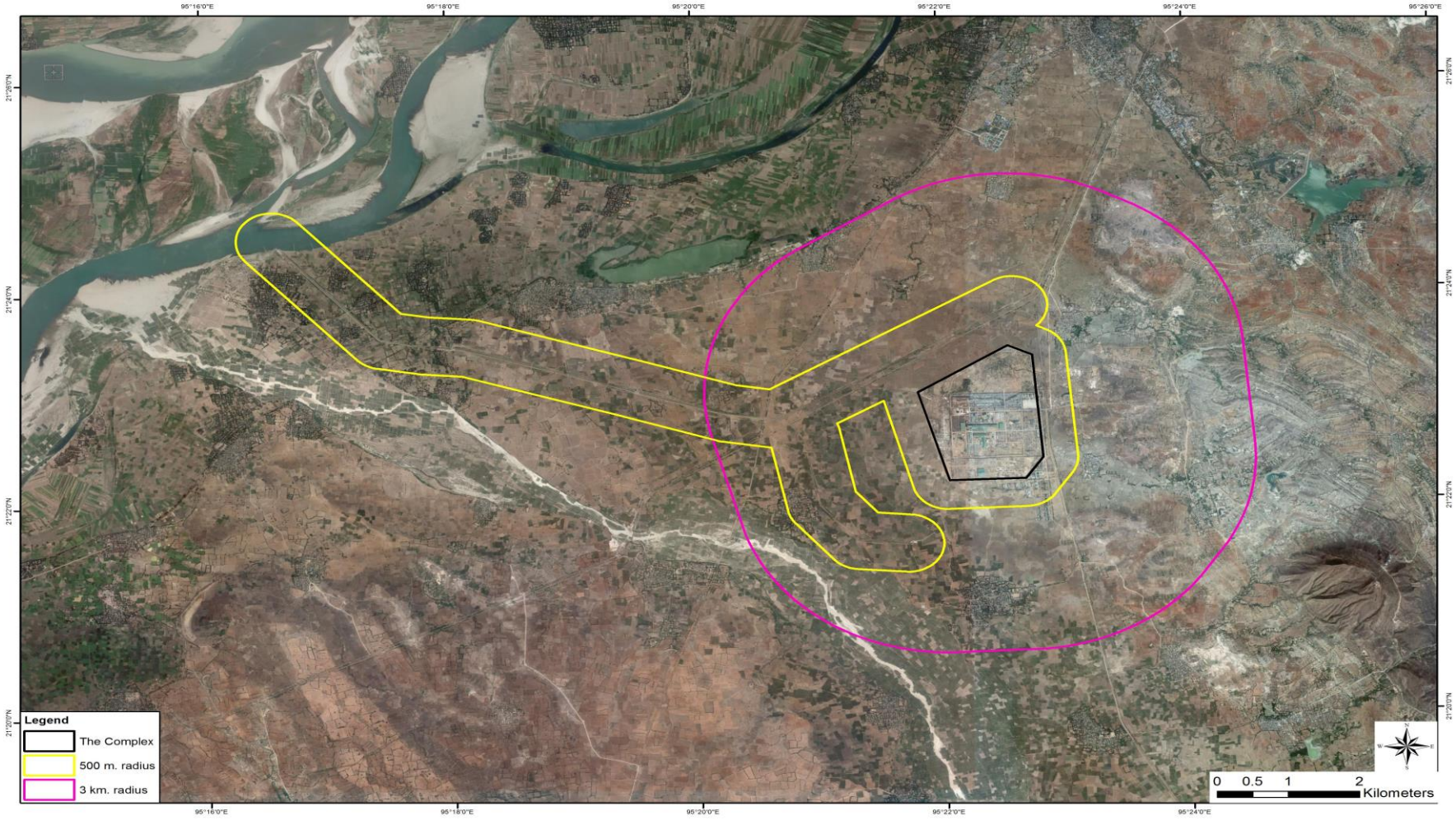
5.1.2 Project Area of Influence (AoI)

The Project Area of Influence (AoI) varies according to the potential impacts on a resource or receptor (influenced by spatial and temporal dimensions). The AoI was determined from initial screening using the IFC Scoping Study undertaken in 2015 and professional judgement of similar types of power projects. The AoI with respect to the biophysical baseline covers the Project Study Area. However, for air quality the AoI was extended to 10km from the Complex to consider stack emissions.

The Government of Myanmar has not yet established numerical standards for environmental parameters, although there are some pending guidelines. In the absence of national standards, the Ministry of Environmental Conservation and Forestry (MOECAF) typically recommends that internationally accepted numerical environmental standards, such as the World Bank Group (WBG) / International Finance Corporation (IFC), Asian Development Bank (ADB) Safeguards Policy Statement and World Health Organisation (WHO) guidelines, should be adopted for environmental assessments.

(1) Myingyan IPP Project – Environmental & Social Consultancy Services in Support of Transaction Advisory Service's for Private Sector Participation Scoping Report – Rev 4 – 18th May 2015.

Figure 5.1 Project Study Area



5.2 CLIMATE AND METEOROLOGY

Information presented in this section has been collected through a combination of publically available data supplemented by meteorological monitoring that has been undertaken by ERM as part of the baseline monitoring programme. Meteorology data collected during the baseline survey included temperature, relative humidity wind speed and wind direction. The 24-hour monitoring has been carried out every month since July 2014 to June 2015 by using a Haz-Scanner EPAS Environmental Perimeter Air Station. Baseline meteorological sampling was undertaken in parallel with the ambient air quality Sensitive Receivers (SRs) described in ***Section 5.3***.

5.2.1 *Myanmar Climatic Conditions*

Most of Myanmar belongs to the tropical region. The climate of Myanmar is roughly divided into three (3) seasons: Summer, Rainy Season, and Winter Season. Summer months are from March to Mid-May; the rain falls from Mid-May to the end of October and the Winter Season starts in November up to the end of February. Due to widely differing topographical situations of the country, its climate conditions also differ widely from one place to another [(1)]. April and May are the hottest months with an average temperature of 32°C (79 – 83°F). The coldest month is January, with an average temperature of 21°C (°F).

The southwest monsoon starts in late March or early April with local turbulence that includes tornados and cyclones, with winds that can reach up to 200 – 300 kph. From October to mid-March the northeast monsoon arrives which is dry and cool. The monsoon rain in the Dry Zone of Myanmar is bimodal with a drought period during July when dry desiccating winds blow from the south of Myanmar.

Rainfall patterns during the dry season are highly variable. There has been an observed decrease of about 45 – 65 % of rainfall over the last five years (2007 – 2012) and further analysis has confirmed the increase in drought occurrence over the past few decades in the Dry Zone region [(2)].

5.2.2 *Mandalay Region Climatic Conditions*

The Project site is located in the central plain of Myanmar, and is primarily located in the Dry Zone of Myanmar, which includes the western and middle part of the Mandalay region; this region is the most susceptible to drought in Myanmar [(3)]. The region is characterised by low annual rainfall that ranges between 508 mm and 1,016 mm per annum with high variability and uneven distribution [(4)]. Mean temperature in the Dry Zone is about 27°C and the temperature often rises to about 43°C in the summer period [(5)].

(1) http://www.unccd.int/ActionProgrammes/myanmar-eng2005.pdf

(2) United Nations Development Programme (2012), *Op cite*

(3) http://lift-fund.net/downloads/Component%203%20Final_19Aug13.pdf

(4) United Nations Development Programme - Adaptation Fund Project/Proposal Information (2012)

(5) United Nations Development Programme (2012) *Op cite*

The central region of Myanmar lies within the following climatic zones:

- Tropical savannah climate (around the Dry Zone) with more pronounced dry seasons between the monsoon rains and thus lower precipitation, but similar mean temperatures to those in the tropical monsoon climate; and
- Tropical steppe climate (Dry Zone), semi-arid climate with less than 1,250 mm of precipitation per annum and mean annual temperatures in excess of 27° C.

5.2.3 Project Site Climatic Conditions

Climatic information for the study was obtained from a weather station located at Myingyan, Mandalay state, which is situated in latitudes 21° 28' 0" N and longitudes 95° 23' 0" E, approximately 14.5km to the north from the Project site [(1)] and meteorology data collected during the baseline survey.

A summary of data available publically for Myingyan is provided in ***Table 5.1***, ***Figure 5.2*** and ***Figure 5.3.***

Temperature

The data obtained from the Myingyan weather station shows that the hottest months in 2013 were April to July, with average temperatures between 31.8°C and 32.4°C. The lowest temperature experienced in 2013 was in January with 20.7 °C.

During July 2014 to June 2015, the five (5) SRs showed an average mean temperature was 27.7°C, with an average maximum temperature of 31.9°C and an average minimum of 22.9°C. The highest temperature was 34.7°C (in May 2015) while the lowest temperature was 21.7°C (in February 2015). This is consistent with the temperatures recorded at the Myingyan weather station for the corresponding months for 2013. On site monitoring data is presented in ***Table 5.2***.

Relative Humidity

On site monitoring at the five (5) SRs showed that the averaged relative humidity fluctuates between 39.9% and 79.3%, with an annual average mean relative humidity of 64.2% (***Table 5.3***). The maximum and minimum monthly average relative humidity were 86% (in June 2015) and 35.2% (in March 2015), respectively.

Rainfall

According to ***Table 5.1***, Myingyan Township in the year 2013 received an average of 632mm of rainfall per year. In 2013, the driest conditions were experienced over 5 months from December to April where 3 – 8mm of rainfall are received. The wettest months were August and September, with a maximum of 112mm and 150 mm of rainfall, respectively.

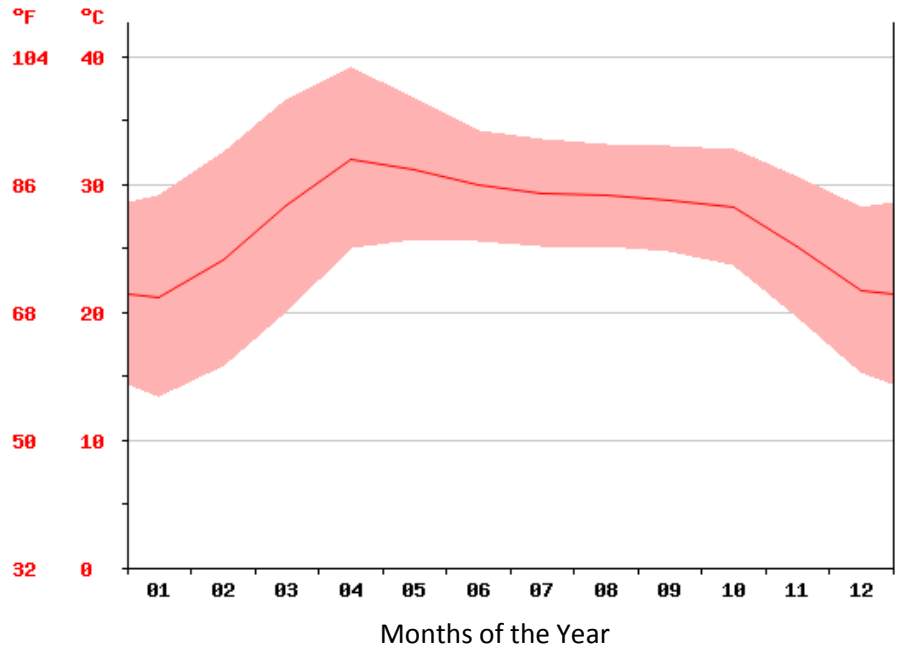
(1) http://weather.gladstonefamily.net/site/48047, accessed 18-06-2014

Table 5.1 Climatic Data of Myingyan, Mandalay State, Myanmar 2013

Climatic Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temperature °C (°F)	28.5	33.5	37.6	39.7	38.6	36.5	36.6	34.6	34.2	32.5	31.1	27.8	34.3
	(83.3)	(92.3)	(99.7)	(103.5)	(101.5)	(97.7)	(97.9)	(94.3)	(93. 6)	(90.5)	(88.0)	(82.04)	(93.7)
Average Temperature °C (°F)	20.7	23.9	28.5	32.1	32.4	31.8	32.4	30.1	29.8	28.2	25.3	21	28.02
	(69.3)	(75.0)	(83.3)	(89.8)	(90.3)	(89.2)	(90.3)	(86.2)	(85.6)	(82.8)	(77.5)	(69.8)	(82.4)
Average Min Temperature °C (°F)	12.9	14.4	19.5	24.5	26.3	26.7	28.3	25.7	25.5	24	19.4	14.4	21.80
	(55.2)	(57.9)	(67.1)	(76.1)	(79.3)	(80.1)	(82.9)	(78.3)	(77.9)	(75.2)	(66.9)	(57.9)	(71.2)
Average Precipitation mm (in)	3.0	3.0	3.0	8.0	84.0	74.0	81.0	112.0	150.0	81.0	28.0	5.0	632.0
	(0.1)	(0.1)	(0.1)	(0.3)	(3.3)	(2.9)	(3.2)	(4.4)	(5.9)	(3.2)	(1.1)	(0.2)	(24.9)

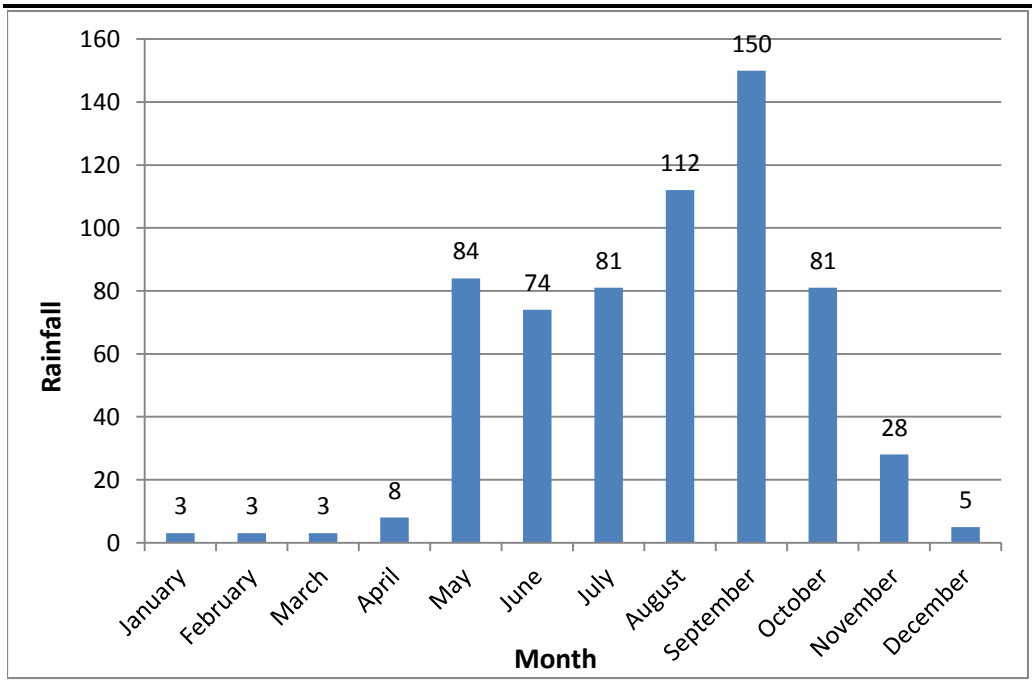
Source: Client data; 2011 – 2013, http://www.levoyageur.net/weather-city-MYINGYAN.html,

Figure 5.2 Myingyan, Myanmar Climate Graph 2013



Source: http://en.climate-data.org/location/318/ (2013)

Figure 5.3 Myingyan, Myanmar Precipitation (in mm) 2013



Source: http://www.levoyageur.net/weather-city-MYINGYAN.html, (2013)

Table 5.2 Average Ambient Temperature (℃) between July to December 2014 and January to June 2015..

ASR Location	2014						2015						Annual
	July	August	September	October	November	December	January	February	March	April	May	June	
ASR-1	29.2	29.2	28.3	27.9	28.0	22.9	22.4	22.7	28.8	32.0	28.3	29.9	27.5
ASR-2	26.4	29.2	28.0	26.8	27.9	22.8	22.5	21.7	27.8	30.5	27.4	29.3	26.7
ASR-3	27.9	26.5	30.3	26.3	25.9	22.2	-	26.0	28.7	30.5	31.1	27.1	27.5
ASR-4	25.5	27.8	30.6	28.5	25.9	24.6	-	29.1	32.0	33.0	34.7	30.6	29.3
ASR-5	28.4	30.0	31.0	28.9	26.9	22.2	25.3	25.1	30.5	33.6	27.4	32.3	28.5
Average	**27.5**	**28.5**	**29.6**	**27.7**	**26.9**	**22.9**	**23.4**	**24.9**	**29.5**	**31.9**	**29.8**	**29.8**	**27.7**
Maximum	**29.2**	**30.0**	**31.0**	**28.9**	**28.0**	**24.6**	**25.3**	**29.1**	**32.0**	**33.6**	**34.7**	**32.3**	**34.7**
Minimum	**25.5**	**26.5**	**28.0**	**26.3**	**25.9**	**22.2**	**22.4**	**21.7**	**27.8**	**30.5**	**27.4**	**27.1**	**21.7**

Note: - No data collected in the Sensitive Receivers

Table 5.3 Average Relative Humidity (%) between July to December 2014 and January to June 2015.

ASR Location	2014						2015						Annual
	July	August	September	October	November	December	January	February	March	April	May	June	
ASR-1	63.3	65.6	78.7	76.2	80.6	76.6	56.9	50.5	35.2	44.8	36.0	67.8	61.0
ASR-2	46.0	66.8	76.7	77.4	79.0	65.9	62.4	59.6	42.3	47.7	78.8	65.9	64.0
ASR-3	62.7	72.2	76.9	85.5	74.0	70.0	-	41.6	42.2	50.1	59.6	75.0	64.5
ASR-4	- [(a)]	75.5	75.6	74.8	73.7	74.0	-	41.9	42.4	49.9	64.0	86.0	65.8
ASR-5	63.7	73.6	72.9	82.7	75.6	75.8	64.0	57.3	37.2	46.6	78.8	75.8	67.0
Average	**58.9**	**70.7**	**76.2**	**79.3**	**76.6**	**72.5**	**61.1**	**50.2**	**39.9**	**47.8**	**63.4**	**74.1**	**64.2**
Maximum	**63.7**	**75.5**	**78.7**	**85.5**	**80.6**	**76.6**	**64.0**	**59.6**	**42.4**	**50.1**	**78.8**	**86.0**	**86.0**
Minimum	**46.0**	**65.6**	**72.9**	**74.8**	**73.7**	**65.9**	**56.9**	**41.6**	**35.2**	**44.8**	**36.0**	**65.9**	**35.2**

Note: [(a)] Over 50% data recorded are invalid, therefore, the R.H. in July cannot be averaged.

Wind Conditions

Dominant wind patterns in the Project Study Area are driven primarily by regular southwest (SW) monsoon wind in the rainy season and northeast (NE) monsoon wind in the winter or cold-dry season. These wind patterns are mediated by more mountainous terrain to the west and east. Localized meteorological conditions are also influenced by diurnal thermal cycles and cloud cover.

Wind data was collected for 24 hours continuously over a seven day period from July 2014 to June 2015. Wind roses for the data for the five SRs are presented in ***Figure 5.4*** to ***Figure 5.8***. The results are presented in ***Table 5.4***.

The dominant wind direction during the time of monitoring (June 2014 to July 2015) was south to southwest. The wind speed throughout the monitoring period is considered low.

Table 5.4 Averaged Wind Speed and Direction at SRs

SR Location	July 2014		August 2014		September 2014		October 2014		November 2014		December 2014	
	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction
ASR-1	1.93	South to southwest	4.80	South to southeast	0.60	Southwest and northeast	0.13	- [a]	0.19	- [a]	0.51	Northeast
ASR-2	1.97	South to southeast	4.12	South to southwest, North	2.20	South and north	0.39	- [a]	0.51	South to southwest	0.41	- [a]
ASR-3	1.64	South to southwest, North	0.84	Southeast	0.15	South	0.28	- [a]	0.03	- [a]	0.37	Southwest
ASR-4	1.65	South to southeast	2.74	Southwest and north	1.16	South to southwest	0.06	- [a]	0.07	- [a]	0.00	- [a]
ASR-5	1.68	West	2.68	Southwest	0.27	South	0.08	- [a]	0.24	- [a]	0.42	East to southeast

SR Location	January 2015		February 2015		March 2015		April 2015		May 2015		June 2015	
	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction	Averaged Wind Speed (m/s)	Prevailing Wind Direction
ASR-1	0.31	West	0.45	Northeast	0.53	East	0.77	Northeast	1.17	South to southwest	2.09	Southwest
ASR-2	0.22	Northwest	0.36	Northwest	0.50	Northwest	0.74	Northwest	1.49	South	3.14	South
ASR-3	- [b]	- [b]	0.15	West	0.55	Southwest	0.78	West	0.89	South	2.34	South
ASR-4	- [b]	- [b]	0.01	West	0.18	South	0.15	Southwest	0.28	South	1.27	South
ASR-5	- [b]	- [b]	0.01	West	0.11	Southeast	0.27	Southwest	0.82	South	1.16	South

Note: -a. Since the averaged wind speed was very low, no prevailing wind was recorded at some ASRs

-b No data collected at the Sensitive Receivers

Figure 5.4 Wind Rose for ASR 1

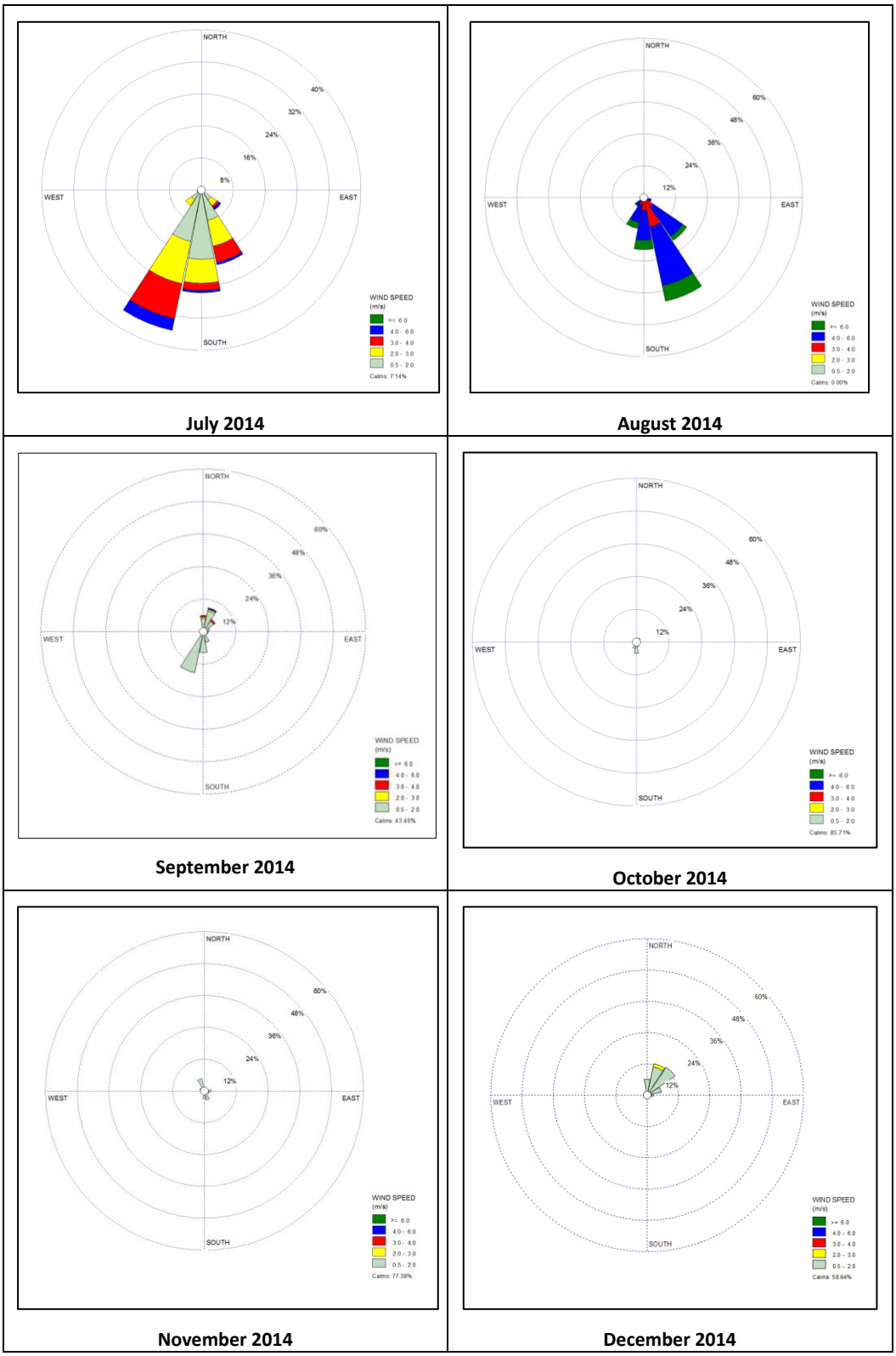
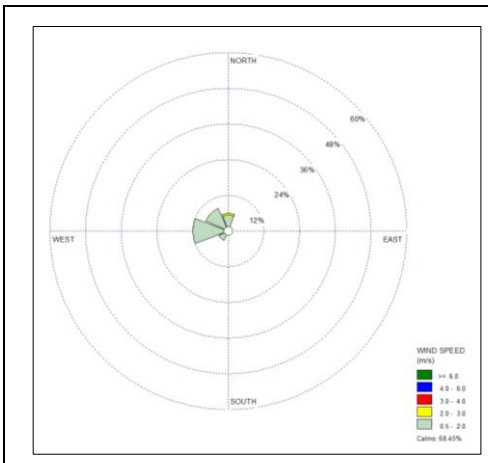
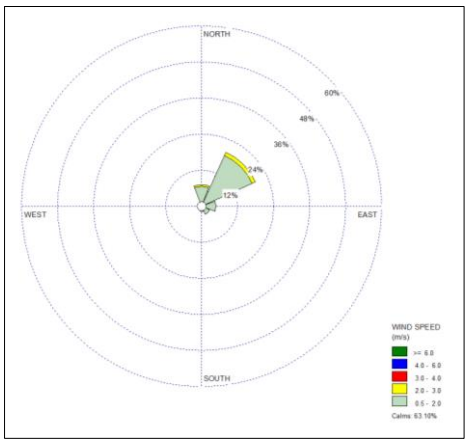


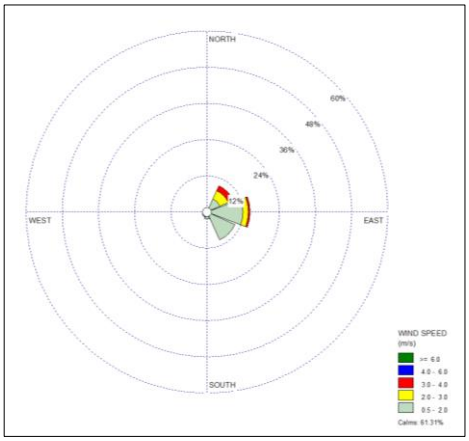
Figure 5.4 Wind Rose for ASR 1 (Cont'd)



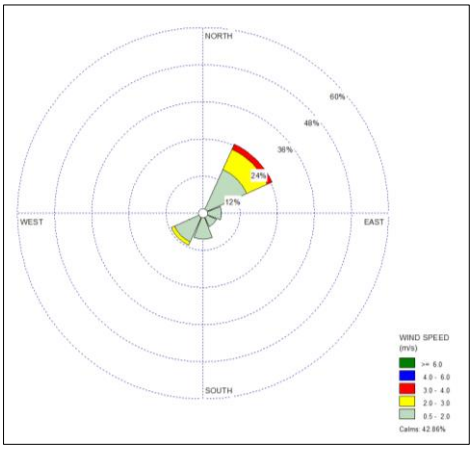
January 2015



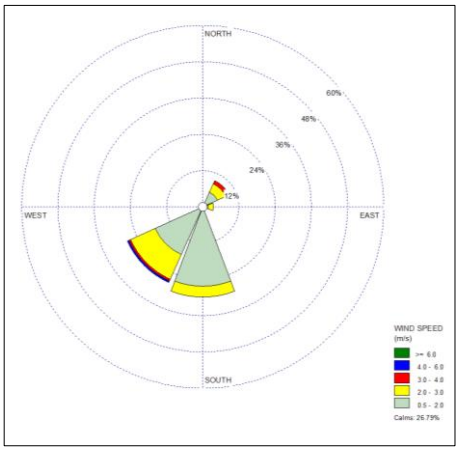
February 2015



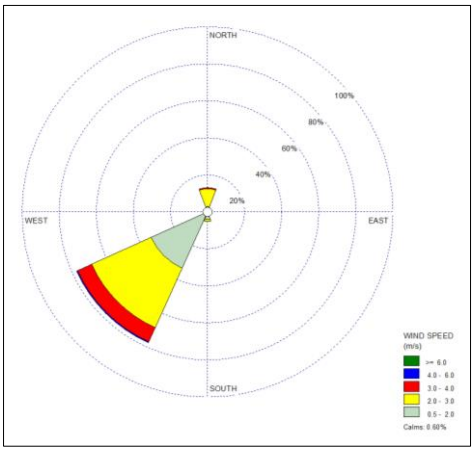
March 2015



April 2015



May 2015



June 2015

Figure 5.5 Wind Rose for ASR 2

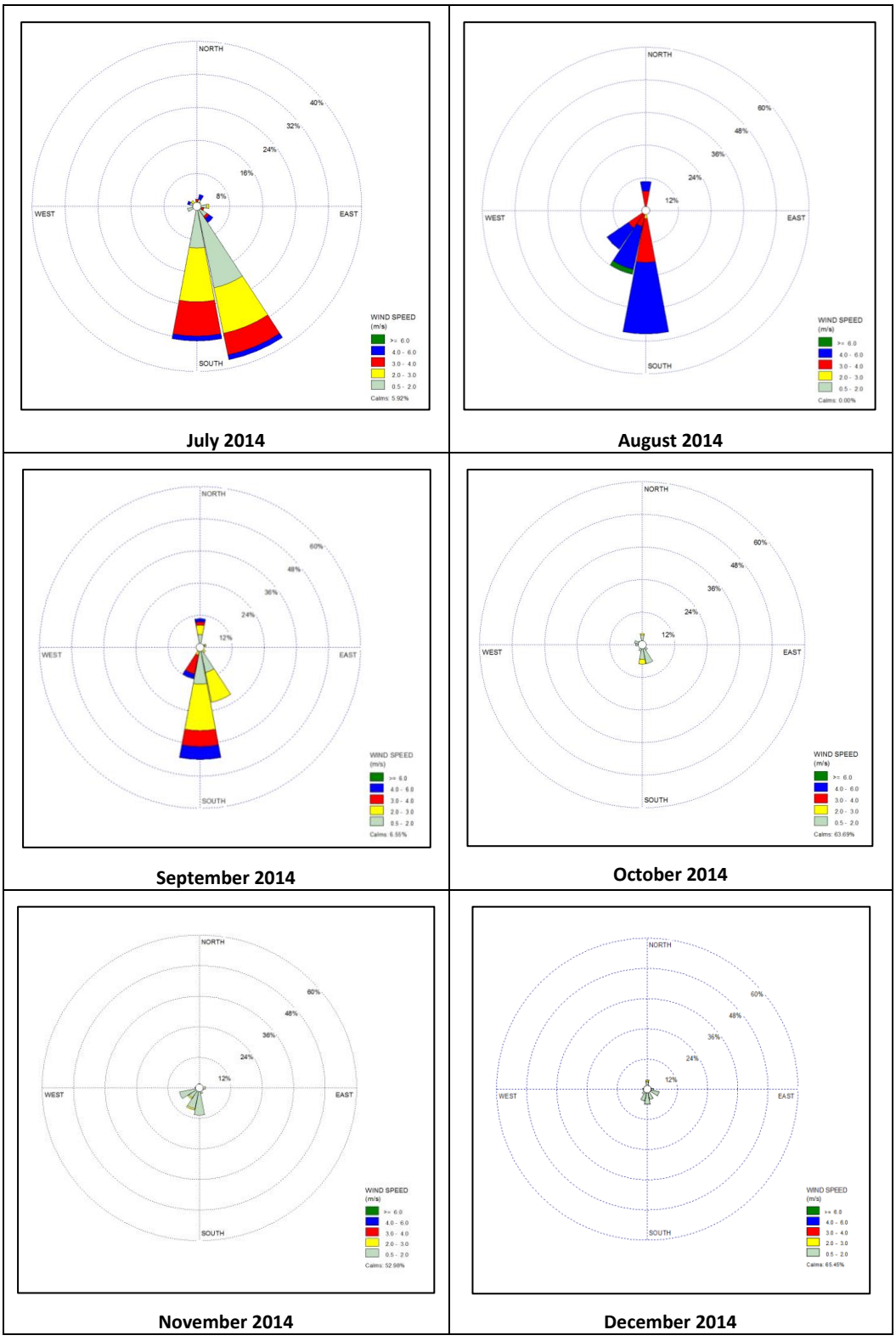


Figure 5.5 Wind Rose for ASR 2 (Cont'd)

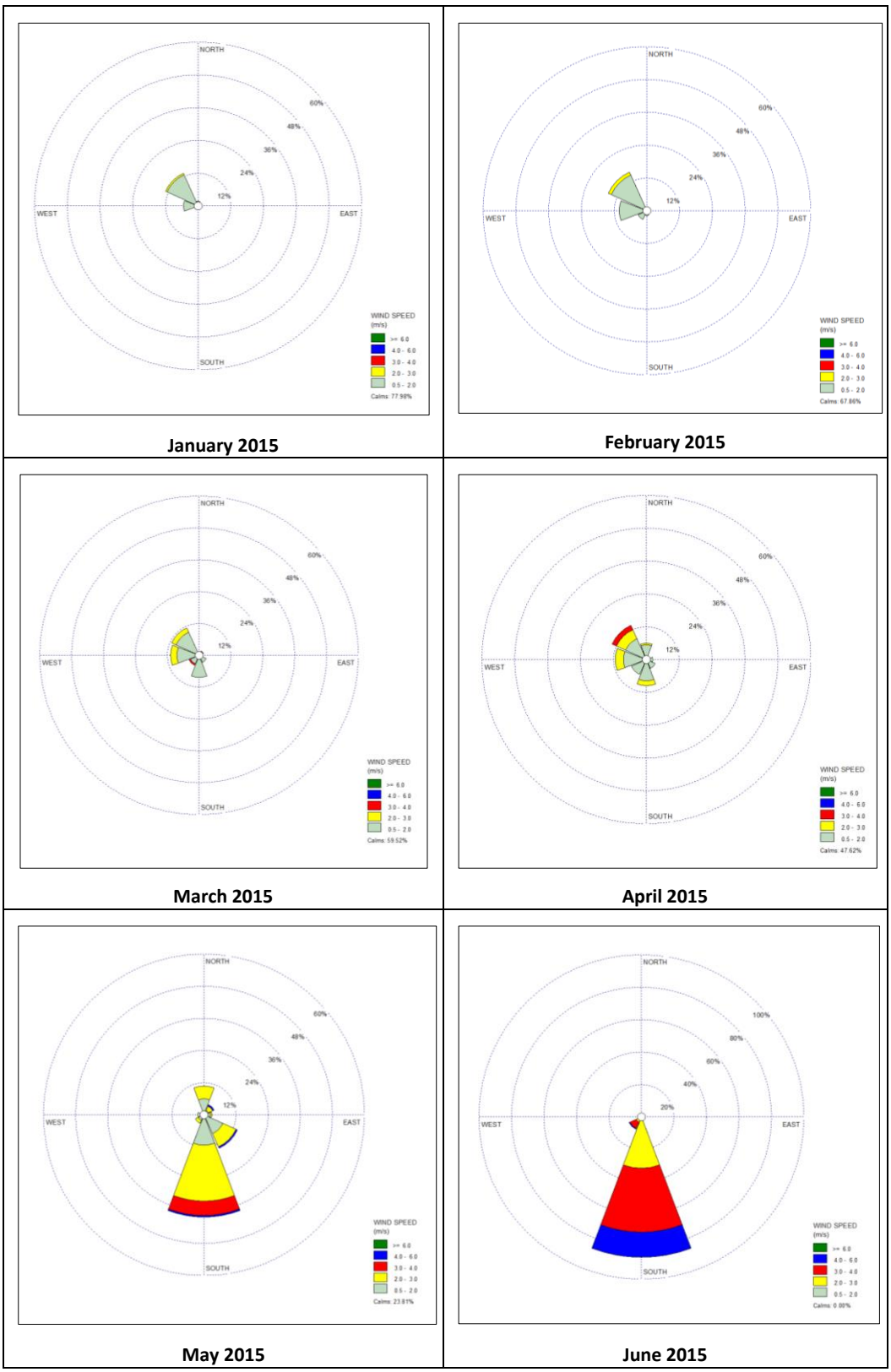


Figure 5.6 Wind Rose for ASR 3

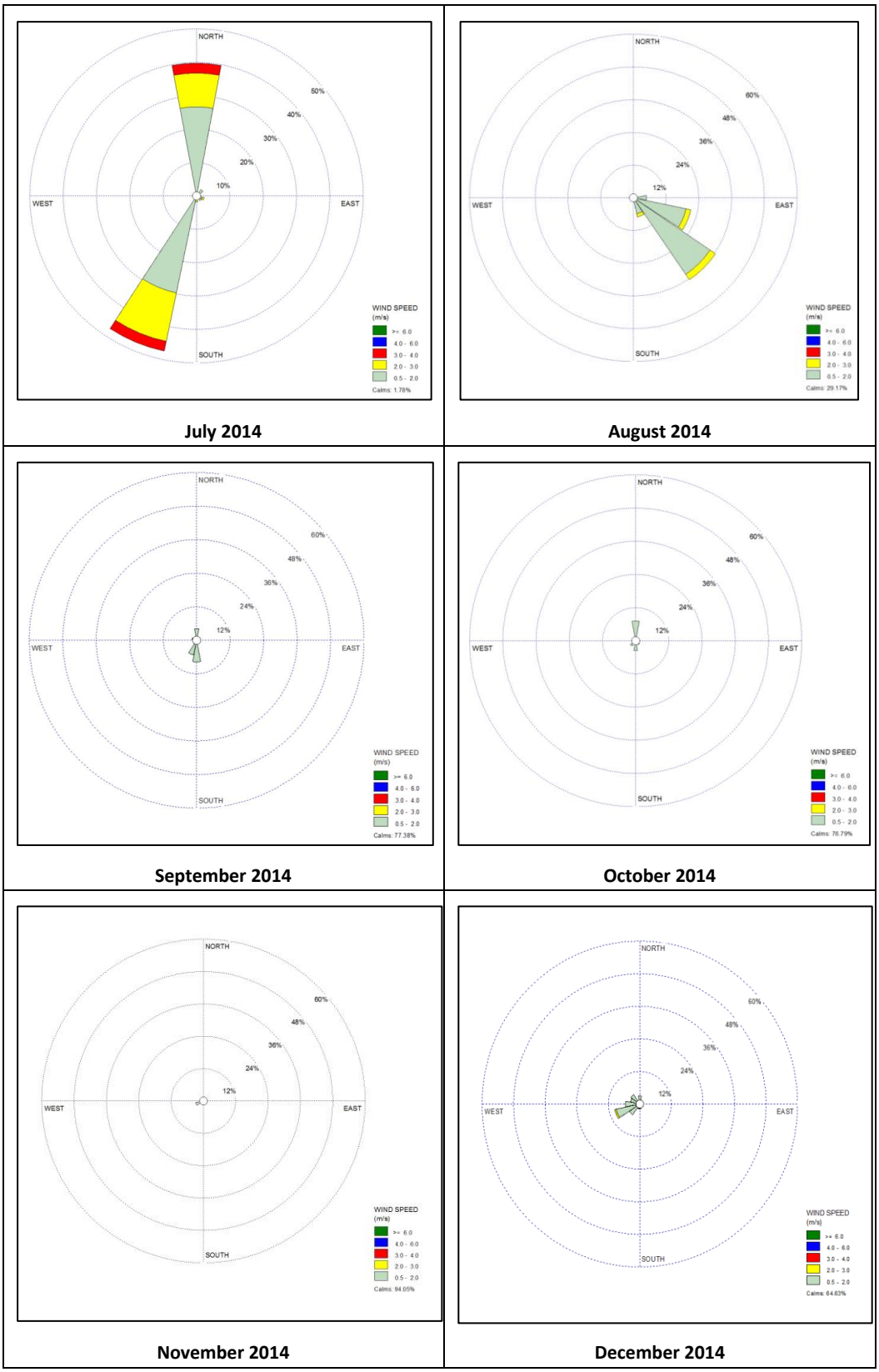


Figure 5.6 Wind Rose for ASR 3 (Cont'd)

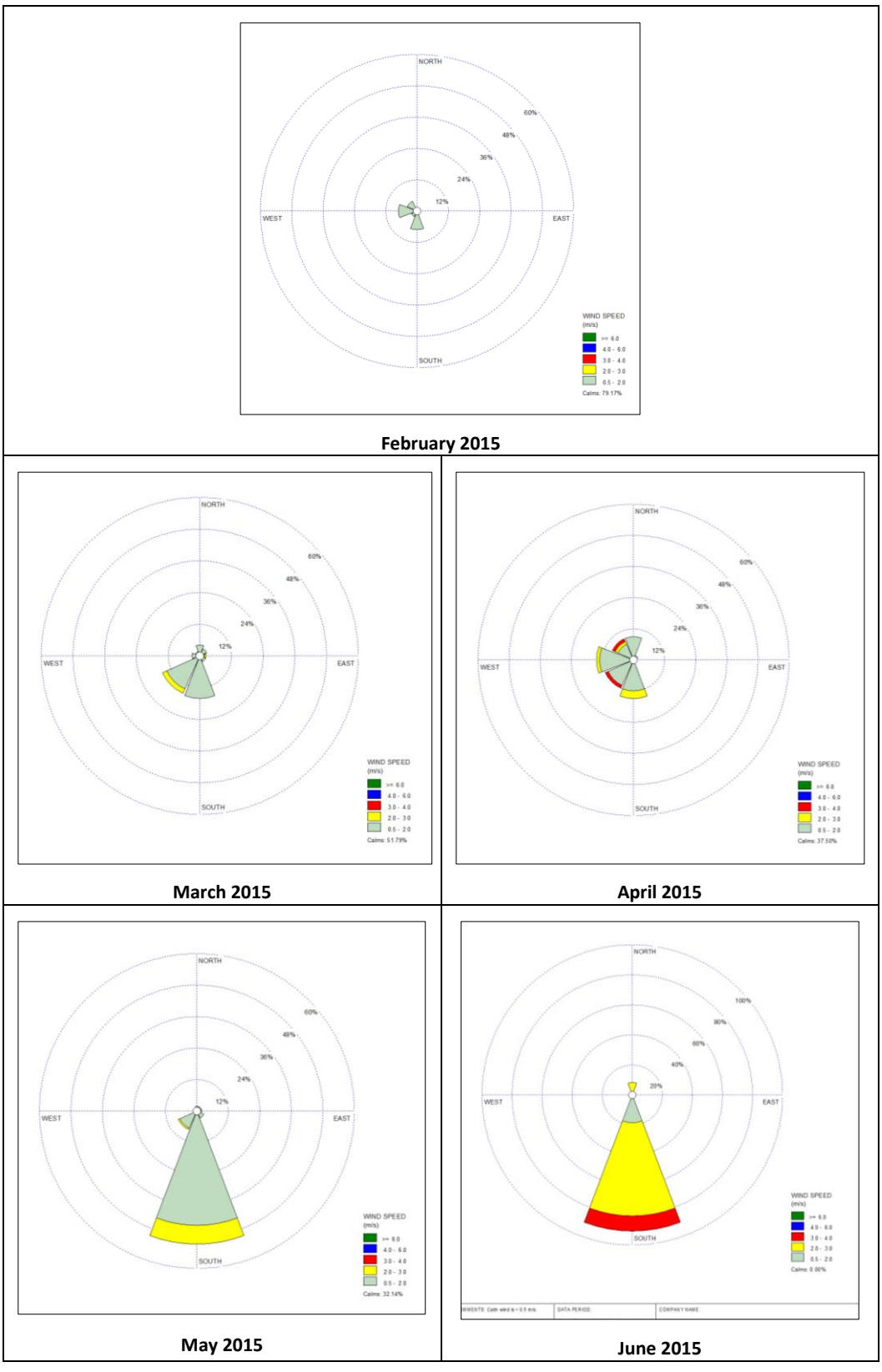


Figure 5.7 Wind Rose for ASR 4

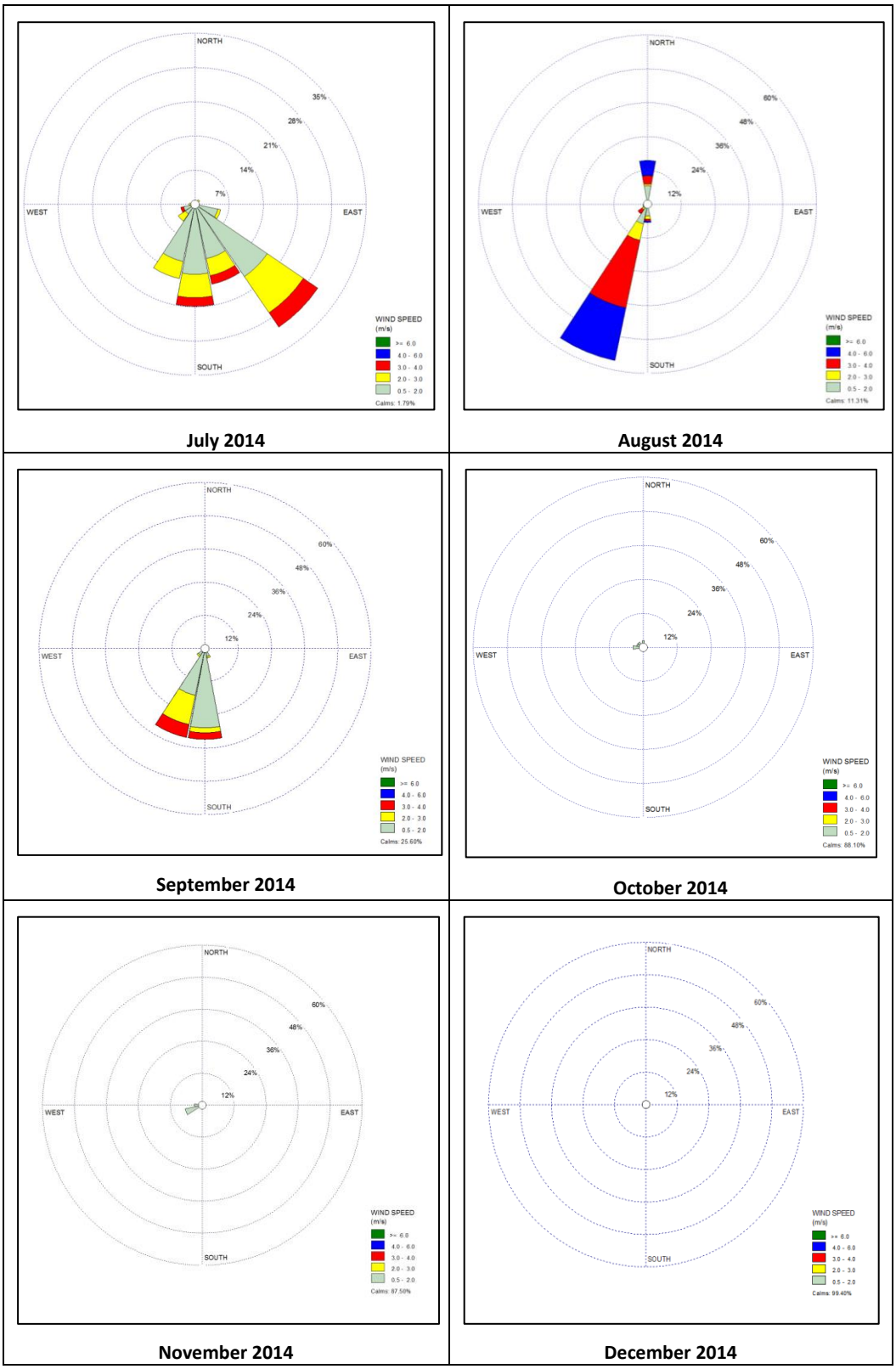


Figure 5.7 Wind Rose for ASR 4 (Cont'd)

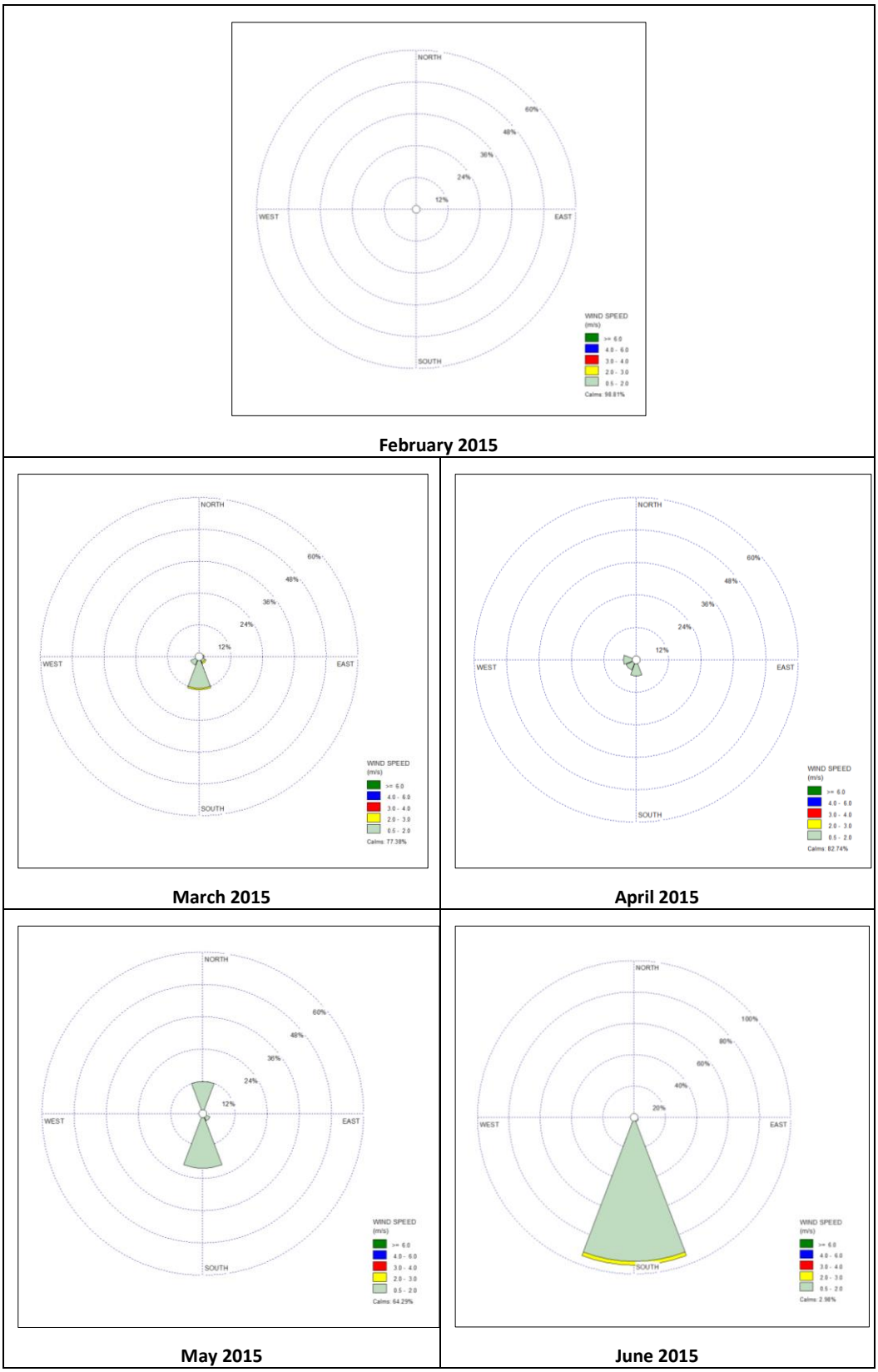


Figure 5.8 Wind Rose for ASR 5

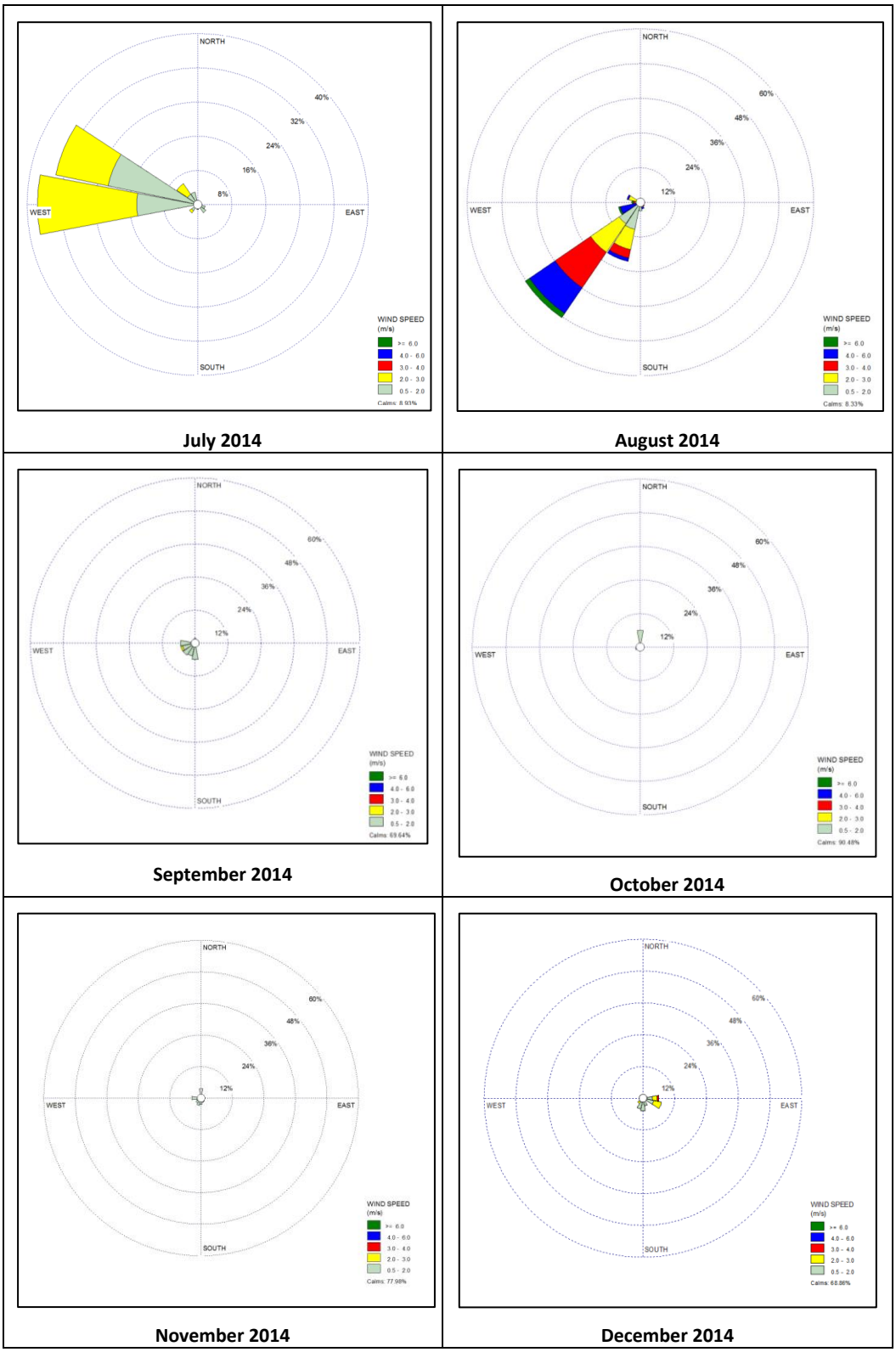
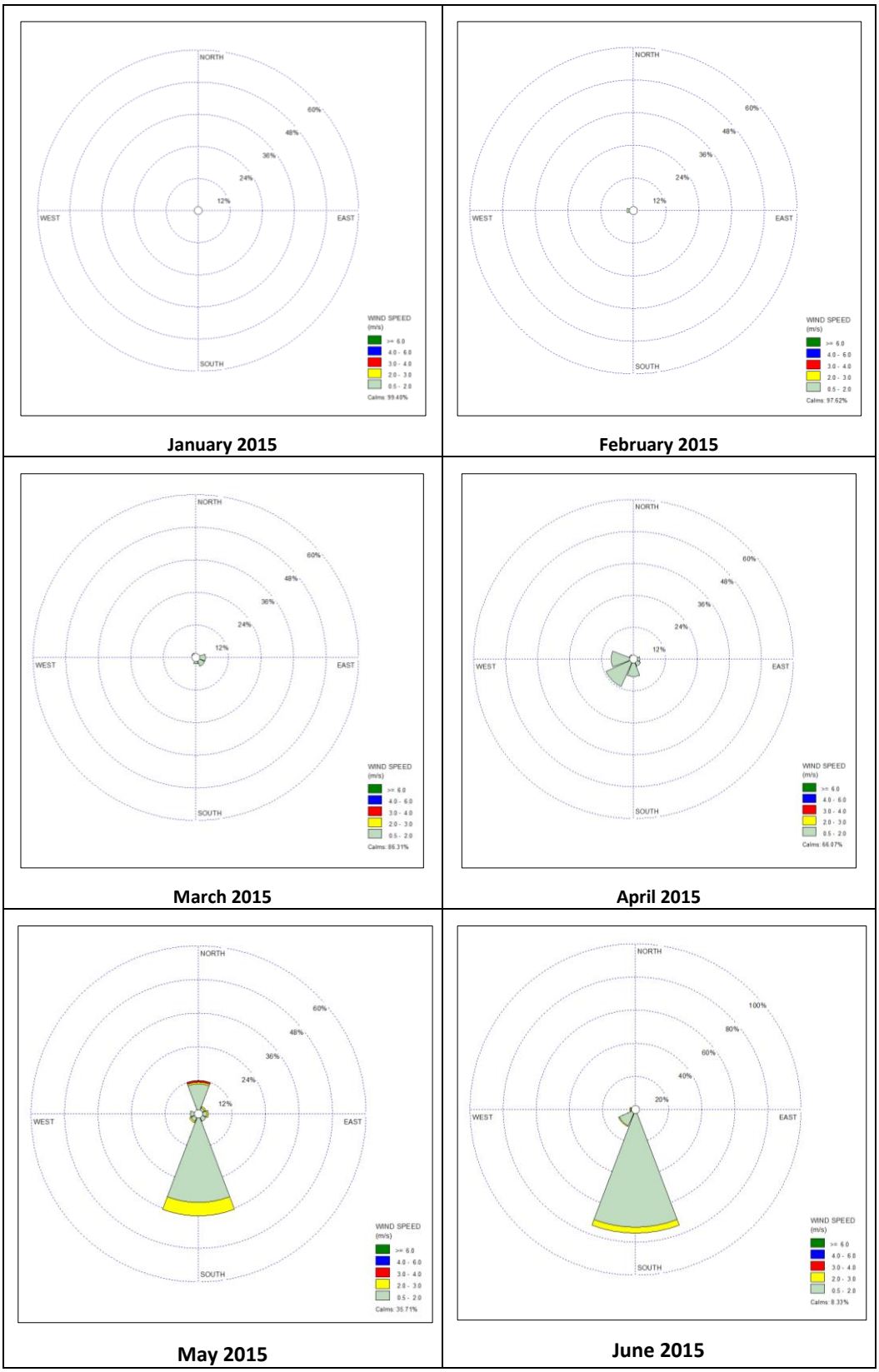


Figure 5.8 Wind Rose for ASR 5 (Cont'd)



5.3 AMBIENT AIR QUALITY

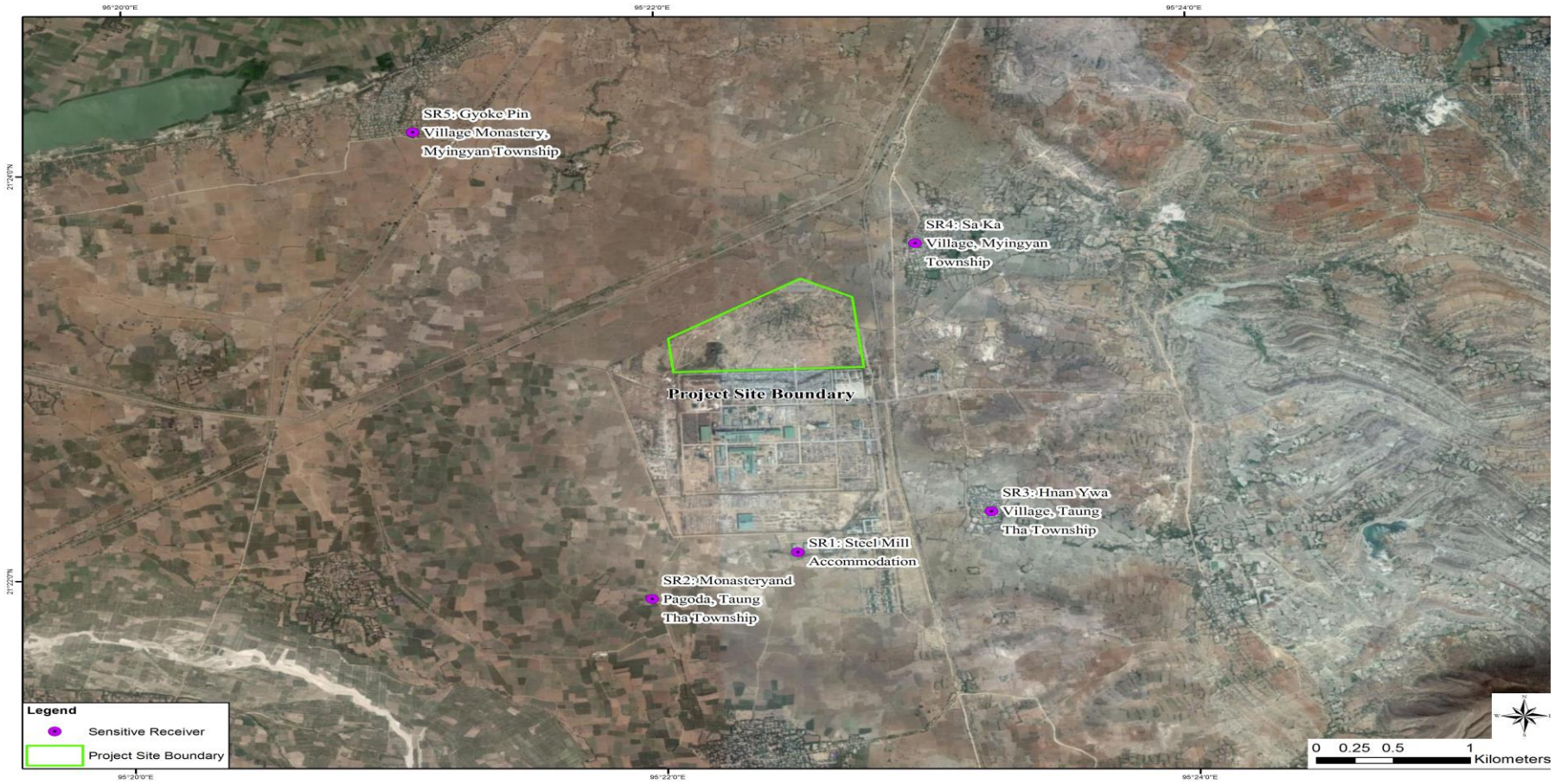
Ambient air quality monitoring was undertaken at each of the selected baseline air sampling locations surrounding the Project site for seven consecutive days per month from July 2014 to June 2015. The ambient air pollutants monitored included sulphur dioxide (SO_2), nitrogen dioxide (NO_2), respirable suspended particulates (PM_{10}) and fine suspended particulates ($PM_{2.5}$), with measurements logged at 1-minute interval. The measurement data were then processed to obtain relevant averaging periods of each air pollutant for comparison with the respective WHO guidelines. Five baseline air sampling locations were selected namely MAQN-1, MAQN-2, MAQN-3, MAQN-4 and MAQN-5 (the locations are shown as sensitive receivers are shown in ***Figure 5.9***). A description of the selected sampling locations is presented in ***Table 5.5***.

Table 5.5 Details of Baseline Air Sampling Locations

Air Sampling Location	Coordinates		Description of Monitoring Locations / Facilities or landmarks in the vicinity
	Easting	Northing	
MAQN-1: Steel Mill Accommodation	95°22'30.25"E	21°22'6.25"N	• Monitoring station set at open space between two compound buildings; • Immediately south of the Myingyan steel plant boundary and approximately 1.8km south of the proposed Project site; • Surrounded by bean and pea field, low land area but the station is located between the buildings of staffs; • Steel mill workers and contractors housing compound and next to a government technical school for young children.
MAQN-2: Monastery and Pagoda, Taung Tha Township	95°21'57.20"E	21°21'52.80"N	• Monitoring station set in front of a small monastery and pagoda, north of Phat Taw village facing the direction of the steel mill; • Surrounded by low lying bean and pea fields; One monk and family lives in the monastery; • Approximately 1km southwest of the Myingyan steel plant and 2.4km southwest of the proposed Project site.
MAQN-3: Hnan Ywa Village, Taung Tha Township	95°23'14.15"E	21°22'17.75"N	• Monitoring station set in the compound of the monastery in the middle of this village; • A village with 120 households, population about 700-800 people; • Approximately 1.2km southeast of the Myingyan steel plant and 1.7km southeast of the Project site.
MAQN-4: Sa Ka Village, Myingyan Township	95°22'58.15"E	21°23'37.50"N	• Monitoring station set at the west portion of Sa Ka village I=in the compound of one residential house located near the main access road to Project site; • A village with about 285 households with population around 1500-1700 people; • Approximately 1km northeast of the Project site, with the closest dwelling being located at about 500m of the Project site boundary.

Air Sampling Location	Coordinates		Description of Monitoring Locations / Facilities or landmarks in the vicinity
	Easting	Northing	
MAQN-5: Gyoke Pin Village Monastery, Myingyan Township	95°21'5.40"E	21°24'11.90"N	• Monitoring station set at the southeast portion of the village towards the direction of the Project, at a monastery compound in front of a primary school, within 30m of the main Myingyan-Nyang Oo highway; • A village with about 1500 households and a population of about 7000 people, similar size to Pet Taw Village in the south; • Approximately 3km northwest of the Project site.

Figure 5.9 Location of Sensitive Receivers



The sampling parameters, sampling equipment and method/standard are presented in ***Table 5.6*** and sampling date and number of samples taken of each sampling parameters are presented in ***Table 5.7.***

Table 5.6 Air Sampling Parameters, Equipment and Methodology / Standard for Baseline Monitoring

Parameter	Equipment	Method / Standard
Sulphur dioxide (SO_2)	• Haz-Scanner EPAS Wireless Environmental Perimeter Air Station	• Recorded on site in real time
Nitrogen dioxide (NO_2)	Haz-Scanner EPAS Wireless Environmental Perimeter Air Station	• Recorded on site in real time
PM_{10} and $PM_{2.5}$	• Haz-Scanner EPAS Wireless Environmental Perimeter Air Station	• Recorded on site in real time

Sampling and analysis of ambient air pollutants was conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner EPAS Environmental Perimeter Air Station was used to collect Ambient Air Monitoring data. The characteristics of the instrument are:

- Portable direct reading;
- Configure up to 14 simultaneous air measurements including U.S. EPA criteria air pollutants;
- Standard configuration measures $PM_{2.5}$, PM_{10} or TSP particulates, CO, NO, NO_2, SO_2, temperature, and relative humidity; and
- Wind parameters are also measured by Haz-sanner and the required data are analyzed by using the WRPLOT View of AERMOD View (ver. 7.0) where calm wind is defined below 0.5m/s.

Table 5.7 Sampling Date and Number of Samples / Measurements

	Air Sampling Location				
Month	MAQN-1	MAQN-2	MAQN-3	MAQN-4	MAQN-5
1	10th- 17th July, 2014	10th- 17th July, 2014	17th- 24th July, 2014	17th- 24th July, 2014	17th- 24th July, 2014
2	10th - 17th August, 2014	17th - 24th August, 2014	17th - 24th August, 2014	17th - 24th August, 2014	10th - 17th August, 2014
3	16th – 23rd September, 2014	9th - 16rd September, 2014	16th - 23rd September, 2014	23rd - 30th September, 2014	16th – 23rd September, 2014
4	10th – 16th & 28th – 30th October 2014	16th – 23rd October, 2014	23rd - 30th October, 2014	16th – 23rd October, 2014	10th – 16th & 28th – 30th October 2014
5	9th – 16th November 2014	16th – 23rd November 2014	23rd – 30th November 2014	16th – 23rd November 2014	9th – 16th November 2014
6	9th – 16th December 2014	16th – 23rd December 2014	23rd – 30th December 2014	16th – 23rd December 2014	9th – 16th December 2014
7	29th January to February 5th, 2015	29th January to February 5th, 2015	-- (a)	-- (a)	29th January to February 5th, 2015

Month	Air Sampling Location				
	MAQN-1	MAQN-2	MAQN-3	MAQN-4	MAQN-5
8	14th to 21st February, 2015	14th to 21st February, 2015	21st to 28th February, 2015	21st to 28th February, 2015	14th to 21st February, 2015
9	14th to 21st March, 2015	14th to 21st March, 2015	21st to 28th March, 2015	21st to 28th March, 2015	14th to 21st March, 2015
10	11th April to 18th April, 2015	11th April to 18th April, 2015	18th April to 25th April, 2015	18th April to 25th April, 2015	11th April to 18th April, 2015
11	16th to 23rd May, 2015	16th to 23rd May, 2015	23rd to 30th May, 2015	23rd to 30th May, 2015	16th to 23rd May, 2015
12	13th to 20th June, 2015	13th to 20th June, 2015	20th to 27th June, 2015	20th to 27th June, 2015	13th to 20th June, 2015

Note:

(a) Monitoring was not undertaken at MAQN-3 and MAQN-4 in January 2015.

The measured results of NO_2, SO_2, PM_{10} and $PM_{2.5}$ at MAQN-1 to MAQN-5 are presented in ***Table 5.8*** to ***Table 5.11***. ***Table 5.8*** shows the range of hourly NO_2 (maximum and minimum). ***Table 5.9*** shows 24-hour (daily) averaged SO_2; ***Table 5.10*** shows 24-hour (daily) averaged PM_{10} and ***Table 5.11*** shows 24-hour (daily) averaged $PM_{2.5}$ results.

All tables show results averaged from data measured for seven consecutive days per month from July 2014 to June 2015. Following the Asian Development Bank (ADB) guidelines and IFC's *Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality*, the current WHO Air Quality Guidelines should be used. Interim target levels for SO_2, PM_{10} and $PM_{2.5}$ have been proposed by WHO to promote steady progress towards meeting the WHO guidance values. Given that air pollution levels in some countries may exceed the WHO guidance values, these proposed interim target levels can be adopted by countries taking into account their specific local circumstances. Countries can choose to adopt different interim targets considering the balance amongst factors such as risks to public health, technological feasibility, economic development and other political and social factors. Myanmar is a developing country and is yet to implement local national air quality standards to regulate local air quality. It is recommended that the monitored SO_2, PM_{10} and $PM_{2.5}$ results are compared with their respective WHO Interim Target 1. Baseline NO_2 results are compared against the WHO guideline value since no interim target for NO_2 has been proposed. Raw hourly readings for NO_2 and SO_2 were in ppb and converted to $\mu g/m^3$ in line with the unit of the WHO AAQG.

5.3.1 *Nitrogen Dioxide (NO_2)*

The baseline results show some hourly exceedance of WHO AAQG NO_2 guidance value ($200\mu g/m^3$) at different monitoring locations over the 12 month period and these are highlighted (in red) in ***Table 5.8***. Some of the hourly NO_2 concentrations were abnormally high. However, the NO_2 concentrations before and after the abnormally high NO_2 concentration were relatively low, therefore, the abnormally high NO_2 concentrations have been considered invalid and excluded when calculating the average background NO_2 concentration to be adopted in the subsequent cumulative impact assessment.

The potential sources of the NO_2 exceedances not under the above conditions have been attributed to tailpipe emissions and emissions from the Steel Mill.

5.3.2 *Sulphur Dioxide (SO_2)*

The monitoring results in ***Table 5.9*** show that concentrations for SO_2 are within the applicable WHO AAQG interim target levels at the five monitoring locations for the duration of the monitoring period. SO_2 results measured at MAQN-5 in July 2014, MAQN-2 and MAQN-4 in August 2014, MAQN-1, 2, 3 and 5 on some days between October and December 2014 were discarded due to equipment failure. Overall, baseline SO_2 levels are considered to be low and typical of the rural setting of the Project site.

5.3.3 *Particulates Matters (PM_{10} and $PM_{2.5}$)*

The monitoring results in ***Table 5.10*** show that concentrations for PM_{10} were within the applicable WHO AAQG interim target levels at the five monitoring locations for the duration of the monitoring period. PM_{10} and $PM_{2.5}$ concentrations are generally low from July to September 2014, with an increasing trend of PM_{10} and $PM_{2.5}$ concentrations from October 2014 through to March 2015. PM_{10} and $PM_{2.5}$ were highest from February to March 2015 during which exceedances of the WHO AAQG $PM_{2.5}$ Interim Target 1 (75µg/m^3) were observed. From March to June 2015, there was a decreasing trend in PM_{10} and $PM_{2.5}$ concentrations. ***Table 5.11*** shows daily exceedances of the WHO AAQG $PM_{2.5}$ Interim Target 1 (75µg/m^3) with exceedances highlighted (in red). The potential sources of the exceedance are burning of wood for cooking and unpaved road dust.

As $PM_{2.5}$ is a subcategory of PM_{10}, an increase in $PM_{2.5}$ should correspond with an increase in PM_{10} levels. Where the measured PM_{10} was lower than $PM_{2.5}$ at the same hour, data was therefore considered invalid and excluded in the 24-hour averaging calculation.

Table 5.8 Measurement Results of NO_2 in Ambient Air at All Monitoring Locations

Monitoring Locations	Monitored Hourly NO_2 Concentration in µg/m^3											
	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	June-15
MAQN-1												
MAX	72.03	70.55	450.34 (c) (d)	136.62	522.58 (c) (d)	284.97 (c) (d)	106.74	573.64 (c) (d)	71.71	122.92	212.93 (c) (d)	256.06 (c) (d)
MIN	0.00	64.72	4.14	5.68	0.22	5.80	4.01	3.95	3.76	3.76	3.76	42.74
MAQN-2												194.50
MAX	240.35 (c)	533.33 (c)(d)	148.55	83.41	148.27	182.20	93.51	217.30 (c) (d)	206.92 (c)	185.60	141.45	55.53
MIN	0.00	3.90	3.76	8.75	0.25	6.80	4.14	36.34	6.90	17.15	4.92	105.19
MAQN-3[(a)]												39.20
MAX	70.61	71.57	591.44 (c) (d)	118.48	191.02	84.19	-	180.27	197.51	114.95	463.83 (c) (d)	100.50
MIN	0.00	0.00	6.37	3.76	1.60	1.03	-	3.76	3.76	3.76	21.79	23.42
MAQN-4[(b)]												130.91
MAX	339.43 (c)	364.81 (c) (d)	88.93	131.70	102.63	90.12	-	146.22	159.70	123.07	160.58	22.67
MIN	0.00	3.76	1.91	4.65	8.37	3.73	-	16.31	42.77	21.17	11.51	200.00
MAQN-5												0.00
MAX	104.32	257.63 (c) (d)	192.51	619.25 (c) (d)	184.72	88.08	115.28	341.54 (c) (d)	124.17	173.09	141.45	0.00
MIN	0.00	17.21	3.76	0.00	6.46	3.73	23.71	27.19	40.95	32.91	4.92	0.00
WHO Guideline 1-hour	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**

Notes:

(a) Monitoring was not undertaken at MAQN-3 in January 2015.

(b) Monitoring was not undertaken at MAQN-4 in January 2015.

(c) WHO 1-hr guideline value is exceeded.

(d) Exceedances considered to be abnormal and would be excluded from calculating the averaged background NO_2 concentration as the hourly NO_2 concentrations before and after the exceedances were relatively low.

Table 5.9 Measurement Results of SO_2 in Ambient Air at All Monitoring Locations

Monitoring Locations	Monitored 24-hour Averaged SO_2 Concentration in µg/m^3											
	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	June-15
MAQN-1												
MAX	4.31	2.92	5.43	12.00	19.70[f]	4.28[f]	0	0	0	0	0	0
AVERAGE	1.99	1.00	3.66	4.58	17.22[f]	2.75[f]	0	0	0	0	0	0
MAQN-2 [a]												
MAX	91.44	-	4.64	5.51*	13.74[f]	5.78[f]	15.23	11.12	16.45	10.42	7.77	4.99
AVERAGE	19.48	-	2.79	3.47*	8.50[f]	3.31[f]	10.62	7.94	11.87	5.89	5.06	3.54
MAQN-3 [b]												
MAX	2.32	1.86	21.54	14.54*	14.28[f]	16.92[f]	-	0	0	0	7.87	3.41
AVERAGE	1.10	1.07	12.73	7.74[f]	12.13[f]	13.46[f]	-	0	0	0	4.18	2.58
MAQN-4 [c] [d]												
MAX	24.05	-	20.04	22.45	18.54	28.92	-	14.09	10.97	15.04	4.72	2.37
AVERAGE	6.50	-	10.00	11.24	10.92	18.57	-	6.10	5.04	5.24	2.71	1.18
MAQN-5 [e]												
MAX	-	15.38	9.65	11.09[f]	15.47[f]	5.90[f]	9.20	2.79	4.56	4.53	7.77	2.08
AVERAGE	-	6.39	6.80	5.92*	6.55*	4.96*	3.61	1.67	3.43	1.99	5.06	1.03
WHO 24-hour (Interim Target 1)	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**

Notes:

[a] No monitoring data at MAQN-2 was available in August 2014 due to equipment failure.

[b] Monitoring was not undertaken at MAQN-3 in January 2015.

[c] Monitoring was not undertaken at MAQN-4 in January 2015.

[d] No monitoring data at MAQN-4 was available in August 2014 due to equipment failure.

[e] No monitoring data at MAQN-5 was available in July 2014 due to equipment failure.

[f] Average and maximum concentrations calculated from less than seven days of data due to equipment failure.

Table 5.10 Measurement Results of PM_{10} in Ambient Air at All Monitoring Locations

Monitoring Locations	Monitored 24-Hour Averaged PM_{10} Concentration in $\mu g/m^3$											
	Jul-14	Aug-14	Sep-14	Oct-14 [a]	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	June-15
MAQN-1												
MAX	13.58	18.21	32.15	51.13	44.64	57.79	89.82	99.83	133.16	77.31	109.35	2.18
AVERAGE	9.68	12.46	25.12	26.66	32.24	50.79	76.77	90.19	109.57	58.65	43.94	2.06
MAQN-2												
MAX	13.03	20.88	26.02	48.55	47.38	70.71	83.37	105.36	136.78	76.73	41.30	96.96
AVERAGE	10.77	16.40	19.55	22.92	34.30	55.05	74.08	88.54	103.95	61.37	23.40	30.17
MAQN-3[b]												
MAX	20.36	21.12	41.01	58.62	53.87	54.89	-	94.80	133.56	60.75	46.56	17.13
AVERAGE	10.76	14.07	24.43	45.21	46.47	46.78	-	83.89	95.11	44.96	31.69	14.29
MAQN-4[c]												
MAX	21.11	27.80	21.67	47.39	71.78	102.59	-	133.18	99.18	58.42	26.31	21.31
AVERAGE	12.27	17.07	18.45	28.28	55.92	86.00	-	90.16	79.92	37.02	23.71	14.24
MAQN-5												
MAX	20.37	20.77	40.25	48.14	63.10	79.79	76.57	86.66	122.99	75.20	41.30	12.29
AVERAGE	15.99	12.32	24.25	41.57	45.82	58.23	69.65	76.88	94.30	51.27	23.40	10.74
WHO 24-hour (Interim Target 1)	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**

Notes:

(a) 8-day maximum/average level measured at MAQN-2 is presented for October 2014

(b) Monitoring was not undertaken at MAQN-3 in January 2015.

(c) Monitoring was not undertaken at MAQN-4 in January 2015.

Table 5.11 Measurement Results of $PM_{2.5}$ in Ambient Air at All Monitoring Locations

Monitoring Locations	Monitored 24-Hour Averaged $PM_{2.5}$ Concentration in $\mu g/m^3$											
	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	June-15
MAQN-1												
MAX	4.80	5.96	20.55	36.21	24.41	50.62	71.94	81.75 [(c)]	114.49 [(c)]	56.48	26.15	1.66
AVERAGE	2.54	4.49	15.71	17.34	18.16	33.01	61.58	74.18	86.27 [(c)]	45.23	15.36	1.39
MAQN-2												
MAX	4.90	13.49	19.73	28.69	33.16	57.82	59.46	77.34 [(c)]	93.11 [(c)]	52.73	22.27	59.10
AVERAGE	4.21	10.61	13.98	14.05	23.56	38.23	50.49	63.73	72.57	38.36	13.01	18.66
MAQN-3[(a)]												
MAX	17.80	11.69	26.49	32.43	40.69	41.79	-	77.17 [(c)]	113.11 [(c)]	41.17	27.64	10.75
AVERAGE	9.25	5.09	15.45	27.11	32.20	30.53	-	68.14	76.12 [(c)]	29.96	17.70	8.42
MAQN-4[(b)]												
MAX	5.01	17.53	14.16	27.00	26.04	50.33	-	31.96	50.71	24.35	13.82	8.13
AVERAGE	2.63	10.55	11.56	16.02	23.13	38.40	-	22.64	36.71	18.10	11.88	6.56
MAQN-5												
MAX	13.81	11.10	26.74	37.35	37.97	65.95	37.10	45.14	64.63	30.52	22.27	7.67
AVERAGE	10.51	8.04	15.75	24.61	26.76	53.08	21.66	40.95	46.49	26.04	13.01	6.71
WHO 24-hour (Interim Target 1)	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**

Notes:

(a) Monitoring was not undertaken at MAQN-3 in January 2015.

(b) Monitoring was not undertaken at MAQN-4 in January 2015.

(c) WHO 24-hr interim target-1 is exceeded.

In summary, baseline SO_2 levels at Myingyan Project site were considered low (typical of rural area with low emission sources) whilst NO_2 levels were considered high. Tailpipe emissions on the adjacent roads (in particular motorcycle), the operation of the steel mill and the general background are the potential sources of the relatively high measured NO_2 concentration. Background PM levels also showed higher concentrations during winter months (October to February) compared to summer months (July to September). High PM_{10} and $PM_{2.5}$ concentrations measured is likely due to local activities, especially burning of wood for cooking by nearby residents and unpaved road dust.

The measured NO_2, SO_2, PM_{10} and $PM_{2.5}$ at all the selected baseline air sampling locations from July 2014 to June 2015 have been averaged to represent the background concentrations of the air pollutants at the Project site area for further air quality impact assessment. A summary of the background concentrations of the pollutants monitored is presented in ***Table 5.12***.

Table 5.12 Background Concentrations of Pollutants

Pollutant	Estimated Background Concentration (µg/m^3)	WHO Air Quality Guidelines			
		10-min	1-hour	24-hour	Annual
SO_2	6.15	500		125	-
NO_2	53.97	-	200	-	40
PM_{10}	43.31	-		150	70
$PM_{2.5}$	26.67	-		75	35

Notes:
(a) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

5.4 NOISE

5.4.1 Baseline Noise Monitoring Locations and Sampling Methodology

Four existing noise sensitive receivers (NSRs) located near the Project Site have been identified to be potentially affected by the Project during construction and operation phases. Baseline noise monitoring was conducted at these NSRs to establish the background levels. The locations of baseline monitoring stations are summarised in ***Table 5.13*** and are shown as sensitive receivers in ***Figure 5.9***.

Table 5.13 Locations of Baseline Noise Monitoring Locations

Monitoring Station ID	Noise Monitoring Location	GPS Coordinates	Description of Sampling Location
MAQN-1	Permanent Steel Mill Construction Worker (EPC) Accommodation, Taung Tha Township	21°22'6.25"N 95°22'30.25"E	In the staff housing compound of the steel mill, Myingyan Township
MAQN-2	Monastery and Pagoda, Taung Tha Township	21°21'52.80"N 95°21'57.20"E	In the compound of the monastery, north of Phat Taw village, Taung tha Township
MAQN-3	Hnan Ywa Village, Taung Tha Township	21°22'17.75"N 95°23'14.15"E	In the compound of the monastery in Hnan Ywa village, Taung tha Township
MAQN-4	Sa Ka Village, Myingyan Township	21°23'37.50"N 95°22'58.15"E	In the compound of one residential house located at the western part of Sar kar village, Myingyan Township

Baseline noise monitoring was conducted from July to September 2014 and from February to June 2015. Hourly A-weighted equivalent continuous sound pressure levels (L_{Aeq}, 1 hour) were recorded continuously over 24 hours at each location during both weekday and weekend. At each location, daytime and night-time L_{Aeq} were calculated by averaging the hourly sound pressure levels measured between 0700 and 2200 hours and between 2200 to 0700 hours, respectively.

Noise levels (L_{Aeq}) were recorded using a type II sound level meter at about 1.5m above ground with no reflecting surface nearby in accordance with IFC guidelines. Sampling frequency was at 10-minute interval for 24 hours continuously. Sound level meter employed for the baseline noise monitoring and the measurement parameter are summarised in ***Table 5.14*** and the detailed monitoring schedule are shown in ***Table 5.15***.

Table 5.14 Equipment Used for Baseline Noise Monitoring and Measurement Parameters

Sound Level Meter	Measurement Parameter
Lutron SL-0423SD	Sound Pressure Level, $L_{Aeq, 1hr}$, dB(A)

Table 5.15 Monitoring Schedule

Monitoring Station ID	Noise Monitoring Location	Measurement Schedule	
		Weekday	Weekend
MAQN-1	Permanent Steel Mill Construction Worker (EPC) Accommodation, Taung Tha Township	14th to 15th July 2014 11th to 12th August 2014 15th to 16th September 2014 16th to 17th February 2015 16th to 17th March 2015 13th to 14th April 2015 18th to 19th May 2015 15th to 16th June 2015	12th to 13th July 2014 16th to 17th August 2014 13th to 14th September 2014 14th to 15th February 2015 14th to 15th March 2015 11th to 12th April 2015 16th to 17th May 2015 13th to 14th June 2015

Monitoring Station ID	Noise Monitoring Location	Measurement Schedule	
		Weekday	Weekend
MAQN-2	Monastery and Pagoda, Taung Tha Township	14th to 15th July 2014 11th to 12th August 2014 22nd to 23rd September 2014 16th to 17th February 2015 16th to 17th March 2015 13th to 14th April 2015 18th to 19th May 2015 15th to 16th June 2015	12th to 13th July 2014 16th to 17th August 2014 20th to 21st September 2014 14th to 15th February 2015 14th to 15th March 2015 11th to 12th April 2015 16th to 17th May 2015 13th to 14th June 2015
MAQN-3	Hnan Ywa Village, Taung Tha Township	21st to 22nd July 2014 18th to 19th August 2014 15th to 16th September 2014 23rd to 24th February 2015 23rd to 24th March 2015 20th to 21st April 2015 25th to 26th May 2015 22nd to 23rd June 2015	19th to 20th July 2014 23rd to 24th August 2014 13th to 14th September 2014 21st to 22nd February 2015 21st to 22nd March 2015 18th to 19th April 2015 23rd to 24th May 2015 20th to 21st June 2015
MAQN-4	Sa Ka Village, Myingyan Township	21st to 22nd July 2014 18th to 19th August 2014 22nd to 23rd September 2014 23rd to 24th February 2015 23rd to 24th March 2015 20th to 21st April 2015 25th to 26th May 2015 22nd to 23rd June 2015	19th to 20th July 2014 23rd to 24th August 2014 20th to 21st September 2014 21st to 22nd February 2015 21st to 22nd March 2015 18th to 19th April 2015 23rd to 24th May 2015 20th to 21st June 2015

5.4.2 *Results of Baseline Noise Monitoring*

Results of the baseline noise monitoring are summarised in ***Table 5.16***. The measured background noise levels are in the range of 50 – 69 dB(A) and 44 – 67 dB(A) during daytime and night-time, respectively. The background noise levels are typical of a general rural environment.

Table 5.16 Results of Baseline Noise Monitoring

Monitoring Station	LAeq, dB(A) [(a) (b)]															
	Jul-14		Aug-14		Sep-14		Feb-15		Mar-15		Apr-15		May-15		Jun-15	
	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N
MAQN-1	57	54	56	49	56	57	51	46	53	47	50	47	54	53	54	51
MAQN-2	48	44	69	67	58	55	53	46	50	44	53	52	56	51	62	63
MAQN-3	59	58	61	57	58	45	60	50	56	60	61	57	58	56	58	58
MAQN-4	54	47	57	54	56	52	55	49	56	51	52	48	56	54	55	55
IFC Noise Level Guidelines, dB(A) [(b)]	55	45	55	45	55	45	55	45	55	45	55	45	55	45	55	45

Notes:

(a) Noise levels are averaged from the data obtained for weekday and weekend without inclusion of highly intrusive noises.

(b) D (Daytime) refers to the hours from 0700 hrs to 2200 hrs while N (night-time) refers to the hours from 2200 hrs to 0700 hrs next day.

The averaged background noise level at each NSR was obtained by averaging the noise levels measured over the 8 months period. ***Table 5.17*** compares the background noise levels to the noise limits set out in the IFC Guidelines. Daytime

averaged background noise levels at Monastery and Pagoda (MAQN-2) and Hnan Ywa Village (MAQN-3) exceeded the IFC guideline values, while measured noise levels at Permanent Steel Mill Construction Worker (EPC) Accommodation (MAQN-1) and Sa Ka Village (MAQN-4) also exceeded the IFC Guidelines at some of the months. Night-time averaged background noise levels at all NSRs exceeded the IFC guideline values. The applicable noise limit level with reference to the IFC Guidelines should not result in a maximum increase in background levels of 3 dB(A) at the NSR.

Table 5.17 Operational Noise Criteria

NSR	Type of Uses	Averaged Background Noise Levels, dB(A) [a]		IFC Operational Noise Level Guidelines, dB(A) [b]		Applicable Operational Noise Criteria for the Project, dB(A) (Background Noise + 3dB(A))	
		Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
MAQN-1 Permanent Steel Mill Construction Worker (EPC) Accommodation, Taung Tha Township	Residential	54	50	55	45	57	53
MAQN-2 Monastery and Pagoda, Taung Tha Township	Institutional	56	53	55	45	59	56
MAQN-3 Hnan Ywa Village, Taung Tha Township	Residential	59	55	55	45	62	58
MAQN-4 Sa Ka Village, Myingyan Township	Residential	55	51	55	45	58	54

Notes:

[a] Noise Levels are averaged over 8 months period from July to September 2014 and from February to June 2015.

[b] The operational noise criteria are based on Table 1.7.1 of the IFC Guidelines.

[c] Daytime refers to the hours from 0700 hrs to 2200 hrs while night-time refers to the hours from 2200 hrs to 0700 hrs.

5.5 SURFACE WATER

5.5.1 Hydrology

The Project Study Area is characterised by a flat terrain, with gentle undulating slopes towards the inlands. Elevations of the Project steel mill complex are between 65 – 76 metres above Mean Sea Level (MSL)[1].

[1] http://www.floodmap.net/Elevation/ElevationMap/?gi=1307835, accessed 18-06-2014

The Project Site is located approximately 10km from the Ayeyarwady River bank. The river is approximately 2,170km long and has a total drainage of approximately 411,000km^2 [(1)]. The catchment above Sangaing (downstream of Mandalay) has a total drainage of 117,900km[(2)] and supplies a mean annual discharge of 8,024m^3/s[(2)]. During the low water season (December through May), riverine morphology alternates between single and multiple channel reaches, the latter created by sand island deposits that emerge near the mouths of convergent tributaries and above and below channel constrictions. Extensive floodplains border the waterways in many places[(3)].An irrigation canal runs from the pumping station at the Ayeyarwady River to the north of the Project Site, lying 0.5 km from the boundary at the closest point. The canal distributes water from the Ayeyarwady River to surrounding agricultural fields.

According to local fishermen interviewed at the initial site visit during preparation of the Scoping Report[(4)], the river floods significantly in the wet season. The last significant flood to affect the area was recorded in 2013, affecting mainly the villages along the banks of the Ayeyarwady River[(5)]. No further details are available on this flood event at this stage. Based on observations during the scoping phase and baseline surveys, it did not appear that any measures had been taken to prevent future flooding, nor has drainage been modified or improved.

Baseline Flow Measurements in Ayeyarwady River

Flow measurements in the southern channel of the Ayeyarwady River were conducted at the surface, mid-depth and bottom of the water column twice a month from July to December 2014 during preparation of the Scoping Report[(5)]. Subsequently, river flow measurements were again conducted at the same location during February to April 2015, as part of the ESIA. One additional flow measurement was taken at a separate location in June 2015. Flow monitoring locations for all sampling periods are shown in ***Table 5.18***, and in ***Figure 5.10*** and ***Figure 5.11***.

Table 5.18 Surface Water Flow Rate Monitoring Locations

Monitoring Location	Monitoring Period	GPS Coordinates
W1: About 300m upstream of the Seik Nyan Pumping Station in Ayeyarwady River	July-December 2014, and February-April 2015	21° 24’ 38.2" N 95° 16’ 40.8” E
MRF-1	June 2015	21° 24' 35.19" N 95° 16' 34.40" E

(1) Vorosmarty C. J., Fekete & B. A. Tucker, (1998) River Discharge Database, Version 1.1. (RivDis,V1 supplement).

(2) Vorosmarty C. J., Fekete & B. A. Tucker, (1998) *Op cite*

(3) Smith B. D., Hobbs L., (2002), Status of Irrawaddy dolphins Orcaella Brevirostris in the upper reaches of the Ayeyarwady River, Myanmar, The Raffles Bulletin of Zoology, Supplement No. 10

(4) Myingyan IPP Project – Environmental & Social Consultancy Services in support of Transaction Advisory Services for Private Sector Participation – Scoping Report – Revision 4 – 18th May 2015

(5) http://c4i.me/site/2013/09/18/flash-flood-asia-myanmar-burma-3/, C4I For Humanity, accessed 20-06-2014

The flow measurement results from the above two sampling periods have been used to estimate the flow rate across both the wet season and dry season in the southern channel of the Ayeyarwady River, near the withdrawal location for the Project. A surface channel width of the southern river channel of 410m, based on satellite imagery, has been assumed to estimate the flow rates. Flow rates at the sampling location have been estimated to be in the range of 64m^3/s (measured on March 28, 2015) to 660m^3/s (measured on August 8, 2014), as shown in ***Table 5.19***.

It is important to note that the flow rates were calculated based on the following approach and assumptions:

- The flow rates have been estimated based on the surface channel width measured on Google Earth satellite imagery of approximately 410m.
- The surface channel width was only measured for the southern channel of the river and therefore flow conditions only represent the flow conditions of the southern river channel.

Table 5.19 Estimated Flow Rates in Southern Channel Ayeyarwady River

Date	Channel Depth (m)	Sample Depth (m)	Velocity (m/s)	Width (m)	Estimated Flow Rate (m^3/s)
12/7/2014	7.3	1	0.22	410	526.809
		3	0.182		
		6	0.163		
24/7/2014	9.9	1	0.071	410	194.914
		5	0.057		
		9	0.036		
8/8/2014	8.7	1	0.19	410	659.69
		4.3	0.19		
		7.7	0.18		
22/8/2014	10.1	1	0.05	410	208.075
		5	0.057		
		9	0.045		
12/9/2014	6.4	1	0.056	410	148.174
		3.2	0.053		
		5.4	0.059		
22/9/2014	6.0	1	0.067	410	129.56
		3	0.06		
		5	0.043		
12/10/2014	7.2	1	0.052	410	170.888
		3.5	0.066		
		6	0.054		
22/10/2014	8.0	1	0.121	410	442.8
		4	0.153		
		7	0.125		
15/11/2014	6.2	1	0.043	410	81.262
		3	0.036		
		5.5	0.026		
29/11/2014	7.4	1	0.095	410	211.273
		3.5	0.087		
		6.5	0.052		
10/12/2014	6.7	1	0.04	410	87.084
		3	0.027		
		6	0.032		
22/12/2014	7.4	1	0.078	410	169.084
		3.5	0.062		
		7	0.046		
17/2/2015	4.8	1	0.04	410	74.21
		2	0.043		
		4	0.035		
28/2/2015	5.0	1	0.042	410	73.8
		2	0.039		
		4	0.033		
14/3/2015	4.7	1	0.052	410	136.817
		2	0.063		
		4	0.081		
28/3/2015	4.8	1	0.038	410	64.616
		2	0.03		
		4	0.032		
11/4/2015	4.6	1	0.088	410	125.952
		2	0.071		
		4	0.057		
25/4/2015	5.0	1	0.042	410	79.54
		2	0.056		
		4	0.032		
17/6/2015	8.4	1	0.163	410	370.07
		4	0.138		
		8	0.074		

5.5.2 *Water Use*

In the Mandalay region, populations may have access to water supply through a network of piped water system and private wells and moat water [(1)]. The source of the piped water supply is from ground water, mainly from tube wells pumping along the banks of the Ayeyarwady River. Until 2006, only 60% of the city area was covered by piped water supply. While those residing in the cities, not covered by the piped water supply had to rely on water from tube wells dug by WSD/MCDC and international donor projects, those residing outside the urban areas have to rely on sources such as open dug wells, springs, rivers and ponds. In Myingyan, the source of irrigation is a piped water supply from canals and streams.

Fishing is not a popular activity in the Project area villages, with the exception of Tha Pyay Thar, as it is the village located closest to the Ayeyarwady River, and Gyoke Pin. Further details on fisheries in the Project area are provided in ***Chapter 6***.

5.5.3 *Surface Water Quality*

The Dry Zone of Myanmar faces challenges regarding reliable supply of safe drinking water, as well as access to water for agriculture [(2)]. The Dry Zone is prone to droughts. During dry periods, water sources and reservoirs are sufficient for household consumption, but not for livestock and agriculture. The main sources of freshwater in the region are the Ayeyarwady River and groundwater, which the villagers extract through wells in the dry season.

In the Project Study Area, potential sources of water contamination include boat vessel discharges in the navigable waterways (such as the Ayeyarwady River), as well as mercury from gold mining operations, which are known to occur in Sagaing Region, 90km upstream of the Project Site[(3)]. It is not currently known if similar operations take place within Myingyan. Research undertaken by the International Union of Conservation of Nature (IUCN) found relatively high levels of Tetrahydrogestrinone (THg) and Ethylene glycol (MeHg) in the muscle of fish sampled from fishermen's catches and fish markets along the Ayeyarwady River [(4)].

Surface Water Quality Baseline Surveys

Sampling Methodology and Locations

For the environmental baseline surveys carried out between July 2014 and December 2014 and February 2015 and April 2015, water quality monitoring was conducted near the Project's planned cooling water intake in the Ayeyarwady River as shown in ***Table 5.20*** and ***Figure 5.10***. Surface water quality was also monitored in June 2015 within the intake channel and at a location further south of the Ayeyarwady River, as shown in ***Table 5.20*** and ***Figure 5.11.***

(1) In the old capital of Burmese King, there is a palace surrounded by moat and water from moat was used for water supply in the past as a main source of water (drinking and domestic use).

(2) United Nations Development Programme - Myanmar (2013); Adaptation Fund - Addressing climate change risks on water resources and food security in the Dry Zone of Myanmar

(3) IUCN (2014), http://www.iucnredlist.org/details/44556/0, accessed 20-06-2014

(4) IUCN (2014), *Op cite*

Table 5.20 Surface Water Quality Monitoring Locations

Monitoring Location	Monitoring Period	GPS Coordinates	Description
W1: About 300m upstream of the Seik Nyan Pumping Station in Ayeyarwady River	July-December 2014, and February-April 2015	21°24’ 39.38”N 95°16’ 41.92”E	Sampling was conducted in the middle of the Ayeyarwady River, upstream of the Seik Nyan floating pumping station; Approximately 10.5 km from the Project site At the time of sampling, one pumping station was operated by the Water Resources and Utilisation Department (WRUD) which pumped freshwater from the River up to the irrigation channel.
MSW-1	June 2015	21° 24' 19.63" N 95° 16' 43.32" E	In irrigation canal of Seik Nyan water gate
MSW-2	June 2015	21° 24' 19.20" N 95° 15' 27.50" E	In Ayeyarwadty river, about 2 km downstream of MRF-1

Parameters that were sampled and analyzed include pH, DO, COD, BOD5, Oil and Grease, TN, TP, TSS, Total Coliform, water temperature, channel depth and flow velocity. Water samples were collected by Alpha horizontal water sampler, and kept in sterilized sample containers. All sampling containers were stored in iced boxes within 2-4 C refrigerators and transported to either the Government of Myanmar MOAI Soil and Water Analytical Laboratory in Myanmar, or SGS laboratories Thailand, depending on parameters to be analyzed. Note that temperature was only monitored at a single depth/location for each sample, which does not allow for determination of temperature gradients. However, the Project’s current design will discharge cooling tower wastewater into the irrigation canal substantially downstream of the Ayeyarwady River, with ultimate fate to be used as irrigation water for surrounding agricultural lands. Therefore the determination of a well-defined mixing zone in the Ayeyarwady River is not necessary for the purposes of assessing the impact of thermal discharge.

Figure 5.10 Monitoring Locations for Surface Water Quality and Flow Rate (1 of 2)

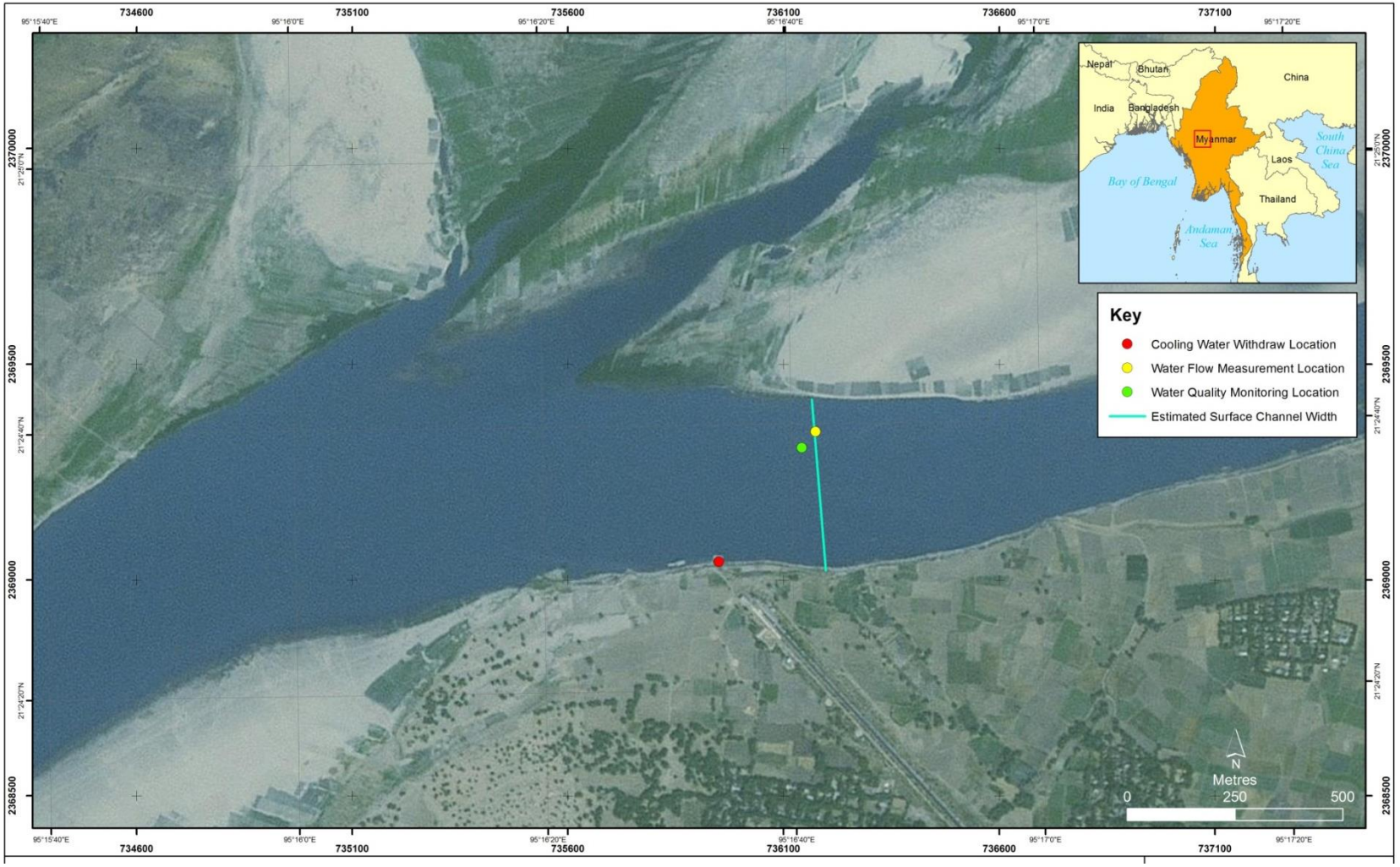


Figure 5.11 ***Monitoring Locations for Surface Water Quality and Flow Rate (2 of 2)***



Analysis Results and Discussion

Table 5.21 presents the baseline monitoring results for surface water quality sampled during the surveys from July 2014 to December 2014, February 2015 to April 2015, and in June 2015. The laboratory reports are provided in ***Annex B***. With the exception of TSS, total coliform bacteria, and iron, all other monitored parameters were found to be below the WBG/IFC guideline values. Some of the water analysis parameters are discussed below in further detail.

Total Suspended Solids (TSS): Measured TSS levels from July 2014 to December 2014 and February 2015 to June 2015 were found to be in the range of 4.4mg/L to 264mg/L. Many of the TSS values, particularly during high flow rates in the rainy season, were above WBG/IFC guideline value of 50mg/L. TSS can be composed of a variety of materials, including silt, decaying plants and animal matter, industrial waste and sewage. The high TSS concentrations measured are likely due to naturally high silt load in the Ayeyarwady River, which tends to be worse during high flow rates. Higher concentrations of TSS can cause or be associated with high turbidity, reduced light and photosynthesis, reduced DO, higher bacteria content and increased water temperature.

pH: All results for pH in the surface water fell within the permissible limits of 6 to 9.

Biochemical Oxygen Demand (BOD): The BOD levels ranged between 0.2 to 7.4 mg/L, and were all below the limit of 30mg/L from the WBG/IFC guideline values.

Coliform Levels: The measured total coliform levels ranged from <1.8 MPN/100 mL (in December 2014 and March 2015) to 1,100 MPN/100 mL (in July 2014). Measurements conducted on 12 July and 8 August 2014 exceeded WBG/IFC guidance limit of 400 MPN/100 mL. This indicates that there is at least some existing faecal contamination of the Ayeyarwady River. Sources of total coliform include sewage waste from humans and fecal matter from warm-blooded animals such as livestock, both of which could either be directly discharged into the river or carried in runoff

during rainfall. It is likely that the coliform levels in the Ayeyarwady River are primarily due to runoff, as indicated by the higher levels observed during the rainy season (July to October) in comparison to other months.

Heavy Metals: Among the heavy metals analysed, all were found to be below the relevant WBG/IFC guideline values, with the exception of iron at MSW-2 in June 2015. Iron was measured to have concentration of 2.63mg/L at MSW-2, which is more than double the WBG/IFC guideline value of 1.0mg/L. Although iron occurs naturally in soil, sediments and ground water, it may also be released to water from natural deposits, industrial wastes, refining of iron ores, and corrosion of iron containing metals. Potential discharges or leaching from the nearby Steel Mill may represent a source of increased iron levels at this location of the Ayeyarwady River.

Table 5.21 Monitoring Results of Baseline Surface Water Quality

No.	Sample No./ Physical Parameter	Unit	Detection Limit	IFC Guidelines	Results																	
1	Location	-	-	-	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	W1, Ayeyarwady River	MSW-1, Irrigation Canal	MSW-2, Ayeyarwady River
2	Date/Time of Sample Collection	-	-	-	12/7/2014 10:00 a.m.	24/7/2014 9:30 a.m.	8/8/2014 10:00 a.m.	22/8/2014 10:00 a.m.	12/9/2014 10:35 a.m.	22/9/2014 11:00 a.m.	12/10/2014 10:30 a.m.	22/10/2014 10:45 a.m.	15/11/2014 10:15 a.m.	29/11/2014 10:25 a.m.	10/12/2014 10:00 a.m.	22/12/2014 9:45 a.m.	17/02/2015 09.30am	28/02/2015 09.00am	14/03/2015 09.30am	28/03/2015 09.00am	11/04/2015 11.40am	25/04/2015 09.00am	17.06.2015 10:30 am	17.06.2015 09:35 am
3	Weather	-	-	-	Partly Cloudy	Partly Cloudy	Sunny	Sunny	Sunny	Sunny	Cloudy	Sunny	Partly Cloudy	Sunny	Partly Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Partly cloudy	Sunny
4	Water Depth	m	-	-	9.3	9.9	8.4	8.9	5.8	5.4	6.8	7.4	6	6.6	5.7	6.5	4.8	5.0	4.7	4.8	4.6	5.0	-	6.3
5	Depth of Sample	m	-	-	1.75	2	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	1.00	1.00	1.00	-	1.00
6	Water Temperature	°C	-	-	27.12	26.65	28.34	28.8	29.1	28.4	29.36	28.8	26.1	25.42	24.6	22.4	23.6	23.4	26.0	26.2	26.7	27.2	30.71	25.44
7	Air Temperature	°C	-	-	34.0	31	35	31	32.5	32	31	32	29.5	30.5	29.5	32	26.5	25.5	36	32	38	30	37	37
8	pH	-		6 – 9*	7.71	8.62	8.03	8.03	8.1	8.05	7.98	8.55	8.21	8.48	8.6	8.42	7.87	7.80	7.70	7.89	7.65	7.73	8.0	7.81
9	Electrical Conductivity	µs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	153	178	124	145	122	129	61	60
10	Dissolved Oxygen	mg/L	-	-	7.26	5.19	6.98	6.86	7.2	8.1	7.23	9.28	3.29	4.28	5.49	6.1	6.02	6.81	8.82	9.28	12.6	9.28	4.59	2.86
11	Turbidity	FNU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.2	9.4	18.1	14.2	31.7	35.1	90.2	226
12	Biochemical Oxygen Demand (BOD)	mg/L	-	30**	2.4	4.5	2	5.2	7	7.4	3	2.8	3.5	5.5	3.8	5.2	0.6	0.8	1.2	0.6	2.4	2.4	0.6	0.2
13	Chemical Oxygen Demand (COD)	mg/L	5.0	125**	6.7	12	5	9.5	17.5	16	7.5	7.5	8.2	13.5	9.5	10.5	20.8	<5.0	9.2	17.5	<5.0	8.0	6.4	12.7
14	Total Nitrogen	mg/L	1.0	10**	ND	ND	ND	ND	0.6	2.24	ND	0.65	ND	ND	ND	0.91	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
15	Total Phosphorus	mg/L	0.005	2**	ND	0.05	0.09	0.05	ND	ND	ND	ND	ND	ND	ND	ND	0.023	0.011	0.025	0.0039	0.016	0.006	0.026	0.032
16	Oil & Grease	mg/L	5.0	10*	ND	2.2	5.9	5.5	5.8	7.1	ND	5.1	6	ND	ND	ND	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
17	Total Suspended Solids (TSS)	mg/L	2.5	50*	**162**	**264**	**101**	**162**	**158**	**141**	**156**	**146**	**148**	**96**	25	**135**	7.0	4.4	8.6	5.6	18.8	20.6	11.5	**74.0**
18	Total Coliform Bacteria (TCB)	MPN/100 mL	1.8	400**	**1,100**	110	**490**	130	140	170	49	240	11	23	<1.8	13	7.8	4.5	7.8	<1.8	4.5	110	130	68
19	Total Residual Chlorine	mg/L	0.01	0.2*	-	-	-	-	-	-	-	-	-	-	-	-	0.07	<0.01	<0.01	0.05	0.02	0.02	<0.01	<0.01
20	Total Chromium (Cr)	mg/L	0.0005	0.5*	-	-	-	-	-	-	-	-	-	-	-	-	0.0010	0.0011	0.0005	<0.0005	0.0021	0.0020	0.0012	0.0039
21	Copper (Cu)	mg/L	0.03	0.5*	-	-	-	-	-	-	-	-	-	-	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
22	Iron (Fe)	mg/L	0.05	1.0*	-	-	-	-	-	-	-	-	-	-	-	-	0.30	0.31	0.34	0.22	0.62	0.83	0.96	**2.63**
23	Zinc (Zn)	mg/L	0.01	1.0*	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Lead (Pb)	mg/L	0.0020	0.5*	-	-	-	-	-	-	-	-	-	-	-	-	0.0030	0.0118	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0033
25	Cadmium (Cd)	mg/L	0.00005	0.1*	-	-	-	-	-	-	-	-	-	-	-	-	0.00008	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
26	Mercury	mg/L	0.0003	0.005*	-	-	-	-	-	-	-	-	-	-	-	-	0.0006	<0.0003	<0.0003	0.00016	<0.0003	0.0010	<0.0003	<0.0003
27	Arsenic	mg/L	0.0002	0.5*	-	-	-	-	-	-	-	-	-	-	-	-	0.0010	<0.0002	0.0006	0.0010	0.0003	0.0004	<0.0002	<0.0002

* IFC EHS Guidelines Thermal Power Plants (2008).

** IFC General EHS Guideline: Environmental Wastewater and Ambient Water Quality (2007).

ND = Not Detectable

5.6 SOILS

5.6.1 Soil Landscape

Based on soil surveys conducted across Myanmar in 1965[1], soils in the Project Study Area are classified as Vertisol Soils (see ***Figure 5.12***). The soils are deep and mostly composed of clayey materials. Their low fertility and declining organic matter level make them difficult for farming, especially under excessively dry or wet conditions. Areas with Vertisol soils that contain natural savannah are used for low volume grazing. Infiltration in the soils is poor, and the soil is alkaline (pH ranging from 7 to 9). Vertisol soils tend to be deficient in nitrogen and phosphorus, but are high in calcium, magnesium, and potassium. Degraded soils have low aggregate stability and are prone to erosion if exposed to rainfall, making preservation of the surface soil organic matter important for the region. Vertisol soils are generally better for perennial crops rather than annual crops. According to Food and Agriculture Organization (FAO), certain types of crop cultivation in the region further contribute to soil erosion, such as cassava, sweet potato and ground nut [(2)].

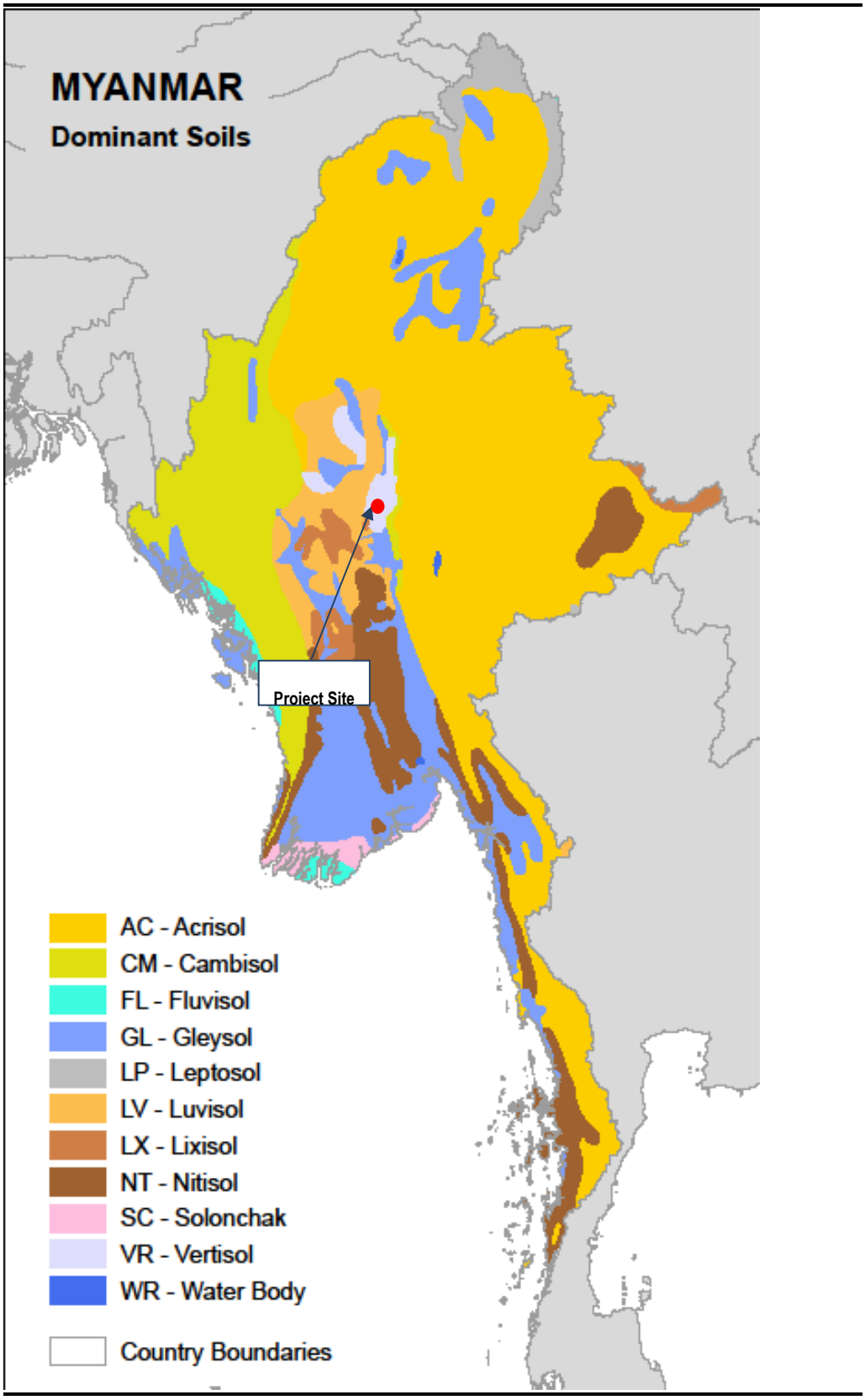
5.6.2 Soil Quality

During site visits over the period from 2014-2015, it was observed that in numerous locations throughout the site, soil has been almost completely removed by wind and water erosion. Surface runoff is likely to be high across the Project Site and vicinity. Removal of the natural savannah vegetation may have exacerbated the rate of erosion, which is more intensive at the start of the monsoon rains on bare soils.

(1) http://www.unccd.int/ActionProgrammes/myanmar-eng2005.pdf

(2) Mineral Soils conditioned by a Wet (Sub) Tropical Climate – Major landforms in sub humid tropics. FAO Corporate Document Repository. Available online, accessed 17th December 2014. http://www.fao.org/docrep/003/y1899e/y1899e08a.htm

Figure 5.12 Myanmar Dominant Soils



Source: Food and Agriculture Organisation of the United Nations ([1])

(1) FAO and Natural Resources and Management and Environment Department, accessed online 17th December 2014

http://www.fao.org/nr/myanmar/SoilMap_Myanmar_300dpi.jpg

Soil Baseline Surveys

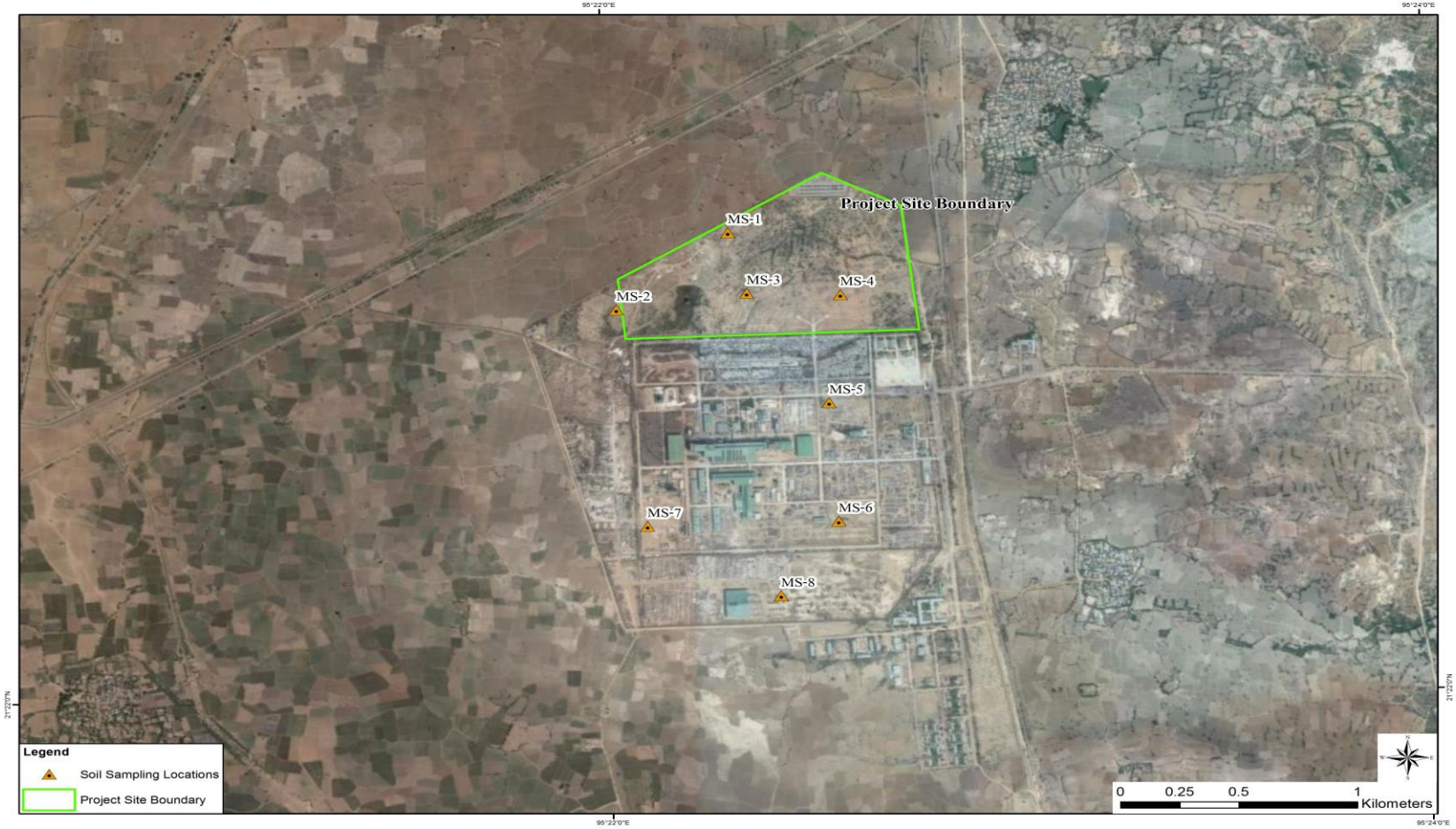
Sampling Methodology and Locations

The location of the soils samples are shown in ***Figure 5.13*** and are described in ***Table 5.22***. Soil sampling was undertaken in accordance with standard operating procedure of U.S. EPA (SOP-2013, SOP2016, and SOP 2003). Soil samples were taken using the standard agricultural sampler (Soil Auger). Top soil was collected from 10 - 30cm in depth and sub soil from 2.7 - 3.0m in depth.

Table 5.22 Location of Soil Samples

Sampling Point	Coordinates	Description of Sampling Point
MS-1	21° 23' 17.56" N 95° 22' 18.27" E	Northern most part of the Project Site.
MS-2	21° 23' 4.88" N 95° 22' 1.76" E	Near existing MOGE gas station; northwestern part of Project Site.
MS-3	21° 23' 7.39" N 95° 22' 20.87" E	Northern part of the Project Site.
MS-4	21° 23' 6.99" N 95° 22' 34.58" E	At proposed Power Plant area, northeastern part of Project Site.
MS-5	21° 22' 48.90" N 95° 22' 32.67" E	Near sub-station within existing steel mill.
MS-6	21° 22' 29.04" N 95° 22' 33.73" E	At southern part of existing steel mill
MS-7	21° 22' 28.59" N 95° 22' 5.73" E	At southwestern part of existing steel mill.
MS-8	21° 22' 16.69" N 95° 22' 25.13" E	At southern part of Project Site

Figure 5.13 Soil Sampling Locations



Guidelines/Standards for Comparison

There are no Myanmar soil or groundwater regulations/standards. In the absence of local country standards, it is ERM's practice to use globally recognized 'Dutch Ministry of Public Housing, Land-use and Environmental Guidelines - Soil and Groundwater Standards' to assess soil quality and to determine the need, if any, for remedial action.

Analysis Results and Discussions

As well as the overall soil landscape (refer to ***Section 5.6.1***) the soil structure and type was described for each sample location, these are summarised as:

- **MS-1** was on a generally flat region and was primarily a silty clay, characterised by light gray colourations in the top soil layer and brown coloured soil in the sub soil. Organic materials such as roots and peat occurred to a depth of approximately 500mm.

- **MS-2** was on a flat region and was predominately a sandy clay. The colour varied from a red-brown top soil to a brown in the sub soil layers.

- **MS-3** is located in the future expansion area of the existing steel mill and is flat barren land. The soil at this location was a clay which occurred in both top and sub-soil layers. It was noted to be very stiff due to a low moisture content.

- **MS-4** is located similarly to MS-3. Both top and sub-soil layers are characterised as light gray coloured silty clay with very low moisture content.

- **MS-5** was collected within the compound of the existing steel mill. This silty clay was gray to dark gray through throughout the soil profile. It was also noted to have a very low moisture content.

- **MS-6** was characterized by sandy silts, with a yellowish to buff coloured top soil and brown coloration within the subsoil. It was noted that .this site and surrounding areas showed features of having previously been excavated.

- **MS-7** was collected on a flat area at the south western part of the existing steel mill. The top soil was a light gray coloured sandy clay, with the sub soil being a dark brown coloured silty clay.

- **MS-8** was collected from the wall of a pit excavated for the foundations of a new structure. This was a yellow coloured sandy clay in the top soil, with a brown colouration in the silty clay sub-soil.

Organic content: aside from some roots and peats noted as occurring within MS-1, none of the other test pits were noted as containing any visible organic matter. No specific analysis was undertaken with regards to soil minerals and nutrients to allow for an in-depth understanding of overall soil fertility to be gained. Additionally, no soil pH investigations were undertaken.

Heavy metals and hydrocarbons: specific analysis was undertaken for a range of hydrocarbons and heavy metals. Almost all of those analysed were found to be either well below the relevant guidelines values, or below detection limits. An exception is mercury, which was detected at levels slightly above Dutch Target Values (level at which there is a sustainable soil quality) at Stations MS-7T, MS-7B, MS-8T, and MS-8B. However, levels were well below Dutch Intervention Values (level of contamination above which there is a serious case of soil contamination).The analysis results of physico-chemical parameters of soil samples are presented in ***Table 5.23***. The laboratory reports are provided in ***Annex B***.

Table 5.23 Soil Quality Results

Parameter	LOQ	Standard 1	Standard 2	Results														
				MS-1T	MS-1B	MS-2T	MS-2B	MS-3T	MS-3B	MS-4T	MS-4B	MS-5T	MS-5B	MS-6T	MS-6B	MS-7T	MS-7B	MS-8T	MS-8B
Oil & Grease	200	N/A	N/A	853	329	363	<200	<200	317	380	239	252	<200	<200	231	<200	282	<200	205
- Kerosene Range Hydrocarbons	20.8-23.8	N/A	N/A	<22.5	<22.4	<22.5	<23.8	<21.7	<21.1	<21.5	<21.1	<21.6	<22.3	<20.8	<21.7	<21.3	<22.8	<20.8	<21.2
- Diesel Range Hydrocarbons	20.8-23.8	N/A	N/A	<22.5	<22.4	<22.5	<23.8	<21.7	<21.1	<21.5	<21.1	<21.6	<22.3	<20.8	<21.7	<21.3	<22.8	<20.8	<21.2
- Heavy Oil Range Hydrocarbons	83.1-95.3	N/A	N/A	<89.8	<89.6	<89.8	<95.3	<86.7	<84.4	<86.0	<84.5	<86.5	<89.0	<83.1	<86.7	<85.1	<91.4	<83.3	<84.7
- Gasoline Range Hydrocarbons	13.6-16.6	N/A	N/A	<16.7	<15.2	<16.5	<16.6	<16.1	<14.3	<16.1	<15.4	<13.9	<14.4	<13.6	<14.5	<15.5	<16.0	<14.3	<13.7
- Benzene	0.181-0.221	1	0.01	<0.223	<0.203	<0.220	<0.221	<0.215	<0.191	<0.215	<0.206	<0.185	<0.193	<0.181	<0.194	<0.207	<0.213	<0.191	<0.183
- Toluene	0.181-0.221	130	0.01	<0.223	<0.203	<0.220	<0.221	<0.215	<0.191	<0.215	<0.206	<0.185	<0.193	<0.181	<0.194	<0.207	<0.213	<0.191	<0.183
- Ethylbenzene	0.181-0.221	50	0.03	<0.223	<0.203	<0.220	<0.221	<0.215	<0.191	<0.215	<0.206	<0.185	<0.193	<0.181	<0.194	<0.207	<0.213	<0.191	<0.183
- Xylenes (total)	0.544-0.664	25	0.1	<0.668	<0.608	<0.659	<0.664	<0.644	<0.572	<0.645	<0.618	<0.555	<0.578	<0.544	<0.581	<0.621	<0.640	<0.573	<0.550
Cadmium (Cd)	1.00	12	0.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium (Cr)	2.50	380	100	28.22	33.55	22.68	33.69	26.37	31.00	36.88	26.56	28.83	33.38	29.73	27.52	34.52	38.27	42.51	29.38
Hexavalent Chromium (Cr^{+6})	0.10	78	N/A	<0.10	<0.10	0.14	<0.10	<0.10	0.19	<0.10	<0.10	<0.10	<0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)	5.00	530	85	5.32	5.50	<5.00	5.62	<5.00	<5.00	5.35	<5.00	5.02	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	5.54
Mercury (Hg)	0.10	10	0.3	0.13	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.42**	**0.33**	**0.61**	**0.38**
Nickel (Ni)	2.00	210	35	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00

Parameter	LOQ	Standard 1	Standard 2	Results															
				MS-1T	MS-1B	MS-2T	MS-2B	MS-3T	MS-3B	MS-4T	MS-4B	MS-5T	MS-5B	MS-6T	MS-6B	MS-7T	MS-7B	MS-8T	MS-8B
Selenium (Se)	0.01	100	0.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver (Ag)	1.5	15	N/A	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50
Arsenic	0.0020	55	29	0.52	0.53	0.47	0.63	0.50	0.56	0.71	0.63	0.63	0.74	0.81	0.50	0.86	0.89	0.97	0.37
Barium (Ba)	5.00	625	160	46.19	44.21	30.03	64.53	39.69	28.71	48.68	36.55	33.38	41.56	37.51	31.21	45.03	52.75	50.05	38.89
Copper (Cu)	1.50	190	36	19.00	22.12	12.81	23.40	15.17	18.25	21.15	16.23	23.19	22.42	17.03	13.39	24.10	28.63	25.16	26.62
Iron (Fe)	2.50	N/A	N/A	34,363	36,311	22,012	35,831	27,496	28,472	28,962	24,282	33,875	34,176	29,418	25,437	34,913	39,723	35,984	33,344
Manganese (Mn)	1.00	N/A	N/A	562.14	744.63	516.65	837.21	532.60	687.80	713.52	660.60	666.93	618.48	610.36	534.03	691.41	815.65	716.34	746.77
Zinc (Zn)	0.50	720	140	87.89	78.42	56.46	81.98	59.01	66.22	81.14	67.80	99.15	79.89	61.85	55.02	85.93	98.36	84.24	94.02

Notes on Source, Parameters and Abbreviations

1. Source -
2. All parameters expressed as mg/kg dry
3. All Standards expressed as mg/kg
4. All Standards based on Circular for Soil Remediation Target and Intervention Values from the Dutch Standards
5. Standard 1 adopted are Intervention Values (from Annex A of Circular on Target Values and Intervention Values for Soil Remediation (Dutch Standards, 2000))
6. Standard 2 adopted are Target Values (from Annex A of Circular on Target Values and Intervention Values for Soil Remediation (Dutch Standards, 2000))
7. LOQ – Limits of Quantification
8. T – topsoil
9. B – bottom soil

Source: Lab Analysis Report STS Green, 2015

5.7 GROUNDWATER

5.7.1 Hydrogeology

On the basis of stratigraphy, there are 13 different types of aquifers in Myanmar, namely Alluvium, Irrawaddian, Peguan, Limestone, Igneous (or Volcanic) and Other Minor Aquifers. The Project Study area is underlain by Irrawadian and Peguan aquifers (***Figure 5.14***).

Quality and quantity of groundwater varies depending on the lithology and depositional environments. Groundwater quality of Irrawadian aquifers is generally suitable for domestic use and irrigation purposes, while groundwater quality from Peguan aquifers is not suitable for drinking water purposes[1]. Groundwater aquifers are prone to leaching during the monsoon periods, especially on impervious surfaces, e.g. clay seams, clay layers, bedrocks, etc. Rising groundwater can cause saturation of the soil and can cause very high pore-water pressure in slopes in sedimentary deposits.

The estimated groundwater potential in the Lower Ayeyarwady Region is 153km^3, while the potential in the Upper Ayeyarwady Region is 92.60km^3, as shown in ***Table 5.24***.

Table 5.24 Estimated Groundwater Potential across Myanmar

Sr	River Basin	Catchment Area (km^2)	Groundwater Potential (km^3)
1	Chiuindwin	115,300	57.58
2	Ayeyarwady (Upper)	193,300	92.60
3	Ayeyarwady (Lower)	95,600	153.25
4	Sittoung	48,100	28.40
5	Rivers in Rakhine State	58,300	41.77
6	Rivers in Tanintharyi Region	40,600	39.28
7	Thanlwin (within Myanmar)	158,000	74.78
8	Mekong (within Myanmar)	28,600	7.05
Total		**737,800**	**494.71**

Source: FAO[2]

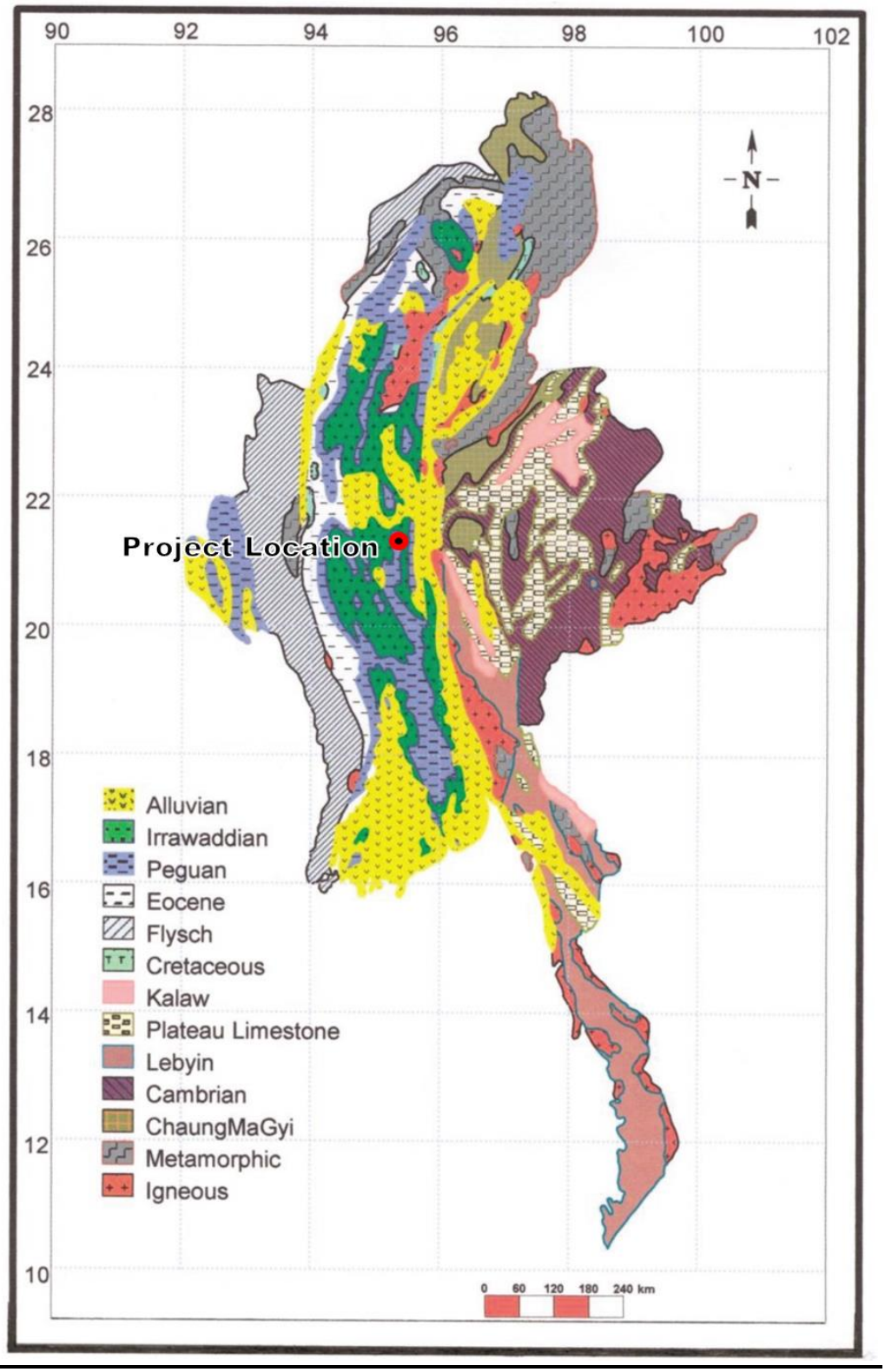
Groundwater in the Myingyan region is dependent upon natural recharge from Ayeyarwady River and the upper watershed [(3)]. Declining groundwater levels in the region have occurred due to associated environmental degradation of water sources, as well as uncontrolled excessive pumping of wells. Siltation, accumulation of waste, and encroachment on the channel areas contribute to reduced drainage capacity.

(1) http://danishwater.dk/wp-content/uploads/2013/09/Ministry-of-Agriculture-and-Irrigation-Department-of-Water-Resources-Utilization-Sustainable-Development-and-Management-of-Groundwater-in-Myanmar.pdf. Retrived on 28 January 2015

(2) http://www.fao.org/docrep/008/ae546e/ae546e04.htm

(3) JICA (2003) *Op cite*, pp:2-136

Figure 5.14 Major Aquifers of Myanmar Relative to Project Study Area



Source: Adapted from http://danishwater.dk/wp-content/uploads/2013/09/Ministry-of-Agriculture-and-Irrigation-Department-of-Water-Resources-Utilization-Sustainable-Development-and-Management-of-Groundwater-in-Myanmar.pdf. Retrived on 28 January 2015

5.7.2 *Groundwater Use*

Exploitation of Myanmar's aquifers has thus far been limited to municipal water supply and intensive irrigation of vegetables and other high value crops from hand-dug wells[1]. Water use in Myanmar has been increasing, particularly in the agricultural and industrial sectors. ***Table 5.25*** shows the water use in different sectors for the year 2008-09. As much as 89% of water use is tapped for irrigation purposes, while about 8% is for domestic consumption and 3 % is for industry.

Initially, the water supply for domestic purposes during construction shall be extracted from the underground tube wells and purified for domestic consumption. Once the water supply pipeline is in operation the raw water from the Ayeyarwady River will be treated to the required specification for domestic consumption.

Table 5.25 Water Use by Different Sectors

Sector	Surface Water	Groundwater	Total
Domestic	1.15 (3%	2.55 (68%)	3.7 (8%)
Industrial	1.17 (3%)	0.33 (9%)	1.5 (3%)
Irrigation	41.97 (94%)	0.85 (23%)	42.82 (89%)
Total	**44.29**	**3.73**	**48.02**

Source: Ministry of Agriculture and Irrigation[2]

5.7.3 *Groundwater Quality*

There is very limited secondary data available regarding groundwater quality in Myanmar. However, studies in some regions of Myanmar, including the Ayeyarwady Region, have shown that there exists some arsenic contamination in the groundwater[3]. This is a potential indication that there could also be groundwater contamination within Mandalay Region.

While conducting site surveys during the preparation of the Scoping Report for the Project, it was noted that there were a large number of scrap cars and metal piled on site associated with the neighboring steel mill operations. This could potentially pose a risk of contamination to soil and groundwater at the site as well as nearby villages.

5.7.3.1 *Groundwater Quality Baseline Surveys*

Sampling Methodology and Locations

Groundwater quality was monitored at eight (8) locations in the Project area, from 16th to 20th June, 2015. The locations of the groundwater samples are shown in ***Figure 5.15*** and are described in ***Table 5.26***.

(1) http://www.fao.org/nr/water/espim/country/myanmar/print1.stm

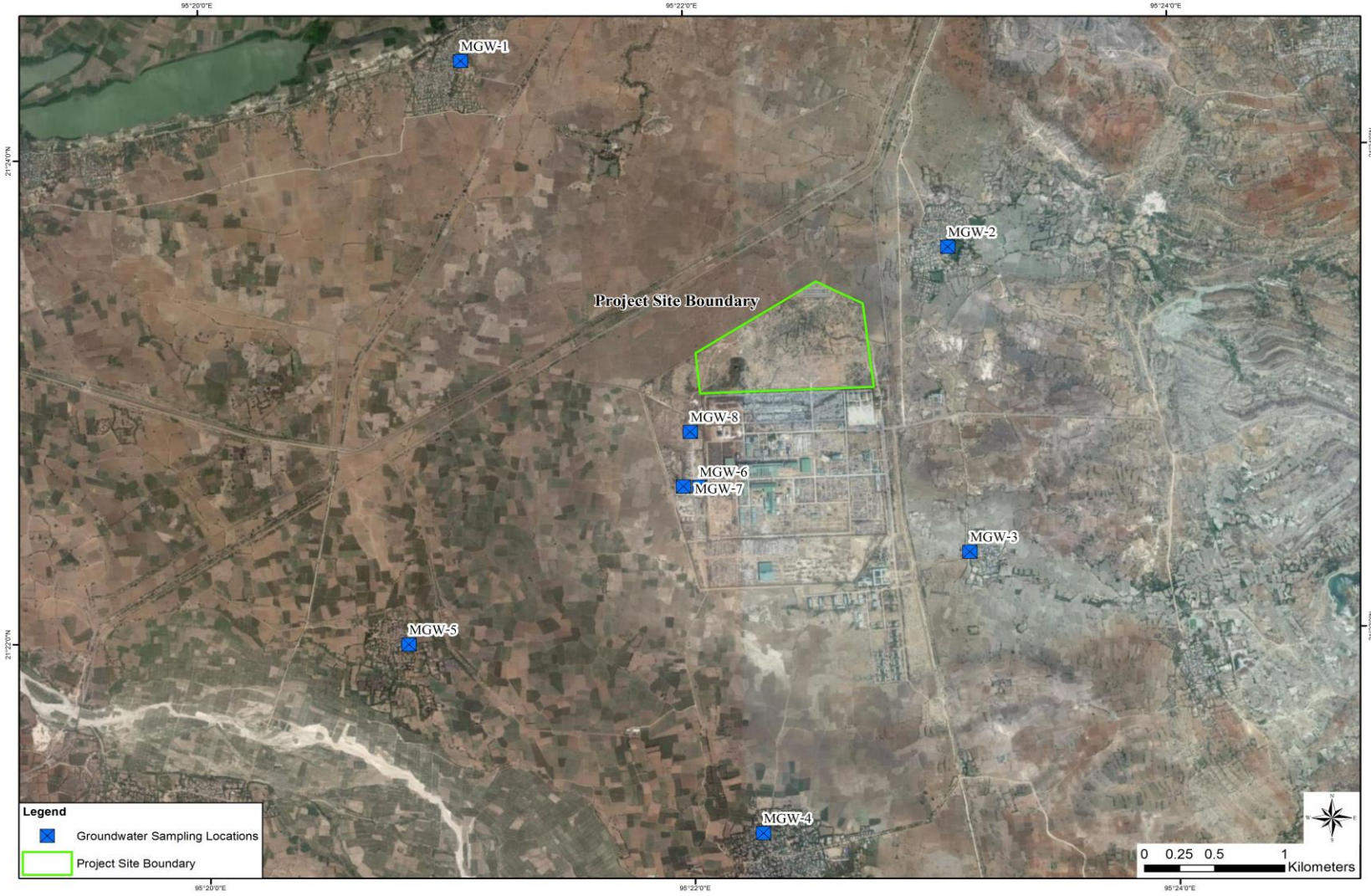
(2) http://danishwater.dk/wp-content/uploads/2013/09/Ministry-of-Agriculture-and-Irrigation-Department-of-Water-Resources-Utilization-Sustainable-Development-and-Management-of-Groundwater-in-Myanmar.pdf

(3) http://wedc.lboro.ac.uk/resources/conference/29/Tun.pdf

Table 5.26 Description of Groundwater Sampling Locations

Sampling Point	Coordinates	Description of Sampling Point
GW-1	21° 24' 23.29" N 95° 21' 5.07" E	Tube well in monastery compound of Gyoke Pin village, Myingyan township.
GW-2	21° 23' 35.49" N 95° 23' 5.00" E	Well in Shwegyaung monastery compound of Sakha village, Myingyan township.
GW-3	21° 22' 19.73" N 95° 23' 9.27" E	Tube well in Hnan Ywa village, Myingyan township.
GW-4	21° 21' 10.60" N 95° 22' 17.00" E	Tube well in Phat Taw village, Taungtha township.
GW-5	21° 21' 58.67" N 95° 20' 50.00" E	Well in Nyaung Kan village, Taungtha township
GW-6	21° 22' 36.81" N 95° 22' 2.55" E	Tube well in compound of Steel Mill.
GW-7	21° 22' 36.92" N 95° 21' 58.62" E	Tube well in compound of Steel Mill.
GW-8	21° 22' 50.41" N 95° 22' 0.50" E	Tube well in compound of Steel Mill.

Figure 5.15 Groundwater Sampling Locations



Guidelines/Standards for Comparison

The Government of Myanmar has not yet established numerical standards for environmental parameters, although there are some pending guidelines. In the absence of national standards, the Ministry of Environmental Conservation and Forestry (MOECAF) typically recommends that internationally accepted numerical environmental standards, such as the World Bank Group (WBG) / International Finance Corporation (IFC) and World Health Organisation (WHO) guidelines, should be adopted for environmental assessments.

As part of the WBG guidelines, ***Section 3.1*** *Water Quality and Availability* indicates that:

> "*Where the project includes the delivery of water to the community or to users of facility infrastructure (such as hotel hosts and hospital patients), where water may be used for drinking, cooking, washing, and bathing, water quality should comply with national acceptability standards or in their absence the current edition of WHO Drinking Water Guidelines.*"

Therefore, WHO guidelines for drinking water quality have been considered applicable for the evaluation of baseline groundwater quality.

Analysis Results and Discussion

The results of groundwater samples collected from the baseline surveys are shown in ***Table 5.27.*** The laboratory reports are provided in ***Annex B***.

Table 5.27 Groundwater Quality Analysis

Item/Sample Name	WHO Standard	MGW-1	MGW-2	MGW-3	MGW-4	MGW-5	MGW-6	MGW-7	MGW-8
Date /Time	N/A	16/6/2015 16:35	16/6/2015 14:15	16/6/2015 15:20	16/6/2015 15:45	16/6/2015 17:10	20/6/2015 8:15	20/6/2015 8:25	20/6/2015 8:35
Weather	N/A	Slightly cloudy	sunny	sunny	sunny	cloudy	Slightly raining	Slightly raining	Cloudy
Transparency	N/A	high	high	high	high	high	high	high	high
Water level in depth (m)	N/A	57	7	150	35	30	40	38	41
Temperature _Water (˚C)	N/A	28.98	26.57	29.26	27.57	28.16	28.57	27.81	28.55
Temperature_Atm (°C)	N/A	37	39	38	38	36	26	26	26
pH	NOC	7.57	7.20	7.78	7.81	7.48	7.43	7.35	8.07
EC (µs)	N/A	1860	923	1209	1516	1166	1983	1871	970

Item/Sample Name	WHO Standard	MGW-1	MGW-2	MGW-3	MGW-4	MGW-5	MGW-6	MGW-7	MGW-8
DO (mg/l)	N/A	3.00	3.1	3.4	3.18	2.25	2.89	2.65	2.46
Turbidity (FNU)	N/A	1.6	0.7	4.8	35.2	36.0	3.3	1.1	0.9
BOD5 (mg/l)	N/A	0.2	0.4	0.4	0.3	0.2	0.1	0.1	0.2
COD (mg/L)	N/A	11.1	<5.0	12.7	6.4	12.7	15.9	8.0	<5.0
TSS (mg/L)	50	<2.5	<2.5	<2.5	<2.5	10	<2.5	<2.5	<2.5
TDS (mg/L)	NOC	966	456	660	844	856	1,176	1,120	1,218
Total Hardness (mg/L as CaCO3	NOC	395	243	203	390	454	253	295	185
Cyanide (mg/L)	0.07	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (mg/L)	1.5	0.44	0.52	0.50	0.45	0.56	0.61	0.84	0.85
Sulfide (mg/L)	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Organics (mg/L)	N/A	<1.0	1.9	<1.0	<1.0	<1.0	1.2	1.2	1.1
Ammonia Nitrogen (Mg/L	NOC	<0.010	<0.010	<0.010	0.024	<0.010	0.016	0.019	0.024
Sulfate (mg/L)	N/A	355	164	162	444	452	407	402	402
Nitrate (mg/L)	50	1.19	0.426	1.20	3.07	0.695	2.70	3.94	1.88
Hexavalent Chromium (mg/L)	N/A		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium (mg/l)	N/A	72.04	47.27	28.52	80.17	78.75	26.68	33.79	17.24
Magnesium (mg/L)	N/A	59.34	21.05	39.28	45.36	57.51	36.75	42.61	28.19
Sodium (mg/L)	N/A	291.01	108.76	171.56	199.14	90.75	422.16	347.59	401.54
Potassium (mg/L)	N/A	3.98	19.37	1.59	4.12	3.02	3.08	2.65	2.44
Mercury (mg/L)	0.006	<0.003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Lead (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium (mg/L)	0.003	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Copper (mg/L)	2	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Iron (mg/L)	N/A	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Tin (mg/L)	N/A	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Item/Sample Name	WHO Standard	MGW-1	MGW-2	MGW-3	MGW-4	MGW-5	MGW-6	MGW-7	MGW-8
Manganese (mg/L)	NOC	<0.02	0.21	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Nitrogen (mg/L)	N/A	1.1	<1.0	<1.0	2.9	<1.0	2.3	4.4	1.5
Total Phosphorous (mg/L)	N/A	<0.005	0.028	<0.005	0.024	0.018	0.010	0.006	0.017
Zinc (mg/L)	N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (mg/L)	0.07	0.0063	0.0033	0.0032	0.0050	0.0039	0.0067	0.0073	0.0069
Arsenic (mg/L)	0.01	<0.002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	<0.0002	0.0007
Chloride (mg/L)	NOC	<1.0	<1.0	<1.0	1.4	44.6	<1.0	<1.0	<1.0
Total Coliform Bacteria MPN/100ml	400	17,000	4.0	130	<1.8	16,000	13	40	21
Oil &Grease (mg/L)	N/A	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Source: Lab Analysis Report STS Green, 2015

N/A – Not Applicable Standard Detailed in WHO Guidelines

NOC – Not of Concern according to WHO Standards

* *Source:* Lab Analysis Report STS Green, 2015

The key parameters in groundwater are discussed below, compared with the WBG/IFC/WHO guidelines Standards for drinking water.

All results for pH were similar for every sampling location and fell within the permissible limits of 6 to 9.

For a range of commonly measured and reported parameters including (but not limited to) BOD, TSS, Total Hardness, metals, arsenic, cyanide and fluoride, all were noted to be within the appropriate WBG/IFC/WHO guidelines for drinking water. However, three key parameters exceeded the established guidelines, two of them substantially. These are Chemical Oxygen Demand (COD), Total Coliform and Sulfates.

COD: COD levels in 6 of the sampled wells exceed the establish standard of 4mg/L. In the case of MGW-6, the COD level was up to 15.9mg/L. A high COD result is generally indicative of the presence of an abundance or organic material and bacteria within the water samples.

Coliform: As with the high COD levels, and as also noted with regards to the surface water baseline discussed previously, extremely elevated of total coliforms were noted. In particular, MGW-1 and MGW-5 had levels of 17,000 and 16,000 MPN/100ml respectively, far exceeding the WBG/IFC/WHO guidance limit of 400PMN/100ml. As these levels are far higher than levels for all other monitored wells (between 1.8 and 130 MPN/100ml) this may indicate that these wells are contaminated by a source of coliforms at or very near the surface. As noted previously, sources of total coliform include sewage waste from humans and faecal matter from warm-blooded animals such as livestock, both of which can make their way into water courses.

Sulfate: Sulfate levels of over 400mg/L were recorded in five of the wells which are still within the appropriate WBG/IFC/WHO guideline of 500mg/L. Generally accepted safe sulfate levels are in the order of 250mg/L (US Environmental Protection Agency). Given that the area has a long history of agriculture, it is likely that these elevated sulfate levels are associated with use of sulfate containing compounds as fertilisers.

5.8 LANDSCAPE AND VISUAL

In the Mandalay region, land is characterized as forestland and agricultural land, which is in line with typical Myanmar land use patterns. The division has 94 forest reserves spread across more than 2.4 million acres and 800,000 acres of preserved forests outside the reserved forests. The forests in the region are classified as Mountain forests, Tropical forests, Indaing forests and bush forests. In addition, Cactus-like plants are known to grow in arid areas of the Ayeyarwady River bank. The Mandalay region is characterized by frequent droughts and increasing land degradation due to loss of natural vegetation, soil erosion and decreasing soil fertility.

The Project Study Area described in ***Section 5.1*** is characterized by flat terrain, with gentle undulating slopes towards the inlands. The Project Study Area is also regarded

as predominately rural comprising of agricultural land and scattered village settlements.

The elevation of the Project ite is between 65-76 m meters above Mean Sea Level (MSL). The Project site is predominately disused cultivated land used for informal grazing, supporting grassland, low shrubs and minimal tree cover, therefore the area is a highly modified habitat. The Project site also comprises the Aggreko 95 MW temporary gas-fired power plant which began operation in April 2015. The temporary gas-fired power plant will be decommissioned once the Power Plant is in operation. The existing steel mill, transmission lines and transmission towers are the most dominant features in the landscape. The construction activities associated with Phase 2 of the steel mill are also dominant features.

5.9 WASTE

The construction and operation of the Project is expected to generate solid and liquid hazardous and non-hazardous wastes that require off-site disposal. During construction, the EPC contractor is responsible for appropriate handling and waste disposal. During operation, the Sponsor is responsible for appropriate handling and waste disposal.

The Mandalay City Development Committee is the responsible agency for waste management in the Mandalay region. Currently, there are existing problems in the Municipal Waste Management system due to a lack of equipment (e.g. vehicles) and personnel, improper collection and management of disposal sites, which are mostly run as semi-landfill systems, lack of awareness and cooperation from the public, and lack of awareness in solid waste management. There are currently no recycling facilities in Myanmar.

The feature of solid waste collection in Myanmar is essentially labour-intensive work and mainly relies on manual labor and non-specialized vehicles. Waste collection systems include block collection, communal depot collection, house-to-house collection, limited collection, and street sweeping. Currently, recycling of municipal waste is not fully and systematically developed as the budget allocation covers only routine works. Also, a framework for hazardous waste management has yet to be developed in Myanmar.

5.10 TERRESTRIAL AND MARINE BIODIVERSITY

5.10.1 *EcoRegion Description*

The Project Study Area resides within the dry zone of central Myanmar. According to the World Wide Fund for Nature (WWF) Wildfinder database, it is located in the Ecoregion known as the Irrawaddy Dry Forests, which have been under intensive conversion pressure to agriculture. In recent years the larger mammal fauna have been hunted to the brink of extinction. The conversion of forests to agricultural land and illegal cutting of timber causes loss and fragmentation of the habitat, while intense poaching of protected animals and the lack of political will to conserve this and other ecoregions in Myanmar leaves the remaining forests devoid of wildlife.

This ecoregion has a harsh climate and is extremely dry, with rarely more than

fifteen days of rain per year. The forests are dominated by dry forests where rainfall is less than 800 mm. The stands are low in stature, with thorny trees. These commonly include *Terminalia oliveri* and *Tectona homiltoniana*. There are also two types of dipterocarp forests: high Indaing and low Indaing, which is more common in the dry zone. Wildlife found in the protected areas include medium and small mammals, such as numerous species of deer and primates. Mid-sized predators such as the jungle cat, Asiatic jackal, and perhaps leopard also persist. Over 300 species of birds are known to live here, including two rare wetland birds: the black stork and the woolly-necked stock (WWF, 2015).

This ecoregion is surrounded by the Irrawaddy Moist Deciduous Forests, which have also been intensively cultivated and its forests converted. Consequently, most of the region's biodiversity has been extirpated, and very little information on its biodiversity is known due to political forces. Moist deciduous forests dominate this ecoregion, of which the dominant species of trees are teak and Pyinkado or ironwood. Species composition is varied and intimately mixed with bamboo groves.

Wildlife is intensively exploited outside protected areas of this ecoregion, and most information about the remaining wildlife comes from work within national parks. Asian elephants survive here, but their numbers have slowly decreased with their habitat. A few wild species that persist in its national parks include the guar, sambar, serow, golden cat, masked palm civet, marbled cat, and leopard cat. There are no endemic mammals, but almost 350 species of birds (WWF, 2015).

5.10.2 Key Biodiversity Areas

In Myanmar, Key Biodiversity Areas (KBAs) fall in different land management categories including protected areas, public protected forests, community-conserved forests, community forests, reserve forests and other resource and land use areas. Therefore, they accommodate different management systems such as government, private, community-led and joint management. Within the last decade, KBAs were reviewed and updated in order to identify and prioritize investment opportunities for biodiversity conservation in Myanmar. A total of 132 KBAs were identified for Myanmar and prioritized based on Species-based Vulnerability and Site-based Vulnerability. A total of three KBAs were identified under Alliance for Zero Extinction (AZE), one as a Ramsar site, 53 important bird areas, and six ASEAN Heritage Parks.

The KBAs closest to the Project Site include the Ayeyarwady River (Bagan Section), Minsontaung Wildlife Sanctuary (W.S.), and Popa Mountain Park (Critical Ecosystem Partnership Fund, 2012). The Ayeyarwady River is the country's largest river and home to a large diversity of animals, including about 43 fish species. The Bagan Section of the river is recognized as a high priority KBA and is about 60km away from the Project Site. It is one of the only areas of river protected in this region of Myanmar. Minsontaung W.S. occupies an area of 23km^2 and is categorized as a medium priority KBA. The sanctuary protects the endangered Eld's Deer and the Burmese star tortoise, and is made up of mostly dry forest. It is located approximately 43 km from the Project Site. Popa Mountain Park is a medium priority national park, approximately 54km from the project site and 129km^2 in size. Home of Mount Popa, this area serves as a popular destination for tourists and Burmese

pilgrims and is home to barking deer, wild pigs, wild dogs, jungle cats and 140 species of birds.

5.10.3 *Protected Areas*

Myanmar currently has a total of 57 Protected Areas (PAs), which account for only 4% of the country's total surface area (Protected Planet, 2014-15). The few protected areas surrounding the Project Site are the same as those described as KBAs in the previous section. Popa National Park was designated as a PA in 1989, and Minsontaung W.S. in 2001. The Lawkananda W.S. is a PA approximately 0.5km^2 in size, located along the Bagan Section of the Ayeyarwady River. It helps to protect the Burmese star tortoise, a Critically Endangered species. All three of these PAs are classified as an IUCN category IV protected area, which are those aiming to protect particular species or habitats and management reflects this priority (IUCN, 2014).

5.10.4 *Species of Conservation Significance*

Species of conservation significance found within the EcoRegion is outlined in ***Table*** 5.28. This species are restricted to mammals, birds and reptiles. There is insufficient information on the conservation status for plant species in Myanmar.

Table 5.28 Species of Conservation Significance found in the Project Ecoregion

Common Name	Conservation Status	Common Name	Conservation Status
Asiatic Black Bear	VU	Asiatic Elephant	EN
Baer's Porchard	EN	Banteng	EN
Binturong	VU	Burmese Peacock Softshell	EN
Chinese Pangolin	EN	Clouded Leopard	VU
Dhole	EN	Fishing Cat	EN
Great Safety Woodpecker	VU	Greater Adjutant	EN
Hog Deer	EN	Indian Skimmer	VU
Jerdon's Babbler	VU	King Cobra	VU
Large-spotted Civet	VU	Lesser Adjutant	VU
Long-billed Vulture	CR	Malayan Pangolin	EN
Marbled Cat	VU	Pale-capped Pigeon	VU
Phayre's Leaf Monkey	EN	Pink-headed Duck	CR
Sambar	VU	Sarus Crane	VU
Smooth-coated Otter	VU	Sun Bear	VU
Tiger	EN	Vordermann's Flying Squirrel	VU
White-bellied Heron	CR	White-winged Duck	EN
Yellow-breasted Bunting	VU	*Geochelone platynota*	CR
Macaca leonina	VU	*Nycticebus bengalensis*	VU
Trachypithecus shortridgei	EN		

5.10.5 *Invasive Species*

Invasive species are any species that are –non-native to a particular ecosystem and whose introduction and spread causes, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health (FAO, 2013). Invasive species are naturalized species that reproduce often in large numbers and are spread over a large area, damaging native species (FAO, 2005).

Invasive species have the capacity to exacerbate their role in ecosystem degradation through combination threats by habitat change, climate change over-exploitation of ecosystem resources and pollution, which further enhances their threat to biodiversity and the human condition (Emerton and Howard, 2008).

The taxa or types of organisms that can become invasive are animals (vertebrates and invertebrates), plants and micro-organisms (including those are free-living as well as those that cause disease in plants, animals, and people) (Emerton and Howard, 2008).

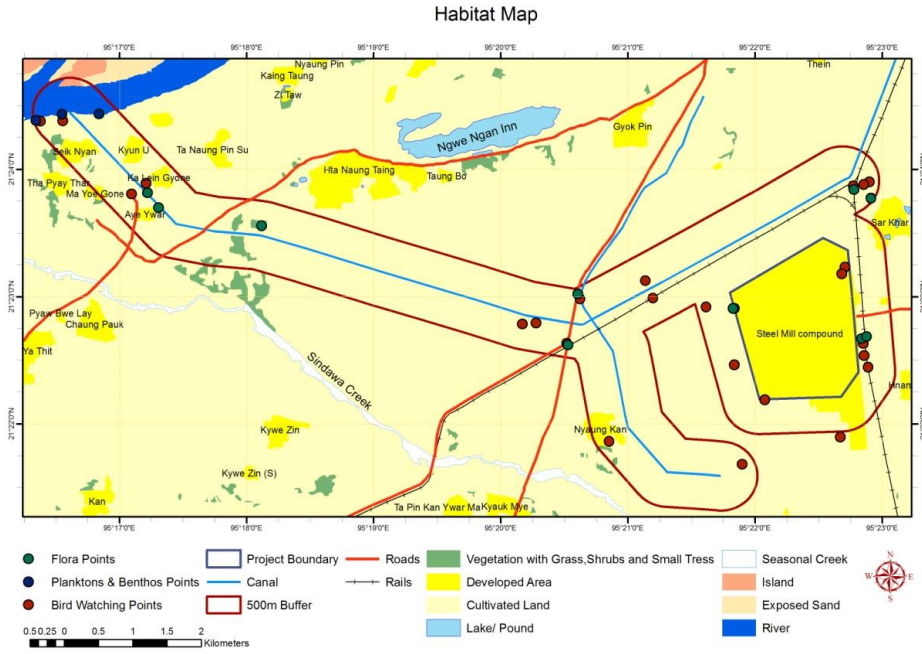
According to the Global Invasive Species Database (GISD) (2015), 97 species have been identified as invasive species in Myanmar. A checklist of invasive species is provided in ***Annex C***. However, the database does not specifically mention on which part of Myanmar that the invasive species are being introduced.

5.10.6 *Flora*

Sampling Sites

The habitat types identified within the Project Study Area are shown in ***Figure 5.16.***

Figure 5.16 Sampling and Habitat Types within the Project Study Area



Methodology

A Global Positioning System was used to navigate and mark coordinates between sample plots around the Project Study Area. In order to obtain essential ecological data for flora, habitat types were classified. Three habitat types were identified in the Project Study Area: area of vegetation with grass, shrubs and small trees; cultivated land; and developed area.

A total of 10 sample plots (3mx3m in size) were set up and observed during the study period. Care has been taken to cover overall spectrum of species diversity.

Species Identification

Flowering plant families were identified using a key issued by the Department of Botany, Yangon University (1994). Specimen identification was performed with the use of literatures by Backer et al., 1963, and Kress et al. 2003 and confirmed at the Herbarium in the Department of Botany, University of Yangon.

Table 5.29 Location of Sample Plots

Plot	Latitude	Longitude	Elevation
1	N 21° 23' 46.3"	E 095° 22' 54.7"	99 M
2	N 21° 23' 50.4"	E 095° 22' 46.6"	90 M
3	N 21° 22' 40.2"	E 095° 22' 50.3"	97 M
4	N 21° 22' 41.2"	E 095° 22' 52.7"	95 M
5	N 21° 23' 48.8"	E 095° 17' 13.1"	69 M
6	N 21° 23' 41.8"	E 095° 17' 18.3"	71 M
7	N 21° 23' 48.4"	E 095° 20' 15.4"	82 M

Plot	Latitude	Longitude	Elevation
8	N 21° 22' 37.2"	E 095° 20' 31.6"	85 M
9	N 21° 23' 01.2"	E 095° 20' 36.3"	85 M
10	N 21° 22' 54.4"	E 095° 21' 49.6"	87 M

5.10.7 *Data Analysis*

Evaluation of Density and Relative Density

The density of a species is the numerical representation of its individual quantity within a unit area. The density of a species indicates the adequacy of its different requirements and the availability of space. Density is determined by:

$$\text{Density (D)} = \frac{\text{No. of individuals of the species in all the sample plots}}{\text{Total no. sample plots studied}}$$

$$\text{Relatively Density (R.D)} = \frac{\text{No. of individuals of the species}}{\text{Total no. individuals of all the species}}$$

Evaluation of Frequency and Relative Frequency

The frequency of a species is expressed as the percentage of occurrence of its individuals in a number of observations. The following calculations are used in order to obtain the frequency of different species growing in a community:

$$\text{Frequency (F)} = \frac{\text{No. of sample plots in which the species occurs}}{\text{Total no. of plots sampled}}$$

$$\text{Relative Frequency (F)} = \frac{\text{No. of occurrences of the species}}{\text{No. of occurrences of all the species}} \times 100$$

Calculation of Species Diversity

Shannon-Wiener Index (1963)

$$H = -\sum_{i=1}^{s}(P_i)(\log_2 P_i)$$

Simpson Index (1949)

$$D = 1-\sum_{i=1}^{s}(P_i)^2$$

H = Shannon-Wiener's index of species diversity
S = number of species
Pi = proportion of total sample belonging to the i th species
D = Simpson's index of species diversity

Evenness (Shannon-Wiener function, 1963)

$$E = \frac{H}{H_{max}} \quad H_{max} = \mathrm{Log}_2 S$$

E = evenness (range 0-1)
H = index of species diversity
H_{max} = species diversity under conditions of maximal equitability
S = number of species

5.10.8 Results

Important Value Index (IVI) of tree species in study area

The total number of tree species with GBH >10cm was 28. Ranking of ecological significance by IVI of tree species in the study area are given in ***Table 5.30***. The tree layer in the study area is dominated by *Tephrosia purpurea* (IVI= 30.42%), *Hyptis suaveolens* (IVI = 23.197%) and *Andrapogan brevifolius* (22.454%). There were twelve species greater than 10% and 10% IVI value ***Figure 5.17***. Those species could be considered as ecological indicator species of the study area.

Table 5.30 Relative Frequency, Relative Density and IVI Value of the Study Area

Sr. No.	Scientific Name	Relative Density (%)	Relaitve Frequency (%)	Relative Dominance (%)	I.V.I Value
1	*Tephrosia purpurea*	10.0372	7.6923	12.6904	30.4198
2	*Hyptis suaveolens* (L.)	8.9219	6.1538	8.1218	23.1976
3	*Andrapogan brevifolius* L.	8.1784	6.1538	8.1218	22.4541
4	*Dipterocarpus malabarica*	7.0632	6.1538	8.1218	21.3389
5	*Jatropha gossypifolia* L.	5.6506	6.1538	8.1218	19.9262
6	Unknown species A	5.1301	6.1538	8.1218	19.4058
7	*Barleria prionitis* L.	4.0892	6.1538	8.1218	18.3649
8	*Euphorbia hypericfolia* L.	5.2045	4.6154	4.5685	14.3884
9	*Phyllanthud urinaria* L.	4.8327	4.6154	4.5685	14.0166
10	*Azadirachta indica* A. Juss.	4.4610	4.6154	4.5685	13.6449
11	*Flueggea leucopyrus* Willd.	3.3457	4.6154	4.5685	12.5296
12	Unknown species B	3.3457	4.6154	4.5685	12.5296
13	*Cocculus villosus* DC.	4.8327	3.0769	2.0305	9.9401
14	*Panicum stagninum Retz.*	4.4610	3.0769	2.0305	9.5683
15	*Diectomis fastigiata Sw.Kunth*	3.3457	3.0769	2.0305	8.4531
16	*Centella asiatica* (L.) Urb.	2.6022	3.0769	2.0305	7.7096
17	*Angustiafolium* vahl.	2.6022	3.0769	2.0305	7.7096

Sr. No.	Scientific Name	Relative Density (%)	Relaitve Frequency (%)	Relative Dominance (%)	I.V.I Value
18	*Abutilon indicum (L.) Sweet.*	2.2305	1.5385	0.5076	4.2766
19	*Virgaatus* stapf	1.4870	1.5385	0.5076	3.5331
20	*Cardiospermum corindum* L	1.4870	1.5385	0.5076	3.5331
21	*Eleusine aegyptiaca Desf.*	1.4870	1.5385	0.5076	3.5331
22	Unknown species C	1.4870	1.5385	0.5076	3.5331
23	*Capparis xanthophylla*	0.7435	1.5385	0.5076	2.7896
24	*Albiza lebbek* (L.) Benth.	0.7435	1.5385	0.5076	2.7896
25	*Acacia Chundra*	0.7435	1.5385	0.5076	2.7896
26	Unknown species D	0.7435	1.5385	0.5076	2.7896
27	*Virgatus sp.*	0.3717	1.5385	0.5076	2.4178
28	*Emblica officinalis* Gaertn.	0.3717	1.5385	0.5076	2.4178
		100	100	100	300

Figure 5.17 Top Ten Relative Frequencies of Plant Species

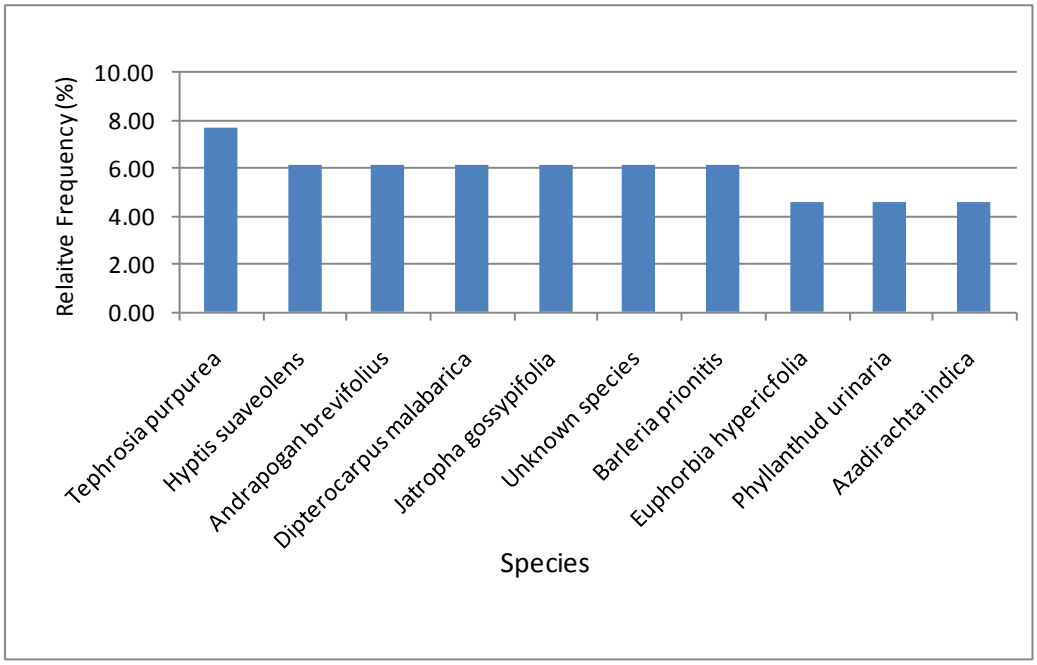
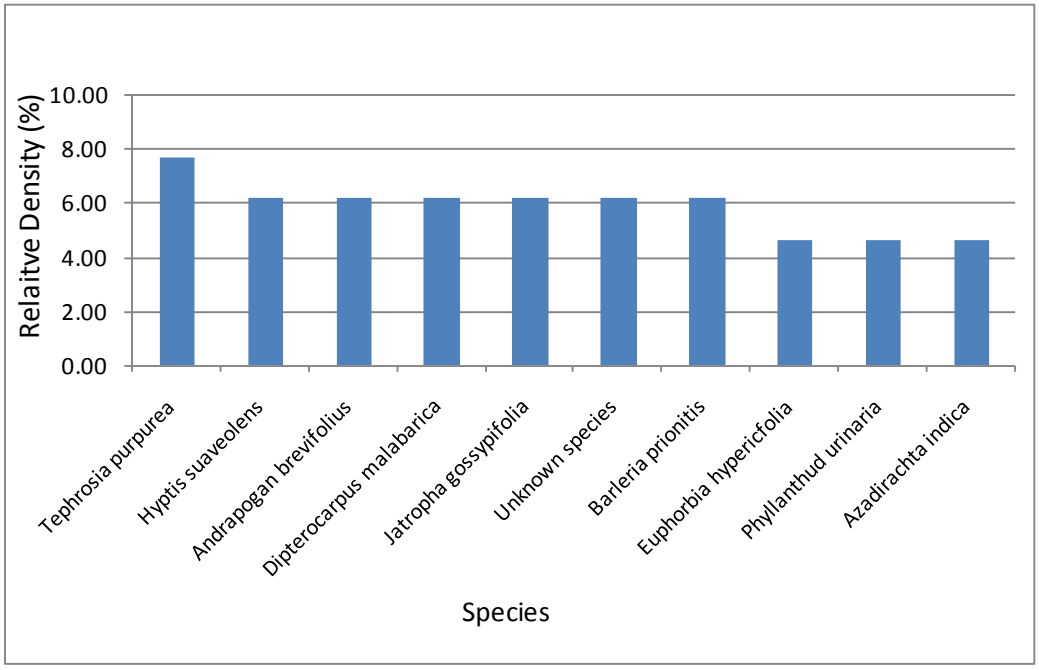


Figure 5.18 Top Ten Relative Densities of Plant Species



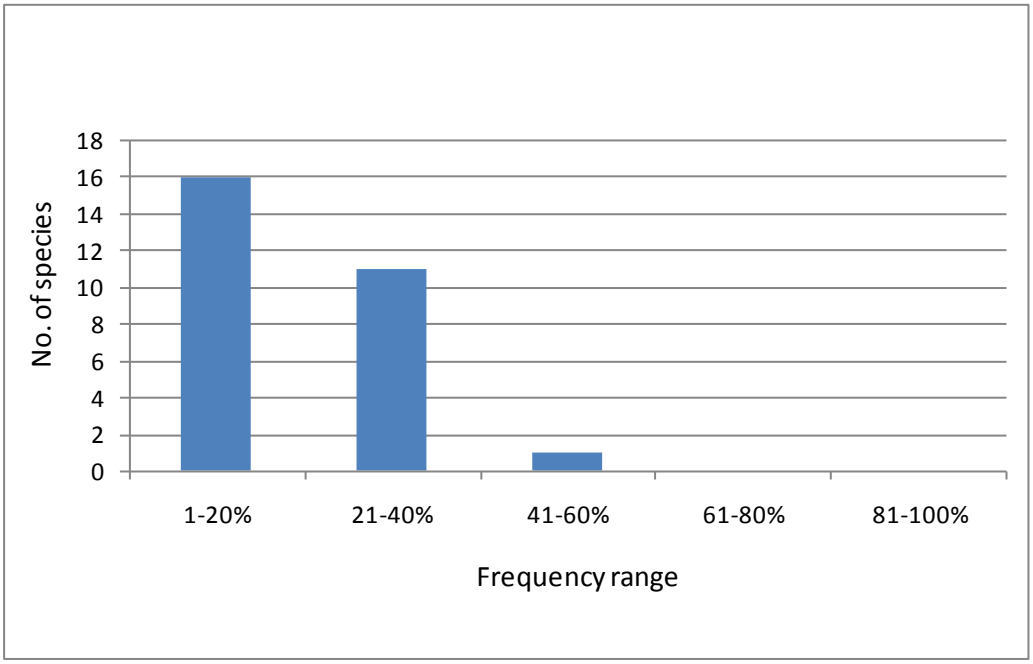
Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the area, species distribution by frequency classes was examined. According to the outcome of the frequency chart, 96% of the total number of species was in the lower frequency classes A and B, while 4% was observed only in the higher frequency class C (***Table 5.31***, ***Figure 5.19***). No species was found in frequency classes D and E. This indicates that the plant species in the study area are floristically heterogeneous, according to Lamprecht (1989). The species that fall in the highest frequency class C can be considered the most common species in the area.

Table 5.31 Species Distribution by Frequency Classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	16	57
B	21-40%	11	39
C	41-60%	1	4
D	61-80%	0	0
E	81-100%	0	0

Figure 5.19 Plant Species Distribution by Frequency Classes



Diversity indices and evenness

The floristic diversity of the plant species was analyzed using the Shannon Wiener index (H), Simpsons index (D), and Shannon Wiener evenness (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices were shown in ***Table 5.32***. According to the result, the diversity indices of the study area were high.

Table 5.32 **Plant Species Diversity Index Values**

Item	Value
Total number of sample plot	10
Shannon-Wiener Diversity (H')	4.417
Simpson Diversity(1-D)	0.946
Camargo Evenness (E')	0.595
No. of equally common species	21
Margalef species richness	8.103

Area of Vegetation with grass, shrubs, and small trees

A total of 53 plant species were noted in the area of vegetation with grass, shrubs and small trees. No threatened species was recorded in the area. All plant species observed have been recorded in ***Table 5.33*** in order of abundance.

Table 5.33 Plant Species Recorded in the Area of Vegetation with Grass, Shrubs, and Small Trees

Sr. No.	Scientific Name	Family Name	Local Name	Habitat	IUCN Status
1	*Acacia carechu*	Mimosaceae	Shar	T	NE
2	*Azadirachta indica*	Meliaceae	Tama	T	NE
3	*Delonix regia*	Caesalpiniceae	Sein-pan	T	NE
4	*Lebbek Benth*	Mimosaceae	Kokko	T	NE
5	*Ardisia colorata*	Myrsinaceae	Kyet-ma-kouk	T	NE
6	*Tamarindus indica*	Caesalpiniceae	Magyi	T	NE
7	*Ficus religosa*	Moraceae	Nyaung	T	NE
8	*Zizyphus jujuba*	Rhamnaceae	Zee	T	NE
9	*Acacia leucophloea*	Mimosaceae	Hta-naung	T	NE
10	*Crossipes Solms*	Pontederiaceae	Banda	T	NE
11	*Bombax ceiba*	Bombacaceae	Let-pan	T	NE
12	*Cassia mimosoides*	Caesalpiniceae	Mae-zeli	T	NE
13	*Tectona grandis L.f.*	Verbenaceae	Kyun	T	NE
14	*Cocos nucifera Linn*	Palmae	Ohn	T	NE
15	*Emblica officinalis*	Euphorbiaceae	Zibyu	T	NE
16	*Leucaena glauca*	Mimosasceae	Bawsakaing	ST	NE
17	*Terminalia pyrifolia*	Combretaceae	Lae	T	NE
18	*Albiza lebbek*	Mimosaceae	Anyar-kokko	T	NE
19	*Oroxylum indicum*	Bignoniaceae	Kyaung-shar	T	NE
20	*Mangifera indica*	Anacardiaceae	Thayat	T	DD
21	*Holoptelea integrifolia*	Solanaceae	Phyouk-seik	T	NE
22	*Acacia Chundra*	Mimosaceae	Gandaya	ST	NE
23	*Boscia variabillis*	Capparaceae	Thamone	ST	NE
24	*Leucaena leucocephala*	Mimosaceae	Awayar	ST	NE
25	*Morinda angustifolia*	Rubiaceae	Yae-yo	ST	NE
26	*Abutilon sp.A*	Malvaceae	Bauk-sein-gyi	H	NE
27	*Jatropha gossypifolia*	Euphorbiaceae	Kana-kho	H	NE
28	*Xylocarpus* sp.	Malvaceae	Kyat-Noe	H	NE
29	*Phyllanthud urinaria*	Euphorbiaceae	Myay-zeephyu	H	NE
30	*Solanum virginanum*	Solanaceae	Myay-poke-kayan	H	NE
31	*Abutilon indicum*	Malvaceae	Bauk-khwe	H	NE
32	*Abutilon* sp.B	Malvaceae	Bauk-sein-kalay	H	NE
33	*Barleria prionitis*	Acanthaceae	Leik-su-shwe	H	NE
34	*Hyptis suaveolens*	Lamiaceae	Nan-saw	H	NE
35	*Euphorbia hypericfolia*	Euphorbiaceae	Hmin-sae	H	NE
36	*Flueggea leucopyrus*	Euphorbiaceae	Kone-chinya	S	NE
37	*Atalantia monophylla*	Rutaceae	Taw-shouk	S	NE
38	*Abutilum asiaticum*	Malvaceae	Baung-mae	S	NE

Sr. No.	Scientific Name	Family Name	Local Name	Habitat	IUCN Status
39	*Centella asiatica*	Apiaceae	Myin-kwar	S	NE
40	*Angustiafolium*	Oleaceae	Taw-sabal	S	NE
41	*Tephrosia purpurea*	Fabaceae	Tapin-shwehti	S	NE
42	*Dipterocarpus malabarica*	Graminae	Myat-cho	G	NE
43	*Andrapogan brevifolius*	Poaceae	Zein-Myat	G	NE
44	*Virgaatus* sp.	Gremineae	Myat-nan	G	NE
45	*Eleusine aegyptiaca*	Graminae	Myat-laykwa	G	NE
46	*Diectomis fastigiata*	Graminae	Myauk-myar	G	NE
47	*Panicum stagninum*	Graminae	Myat-thi	G	NE
48	*Cynodon dactylon*	Graminae	Myaysar-Myat	G	NE
49	*Eragrotis pilosa*	Graminae	Myat-sat	G	NE
50	*Cardiospermum corindum*	Sapindaceae	Kalar-myatsi	Cl	NE
51	*Capparis xanthophylla*	Capparaceae	Madi-thanlyat	Cl	NE
52	*Cocculus villosus*	Menispermaceae	Kywet-nabaung	Cl	NE
53	*Mimosa pudica*	Mimosaceae	Hti-ka-yone	Cl	NE

Cl - Cultivated Land
T - Trees
ST - Small Trees
H - Heath
S - Shrubs
G - Grassland
NE - Not Evaluated
DD - Data Deficient (IUCN)

Developed area

Plant species in the developed area were dominated by *Areca catechu L.*, *Azadirachta indica* and *Mangifera indica*. A total of 54 species under 29 families were listed in the developed area (***Table 5.34***).

Table 5.34 Plant Species Recorded in the Developed Areas

Sr. No.	Scientific Name	Family Name	Local Name	Habit	IUCN Status
1	*Acacia catechu*	Mimosaceae	Shar	T	NE
2	*Azadirachta indica*	Meliaceae	Tama	T	NE
3	*Delonix regia*	Caesalpiniceae	Sein-pan	T	NE
4	*Lebbek Benth*	Mimosaceae	Kokko	T	NE
5	*Tamarindus indica*	Caesalpiniceae	Magyi	T	NE
6	*Ficus religosa*	Moraceae	Nyaung	T	NE
7	*Eucalyptus camaldulensis*	Myrtaceae	U-ka-lit	T	NE
8	*Zizyphus jujuba*	Rhamnaceae	Zee	T	NE
9	*Acacia leucophloea*	Mimosaceae	Hta-naung	T	NE
10	*Crossipes Solms*	Pontederiaceae	Banda	T	NE
11	*Bombax ceiba*	Bombacaceae	Let-pan	T	NE

Sr. No.	Scientific Name	Family Name	Local Name	Habit	IUCN Status
12	*Cassia mimosoides*	Caesalpiniceae	Mae-zeli	T	NE
13	*Tectona grandis L.f.*	Verbenaceae	Kyun	T	NE
14	*Polyalthia longifolia*	Annonaceae	Thinbaw-tae	T	NE
15	*Cocos nucifera Linn*	Palmae	Ohn	T	NE
16	*Borassus flabellifer*	Palmae	Htan	T	NE
17	*Acacia auriculiformis*	Fabaceae	Malasia-patauk	T	NE
18	*Emblica officinalis*	Euphorbiaceae	Zibyu	T	NE
19	*Leucaena glauca*	Mimosasceae	Bawsakaing	ST	NE
20	*Terminalia pyrifolia*	Combretaceae	Lae	T	NE
21	*Albiza lebbek*	Mimosaceae	Anyar-kokko	T	NE
22	*Oroxylum indicum*	Bignoniaceae	Kyaung-shar	T	NE
23	*Mangifera indica*	Anacardiaceae	Thayat	T	DD
24	*Acacia Chundra*	Mimosaceae	Gandaya	ST	NE
25	*Boscia variabillis*	Capparaceae	Thamone	ST	NE
26	*Leucaena leucocephala*	Mimosaceae	Awayar	ST	NE
27	*Morinda angustifolia*	Rubiaceae	Yae-yo	ST	NE
28	*Abutilon sp.A*	Malvaceae	Bauk-sein-gyi	H	NE
29	*Jatropha gossypifolia*	Euphorbiaceae	Kana-kho	H	NE
30	*Phyllanthud urinaria*	Euphorbiaceae	Myay-zeephyu	H	NE
31	*Solanum virginanum*	Solanaceae	Myay-poke-kayan	H	NE
32	*Abutilon indicum*	Malvaceae	Bauk-khwe	H	NE
33	*Abutilon* sp.B	Malvaceae	Bauk-sein-kalay	H	NE
34	*Barleria prionitis*	Acanthaceae	Leik-su-shwe	H	NE
35	*Hyptis suaveolens*	Lamiaceae	Nan-saw	H	NE
36	*Euphorbia hypericfolia*	Euphorbiaceae	Hmin-sae	H	NE
37	*Flueggea leucopyrus*	Euphorbiaceae	Kone-chinya	S	NE
38	*Atalantia monophylla*	Rutaceae	Taw-shouk	S	NE
39	*Neriifolia* L.	Euphorbiaceae	Tazaung-minthar	S	NE
40	*Euphorbia antiquaruim*	Euphorbiaceae	Tazaung-pyathat	S	NE
41	*Centella asiatica*	Apiaceae	Myin-kwar	S	NE
42	*Angustiafolium*	Oleaceae	Taw-sabal	S	NE
43	*Tephrosia purpurea*	Fabaceae	Tapin-shwehti	S	NE
44	*Dipterocarpus malabarica*	Graminae	Myat-cho	G	NE
45	*Andrapogan brevifolius*	Poaceae	Zein-Myat	G	NE
46	*Virgaatus* sp.	Gremineae	Myat-nan	G	NE
47	*Eleusine aegyptiaca*	Graminae	Myat-laykwa	G	NE
48	*Diectomis fastigiata*	Graminae	Myauk-myar	G	NE
49	*Panicum stagninum*	Graminae	Myat-thi	G	NE
50	*Cynodon dactylon*	Graminae	Myaysar-Myat	G	NE
51	*Eragrotis pilosa*	Graminae	Myat-sat	G	NE

Sr. No.	Scientific Name	Family Name	Local Name	Habit	IUCN Status
52	*Cardiospermum corindum*	Sapindaceae	Kalar-myatsi	Cl	NE
53	*Cocculus villosus*	Menispermaceae	Kywet-nabaung	Cl	NE
54	*Mimosa pudica*	Mimosaceae	Hti-ka-yone	Cl	NE

Cl - Cultivated Land
T - Trees
ST - Small Trees
H - Heath
S - Shrubs
G - Grassland
NE - Not Evaluated (IUCN)
DD - Data Deficient (IUCN)

Cultivated land

Agricultural land is cultivated land in the Project Study Area where some crops such as beans and *Oryza sativa L*. were observed. No big or small trees were normally found in this area. A total of 21 species under 29 families were listed in the agricultural land (***Table 5.35***).

Table 5.35 Plant Species Recorded in the Cultivated Land

Sr. No.	Scientific Name	Family Name	Local Name	Habit	IUCN Status
1	*Eucalyptus camaldulensis*	Myrtaceae	U-ka-lit	T	NE
2	*Tectona grandis L.f.*	Verbenaceae	Kyun	T	NE
3	*Borassus flabellifer*	Palmae	Htan	T	NE
4	*Mangifera indica*	Anacardiaceae	Thayat	T	DD
5	*Abutilon sp.A*	Malvaceae	Bauk-sein-gyi	H	NE
6	*Solanum virginanum*	Solanaceae	Myay-poke-kayan	H	NE
7	*Hyptis suaveolens*	Lamiaceae	Nan-saw	H	NE
8	*Centella asiatica*	Apiaceae	Myin-kwar	S	NE
9	*Tephrosia purpurea*	Fabaceae	Tapin-shwehti	S	NE
10	*Dipterocarpus malabarica*	Graminae	Myat-cho	G	NE
11	*Andrapogan brevifolius*	Poaceae	Zein-Myat	G	NE
12	*Virgaatus* sp.	Gremineae	Myat-nan	G	NE
13	*Eleusine aegyptiaca*	Graminae	Myat-laykwa	G	NE
14	*Diectomis fastigiata*	Graminae	Myauk-myar	G	NE
15	*Panicum stagninum*	Graminae	Myat-thi	G	NE
16	*Cynodon dactylon*	Graminae	Myaysar-Myat	G	NE
17	*Eragrotis pilosa*	Graminae	Myat-sat	G	NE
18	*Zea mays*	Poaceae	Pyaung	G	NE
19	*Oryza sativa*	Poaceae	Rice	G	NE
20	*Piper betle*	Piperaceae	Kon	Cl	NE
21	*Mimosa pudica*	Mimosaceae	Hti-ka-yone	Cl	NE

Cl - Cultivated Land

T - Trees
ST - Small Trees
H - Heath
S - Shrubs
G - Grassland
NE - Not Evaluated
DD - Data Deficient (IUCN)

Discussion

The plant species recorded varied among the habitat types, as did the dominant plant species. A total of 62 plant species under 30 families were listed in the study area (***Table 5.36***).

The tree layer in the study area is dominated by *Tephrosia purpurea*, *Hyptis suaveolens* and *Andrapogan brevifolius*. These species could be considered as ecological indicator species of the study area.

Table 5.36 Plant Species Composition in the Proposed Area

Sr. No	Scientific Name	Family Name	Local Name	Habitat	IUCN Status
1	*Acacia carechu Willd.*	Mimosaceae	Shar	T	NE
2	*Azadirachta indica* A. Juss.	Meliaceae	Tama	T	NE
3	*Delonix regia* (Bojer ex Hook.)Raf.	Caesalpiniceae	Sein-pan	T	NE
4	*Lebbek Benth*	Mimosaceae	Kokko	T	NE
5	*Ardisia colorata* Roxb.	Myrsinaceae	Kyet-ma-kouk	T	NE
6	*Tamarindus indica L.*	Caesalpiniceae	Magyi	T	NE
7	*Ficus religosa Linn.*	Moraceae	Nyaung	T	NE
8	*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	U-ka-lit	T	NE
9	*Zizyphus jujuba* lamk	Rhamnaceae	Zee	T	NE
10	*Acacia leucophloea* (Roxb)Willd	Mimosaceae	Hta-naung	T	NE
11	*Crossipes Solms*	Pontederiaceae	Banda	T	NE
12	*Bombax ceiba* L.	Bombacaceae	Let-pan	T	NE
13	*Cassia mimosoides* L.	Caesalpiniceae	Mae-zeli	T	NE
14	*Tectona grandis L.f.*	Verbenaceae	Kyun	T	NE
15	*Polyalthia longifolia* (Lam.) Benth. & Hook. F.	Annonaceae	Thinbaw-tae	T	NE
16	*Cocos nucifera Linn*	Palmae	Ohn	T	NE
17	*Borassus flabellifer Linn*	Palmae	Htan	T	NE
18	*Acacia auriculiformis* Cunn. Ex Benth.	Fabaceae	Malasia-patauk	T	NE
19	*Emblica officinalis* Gaertn.	Euphorbiaceae	Zibyu	T	NE
20	*Leucaena glauca* Benth.	Mimosasceae	Bawsakaing	ST	NE
21	*Terminalia pyrifolia* Kz.	Combretaceae	Lae	T	NE
22	*Albiza lebbek* (L.) Benth.	Mimosaceae	Anyar-kokko	T	NE
23	*Oroxylum indicum (L.) Kurz*	Bignoniaceae	Kyaung-shar	T	NE

Sr. No	Scientific Name	Family Name	Local Name	Habitat	IUCN Status
24	*Mangifera indica* L.	Anacardiaceae	Thayat	T	DD
25	Unknownn species A		Phyouk-seik	T	NE
26	*Acacia Chundra*	Mimosaceae	Gandaya	ST	NE
27	*Boscia variabillis* Cillett & Hemsl.	Capparaceae	Thamone	ST	NE
28	*Leucaena leucocephala* (Lam.) De Wit	Mimosaceae	Awayar	ST	NE
29	*Morinda angustifolia* Roxb.	Rubiaceae	Yae-yo	ST	NE
30	*Abutilon* sp. A	Malvaceae	Bauk-sein-gyi	H	NE
31	*Jatropha gossypifolia* L.	Euphorbiaceae	Kana-kho	H	NE
32	Unknownn species A		Kyat-Noe	H	NE
33	*Phyllanthud urinaria* L.	Euphorbiaceae	Myay-zeephyu	H	NE
34	*Solanum virginanum* L.	Solanaceae	Myay-poke-kayan	H	NE
35	*Abutilon indicum (L.) Sweet.*	Malvaceae	Bauk-khwe	H	NE
36	*Abutilon siamensis*	Malvaceae	Bauk-sein-kalay	H	NE
37	*Barleria prionitis* L.	Acanthaceae	Leik-su-shwe	H	NE
38	*Hyptis suaveolens* (L.) Poit	Lamiaceae	Nan-saw	H	NE
39	*Euphorbia hypericfolia* L.	Euphorbiaceae	Hmin-sae	H	NE
40	*Flueggea leucopyrus* Willd.	Euphorbiaceae	Kone-chinya	S	NE
41	*Atalantia monophylla* A. DC.	Rutaceae	Taw-shouk	S	NE
42	*Neriifolia* L.	Euphorbiaceae	Tazaung-minthar	S	NE
43	*Euphorbia antiquaruim* L.	Euphorbiaceae	Tazaung-pyathat	S	NE
44	*Abutilon* sp. B	Malvaceae	Baung-mae	S	NE
45	*Centella asiatica* (L.) Urb.	Apiaceae	Myin-kwar	S	NE
46	*Angustiafolium* vahl.	Oleaceae	Taw-sabal	S	NE
47	*Tephrosia purpurea* pers.	Fabaceae	Tapin-shwehti	S	NE
48	*D.Indica Spreng D.malabarica L. Merr.*	Graminae	Myat-cho	G	NE
49	*Andrapogan brevifolius* L.	Poaceae	Zein-Myat	G	NE
50	*Virgaatus* sp.	Gremineae	Myat-nan	G	NE
51	*Eleusine aegyptiaca Desf.*	Graminae	Myat-laykwa	G	NE
52	*Diectomis fastigiata Sw.Kunth*	Graminae	Myauk-myar	G	NE
53	*Panicum stagninum Retz.*	Graminae	Myat-thi	G	NE
54	*Cynodon dactylon (L.)*	Graminae	Myaysar-Myat	G	NE
55	*Eragrotis pilosa*	Graminae	Myat-sat	G	NE
56	*Zea mays L.*	Poaceae	Pyaung	G	NE
57	*Oryza sativa L*	Poaceae	Rice	G	NE
58	*Cardiospermum corindum* L	Sapindaceae	Kalar-myatsi	Cl	NE
59	*Capparis xanthophylla* Collett&Hemsl.	Capparaceae	Madi-thanlyat	Cl	NE
60	*Cocculus villosus* DC.	Menispermaceae	Kywet-nabaung	Cl	NE

Sr. No	Scientific Name	Family Name	Local Name	Habitat	IUCN Status
61	*Piper betle* L.	Piperaceae	Kon	CI	NE
62	*Mimosa pudica* L.	Mimosaceae	Hti-ka-yone	CI	LC

CI - Cultivated Land
T - Trees
ST - Small Trees
H - Heath
S - Shrubs
G - Grassland
NE - Not Evaluated
DD - Data Deficient (IUCN)
LS - Least Concern (IUCN)

5.10.9 *Habitats*

Three habitat types were identified in the Project Study Area: cultivated land; developed area; and the area of vegetation with grass, shrubs and small trees. All are considered as modified habitat as defined by IFC PS6.

Vegetation with grass, shrubs and small tree

The area was found in small patches of the study area. The recorded plant species showed that tree species occurred in relatively large numbers. The vegetation patches were observed among the cultivated lands.

Developed area

The plant species in the developed area was dominated by Areca catechu L. and Azadirachta indica and Mangifera indica. Most of the recorded plant species were grown by local villagers.

Agricultural land

Agricultural land is cultivated land in the Project Study Area where the dominant land cover is paddy fields. Some cropland patches growing mustard, chili and beans also exist. No big or small trees were normally found in this area.

Threatened communities include water bodies, soil and biodiversity that support the ecosystem services and function. Solid and liquid waste may have an effect on the community. Biodiversity may be affected during construction and operation phases due to the disturbance and clearance of land. Ecosystem services of the River and remnant vegetation patches are still maintained in nature although there are disturbances.

5.10.10 *Fauna*

Bird survey

A Random Point count method was used to survey and photograph birds in the area shown in ***Figure 5.16***. Birds were observed with binoculars and identified with aid of a field guide. Nocturnal birds were observed at dusk. Point count and opportunistic

methods were used to census the species richness, and point and transect counting used to get the relative measure of bird abundance.

Mammal survey

Distribution and presence of mammals were examined by conducting track and sign surveys. Sighting of prey species, tracks, scats, droppings were undertaken as data gathering in the field. A Questionnaire Survey was conducted and the results of each individual informant were treated as a distinct sample.

Reptile and Amphibian survey

The study of reptilian and amphibian species was based on active search and trapping methods. Stratification of the habitat was relatively similar to that of the mammal study. Reptilian and amphibian species were actively searched during the survey period. The collected specimens were preserved in 10% formalin for further identification in the laboratory.

Butterfly survey

Butterflies were collected using hand-nets along the transect lines set up at various areas in the proposed project site. The specimens were photographed and kept in paper envelopes for further identification in the laboratory.

Fish survey

Fish were collected with the help of fishermen as shown at the sampling location shown in ***Figure 5.16*** above. Some fish samples, which could not be identified in the field, were preserved in a plastic bottle or a jar containing 10% formalin solution. The bottle was labelled with information such as date of sampling, station code, and name of collector and time of collection. The samples were sent to a laboratory for species identification. In the laboratory, fish sampled from each station were identified using a magnifier, dissection microscope and classification guidance books. Their productivity in the river was recorded.

Plankton sampling

Plankton sampled from those stations was conducted using a plankton net of 50 µm mesh size. Approximately 5 x 1 L containers of river surface water were collected and passed through the 50 µm mesh size plankton net at each point. Samples were preserved in a plastic bottle containing 5% formalin solution. Information such as the code of sampling station and date were marked on the bottle. The specimens were sent to a laboratory for species identification and density assessment.

Benthic sampling

Benthic fauna at each station was sampled using a local dredge and sieving method. The samples were sifted through a 1 mm-mesh sieve. Each specimen was preserved in a separate bottle containing 7% formalin solution. Necessary information was labelled on the bottle. They were then delivered to a laboratory for species identification and density assessment.

Birds

A total of 46 bird species were recorded during the survey period. The species *Metopidius indicus*, *Acridotheres tristis*, *Columba livia*, *Hirundo rustica* were the most common in the area (***Table 5.37***). Population sizes of birds were higher in cultivated land and developed areas. No threatened species was found in the Project Study Area. Shannon species diversity index value was 4.499 and Evenness index value was 0.370 (***Table 5.38***).

Table 5.37 **Bird Species Recorded during the Survey Period**

Sr. No.	Scientific Name	Common Name(s)	Family	IUCN Status
1	*Corurnix coturnix*	Common Quail	PHASIANIDAE	NE
2	*Buteo buteo*	Common Buzzard	ACCIPITRIDAE	LC
3	*Milvus migrans*	Black kite	ACCIPITRIDAE	LC
4	*Threskiornis melanocephalus*	Black -headed Ibis	THRESKIORNITHIDAE	NT
5	*Plegadis falcinellus*	Glossy Ibis	THRESKIORNITHIDAE	LC
6	*Egretta grazetta*	Eastern Cattle Egret	ARDEIDAE	NE
7	*Ardea alba*	Little Egret	ARDEIDAE	LC
8	*Ardecola bacchus*	Chinese pond-heron	ARDEIDAE	NE
9	*Ardeola grayii*	Indian pond-heron	ARDEIDAE	LC
10	*Phalacrocorax niger*	Little Commorant	PHALACROCORACIDAE	LC
11	*Amauronis phoenicurus*	White-breasted Waterhen	RALLIDAE	NE
12	*Streptopelia orientalis*	Oriental Turtle Dove	COLUMBIDAE	LC
13	*Metopidius indicus*	Spotted Dove	COLUMBIDAE	LC
14	*Streptopelia tranquebarica*	Red-Collared Dove	COLUMBIDAE	LC
15	*Columba livia*	Rock Pegion	COLUMBIDAE	LC
16	*Hirundo rustica*	Barn swallow	HIRUNDINIDAE	LC
17	*Vanellus indicus*	Red-wattled Lapwing	CHARADRIINEE	LC
18	*Lanius cristatus*	Brown Shrike	LANIIDAE	LC
19	*Lanius collurioides*	Burmese Shrike	LANIIDAE	LC
20	*Halcyon smyrnensis*	White- throated Kingfisher	HALCYONIDAE	LC
21	*Coracias benghalensis*	Indian roller	CORACIIDAE	LC
22	*Oxylophus jacobinus*	Pied Cuckoo	CUCULIDAE	LC
23	*Merops orientalis*	Little green bee-eater	MEROPIDAE	LC
24	*Merops philippinus*	Blue-tailed Bee-eater	MEROPIDAE	LC
25	*Centropus sinensis*	Greater Coucal	CENTROPADIDAE	LC
26	*Corvus splendens*	House Crow	CORVINEE	LC
27	*Aegithina tiphia*	Common Iora	AEGITHININEE	LC
28	*Copsychus saularis*	Oriental Magpie-Robin	SAXICOLIDAE	LC
29	*Pyconotus jocosus*	Red-Whiskered Bulbul	PYCNONTIDAE	NE
30	*Pyconotus cafer*	Red-Vented Bulbul	PYCNONTIDAE	NE

Sr. No.	Scientific Name	Common Name(s)	Family	IUCN Status
31	*Pyconotus blanfordi*	Streak-eared Bulbul	PYCNONTIDAE	NE
32	*Acridotheres burmannicus*	Vinous-breasted Myna	STURNIDAE	NE
33	*Acridotheres tristis*	Common Myna	STURNIDAE	LC
34	*Acridotheres fuscus*	Jungle Myna	STURNIDAE	LC
35	*mirafra crythrocephala*	Burmese bushlark	ALAUDIDAE	NE
36	*Saxicola maura*	Siberian Stonechat	SAXICOLIDAE	NE
37	*Saxicola caprata*	Pie bushchat	MUSCICAPIDAE	LC
38	*Prinia flaxiventris*	Plain prinia	MUSCICAPIDAE	NE
39	*Cisticola juncidis*	Zitting Cisticola	CISTICIOLIDAE	LC
40	*Orthotomus sutorius*	Common Tailorbird	SYLVIIDAE	LC
41	*Turdoides gularis*	White- throated Babbler	SYLVINEE	LC
42	*Chrysomma sinense*	Yellow-eyed Babbler	SYLVINEE	LC
43	*Passer montanus*	Eurasian Tree-sparrow	PASSERIDAE	LC
44	*Passer domesticus*	House Sparrow	PASSERIDAE	LC
45	*Motacilla alba*	White Wagtail	MOTACILLINEE	LC
46	*Lonchura punctulata*	Scaly-breasted Munia	ESTRILDINEE	LC

NE - Not Evaluated (IUCN)
DD - Data Deficient (IUCN)
LC - Least Concern (IUCN)

Table 5.38 Species Diversity Index Values of Birds in the Project Study Area

Index/Item	Value
Shannon Diversity H' (range)	4.499
Simpson's Index (1-D)	0.937
Brillouin's H	4.414
Evenness E'	0.370
Number of equally common species	23
No. of species	46
N	1718

Mammals

Three mammal species were recorded around the Project Study Area (***Table 5.39***). Among the recorded mammal species, the most common was *Callosciurus pygerithrus*. No threatened mammal species was found around the Project Study Area.

Table 5.39 Mammal Species Recorded during the Survey Period

No	*Scientific Name*	Family	Common Name	Remark	IUCN Status
1	*Lepuspe guensis*	Leporidae	Burmese hare	Pellets observed	LC
2	*Echinosorex gymnurus*	Erinaceidae	Moon rat	Interview	LC
3	*Callosciurus pygerithrus*	Sciuridae	Gray squirrel	Observed	LC

NE - Not Evaluated (IUCN)
DD - Data Deficient (IUCN)
LC - Least Concern (IUCN)

Reptiles and Amphibians

In the study of reptiles and amphibians, 4 snake species, 3 amphibian species, 1 skink species, and 1 lizard species were recorded around the Project Study Area. Among the recorded species, *Daboia russelii* and *Calotes versicolor* were found as common species within the Project Study Area (***Table 5.40***).

Table 5.40 Reptile and Amphibian Species Recorded during the Survey Period

Sr. No.	Scientific name	Common name	Family name	IUCN Status	Remark
	Snake				
1	*Daboia russelii*	Russsell's viper	Viperidae	LC	Observed
2	*Ptyas korros*	Indochinese rat snake	Colubridae	NE	Interview
3	*Xenochrophis piscator*	Checkered keelback	Colubridae	NE	Observed
4	*Xenochrophis sp*	Water snake	Colubridae	NE	Interview
	Amphibians				
5	*Fejervarya limnocharis*	Cricket frog	Rannidae	LC	Interview
6	*Bufo melanostictus*	Common toad	Bufonidae	LC	Observed
7	*Kaloula pulchra*	Painted bull frog	Microhylidae	LC	Interview
	Skink				
8	*Eutropis multifasciata*	Common sun skink	Lacertidae	NE	Observed
	Lizard				
9	*Calotes versicolor*	Garden lizard	Agamidae	NE	Observed

NE - Not Evaluated (IUCN)
DD - Data Deficient (IUCN)
LC - Least Concern (IUCN)

Butterflies

Ten common butterfly species were listed around the Project Study Area (***Table 5.41***). Butterfly population was large in developed areas and cultivated land. No threatened butterfly species was found in the area. Shannon species diversity index value was 3.107 and Evenness index value was 0.696 (***Table 5.42***).

Table 5.41 Butterfly Species Recorded during the Survey Period

Sr. No.	Species	Common name	Family	General Status
1	*Danaus chrysippus* (Linnaeus, 1758)	Plain Tiger	Danaidae	Very Common
2	*Danaus genutia* (Cramer, 1779)	Common Tiger or Striped Tiger	Danaidae	Common
3	*Papilio demoleus* Linnaeus, 1758	Lime butterfly	Papilionidae	Very Common
4	*Junonia almana* (Linnaeus, 1758)	Peacock Pansy	Nyamphalidae	Common
5	*Junonia atlites* Linnaeus, 1758	Grey Pansy	Nyamphalidae	Common
6	*Eurema hecabe* (Linnaeus, 1758)	Common Grass Yellow	Pieridae	Very Common
7	*Catopsilia pomonacomelius* Fabricius, 1787	Orange Emigrant	Pieridae	Common
8	*Catopsilia pomona* Fabricius, 1775	Emigrant	Peridae	Very Common
9	*Cepora nerissa*	Common gull	Pieridae	Common
10	*Elymnias hypermnestra*	Palmfly	Amathusiidae	Common

Table 5.42 Species Diversity Index Values of Butterflies in the Project Study Area

Index/Item	Value
Shannon Diversity H' (range)	3.107
Simpson's Index (1-D)	0.883
Brillouin's H	2.743
Evenness E'	0.696
Number of equally common species	9
No. of species	10
N	57

Fish

A total of 26 fish species were recorded from the River. Three near-threatened species, *Ompok bimaculatus*, *Wallago attuwere* and *Bagarius bagarius* were found in the River. Commercially important fish species recorded in the area were *Catla catla*, *Mystus gulio*, and *Cirrhinus mrigala*. No threatened species was found in the area.

Table 5.43 Fish Species Recorded during the Survey Period

Sr. No.	Scientific name	Common name	Family	IUCN status
1	*Channa strita*	Snakehead Murrel	Channidae	LC
2	*Heteropneustes fossilis*	Stinging catfish	Heteropneustidae	LC
3	*Notopterus notopterus*	Bronze featherback	Notopteridae	LC
4	*Barbodes binotatus*	Spotted barb	Cyprinidae	LC
5	*Lepidocephalichthys berdmorei*	Burmese loach	Cobitidae	LC

Sr. No.	Scientific name	Common name	Family	IUCN status
6	*Wallago attu*	Wallago	Siluridae	NT
7	*Osteobrama alfredianus*	Carplet	Cyprinidae	LC
8	*Clarias Batrachus*	Walking catfish	Clariidae	LC
9	*Xenentodon cancila*	Freshwater garfish	Belonidae	LC
10	*Mystus vittatus*	Striped dwarf catfish	Bagridae	LC
11	*Ompok bimaculatus*	Butter catfish	Siluridae	NT
12	*Glossogobius giuris*	Tank goby	Gobiidae	LC
13	*Macrogathus zebrinus*	Zebra spiny eel	Mystacembelidae	LC
14	*Anabas testudineus*	Climbing perch	Anabantidae	DD
15	*Oreochromis niloticus*	Nile tilapia	Cichlidae	LC
16	*Monopterus albus*	Swamp eel	Synbranchidae	LC
17	*Cirrhinus mrigala*	Mrigal	Cyprinidae	LC
18	*Parambassis ranga*	Indian glassy fish	Ambassidae	LC
19	*Channa orientalis*	Walking snakehead	Channidae	LC
20	*Silonia silondia*	Silond catifish	Schilbeidae	LC
21	*Mastacembelus unicolor*	Colorful eel	Mastacembelidae	LC
22	*Catla catla*	Catla	Cyprinidae	LC
23	*Bagarius bagarius*	Dwarf goonch	Sisoridae	NT
24	*Sperata seenghala*	Long-whiskered catfish	Bagridae	LC
25	*Mystus gulio*	*Long whiskers Catfish*	*Bagridae*	LC
26	*Trichogaster pectoralis*	Snakeskin gourami	Osphronemidae	LC

NE - Not Evaluated (IUCN)
DD - Data Deficient (IUCN)
LC - Least Concern (IUCN)

Plankton

Nine zooplankton and 12 phytoplankton species were identified from the collected samples. Most of the plankton species were recorded from the samples collected from upstream, downstream and sites parallel to the project site (***Table 5.43*** to ***Table 5.46***). Two benthos species were recorded from the samples (***Table 5.47***).

Table 5.44 Sampling Points of Plankton and Benthos

Item	Latitude	Longitude	Elevation	Site No.
Upstream	N 21 24 26.0	E 095 16 50.2	58 m	I
Mid-point	N 21 24 25.9	E 095 16 32.8	59 m	II
Downstream	N 21 24 23.0	E 095 16 20.5	59 m	III

Table 5.45 Zooplankton Species Recorded during the Survey Period

Sr. No.	Species	Phylum	Station
1	*Monostyla lunaris*	Rotifer	II, III
2	*Spirostomum minus*	Protozoa	I,III

Sr. No.	Species	Phylum	Station
3	*Cyclops vicinus*	Arthropoda	III
4	*Cyclops sternuns*	Arthropoda	I,II,III
5	*Bosminopsis sp*	Arthropoda	II, III
6	*Daphnia sp*	Arthropoda	I,II,III
7	*Daphnia pulex*	Arthropoda	I,II,III
8	*Brachionus havanaensis*	Rotifer	I
9	*Lecane ungulata*	Rotifer	II, III

Table 5.46 Phytoplankton Species Recorded during the Survey Period

Sr. No.	Species	Class	Station
1	*Diatoma elongaum*	Bacillariophyceae	I,III
2	*Campsopogan caeruleus*	Rhodophyceae	I,III
3	*Synedra affinis*	Chrysophyta	II
4	*Dinobryon divergens*	Chrysophyta	I,II,III
5	*Staurastrum leptopus*	Chlorophyceae	II,III
6	*Spirogyra cylindrospora*	Chlorophyceae	III
7	*Spiroyra prolifica*	Chlorophyceae	I,III
8	*Spirogyra azygospora*	Chlorophyceae	II,III
9	*Oscillatoria laete-virens*	Cyanophyceae	I,II,III
10	*Oscillatoria subbrevis*	Cyanophyceae	I,II
11	*Planktothrix raciborskii*	Cyanophyceae	I,III
12	*Treubaria crassispina*	Cyanophyceae	I,II,III

Table 5.47 Benthos Species Recorded during the Survey Period

Sr. No.	Species	Family	Group	Remark
1	*Trithemis aurora*	Libellulidae	Dragonfly nymph	Common
2	*Ictinogomphus sp.*	Gomphidae	Dragonfly nymph	Common

6 DESCRIPTION OF THE SOCIO-ECONOMIC BASELINE

The following Chapter provides an overview of the socio-economic conditions of the Project area.

6.1 DATA COLLECTION

The information presented in this Chapter was gathered through a desktop review of publicly available sources and data collected through a visit to the Project area. A considerable amount of secondary information was sourced through the desktop review. Much of the information available was national level data – meaning that little, if any, local (i.e. village level) data was available. For this reason, a visit to Project area was conducted to collect information about the local area.

Primary data was collected through a variety of methods. This included:

- Key informant interviews with village leaders. Interviews were undertaken to better understand the profile of the population of each village (e.g. population size, leadership structure, ethnicity, religion, sources of income);
- Focus groups with key groups within each village. Six focus groups were conducted in each village with representatives from the following groups - farmers, women, youth, fishermen, healthcare providers and those involved in utilising ecosystem services. The types of information gathered included economic activities (e.g. industries of employment, income levels), provision of community infrastructure and services (e.g. access to education, water and sanitation services and healthcare, transportation), and health issues/ concerns. The focus groups also ensured that a cross-section of each village was engaged and had an opportunity to contribute to the data collection process (including women and youth); and
- Household surveys. A total of 300 household surveys were completed to better understand the demographic profile of the villages. To the extent possible, 10% of each village was surveyed. The focus was on gathering information on economic activities, land uses, access to community services and key challenges within each village. The questionnaires are included in ***Annex D***.

The collection of secondary and primary data provided an opportunity to triangulate the data to confirm the accuracy of the information presented. It also ensured a more robust baseline against which the likely impacts associated with the Project could be assessed.

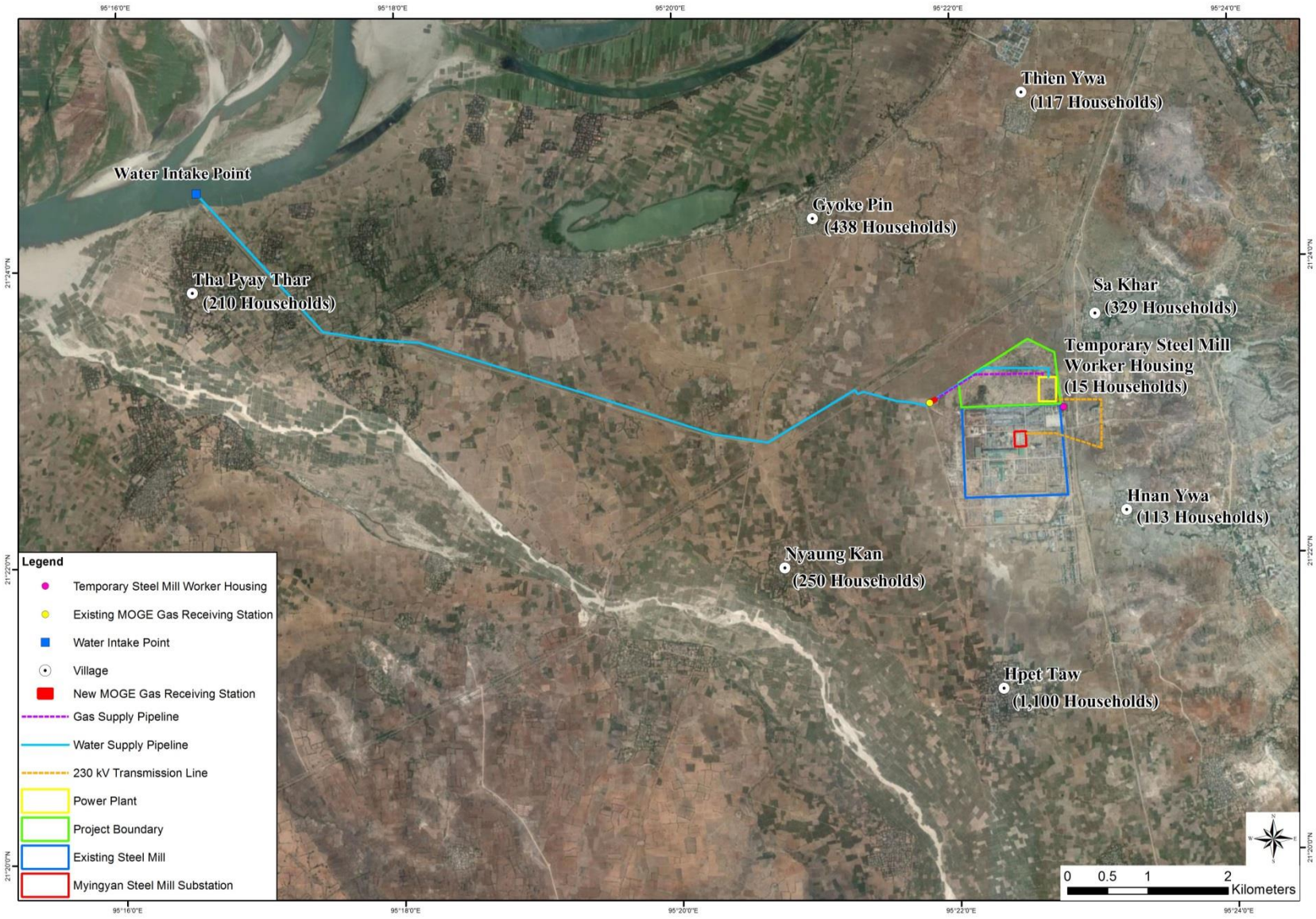
6.2 SOCIAL RECEPTORS

The baseline focuses on the receptors that may be impacted or influenced by the Project due to their proximity to the Project site and/ or Project associated infrastructure. This includes people living in:

- Sa Khar village. The village is located less than 1km north east of the Project site, and is the closest village to the Project site. The village is also located along the road that connects the Project site to Myingyah and Mandalay;
- Hnan Ywa village. The village is located approximately 1.5 km south east of the Project site;
- Hpet Taw village. The village is located approximately 3.2 km south of the Project site;
- Nyaung Kan village. The village is located approximately 2.7 km south west of the Project site;
- Gyoke Pin village. The village is located approximately 2.7 km north west of the Project site;
- Thien Ywa. The village is located approximately 2.7 km north of the Project site;
- Tha Pyay Thar village. The village is located near the water intake point not far from the Ayeyarwady River; and
- The temporary accommodation located adjacent to the Project site, which is home to approximately 30 people (***Figure 6.1***) (The accommodation has been constructed by the nearby steel mill to house a small portion of its workforce on a temporary basis. The aim is for the workers to be moved to the steel mill's permanent accommodation by 2018.)

There is also a government run school located in close proximity to the site. It services the nearby communities, including Sa Khar village and Hnan Ywa village. The students and staff are potential receptors.

Figure 6.1 Project Area



Source: Sembcorp, 2015 (modified by ERM)

6.3 INTRODUCTION

Myanmar is located in Southeast Asia. The country is bordered to the east by Thailand and Laos, to the north by China and to the west by India. Myanmar has a lengthy coastline that extends for approximately 2,400 km along the Andaman Sea and Bay of Bengal (***Figure 6.2***).

There are a number of mountain ranges and river systems, which run north to south through the country – creating natural divisions. This includes the Ayeyarwady River, which is the largest river system in Myanmar. It starts in the Himalayas and empties into the Bay of Bengal, and accommodates about 70% of the country's population and transports 40% of its commerce.

There are three distinct seasons in Myanmar. The cold and dry season runs from November to February, while the hot season is March and April, and the rainy season extends from May to October. During the rainy season monsoons can occur, causing flooding and landslides.

Myanmar is split into number of States and Regions (sometimes also referred to as Divisions), which are further divided into Townships for administrative or governance purposes. The Project site is located in the Myingyan Township in the Mandalay Region near the Ayeyarwady River.

Figure 6.2 Map of Myanmar



Source: Cartographic Section, Department of Field Support, United Nations, June 2012

6.4 DEMOGRAPHIC PROFILE

As of 2013, it was estimated that the population of Myanmar was approximately 53 million, with an annual growth rate of approximately 1% (CIA 2015). The population in the Mandalay Region is estimated to be 6.2 million, making it the second largest region in the country in terms of population, behind Yangon, which has a population of approximately 7.3 million.

Much of the population in Myanmar lives in rural areas. As of 2014, it was estimated that 65.7% of the population lives in rural areas, while 34.3% of the population resides in urban areas. Myingyan Township has a population of approximately 1 million people, most of whom (approximately 888,006 people) live in rural areas.

The population density in Myanmar is approximately 76.1 people per km^2. The Mandalay Region has the second highest density at 200 people per km^2, behind Yangon, which has the highest population density in the country at 716 people per km^2.

There are approximately 135 ethnic groups in Myanmar. The largest group is the Burmans, which make up more than half of the population (68%). This is followed by Shan (9%), Karen (7%), Rakhine (4%), Chinese (3%), Indian (2%), Mon (2%), and other (5%) (CIA 2015).

The official language is Myanmar. However, there are over 100 languages and dialects spoke within the country. These languages largely fall into one of four language families, namely, the Sino-Tibetan, Tai-Kadai, Austro-Asiatic and Indo-European, of which the Sino-Tibetan is the dominant group.

In terms of religion, the majority of the population is Buddhist (89%). However, other religions are represented. This includes Christian (4%), Muslim (4%), Baptist (3%), Catholic (1%), Animist (1%) and other (2%) (CIA 2015).

In terms of the villages located in the Project area, the largest village is Hpet Taw, with a population of approximately 5,600 people, while the smallest village is Hnan Ywa, with a population of approximately 598 people. The villages in terms of ethnicity, language and religion, reflect the broader Myanmar population – i.e. are Buddhist Burmans that speak Myanmar (***Table 6.1, Figure 6.3*** and ***Figure 6.4***).

Table 6.1 Village Overview

Village	Households*	Estimated population	Ethnicity	Language	Religion
Sa Khar	329	1,722 (m: 783/ f:939)	Burmans	Myanmar	Buddhist
Hnan Ywa	113	598 (m: 267/ f: 337)	Burmans	Myanmar	Buddhist
Hpet Taw	1,100	5,600 (m: 2,670/ f: 2,930)	Burmans	Myanmar	Buddhist
Nyaung Kan	250	1,224 (m: 600/ f: 624)	Burmans	Myanmar	Buddhist
Gyoke Pin	438	1,820 (m: 750/ f: 1,070)	Burmans	Myanmar	Buddhist
Thien Ywa	117	747 (m: 353/f: 394)	Burmans	Myanmar	Buddhist
Tha Pyay Thar	210	1,270 (m: 570/ f: 700)	Burmans	Myanmar	Buddhist

* The average household size in Myanmar is five, with little difference between rural (5) and urban (4.9) households.
Source: Field surveys 2015

Figure 6.3 Buddha Statue and Monk



Monastery in Hpet Taw village

Figure 6.4 Local Population



6.5 COMMUNITY HEALTH

The life expectancy in Myanmar is 64 years of age for men and 68 years of age for women (***Table 6.2***). Between 2000 and 2012, the life expectancy increased by 3 years for both males and females; however, during this same time the average increase in life expectancy in Myanmar's neighbouring countries was 5 years (WHO 2013).

Table 6.2 Key Health Indicators

Indicator	Myanmar	Thailand	Laos
Total population (2013)	53 million	67 million	6.7 million
Life expectancy at birth (2013)	64 males 68 females	71 males 79 females	65 males 68 females
Total expenditure on health per capita (2013)	37	658	95
Total expenditure on health as % of GDP (2013)	1.8	4.6	2.0
Total fertility rate (2014)	2.29	--	--
Infant mortality rate (deaths per 1,00 live births) (2014)	62	--	--
Under five mortality rate (deaths per 1,000 live births)	72	--	--

6.5.1 *Morbidity*

Morbidity is the state of being in poor health and encompasses both acute and chronic diseases. Many of the leading causes of morbidity in Myanmar are associated with communicable diseases and pregnancy/ child birth (***Table 6.3***).

Table 6.3 Leading Causes of Morbidity in Myanmar (2012)

No.	Causes	Percent
1.	Other injuries of specified, unspecified and multiple body regions	10.0
2.	Other complications of pregnancy and delivery	6.9
3.	Single spontaneous delivery	6.0
4.	Diarrhoea and gastroenteritis of presumed infectious origin	5.8
5.	Other viral diseases	3.8
6.	Other pregnancies with abortive outcome	2.6
7.	Gastritis and duodenitis	2.4
8.	Malaria	2.4
9.	Cataract and other disorders of lens	2.4
10.	Other acute upper respiratory infections	2.0
11.	Pneumonia	1.8
12.	Other conditions originating in the perinatal period	1.7
13.	Toxic effects of substances chiefly non-medicinal as to source	1.6
14.	Fractures of other limb bones	1.5
15.	Disease of appendix	1.5
	All other causes	47.6
	Total	**100.0**

Source: Ministry of Health 2014

Although not reflected in ***Table 6.3*** considerable focus has been given to tuberculosis (TB) over the past few years as it is considered a major public health problem in

Myanmar. In 2013, the estimated TB prevalence[1] and incidence was 473 and 373 per 100,000 people respectively (WHO 2015). Although rates of TB are lower in the Mandalay Region than many other parts of the country, TB is still an issue of concern (***Table 6.4***). To address the rates of TB, the Myanmar Government has established the National Tuberculosis Programme, which focuses largely on improving detection.

Table 6.4 Diseases under Myanmar National Surveillance (2012)

Regions / States	Diarrhoea		Malaria		TB: sputum +ve		TB: sputum -ve		TB: Extra pulmonary	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Kachin	916.3	0.4	2,374.2	3.8	44.	1.0	80.0	1.9	58.6	0.2
Kayah	1,388.0	6.7	1,858.6	0.7	12.0	0.0	26.2	0.7	5.6	0.0
Kayin	907.5	0.0	970.0	1.4	74.1	0.1	155.7	0.1	8.4	0.0
Chin	1,803.1	5.4	2,613.6	1.9	23.2	0.4	58.3	0.6	78.5	0.0
Sagaing	846.9	0.9	1,085.6	1.6	46.7	0.3	55.0	0.4	36.0	0.1
Tanintharyi	862.3	0.3	2,166.9	1.2	56.5	0.2	182.9	1.2	88.0	0.5
Bago	549.0	0.2	484.5	0.6	48.6	0.5	98.9	0.9	13.0	0.1
Magway	714.9	0.4	322.1	0.1	40.2	0.4	46.9	0.4	35.5	0.1
Mandalay	**547.5**	**0.1**	**279.5**	**0.1**	**54.0**	**0.4**	**44.9**	**0.3**	**42.6**	**0.1**
Mon	755.3	0.2	362.2	0.6	66.0	0.8	173.2	1.8	18.7	0.1
Rakhine	1,150.4	0.4	1,752.8	0.6	43.9	0.7	47.1	0.5	16.8	0.1
Yangon	255.0	0.4	25.4	0.0	109.4	0.6	114.6	0.6	36.4	0.1
Shan (S)	672.4	1.1	845.3	1.5	39.2	0.6	47.2	0.4	21.9	0.2
Shan (N)	697.0	1.4	934.6	1.1	63.1	0.1	58.5	0.3	70.1	0.0
Shan (E)	1,015.1	0.5	209.5	0.0	101.7	0.7	160.9	0.2	37.6	0.0
Ayeyarwady	523.8	0.3	361.3	0.6	49.1	0.4	61.4	0.6	28.5	0.1
Naypyitaw	476.4	0.2	250.3	0.1	59.6	0.0	38.6	0.2	36.9	0.1
Union	**670.5**	**0.5**	**686.0**	**0.7**	**58.0**	**0.5**	**78.6**	**0.6**	**33.7**	**0.1**

Source: Ministry of Health 2014

Note: (1) Number of cases per 100,000 populations. (2) Number of deaths per 100,000 populations.

Malaria is considered to be another health issue. The cities of Yangon and Mandalay and areas above 1000 metres in elevation are considered to be malaria-free, making malaria largely an issue in rural areas of the country, most notably in Bago, Kachin, Kayah, Kayin, Shan, and Tanintharyi. The issue is compounded by the increasing presence of the multi-drug resistant form of malaria, which is now widespread along much of the Myanmar-Thailand border.

Other vector borne diseases common in Myanmar include dengue fever and Chikungunya virus, which are spread by two species of day-time feeding mosquitoes - *Aedes aegypti* and *Aedes albopictus*. Unlike the mainly rural-dwelling mosquitoes that spread malaria, the *Aedes* mosquitoes thrive in cities as well as rural areas.

In terms of morbidity in the villages in the Project area, based on feedback from the field surveys, communicable and non-communicable diseases are present. Leading causes of morbidity appear to be hypertension, tuberculosis and gastroenteritis (***Table 6.7***).

[1] Prevalence is the proportion of cases in the population at a given time, while incidence is the rate of occurrence of new cases.

During the field surveys, there was no mention of health concerns associated with pregnancy and/ or child birth; however, these are issues of common within the wider Myanmar population. It was noted that most children are born at home with the support of a midwife.

Table 6.5 Village Health - Morbidity

Village	Leading causes of morbidity
Sa Khar	Fever, and hypertension
Hnan Ywa	Fever, hypertension, cardiac, tuberculosis, and gastroenteritis
Hpet Taw	Fever, hypertension, tuberculosis, diabetes, cholera, bronchitis, pneumonia, gastroenteritis, and haemorrhagic stroke
Nyaung Kan	Fever, hypertension, tuberculosis, disease of liver, diabetes, bronchitis, and gastroenteritis
Gyoke Pin	Fever, hypertension, cardiac, tuberculosis, and gastroenteritis
Thien Ywa	Fever, hypertension, diabetes, diarrhoea, dengue fever, and haemorrhagic stroke
Tha Pyay Thar	Fever, hypertension, tuberculosis, and gastroenteritis

Source: Field surveys 2015

6.5.2 Mortality

Mortality is the measure of deaths per population over time, and is a key indicator of population health. The leading cause of mortality in Myanmar is human immunodeficiency virus (HIV)/ acquired immune deficiency syndrome (AIDS) (a communicable disease) (***Table 6.6***).

Myanmar has one of the highest rates of HIV / AIDS infection in Southeast Asia. In 2013, the number of people living with HIV in Myanmar was estimated to be around 190,000; while an estimated 11,000 people died of AIDS in 2013 (UN AIDS 2015). (There is often a correlation between TB and HIV/ AIDS – as TB, worldwide, is the leading cause of death in people living with HIV.) This may change in the future, as recent data shows that rates of HIV/ AIDS have begun to decline.

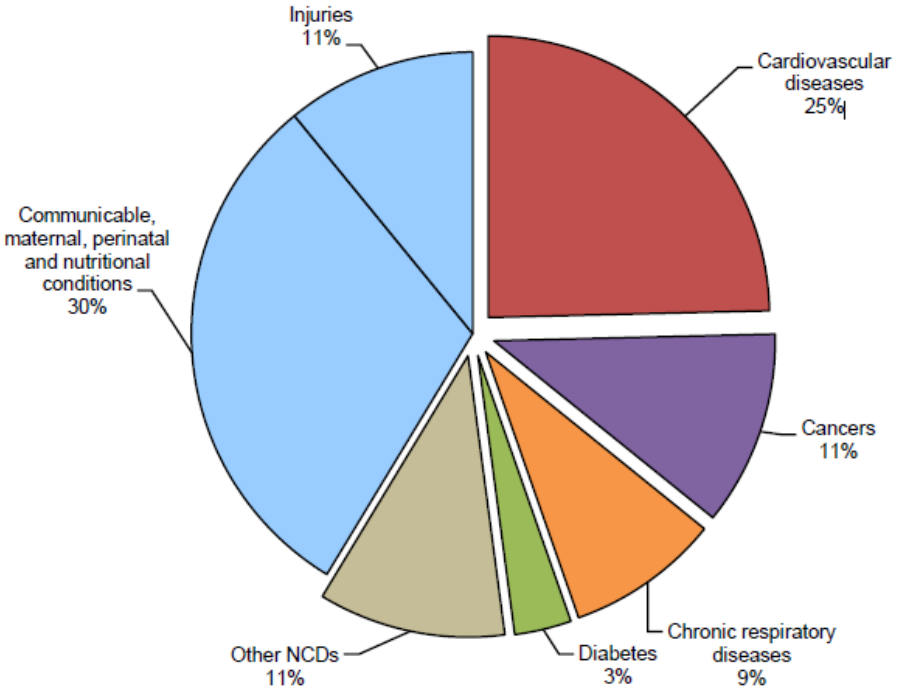
Table 6.6 Leading Causes of Mortality in Myanmar (2012)

No.	Causes	Percent
1.	Human immunodeficiency virus (HIV) / Acquired immune deficiency syndrome (AIDS)	6.6
2.	Septicaemia	6.1
3.	Other injuries of specified, unspecified and multiple body regions	5.4
4.	Slow foetal growth, foetal malnutrition and disorders related to short gestation and low birth weight	4.6
5.	Other diseases of the liver	4.0
6.	Other disease of respiratory system	3.7
7.	Intrauterine hypoxia and birth asphyxia	3.4
8.	Heart failure	3.3
9.	Respiratory tuberculosis	3.2
10.	Intracranial haemorrhage	2.9
11.	Other heart diseases	2.8
12.	Intracranial injury	2.7
13.	Malaria	2.6
14.	Pneumonia	2.6
15.	Stroke, not specified as a haemorrhage or infarction	2.5
	All other causes	43.6
	Total	**100.0**

Source: Ministry of Health 2014

Although communicable diseases top the list of causes of mortality, there are a number of non-communicable diseases that also contribute. The World Health Organisation estimated that in 2014 non-communicable diseases accounted for 59% of all deaths in Myanmar (***Figure 6.5***).

Figure 6.5 Proportional Mortality (2014)



Source: WHO 2014

The trends in mortality and fertility indicate that Myanmar is currently in demographic transition - while the current population is young, Myanmar is moving slowly towards an ageing population (WHO 2014). This reflects broader global trends, and will present new challenges for the health system.

In terms of the mortality in the villages in the Project area, hypertension appears to be a key issue. However, there was no discussion within the local villages regarding issues associated with sexually transmitted infections – such as HIV/ AIDS (***Table 6.7***). (Health practitioners were asked about the rates of sexually transmitted infections – however, no data was available. In addition, sexually transmitted infections were not raised as an issue of concern by villagers.)

Table 6.7 Village Health - Mortality

Village	Leading causes of mortality
Sa Khar	Hypertension
Hnan Ywa	Hypertension, cardiac, and tuberculosis
Hpet Taw	Hypertension, tuberculosis, pneumonia, and haemorrhagic stroke
Nyaung Kan	Hypertension, tuberculosis, and liver disease
Gyoke Pin	Hypertension, cardiac, and tuberculosis
Thien Ywa	Hypertension
Tha Pyay Thar	Hypertension

Source: Field surveys 2015

6.5.3 *Access to Water and Sanitation*

The prevalence of communicable diseases can be exacerbated by availability of and access to clean drinking water and sanitation facilities. This includes issues such as gastroenteritis, which was identified as an issue in the Project area villages.

In terms of water use, approximately, 89% of water withdrawn in Myanmar is used for agricultural purposes, while the remainder is used by municipalities (10%) and industry (1%). This is expected to change in the coming years as the industrial sector expands.

Approximately 91% of the total water withdrawn is from surface water, while 9% is from groundwater. The groundwater that is withdrawn is largely used for domestic purposes (*FAO 2011*).

Sanitary latrine coverage of the population in 2012 was 93% for urban areas and 76.8% for rural areas, and access to improved drinking water was available for 80% of the population in Myanmar.

In the Mandalay Region, there is better access to sanitary latrines when compared to the broader population, with coverage at 96.7% for urban areas and 78.9% for rural areas. Access to improved drinking water in the Mandalay Region was available to 87.7% of the population (Public Health Statistics 2012; Ministry of Health 2014).

Villages in the Project area largely rely on groundwater as a source of drinking water; however, it is not the only source. Some villagers collect rainwater for domestic purposes; while others take water from the Ayeyarwady River (***Table 6.8*** and ***Figure 6.6*** and ***Figure 6.7***). Waste is typically discharged directly back into the ground (***Figure 6.8***).

Table 6.8 Village Water Sources

Village	Description of Water Sources
Sa Khar	Water is piped into most households and accessed via a tap. Groundwater is the principle source of domestic water supply. Other water sources include groundwater accessed via hand dug wells and hand pumps and rain water.
Hnan Ywa	There is a community tap for water. Groundwater is the principle source of domestic water supply. Other water sources include groundwater accessed via tube wells and rain water.
Hpet Taw	Most people use water from a piped water supply system. Other water sources include groundwater accessed via hand dug wells and hand pumps and rain water.
Nyaung Kan	Most people use water from an existing piped system – which relies on groundwater. Other water sources include groundwater accessed via tube wells and pumps, rain water and river water. The distance to the Ayeyarwady River is approximately three miles.
Gyoke Pin	There is a central water supply in the village, which is drawn from groundwater. Although most people access the central piped system, some households have established their own systems. Other water sources include groundwater accessed through hand dug wells and hand pumps, rainwater and the river. The distance to the Ayeyarwady River is approximately one mile.
Thien Ywa	Most people use groundwater from hand dug wells during the dry season. During the rainy season, most of people draw water from a local pond. Other

Village	Description of Water Sources
	water sources include groundwater accessed via hand pumps and rain water.
Tha Pyay Thar	Most people use groundwater accessed via hand pumps. There are approximately 100 groundwater pumps shared within the village. Other water sources include groundwater accessed via hand dug wells, rainwater, and river water. The distance to the Ayeyarwady River is approximately 2 miles.

Source: Field surveys 2015

Figure 6.6 Drinking Water



Myanmar jar (Sa Khar village)



Myanmar jar (Hpet Taw village)

Figure 6.7 Water Sources



Well (Sa Khar village)



Water supply (Sa Khar village)



Rainspout (Sa Khar village)



Tube well hand pump (Tha Pyay Thar village)

Figure 6.8 Wastewater Discharge



Sa Khar village



Gyoke Pin village

6.5.4 Behavioural Factors

Behavioural factors, such as tobacco and alcohol use, diet and physical activity, are often seen as being key determinants of health.

In Myanmar, most of the population abstains from consuming alcohol. The World Health Organisation estimates that approximately 92.1 percent of the population (over 15 years of age) abstains from drinking alcohol. The rate of abstinence is considerably higher in Myanmar when compared to other nearby countries.

Table 6.9 Alcohol Use

Indicator	Population	Male	Female
Abstainers over past 12 months (15+)	92.1	87.6	96.2
Lifetime abstainers (15+)	84.1	91.1	76.5
Former drinks (15+)	8.0	11.1	5.2
Alcohol use disorders	1.5	2.7	0.5
Alcohol dependence	0.7	1.3	0.2

In terms of the Project area villages, based on the field surveys, appears to be consumed in most of the villages, but only in small quantities. However, consumption was not identified as an issue in most villages, with the exception of Hpet Taw, where it was indicated that consumption has led to issues, such as fighting amongst youth.

Similar to alcohol, most villages indicated that drug use was not an issue of concern. However, betel nut use is prevalent in most of the Project area villages. Chewing betel nut can have a number of health consequences, including discoloration of teeth and gums, mouth and stomach ulcers, gum disease, oral cancers, and heart disease.

Women in a number of the Project area villages indicated that they collect betel leaves and make cheroot to generate income. Cheroot is a cigar that is distinctive to Myanmar. It is made from a blend of tobacco and fragrant wood chips, and is consumed by women and men in the Project area villages.

6.5.5 *Healthcare Facilities*

According to the Ministry of Health, in 2012, Myanmar had 987 public hospitals with a total of 54,503 beds (***Table 6.10***). As of 2012, there were 28,077 doctors. This includes 11,460 doctors in the public sector and 16,617 doctors based in co-operatives/ private sector (***Table 6.11****)*.

In addition to existing health facilities, the use of traditional medicine exists, and often forms an integral part of the country's health services. However, the use of traditional medicine does not seem to be a common practice in the Project area villages.

Table 6.10 Health Facilities in Myanmar

Health Facilities	1988-1989	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Hospitals (Public Sector)	631	839	846	871	924	987
Total No. of Hospital Beds	25,309	36,949	38,249	39,060	43,789	54,503
No. of primary and Secondary Health Centres	64	86	86	86	86	87
No. of Maternal and Child Health Centres	348	348	348	348	348	348
No. of Rural Health Centres	1,337	1,473	1,481	1,504	1,558	1,556
No. of school Health Teams	80	80	80	80	80	80
No. of Traditional Medicine Hospitals	2	14	14	14	14	14
No. of Traditional Medicine Clinics	89	237	237	237	237	237

Source: Ministry of Health 2014

Table 6.11 Health Personnel in Myanmar

Health Manpower	1988-1989	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Total No. of Doctors	12,268	21,799	23,740	24,536	26,435	28,077
- Public	4,377	7,976	9,583	9,728	10,927	11,460
- Co-operative &private	7,891	13,823	14,808	14,808	15,508	16,617
Dental Surgeon	857	1,867	2,092	2,308	2,562	2,770
- Public	328	793	777	703	813	848

Health Manpower	1988-1989	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
- Co-operative &private	529	1,074	1,315	1,605	1,749	1,922
Nurses	8,349	22,027	22,885	24,242	25,644	26,928
Dental Nurses	96	177	244	262	287	316
Health Assistants	1,238	1,788	1,822	1,845	1.899	1,536
Lady Health Visitors	1,557	3,197	3,238	3,278	3,344	3,371
Midwives	8,121	18,098	18,543	19,051	19,556	20,044
Health Supervisor	1,161	1,973	2,013	2,174	2,621	2,330
Traditional Medicine Practitioners						
- Public	290	945	950	890	890	885
- Private	2,500	5,163	5,397	5,737	5,737	5,867

Source: Ministry of Health 2014

Most of the villages in the Project area do not have their own health care facility (***Table 6.12***). However, most villages are visited by a health care professional on a monthly basis. If an issue arises, villagers typically visit one of a number of nearby health facilities, including the hospital located in Myingyan.

Table 6.12 Village Healthcare Facilities

Village	Description of Healthcare Facilities
Sa Khar	• The nearest health centre is a five-minute walk away. A midwife is the key health contact for the village. Most people have home births with support from the midwife. • A doctor visits the village monthly. The doctor administers vaccinations, which occurs at the village leader's home. • In case of an incident or serious disease, most people go to Myingyan Hospital. It is approximately a 20 minute motorbike ride to the hospital.
Hnan Ywa	• There is no health care facility in the village. • Most people have home births with support from a midwife. • A doctor visits the village monthly. The doctor administers vaccinations, which occurs at the village leader's home. • In case of an incident or serious disease, most people go to Myingyan Hospital. During the dry season, it is approximately a 30 minute motorbike ride to the hospital; however, during the wet season it is typically a 2 hour ride.
Hpet Taw	• There is a rural health clinic located approximately 10-20 minute walk from the village. Five (5) people are employed in the rural clinic: one (1) medical supervisor, one (1) nurse, one (1) midwife, and two (2) health supervisors. All children are vaccinated at the clinic. • Most people have home births with support from a midwife. • In case of an incident or serious disease, most people go to Myingyan Hospital. It is approximately a 30 minute motorbike ride to the hospital. • Some villages utilise traditional medicines.
Nyaung Kan	• There is a rural health clinic located approximately 10-20 minute motorbike ride from the village. A nurse is the key health contact. • Most people have home births with support from a midwife. • A doctor visits the village monthly. The doctor administers vaccinations, which occurs at the village leader's home. • In case of an incident or serious disease, most people go to Myingyan Hospital. It is approximately a 30 minute motorbike ride to the hospital.
Gyoke Pin	• There is public hospital located in Hla Nuang Tang village, which is approximately 20 minutes via motorbike away. Three (3) people are employed in the public hospital: one (1) doctor, one (1) nurse, and one (1) health assistant.

Village	Description of Healthcare Facilities
	• Most people have home births with support from a midwife. • A doctor visits the village monthly. The doctor administers vaccinations, which occurs at the local midwife's house. • In case of an incident or serious disease, most people go to Myingyan Hospital. It is approximately a 30 minute motorbike ride to the hospital.
Thien Ywa	• There is government rural clinic located near the village. It is approximately a 5 minute walk to the rural clinic. • Most people have home births with support from a midwife. • A doctor visits the village monthly. The doctor administers vaccinations, which occurs at the village leader's home. • In case of an incident or serious disease, most people go to Myingyan Hospital. It is approximately a 15 minute motorbike ride to the hospital.
Tha Pyay Thar	• There is government rural clinic located near the village. It is approximately a 20 minute trip to the clinic via motorbike. The rural clinic nurse is the key health contact for the village. • Most people have home births with support from a midwife. • A doctor visits the village monthly. The doctor administers vaccinations, which occurs at the village leader's home. • In case of an incident or serious disease, most people go to Myingyan Hospital. In the dry season, it is approximately a 45 minute motorbike ride to the hospital, but during the wet season it is approximately a 1.5 hour ride. • Some villagers utilise traditional medicine.

Source: Field surveys 2015

6.6 ECONOMY AND LIVELIHOODS

In 2013/2014, Myanmar's gross domestic product (GDP) was estimated to be $56.8 billion. This means that the per capita GDP was approximately $1,505 - one of the lowest in Southeast Asia (World Bank 2015). In fact, nearly one-third of the country's population lives in poverty.

Changes are underway in Myanmar to respond to the levels of poverty being experienced. Myanmar is in a transition from a centrally directed economy to a market-oriented economy. This has been supported by a reform program launched by the government in 2011.

As a result of the reforms, Myanmar's economy grew by an estimated rate of 8.3% in 2013/ 2014; however, the unemployment rate remained stagnant at around 5.1% (World Bank 2015). The growth seen in the economy was largely driven by the construction, manufacturing and service industries (World Bank 2015). (For example, as a result of foreign direct investment on average more than one new garment factor opened each week in 2014 (ADB 2015).) The economy is expected to grow by a further 8.5% in 2014/2015, due to investment from gas producers (World Bank 2015).

The following section provides a brief overview of key sectors in the economy – including agriculture, forestry and fishing. In terms of the Project area, the villagers are largely reliant on the agricultural sector for income.

6.6.1 *Agriculture*

Traditionally, Myanmar has been reliant on the agricultural sector (and to a lesser extent forestry and fishing). In fact, at one point, Myanmar was the world's largest exporter of rice.

Even with recent effort to diversify, the agricultural sector still accounts for approximately 37% of GDP (as of 2014), while the services sector accounts for 41.6% and the industrial sector accounts for 21.3% (CIA 2015).

It is estimated that, as of 2014, approximately 21.1 million people worked in the agricultural sector. This means that approximately 65.8% of the labour force is employed in the agricultural sector in Myanmar (FAO 2015). This includes a large number of people considered to be 'landless' - who work as seasonal farm labourers and migrate to urban areas during non-planting and /or harvesting times to find temporary employment. It also includes women – as women play a substantial role in crop production in farming households in Myanmar (in part because women are typically seen as responsible for meeting the food security needs of their families).

Approximately half of all agricultural land in Myanmar is devoted to cereal crops, such as rice. Other agricultural products include beans, sesame, groundnuts, sugarcane, and hardwood.

Crops in the central dry zone (i.e. the Project's location) typically require some level of irrigation. The most common form is surface (or flood) irrigation, associated with river diversions, dams or tanks and more recently wells and river pumps.

The Myanmar Government has 170 irrigation projects across the country - covering an area of approximately 928,599 ha. The Mandalay Region has the highest number of government irrigation projects (42) (***Table 6.13***).

Table 6.13 Government Irrigation Projects

State/Division	Government Irrigation Projects	Beneficial Area (ha)	Percentage of Beneficial Area
Kayah	2	1,275	0.14
Kayin	1	40	0.01
Chin	1	202	0.02
Sagaing	18	149,714	16.12
Thanintharyi	1	Water Supply	-
Bago	40	253,731	27.32
Magway	31	118, 712	12.78
Mandalay	**42**	**135,392**	**14.58**
Mon	7	25,820	2.78
Rakhine	4	182	0.02
Yangon	14	90,449	9.74
Shan	2	44,858	4.83
Ayeyarwady	7	108,224	11.66
Total	**170**	**928,599**	**100.00**

Source: FAO AQUASTAT Survey 2011

The agricultural sector is the primary employer in the Project area (***Table 6.14***). Some people are self-employed (i.e. produce crops on their own land), while others earn money as day labourers.

Table 6.14 Income from Agriculture

Village	Average land holding	Households	Income*	Markets	Notes
Sa Khar	5 acres	183	500,000-2,500,000 Kyats/year	Myingyan Township	• The key water sources for agriculture include rainwater and tube wells. • People typically travel to market by bus, motorbike, and train.
Hnan Ywa	5 acres	30	500,000-2,500,000 Kyats/year	Myingyan Township	• The key water sources for agriculture include rainwater and tube wells. • People typically travel to market by bus, motorbike, and train.
Hpet Taw	4 acres	560	500,000-2,500,000 Kyats/year	Myingyan Township	• The key water sources for agriculture include rainwater and tube wells. • People typically travel to market by bus and motorbike.
Nyaung Kan	1 acres	200	500,000-1,500,000 Kyats/year	Myingyan Township	• The key water sources for agriculture include rainwater, tube wells, and the river. The distance from the Ayeyarwady River is approximately 3 miles. • People typically travel to market by bus and motorbike.
Gyoke Pin	5 acres	275	500,000-2,500,000 Kyats/year	Myingyan Township	• The key water sources for agriculture include rainwater and the river. The distance from the Ayeyarwady River is approximately 1 mile. • People typically travel to market by bus and motorbike.
Thien Ywa	5 acres	85	500,000-2,500,000 Kyats/year	Myingyan Township	• Rainwater is the key water source for agriculture. • People typically travel to market by bus and motorbike.
Tha Pyay Thar	2 acres	140	500,000-1,500,000 Kyats/year	Myingyan Township	• The key water sources for agriculture include rainwater, tube wells, and the river. The distance from the Ayeyarwady River is approximately 2 miles. • People typically travel to market by bus and motorbike.

*Household income is dependent on size of total land holding.

Source: Field surveys 2015

The typical income ranges between 500,000 and 2,500,000 Kyats/year – and is largely dependent on the size of the land holding (***Table 6.15***). Crops are sold at the local market – i.e. Myingyan Township market. Crops are transported to market using a variety of methods including bus, motorbike, and train.

Table 6.15 Household Income

Village	25,000 - 50,000 kyats	50,000 – 100,000 kyats	100,000 – 200,00 kyats	200,000 – 300,000 kyats	300,000+ kyats
Sa Khar	20 (6%)	100 (30%)	180 (55%)	24 (7%)	5 (2%)
Hnan Ywa	30 (27%)	55 (49%)	28 (24%)	--	--
Hpet Taw	--	660 (60%)	330 (30%)	110 (10%)	--
Nyaung Kan*	--	87 (58%)	63 (42%)	--	--
Gyoke Pin	--	219 (50%)	148 (33%)	73 (17%)	--
Thien Ywa	--	82 (70%)	23 (20%)	12 (10%)	--
Tha Pyay Thar	--	160 (76%)	50 (24%)	--	--

*Not all households are accounted for in the figures presented.

Source: Field surveys 2015

In addition to selling crops, crops are grown for personal consumption. This is often the case in Hnan Ywa and Nyaung Kan, as villagers noted that much of their crops are used for personal consumption rather than for sale.

Both men and women are actively involved in crop production in the Project area villages – either running their household crop production activities or taking up roles as day laborers. (Crop production is led by women in some instances.) For day laborers, men tend to earn more (on average 1,000 kyats more) per day when compared to women.

Villagers noted that despite the reliance on agriculture, there has been a shift in recent years, with an increasing number of people seeking employment (e.g. as laborers) in other countries.

A range of crops are grown in the Project area on a rotational basis – typically three crops are grown each year. The crops grown are identified in ***Table 6.16*** and ***Table 6.17*** by season (

Figure 6.9). Cattle and tractors are used to help cultivate local crops.

Table 6.16 Crops – Dry Season

Crop	December	January	February	March	April	May	June
Pulses	X	X	X	X	X		
Onion	X	X	X	X	X		
Maize	X	X					
Sesame	X					X	X
Mung bean						X	X
Corn	X	X	X	X	X	X	X
Sweet Potato	X	X	X				
Tomato							
Cotton	X	X	X				
Monsoon paddy							
Oil seeds	X	X	X	X	X		
Betel nut	X	X	X	X	X	X	X
Betel leaf	X	X	X	X	X	X	X
Peas	X	X	X	X	X		
Fruits	X	X	X	X	X	X	X
Wheat	X	X	X				
Nipa palm	X	X	X	X	X	X	X
Chili	X	X	X	X	X		

Source: Field surveys 2015

Table 6.17 Crops – Wet Season

Crop	July	August	September	October	November
Pulses	X	X	X	X	X
Onion					X
Maize	X	X	X	X	X
Sesame	X	X	X	X	X
Mung bean					
Corn	X	X	X	X	
Sweet Potato				X	X
Tomato	X	X	X	X	
Cotton	X	X	X	X	X
Monsoon paddy	X	X	X	X	X
Oil seeds					
Betel nut	X	X	X	X	X
Betel leaf	X	X	X	X	X
Peas	X	X	X	X	X
Fruits	X	X	X	X	X
Wheat					X
Nipa palm	X	X	X	X	X
Chili	X	X	X	X	X

Source: Field surveys 2015

Villages in the Project area largely rely on rainwater irrigate their crops. However, some of villages utilise the local irrigation channel, which diverts water from the Ayeyarwady River inland, and groundwater.

Figure 6.9 Village Agricultural Practices



Paddy (Gyoke Pin village)



Onion (Nyaung Kan village)



Cotton (Thien Ywa village)



Maize (Nyaung Kan village)



Betel leaf (Nyaung Kan village)



Pulses (Nyaung Kan village)

6.6.2 Livestock

In addition to crops, livestock rearing is another source of income in Myanmar. A variety of animals are raised, including duck, cattle, water buffalo, goats, sheep, chickens, and pigs. In 2013/2014, duck was the most commonly raised livestock, with 18.3 million, followed by cattle and chicken.

In the Mandalay Region, the most commonly raised livestock is cattle, followed by pigs and chicken (***Table 6.18***).

Table 6.18 Livestock Population by State and Region (2013-2014)

No.	State /Region	Number of Animal Population in lakh (100,000 unit)							
		Buffalo	Cattle	Sheep/ Goat	Pig	Chicken	Duck	Turkey/ Geese/ Muscovy	Quail
1	Nay Pyi Taw	0.68	2.29	-	0.14	2.32	0.86	0.05	-
2	Kachin	2.67	3.58	-	0.62	8.9	2.61	0.56	-
3	Kayah	0.34	0.9	-	0.03	1.24	0.2	0.08	-
4	Kayin	0.92	3.56	-	0.82	3.7	3.4	0.47	-
5	Chin	0.48	1.68	-	0.94	3.58	0.35	0.09	-
6	Sagaing	4.67	23.99	2.07	3.69	11.15	2.85	0.6	3.95
7	Thanintharyi	1.55	1.58	-	0.35	2.05	5.17	0.29	-

No.	State /Region	Number of Animal Population in lakh (100,000 unit)							
		Buffalo	Cattle	Sheep/ Goat	Pig	Chicken	Duck	Turkey/ Geese/ Muscovy	Quail
8	Bago	3.12	14.91	-	0.64	9.68	71.75	1.36	-
	Bago (East)	2.59	7.42	-	0.3	6	63.03	0.81	-
	Bago (West)	0.53	7.49	-	0.34	3.68	8.72	0.55	-
9	Magway	1.49	26.07	5.73	24.43	25.64	2.96	0.15	-
10	**Mandalay**	**0.7**	**21.86**	**2.36**	**10.9**	**6.74**	**4.45**	**0.57**	**3.97**
11	Mon	0.91	4.9	-	1.05	3.88	14.4	0.8	-
12	Rakhine	3.88	11.02	-	3.11	3.13	3.64	1.27	-
13	Yangon	1.52	6.34	-	1.01	10.51	31.74	2.48	2.72
14	Shan	7.91	14.93	-	0.86	18.17	4	0.72	0.2
	Shan (South)	3.2	7.89	-	0.21	5.11	1.29	0.43	-
	Shan (East)	1.57	1.45	-	0.19	3.14	1.73	0.11	-
	Shan (North)	3.14	5.59	-	0.46	9.91	0.97	0.18	0.2
15	Ayeyarwady	2.34	12.33	-	1.05	14.98	34.94	3.79	0.18
16	**Union**	**33.18**	**149.93**	**10.16**	**49.65**	**125.67**	**183.32**	**13.28**	**11.02**

Source: Livestock Sector, Ministry of Livestock, Fisheries and Rural Development

In terms of the Project area, villages raise a variety of livestock, including poultry, cattle, sheep and pigs (***Table 6.19*** and ***Figure 6.10***). However, more households are involved in crop production, than livestock rearing.

In many instances the livestock are reared for personal consumption or to be sold at the market, with the exception of cattle. The milk from the cattle is often sold at the market, while the cattle themselves help around the farm (e.g. to till the land).

Both men and women are involved in the rearing of livestock. This includes fodder collection, dung cake preparation, milking and selling of milk or taking it to cooperatives, and vaccination and other veterinary services.

Table 6.19 Village Livestock Practices

Village	Income*	Households	Livestock	Markets	Notes
Sa Khar	84,000-500,000 Kyats/year	3	Cattle and poultry	Myingyan Township	People in Sa Khar do not consume pig, sheep and goat due to cultural beliefs. There are approximately 1,000 cattle and 1,000 poultry in the village. Cattle are used for agricultural purposes, whereas the poultry is sold for income.
Hnan Ywa	84,000-500,000 Kyats/year	61	Cattle, and poultry	Myingyan Township	There are approximately 210 cattle and 100 poultry in the village. Cattle are used for agricultural purposes. Poultry is for household consumption.
Hpet Taw	84,000-500,000 Kyats/year	100	Cattle, poultry, and pig	Myingyan Township	Approximately, 100 households have cattle that are used for agricultural purposes, while pigs are owned by approximately 50 households. Almost all (1,100) households have poultry. Milk from the cattle is sold for

Village	Income*	Households	Livestock	Markets	Notes
					income.
Nyaung Kan	84,000-500,000 Kyats/year	10	Cattle, poultry, pig, and sheep	Myingyan Township	There are approximately 300 cattle that are used for agricultural purposes within the village. There are approximately 100 poultry, which are consumed or sold – depending on the household needs. There are 50 pigs and 400 sheep which are reared for sale. Milk from the cattle is sold for income.
Gyoke Pin	150,000-1,200,000 Kyats/year	13	Cattle, poultry, pig, sheep, goat, and horse	Myingyan township	There are approximately 600 cattle that are used for agricultural purposes. There are approximately 1,100 poultry, which are consumed or sold – depending on the household needs. There are 200 pigs. There are 100 sheep/ goats which are sold or milked – depending on the household needs. Milk from the cattle is sold.
Thien Ywa	100,000-1,050,000 Kyats/year	8	Cattle, poultry, pig, sheep, goat, and horse	Myingyan township	There are approximately 1,000 cattle that are used for agricultural purposes. There are approximately 1,100 poultry, which are consumed or sold – depending on the household needs. There are 600 sheep/ goats which are sold or milked – depending on the household. A small number of households have their own pigs as well.
Tha Pyay Thar	100,000-1,200,000 Kyats/year	70	Cattle, poultry, pig, sheep, goat, and buffalo	Myingyan township	A small number of households (e.g. 5) have their own cattle and/ or buffalo that are used for agricultural purposes. Approximately, 20 households have their own sheep/goat, while 200 households have their own pigs and poultry. Milk from cattle is sold.

*Household income is dependent on the number of livestock

Source: Field surveys 2015

Figure 6.10 Village Livestock Practices



Cattle (Hnan Ywa village)



Sheep (Tha Pyay Thar village)

6.6.3 Forestry

Approximately 48% of Myanmar is covered by forest, which equates to an area of approximately 31,773,000 ha. In 2011, the forestry sector contributed approximately 0.5% to GDP, and employed approximately 36,000 people.

The Myanmar Timber Enterprise (MTE), a government-owned company, manages the timber industry within the country. The focus is largely on teak and other hardwoods.

The dragging of logs is done mainly by elephants and, to a lesser extent, water buffalo. This process is referred to as skidding. The use of animals in log extraction is considered to have a lower impact on the environment than other methods.

In addition to the timber industry, many people in rural areas of Myanmar are dependent on forest products, especially for fire wood and fodder for livestock. Often poorer farmers and agricultural labourers supplement their incomes by cutting wood for fuel.

None of the villages in the Project area are involved in the forestry sector. The only nearby forest is the Thaung Thar Mountain Reserve, which is a government owned reserve located near Hnan Ywa (and approximately 4.7 km from the Project site) (***Figure 6.11***). The Reserve is not used by Project area villages.

Figure 6.11 Thaung Thar Mountain Reserve



Thaung Thar Mountain Reserve

Villagers in the Project area use wood for cooking. The wood is collected from areas close to the villages – e.g. nearby agricultural properties. This includes the Project site, although the site is fenced on all sides to prevent access.

6.6.4 Fisheries

The fishing industry contributes approximately 8% to GDP. The industry is separated into three components – inland fisheries, marine fisheries and aquaculture. The marine sector makes up approximately 52% of the industry, followed by inland fisheries (28%) and aquaculture (20%).

Inland fisheries in Myanmar are mostly associated with open waters (e.g. riverine and estuarine systems) and flood plains. Inland water bodies, such as natural lakes, reservoirs, river systems and ponds, cover about 8.1 million hectares, of which 1.3 million hectares are permanent, while the remainder are seasonally inundated floodplains (***Figure 6.12***).

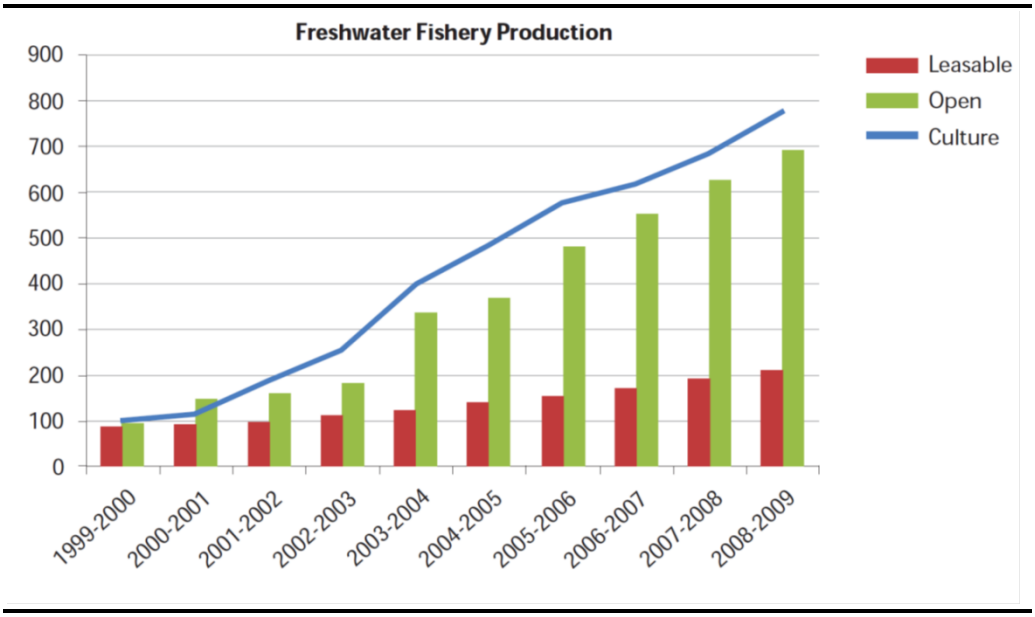
In 2008-2009, the total fish production in Myanmar was around 3,542,190 tons, of which 899,430 tons was from inland fisheries (***Figure 6.13***). Common fishing techniques include drift net, gillnet, traps and pots, pole-and-line, stationary traps, and bamboo stake traps in the near shore of rivers.

Figure 6.12 Rivers of Myanmar



Source: Maps of the World 2013

Figure 6.13 Inland Fisheries Production in Myanmar



Source: Ministry of Livestock and Fisheries 2014

The aquaculture industry is also prevalent in Myanmar and includes fin fish, crustaceans, and sea weed. At present, the aquaculture industry covers approximately 182,315 ha. This is broken down as follows:

- Freshwater fin fish: 89,138 ha;
- Freshwater prawn: 4,119 ha;
- Marine shrimp (in ponds): 88,308 ha; and
- Soft shell crab: 750 ha.

Fish constitutes approximately 75% of the animal protein consumed in Myanmar. It is anticipated that approximately 10-15% of monthly household expenditure for food is on fish or fish products.

In the Project area, only two villages indicated that they are actively involved in the fishing sector - Tha Pyay Thar (i.e. the village located closest to the Ayeyarwady River) and Gyoke Pin. (***Table 6.20***) Those involved in the fishing sector largely fish in the Ayeyarwady River, which can be done year round.

Table 6.20 Village Fisheries Practices

Village	Fish Species	Methods	Income	Notes
Sa Khar	-	-	-	There is no fishing.
Hnan Ywa	-	-	-	There is no fishing.
Hpet Taw	-	-	-	There is no fishing.
Nyaung Kan	-	-	-	There is no fishing.
Gyoke Pin	*Nga gyin, Tilapia, Nga yant*	Dip net	2,000-12,000 kyats per a peittha or viss*	There are 30 fishing households. Most of the households fish in the Ayeyarwady River year round and sell their catch at nearby markets. In some instances, buyers come directly to the village to purchase fish. A few villagers fish for personal consumption.

Village	Fish Species	Methods	Income	Notes
Thien Ywa	-	-	-	There is no fishing.
Tha Pyay Thar	*Nga gyin, Nga yant*	Dip net	2,000-12,000 kyats per a peittha or viss*	There are 70 fishing households. Most of the households fish in the Ayeyarwady River year round and sell their catch at nearby markets. A few villagers fish for personal consumption.

*This is a unit of measurement in Myanmar. A peittha or viss is equivalent to 1.6 kilograms
Source: Field surveys 2015

Unlike other areas of Myanmar, there does not appear to be any aquaculture in the Project area. Most of villagers rear livestock instead of relying on fish as a source of protein, which differs from other areas of Myanmar.

6.6.5 *Industry*

With the economic reforms underway, industry is a growing sector in the Myanmar economy. The key industries are: agricultural processing; wood and wood products; copper, tin, tungsten, and iron; cement and construction materials; pharmaceuticals; fertilizer; oil and natural gas; garments; and gems (CIA 2015). Many of the industries that exist or are being developed in the Myanmar are directly related to the availability of Myanmar's natural resources, such as oil and gas, copper, and tin.

In terms of the Project area, although the majority of people are involved in the agricultural sector, a small number of people own and operate businesses. This includes a range of shops – from bakeries to food stalls to stores that make and sell cheroot (***Figure 6.14***). (Cheroot production is largely an activity limited to women.)

Three villages indicated that households earned involve through business. This included Sa Khar (46 households), Hnan Ywa (2 households) and Thien Ywa (5 households).

There is also a steel mill, which is located adjacent to the Project site. The workforce for the steel mill has largely been sourced from outside the local area – due to the skill sets required to operate the mill.

Figure 6.14 Local Businesses



Making cheroot (Sa Khar)



Local shop (Gyoke Pin)




Local bakery (Nyaung Kan)

6.7 COMMUNITY INFRASTRUCTURE AND PUBLIC SERVICES

The limited access to and the poor state of existing infrastructure and services have been identified as impediments to development in Myanmar. This includes the provision of basic health and education services, as well as other infrastructure such as roads, telecommunications, drinking water and waste management (World Bank 2015).

The following section provides an overview of key existing infrastructure and services. (Note that healthcare infrastructure and drinking water and sanitation are covered in the section on community health.)

6.7.1 Education and Schools

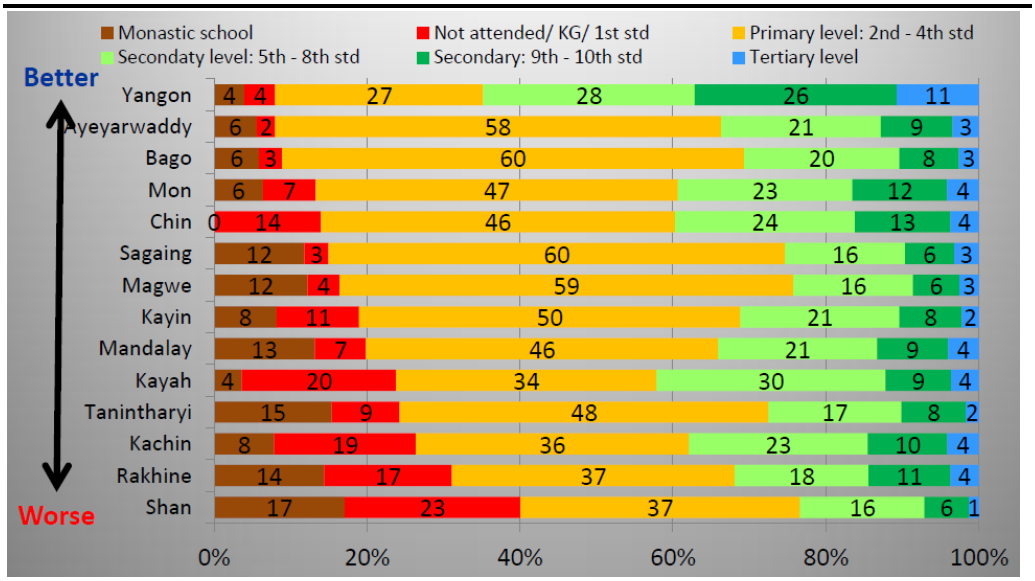
As of 2014, the adult literacy rate in Myanmar was 89.5%. However, the rate differs between men and women – with literacy being higher amongst males. The male literacy rate is 92.6%, while the literacy among females is 86.9%.

The literacy rate in the Mandalay Region was 93.8% as of 2014. Again the rate was higher amongst males (97.3%) when compared to females (90.9%). The rates in the Mandalay Region are lower than Yangon, which has a literacy rate of 96.6% - the highest in the country.

In terms of schools, it is common for children to attend primary school, but few move on to secondary school and even fewer complete years 9 and 10 or tertiary education.

In the Mandalay Region, approximately 46% of students attended primary school in 2011; however, less than 20% of these students reached high school (***Figure 6.15***). As of 2009, the Mandalay Region had 3,859 schools, of which 70 were high schools. There are a few colleges and universities in the Region, most of which are located in Mandalay.

Figure 6.15 Household Education Attainment Levels in Myanmar



Source: Poverty Profile, Integrated Household Living Conditions Survey (2011)

There are a host of educational facilities in the Project area (***Table 6.21*** and ***Figure 6.16***). Most villages have access to a primary, middle and high school, while two villages have technical education centres.

Table 6.21 Village Educational Facilities

Village	Description of Educational Facilities
Sa Khar	There is primary school near the village; it is approximately a 5 minute walk to the school. Most youth in the village obtain middle school level education. A few villagers have graduated from university in Yangon. There is a government technical high school located near the village - approximately a 15 minute motorbike ride away.
Hnan Ywa	There is primary school near the village; it is approximately a 5 minute walk to the school. Most of youth in the village complete primary school, but do not advance further. There is a government technical high school located nearby – approximately a 10 minute motorbike ride from the village.
Hpet Taw	There is a primary school and a high school located approximately a 5 minute walk from the village. Most youth in the village graduate from high school.
Nyaung Kan	There is primary school located approximately a 5 minute walk from the village. Nearly 70% of the youth in the village obtain primary school level education; while approximately 20% and 10% of them obtain middle school level and high school level education, respectively.
Gyoke Pin	There is a primary school located near the village; it is approximately a 5 minute walk to the school. Most youth in the village graduate from high school. A few villagers have graduated from university in Yangon.
Thien Ywa	There is a primary school located near the village; it is approximately a 5 minute walk to the school. Most youth in the village obtain a middle school level education.
Tha Pyay Thar	There is a primary school located near the village; it is approximately a 5 minute walk to the school. Most youth in the village obtain a middle school level education. A few villagers have graduated from university in Yangon.

Source: Field surveys 2015

Figure 6.16 Village Schools



A primary school (Nyaung Kan village)



A government technical high school

In most instances, villagers obtain a primary school education, while some continue on to middle school and/ or high school. A small number of villagers have obtained a university education. Villagers indicated that boys and girls both attended school – and there was no difference between the level of education achieved.

6.7.2 Waste Management

In Myanmar, it is anticipated that approximately 0.45 kilograms of waste is produced per capita per day (Glawe et al. n.d.). This includes organic waste, commercial waste and paper and plastic waste.

It is estimated that nearly 65% of the waste generated is organic waste. This is attributed to the size of the agricultural sector, as the agricultural sector largely generates organic waste.

In most major cities – such as Yangon – household waste is collected and disposed of for a small fee. However, outside major cities, waste disposal is typically the responsibility of the household. In both instances, solid waste is often disposed of at open dump sites, in other words uncontrolled sites. In a small number of cases, composting and recycling is carried out.

In terms of waste in the Project area, wastewater is largely directed back into the ground (***Figure 6.17***). Solid waste disposal is the responsibility of each household. Most households either burn their waste or dump their waste on nearby land, neither of which is regulated or controlled (***Figure 6.18***).

Figure 6.17 Wastewater Discharge



Sa Khar village

Figure 6.18 Solid Waste Disposal



Gyoke Pin village

6.7.3 Electricity and Energy

In Myanmar, most of the population is reliant on firewood for cooking (***Table 6.22***). This practice is contributing to the increasing rates of deforestation seen within the country.

Table 6.22 Access to Energy

Source	Cooking
Electricity	16.4%
LPG	0.4%
Kerosene	0.2%
Biogas	0.3%
Firewood	69.2%
Charcoal	11.8%
Coal	0.3%
Other	1.4%

Source	Lighting
Electricity	32.4%
Kerosene	8.1%
Candle	20.7%
Battery	17.0%
Generator	9.3%
Water mill	1.6%
Solar system	8.7%
Other	2.2%

In terms of lighting, a range of sources are available. The most commonly used are electricity, candle, and batteries. The access to electricity is likely to change in the future given the investment that the Myanmar government is making in the power sector; a number of new power plants are being developed in order to provide an increasing number of people with electricity.

The villages in the Project area largely use wood for cooking (***Table 6.23*** and ***Figure 6.19***); while a range of lighting sources exist including government supplied electricity. For those households that do not have access to electricity, batteries, candles, and generators are used for lighting.

Table 6.23 Village Energy Sources

Village	Description of Energy Sources
Sa Khar	Approximately 212 households are provided electricity by the government. Lighting is provided 24 hours per day by government. Most households use wood for cooking. Firewood is collected from farmland and along local roads. Some villagers purchase firewood.
Hnan Ywa	Approximately 50 households have access to electricity from a private/ commercial generator. Lighting is provided for 3 hours per day. Most villagers use wood for cooking. Firewood is collected from farmland and along local roads. Some villagers purchase firewood.
Hpet Taw	Approximately 260 households are provided electricity by the government. Lighting is provided 24 hours per day by government. Most households use wood for cooking. Most villagers buy firewood from outside the village. A small number of villagers collect firewood from farmland and areas along local roads.
Nyaung Kan	Approximately 250 households have access to electricity. Local solar power infrastructure provides 3 hours of lighting per day. Most villagers use wood for cooking. Firewood is collected from farmland and along local roads. Some villagers purchase firewood.
Gyoke Pin	Approximately 268 households are provided electricity by the government. Lighting is provided 24 hours per day by government. Most households use wood for cooking. Firewood is collected from farmland and along local roads.
Thien Ywa	Approximately 60 households have access to electricity from a private/ commercial generator. Lighting is provided for 3 hours per day. Most villagers use wood for cooking. Firewood is collected from farmland.
Tha Pyay Thar	Approximately 150 have access to electricity. Local solar power infrastructure provides 3 hours of lighting per day. Most villagers use wood for cooking. Firewood is collected from farmland and along local roads. Some villagers purchase firewood.

Source: Field surveys 2015

Figure 6.19 Village Energy Sources



Household access to electricity from the government (Sa Khar village)



Firewood used for cooking (Sa Khar village)

6.7.4 Transportation

A variety of transport methods are used in Myanmar, including roads, rail, air and water. In some areas the modes of transport are well developed, while in other areas they are quite limited (***Figure 6.20***).

Central Myanmar, where the Project is located, has a relatively well developed transport system compared to other parts of Myanmar. Due to its geography, central Myanmar, particularly Mandalay Region, acts as the central hub for transport. Existing infrastructure includes:

- Rail: The Yangon-Mandalay railway, which runs through eastern Mandalay, connects the region to Naypyidaw and Yangon;
- Water: The Ayeyarwady River plays a major role in transportation in the Mandalay Region. The River transports both goods and people through the Mandalay Region; and
- Air: There are three international airports in Myanmar - in Mandalay, Naypyidaw and Yangon.

Figure 6.20 Myanmar Transportation Network



Source: Cartographic Section, Department of Field Support, United Nations, June 2012

In terms of roads, most urban areas in Myanmar are accessible only by road. However, nearly half of all roads are not passable during the monsoon season (World Bank 2015) – limiting access to key areas within the country.

Myanmar has three main highways or corridors running north-south, as follows:

- Yangon-Mandalay Road – The road passes through major cities in central Myanmar such as Bago, Thungoo, Pyinmana, Naypyidaw, and Meikhtila;
- Yangon-Pyay Road – This road runs west of the Pegu Range; and
- Western Union Highway – The road connects urban areas west of the Ayeyarwady River, but is still largely under construction.

There are 2 main roads that transect the Project area are:

- Myingyan to Mandalay - The road starts in Mandalay and ends in Lashio, from which another road extends up to Muse; and
- Myingyan to Bagan - The road runs along the east bank of Ayeyarwady River from Magway to Bagan, passing through Yenanchaung.

Traffic accidents in Myanmar increased between 2013 and 2014 (***Table 6.24***). The overall number of accidents, injuries and fatalities in 2014 were 10,818, 18,621 and 3,064, respectively. For the Mandalay Region, the statistics are 1,116, 1,960 and 354, respectively.

Table 6.24 Road Traffic Accidents by States and Regions in Myanmar (2013-2014)

No.	State/Region	2014 January to October			2013 January to October		
		Accident	Injury	Fatality	Accident	Injury	Fatality
1.	Naypyitaw	279	472	143	306	450	172
2.	Kachin	352	507	136	259	445	109
3.	Kayah	102	140	33	95	150	20
4.	Kayin	313	629	96	294	537	62
5.	Chin	69	146	30	57	109	24
6.	Sagaing	1,241	2,302	312	530	881	144
7.	Taninthayi	252	406	97	3,16	624	76
8.	Bago	1,163	2,193	340	1,208	2,108	288
9.	Magway	923	2,060	221	785	1,610	179
10.	**Mandalay**	**1,116**	**1,960**	**354**	**988**	**1,603**	**300**
11.	Mon	434	712	193	456	723	203
12.	Rakhine	263	465	76	215	334	69
13.	Yangon	2,295	3,231	425	2,177	3,210	324
14.	Shan	401	742	137	341	665	106
15.	Shan(Lashio)	307	402	169	235	396	84
16.	Shan(Kyaington)	137	287	73	139	257	65
17.	Ayeyarwady	1,171	1,967	229	875	1627	190
	Total	10,818	18,621	3,064	9,276	15,729	2,415

Source: Road Transport and Administration Department 2014

In terms of modes of transport, the most commonly owned vehicles are motorcycles and bicycles, with higher levels of ownership in urban areas compared to rural areas (***Table 6.25***).

Table 6.25 Vehicle Ownership

Method	Total	Urban	Rural
Car/ truck/ van	3.1%	8.1%	1.2%
Motorcycle/ moped	38.7%	41.2%	37.7%
Bicycle	35.9%	46.9%	31.7%
4-Wheel tractor	2.5%	1.4%	2.9%
Canoe/boat	3.9%	0.6%	5.1%
Motor boat	2.25%	0.5%	2.8%
Cart	21.6%	2.5%	29.1%

Within the Project area, most of the roads are in considered to be of poor quality. They are largely due to the fact that the roads are made of dirt and experience heavy

rains during the wet season. Often during the rainy season, the roads become unusable.

In terms of modes of transport, some villagers own their own vehicles – such as two-wheelers and four-wheelers (***Table 6.26***). Those that do not have vehicles rely on public transport, including buses, trains and motor cycle taxis (***Figure 6.21***). There is one train station within the Project area – it is located not far from Sa khar and Hnan Ywa.

Table 6.26 Village Vehicle Ownership

Village	Households*	Motorcycle	Car/ truck/ van	Canoe/boat
Sa Khar	329	200	5	-
Hnan Ywa	113	40	5	-
Hpet Taw	1,100	875	110	-
Nyaung Kan	250	200	10	-
Gyoke Pin	438	438	3	7
Thien Ywa	117	100	4	-
Tha Pyay Thar	210	150	-	50

* Note: Some villagers own their own vehicles.
Source: Field surveys 2015

Figure 6.21 Village Vehicle Ownership



Motorcycle (Nyaung Kan village



Bicycle (Hpet Taw)

6.8 CULTURAL HERITAGE

Cultural heritage study area consists of an area 3km from the Complex (Project site and existing Steel Mil) and 500m buffer of the water supply pipeline route presented in the Scoping Study undertaken by IFC in 2015[1] (see ***Figure 6.22***). The principal types of tangible cultural heritage resources of concern are:

- Archaeological resources (e.g. sites, artefacts, ruins);
- Ancient above ground resources (e.g. monuments, buildings, structures, and facilities over 100 years old); and
- Living heritage sites (e.g. temples, cemeteries, shrines, and sacred sites).

(1) Myingyan IPP Project – Environmental & Social Consultancy Services in Support of Transaction Advisory Service's for Private Sector Participation Scoping Report – Rev 4 – 18th May 2015.

Desktop study supplemented by field survey conducted between 7 and 16 July 2015 identified no known archaeological resources; three items of ancient above ground resources and 20 items of living heritage sites within the cultural heritage study area (***Table 6.27***). All the identified items are pagoda complexes and monasteries. Most of these items are located within or in close proximity to human settlements. The villages located within the cultural heritage study area include Tha Pyay Thar, Nyaung Kan, Hpet Taw, Hnan Ywa, Thein Ywa and Gyoke Pin. No tangible cultural heritage resources were identified within the project's footprint (i.e. the CCGT plant site boundary and proposed water intake pipeline).

No significant intangible cultural heritage (e.g. tradition, ritual and religious practice, ceremonies) was identified through interview with villagers and stakeholder's meeting. Examples of national festivals and ceremonies to be held are Water Festivals, Myanmar New Year, Full moon Day of Tabaung and Novitiation Ceremonies etc. Pagoda complexes and monasteries are the centre of traditional and religious life. Take Novitiation Ceremonies for instance, the ceremonies will take place at all villages on a certain day in March and April which the date is specific for each village, chosen by the abbots of the monasteries. Boys would shave their hair, wear the robe and start to learn Buddhism. On the other hand, worship to local spirit "Amay Shwe Khar" (golden mother Khar), aunt of famous sprit "Ko Gyi Kyaw"(drunken spirit is representing Ava period (1364-1555)) was found particularly popular at Sar Khar Village, which worshippers are restricted from livestock breeding of goat, pig and duck.

Table 6.27 List of Key Tangible Cultural Heritage Resources Identified within the Cultural Heritage Study Area

Item	Tangible Cultural Heritage Resources (Type)	Proximity to the Project's Footprint (Figure Number)
TPT1	Pagoda complex (Living Heritage Sites)	Located in Tha Pyay Tha Village, about 60.7m from the proposed water intake pipeline (***Figure 6.23***)
TPT2	Pagoda complex (Living Heritage Sites)	Located in Tha Pyay Tha Village, about 491.7m from the proposed water intake pipeline (***Figure 6.23***)
TPT3	Pagoda complex (Living Heritage Sites)	Located in Tha Pyay Tha Village, about 47.2m from the proposed water intake pipeline (***Figure 6.23***)
TPT4	Kyun Oo pagoda (Living Heritage Sites)	Located in village opposite to Tha Pyay Tha Village, about 311m from the proposed water intake pipeline (***Figure 6.23***)
NK1	Pagoda complexe (Living Heritage Sites)	Located in Nyaung Kan 2,102.5m from the CCGT plant site boundary and 379.9m from the proposed water intake pipeline (***Figure 6.24***)
NK2	Pagoda complex (Living Heritage Sites)	Located in Nyaung Kan, about 1,093.4m from the CCGT plant site boundary and 230.9m from the proposed water intake pipeline (***Figure 6.24***)
NK3	Pagoda complex (Living Heritage Sites)	Located in Nyaung Kan, about 2,313.5m from the CCGT plant site boundary and 479.9m from the proposed water intake pipeline (***Figure 6.24***)

Item	Tangible Cultural Heritage Resources (Type)	Proximity to the Project's Footprint (Figure Number)
HT1	Shinbin Dawne' Ancient Pagoda (Ancient Above Ground Resources)	Located between Myingyan steel mill and Hpet Taw, 640.2m to the southwest of the CCGT plant site boundary (***Figure 6.25***)
HT2	Pagoda complex (Living Heritage Sites)	Located in Hpet Taw, about 1,937m from the CCGT plant site boundary and 1,480.8m from the proposed water intake pipeline (***Figure 6.25***)
HT3	Pagoda complex (Living Heritage Sites)	Located in Hpet Taw, about 1,986.8m from the CCGT plant site boundary and 1,897.2m from the proposed water intake pipeline (***Figure 6.25***)
HY1	Pagoda complex and Buddhist monastery for young monks (Living Heritage Sites)	Located in Hnan Ywa village, 631.5m to the southeast of the CCGT plant site boundary (***Figure 6.26***)
HY2	Pagoda complex (Living Heritage Sites)	Located in Hnan Ywa village, 1,323m from of the CCGT plant site boundary (***Figure 6.26***)
HY3	Pagoda complexes (Living Heritage Sites)	Located in Hnan Ywa village, 1,364.3m from of the CCGT plant site boundary (***Figure 6.26***)
HY4	Huan Ywa Pagoda	Located in Hnan Ywa village, 887.5m from of the CCGT plant site boundary (***Figure 6.26***)
SK1	Uttarathiri monastery pagoda complex (Ancient Above Ground Resources)	Located near Sar Khar village, about 892.5m to the north of the CCGT plant site boundary and 741m from the proposed water intake pipeline (***Figure 6.27***)
SK2	Pagoda complexes (Living Heritage Sites)	Located in Sar Khar village, about 1022.4m from the CCGT plant site boundary (***Figure 6.27***)
SK3	Su Taung Pyae Pagoda, Thein Taw Shin Pagoda (Thein Taung pagoda complex) (Ancient Above Ground Resources)	Located in Sar Khar village, about 767.7m from the CCGT plant site boundary (***Figure 6.27***)
SK4	Amay Shwe Khar's Abode and worshipers (Living Heritage Sites)	Located in Sar Khar village, about 695.4m from the CCGT plant site boundary (***Figure 6.27***)
TY1	Pagoda complex (Living Heritage Sites)	Located in Thein Ywa Village, about 1,840.5m from the CCGT plant site boundary (***Figure 6.28***)
TY2	Pagoda complex (Living Heritage Sites)	Located in Thein Ywa Village, about 2,287.1m from the CCGT plant site boundary (***Figure 6.28***)
GP1	Pagoda complexes (Living Heritage Sites)	Located in Gyoke Pin village, about 1,647.6m from CCGT plant site boundary and 1,058.2m from the proposed water intake pipeline (***Figure 6.29***)
GP2	Pagoda complex (Living Heritage Sites)	Located in Gyoke Pin village, about 2869.6m from the CCGT plant site boundary and 2,272.3m from the proposed water intake pipeline (***Figure 6.29***)
GP3	Pagoda complex (Living Heritage Sites)	Located in Gyoke Pin village, about 2,957.8m from the CCGT plant site boundary and 2,343m from the proposed water intake pipeline

Item	Tangible Cultural Heritage Resources (Type)	Proximity to the Project's Footprint (Figure Number)
		(***Figure 6.29***)

Source: Field surveys 2015

Figure 6.22 Key Tangible Cultural Heritage Resources Identified within the Cultural Heritage Study Area

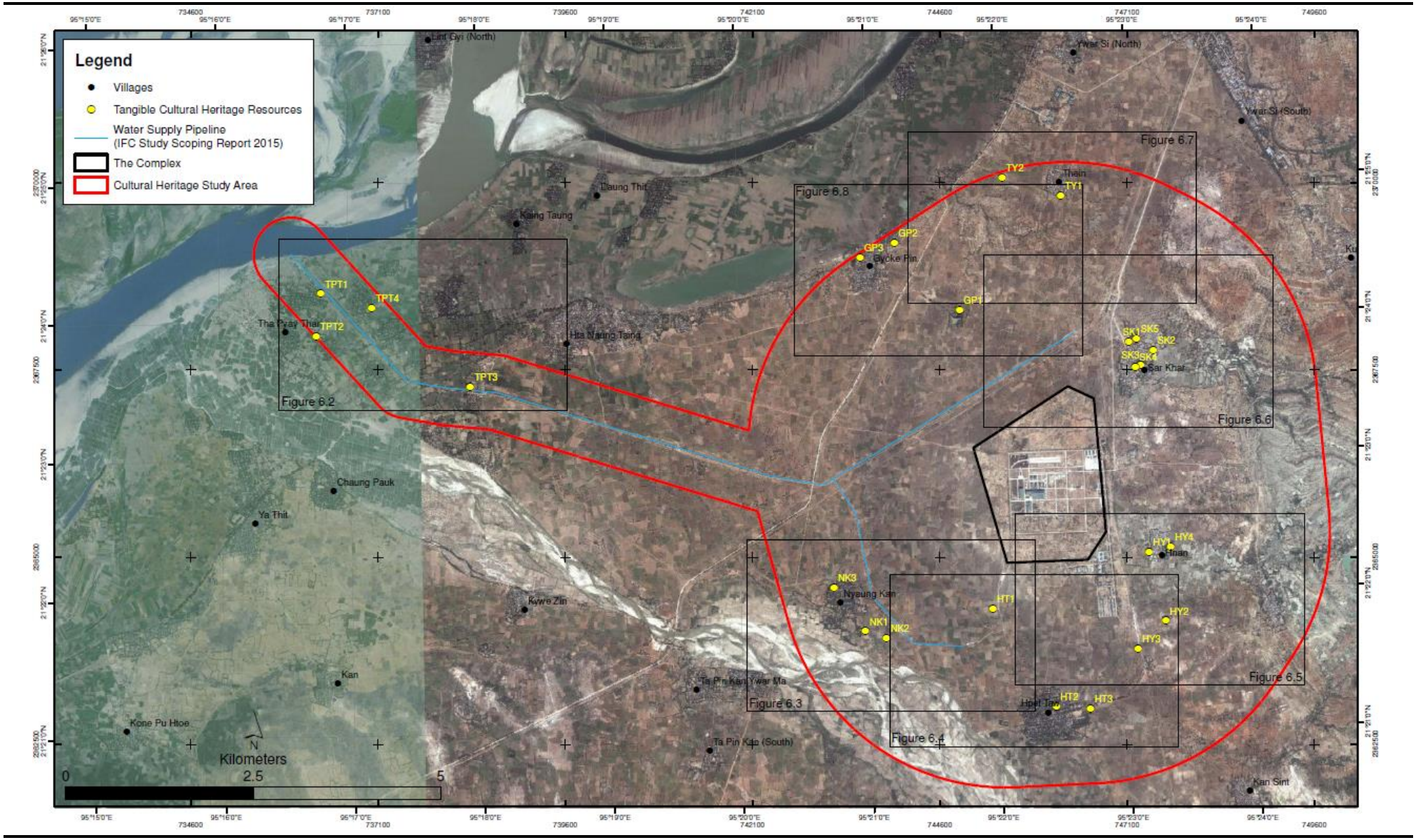


Figure 6.23 Cultural and Social Heritage Resources Identified at/ near Tha Pyay Tha

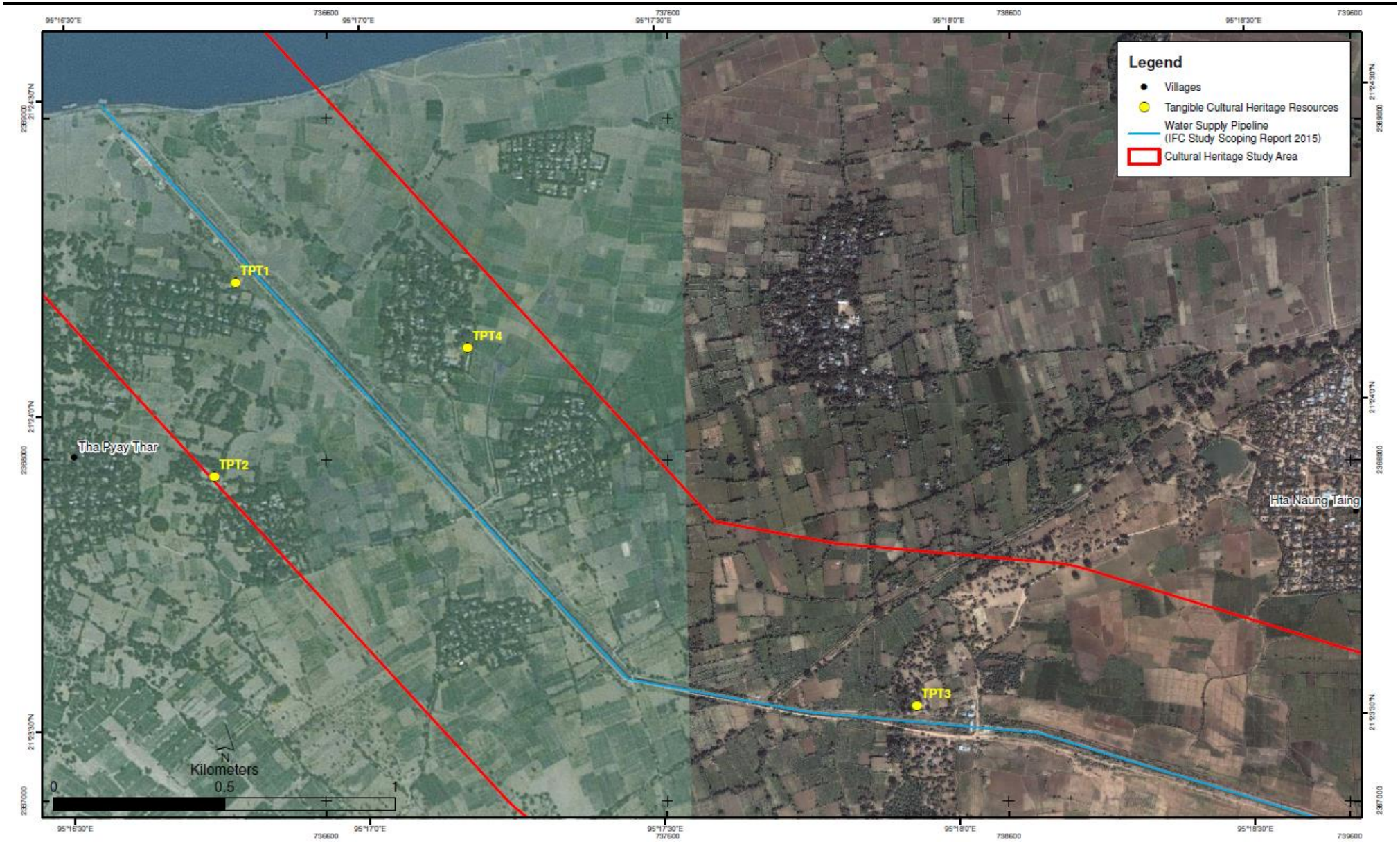


Figure 6.24 Cultural and Social Heritage Resources Identified at/ near Nyaung Kan

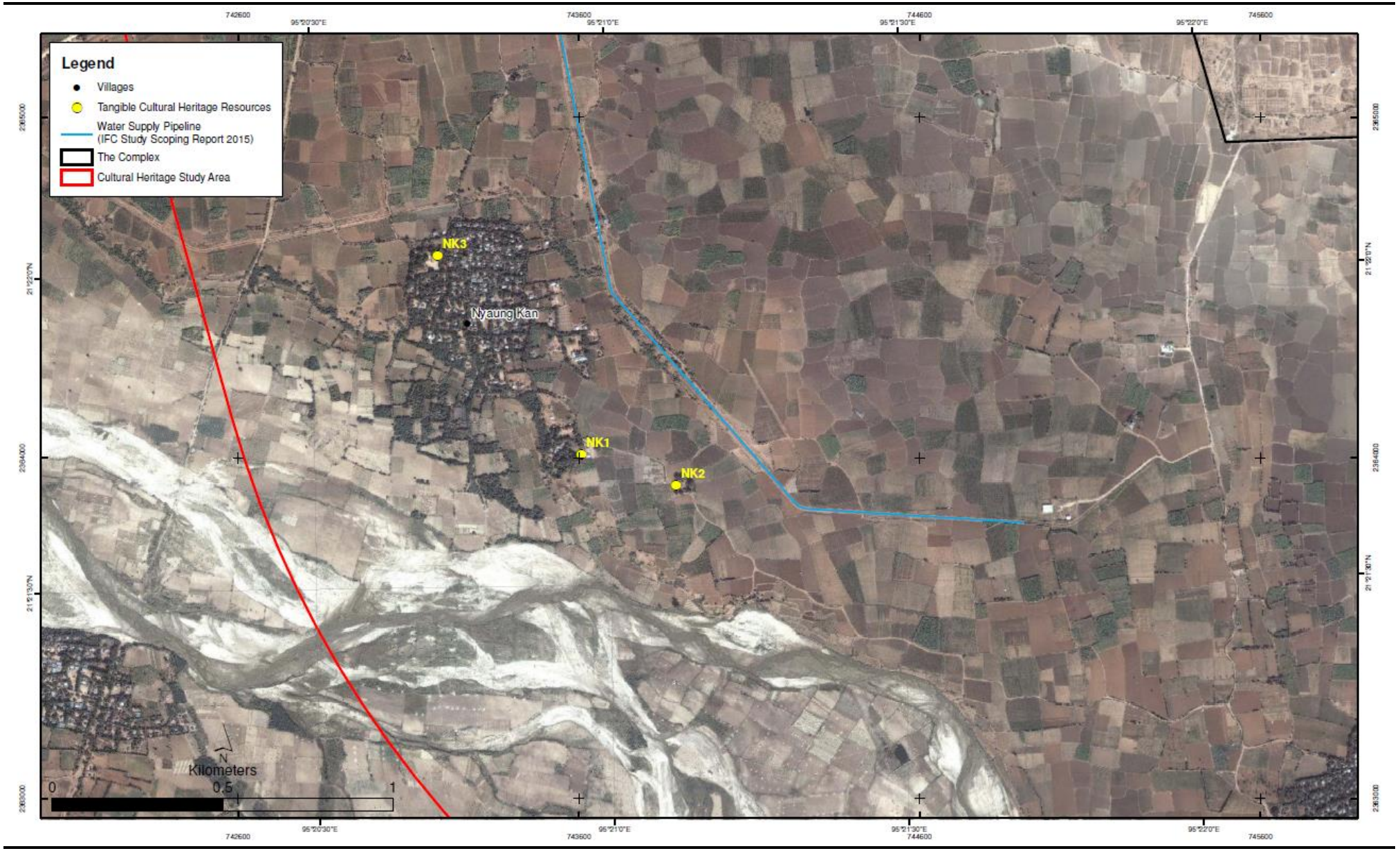


Figure 6.25 Cultural and Social Heritage Resources Identified at/ near Hpet Taw

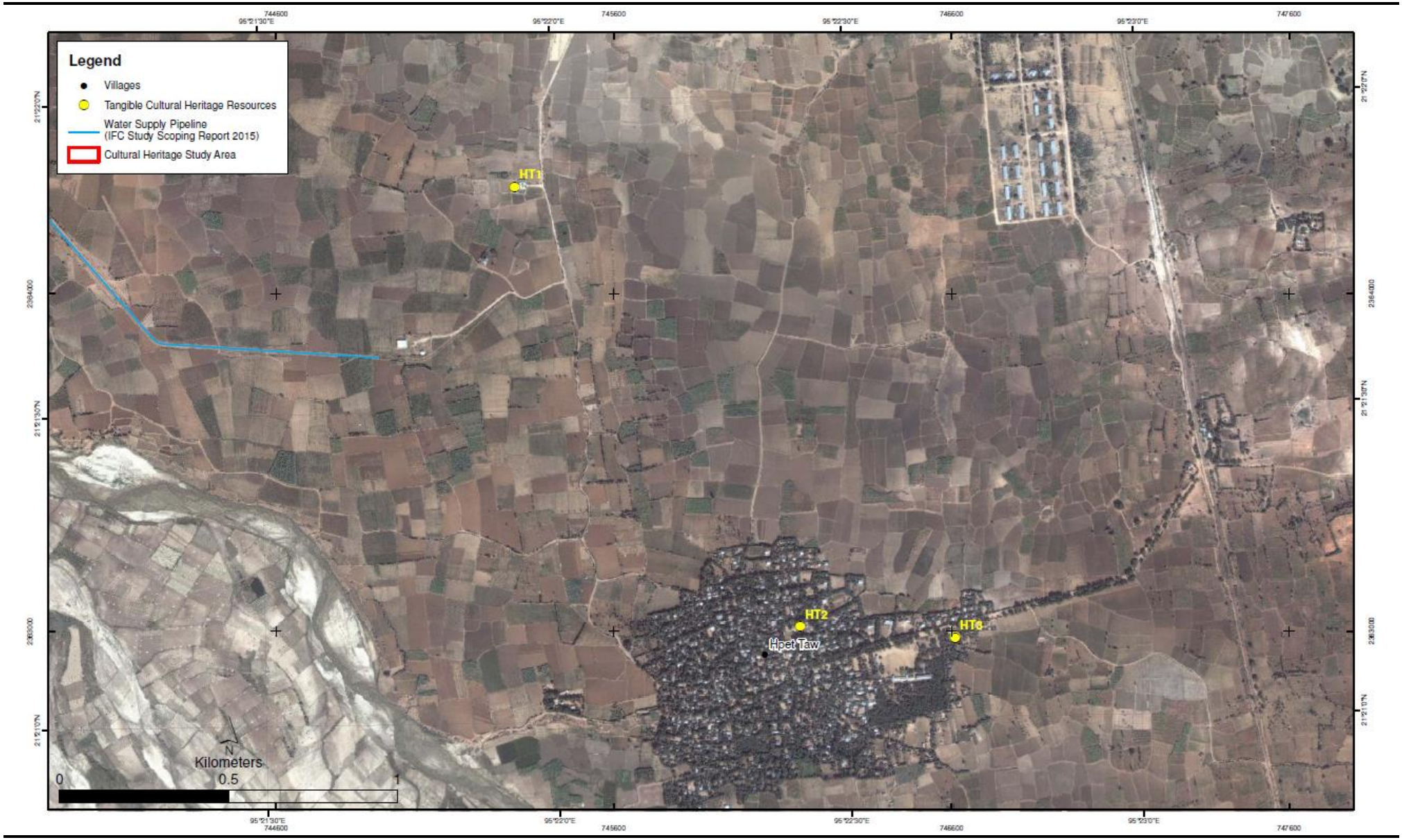


Figure 6.26 Cultural and Social Heritage Resources Identified at/ near Hnan Ywar

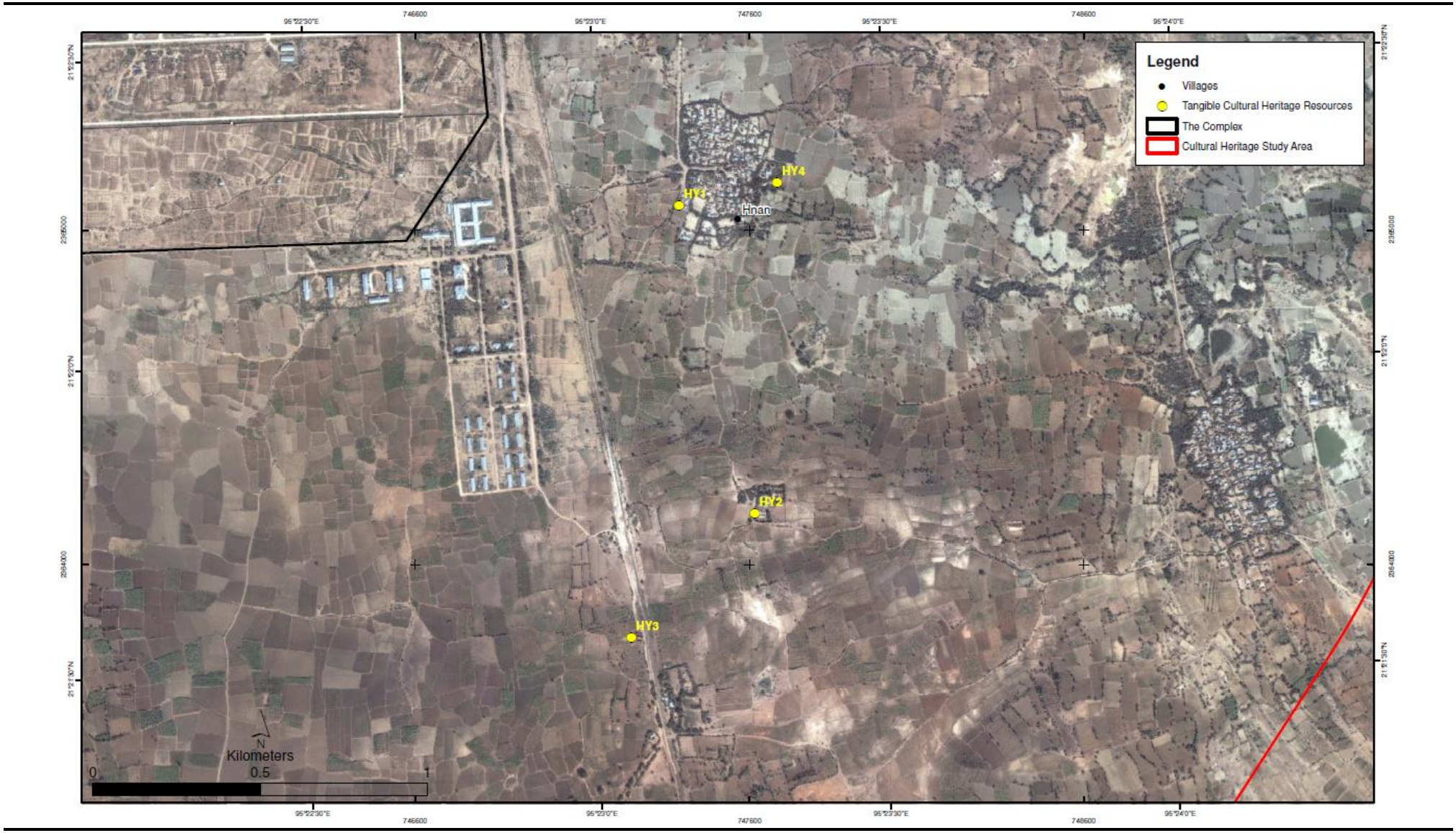


Figure 6.27 Cultural and Social Heritage Resources Identified at/ near Sa Khar

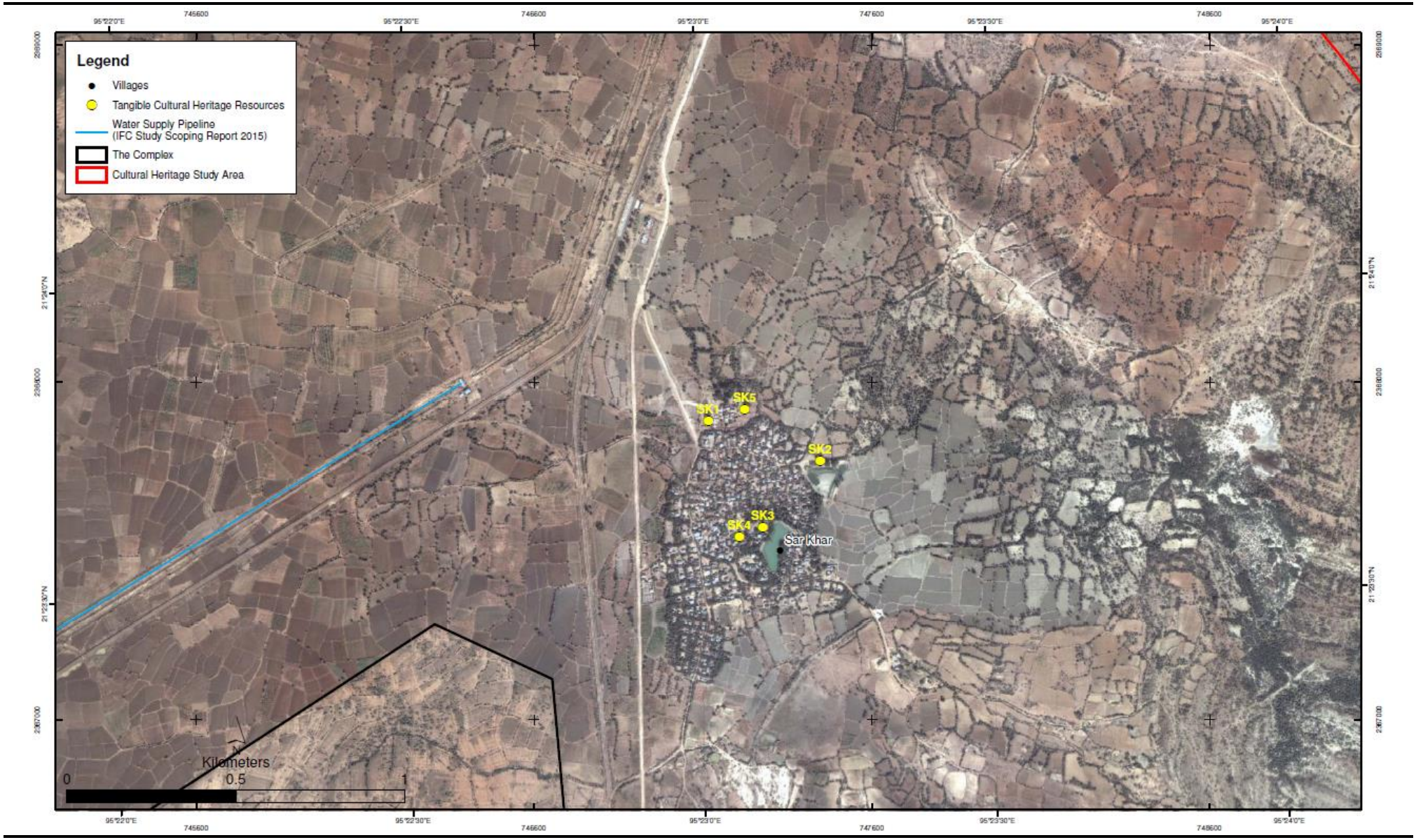


Figure 6.28 Cultural and Social Heritage Resources Identified at/ near Thein Ywa

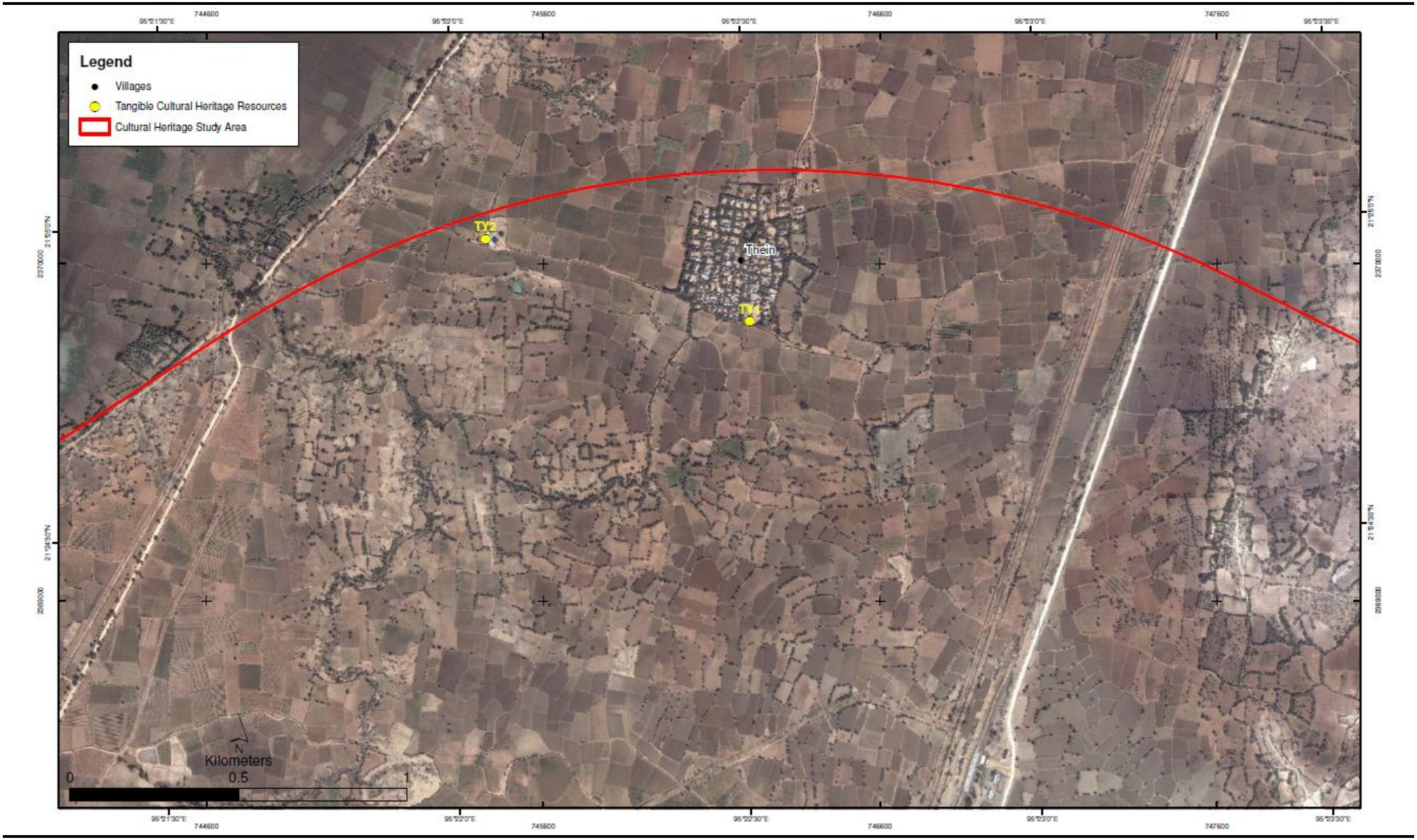
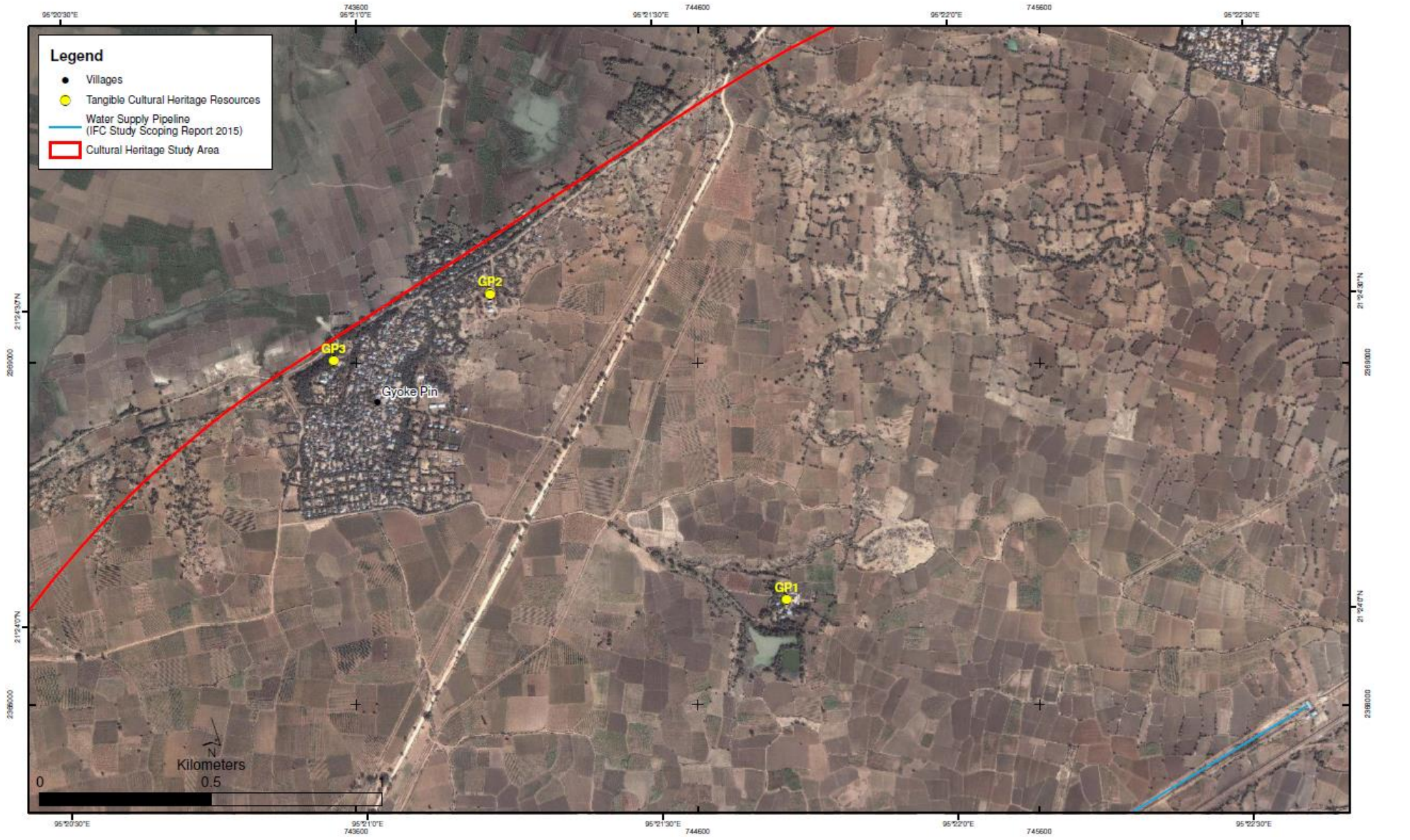


Figure 6.29 Cultural and Social Heritage Resources Identified at/ near Gyoke Pin



7 AIR QUALITY

7.1 INTRODUCTION

This Chapter presents an assessment of the potential impacts of the proposed Combined Cycle Power Plant in Myingyan (hereafter referred to as "the Project") on ambient air quality during the construction and operational phases. Air sensitive receivers (ASRs) and potential sources of air emissions were identified and an assessment of the potential air quality impacts arising from these air emissions was carried out. Mitigation measures and recommendations are provided for consideration where necessary to be implemented to reduce any potential residual impacts to acceptable levels where practicable.

7.2 ASSUMPTIONS AND LIMITATIONS

The air quality impact assessment presented in this Chapter is based on the information available from the Sponsor.

The construction air quality impact assessment was carried out qualitatively, while the operation air quality impact assessment was carried out quantitatively.

The air modelling input data of the Project have been agreed by Sponsor. The cumulative air quality impact assessment for the operational phase has taken into account the potential impact from the Project itself and the baseline air quality data. The baseline air quality data is derived from the background pollutant concentrations monitored at a number of identified monitoring stations in the vicinity of the Project, as outlined in the ***Chapter 5***. An operating Steel Mill plant was identified to the south of the Project. It is assumed that the air quality impact due to emissions from the adjacent operating Steel Mill plant (Phase I) has been captured in the baseline air quality data.

Should there be significant change of the plant or stack design which will affect the predicted results, an update of the air quality modelling and additional operational phase assessment will be required.

7.3 SCOPE OF THE ASSESSMENT

The air quality impact assessment has focussed on the following components of the Project:

- Construction phase activities with potential air quality impact:
  - Fugitive dust emissions from the dusty activities from construction of power plant facilities including excavation and filling, materials handling, vehicle movement on the haul roads and wind erosion of open stockpile area or open bare ground; and
  - Emissions from vehicle movement and non-road machineries.
- Operational phase activities with potential air quality impact:
  - Air emissions from stacks during the operation of the Project.

The assessment of the potential construction air quality impacts has been focussed within the Area of Influence (AoI) which is generally defined as 500m area from the

Project site boundary as the impact is localized. For the impact assessment of stack emission, the AoI is extended to 10km area from the Project site boundary.

The air pollutants of concern during construction and operational phases are summarized in ***Table 7.1*** below:

Table 7.1 Air Pollutants of Concern during Construction and Operational Phase of the Project

Phase	Activities	Concerned Air Pollutant
Construction	Construction Dust Emissions from vehicle and non-road machinery	Particulate matters (PM) Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), particulate matters in terms of PM_{10} and $PM_{2.5}$
Operational	Stack emissions	NO_2, SO_2, PM_{10} and $PM_{2.5}$

7.4 LEGISLATION REQUIREMENTS AND IFC GUIDELINES

At present, the Government of Myanmar has not yet established any numerical standard for ambient air quality. Following the IFC's *Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality*, in the absence of the national legislated standards, the current World Health Organization (WHO) Air Quality Guidelines should be used. ***Table 7.2*** shows WHO's Air Quality Guidelines for each of the ambient air parameters at different averaging periods.

In addition to guidance values, WHO also provides interim targets for concentrations of various air pollutants, which are aimed at promoting a gradual tightening of ambient air pollutant concentrations. Given that air pollution levels in some countries may far exceed the WHO recommended guidance values, these proposed interim target levels can be adopted by countries taking into account their specific local circumstances. Countries can choose to adopt different interim targets considering the balance amongst factors such as risks to public health, technological feasibility, economic development and other political and social factors.

Since Myanmar is a developing country which is yet to have its local national air quality standards to regulate local ambient air quality, it is recommended that the WHO Interim Target 1 would be adopted as the ambient air quality guidelines in Myanmar and the assessment criteria for this Project. If no WHO interim target is provided for some pollutants, the ultimate guideline value would be adopted.

Table 7.2 WHO Ambient Air Quality Guidelines (2005) [(a)]

Pollutant	Averaging Period (mean)	Guidance Value in µg/m^3	
Sulphur dioxide (SO_2)	24-hour	125	(Interim target-1)
		50	(Interim target-2)
		20	(guideline)
	10 minute	500	(guideline)
Nitrogen dioxide (NO_2)	1-year	40	(guideline)
	1-hour	200	(guideline)
Particulate Matter PM_{10}	1-year	70	(Interim target-1)
		50	(Interim target-2)
		30	(Interim target-3)
		20	(guideline)
	24-hour	150	(Interim target-1)
		100	(Interim target-2)
		75	(Interim target-3)
		50	(guideline)
Particulate Matter $PM_{2.5}$	1-year	35	(Interim target-1)
		25	(Interim target-2)
		15	(Interim target-3)
		10	(guideline)
	24-hour	75	(Interim target-1)
		50	(Interim target-2)
		37.5	(Interim target-3)
		25	(guideline)
Ozone	8-hour daily maximum	160	(Interim target-1)
		100	(guideline)

Note:

(a) Extracted from WBG EHS General Guidelines, Environmental Chapter, Section 1.1, Table 1.1.1 based on World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

For the said project, IFC's emissions guidelines for combustion turbine using natural gas are shown in ***Table 7.3***.

Table 7.3 Emission Guidelines for Combustion Turbine (in mg/Nm^3 or as indicated) [(a)]

Combustion Technology / Fuel	Particulate Matter (PM)		Sulphur Dioxide (SO_2)		Nitrogen Oxides (NO_x)	Dry Gas, Excess O_2 Content (%)
	NDA [(b)]	DA [(b)]	NDA	DA	NDA/DA	NDA/DA
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%

Notes:

(a) Extracted from IFC EHS General Guidelines for Thermal Power Plant, Table 6(B), p21 dated December 19, 2008.

(b) NDA: Non Degraded Airshed
DA: Degraded Airshed (poor air quality)
Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly. For detailed notes and explanation refer to IFC EHS General Guidelines for Thermal Power plants, Table 6(B).

7.5 SUMMARY OF RELEVANT BASELINE CONDITIONS

Chapter 5 provides the details on the baseline conditions for air quality in the Project AoI. Five locations (namely MAQN-1 to MAQN-5), which are located in the vicinity of the Project Site, were selected as the baseline air sampling locations. NO_2, SO_2, PM_{10} and $PM_{2.5}$ were measured at the selected baseline air sampling locations for seven consecutive days each month from July 2014 to June 2015 (refer to ***Table 5.6*** in ***Section 5***).

The measured NO_2, SO_2, PM_{10} and $PM_{2.5}$ at all the selected baseline air sampling locations from July 2014 to June 2015 have been averaged to represent the average background concentrations of the air pollutants at the Project site area. A summary of the background concentrations of NO_2, SO_2, PM_{10} and $PM_{2.5}$ for air quality impact assessment is presented in ***Table 7.4***.

Table 7.4 Summary of the Average Background Air Pollutant Concentrations in the Project Site Area

Air Pollutant	Average Background Concentration (µg/m^3)
SO_2	6.2
NO_2	54.0
PM_{10}	43.3
$PM_{2.5}$	26.7

7.6 IDENTIFICATION OF AIR SENSITIVE RECEPTORS

The representative Air Sensitive Receptors (ASRs) that will potentially experience air quality impacts from activities during the construction and operation phase of the Project have been identified.

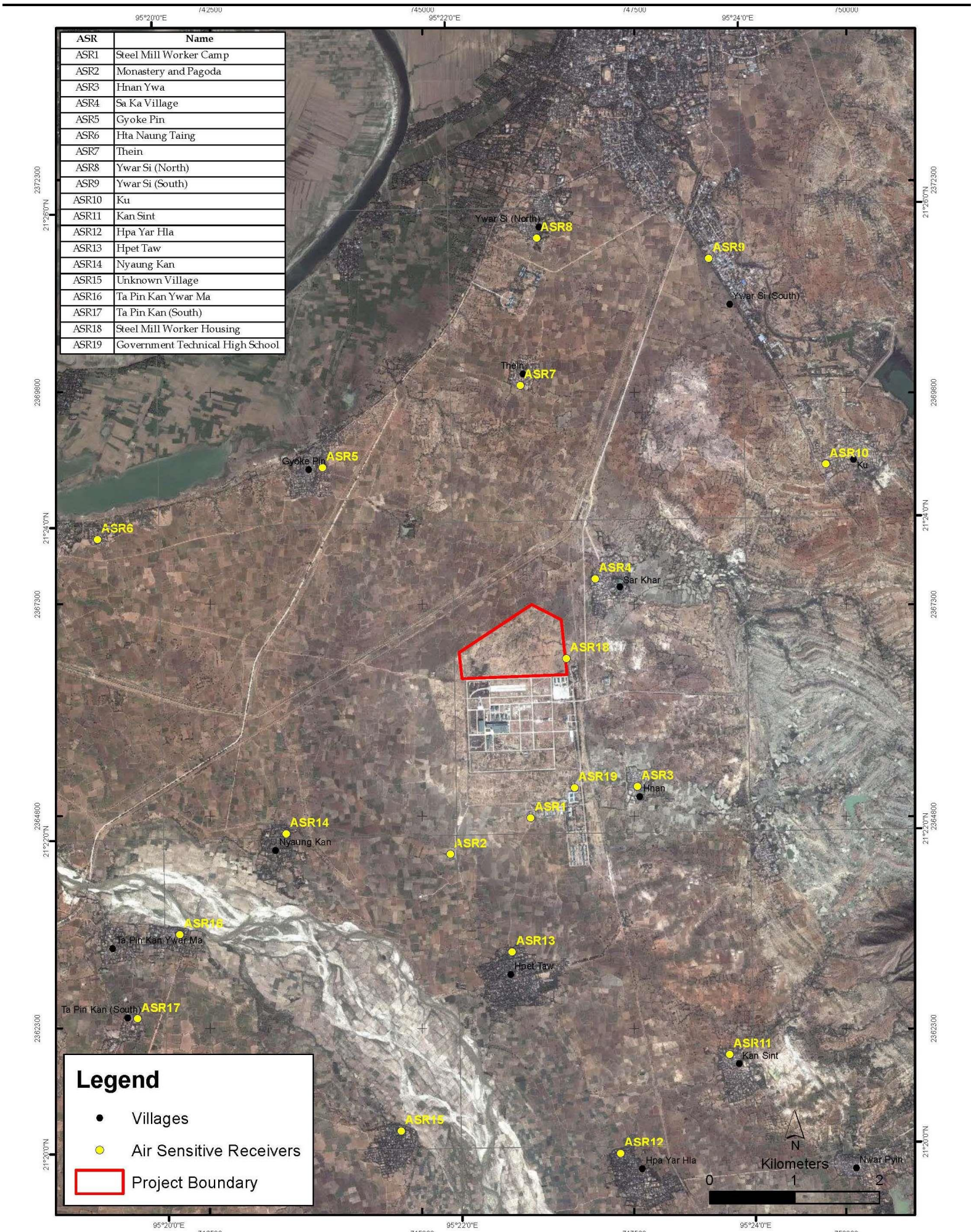
The locations of the identified representative ASRs are listed in ***Table 7.5*** and shown in ***Figure 7.1***.

Table 7.5 Representative Air Sensitive Receptors (ASRs)

ASR	Location	Type of Uses	Approximate Nearest Distance to the Project Site Boundary (m)
ASR1	Steel Mill Worker Camp	Industrial	1,670
ASR2	Monastery and Pagoda	Residential	2,075
ASR3	Hnan Ywa	Residential	1,560
ASR4	Sa Ka Village	Residential	630
ASR5	Gyoke Pin	Residential	2,720
ASR6	Hta Naung Taing	Residential	4,470
ASR7	Thein	Residential	2,590
ASR8	Ywar Si (North)	Residential	4,320
ASR9	Ywar Si (South)	Residential	4,585
ASR10	Ku	Residential	3,620
ASR11	Kan Sint	Residential	4,870
ASR12	Hpa Yar Hla	Residential	5,680
ASR13	Hpet Taw	Residential	3,240
ASR14	Nyaung Kan	Residential	2760
ASR15	Unknown Village	Residential	5,380
ASR16	Ta Pin Kan Ywar Ma	Residential	4,490
ASR17	Ta Pin Kan (South)	Residential	5,545

ASR	Location	Type of Uses	Approximate Nearest Distance to the Project Site Boundary (m)
ASR18	Steel Mill Worker Housing	Residential	10
ASR19	Government Technical High School	Institutional	1,350

Figure 7.1 Location of Representative Air Sensitive Receivers



7.7 IDENTIFICATION OF IMPACTS

7.7.1 Construction Phase

The construction activities of the Project have been outlined in ***Chapter 2***. The construction of the Project is anticipated to commence in the first quarter of 2016 and will last for about 22.5 months. The key activities which may potentially cause air quality impacts are listed below:

- Site clearance, site formation and levelling involving excavation and backfilling; and
- Construction of substructure and superstructure of the main power plant facilities including infrastructure and buildings.

Construction dust arising from the dust generating activities and air emissions from construction vehicles and non-road machinery within the construction site boundary are the key concerns during construction of the Project.

7.7.2 Operational Phase

The key emission source associated with the operation of the Project is stack emissions from the combustion of natural gas during combined cycle and simple cycle operation.

The main air pollutant of concern for a gas-fired combined cycle power plant is nitrogen dioxide (NO_2) whilst emissions of sulphur dioxide (SO_2) and particulate matters (PM) including respirable suspended particulates (PM_{10}) and fine suspended particulates ($PM_{2.5}$) are likely to be minimal provided that the combustion process is optimised and efficient.

7.8 ASSESSMENT METHODOLOGY

7.8.1 Construction Phase

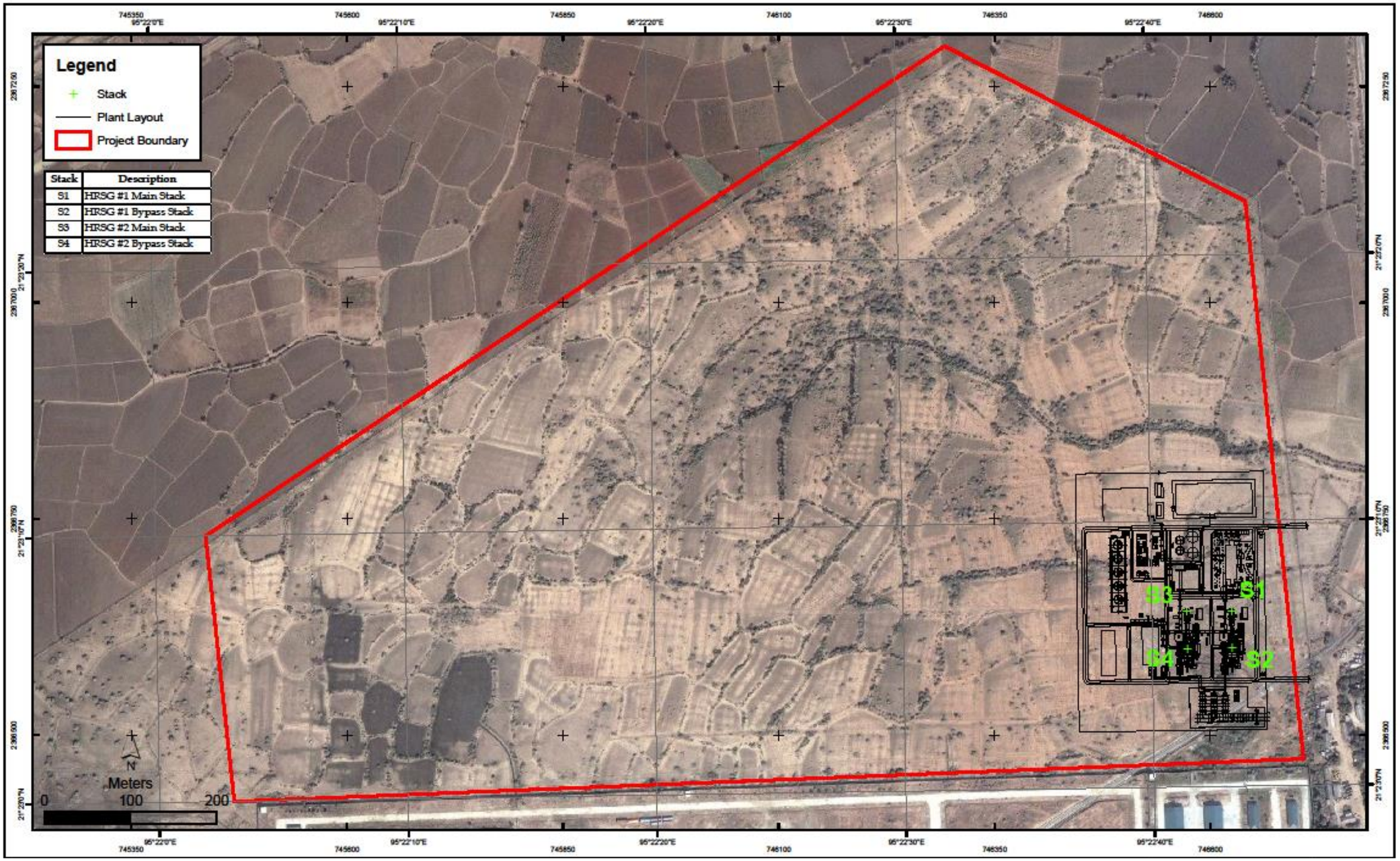
The air quality impacts during construction of the Project have been assessed in a qualitative manner following IFC guidelines and based on the best available information.

7.8.2 Operational Phase

Overview of Stack Emissions from the Project

Stack emission has been identified as key source of air pollution during operation of the Project. The Project consists of two sets of gas turbine generating unit, two sets of heat recovery steam generator (HRSG) and one steam turbine generating unit with associated auxiliary equipment. The Project will be designed to operate continuously throughout the year in either simple cycle or combine cycle mode. Each gas turbine is equipped with one bypass stack for simple cycle mode and one main stack for combined cycle mode. The Project site boundary and the locations of the bypass stack and main stack for each gas turbine within the Project site are shown in ***Figure 7.2***.

Figure 7.2 Stack Location with Project Site



During combined cycle operation, the heat of exhaust gas will be admitted to the HRSG where superheated steam will be produced which will then drive the steam turbine to generate additional electrical power. The flue gas from the HRSG will be emitted via the main stack (S1 and S3). During simple cycle operation, the flue gas from the gas turbine will be emitted via the bypass stack (S2 and S4).

During normal operation of the Project, the plant will be operated in combined cycle mode and the main stack will be in operation. Simple cycle operation will occur during the first 5 months of the operation of the Project before the combined cycle plant is commissioned, as well as during shutdown of steam turbine for maintenance of approximately 40 days once in 3 years. The main stack and the bypass stack will not be operating concurrently at any time.

The contributions of stack emissions from the Project during operation phase have been quantitatively assessed using an air dispersion model, AERMOD (version 14134) [(1)]. The modelling input data for the main stack and bypass stack as provided are presented in ***Table 7.6***.

Table 7.6 Summary of Modelling Input Data for Stack Emissions of the Project

Input Parameter		HRSG Main Stacks	HRSG Bypass Stacks	Remarks
Operation mode		Combined-cycle	Simple-cycle	-
Number of stack		2 (S1 and S3)	2 (S2 and S4)	2 gas turbine units, each has 1 main stack and 1 bypass stack
Coordinates of stack (X, Y)		S1: 746624.6, 2366644 S3: 746572.8, 2366643	S2: 746625.3, 2366601 S4: 746573.4, 2366600	Obtained from site layout plan provided by Sembcorp
Stack height (m above ground)		40	30	Provided by Sembcorp
Diameter of each stack (m)		3.72	4	Provided by Sembcorp
Flue gas exit temperature (^{o}K/ ^{o}C)		375/ 101	892 / 619	At operating condition
Flue gas exit velocity (m/s)		20.1	41.3	At operating condition
Flue gas exit flow rate (wet) under standard condition (Nm^3/s)		158.72	158.72	Provided by Sembcorp; Condition: 0^{o}C, 1 atm, 12.9% O_2, 9.8% H_2O
Flue gas exit flow rate (dry) under standard condition (Nm^3/s)		194.12	194.12	Standard condition: 0^{o}C, 1 atm, 15% O_2, dry
Emission concentration of pollutants (per stack)	NO_x (mg/m^3):	51.329	51.329	Provided by Sembcorp; Condition: 0^{o}C, 1 atm, 15% O_2, dry
	SO_2 (mg/m^3):	1.754	1.754	
	PM_{10} (mg/m^3):	1.7	1.7	
	$PM_{2.5}$ (mg/m^3):	1.7	1.7	
Emission rates of pollutants (per stack)	NO_x (g/s):	9.964	9.964	Estimated from emission concentration and flue gas exit flow rate under standard condition
	SO_2 (g/s):	0.34	0.34	
	PM_{10} (g/s):	0.33	0.33	
	$PM_{2.5}$ (g/s):	0.33	0.33	

([1]) AERMOD is an internationally recognized model, and is one of the preferred and recommended models of the US Environmental Protection Agency (US EPA).

Modelling Assumptions

As the representative ASRs are generally low-rise village houses, ground level concentrations (GLCs) at 1.5m above ground (breathing level of human receptors) of these ASRs have been modelled.

Main stacks associated with normal combined cycle operation are assumed to be operating continuously throughout the year. Bypass stacks associated with simple cycle operation will only be operated intermittently throughout the year; therefore no annual air quality impact is predicted for simple cycle operation. Main stacks and bypass stacks will not be operational concurrently. Two modelling scenarios have been assessed and they are summarised in ***Table 7.7***.

Table 7.7 Modelling Scenarios

Scenario	HRSG 1 Main Stack (S1)	HRSG 1 Bypass Stack (S2)	HRSG 2 Main Stack (S3)	HRSG 2 Bypass Stack (S4)
Main stacks in operation	✓		✓	
Bypass stacks in operation		✓		✓

Notes:
(a) ✓ = assessed in the modelling scenario

NO_2 is assumed to be 50% of NO_x for short-term averages (i.e., hourly and daily averaged) and 100% of NO_x for long-term average (annual average) as a conservative approach. This assumption is made reference to the air quality modelling guidelines recommended by the *Air Quality Modelling and Assessment Unit of UK Environmental Agency* [(1)].

A general factor of 1.43 has been applied to convert hourly SO_2 modelled results to 10-min averaged results [(2)].

For conservative approach in this assessment, emission rates for PM_{10} and $PM_{2.5}$ are assumed to be the same.

Meteorological Data

The MM5 surface and upper air meteorological data [(3)] in the vicinity for the recent 5 years (i.e., 2010 – 2014) were adopted for the model simulation. ***Figure 7.3*** shows the wind roses at the Project site area for the five years.

The MM5 meteorological data were processed using AERMET (version 14134) to generate AERMOD-ready meteorological data. According to rainfall record, the wet season in Myanmar runs from May to October and the dry season runs from November to April. The land use within 3km of the Project was analysed to

(1) UK EA, Air Modelling Guidelines on conversion ratio for NO_x to NO_2 : http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

(2) Richard A. Duffee, Martha A. O'Brien and Ned Ostojic (1991) Odor Modeling - Why and How. Page 295, Recent Developments and Current Practices in Odor Regulations, Controls and Technology. Air & Waste Management Association, 1991.

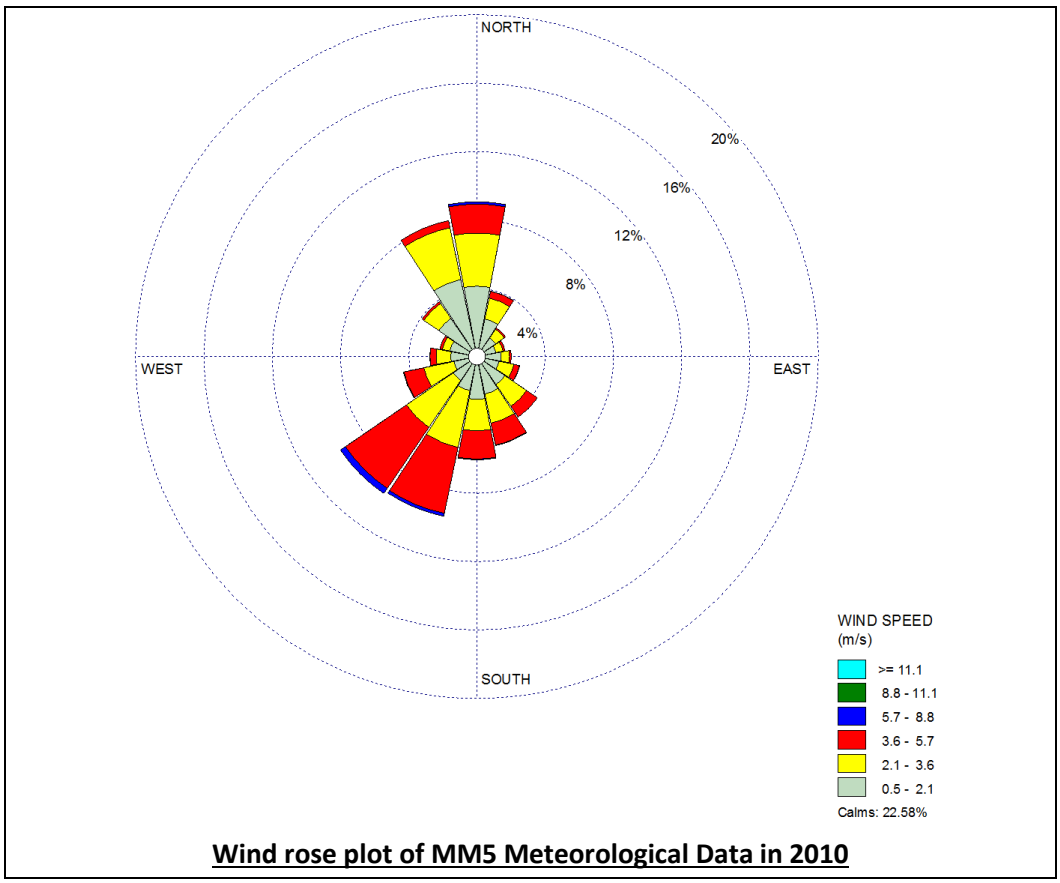
(3) MM5 is the Fifth-generation NCAR / Penn State Mesoscale Model which is the latest in a series that developed from a mesoscale model.

determine values assumed for the roughness length, Bowen ratio and Albedo. In view of the nature of the land use, it should be classified as cultivated land and its assumed values shown in ***Table 7.8*** are used for the meteorological data processing.

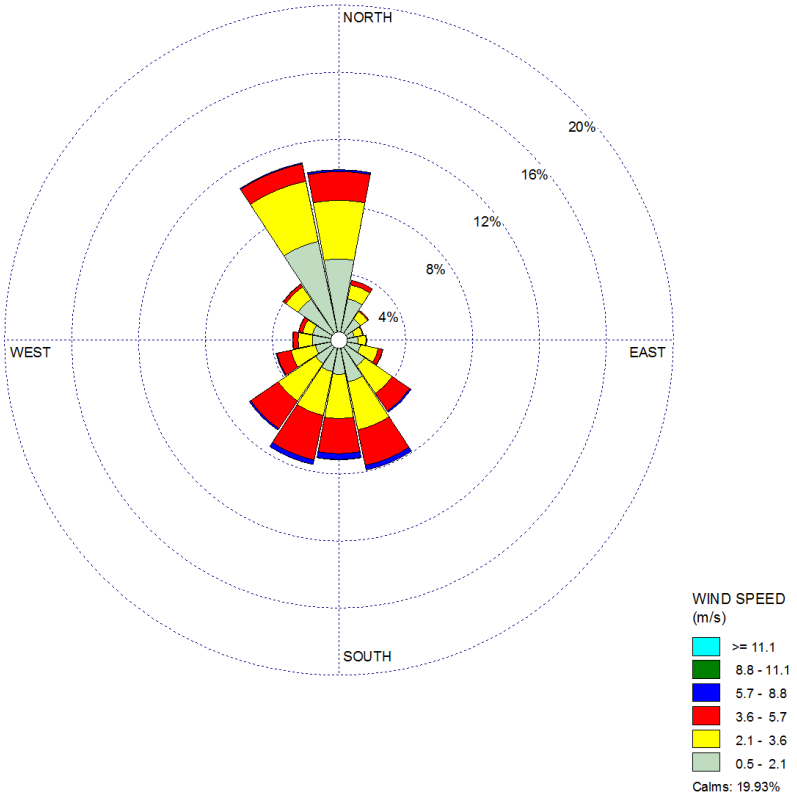
Table 7.8 Summary of Assumed Parameter Values for Meteorological Data Processing

Parameter	Cultivated Land
Sector (0^o as due North)	0^o – 360^o
Albedo	0.2
Bowen Ratio	0.3 (wet season) 1.5 (dry season)
Surface roughness length (m)	0.2

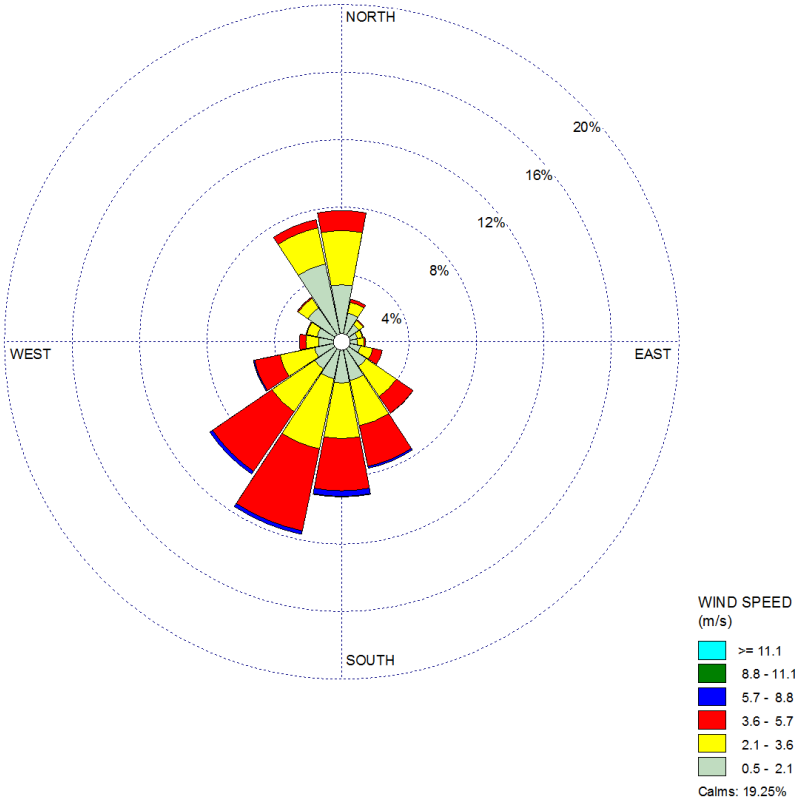
Figure 7.3 Wind roses of MM5 Meteorological Data for Year 2010 – 2014



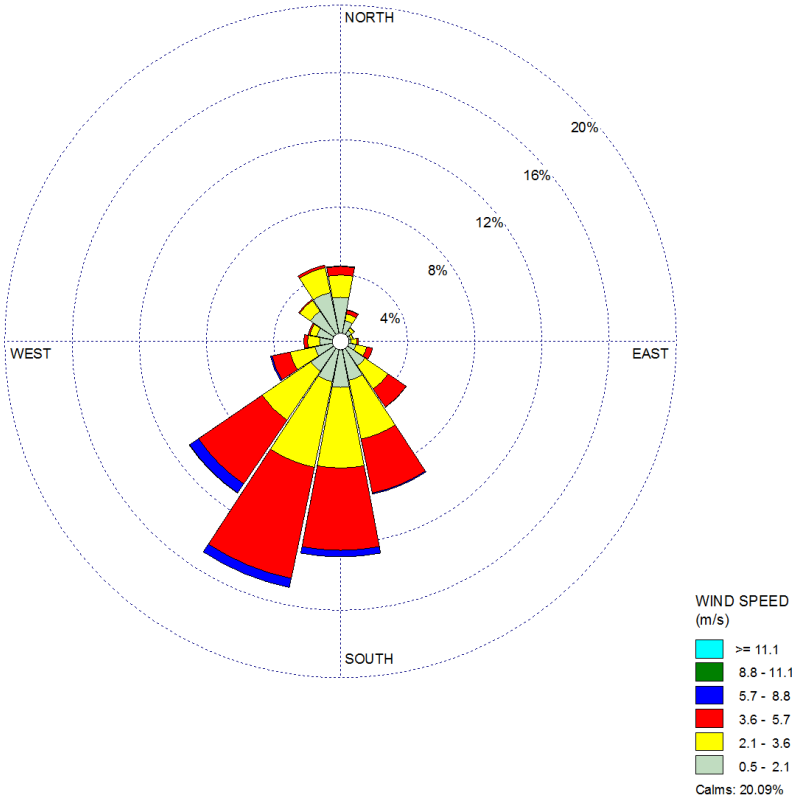
Wind rose plot of MM5 Meteorological Data in 2010



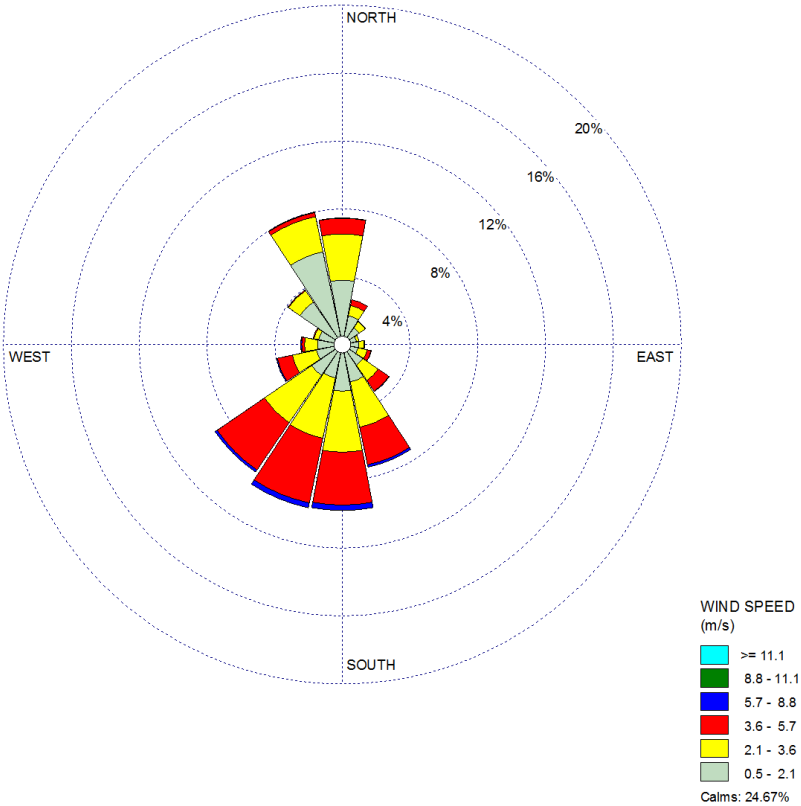
Wind rose plot of MM5 Meteorological Data in 2011



Wind rose plot of MM5 Meteorological Data in 2012



Wind rose plot of MM5 Meteorological Data in 2013



Wind rose plot of MM5 Meteorological Data in 2014

Terrain

Local terrain data within 10km of the emission source were processed using AERMAP (version 11103) for input into AERMOD to model the effects of terrain features on the dispersion of air emissions from the Project.

Building Downwash

Since nearby buildings and structures (e.g. administration building, warehouses) are less than 10m high while the stack height of the main stack and bypass stack is 40m and 30m, respectively, building downwash effects on plume dispersion would be minimal and have not been taken into account.

Receptor Grid

A grid of 20km by 20km centred at the stack locations was used for predicting GLCs within this area. A grid spacing of 100m was chosen for the first 1km from the centre of the stack locations and a spacing of 500m was used for the next 9km away from the centre of the stack locations.

Assessment of Air Quality Impacts

Impact from project contribution only and cumulative impacts (Project and general background) have been quantitatively assessed. Quantitative assessment for the emissions of these air pollutants during combined cycle operation and simple cycle operation has been conducted separately in two modelling scenarios, and the contributions of Project emissions at the representative ASRs were predicted. The maximum GLCs of the air pollutants at the ASRs were predicted for each of the five recent years (2010 to 2014). The overall maximum predicted GLCs at the ASRs within these five years were presented. For assessment of cumulative impacts, general background concentrations of the air pollutants, as presented in ***Table 7.4***, were added to the maximum predicted GLCs at the ASRs.

7.8.3 Assessment Criteria for Quantitative Assessment

In jurisdictions that do not have an agreed approach to assess the magnitude of the impact, the most commonly used approach is that based upon guidance from the IFC and Asian Development Bank (ADB) Safeguards Policy Statement 2009, which is typically used in projects seeking IFC, ADB or external funding and follows the Equator Principles. This approach, which in general conforms with guidelines for projects located in non-degraded or degraded airsheds as stated in IFC's *Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality* and IFC's *Environmental, Health and Safety Guidelines: Thermal Power Plants*, is outlined in ***Table 7.9***. On the basis of the project contribution (PC), predicted environmental concentration (PEC) and the air quality standard (AQS), the magnitude is determined. This is then combined with the sensitivity of the receptor to determine the impact significance using the standard impact assessment methodology. As explained in ***Section 7.4***, relevant WHO guidelines have been adopted as the AQS for this Project and are presented in ***Table 7.10***.

Table 7.9 Determination of Impact Magnitude based upon IFC Method

Magnitude of Impact	Non Degraded Airshed (Baseline < AQS)	Degraded Airshed (Baseline > AQS)
Negligible	PC < 25% of AQS	PC < 10% of AQS
Small	PC>25% of AQS, <50% of AQS, and PEC<100% of AQS	PC>10% of AQS, <15% of AQS
Medium	PC>25% of AQS, <50% of AQS, and PEC>100% of AQS; or PC>50% of AQS, <100% of AQS, and PEC<100% of AQS	PC>15% of AQS, <25% of AQS
Large	PC>100% of AQS	PC<25% of AQS

Note:

(a) The impact magnitude table is referenced from Annex B-7 (Air Quality Impacts) of *The ERM Impact Assessment Standard.* *The ERM Impact Assessment Standard* has been developed with reference to IFC Guidelines and includes key guiding principles and best practices for assessing environmental impacts of projects. It is applied to environmental impact assessment projects including ESIA.

Table 7.10 Relevant WHO Guidelines Adopted as Air Quality Standards for this Project

Pollutant	Averaging Period (mean)	Guidance Value in µg/m^3	
Sulphur dioxide (SO_2)	24-hour	125	(Interim target-1)
	10 minute	500	(guideline)
Nitrogen dioxide (NO_2)	1-year	40	(guideline)
	1-hour	200	(guideline)
Particulate Matter PM_{10}	1-year	70	(Interim target-1)
	24-hour	150	(Interim target-1)
Particulate Matter $PM_{2.5}$	1-year	35	(Interim target-1)
	24-hour	75	(Interim target-1)

7.9 ASSESSMENT OF IMPACTS

7.9.1 Construction Phase

Potential Impact

The construction of the Project will last for about 22.5 months from notification to proceed. The construction of Project that may potentially generate air quality impacts involves site clearance, site formation and levelling, as well as construction of substructure and superstructure of the Power Plant facilities.

Site formation and levelling works will be required within the Project site where excavation, backfilling and stockpiling of materials will be carried out on site and there will be potential to cause fugitive dust impact. It is estimated that about 20,000m^3 of soil will be excavated and all excavated material will be backfilled with no surplus. The excavated materials suitable for backfilling will be temporarily stockpiled onsite. The Project site is more than 600m away from the nearest village, Sa Ka Village, to the northeast of the Project site.

Heavy cargo will be transported by barge from Thilawa Port in Yangon to Nyaung Hla Jetty on the Ayeyarwady River, and then from Nyaung Hla Jetty to the Project site by trucks and trailers.

Construction equipment (electric and diesel-powered) will be operating in different areas of the entire worksite area. Materials handling, trucks movements within the work sites, wind erosion of the open uncovered areas are the potential sources of fugitive dust emissions. Hoardings of minimum 2m height will be erected along the boundary of the Project site to suppress wind-blown dust. Furthermore, dust suppression measures and good site practices as mentioned below will be implemented to minimize the fugitive dust emission during the construction works.

The access roads within works areas will be watered and maintained wet all the time.

An onsite concrete batching plant (CBP) with a total production rate of 500m^3 per day will be located within the Project site. The operation time will be 12 hours per day throughout the construction period. The CBP has the potential to generate dust emissions to ASRs. The nearest identified ASR, the Sa Ka Village, is more than 600m away.

Potential Consequence

Fugitive dust impact is localized within about 100m area due to relatively large particle size of fugitive dust. The nearest ASR, the Sa Ka Village located to the northeast of the Project site, is more than 600m away from the Project site boundary. This large separation distance would provide sufficient setback for protecting Sa Ka Village (ASR 4) from any potential construction dust impacts. During the construction period, dust suppression measures and good site practices as described below will be implemented. With the implementation of the dust suppression measures and good site practices mentioned below as well as the provision of sufficient setback and site hoardings, the fugitive dust impact on the ASRs is anticipated to be minor and transient.

Dust suppression measures described below will be in-place during the operation of the CBP. Also, the CBP will be located at least 600m away from the air sensitive receptors and the CBP will only be operated during the construction phase, therefore, the dust impact from emission of the CBP is expected to be minor and short term.

With the implementation of recommended mitigation measures described below, the air quality impact arising from the fugitive dust emissions from site clearance, site formation and levelling works during the construction phase would be minimal.

Existing and / or In-place Controls

The following dust suppression measures and good site practices are recommended for the construction phase and taken into account when assessing the significance of potential impacts:

- Erection of minimum 2m high site hoardings around the site boundary;
- Water spraying of or covering all exposed areas and stockpiles;
- Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust;

- Minimizing the size of exposed areas and material stockpiles and the periods of their existence;
- Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time;
- Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions;
- Cleaning wheels and the lower body parts of trucks at all exits of the construction site;
- Cleaning the entire construction work sites at least once per week;
- Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary;
- Watering the main haul road regularly to suppress dust emissions during truck movement;
- Prohibiting the burning of waste or vegetation on site;
- Compacting the reclaimed land immediately to avoid fugitive dust emissions;
- Maintaining and checking the construction equipment regularly;
- Switching off engines when idling; and
- Using ultra-low sulphur diesel for trucks and diesel-fuelled construction equipment if available.

In particular for concrete batching plant, the following air suppression measures will be implemented:

- Using grid electricity for the operation of the CBP to minimize the potential air emissions from diesel burning;
- Equipping all vent exhausts with dust suppression measures such as dust filter or scrubber, etc., to reduce dust emissions as much as possible;
- Carrying out in such a manner that dust emissions will be prevented or minimized during loading, unloading, handling, transfer or storage of other raw materials which may generate airborne dust emissions such as crushed rock, sand, stone aggregates;
- Enclosing all receiving hoppers and belt conveyor systems totally;
- Storing all aggregates with a nominal size of less than or equal to 5 millimetres and cement in an enclosed area;
- Wetting all access roads and routes within the CBP; and
- Maintaining a high standard of housekeeping always. All spillages or deposits of materials on ground, support structures or roofs will be cleaned up promptly. Any dumping of materials in open areas will be prohibited.

Significance of Impact

With the implementation of the recommended control measures (namely, the dust suppression measures and good site practices at the construction worksites and the CBP), the magnitude of the construction dust impact is considered to be small and short-term. The sensitivity for human health within the general population is considered as “medium” as the identified ASRs are residential. The overall impact

significance during the construction is considered **minor.** The impact assessment is summarised in ***Table 7.11*** below.

Table 7.11 Assessment of Air Quality Impact during Construction of Project

Impact	Fugitive dust emissions associated with the materials handling, wind erosion of open areas and truck movements on access roads within the construction worksites and operation of concrete batching plant; and Air emissions including NO_2, SO_2, PM_{10} and $PM_{2.5}$ from construction equipment and trucks within the entire work areas.				
Impact Nature	**Negative**	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	**Direct**	Indirect	Induced		
	Impact on human health within the general population is direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impacts are considered short-term, as the construction will last for 22.5 months.				
Impact Extent	**Local**	Regional	International		
	Impacts on human health within the general population are expected to be local.				
Impact Scale	The fugitive dust impacts are expected to be limited, localized (within 100m from the worksite boundary) and short-term (i.e., throughout the construction period of 22.5 months). The air quality impacts are expected to be small provided that all mitigation measures and good site practices are implemented.				
Frequency	Throughout the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small as the fugitive dust impact will be reduced as much as possible after the proper implementation of all in-place dust suppression measures and good site practice. There is also large separation distance between the Project site boundary and the air sensitive receptors.				
Receptor Sensitivity	Low	**Medium**	High		
	The receptor sensitivity is considered medium as the ASRs identified in the surrounding are residential type which is general population.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is considered to be **Minor.**				

Mitigation and / or Management Measures

As the significance of the potential fugitive dust during the construction phase is assessed as minor and short-term, no additional mitigation/management measures are required.

Residual Impacts

As the impact significance is minor and no additional mitigation measures are required, the residual impact remains **minor**.

Environmental Monitoring and Audit (EM&A) during the Construction Phase

As the air quality impact during the construction phase of the Project is anticipated to be minor, monitoring of fugitive dust at the air sensitive receptors is considered not necessary. However, to ensure proper implementation of all recommended dust

suppression measures and good site practices, monthly site inspection is recommended throughout the construction period. Details on the EM&A programme should be referred to ***Chapter 17***.

7.9.2 Operation Phase

Potential Impact

Quantitative assessment has been conducted for stack emissions of NO_2, SO_2, PM_{10} and $PM_{2.5}$ at the identified air sensitive receptors and the area within 10km from the centre of the stack locations following the assessment methodology described in ***Section 7.8.2***. The highest predicted GLCs of NO_2, SO_2, PM_{10} and $PM_{2.5}$ under different time averaging at the representative ASRs attributed to the Project during normal combined cycle operation and simple cycle operation are presented in ***Table 7.12*** and ***Table 7.13***. For simple cycle operation, annual averaged results are not presented since simple cycle mode will only be carried out intermittently throughout the year. Detailed results for each assessment year are presented in ***Annex E1***. The predicted NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations under different time averaging at the ASRs are small, with maximum project contribution at the ASRs about 11% of the relevant air quality standards.

Table 7.12 Predicted Maximum Ground Level Concentrations at Representative Air Sensitive Receptors during Combined Cycle Operation (Project Only)

ASR	Combined Cycle Mode (Main stacks S1 and S3 in operation)							
	Maximum Ground Level Concentration (µg m^{-3})							
	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
ASR1	8.80	0.54	0.86	0.08	0.08	0.02	0.08	0.02
ASR2	7.93	0.28	0.77	0.06	0.06	0.01	0.06	0.01
ASR3	10.65	0.54	1.04	0.09	0.09	0.02	0.09	0.02
ASR4	10.10	1.06	0.99	0.20	0.19	0.04	0.19	0.04
ASR5	6.75	0.19	0.66	0.04	0.04	0.01	0.04	0.01
ASR6	7.10	0.12	0.69	0.03	0.03	0.00	0.03	0.00
ASR7	7.81	0.31	0.76	0.06	0.06	0.01	0.06	0.01
ASR8	8.29	0.23	0.81	0.04	0.04	0.01	0.04	0.01
ASR9	7.77	0.30	0.76	0.05	0.05	0.01	0.05	0.01
ASR10	7.15	0.25	0.70	0.04	0.04	0.01	0.04	0.01
ASR11	7.22	0.27	0.70	0.05	0.05	0.01	0.05	0.01
ASR12	6.23	0.25	0.61	0.05	0.04	0.01	0.04	0.01
ASR13	6.93	0.31	0.68	0.06	0.06	0.01	0.06	0.01
ASR14	7.50	0.16	0.73	0.06	0.06	0.01	0.06	0.01
ASR15	7.72	0.17	0.75	0.04	0.04	0.01	0.04	0.01
ASR16	6.79	0.12	0.66	0.05	0.05	0.00	0.05	0.00
ASR17	6.48	0.11	0.63	0.05	0.05	0.00	0.05	0.00
ASR18	22.13	1.74	2.16	0.38	0.36	0.06	0.36	0.06
ASR19	10.51	0.79	1.03	0.12	0.11	0.03	0.11	0.03
Assessment Criteria	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
Max % of Project contribution to criteria	**11.07%**	**4.35%**	**0.43%**	**0.30%**	**0.24%**	**0.08%**	**0.49%**	**0.16%**

ASR	Combined Cycle Mode (Main stacks S1 and S3 in operation)
	Maximum Ground Level Concentration (µg m^{-3})

Notes:

(a) Reference to UK Air Quality Assessment Guidelines – short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

(b) A general factor of 1.43 is used to convert hourly SO_2 results to 10-min results [1]

(c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

Table 7.13 Predicted Maximum Ground Level Concentrations at Representative Air Sensitive Receptors during Simple Cycle Operation (Project Only)

ASR	Simple Cycle Mode (Main stacks S2 and S4 in operation)							
	Maximum Ground Level Concentration (µg m^{-3})							
	1-hr NO_2 (a)	Annual NO_2 (a)(d)	10-min SO_2 (b)	24-hr SO_2	24-hr PM_{10} (c)	Annual PM_{10} (c) (d)	24-hr $PM_{2.5}$ (c)	Annual $PM_{2.5}$ (c) (d)
ASR1	2.32	-	0.23	0.03	0.03	-	0.03	-
ASR2	2.33	-	0.23	0.02	0.02	-	0.02	-
ASR3	3.06	-	0.30	0.03	0.03	-	0.03	-
ASR4	3.11	-	0.30	0.05	0.05	-	0.05	-
ASR5	2.04	-	0.20	0.02	0.02	-	0.02	-
ASR6	1.62	-	0.16	0.02	0.02	-	0.02	-
ASR7	2.23	-	0.22	0.02	0.02	-	0.02	-
ASR8	1.77	-	0.17	0.02	0.02	-	0.02	-
ASR9	1.99	-	0.19	0.02	0.02	-	0.02	-
ASR10	2.14	-	0.21	0.02	0.02	-	0.02	-
ASR11	2.60	-	0.25	0.03	0.02	-	0.02	-
ASR12	2.19	-	0.21	0.03	0.02	-	0.02	-
ASR13	2.83	-	0.28	0.02	0.02	-	0.02	-
ASR14	1.99	-	0.19	0.02	0.02	-	0.02	-
ASR15	1.99	-	0.19	0.02	0.02	-	0.02	-
ASR16	1.81	-	0.18	0.02	0.02	-	0.02	-
ASR17	1.70	-	0.17	0.02	0.02	-	0.02	-
ASR18	2.99	-	0.29	0.05	0.05	-	0.05	-
ASR19	2.87	-	0.28	0.05	0.04	-	0.04	-
Assessment Criteria	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
Max % of Project contribution to criteria	**1.56%**	**-**	**0.06%**	**0.04%**	**0.03%**	**-**	**0.07%**	**-**

Notes:

(a) Reference to UK Air Quality Assessment Guidelines – short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

(b) A general factor of 1.43 is used to convert hourly SO_2 results to 10-min results[2]

(c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

(d) Annual averaged results are not presented since simple cycle mode will only be operating intermittently throughout the year.

(1) Richard A. Duffee, Martha A. O'Brien and Ned Ostojic (1991) Odor Modeling - Why and How. Page 295, Recent Developments and Current Practices in Odor Regulations, Controls and Technology. Air & Waste Management Association, 1991

(2) Richard A. Duffee, Martha A. O'Brien and Ned Ostojic (1991) Odor Modeling - Why and How. Page 295, Recent Developments and Current Practices in Odor Regulations, Controls and Technology. Air & Waste Management Association, 1991

Potential Consequence

For short-term and long-term impacts during normal combined cycle operation, it has been predicted that the project contribution for all pollutants at ASRs is low. Detailed results predicted in 2010 to 2014 and ***Table 7.12*** show that the project contribution from different air pollutants at ASRs under normal combined cycle operation was predicted to be well below their respective air quality standards. The highest project contribution to air quality standards at the ASRs is about 11% (1-hour averaged NO_2). Contour plots of maximum 1-hour averaged and annual averaged NO_2 concentrations at ground level for different years under normal combined cycle operation are shown in ***Figure 7.4*** to ***Figure 7.13***.

Figure 7.4 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2010

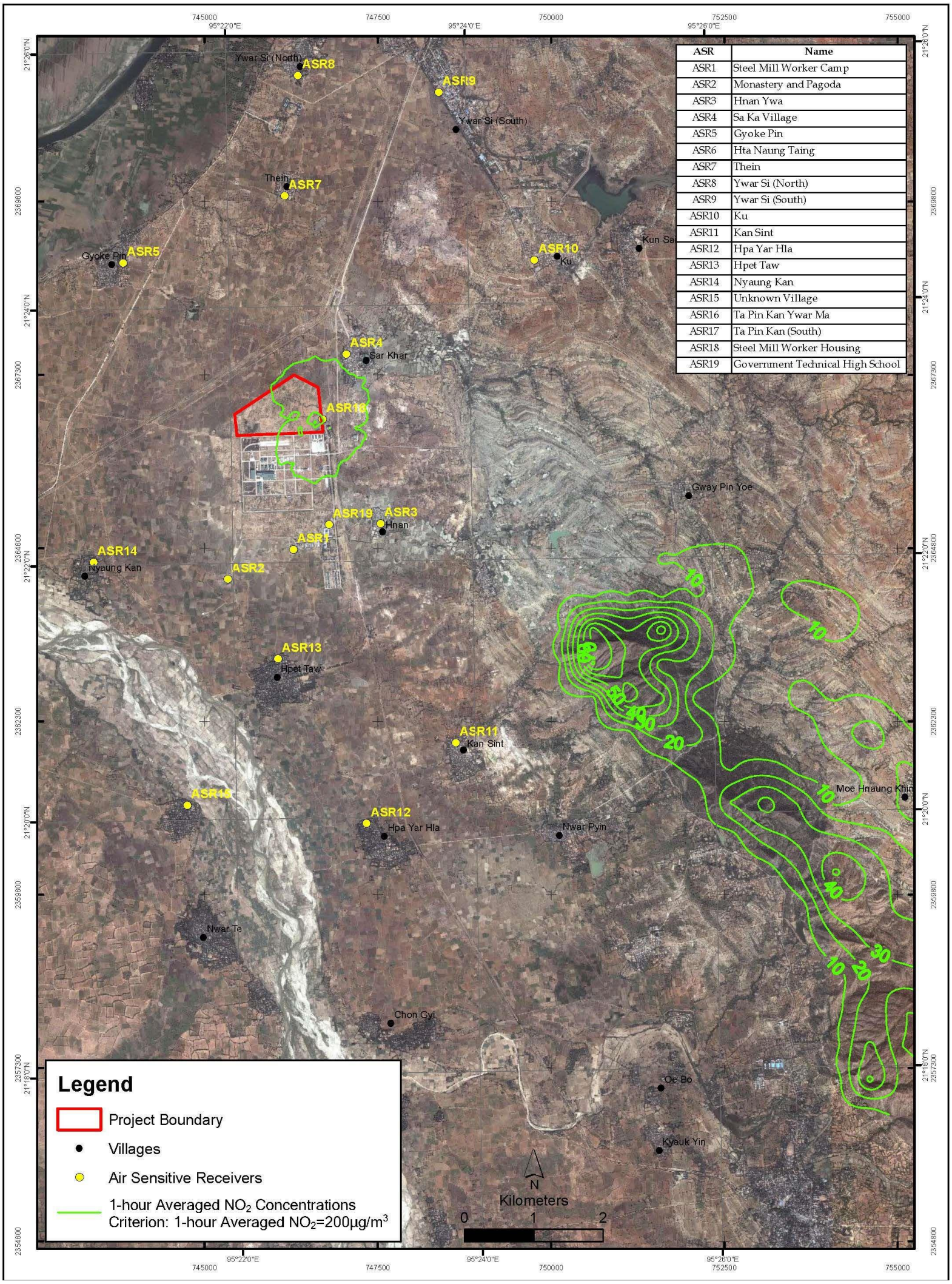


Figure 7.5 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2011

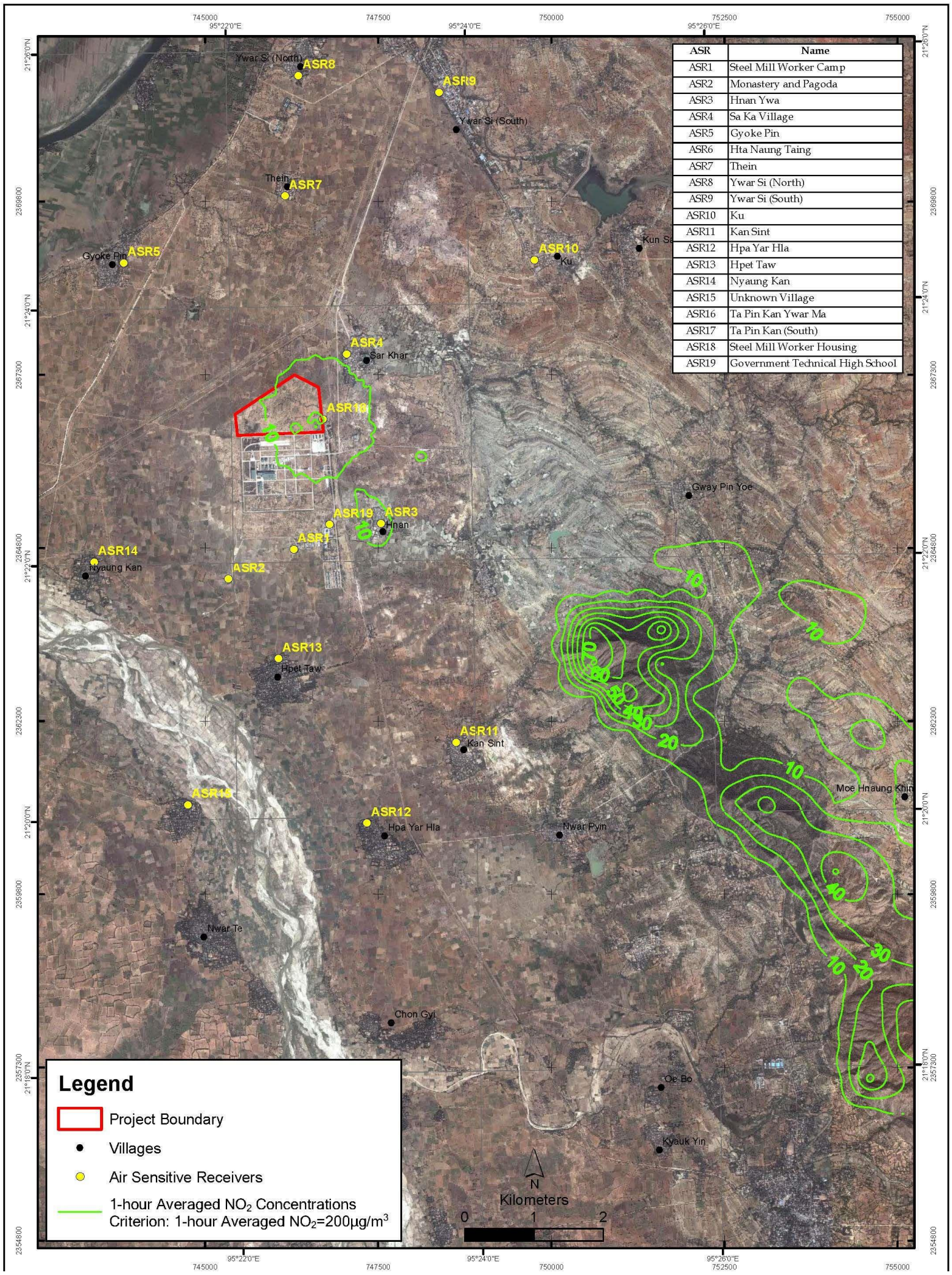


Figure 7.6 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2012

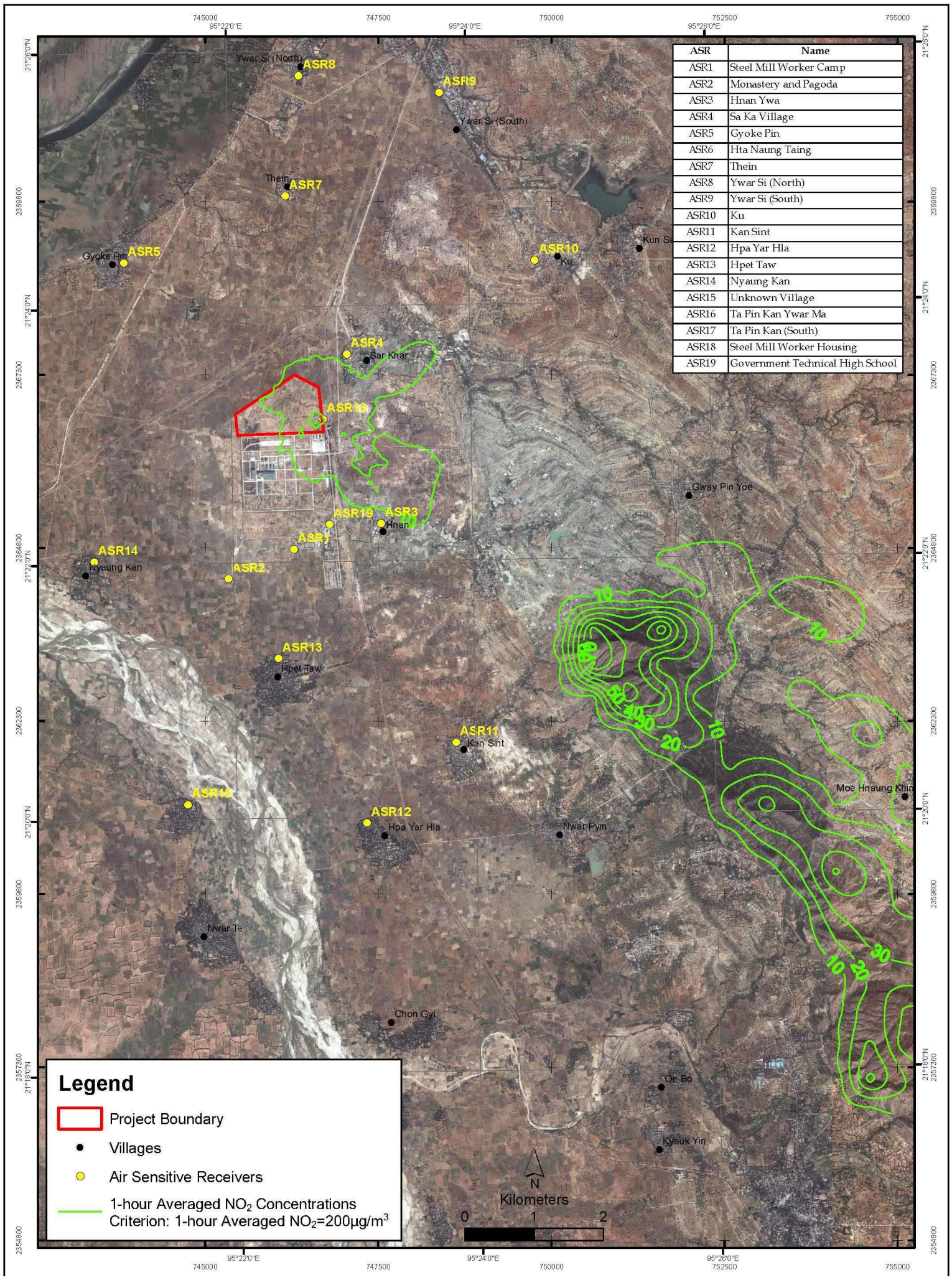


Figure 7.7 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2013

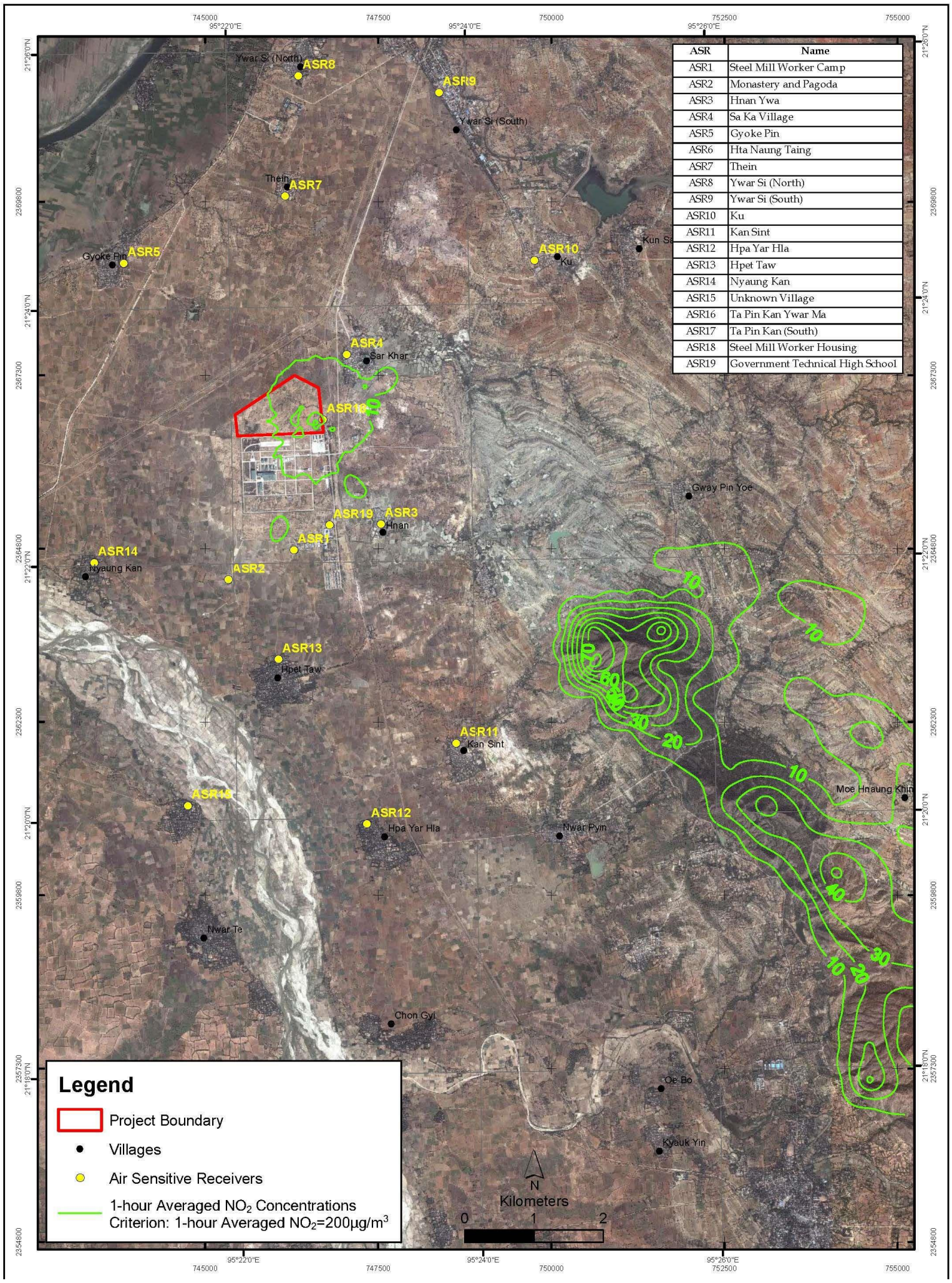


Figure 7.8 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2014

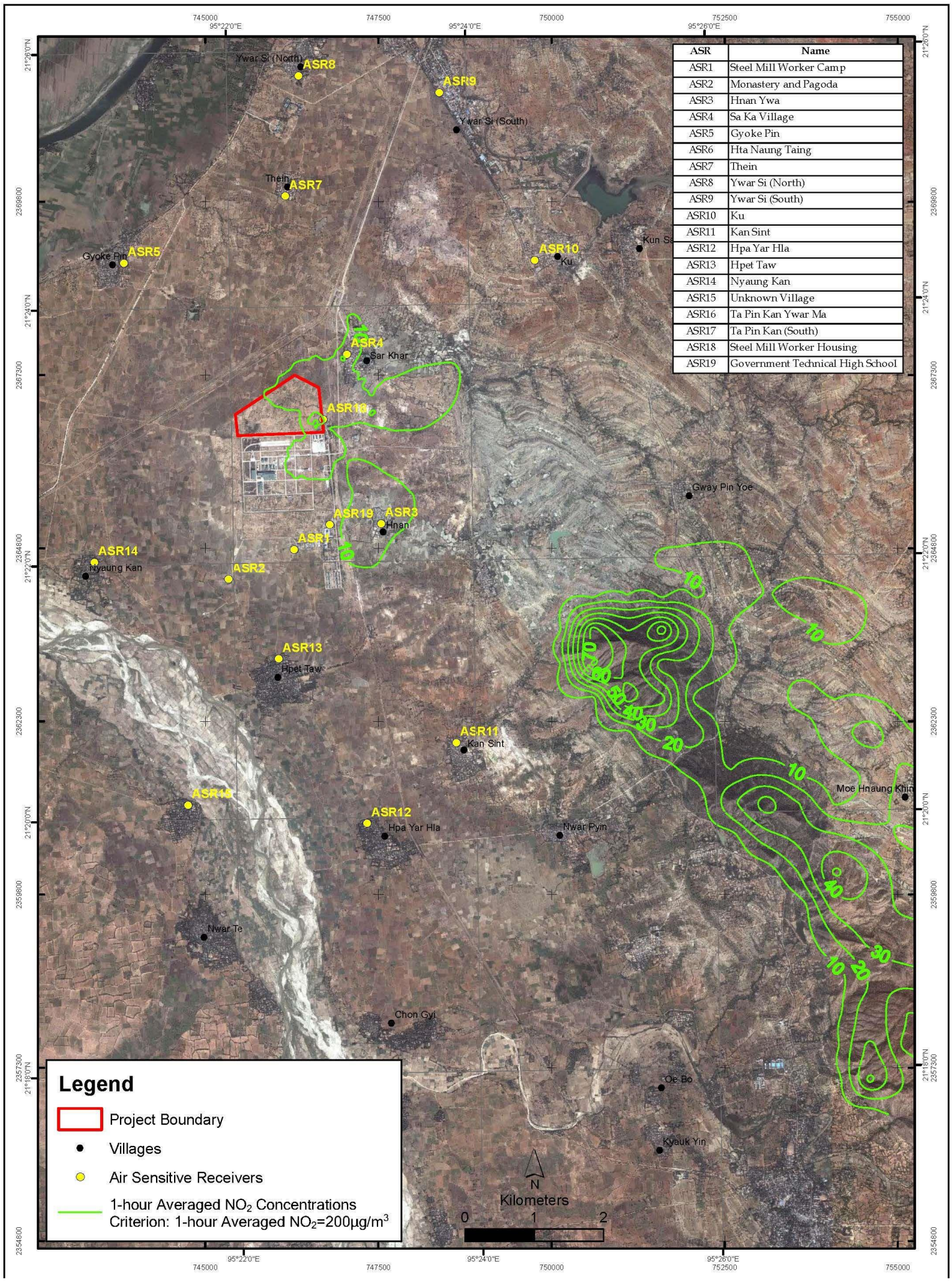


Figure 7.9 Predicted Maximum Ground Level Annual Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2010

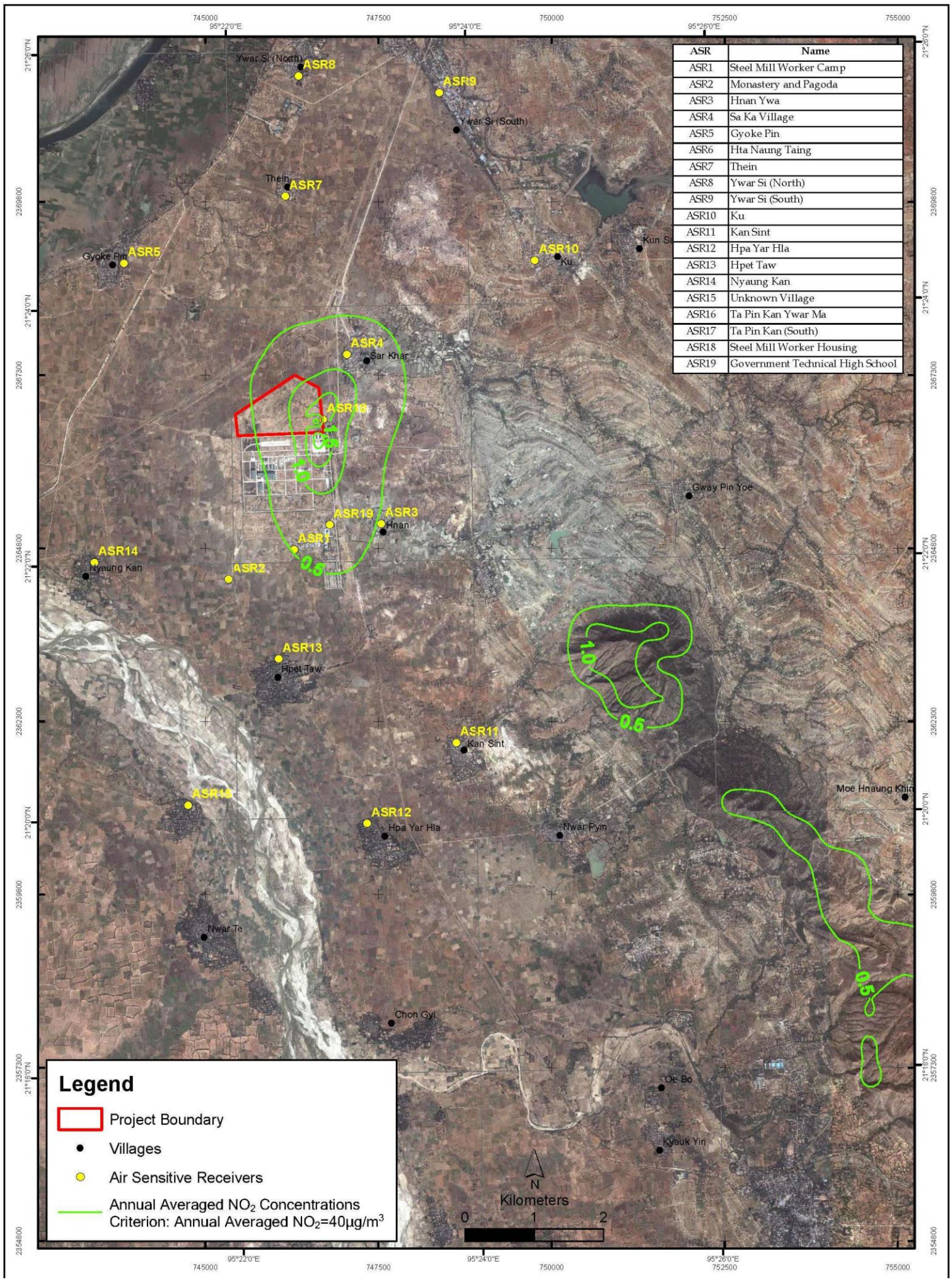


Figure 7.10 Predicted Maximum Ground Level Annual Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2011

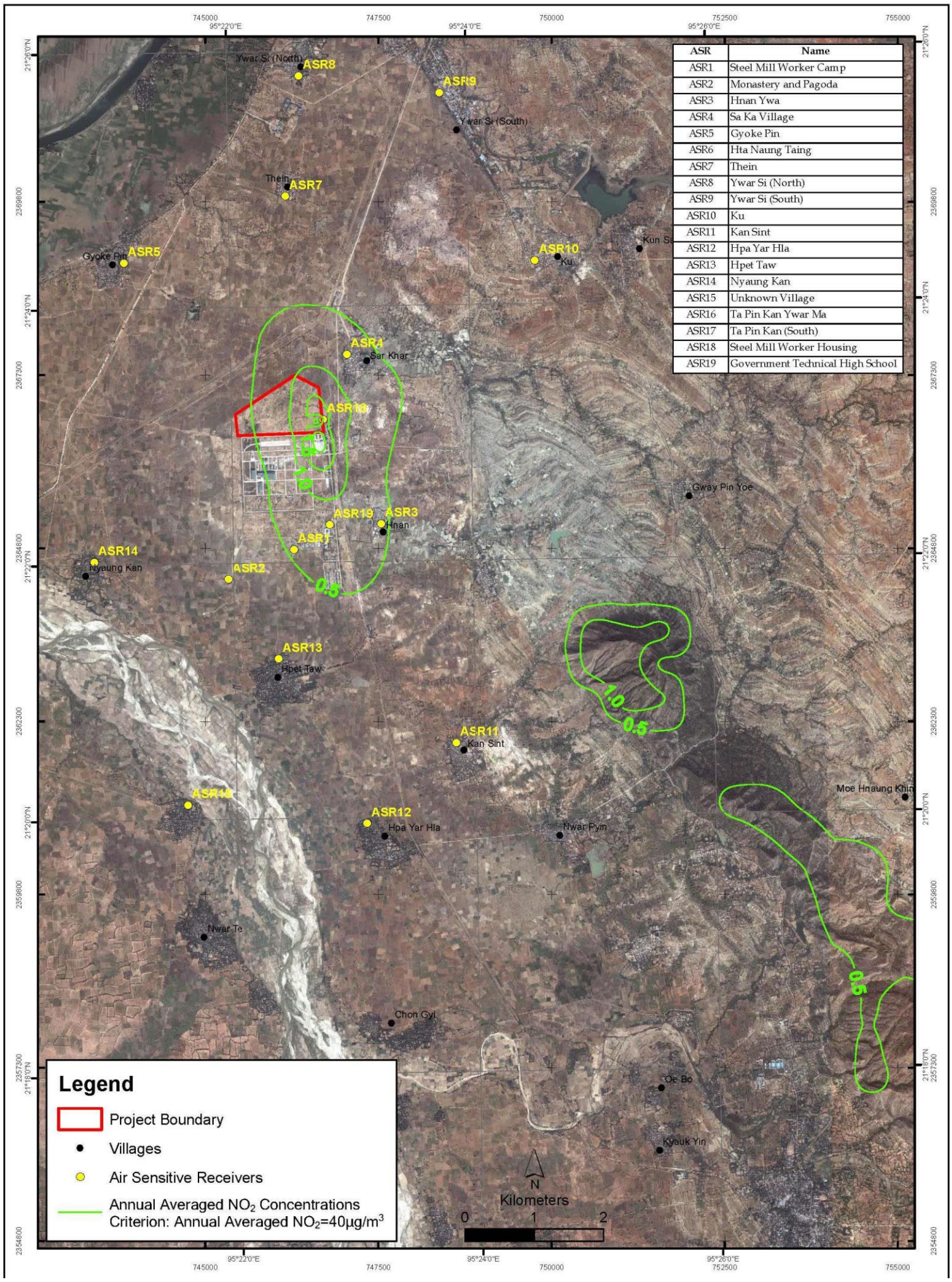


Figure 7.11 Predicted Maximum Ground Level Annual Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2012

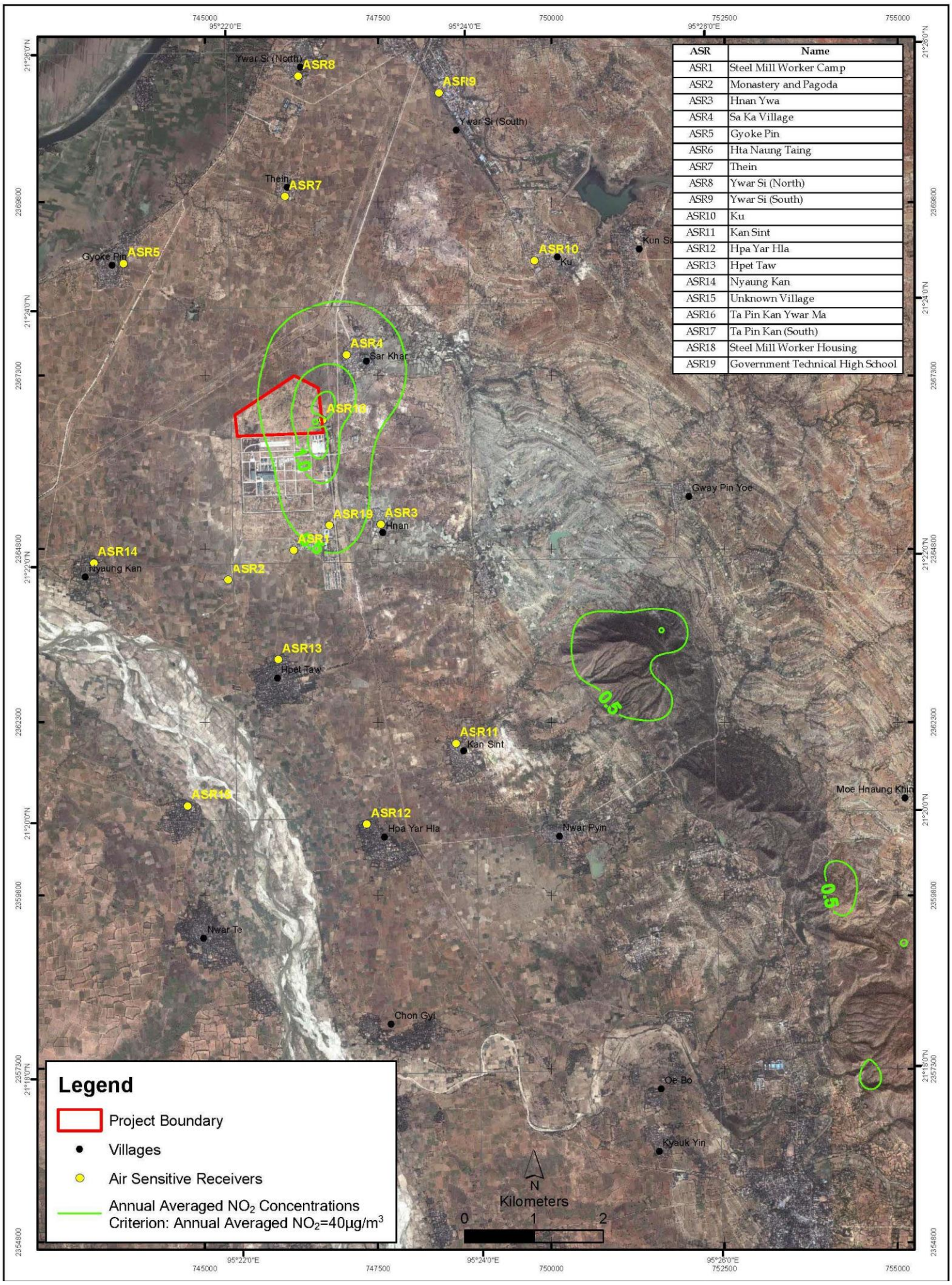


Figure 7.12 Predicted Maximum Ground Level Annual Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2013

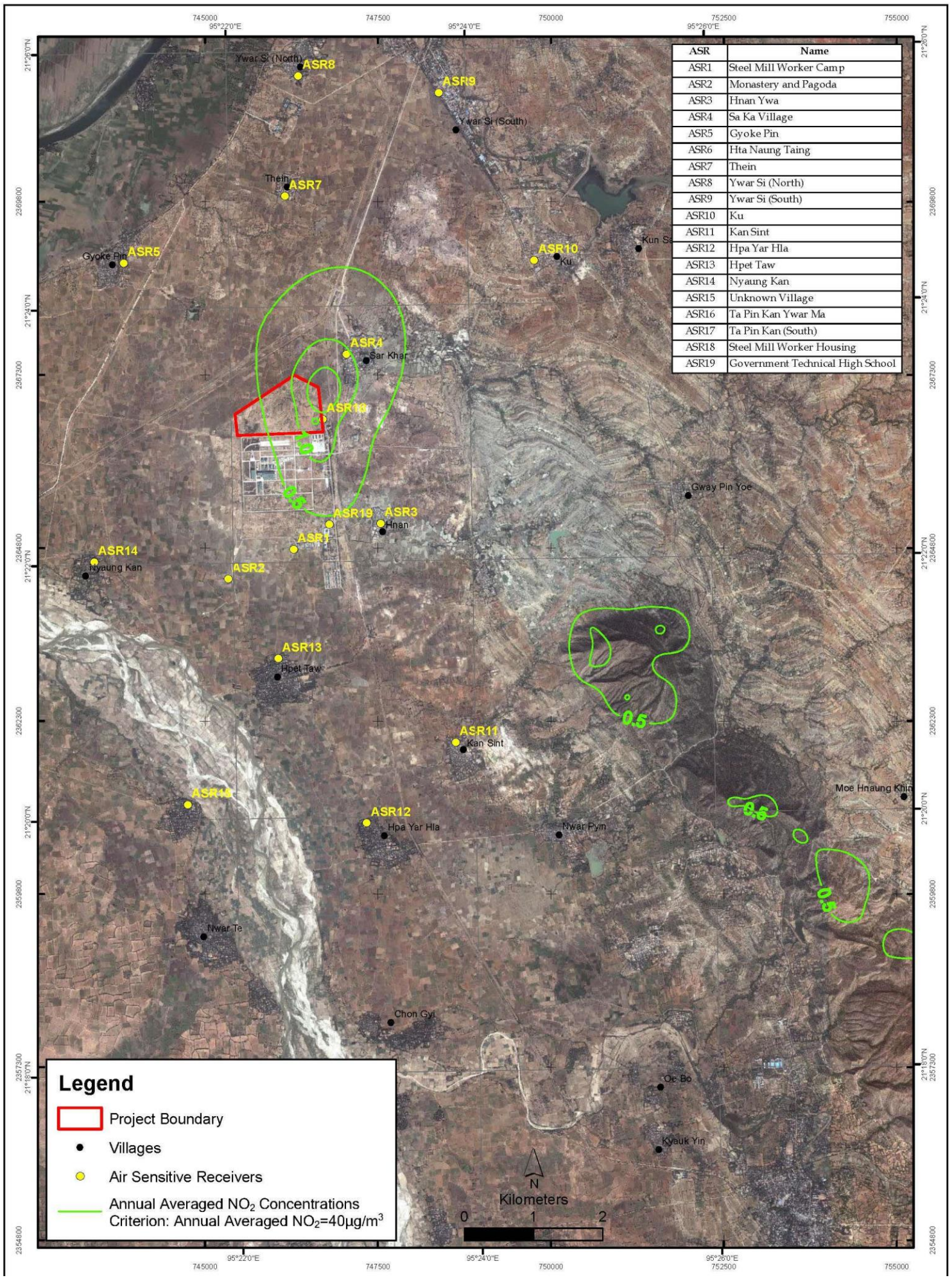
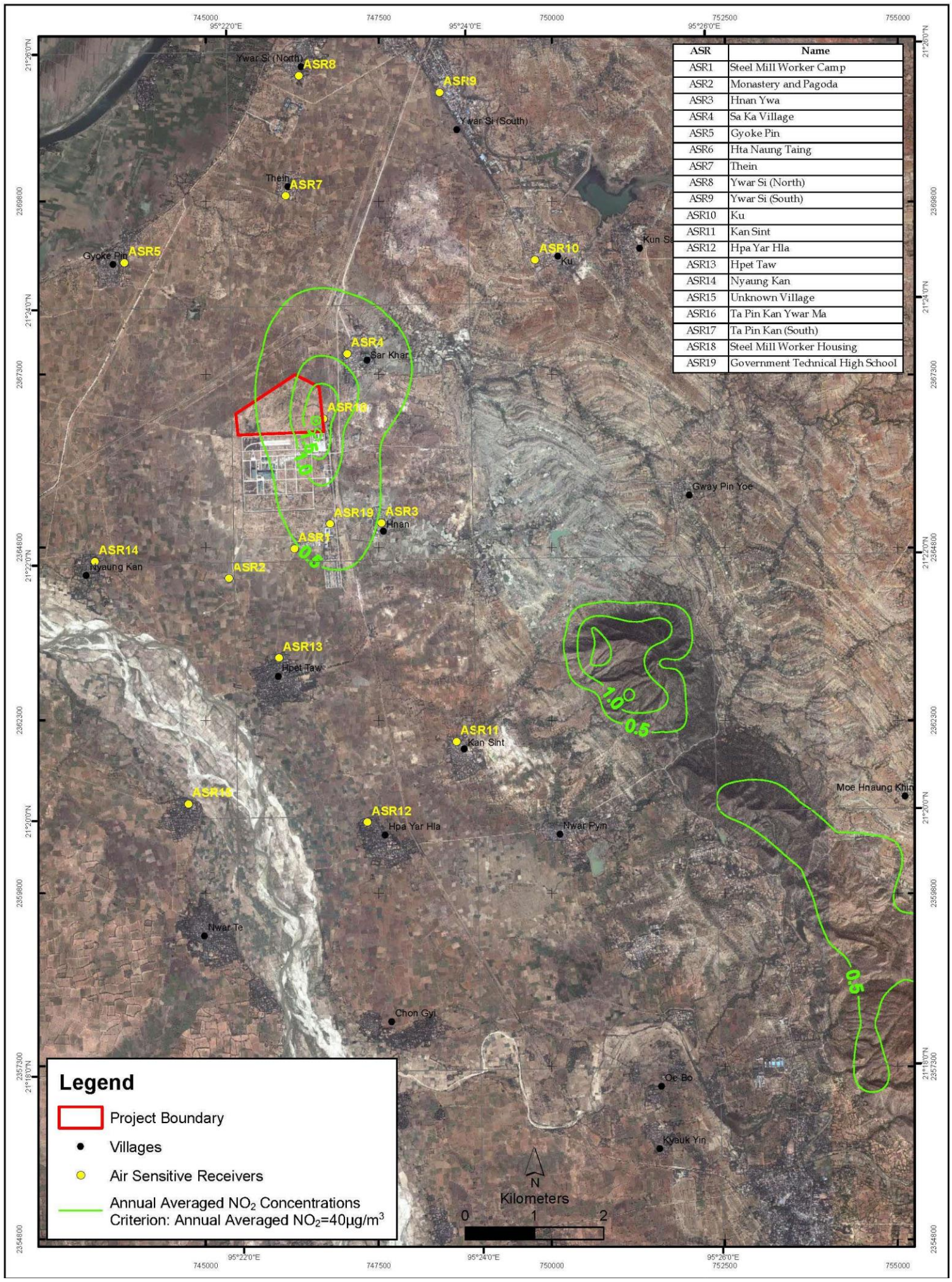


Figure 7.13 Predicted Maximum Ground Level Annual Average NO_2 Concentrations during Combined Cycle Operation (Project Only) in 2014



Similarly, for short-term impact during simple cycle operation, it has been predicted that the project contribution for all pollutants at ASRs is also low. Detailed results predicted in 2010 to 2014 and ***Table 7.13*** show that the project contribution from different air pollutants at ASRs under simple cycle operation was predicted to be well below their respective air quality standards. The highest project contribution to air quality standards at the ASRs is about 1.6% (1-hour averaged NO_2). Contour plots of maximum 1-hour averaged NO_2 concentrations at ground level for different years under simple cycle operation are shown in ***Figure 7.14*** to ***Figure 7.18***.

As presented in ***Table 7.4***, the background NO_2 level at the Project site area has exceeded the air quality standard for annual NO_2 and the airshed within which the Project site is located should be considered degraded. Modelling results show that pollutant concentrations at ASRs contributed by normal combined cycle operation or simple cycle operation of the Project are predicted to be low, with maximum contribution of about 11% of the relevant air quality standards. Therefore, following the criteria for defining magnitude of impact for degraded airshed in ***Table 7.9***, the impact magnitude is considered small.

Existing and / or In-place Controls

The following controls have been included in the stack design:

- Built-in dry low NOx burners to reduce NOx emission at stack to below 25ppm at all times.

Significance of Impact

The magnitude of impacts from the stack emissions at identified ASRs, during normal combined cycle operation or simple cycle operation, is considered small as the maximum project contribution is between 10% and 15% of relevant air quality standards for degraded airshed, following the criteria for defining magnitude of impact in ***Table 7.9***.

Figure 7.14 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Simple Cycle Operation (Project Only) in 2010

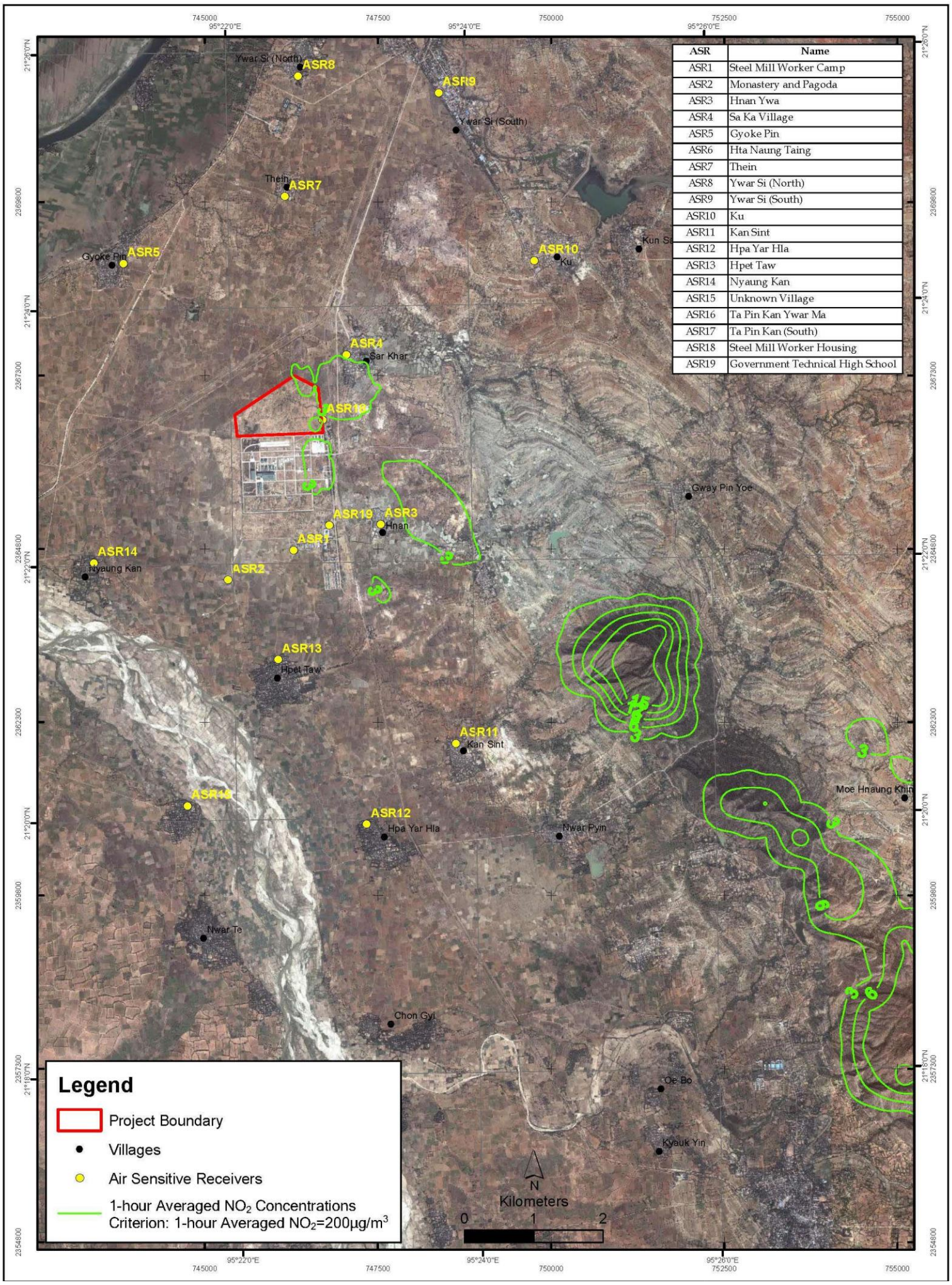


Figure 7.15 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Simple Cycle Operation (Project Only) in 2011

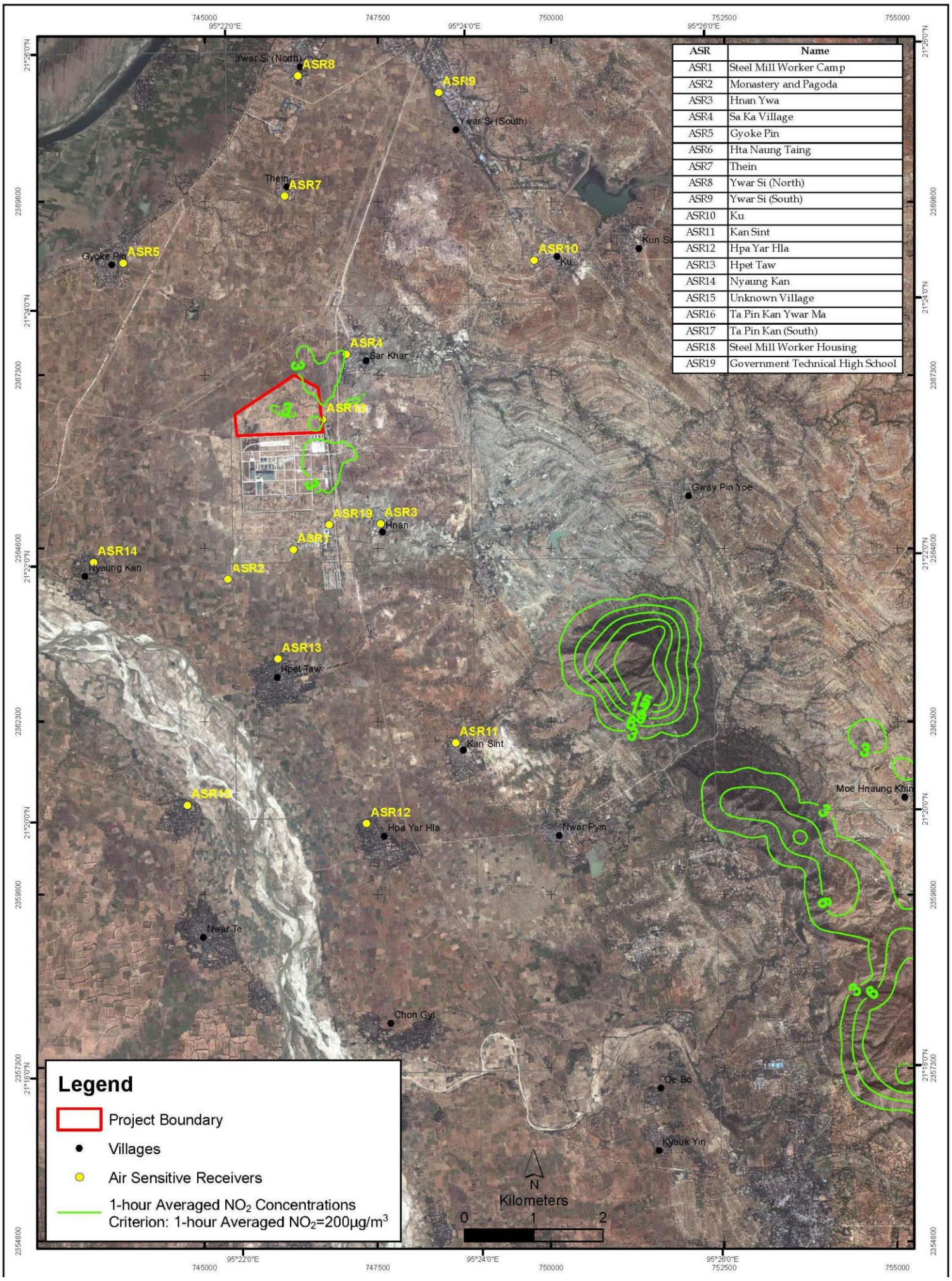


Figure 7.16 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Simple Cycle Operation (Project Only) in 2012

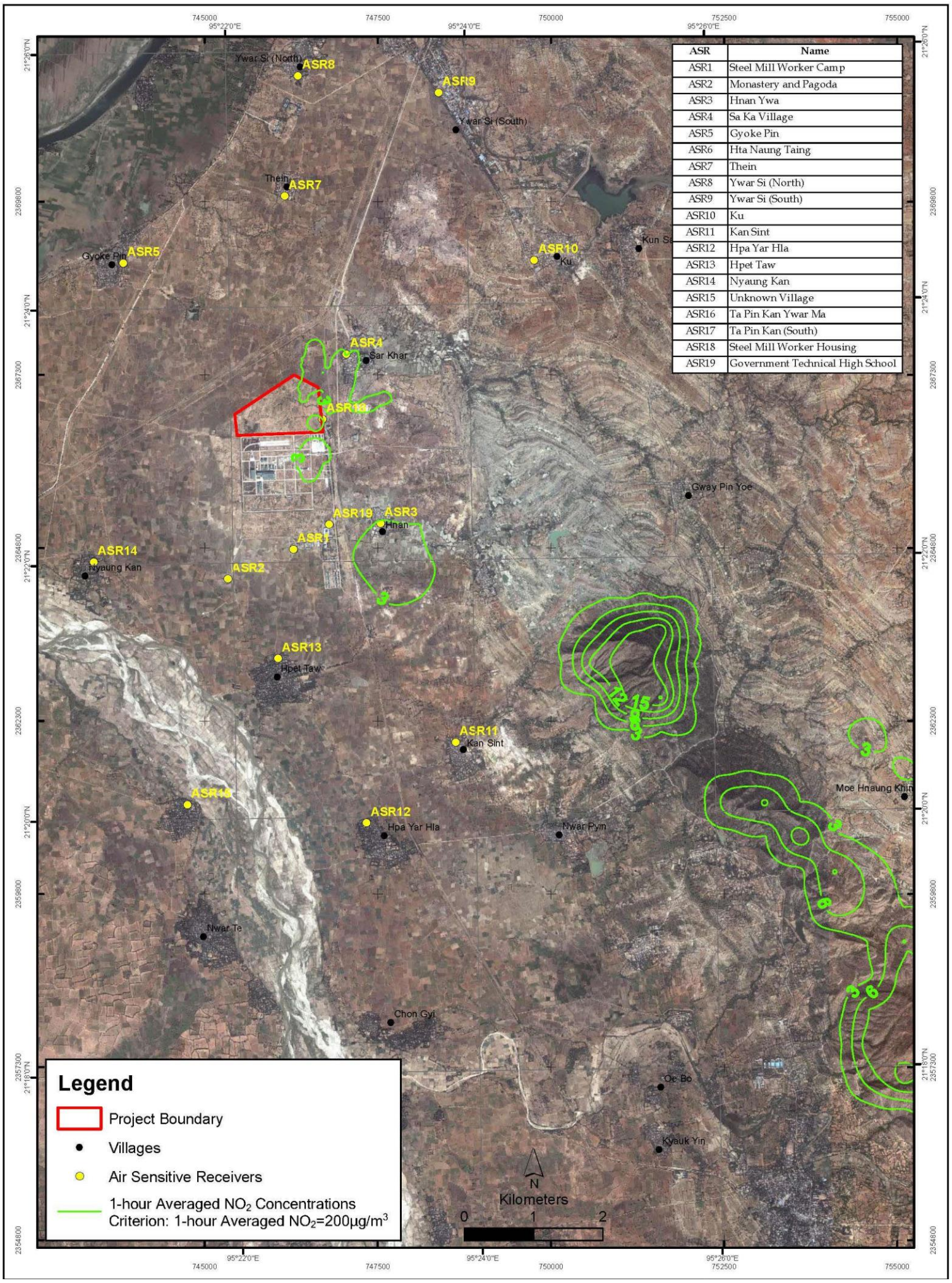


Figure 7.17 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Simple Cycle Operation (Project Only) in 2013

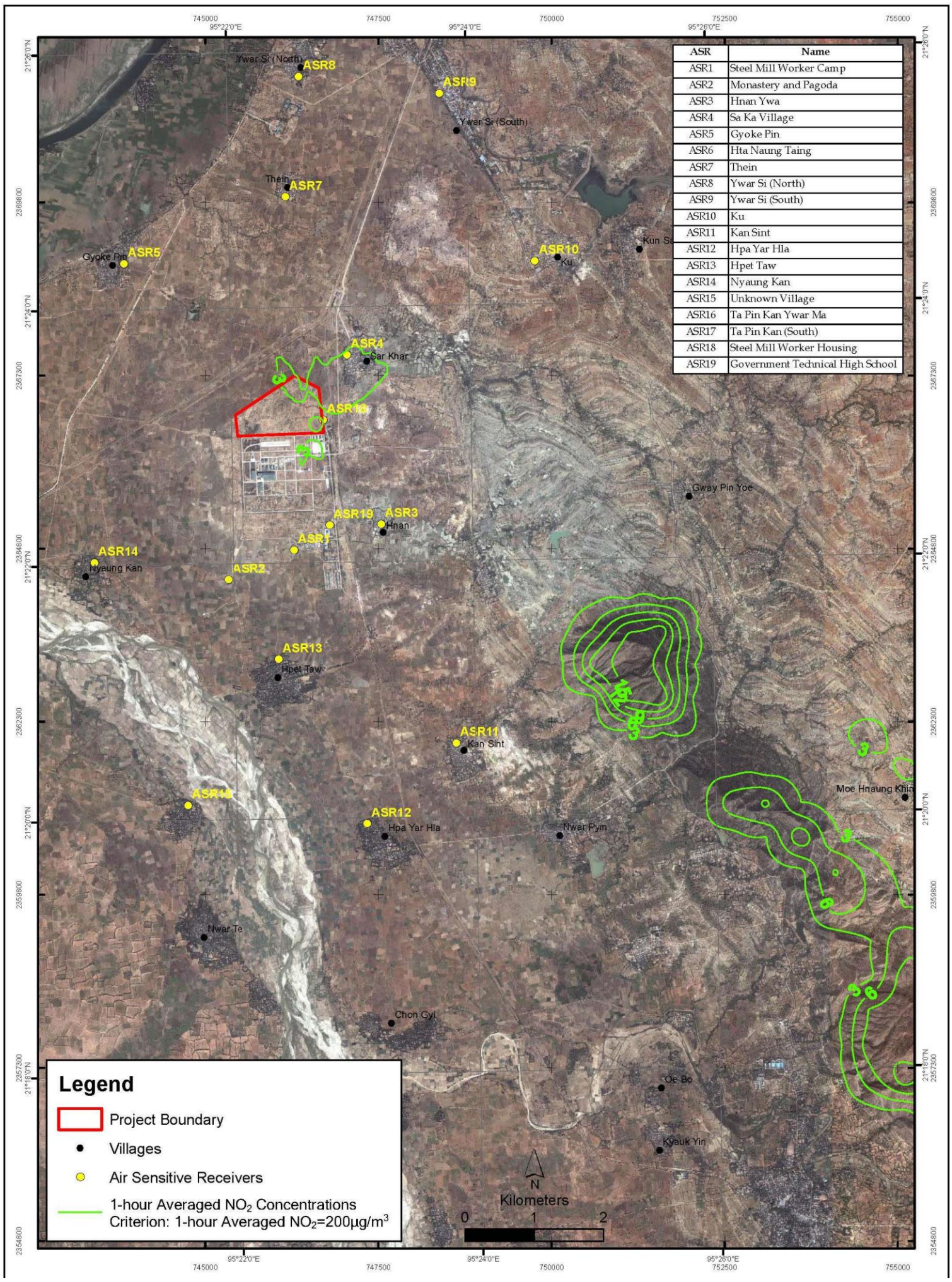
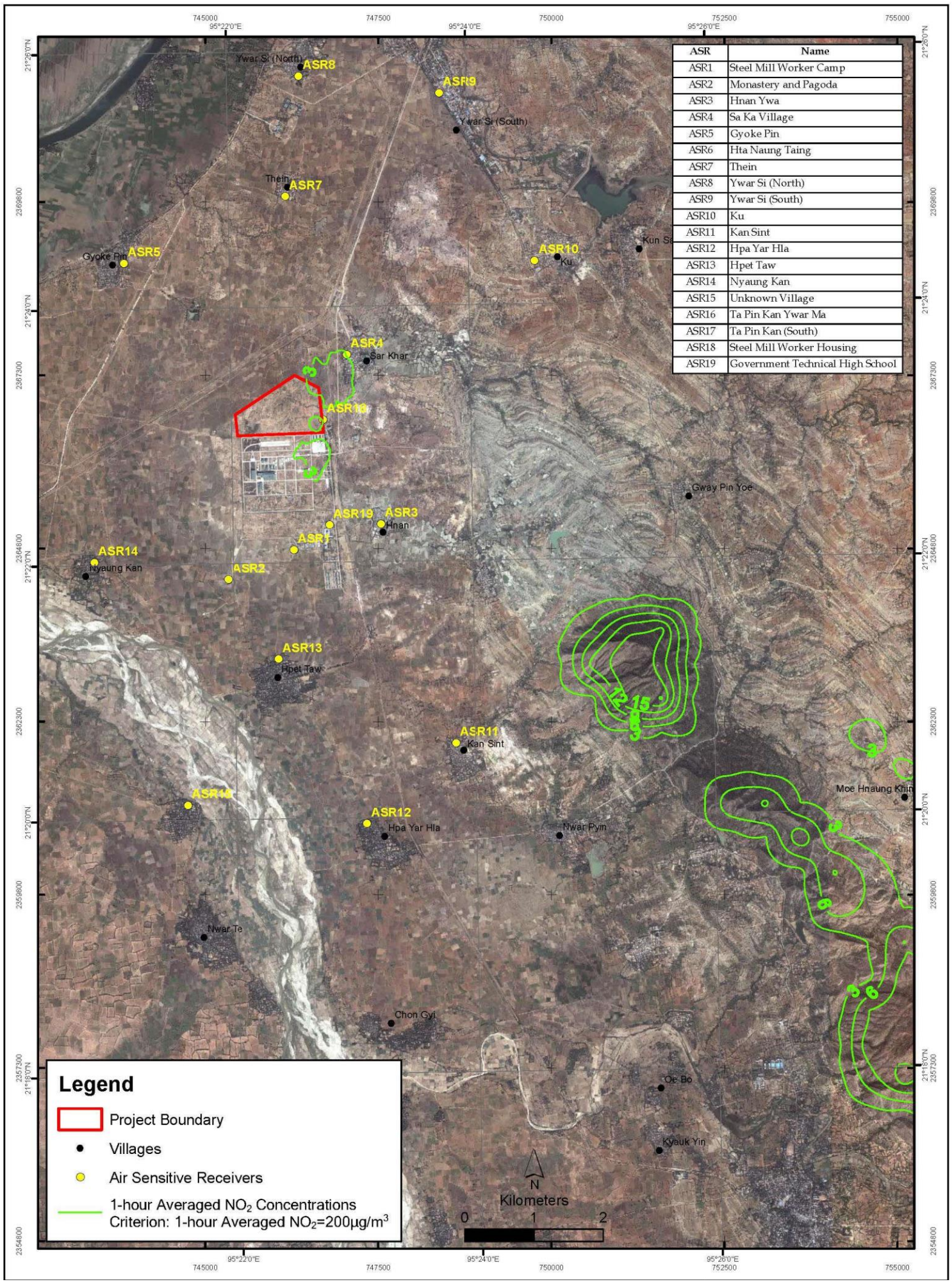


Figure 7.18 Predicted Maximum Ground Level 1-hour Average NO_2 Concentrations during Simple Cycle Operation (Project Only) in 2014



As the sensitivity for human health within the general population is "medium", the overall significance of impact from the operation of the Project at identified ASRs is considered **minor.** The impact assessment is summarised in ***Table 7.14*** below.

Table 7.14 Assessment of Air Quality Impacts from Stack Emission at Identified Air Sensitive Receptors

Impact	Stack emissions potentially affecting the identified Air Sensitive Receptors				
Impact Nature	**Negative**	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	**Direct**	Indirect	Induced		
	Impact on health within the general population is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long-term, as the impacts will occur throughout the operation of the power plant.				
Impact Extent	**Local**	Regional	International		
	Impacts on human health are mostly expected to be local within 10 km.				
Impact Scale	The scale of the impact is estimated to be the area within 10 km area from the power plant boundary.				
Frequency	Throughout the operation period of power plant.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered small as the project contribution within the degraded airshed is between 10% and 15% of the relevant air quality standards at the identified ASRs.				
Receptor Sensitivity	Low	**Medium**	High		
	The receptor sensitivity is considered as medium as the ASRs identified in the surrounding are generally population.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is considered to be **Minor.**				

7.9.3 Cumulative Impacts

Potential Impact

As noted in ***Section 7.8.2***, the assessment of cumulative impact includes air quality impacts attributed to the operation of the Project and the general background air quality in the Project site area. Therefore, the cumulative NO_2, SO_2, PM_{10} and $PM_{2.5}$ impacts are assessed based on the following equation:

Cumulative results (NO_2 or SO_2 or PM_{10} or $PM_{2.5}$) = Average background air pollutant concentrations (as presented in *Table 7.4*) + predicted maximum GLCs (as presented in *Table 7.13* and *Table 7.14* for combined cycle operation and simple cycle operation, respectively).

The highest cumulative results at the ASRs during combined cycle operation and simple cycle operation are presented in ***Table 7.15*** and ***Table 7.16***, respectively. Detailed results for each assessment year are presented in ***Annex E2***. For combined cycle operation, the cumulative maximum NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations under different time averaging at the ASRs comply with the respective air quality standards,

except for annual averaged NO_2, which has exceeded the criterion of 40µgm^{-3}. For simple cycle operation, the cumulative maximum NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations under different time averaging at the ASRs comply with the relevant air quality standards.

Table 7.15 Cumulative Maximum Ground Level Concentrations at Representative Air Sensitive Receivers during Combined Cycle Operation

ASR	Combined Cycle Mode (Main stacks S1 and S3 in operation)							
	Maximum Ground Level Concentration (µg m^{-3})							
	1-hr NO_2 [(a)]	Annual NO_2 [(a)(e)]	10-min SO_2 [(b)]	24-hr SO_2	24-hr PM_{10} [(c)]	Annual PM_{10} [(c)]	24-hr $PM_{2.5}$ [(c)]	Annual $PM_{2.5}$ [(c)]
ASR1	62.8	**54.5**	7.0	6.2	43.4	43.3	26.8	26.7
ASR2	61.9	**54.2**	6.9	6.2	43.4	43.3	26.7	26.7
ASR3	64.6	**54.5**	7.2	6.2	43.4	43.3	26.8	26.7
ASR4	64.1	**55.0**	7.1	6.3	43.5	43.3	26.9	26.7
ASR5	60.7	**54.2**	6.8	6.2	43.3	43.3	26.7	26.7
ASR6	61.1	**54.1**	6.8	6.2	43.3	43.3	26.7	26.7
ASR7	61.8	**54.3**	6.9	6.2	43.4	43.3	26.7	26.7
ASR8	62.3	**54.2**	7.0	6.2	43.4	43.3	26.7	26.7
ASR9	61.7	**54.3**	6.9	6.2	43.4	43.3	26.7	26.7
ASR10	61.1	**54.2**	6.8	6.2	43.3	43.3	26.7	26.7
ASR11	61.2	**54.2**	6.9	6.2	43.4	43.3	26.7	26.7
ASR12	60.2	**54.2**	6.8	6.2	43.4	43.3	26.7	26.7
ASR13	60.9	**54.3**	6.8	6.2	43.4	43.3	26.7	26.7
ASR14	61.5	**54.1**	6.9	6.2	43.4	43.3	26.7	26.7
ASR15	61.7	**54.1**	6.9	6.2	43.3	43.3	26.7	26.7
ASR16	60.8	**54.1**	6.8	6.2	43.4	43.3	26.7	26.7
ASR17	60.4	**54.1**	6.8	6.2	43.4	43.3	26.7	26.7
ASR18	76.1	**55.7**	8.3	6.5	43.7	43.4	27.0	26.7
ASR19	64.5	**54.8**	7.2	6.3	43.4	43.3	26.8	26.7
Background Concentration [(d)]	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**
Assessment Criteria	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
Max % of Cumulative Impact to criteria	**38%**	**139%**	**2%**	**5%**	**29%**	**62%**	**36%**	**76%**

Notes:

(a) Reference to UK Air Quality Assessment Guidelines – short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

(b) A general factor of 1.43 is used to convert hourly SO_2 results to 10-min results

(c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

(d) Average background pollutant concentrations presented in Table 7.4 have been included to assess cumulative impact.

(e) Exceedance of air quality standard for cumulative annual NO_2 at ASRs due to high background NO_2 concentrations in the Project site area.

Table 7.16 Cumulative Maximum Ground Level Concentrations at Representative Air Sensitive Receivers during Simple Cycle Operation

ASR	Simple Cycle Mode (Main stacks S2 and S4 in operation)							
	Maximum Ground Level Concentration (µg m^{-3})							
	1-hr NO_2 [(a)]	Annual NO_2 [(d)]	10-min SO_2 [(b)]	24-hr SO_2	24-hr PM_{10} [(c)]	Annual PM_{10} [(c) (d)]	24-hr $PM_{2.5}$ [(c)]	Annual $PM_{2.5}$ [(c) (d)]
ASR1	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR2	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR3	57.0	-	6.4	6.2	43.3	-	26.7	-

ASR	Simple Cycle Mode (Main stacks S2 and S4 in operation)							
	Maximum Ground Level Concentration (µg m^{-3})							
	1-hr NO_2 [a]	Annual NO_2 [d]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c] [d]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c] [d]
ASR4	57.1	-	6.5	6.2	43.4	-	26.7	-
ASR5	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR6	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR7	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR8	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR9	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR10	56.1	-	6.4	6.2	43.3	-	26.7	-
ASR11	56.6	-	6.4	6.2	43.3	-	26.7	-
ASR12	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR13	56.8	-	6.4	6.2	43.3	-	26.7	-
ASR14	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR15	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR16	55.8	-	6.3	6.2	43.3	-	26.7	-
ASR17	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR18	57.0	-	6.4	6.2	43.4	-	26.7	-
ASR19	56.8	-	6.4	6.2	43.4	-	26.7	-
Background Concentration [e]	**54.0**	**-**	**6.2**	**6.2**	**43.3**	**-**	**26.7**	**-**
Assessment Criteria	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
Max % of Cumulative Impact to criteria	**29%**	**-**	**1%**	**5%**	**29%**	**-**	**36%**	**-**

Notes:

[a] Reference to UK Air Quality Assessment Guidelines – short-term (1-hour) NO_2 = 50% of NO_x

[b] A general factor of 1.43 is used to convert hourly SO_2 results to 10-min results

[c] For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

[d] Annual averaged results are not presented since simple cycle mode will only be operating intermittently throughout the year.

[e] Average background pollutant concentrations have been included to assess cumulative impact.

Potential Consequence

For combined cycle operation, the cumulative short-term and long-term impacts have been assessed. From ***Table 7.15***, the cumulative NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations at the ASRs comply with the respective air quality standards, except for annual averaged NO_2 which has exceeded the annual criterion. However, it should be noted that, due to high NO_2 background concentration in the Project site area (54.0µgm^{-3}), the annual NO_2 criterion has already been exceeded even without the presence of the Project. The maximum project contribution of annual averaged NO_2 concentration at ASRs is only about 4.4% of the annual criterion as presented in ***Table 7.12***.

For simple cycle operation, only the cumulative short-term impacts (1-hour and 24-hour averaging time) have been assessed since simple cycle mode will only be operating intermittently throughout the year. From ***Table 7.16***, the cumulative short-term impacts of NO_2, SO_2, PM_{10} and $PM_{2.5}$ at the ASRs comply with the respective air quality standards.

Since the background NO_2 levels at the Project site area are relatively high and exceed the relevant annual NO_2 criterion, the Project site area should be considered as degraded airshed. As discussed in ***Section 7.9.2*** and following the criteria for defining magnitude of impact in ***Table 7.9***, the magnitude of cumulative air quality impact is

considered small since the maximum project contribution at the ASRs is between 10% and 15% of the air quality standards for degraded airshed.

Existing and / or In-place Controls

The embedded controls of the power plant have been described in ***Section 7.9.2***.

Significance of Impact

The magnitude of impacts from the operation of the Project and general background is considered small as the maximum project contribution at the ASRs is between 10% and 15% of the air quality standards for degraded airshed, following the criteria for defining magnitude of impact in ***Table 7.9***.

As the sensitivity for human health within the general population is "medium", the overall significance of impact arising from the operation of the Project and general background is considered **minor.** The impact assessment is summarised in ***Table 7.17*** below.

Table 7.17 Assessment of Cumulative Air Quality Impacts from the Operation of the Project and General Background Air Quality

Impact	Operation of the Project and general background air quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	**Direct**	Indirect	Induced		
	Impact on health within the general population is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long-term, as the impacts will occur throughout the operation of the power plant.				
Impact Extent	**Local**	Regional	International		
	Impacts on human health are mostly expected to be within 10 km.				
Impact Scale	The scale of the impact is estimated to be the area within 10 km area from the power plant boundary.				
Frequency	Throughout the operation period of power plant.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered small as the project contribution is between 10% and 15% of the relevant air quality standards at the identified ASRs within degraded airshed.				
Receptor Sensitivity	Low	**Medium**	High		
	The receptor sensitivity is considered as medium as the ASRs identified in the surrounding are generally population.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is considered to be **Minor.**				

Mitigation and / or Management Measures

As discussed in ***Section 7.9.2***, the predicted maximum contribution of air pollutants at the ASRs arising from the operation of the Project is low, about 11% of the relevant air quality standards. Referring to ***Table 7.9***, since the Project is located in degraded airshed and the maximum Project contribution is predicted to be between 10% and 15%

of the relevant air quality standards, the cumulative impact significance is also considered minor during the operation of the Project. No additional mitigation measure associated with the operation of the Project is therefore required.

It is recommended to include the stack design parameters and emission limits adopted in this assessment in the future EPC's contract as one of the contractual requirement.

Residual Impacts

As the cumulative impact significance is considered minor and no additional mitigation measure is required, no residual impact arising from the operation of the Project is anticipated.

Environmental Monitoring and Audit during the Operational Phase

It is proposed to carry out an environmental monitoring and audit programme, which includes the monitoring of the emission concentrations at the main stacks and bypass stacks, as well as ambient air quality monitoring at nearby air sensitive receptor. The proposed environmental monitoring programme is presented in ***Table 7.18***.

Table 7.18 Environmental Monitoring Program for Stack Emissions and Ambient Air Quality at Air Sensitive Receptors during the Operation of the Project

Aspect	Frequency	Sampling location	Parameters	Recommended Method
Stack emission	Continuous	Main stacks Bypass stacks	• NO_x as NO_2, PM, SO_2, O_2, moisture content • Frequency: continuous and annually	• Continuous Emission Monitoring System (CEMS) • Annual stack emission test : following USEPA method or equivalent
Ambient air quality	Monthly (year 1 – first 3 months of operation) Quarterly (year 1 – after first 3 months of operation)[1]	• One village house at Hnan Ywa village (ASR3) • One village house at Sa Ka village (ASR4) • One village house at Gyoke Pin village (ASR5) • One village house at Nyaung Kan village (ASR14)	• 1-hour and 24-hour averaged NO_2 and SO_2 • 24-hour averaged PM, PM_{10} and $PM_{2.5}$	• Method published by International Organization for Standardization, or USEPA or European Committee for Standardization or equivalent

7.10 RESIDUAL IMPACT ASSESSMENT CONCLUSIONS

The assessments indicate that the air quality associated with the construction will be controlled to minor; no adverse air quality impact during construction phase will be anticipated provided all recommended air mitigation measures will be implemented.

[1] As outlined in the IFC EHS Guidelines for Thermal Power Plants (2008), the effectiveness of the ambient air quality monitoring program should be reviewed regularly. If compliance is shown from the monitoring in year 1 monitoring may be stopped in year 2.

The potential air quality impacts arising from the Project during the operational phase have been predicted to be small relative to the relevant WHO Ambient Air Quality Guidelines as recommended in the IFC Guidelines. The significance of impact during the operation phase of the Project is considered minor and the Project contribution is low. Therefore, no significant air quality impact during operational phase of the Project will be anticipated at the ASRs and in the vicinity of the Project site provided all embedded air mitigation measures will be implemented.

8 GREENHOUSE GAS

8.1 INTRODUCTION

This chapter provides an estimate of the greenhouse gas (GHG) emissions that are likely to be emitted by the Project, as related to the issue of climate change. GHGs are assessed in order to provide an indication of what a Project's GHG emissions will be, and to find ways to mitigate them early on in the development process.

8.2 ASSUMPTIONS AND LIMITATIONS

As per Equator Principles III definitions, quantification of GHG emissions includes Scope 1 emissions (direct emissions from the facilities owned or controlled within physical Project boundary) and Scope 2 (indirect emissions associated with the off-site production of energy used by the Project).

Scope 1 assumptions are as follows:

- Construction phase
  - General use construction equipment for the Project is medium size load and average horsepower of 200hp.
  - The type of fuel used for all equipment is diesel.
  - Fuel used was estimated to be 21.86 litres of diesel fuel per hour (based on the estimated liters of fuel used per machine hour of FAO [1]).
- Operation phase
  - Gas turbine generator as it is the main source of emissions.

Scope 2 assumptions are as follows:

- Construction phase
  - During peak construction period, the energy requirement for each hour is approximately 16,000 kW. To represent the worst case scenario, the maximum electricity requirement for construction phase is used in assessment in which 86,400,000 kWh will be required, based on the 540 working days and 10 working hours per day.
  - The electricity will be sourced off-site from an external provider in Myanmar.
  - Due to the lack of emission factor from electricity supplier, national grid emission factor was used to calculate the Scope 2 emissions.
- Operation phase
  - No power requirement from external providers.

(1) Estimated following FAO's formula http://www.fao.org/docrep/t0579e/t0579e05.htm#3. calculation of machine rates

8.3 SCOPE OF ASSESSMENT

8.3.1 Project Activities

Based on the Scoping and the Project Description, the key potential impacts on greenhouse gas identified arise from the following combustion sources:

Construction Phase

During construction, the Project will involve Scope 1 and Scope 2 emissions as follows;

- Scope 1 direct emission mainly from construction site equipment and site vehicles and vessel transportation; and
- Scope 2 indirect emission from purchased electricity from external provider in Myanmar.

Operation Phase

Once operational, electricity for the Power Plant will be supplied by the Plant itself, so there would be no Scope 2 emissions to consider. Scope 1 emissions of GHG from the plant operation will mainly come from the following source:

- Scope 1 direct emission from gas turbine generators.

8.4 LEGISLATION REQUIREMENTS

Myanmar participated at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro and signed the United Nations Framework Convention on Climate Change (UNFCCC) in June 1992.[(1)] It has embarked as one of the 12 participating countries on the Asian Least Cost Greenhouse Gas Abatement Strategy (ALGAS) Myanmar ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 25 November, 1994 as a non-Annex I Party.

International guidelines i.e. the Equator Principles and IFC Performance Standards applicable to the Project in term of GHG emissions and requirements are provided in ***Chapter 3.***

8.5 SUMMARY OF RELEVANT BASELINE CONDITIONS

According to data from the World Resources Institute (2014), Myanmar's total GHG emissions (excluding land use change and forestry) in 2012 were 98.93 million tons of CO_2 equivalent ($MtCO_2$)[2]. The major sectors producing CO_2 emissions are agriculture (67.8%) and energy (20.4%).

(1) MOECF (2012) Myanmar's Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC) available at http://www.burmalibrary.org/docs18/Myanmar's_1st_%20report_to_UNFCCC-2012-red.pdf

(2) http://cait.wri.org/profile/Myanmar

8.6 ASSESSMENT METHODOLOGY

For Scope 1, GHG emissions calculation is based on the international guidelines. The main document used is Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, 2006 (2006 IPCC Guidelines). Other applicable guidelines and approaches come from a variety of sources, including American Petroleum Institute (API) and the World Business Council for Sustainable Development, World Resources Institute (WBCSD/WRI).

For Scope 2, GHG emissions calculation is based on tools provided by the GHG Protocol. The tool allows entering information into the spreadsheet (e.g. country, electricity requirement) along with the fuel and automatically calculates the resulting CO_2 released. The GHG Protocol is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions. It has been developed jointly by WBCSD and WRI.

The assessment of impact magnitude and significance related to GHG is based on the methodology described in ***Chapter 4***. The mitigation measures are based on international good practice (as recommended under the IFC EHS Guidelines), and good practice relevant to GHG emissions.

8.7 ASSESSMENT OF IMPACTS

8.7.1 Construction Phase

Scope 1 Direct Emissions

During construction, the Project will involve the movement of equipment in the construction areas such as crawler crane, hydraulic crane, excavators, trucks and barges.

GHG emissions are estimated using emission factors for the three (3) main greenhouse gases (CO_2, CH_4 and N_2O), and converted to CO_2 equivalent using global warming potential (GWP). ***Table 8.1*** presents the GWPs on a 100-year time horizon relative to CO_2 for ozone-depleting substances and their replacements (*IPCC, 2007*).

Table 8.1 Greenhouse Gas and Global Warming Potentials

Designation or Name	Chemical formula	100 yr GWP (AR4)[1]
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265

Source: [1] IPCC Fifth Assessment Report (AR5) (2013)

GHG emissions are estimated in terms of CO_2 equivalent (CO_2e) according to the following equation:

$$\text{Emissions}_{GHG,\,fuel} = \text{Fuel Consumption}_{fuel} \times \text{Emission Factor}_{GHG,\,fuel}$$ ***Equation 8.1***

Where:

Emissions $_{GHG,fuel}$ = z
Fuel Consumption $_{fuel}$ = amount of fuel combusted (TJ)
Emission Factor $_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg of greenhouse gas/TJ).

The type of fuel used for all equipment is diesel. To convert the consumption of diesel in volume (liters) to energy (TJ), the following conversion factors can be applied:

- 1 kg = 10^{-3} tonne = 10^{-6} Gg,
- 1 liter = 10^{-3} m^3
- Default net calorific value for gas/diesel oil = 43.0 TJ/Gg[(1)]
- Density of Diesel = 874.31 kg/m^3 [(2)]

Fuel consumption for diesel (in terms of TJ of energy) can therefore be calculated as follows:

Fuel Consumption (TJ) = Diesel Use (l) x Diesel Density (kg/m^3) x Net Calorific Value (TJ/Gg) x 10^{-9} (Gg/kg)
= Diesel Use (l) x 43.0 (TJ/Gg) x 874.31 (kg/m^3) x 10^{-9} (Gg/kg)
= Diesel Use (l) x 3.67 x 10^{-5} (TJ/l)

General-use construction equipment for the Project, assuming they are medium size load and average horsepower of 200hp, will consume approximately 21.86 liters of diesel fuel per hour.

It is expected that construction activities will be completed in 22.5 months. Construction hours are anticipated to be 10 hours per day, 6 days per week. Therefore, total days for construction are approximately 540 days.

GHG emissions from construction equipment are estimated following the approach of the IPCC (***Equation 8.1***) and converted to CO_2e using GWP (***Table 8.1***), with fuel consumption of 21.86 liters/hr and emission factor for diesel mobile combustion (***Table 8.2***).

Table 8.2 Default Emission Factors (kg of greenhouse gas per TJ on a Net Calorific Basis)

Sources/Fuel	CO_2	CH_4	N_2O
Stationary Combustion			
Gas/Diesel Oil	74100	3.0	0.6
Natural Gas	56100	1	0.1
Mobile Combustion			
Road Transport - Gas/Diesel Oil	74100	3.9	3.9
Water-Borne Navigation - Gas/Diesel Oil	74100	7	2

Source: IPCC Chapter 2 - Stationary Combustion and Chapter 3 Mobile Combustion of Volume 2

(1) Table 1.2 in Chapter 1 of Volume 2, IPCC (2006)
(2) Table 3-8 Density of distillate oil (Diesel), API (2009)

For a total of 540 days of construction, the release of Scope 1 emissions in CO_2 equivalent is estimated to be at 9,123.48 tonnes, as shown in ***Table 8.3***.

Table 8.3 Scope 1 Emission during Construction Phase

Source Type	Quantity	Activity Data			Total Fuel Consumption		GHG Emission				
							(kg CO_2e)				(ton CO_2e)
		Fuel Consumed	Working Hours	Working Day			CO_2	CH_4	N_2O	Total	Total
		(liter/hr)	(hr)	(day)	(liter)	(TJ)					
Emission Factors for Road Transport - Gas/Diesel Oil (kg of greenhouse gas per TJ)							**74100**	**3.9**	**3.9**		
Emission Factors for Water-Borne Navigation - Gas/Diesel Oil (kg of greenhouse gas per TJ)							**74100**	**7**	**2**		
Global Warming Potential for 100-year time horizon							**1**	**28**	**265**		
-Crawler Crane (100t)	1	21.86	10	540	118,044.00	4.33	321,017.12	473.08	4,477.34	325,967.54	325.97
-Crawler Crane (50t)	1	21.86	10	540	118,044.00	4.33	321,017.12	473.08	4,477.34	325,967.54	325.97
- Hydraulic Crane (50t)	2	21.86	10	540	236,088.00	8.66	642,034.23	946.16	8,954.69	651,935.08	651.94
- Hydraulic Crane (75t)	2	21.86	10	540	236,088.00	8.66	642,034.23	946.16	8,954.69	651,935.08	651.94
- Vibrating Compactor (20t)	5	21.86	10	540	590,220.00	21.66	1,605,085.58	2,365.39	22,386.72	1,629,837.69	1,629.84
- Concrete Truck ($6m^3$)	3	21.86	10	540	354,132.00	13.00	963,051.35	1,419.23	13,432.03	977,902.62	977.90
- Concrete Pump	2	21.86	10	540	236,088.00	8.66	642,034.23	946.16	8,954.69	651,935.08	651.94
- Compressor	1	21.86	10	540	118,044.00	4.33	321,017.12	473.08	4,477.34	325,967.54	325.97
- Reverse Excavator	3	21.86	10	540	354,132.00	13.00	963,051.35	1,419.23	13,432.03	977,902.62	977.90
- Bull dozer	3	21.86	10	540	354,132.00	13.00	963,051.35	1,419.23	13,432.03	977,902.62	977.90
- Dump truck	3	21.86	10	540	354,132.00	13.00	963,051.35	1,419.23	13,432.03	977,902.62	977.90
- Barge	2	21.86	10	540	236,088.00	8.66	642,034.23	1,698.23	4,592.15	648,324.61	648.32
										Total GHG emissions during construction phase	**9,123.48**

Scope 2 Indirect Emissions

The maximum electricity of 16,000 kW or of 86,400,000 kWh of the worst case might be required during the construction period. The electricity will be purchased from the national grid.

The GHG emissions are calculated using GHG protocol tools for purchased electricity. The total estimated Scope 2 emissions during construction are approximately 18,680.17 tonnes CO_2e (***Table 8.4***).

Table 8.4 Scope 2 Emissions during Construction Phase

Source	Electricity Consumption (kWh)	Emissions (tonnes CO_2e)	Source of Emission Factor
Purchased Electricity	86,400,000	18,680.17	Based on the national average of all fuel in Power Plant in Myanmar. (Source: World Resource Institute (2015). GHG Protocol Tool for Stationary Combustion. Version 4.7)

Total GHG Emissions during Construction Phase (Scope 1&2)

Combing Scope 1 and Scope 2 emissions, the total release of GHG emissions during construction phase is estimated to be 27,803.65 tonnes CO_2e as shown in ***Table 8.5***.

Table 8.5 Assessment of GHG Emissions during Construction Phase

Sources	Emissions (tonnes CO_2e)
Scope 1 direct emission from construction site equipment and site vehicles and vessel transportation	9,123.48
Scope 2 indirect emission from purchased electricity from external provider in Myanmar	18,680.17
Total	**27,803.65**

Potential Impact

Based on the calculated GHG emissions, the emissions from the construction phase (22 months) are estimated to be 27,803.65 tonnes CO_2e. This is considered insignificant emissions according to IFC.

Potential Consequence

GHG is global pollutants. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Although overall the atmosphere is sensitive to impacts from GHG emissions, the local atmosphere is not expected to be any more or less sensitive to potential impacts to GHG.

Existing and / or In-place Controls

No existing or in place control.

Significance of Impact

The significance of potential impacts to greenhouse gas during construction phase is assessed in ***Table 8.6***, and mitigation measures are presented. Magnitude is considered small as emissions contribution is accounted for 0.028% of national GHG emissions in 2012. Receptor sensitivity is considered low because the local atmosphere is not expected to be any more or less sensitive to potential impacts to GHG. Therefore, using impact significance matrix in ***Chapter 4***, significance of the impact is considered **negligible**.

Table 8.6 Assessment of GHG Emissions during Construction Phase

Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from combustion process of construction equipment.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gases can potentially affect the Earth's climate.				
Impact Scale	The emissions from construction phase are calculated to be 27,803.65 tonnes CO_2e or 0.028 million tonnes CO_2e. Compared to Myanmar's CO_2 release of 98.83 million tons in 2012, the total GHG releases from the Project are insignificant (approximately 0.028%).				
Frequency	Emissions will be released intermittently, but repeatedly throughout the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Minor emissions of GHG will be emitted as a result of the Project, and considered insignificant emissions according to IFC. Magnitude is considered Small.				
Receptor Sensitivity	**Low**	Medium	High		
	GHG is global pollutant. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor/resource sensitivity is rated as Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	As per the impact assessment methodology defined in ***Chapter 4***, the combination of a Low resource sensitivity and Small impact magnitude will result in an overall Negligible potential impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during construction to reduce GHG emissions;

- Implement the same mitigation measures to minimize impacts to Air Quality (***Chapter 7***).
- Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.
- Develop vehicle maintenance plan.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

8.7.2 Operation Phase

Scope 1 Direct Emissions

During the operation phase of the Project, GHG emissions would be generated mainly from the gas turbine generators in the Combined Cycle Gas Turbine (CCGT) Power Plant.

The gas turbine will use natural gas as the only fuel. Net heat rate of natural gas in CCGT Power Plant is 6,606 KJ/KWH. To convert units of KJ/KWH to units of terajoules (TJ), the following conversion factors can be applied:

- 1 kJ = 10^{-9} TJ
- Total power output during combined cycle operation = 225 MW or 225,000 KW
- Daily operation hours = 24 hr

Fuel consumption for natural gas (in terms of TJ of energy) can therefore be calculated as follows:

Fuel Consumption (TJ) = Net heat rate of natural gas (KJ/KWH) x Power output (KW) x Daily operation hours (Hr/day)
= 6,606 (KJ/KWH) x 225,000 (KW) x 24 (Hr/day) x $1/10^{9}$ (TJ/KJ)
= 35.67 TJ/day

In order to calculate GHG emissions, ***Equation 8.1*** can be applied, considering the quantity of fuel consumed for combustion purposes. The result of GHG emissions calculations are shown in ***Table 8.7***.

It is anticipated that the emission of greenhouse gas is estimated to be 2,003.03 tonnes of CO_2e/day, and annual emission is 731,106.32 tonnes.

The estimated GHG emissions from the Power Plant during operation will exceed the threshold that defines significant emitters of GHGs by the ADB SPS and EP III (100,000 tonnes CO_2e per year) and IFC PS3 (25,000 tonnes CO_2e per year). Therefore, the Project is required to report annual GHG emissions as per the applicable reference framework.

Table 8.7 Estimated GHG Emissions during Operation Phase

Source	Fuel Type	Fuel Consumed	GHG Emissions (kg CO_2e/day)			
		(TJ/day)	CO_2	CH_4	N_2O	Total
Global Warming Potential for 100-year time horizon			1	28	265	
Default Emission Factor (kg of greenhouse gas per TJ)			56100	1	0.1	
Gas Turbine Generator	Natural Gas	35.67	2,001,087.00	998.76	945.26	2,003,031.02
GHG Emission (tonnes CO_2e/day)						**2,003.03**
Annual GHG Emission (365 days) (tonnes CO_2e/year)						**731,106.32**

Potential Impact

Greenhouse gas (GHG) emissions have the potential to adversely affect the environment because they contribute to global climate change.

Potential Consequence

GHG is global pollutants. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Although overall the atmosphere is sensitive to impacts from GHG emissions, the local atmosphere is not expected to be any more or less sensitive to potential impacts to GHG.

Existing and / or In-place Controls

The Project has employed a CCGT technology which was designed for high reliability and efficiency operation with lower environmental impact. CCGT plant offer lower half as much CO_2 per kWh compared to coal-fire power. Non-greenhouse gas (GHG) emissions such as SO_2, NOx, and particulate matter are also relatively low.[1] Therefore, the development of electric energy in the form of combined heat energy is considered one of the most effective GHG reduction measure.

Significance of Impact

The significance of potential impacts to greenhouse gas during operation phase is assessed in ***Table 8.8***, and mitigation measures are presented. Magnitude is considered medium as emissions contribution will exceed the threshold that defines significant emitters of GHGs. Receptor sensitivity is considered medium because significant increase of GHG concentration in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the

[1] Energy Technology Systems Analysis Programme (2010). Gas-Fired Power. http://www.iea-etsap.org/web/e-techds/pdf/e02-gas_fired_power-gs-ad-gct.pdf

atmosphere. Therefore, using impact significance matrix in ***Chapter 4***, significance of the impact is considered **moderate**.

Table 8.8 Assessment of GHG Emissions during Operation Phase

Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from Project operation.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gases can potentially affect the Earth's climate.				
Impact Scale	The emissions from Power Plant are calculated to be 731,106.32 tonnes CO_2e or 0.73 million tonnes CO_2e per annum. Compared to Myanmar's CO_2 release of 98.83 million tons in 2012, the total GHG releases from the Project is approximately 0.73%.				
Frequency	Emissions will be released continuously throughout the operation period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	GHG will be emitted as a result of the Project. The emissions from Power Plant are calculated to be 731,106.32 tonnes CO_2e per year. This is considered 'significant emissions' according to ADB SPS and EP III (100,000 tonnes CO_2e per year) and of IFC PS3 (25,000 tonnes CO_2e per year). Magnitude is therefore considered Medium.				
Receptor Sensitivity	Low	**Medium**	High		
	GHG is global pollutants. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Receptor/resource sensitivity is rated as Medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	As per the impact assessment methodology defined in ***Chapter 4***, the combination of a Medium resource sensitivity and Medium impact magnitude will result in an overall Moderate potential impact.				

Mitigation and Management Measures

The technology of the Project is an efficient form of CCGT power generation. In additional the Project uses natural gas as its only fuel to generate electricity that provides more efficiency than coal because of higher operating temperatures, and when used together with the more efficient combined-cycle results in even higher efficiencies (*IEA, 2006*).[1] Therefore at this stage it is considered that further design measures and control measures are not considered necessary.

It is therefore proposed to undertake an annual GHG inventory to monitor the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC):

- Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO_2e unit.

[1] IEA, 2006a: Energy Technology Perspectives 2006: Scenarios and strategies to 2050. International Energy Agency, Paris, 484 pp.

Residual Impacts

The Project employs the most effective GHG reduction measure. The mitigation measures above have been put in place to monitor the GHG emission. There will be no reduction in the impact level, residual impact significance would be **moderate**.

9 SURFACE WATER QUALITY

9.1 INTRODUCTION

During the construction and operation phases, different activities have the potential to generate wastewater, accidental spills, sedimentation, and increased water consumption, which could lead to impacts on the hydrology and quality of surrounding freshwater bodies. In the Project Study Area, the Ayeyarwady River is identified as the most prominent potential receiving body. Therefore, it is important to understand the interaction between impacts generated from construction and operation activities of the Project and the subsequent effects on surface water quality and hydrology. This Chapter presents an evaluation of the potential impacts on surface water associated with the construction and operation of the proposed Project based on the impacts identified during Scoping (outlined in ***Chapter 5***). Mitigation measures have also been provided where necessary to be implemented alongside in-place controls to reduce the potential residual impacts to acceptable levels.

9.2 ASSUMPTIONS AND LIMITATIONS

The assessment of potential impacts related to surface water in this section is based on the environmental baseline data (presented within ***Chapter 5***), socio-economic baseline data (presented within ***Chapter 6*****)** and the information available from the Sponsor at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. It is noted that no quantitative modelling has been undertaken with regards to any elements of the surface water impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the Project, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

The environmental parameters sampled in the baseline survey (refer to ***Chapter 5***) are based upon commonly found contaminants.

This chapter focuses purely on water bodies as the receptor. It is recognised that any changes to surface water may potentially impact sensitive receptors that utilise these surface water resources. It is recognised that there is considerable cross over between assessment of impacts to surface water, and assessment of impacts to fish stock, mangrove ecosystems and any surface water users. In this regard, this chapter assesses impacts and develops management, mitigation and monitoring measures in relation to reducing impacts to surface water only. Assessing impacts to receptors from identified changes to water quality or hydrology (identified as a result of this **Chapter**) has been undertaken within the scope of ***Chapter 13***, ***Chapter 14*** and ***Chapter 17***, and taken into account the various management, mitigation and monitoring measures developed within this chapter.

9.3 SCOPE OF ASSESSMENT

Based on the IFC Scoping Study and the Project Description in ***Chapter 2***, the key potential impacts on surface water identified arise from the following activities.

Construction Phase

- Power Plant
  - Pre-commissioning & Testing
  - Wastewater Discharges and Run-off
  - Waste Storage & Disposal
  - Accidental Events (spills/uncontrolled releases)
- Water Supply Pipeline and Water Discharge Pipeline
  - New Pumping Station or retrofit (Sedimentation/Siltation)
- Gas Supply Pipeline
  - Accidental Events (spills, uncontrolled releases)

Operation Phase

- Power Plant
  - Waste Storage & Disposal
  - Accidental events (spills/uncontrolled releases)
- Water Supply Pipeline and Water Discharge Pipeline
  - Cooling Water Withdrawal
- Gas Supply Pipeline
  - Accidental Events (leaks, uncontrolled releases)

9.4 LEGISLATION REQUIREMENTS

The surface water impact assessment is based on international guidelines. The requirements of these international guidelines have been reviewed and discussed in detail in ***Chapter 3***.

9.5 SUMMARY OF BASELINE CONDITIONS

9.5.1 Hydrology

There are no permanent surface water features present at the Project Site. The Ayeyarwady River is approximately 10 km northwest from the Project Site. An irrigation canal runs from the pumping station at the Ayeyarwady River to the north of the Project Site, being 0.5 km from the boundary at the closest point. The Ayeyarwady River is about 2,170 km long and has a total drainage of about 411,000 km^2 [(1)]. The catchment above Sangaing (downstream of Mandalay) has a total drainage of 117,900 km^2 and supplies a mean annual discharge of 8,024 m^3/s [(2)]. During the low water season (December through May), riverine morphology alternates between single and multiple channel reaches, the latter created by sand island deposits that emerge near the mouths of convergent tributaries and above

(1) Vorosmarty C. J., Fekete & B. A. Tucker, (1998) River Discharge Database, Version 1.1. (RivDis,V1 supplement).

(2) Vorosmarty C. J., Fekete & B. A. Tucker, (1998) *Op cite*

and below channel constrictions. Extensive floodplains border the waterways in many places [1].

According to local fishermen interviewed at the initial site visit during preparation of the IFC Scoping Report, the river floods significantly in the wet season. The last significant flood to affect the area was recorded in 2013, affecting mainly the villages along the banks of the Ayeyarwady River [2]. No further details are available on this flood event at this stage.

Flow measurement results from the Ayeyarwady River, near the withdrawal location for the Project, have been estimated to be in the range of 64 m^3/s (measured on March 28, 2015) to 660 m^3/s (measured on August 8, 2014).

9.5.2 *Water Use*

In the Mandalay region, populations may have access to water supply through a network of piped water system and private wells and moat water [3]. The source of the piped water supply is from ground water, mainly from tube wells pumping along the banks of the Ayeyarwady River. Until 2006, only 60% of the city area was covered by piped water supply. While those residing in the cities, not covered by the piped water supply had to rely on water from tube wells dug by WSD/MCDC and international donor projects, those residing outside the urban areas have to rely on sources such as open dug wells, springs, rivers and ponds. In Myingyan, the source of irrigation is a piped water supply from canals and streams.

Fishing is not a popular activity in the Project area villages, with the exception of Tha Pyay Thar, as it is the village located closest to the Ayeyarwady River, and Gyoke Pin. Further details on fisheries in the Project area are provided in ***Chapter 6***.

9.5.3 *Water Quality*

Based on the baseline monitoring results for surface water quality in the Ayeyarwady River from July 2014 to July 2015, with the exception of TSS and total coliform bacteria, all other monitored parameters were found to be below the WBG/IFC guideline values.

9.6 ASSESSMENT METHODOLOGY

Potential impacts on water quality and hydrology associated with the construction and operation of the Project have been reviewed in the scoping. Based on this review, potential sources of surface water impact that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined considering the factors of the nature and magnitude of impacts and sensitivity of the surface water bodies.

(1) Smith B. D., Hobbs L., (2002), Status of Irrawaddy dolphins Orcaella Brevirostris in the upper reaches of the Ayeyarwady River, Myanmar, The Raffles Bulletin of Zoology, Supplement No. 10

(2) http://c4i.me/site/2013/09/18/flash-flood-asia-myanmar-burma-3/, C4I For Humanity, accessed 20-06-2014

(3) In the old capital of Burmese King, there is a palace surrounded by moat and water from moat was used for water supply in the past as a main source of water (drinking and domestic use).

9.6.1 *Impact Identification*

There are a number of intrusive activities that occur throughout the lifecycle of the Project which, if not managed effectively, may cause impacts to the surface water in the vicinity of the Project Area. The temporal and spatial spread of activities will mean that actual impacts will be dependent on the specific activities. Accordingly, to enable clearer identification of impacts and development of management and mitigation measures specific to each activity, the potential surface water impacts are described on an activity basis.

Note that any impacts to surface water quality have the potential to cause secondary impacts to aquatic ecology and local fisheries. However, these impacts are assessed in separate sections, namely ***Chapter 14*** (Biodiversity), and ***Chapter 15*** (Social Impact Assessment), respectively.

9.7 *ASSESSMENT OF IMPACTS*

9.7.1 *Construction Phase*

Construction of the power plant will be carried out by the construction contractor appointed by the Sponsor. The construction phase for the Project will comprise of primarily two distinct phases: (a) civil construction work that would require a minimum of one year for completion; and (b) mechanical and electrical work for Plant commissioning. The entire construction phase is expected to continue for approximately 22.5 months. The approximate number of workers for both civil and mechanical works is expected to be around 600 - 900. During the construction phase, potential water quality impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, and sedimentation.

Wastewater Discharges and Runoff

Wastewater discharge and runoff during the construction phase may lead to contamination of freshwater sources if not managed appropriately. During the construction phase, there are a number of anticipated wastewater sources.

Workers will be accommodated in a worker's camp adjacent to the site, and sanitary wastewater streams from the workers could potentially impact surface water. Sanitary facilities, including toilets and septic tanks, will be provided for the use of the construction workforce both on-site and at the workers' accommodation. If not adequately designed and positioned to reflect the local hydrological and hydrogeological patterns, untreated sanitary wastewater due to leakages or overflows could have the potential to enter surface water. Periods of high rainfall could lead to overflow, or rapid through-flow, of the effluent to surface water prior to its full digestion in the septic tanks. Raw sewage can impact surface water quality by promoting the growth of algae and delivering pathogens that may be harmful to human and ecological receptors. Sanitary wastewater is generally characterized as having a high concentration of solids (suspended and dissolved), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), nutrients (nitrogen, ammonia) and faecal coliform counts. The organic substances (e.g. hydrocarbon, protein) are decomposed in water, and the decomposition of organic matter will reduce the oxygen content dissolved in water. Quantities of sanitary wastewater discharge for

the Project are not yet known, but estimates can be made based on the number of workers. The approximate number of people onsite during the construction phase is expected to be an average of 600 people per day. Conservatively assuming 100 L/person/day of water consumption, and considering sanitary wastewater production to be 80% of water consumption per person (for non-continuous use), this equates to the production of 48,000 liters of sanitary wastewater daily. In addition, construction activities such as site clearance, earthworks, disposal of back fill materials, installation of hard standing areas, etc., could cause runoff of unconsolidated sediments during rainfall. The generation of sediment laden run off could be transferred to the nearby freshwater bodies, which could increase total suspended solids and turbidity in receiving waters. Construction or retrofit of the pumping station at the Ayeyarwady River may cause impacts on surface water quality if piling or dredging activities are required. This could result in localised impacts such as runoff and erosion of exposed bare soil, slopes and earth, and release of cement materials into surface water bodies with stormwater runoff. Baseline surveys for the Ayeyarwady River found that there were already elevated levels of TSS.

Wastewater may also be generated from washing of equipment and machinery on site, as well as from the concrete batching plant. This wastewater may contain suspended solids and traces of hydrocarbons. The discharge of wastewater produced during concreting can also lead to changes in the pH of the receiving water body, if not first treated.

The type of treatment system to be used will be an aerobic type of septic tank, which is a common method of sanitary wastewater treatment used during construction of various industrial facilities. Solids are retained in the septic tank, and the clear (treated) water will be discharged to the site drainage. The capacity of the system is based on the number of workers and will be equivalent to 48 (simultaneous) persons. Additional septic tanks will be provided, if necessary, depending upon the location and number of workers as per the site condition.

The contractor will be responsible for ensuring that any wastewater discharged meets the applicable World Bank/ IFC General EHS Guidelines prior to discharge of such wastewater. Stormwater runoff will be drained to a common settlement tank to remove solids, before being discharged to a common drain.

Potential impacts to surface water quality are expected to be short-term and localised in nature, and can be controlled if wastewater treatment systems are adequately designed.

The significance of potential impacts to surface water due to wastewater discharges and runoff during the construction phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for impacts to surface water due to wastewater discharges and sediment-laden runoff.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The construction phase will last approximately 22.5 months. The duration of potential impacts is therefore long-term.			

Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
Scale	Based on experience with similar projects, the total approximate quantities of wastewater that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include: • 48,000 L/day of sanitary wastewater				
Frequency	Impacts to surface water from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the construction phase (12-16 months).				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Potential impacts to surface water quality in the Project area from wastewater discharges and runoff are expected to be of Medium magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.				
Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude will result in an overall Moderate Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system;
- Implement adequate sanitary facilities, (one toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce;
- Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge;
- Septic tanks will be provided to treat sanitary discharge;
- Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;
- Open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including wheel cleaning facilities;
- Provision of channels, earth bunds or sand bag barriers on site to direct stormwater to silt removal facilities;
- Design drainage pipes and culverts for the controlled release of storm flows;
- Protect temporary trafficked areas on-site with coarse stone ballast or equivalent;
- Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times;
- Provide measures to reduce the ingress of site drainage into excavations. If trenches have to be excavated during the wet season, excavate and backfill them in short sections wherever practicable. Discharge any water pumped out from trenches or foundation excavations into storm drains via silt removal facilities;
- Mulch to stabilise exposed areas, where practicable and appropriate;

- Re-vegetate areas promptly, where practicable and appropriate;
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage system of open stockpiles of construction materials;
- Install onsite wastewater treatment facilities or processes such as filtration, flocculation or biochemical treatment before discharge to river;
- Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the stormwater system;
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater; and
- Oil-contaminated water, if any, will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage).

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **minor**.

Waste Storage and Disposal

During the construction phase, waste materials, if not stored and disposed of appropriately, have the potential to cause surface water contamination through direct release or from contaminated stormwater runoff.

The majority of the generated wastes from the Project during the construction phase will be non-hazardous. General construction waste will comprise of surplus or off-specification materials such as concrete, steel cuttings/filings, wooden planks, packaging paper or plastic, wood, plastic pipes, metals, etc. Domestic wastes consisting of food waste, plastic, glass, aluminium cans and waste packages will also be generated by the construction workforce. A small proportion of the waste generated during construction will be hazardous, including used paint, engine oils, hydraulic fluids and waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on site.

Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include:

- 600 kg/day of solid (non-hazardous) waste; and
- 135 kg/month hazardous waste.

Infill will be used for backfilling, while steel waste will be sold as scrap. Wooden crates will be disposed by authorized 3rd party disposal contractors. Hazardous wastes will be disposed of by authorized 3rd party disposal contractors. The construction contractor will handle, store and dispose of all waste in accordance with applicable guidelines. Concrete waste of inert nature will be stored in a laydown area near the concrete batching plant and will be reused where possible. Any bitumen waste will be stored separately in a lined area to be disposed of by licensed contractors.

The significance of potential impacts to surface water due to contamination from inappropriate waste storage and disposal during the construction phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for surface water contamination from inappropriate waste management.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The construction phase will last approximately 22.5 months. The duration of impacts is therefore long-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the Project area and downstream of the Ayeyarwady River, and hence would be considered to be local.			
Scale	Construction activities will take place within the Project area. Based on experience with similar projects, the total approximate quantities of waste that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include: • 600 kg/day of solid waste • 135 kg/month hazardous waste The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, but appropriate waste management practices will mitigate the impacts.			
Frequency	Impacts to surface water due to inappropriate waste storage and disposal could occur intermittently but repeatedly throughout the day for the duration of the construction phase.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in Project area due to inappropriate waste disposal are expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Implement the same mitigation measures to minimize impacts to Waste Management (***Chapter 13***);
- Provide training to labourers for waste disposal in designated areas and use of sanitation facilities;
- Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials;
- Implement construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain;
- Store waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensure that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
- Dispose of waste by licensed contractors.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Accidental Spills and Leaks

Surface water contamination may occur during the construction phase due to accidental leaks or spills of chemicals or hazardous materials such as oils, lubricants or fuel from heavy equipment, and improper chemical/fuel storage. Additionally, HRSG chemical cleaning during the pre-commissioning activities may impact surrounding surface water quality, should leakages of HRSG cleaning chemicals occur. Such spills can impact surface water quality either due to direct discharge or indirect discharge due to stormwater runoff. In addition, discharges of oily bilge or ballast water from barges could impact surface water quality during construction.

Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:

- 30,000 L/month diesel fuel;
- Small, infrequent quantities of lubricants, oil; and
- HRSG cleaning chemicals.

Spill control measures such as storage and handling of chemicals and fuels on impervious areas (such as concrete surfaces) will be implemented to minimize impacts in case of spills. Heavy equipment will be checked for lubricant leaks, and

workers will be trained not to dispose of waste improperly in the area. Liquid effluents arising from construction activities will be treated to the applicable World Bank/IFC guidelines prior to discharge.

The significance of potential impacts to surface water due to contamination from accidental spills and leaks during the construction phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for impacts to surface water due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuel storage.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The construction phase will last approximately 22.5 months. The duration of potential impacts is therefore long-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the Project site footprint and gas pipeline and transmission line corridors, and hence would be considered to be local.			
Scale	Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include: • 30,000 L/month diesel fuel • Small, infrequent quantities of lubricants, oil • Hydrostatic testing chemicals The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.			
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in the Project area due to accidental releases is expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal;
- Hazardous waste storage areas will comply with best practice/ international standards;
- Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the early stages of the Project implementation;
- Carry out land contamination assessments and identification of legacy contaminated land sites;

- Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks;
- Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals;
- A site specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination;
- Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;
- Contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events;
- Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period;
- Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain.
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container;
- Storage of inert concrete waste in a laydown area near the concrete batching plant and reuse of these wastes under floors or roads;
- Dispose of hazardous waste including bitumen by licensed contractors;
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage); and
- Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor.
- Only barge operators that comply with the relevant local and international standards and are permitted to operate barges for transportation purposes will be engaged.
- Barges used for Project material transport will be independently inspected and audited by the Project EHS Management Team. Each barge will be inspected at least once every 6 months and records maintained. If any continued non-compliance is observed over two (2) audit inspections, the Project will terminate the services of the barge transporter.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

9.7.2 *Operation and Maintenance Phase*

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 80. The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the power plant. During the operation phase, potential surface water impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, cooling water withdrawal, erosion, and sedimentation.

Wastewater Discharges and Runoff

Sources and estimated quantities of wastewater generation from the Plant during the operation and maintenance phase are as follows:

- Sludge from river water pre-treatment : 1 m^3/hr
- DM plant neutralized water : 5 m^3/hr
- Cooling tower blowdown : 70.5 m^3/hr
- Stormwater: intermittent
- Washing water from Main Block : intermittent
- Sanitary wastewater (sewage): ~ 4 m^3/hr

Stormwater, industrial wastewater and sewage water will be collected and treated in the power plant prior to discharge. Wastewater conditions will comply with the international standards, as described in ***Chapter 3***. All treated wastewater will be collected, monitored and discharged into the irrigation canal.

As wastewater will be discharged to the irrigation canal, there may be potential impacts to downstream users of the irrigation canal due to altered water quality. In particular, some water quality-related problems in irrigated agriculture include high salinity, which can reduce water availability to crops, and excess ions (such as sodium, chloride or boron) which can accumulate in sensitive crops to cause crop damage and reduce yields. Excessive nutrients may also reduce crop yield or quality. There also exists some evidence that irrigation water temperature can affect crop quality, because colder water holds more dissolved oxygen, and colder water usually contains less dissolved salt.

There are very few international standards relating specifically to water quality for irrigation purposes. However, the Food and Agriculture Organization (FAO) does have Guidelines for Interpretations of Water Quality for Irrigation, which are presented in ***Table 9.1***. The Project will, as much as possible, control the effluent discharged to the irrigation canal to be below the "Severe" restriction on use according to the indicative guidelines. In addition, the temperature of the effluent discharged will not exceed 40°C in winter and 45°C in summer. Sembcorp is also currently in discussions with MEPE and the Water Resource Utilization Department (WRUD) to agree on appropriate quality of water discharge into the irrigation canal.

Table 9.1 FAO Guidelines for Interpretations of Water Quality for Irrigation[1]

Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
Salinity*(affects crop water availability)*[2]							
	EC_w			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	TDS			mg/l	< 450	450 – 2000	> 2000
Infiltration*(affects infiltration rate of water into the soil. Evaluate using EC_w and sodium adsorption ratio (SAR) together)*[3]							
SAR	= 0 – 3	**and EC_w**	=		> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6		=		> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12		=		> 1.9	1.9 – 0.5	< 0.5
	= 12 – 20		=		> 2.9	2.9 – 1.3	< 1.3
	= 20 – 40		=		> 5.0	5.0 – 2.9	< 2.9
Specific Ion Toxicity *(affects sensitive crops)*							
	Sodium (Na)[4]						
	surface irrigation			SAR	< 3	3 – 9	> 9
	sprinkler irrigation			me/l	< 3	> 3	
	Chloride (Cl)[4]						
	surface irrigation			me/l	< 4	4 – 10	> 10
	sprinkler irrigation			me/l	< 3	> 3	
	Boron (B)[5]			mg/l	< 0.7	0.7 – 3.0	> 3.0
	Trace Elements (see Table 21)						
Miscellaneous Effects *(affects susceptible crops)*							
	Nitrogen (NO_3 - N)[6]			mg/l	< 5	5 – 30	> 30
	Bicarbonate (HCO_3)						
	(overhead sprinkling only)			me/l	< 1.5	1.5 – 8.5	> 8.5
	pH				**Normal Range 6.5 – 8.4**		

An overview of management of wastewater and treatment from the Plant is as follows:

Wastewater Treatment System

The wastewater system will collect and neutralize chemical wastes from the water treatment plant (regeneration waste) and the drainage from chemical containment areas.

Drains from all equipment containment drainage, spills, floor wash downs and fire protection discharges will be led to oil-water separator. One oil/water separator will be designed for outdoor, underground in RCC construction.

The precise effluent characteristics of the wastewater from the Plant are not yet known. However, it will only consist of the chemical wastewater from regeneration wastes and the cooling tower blow down. Other industrial wastewater that is typical of a coal fired plant – like coal storage yard wash water, air preheater wash water etc, are not present for this facility. All effluents will be treated to comply with

[1] Adapted from University of California Committee of Consultants 1974.

discharge limit criteria according to international standards, as described in ***Chapter 3***.

Note that Myingyan municipality will be engaged for appropriate disposal of the dried sludge from process wastewater, and will be by a licensed waste contractor.

Plant Wastewater Monitoring System

The Central Monitoring Basin will collect all the neutralized wastes, separated water from oil-water separator, and cooling tower blow down water for monitoring to ensure compliance to wastewater effluent quality before discharge. The wastewater will be discharged to the irrigation canal outside of the Power Plant.

Sanitary Wastewater (Sewage) Treatment System

Sanitary wastewater will be treated by a package sewage treatment facility. The capacity of the plant will be sufficient for simultaneous use by 25 equivalent (simultaneous) persons, and the volumetric capacity will be designed to ensure it can accommodate the above mentioned quantities. The sewage water system will consist of underground pipelines with catch basins. The sewage water will be collected by sewage water pipe and gravity flow, which will convey the sanitary wastewater to the sewage water treatment device. One set of septic tanks will be installed underground to treat the sanitary wastewater. Treated wastewater will be combined with the plant wastewater before discharge.

The actual final design specification fo the treatment system will be provided during the engineering stage of the Project. However, Indicative Values of the Treated Sanitary Sewage Discharges (per WB/IFC guidelines) are as follows:

- pH – 6 to 9
- BOD – 30 mg/l
- COD – 125 mg/l
- Total Nitrogen – 10 mg/l
- Total Phosphorus – 2 mg/l
- Oil & Grease – 10 mg/l
- TSS – 50 mg/l

Stormwater Drainage System

The stormwater drainage system will consist of a series of underground conduits and drainage outflows. The drainage system will be designed to be able to accommodate a worst-case storm event based on local meterological conditions. Additional details on the potential volumes of stormwater runoff that may occur during operations are presented in *Section 9.7.2.5*.

Oily Water Treatment System

Oily wastewater treatment is designed to treat the oily water from the main power block. Oily wastes are treated by an oil water separator and the the treated water will drain to the irrigation canal near the Plant.

Instrumentation will be used to monitor the Plant's compliance with discharge limitations. In the event that the effluent discharge is detected above the effluent discharge limit criteria, isolation valves will be automatically closed to prevent accidental discharge of untreated effluent.

The significance of potential impacts to surface water due to wastewater discharges and runoff during the operation phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for impacts to surface water due to wastewater discharges during plant operation. Potential secondary impacts to downstream users of irrigation canal.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.			
Scale	Sources and estimated quantities of wastewater generation from the Plant during the operation and maintenance phase are as follows: • Sludge from river water pre-treatment : 1 m^3/hr • DM plant neutralized water : 5 m^3/hr • Cooling tower blowdown : 70.5 m^3/hr • Stormwater: intermittent • Washing water from Main Block : intermittent • Sanitary wastewater (sewage): ~ 4 m^3/hr The scale of potential impacts due to release of wastewater is potentially large due to the quantities present during this stage, but in-place treatment and management systems will reduce effluent levels to within IFC standards. Discharged water will be treated to meet applicable IFC EHS Guidelines, as well as FAO Guidelines as applicable for irrigation water.			
Frequency	Impacts to surface water from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the operation phase (25 years).			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in the Project area from wastewater discharges and runoff are expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Install oil/water separators to treat surface run-off prior to discharge to the stormwater system;
- Implement adequate sanitary facilities for onsite personnel;

- Liquid effluents arising from operations will be treated to the applicable IFC guideline prior to discharge;
- Design drainage pipes and culverts for the controlled release of storm flows.
- Install onsite wastewater treatment facilities or processes such as filtration, flocculation or biochemical treatment before discharge;
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater;
- Conduct monitoring of temperature at the cooling water discharge point at a frequency of once every 15 days;
- Implement discharge system shutdown in event that discharge temperature of effluent exceeds standard;
- Efforts to be made to increase the cycle of concentration to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower;
- Stormwater drainage and wastewater will be treated in accordance to the applicable WB/IFC EHS Guidelines for Thermal Power Plant (2008);
- Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream. The treated de-oiled water will be discharged with the plant wastewater. The Project will study the possibility to transfer to cooling water basin and used as part of cooling water stream during detailed engineering;
- The sewage from the entire plant area will be collected and treated in a sewage treatment plant (STP). No untreated sewage will be directly discharged into the Ayeyarwady River or the irrigation canal near the site, or disposed of on land, for the duration of the project life cycle;
- The treated effluent will comply with WB/IFC EHS Guidelines for Thermal Power Plant (2008) before discharge outside the plant premises.
- In order to monitor STP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of STP.
- The stormwater drainage system will be periodically inspected for blockages and cleaned at least once before the monsoon season each year; and
- Operating personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Waste Storage and Disposal

During the operation and maintenance phase, waste materials, if not stored and disposed of appropriately, have the potential to cause impacts to surface water quality.

The majority of the generated wastes from the Project during the operation phase will be non-hazardous. A small proportion of the waste generated during construction will be hazardous, including used paint, engine oils, hydraulic fluids and

waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on site.

Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an average of 80 workers per day) include:

- 80 kg/day of solid (non-hazardous) waste; and
- 18 kg/month hazardous waste.

Hazardous wastes will be disposed of by authorized 3rd party disposal contractors. The Sponsor will handle, store and dispose of all waste in accordance with applicable guidelines.

The significance of potential impacts to surface water due to contamination from waste storage and disposal during the operation phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for surface water contamination from inappropriate waste management.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.			
Scale	Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an average of 80 workers per day) include: • 80 kg/day of solid (non-hazardous) waste • 18 kg/month hazardous waste			
Frequency	Impacts to surface water due to inappropriate waste storage and disposal could occur intermittently but repeatedly throughout the day for the duration of the operation phase.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in Project area due to inappropriate waste disposal are expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Implement the same mitigation measures to minimize impacts to Waste Management (***Chapter 13***);

- Provide training to all staff for waste disposal in designated areas and use of sanitation facilities;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain;
- Store waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensure that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container and
- Dispose of waste by licensed contractors.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Water Intake

As discussed in ***Chapter 2***, the Project will require raw water intake from the Ayeyarwady River for several processes during the operational phase, make up water for cooling towers, demineralized water system, service water system, potable water system, etc. Small quantities may also be required during the construction phase. This water withdrawal from the Ayeyarwady River may have potential impacts related to existing water uses, as follows:

- Impact on downstream agricultural water users; and
- Impact on downstream fishing activity having negative impact on fisherman's livelihood

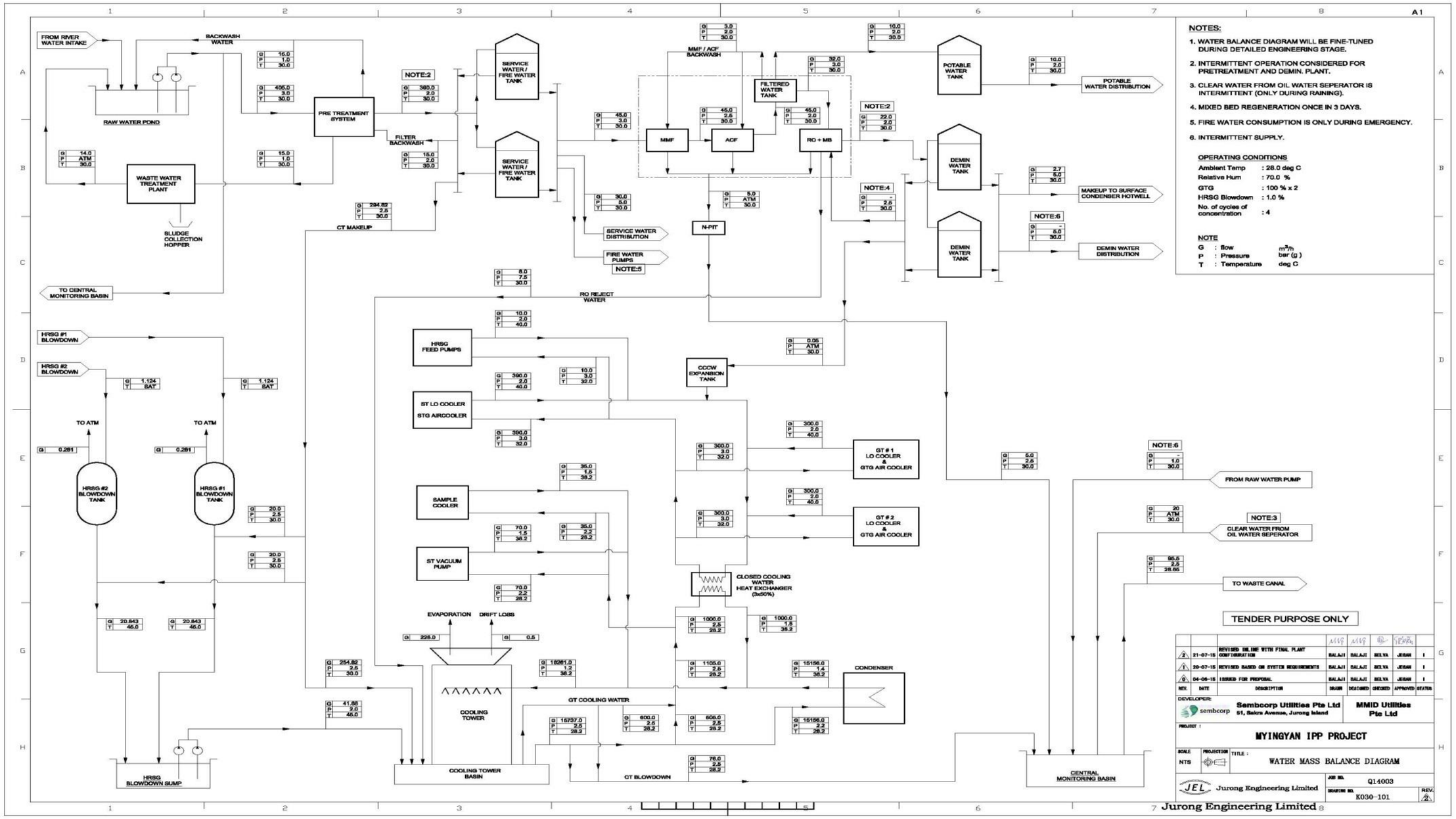
According to the Sponsor, an average of approximately 0.12 m^3/s (405 m^3/hr) water will be required from the river intake to supply Project operations. The maximum water requirements from the Ayeyarwady River are expected to be 0.13 m^3/s, and the minimum water requirements are expected to be 0.028 m^3/s. The Project's Water Balance Diagram is shown in ***Figure 9.1*****.**

The lowest flow rate estimated from flow velocity measurements in the dry season in the southern channel of the Ayeyarwady River, where the Project will withdraw from, is 64 m^3/s, which would be equivalent to 5,529,600 m^3/day. The maximum intake requirement for the Project is expected to be 0.13 m^3/s, which would be equivalent to 11,232 m^3/day assuming the maximum intake was required over a 24 hour period. This is equivalent to approximately 0.20% of the lowest dry season flow in the southern channel of the river. This is based on a worst case scenario, comparing the Project's maximum expected water withdrawal requirements, with a constant withdrawal over a 24-hour period, during the lowest measured flow rate in the dry season.

Based on the above comparison of the Project's water intake requirements with the estimated flow rates of the river from July 2014 to July 2015, it is expected that there will be adequate flow to support the Project's water withdrawal, and the Project is

not expected to have any significant impacts on current water users for the southern channel of the Ayeyarwady River.

Figure 9.1 Water Balance Diagram



The significance of potential impacts to surface water due to the Project's water intake during the operation phase is assessed in the following table, and mitigation measures are presented.

Impact	Project water withdrawal from the Ayeyarwady River may have potential impacts related to existing water uses, as follows: • Impact on downstream agricultural water users. • Impact on downstream fishing activity having negative impact on fisherman's livelihood.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to hydrology and water use would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
Extent	**Local**	Regional	International	
	Water use impacts from the Project would be local to the project footprint and vicinity of water withdrawal at the Ayeyarwady River.			
Scale	The maximum intake requirement for the Project is expected to be 0.13 m^3/s. This is equivalent to approximately 0.20% of the lowest dry season flow in the southern channel of the river.			
Frequency	Water intake for the Project would be near-continuous for the Project's duration.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in Project area due to inappropriate waste disposal are expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	There are a number of current water uses in the Project area, and the Ayeyarwady River is considered an important water resource. The resource/receptor sensitivity is considered Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- The Project commits to comply with following WB/IFC EHS Guideline measures or equivalent of them that are pertinent to river water intake systems:
  - Reduction of intake flow to such a level that there is sufficient flow in the river to maintain resource use (i.e., irrigation) as well as biodiversity during annual mean low flow conditions.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Cooling Water Discharge

The Project's cooling water discharge may cause impacts from release of water with significantly higher temperature than the ambient temperature in the surrounding surface water. The cooling water blowdown will be collected in a monitoring

chamber (to ensure compliance with effluent discharge limits) before discharge into the existing irrigation canal.

The Sponsor estimates that cooling water blowdown will consist of approximately 70.5 m^3/hr on a continuous basis.

The cooling water and all other effluents will be disposed to the irrigation canal after being treated according to the applicable WB/IFC EHS Guidelines for Thermal Power Plants (2008).

As the cooling water will be discharged to the irrigation canal, there may be potential impacts to downstream users of the irrigation canal due to altered water quality, as described in "Wastewater Discharges and Runoff" above.

The significance of potential impacts to surface water due to cooling water discharge during the operation phase are assessed in the following table, and mititgation measures are presented.

Impact	Potential for surface water impacts from discharge of cooling water. Potential secondary impacts to downstream users of irrigation canal.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to surface water would be direct impacts from Project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
Scale	Cooling water blowdown will consist of approximately 70.5 m^3/hr. The water is discharged into the irrigation canal near the Plant, which is over 10 km from the Ayeyarwady River. Discharged water will be treated to meet applicable IFC EHS Guidelines, as well as FAO Guidelines as applicable for irrigation water.				
Frequency	Impacts to surface water due to cooling water discharge could occur intermittently but repeatedly throughout the day for the duration of the operation phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water in the Project area due to cooling water discharge is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The temperature of the Ayeyarwady River was found to range from 22.4 to 29.36 degrees Celcius. Overall sensitivity is rated as Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Comply with WB/IFC EHS Guidelines for Thermal Power Plant (2008) regarding the cooling water discharge standards;
- Cooling water discharge will be regularly monitored for temperature at the outfall point; and
- Monitor surface water quality at the wastewater discharge point as per the Environment Monitoring Program formulated for the Project.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Impacts to Surface Water Hydrology from Increased Impervious Surfaces

During the operation phase, the physical footprint of the power plant and gas supply pipeline will increase the impermeable area of the Project site, resulting in changed hydrological characteristics, such as reduced water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers. Surface water bodies may have the potential to be affected by changes to their flow rates and discharge volumes due to variation in the drainage patterns in their basin. In addition, the increased stormwater runoff from the Project's impermeable surfaces will have to be accommodated by the drainage channel of the Project site, as well as the irrigation canal (which is the eventual point of discharge).

To provide an estimate of stormwater volume that will need to be accommodated by the drainage channel/irrigation canal, peak runoff discharges around the Project site have been estimated using an analytical calculation which takes into account catchment area, rainfall intensity and runoff coefficient (also called the "Rational Method"). The peak runoff discharge from the impermeable surfaces of the Project site is estimated as follows:

$$Q = 0.278 \times 10^{-6} CIA \qquad \textbf{\textit{Eq. 1}}$$

where

Q = estimated runoff flow rate (m^3/s)

C = runoff coefficient

I = rainfall intensity (mm/hour)

A = catchment area (m^2)

For rainfall intensity, a return period of 25 to 100 years is commonly used in sizing detention ponds or drainage ditches (Osman Akan, 1993[1]). During their study of the Letpadaung Copper Mine in Salingyi[2], Knight Piésold found that, for a 1-in-100 year storm of 15-minute duration, the rainfall intensity in the region was 221 mm/h. Salingyi is 65 km north of Myingyan, and the rainfall data is therefore expected to be very similar.

As a worst case scenario, taking the catchment area to be equivalent to a concrete surface (C = 0.90), and the area of the Project footprint (including pipelines) to be 10.55 ha (10,550 m^2), the estimated runoff for a worst case 15-minute duration storm with a return period of 100 years, would be approximately 0.000162 m^3/s, or 0.58 m^3/hr. Therefore, the drainage channel should be designed to allow for the maximum runoff rate as indicated above.

The significance of potential impacts to surface water due to increased runoff from impervious surfaces during the operation phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for surface water impacts from altered hydrology due to an increase in impervious surfaces in the Project area.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to surface water would be direct impacts from Project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
Scale	The estimated runoff from Project surfaces for a worst case 15-minute duration storm with a return period of 100 years, would be approximately 0.000162 m^3/s, or 0.58 m^3/hr.				
Frequency	Impacts to surface water due to increased rainwater runoff would occur during rainfall events, and will be more frequent during the rainy season.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water in the Project area due to increased rainfall runoff from impervious surfaces are expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	There are a number of current water uses in the Project area, and the Ayeyarwady River is considered an important water resource. The resource/receptor sensitivity is considered Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

(1) Osman Akan, A. 1993. Urban Stormwater Hydrology. http://books.google.co.th/books?id=ZyJtRojkDg0C&pg=PA6&lpg=PA6&dq=design+ponds+return+period+duration+rainfall&source=web&ots=-U4jCFGjeK&sig=dLhEjM42jFuFitaII3VXcTUSRtI&hl=en&sa=X&oi=book_result&resnum=5&ct=result

(2) Knight Piésold. 2013. Myanmar Wanbao Mining Copper Ltd Letpadaung Copper Project, Environmental and Social Impact Assessment

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Ensure that drainage channel and irrigation canal has enough capacity to accommodate the increased rainfall runoff from the Project's impervious surface.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Accidental Spills and Leaks

Accidental releases from operational activities, including the gas supply pipeline, and PCB and SF6 insulant chemicals from operation of the transmission line, have the potential to impact surrounding surface water and groundwater. Leakage from chemical storage facilities may result in surface & groundwater contamination. Uncontrolled releases from operational activities of the water supply and discharge pipelines may also cause release of contents causing sedimentation and/or siltation of river. A further risk to water resources during the operational phase is from a potential spill in back up fuel (should this be used to provide a back up fuel supply during breaks in the gas supply). Theses discharges may have a direct impact on the water quality which in turn would have ecological implications.

Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:

- 4,000 L/month diesel fuel; and
- Small, infrequent quantities of lubricants, oil.

Spill control measures such as storage and handling of chemicals and fuels on impervious areas (such as concrete surfaces) will be implemented to minimize impacts in case of spills. Heavy equipment will be checked for lubricant leaks, and workers will be trained on the proper handling and management of waste. Liquid effluents arising from construction activities will be treated to the applicable World Bank/IFC guidelines prior to discharge. All hazardous materials will be segregated and stored according to their MSDS, and will be disposed of appropriately.

The significance of potential impacts to surface water due to contamination from accidental spills and leaks during the operation and maintenance phase are assessed in the following table, and mitigation measures are presented.

Impact	Potential for impacts to surface water due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuel storage.			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the Project site footprint and gas pipeline and transmission line corridors, and hence would be considered to be local.			
Scale	Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include: • 4,000 L/month diesel fuel • Small, infrequent quantities of lubricants, oil The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.			
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in the Project area due to accidental releases is expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- To optimize use of antifouling and corrosion inhibiting chemicals, appropriate depth of water intake will be maintained, and use of screens will be ensured;
- Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed;
- Waste storage areas will be equipped with secondary containment and spill control measures (similar to the hazardous material storage areas) to limit impact to ground;
- Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas;
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground;
- Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal;
- Hazardous waste storage areas will comply with best practice/ international standards;
- Store and handle all hazardous substances in accordance with their MSDS.

- Keep a register for all hazardous substances on site and relevant Material Safety Data Sheets (MSDSs) readily accessible for reference.
- Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container;
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage);
- Guidelines and procedures should be established for immediate clean up actions following any spillages of oil, fuel or chemicals;
- As part of the facility-wide HSEMS, SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis;
- Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation;
- The spill prevention and response guidance presented in Sections 1.5 and 3.7 respectively of the WB/IFC General IFC EHS Guidelines (2007) will be followed and implemented.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

10 NOISE AND VIBRATION

10.1 INTRODUCTION

This *Chapter* presents an assessment of the potential noise impacts arising from the construction and operational phases of the Project. Noise sensitive receivers (NSRs) and potential sources of noise generation were identified and an assessment of the potential impacts from the latter was carried out. Mitigation and management measures are recommended where necessary.

10.2 ASSUMPTIONS AND LIMITATIONS

The noise impact assessment was carried out based on an assumed plant inventory for the construction and operational phases of the Sembcorp Myingyan Combined Cycle Gas Turbine (CCGT, hereafter referred to as 'the Project'). These will be confirmed by the Engineering, Procurement and Construction (EPC) contractor prior to commencement of each phase. Should there be significant differences between the assumed plant inventory and that used on site, additional assessments may be needed and the proposed noise mitigation measures should be updated and implemented accordingly.

10.3 SCOPE OF THE ASSESSMENT

Scoping of potential noise impacts has been undertaken in two stages:

- First, potential interactions between project activities and NSRs have been identified; and
- Second, taking into consideration the information gathered on the extent and nature of project activities, and the existing conditions / sensitivities of the baseline, these potential interactions have been prioritised in terms of their potential to cause significant impacts.
- The potentially significant noise impacts arising from the activities during the construction and operational phases of the Project have been identified as:
- Construction activities, mainly from trucks, cranes, pilling rig and generators during site preparation, foundation, construction of buildings and infrastructures such as internal roads; and
- Noise generation due to operation of fixed plant and machinery.

10.4 LEGISLATION REQUIREMENTS

The noise impact assessment was conducted with reference to relevant international guidelines and local legislation, regulations, standards where available. Further detail is summarised here for reference.

10.4.1 *Myanmar Legislation*

Construction and Operational Phases

The Government of Myanmar has not yet established numerical standards for noise impact arising from construction noise and operational noise. In the absence of national standards, the Ministry of Environmental Conservation and Forestry (MOECAF) typically recommends that internationally accepted numerical

environmental standards, such as International Finance Corporation (IFC) to be adopted for any noise assessment.

10.4.2 IFC Guidelines

The *IFC EHS Guidelines - Thermal Power Plants* [(1)], the *IFC General EHS Guidelines: Environmental – Noise Management* [(2)] and the *IFC General EHS Guidelines: Construction and Decommissioning* [(3)] are relevant to the Project.

Table 10.1 outlines the IFC's day time and night time noise level limits for different types of receptors. Given that the identified NSRs for the Project are the villages, monastery and a worker camp, the noise guideline values for residential, institutional and educational receptors are adopted for this assessment. The applicable standards are 55 dB(A) L_{Aeq},1 hour for daytime and 45 dB(A) L_{Aeq}, 1 hour for night-time (as presented in ***Table 10.1***) or a maximum increase in background levels of not more than 3 dB(A) at the nearest NSR. Since baseline monitoring was conducted, noise criterion of a maximum increase in background levels of not more than 3 dB(A) was adopted as the assessment criterion. Details of measured noise levels and proposed noise criteria are given in ***Section 10.6***.

Table 10.1 Noise Level Guidelines (2007)

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime (07:00 - 22:00)	Nighttime (22:00 - 07:00)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Note: Guidelines values are for noise levels measured outdoors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

10.5 NOISE SENSITIVE RECEIVERS

The nearest representative NSRs that may potentially experience noise impacts from the work sites of the Project during construction and operational phases are identified and described below:

- NSR1, a permanent steel mill construction worker (EPC) accommodation in Taung Tha Township located approximately 1920 m to the south of the notional noise source.
- NSR2, a monastery and pagoda in Taung Tha Township located approximately 2670 m to the south of the notional noise source.
- NSR3, a Hnan Ywa Village in Taung Tha Township located approximately 1810 m to the south-east of the notional noise source.

(1) IFC EH&S Guidelines for Thermal Power Plants (December 2008), Available from: http://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734

(2) IFC EH&S Guidelines: Noise Management (April 2007), Available from: http://www.ifc.org/wps/wcm/connect/06e3b50048865838b4c6f66a6515bb18/1-7%2BNoise.pdf?MOD=AJPERES

(3) IFC EH&S Guidelines: Construction and Decommissioning (April 2007), Available from: http://www.ifc.org/wps/wcm/connect/3aa0bc8048855992837cd36a6515bb18/4%2BConstruction%2Band%2BDecommissioning.pdf?MOD=AJPERES

- NSR4, Sa Ka Village in Myingyan Township located approximately 1060 m to the north-east of the notional noise source.
- NSR5, a temporary Steel Mill Worker Housing in Myingyan Township located approximately 170m to the east of the notional noise source. As all workers are on-site during daytime, there is no people present at NSR5 during daytime. Based on this, NSR5 will not be affected by the daytime construction noise from the Project. This temporary Steel Mill Worker Housing will be relocated to the area of NSR1 by the start of operation of the Project. Based on this, NSR5 will also not be affected by the operation of the Project.
- NSR6, a Government Technical High School in Taung That Township located approximately 1560m to the south-east of the notional noise source.

The locations of representative NSRs are summarised in ***Table 10.2*** and shown in ***Figure 10.1***

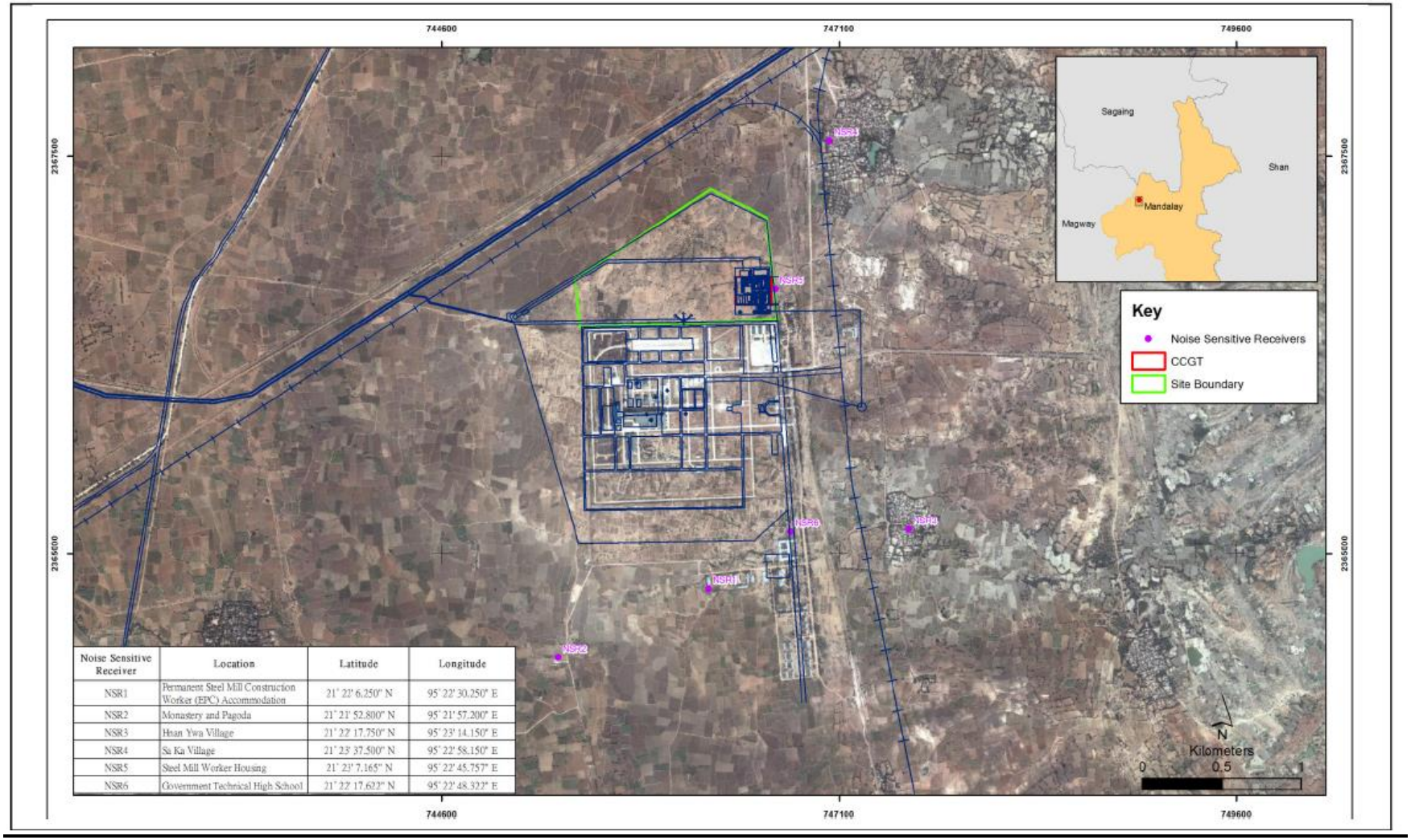
Table 10.2 Representative Noise Sensitive Receivers

NSR	Location	Type of Uses	Approximate Nearest Distance to the Notional Noise Source
NSR1	Permanent Steel Mill Construction Worker (EPC) Accommodation	Existing Residential	Approx. 1920 m to the south of the notional noise source.
NSR2	Monastery and Pagoda	Existing Institutional	Approx. 2670 m to the south of the notional noise source.
NSR3	Hnan Ywa Village	Existing Residential	Approx. 1810 m to the south-east of the notional noise source.
NSR4	Sa Ka Village	Existing Residential	Approx. 1060 m to the north-east of the notional noise source.
NSR5[(a)]	Steel Mill Worker Housing	Temporary Residential	Approx. 170 m to the east of the notional noise source.
NSR6	Government Technical High School	Existing Institutional	Approx. 1560 m to the south-east of the notional noise source.

Note:

(a) As no people present at NSR5 during daytime, NSR5 will not be affected by the daytime construction noise from the Project. And, this temporary Steel Mill Worker Housing will be relocated to the area of NSR1 by the start of operation of the Project, NSR5 will also not be affected by the operation of the Project. Based on these, noise prediction has not been conducted for NSR5 due to the construction works during daytime and operation of the Project.

Figure 10.1 Locations of Representative Noise Sensitive Receivers



Noise Sensitive Receiver	Location	Latitude	Longitude
NSR1	Permanent Steel Mill Construction Worker (EPC) Accommodation	21° 22' 6.250" N	95° 22' 30.250" E
NSR2	Monastery and Pagoda	21° 21' 52.800" N	95° 21' 57.200" E
NSR3	Hnan Ywa Village	21° 22' 17.750" N	95° 23' 14.150" E
NSR4	Sa Ka Village	21° 23' 37.500" N	95° 22' 58.150" E
NSR5	Steel Mill Worker Housing	21° 23' 7.165" N	95° 22' 45.757" E
NSR6	Government Technical High School	21° 22' 17.622" N	95° 22' 48.322" E

10.6 BASELINE CONDITIONS

Baseline noise monitoring was conducted continuously at the four NSRs from July to September 2014 and from February to June 2015. Hourly A-weighted equivalent continuous sound pressure levels (L_{Aeq}, 1 hour) were recorded continuously over 24 hours at each location during both weekday and weekend. At each location, daytime and night-time L_{Aeq} were calculated by averaging the hourly sound pressure levels measured between 0700 and 2200 hours and between 2200 to 0700 hours, respectively.

Results of the background noise measurement are presented in***Table 10.3.***

Table 10.3 Results of Background Noise Measurement

NSR	Type of Uses	Averaged Background Noise Levels, dB(A) [a]		IFC Operational Noise Level Guidelines, dB(A)	
		Daytime	Night-time	Daytime	Night-time
NSR1	Existing Residential	54	50	55	45
NSR2	Existing Institutional	56	53	55	45
NSR3	Existing Residential	59	55	55	45
NSR4	Existing Residential	55	51	55	45
NSR5[c]	Existing Residential	-	-	55	45
NSR6[c]	Existing Institutional	-	-	55	45

Notes:

(a) Noise Levels are averaged over 8 months period from July to September 2014 and from February to June 2015.

(b) Daytime refers to the hours from 0700 hrs to 2200 hrs while night-time refers to the hours from 2200 hrs to 0700 hrs.

(c) Background noise levels are not available for NSR5 and NSR6.

10.7 DETERMINATION OF CRITERIA

10.7.1 *Construction Noise Criteria for Assessment*

Since there is no national noise standard in Myanmar to control the noise arising from construction of the Project, IFC Guidelines have been adopted as the construction noise criteria for the assessment in this study. The maximum increase in background levels should not be more than 3 dB(A) at the identified representative NSRs.

10.7.2 *Operational Noise Criteria for Assessment*

Since there is no national noise standard in Myanmar to control the noise arising from operation of the Project, IFC Guidelines have been adopted as the operational noise criteria for the assessment in this study. The maximum increase in background levels (See ***Table 10.3***) should not be more than 3 dB(A) at the identified representative NSRs.

10.8 ASSESSMENT METHODOLOGY

10.8.1 *Construction Noise*

The methodology adopted for the noise impact assessment is based on standard acoustics principles. The procedures of the assessment are summarised as follows:

- locate representative NSRs that may be affected by the works;
- assign Sound Power Level (SWL) to each plant item proposed and calculate the overall SWL associated with the proposed plant inventory;
- determine the national noise source positions of Project work sites, which was assumed to be midway between the approximate geographical centre of the sites and its boundary closest to the NSR;
- apply the correction factors based on the distance between the representative NSRs and the notional noise source position, and façade correction, in accordance with BS5228: Part 1: 2009(1); and
- predict the construction noise levels at NSRs on the basis of the plant activity and an in built design controls.

It was assumed that the noise generated from the plant items would propagate to NSRs in the form of hemispherical waves. As a conservative approach to the assessment, the atmospheric absorption during sound transmission was not included in the assessment.

10.8.2 *Operational Noise*

Noise model SoundPLAN was used for the operational noise impact assessment, in accordance with the *Acoustics -- Attenuation of sound during propagation outdoors -- Part 1: Calculation of the absorption of sound by the atmosphere* (ISO 9613-1:1993) and *Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation* (ISO 9613-2:1996).

The assessment results are presented in noise contours to provide an overall view of the predicted noise levels around the Project Site.

10.8.3 *Magnitude of the construction and operational noise impacts*

Based on the effects of noise on health in consideration of annoyance, speech intelligibility, communication interference, disturbance of information extraction, sleep disturbance, and hearing impairment, the sensitivity of the NSRs are determined as follows:

(1) *Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control*. British Standard, BS5228: Part 1: 2009

- High Sensitivity - hospitals and theatres;
- Medium Sensitivity - residential, educational and religious; and
- Low Sensitivity - industrials and commercials.

The magnitude of the construction and operational noise impacts are determined based on the criteria given in ***Table 10.4*** below:

Table 10.4 Predicted Construction and Operational Phase Noise Impacts

Impact Classification / Magnitude[1]	Negligible	Small	Medium	Large
Construction Noise:				
Noise Level, in dB(A) $L_{eq, 1\ hr}$	≤ background + 3	> background + 3 to background + 8	> background + 8 to background + 13	> background + 13
Operational Noise:				
Daytime Noise Level, in dB(A) $L_{eq, 1hr}$	≤ background + 3	> background + 3 to background + 8	> background + 8 to background + 13	> background + 13
Night-time Noise Level, in dB(A) $L_{eq, 1hr}$	≤ background + 3	> background + 3 to background + 8	> background + 8 to background + 13	> background + 13

10.9 IDENTIFICATION OF IMPACTS

10.9.1 Construction Phase

The construction activities of particular importance for potential noise impacts are noted below:

- Site preparation, pile driving and foundation works;
- Installation of equipment; and
- Construction of the infrastructure such as internal access roads, storm water drains and security fence.

Operation of the powered mechanical equipment (PME) will be the major sources of noise impact to the NSRs.

An indicative construction plant inventory for the construction activities during daytime period of the Project is summarised in ***Table 10.5.*** Construction works will be carried out during daytime period from 0730 to 1830 hours.

[1] Institute of Environmental Management and Assessment Institute of Acoustics Guidelines for Noise Impact Assessmnet (2007)

Table 10.5 Indicative Construction Plant Inventory (Daytime)

Plant Item	Reference [(a)]	Quantity during Peak hour	On-time %	Unit SWL, dB(A)	Sub- Total SWL, dB(A)	Overall SWL, dB(A) [(b) (c)]
Site formation						
Excavator	BS D3 35	3	100%	106	111	125
Bulldozer	BS D3 27	3	100%	109	114	
Dump truck	BS D3 52	3	100%	109	114	
Piling						
Piling rig	BS C3 1	4	100%	117	123	
Substructure & superstructure						
Batching plant	BS D5 11	1	100%	108	108	
Vibrating compactor	BS D3 116	5	100%	106	113	
Concrete truck	BS D6 23	3	100%	100	105	
Concrete pump	BS D6 34	2	100%	107	110	
Compressor	BS D7 44	1	100%	103	103	
Genset 120kVA	BS D7 56	1	100%	110	110	
Steel structure						
Crawler crane 100t – diesel	BS C4 41	1	100%	99	99	
Crawler crane 50t – diesel	BS C4 46	1	100%	95	95	
Hydraulic crane 50t – diesel	BS C4 46	2	100%	95	98	
Hydraulic crane 75t – diesel	BS C4 41	2	100%	99	102	

Notes:

(a) *Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control*. British Standard, BS5228: Part 1: 2009.

(b) The figures are rounded-up to a whole number.

(c) The overall SWL represents the maximum potential noise impact during construction phase.

10.9.2 Operational Phase

Testing and commissioning (T&C) will predominantly done during daytime, but sometimes it may be extended into night-time. The activities during night-time are listed as follows:

- Steam blowing activity will be carried out to cool down the pipes for maintaining the cyclic reaction during night-time;
- Load rejection activities will be performed during night-time if restricted to be performed during daytime;
- 24-hours transformer Soak Test, Withstand test for the transformer and substation, and Transmission lines will be carried out during night-time;
- Reliability Run test will be operated 24-hours continuously; and
- Boiler chemistry will be operated continuously in order to carry out the steam turbine commissioning.

During all the above events, following by the “continuous steam blow” procedure which is generally quieter than the Pack and Blow operation and the sound pressure levels (SPLs) will be intended to maintain at 70 dB(A) at 1m from the plant items. No adverse noise impact is anticipated during T&C.

The sources of noise associated with the operation of the power plant are expected to include the heat recovery steam generators (HRSG), gas turbines, steam turbine and cooling tower**.** The key assumption for the noise assessment is that the power plant will be generally operated for 24 hours per day throughout the year, unless dispatched off-line by the grid control centre or shut down for maintenance. An operational plant inventory for the power plant as provided by the Client (excluding downtime for maintenance or an offline instruction) is presented in ***Table 10.6***. SPLs are assumed to be 85 dB(A) at 1 m from each of the plant items.

It is anticipated that there will only be 2 trips of company bus/mini-van and 12 trips of trucks per day during the operational phases for fetching employees and plant works transportation respectively. As the traffic generation is insignificant, it is expected that the increase in road traffic noise level would be less than 3 dB(A) during the Project operation. No adverse noise impact due to traffic generation is anticipated during operation.

Table 10.6 Indicative Operation Plant Inventory List

Plant Item	Quantity during peak hour	On-time during peak hour	Sound Pressure Level (SPL) at 1m, dB(A)
Heat Recovery Steam Generator (HRSG)	2	100%	85
Heat Recovery Steam Generator (HRSG) Main Stack	2	100%	85
Heat Recovery Steam Generator (HRSG) Main Bypass Stack	2	100%	85
Gas Turbine (GT) Air Inlet	2	100%	85
Gas Turbine (GT) Generator	2	100%	85
Gas Turbine (GT) Transformer	2	100%	85
Steam Turbine (ST) Hall	1	100%	85
Steam Turbine (ST) Transformer	1	100%	85
Cooling Tower	1	100%	85

10.10 ASSESSMENT OF NOISE IMPACT

10.10.1 Assessment of General Construction Noise

Potential Impacts

The results of the predicted construction noise levels at the representative NSRs are presented in ***Table 10.7***.

Table 10.7 Predicted Construction Noise Levels at Representative NSRs during Daytime Period

NSR	Overall SWL from Construction Activities[(a)], dB(A)	Distance between notional noise source positions of the construction work sites and NSR (D), m	Predicted Noise Level[(b) (c)], dB(A)
NSR1	125	1920	54
NSR2	125	2670	52
NSR3	125	1810	55
NSR4	125	1060	60
NSR6	125	1560	56

NSR	Overall SWL from Construction Activities[(a)], dB(A)	Distance between notional noise source positions of the construction work sites and NSR (D), m	Predicted Noise Level[(b) (c)], dB(A)

Notes:

(a) Overall SWL from *Table 10-5*.

(b) Predicted noise level = overall SWL + distance correction + façade reflection
= 125 – (20 x log D + 8) + 3

(c) The figures are rounded-up to a whole number.

Potential Consequence

With the indicative plant inventory presented in ***Table 10.5***, the predicted construction noise levels at the representative NSRs are in the range of 53 - 60 dB(A). Cumulative noise impact is presented in ***Table 10.8***.

Table 10.8 Cumulative Construction Noise Levels at Representative NSRs during Daytime Period

NSR	Predicted Noise Level (A), dB(A)	Daytime Averaged Background Noise Level (B), dB(A)	Cumulative noise level , dB(A) [(a)]	Increase in background noise [(b)], dB(A)	Compliance [(a)]
NSR1	54	54	57	3	Yes
NSR2	52	56	58	2	Yes
NSR3	55	59	61	2	Yes
NSR4	60	55	61	6	No
NSR6	56	- [(c)]	- [(c)]	- [(c)]	No [(c)]

Notes:

(a) Cumulative Noise Level (C) = 10 x log ($10^{(A/10)}$+ $10^{(B/10)}$)

(b) With reference to assessment noise criterion of a maximum increase in background levels of not more than 3 dB(A).

(c) Background noise level at NSR6 is not available. The predicted noise level is 1 dB(A) above the IFC General EHS Guidelines during daytime period.

The construction noise level at NSR4 during daytime is predicted with 6 dB(A) increase in background noise level, which exceeds the IFC General EHS Guidelines during daytime period. While that for NSR6 is 1 dB(A) above the IFC General EHS Guidelines during daytime period. The noise exceedance are mainly due to the use of the piling rigs, and equipments for site formation, substructure and superstructure. Noise mitigation measures are considered necessary to mitigate the construction noise impact.

Proposed Noise Mitigation Measures

In view of the predicted noise exceedances during the construction of the Project at NSR4 and NSR6, noise mitigation measures with the use of temporary noise barriers have been proposed to screen noise.

The use of temporary noise barriers will be an effective means to mitigate the noise impact arising from the construction works. Noise barriers shall be high enough to screen the direct line of sight between the construction plant and the NSR. It is anticipated that the major noise source of all PMEs, including movable and large PMEs, will be located at a level lower than the top of the proposed noise barriers, and therefore these barriers could reduce noise level by at least a 5 dB(A) n for

mobile plant such as excavator as well as large scale plant such as a crane. The noise barrier material should have a superficial surface density of at least 7kg m^{-2} and have no openings or gaps.

Proposed noise mitigation measures and the reduced SWLs are shown in ***Table 10.9***.

Table 10.9 Proposed Noise Mitigation Measures

Plant Item	Noise Mitigation Measures	Noise Reduction, dB(A)	Reduced SWL, dB(A)
Site formation			
Excavator	Noise barrier	-5	106
Bulldozer	Noise barrier	-5	109
Dump truck	Noise barrier	-5	109
Piling			
Piling rig	Noise barrier	-5	118
Substructure & superstructure			
Batching plant	Noise barrier	-5	103
Vibrating compactor	Noise barrier	-5	108
Concrete truck	Noise barrier	-5	100
Concrete pump	Noise barrier	-5	105
Compressor	Noise barrier	-5	98
Genset 120kVA	Noise barrier	-5	105
Steel structure			
Crawler crane 100t – diesel	-	-	99
Crawler crane 50t – diesel	-	-	95
Hydraulic crane 50t – diesel	-	-	98
Hydraulic crane 75t – diesel	-	-	102
		Overall SWL	**120**

With the implementation of the noise barriers, the mitigated noise levels due to the construction of the Project were calculated at the representative NSRs with results summarised in ***Table 10.10***.

Table 10.10 Predicted Construction Noise Levels at NSR4 with Noise Mitigation Measures

NSR	Overall SWL from Construction Activities[(a)], dB(A)	Distance between notional noise source positions of the construction work sites and NSR (D), m	Predicted Noise Level[(b) (c)] (A), dB(A)	Daytime Averaged Background Noise Level (B), dB(A)	Cumulative noise level (C), dB(A) [(d)]	Increase in background noise, dB(A)	Compliance
NSR4	120	1060	55	55	58	3	Yes [(e)]
NSR6	120	1560	52	- [(f)]	- [(f)]	- [(f)]	Yes [(f)]

Notes:

(a) Overall SWL from *Table 10.9*.

(b) Predicted noise level = overall SWL + distance correction + façade reflection
= 120 – (20 x log D + 8) + 3

(c) The figures are rounded-up to a whole number.

(d) Cumulative Noise Level (C) = 10 x log ($10^{(A/10)}$+ $10^{(B/10)}$)

(e) With reference to assessment noise criterion of a maximum increase in background level of not more than 3 dB(A).

(f) Background noise level at NSR6 is not available. The predicted noise level of 52 dB(A) complies with the IFC General EHS Guidelines during daytime period.

With the adoption of the recommended mitigation measures, the mitigated noise levels comply with the IFC EHS Guidelines during the construction phase at all NSRs.

Significance of Impacts

As presented in ***Table 10.10***, the mitigated noise levels comply with the assessment noise criteria. The construction noise impact is considered to be of **negligible** significance at the nearest receptor. A construction noise impact assessment summary is given in ***Table 10.11***.

Table 10.11 Noise Impact Assessment - General Construction Phase

Impact	Noise impact from the construction works during construction phase				
Impact Nature	**Negative**	Positive	Neutral		
	Noise impact from the construction activities is **negative**.				
Impact Type	**Direct**	Indirect	Induced		
	Noise impact from the construction activities is **direct**.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Noise impact from the construction activities is **temporary**.				
Impact Extent	**Local**	Regional	International		
	Noise impact from the construction equipment and activities is **local**.				
Impact Scale	Project area				
Frequency	Throughout the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Considering the predicted noise levels comply with both the noise criteria. The magnitude of the noise impact is **negligible** as per *Table 10-4*.				
Receptor Sensitivity	Low	**Medium**	High		
	The identified NSR are residential, the sensitivity of the receptor is considered as **medium.**				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	As the impact magnitude is negligible and the receptor sensitivity is medium, the impact significance is considered as **negligible**.				

Mitigation and Management Measures

The use of noise barriers and good site practices are recommended and will be implemented to minimise potential noise impacts during the construction phase, including:

- Install noise barriers as described in ***Section 10.10.1*** and ***Table 10.9***. In accordance with BS 5228-1:2009, the barrier material shall have a mass per unit of surface area in excess of about 7 kg/m^2 and no gaps at the joints. The minimum height of barriers is typically such that no part of the noise source will be visible from the noise sensitive receiver;
- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use;

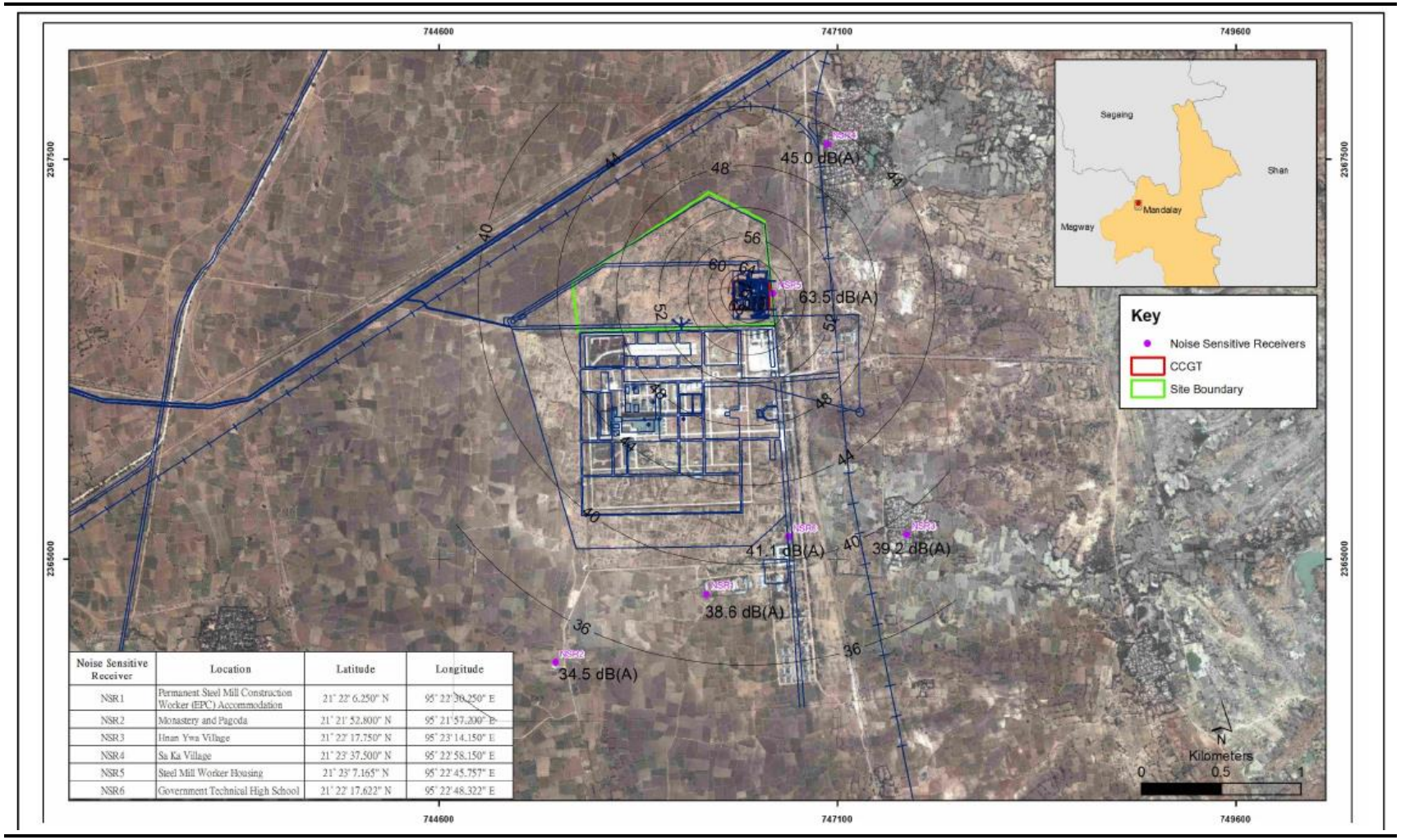
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant as far away from receptors as practicable;
- Avoid transportation of materials on- and off-site through existing community areas;
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities;
- Vehciles shound be regularly maintained; and
- Avoid transportation of materails on and off-site through existing community areas.

10.10.2 Assessment of General Operational Noise

Potential Impacts

The operational noise levels at the representative NSRs were predicted based on the plant inventory presented in ***Table 10.6.*** The output noise contour is illustrated in ***Figure 10.2*****.** The predicted operation noise levels are summarized in ***Table 10.12*****.**

Figure 10.2 Fixed Plant Noise Contour



Noise Sensitive Receiver	Location	Latitude	Longitude
NSR1	Permanent Steel Mill Construction Worker (EPC) Accommodation	21° 22' 6.250" N	95° 22' 36.250" E
NSR2	Monastery and Pagoda	21° 21' 52.800" N	95° 21' 57.200" E
NSR3	Hnan Ywa Village	21° 22' 17.750" N	95° 23' 14.150" E
NSR4	Sa Ka Village	21° 23' 37.500" N	95° 22' 58.150" E
NSR5	Steel Mill Worker Housing	21° 23' 7.165" N	95° 22' 45.757" E
NSR6	Government Technical High School	21° 22' 17.622" N	95° 22' 48.322" E

Table 10.12 Predicted Operation Noise Levels at Representative NSRs

NSR	Predicted Noise Level (A), dB(A)	Averaged Background Noise Level (B), dB(A)		Cumulative noise level (C), dB(A) [(a)]		Increase in background noise [(b)] (Day/Night), dB(A)		Compliance	
		Daytime	Night-time	Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
NSR1	39	54	50	54	50	0	0	Yes	Yes
NSR2	35	56	53	56	53	0	0	Yes	Yes
NSR3	39	59	55	59	55	0	0	Yes	Yes
NSR4	45	55	51	55	52	0	1	Yes	Yes
NSR6	41	- [(c)]	- [(c)]	- [(c)]	- [(c)]	- [(c)]	- [(c)]	Yes [(c)]	Yes [(c)]

Notes:

(a) Cumulative Noise Level (C) = 10 x log ($10^{(A/10)}$+ $10^{(B/10)}$)

(b) With reference to assessment noise criterion of a maximum increase in background levels of not more than 3 dB(A).

(c) Background noise level at NSR6 is not available. The predicted noise level of 41 dB(A) complies with the IFC General EHS Guidelines during both daytime and night-time periods.

Potential Consequence

The predicted noise levels in the range of 35 to 45 dB(A) comply with the IFC General EHS Guidelines during both daytime and night-time periods. The increase in background levels is not more than 1 dB(A) at all NSRs. The increase in background noise level at NSR4 is mainly due to the operation of the two sets of Heat Recovery Steam Generators. Noise mitigation measures are considered not necessary for the operation of the Project.

Existing/In-Place Controls

There are currently no existing or in-place controls for noise impacts associated with the operation of the Project.

Significance of Impacts

As presented in ***Table 10.11***, the predicted noise levels comply with the assessment noise criteria. The operational noise impact is considered to be of **negligible** significance at the nearest receptor. An operational noise impact assessment summary is given in ***Table 10.82***.

Table 10.82 Noise Impact Assessment - General Operational Phase

Impact	Noise impact from the operation of fixed plant and machinery during operational phase				
Impact Nature	**Negative**	Positive	Neutral		
	Noise impact from the operational activities is **negative**.				
Impact Type	**Direct**	Indirect	Induced		
	Noise impact from the operational activities is **direct**.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Noise impact from the operational activities is **long-term**.				
Impact Extent	**Local**	Regional	International		
	Noise impact from the operation activities is **local**.				
Impact Scale	Project area				
Frequency	Throughout the operation period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Considering the predicted noise levels comply with both the noise criteria. The magnitude of the noise impact is **negligible** as per *Table 10-9*.				
Receptor Sensitivity	Low	**Medium**	High		
	The identified NSR are residential, the sensitivity of the receptor is considered as **medium.**				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	As the impact magnitude is negligible and the receptor sensitivity is medium, the impact significance is considered as **negligible**.				

Mitigation and Management Measures

Good site practices to minimise potential noise impacts during operational phase that should be considered include:

- Selecting quieter equipment;
- Installing silencers, mufflers or acoustic enclosures to reduce sound power level of noisy equipment at all times;
- Installing acoustic enclosures or other applicable control measures to ensure a maximum of 85 dB(A) at 1m away from the noise emitting equipment;
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Siting permanent facilities away from community areas if possible; and
- Taking advantage of the natural topography as a noise buffer during facility design.

10.10.3 Residual Impact Assessment Conclusions

With the adoption of the recommended mitigation measures, the predicted construction noise levels comply with the IFC EHS Guidelines during the construction phase at all NSRs. It is not anticipated that adverse noise impacts will occur during the construction phase of the Project.

With the proposed plant inventory and its corresponding source level (i.e. 85 dB(A) at 1 m from the plant items) to be used during operational phase, results of the assessment indicate that the noise associated with the operation of the Project complies with the IFC EHS Guideline during operation. It is not anticipated that adverse noise impacts will occur during the operational phase of the Project.

In the case of significant changes to the construction and operation plant inventories and respective operating parameters from the current assumptions, re-assessment may be required to be conducted to identify compliance with noise criteria.

10.11 VIBRATION IMPACT

Vibration will be generated from machinery during construction and operation, such as piling, drilling, and operation of compressors and generators, etc. In view of the nearest NSR is located at more than 900m from the Project Site, no vibration impact is anticipated.

11 LANDSCAPE AND VISUAL

11.1 INTRODUCTION

The development of the Project will be introducing a number of new elements into the existing landscape and visual environments. This Chapter presents a purely qualitative assessment of impacts to the landscape (essentially as an impact on an environmental resource with its own defined intrinsic value) and visual amenity (assessed as one of the interrelated effects on population and how various groups experience and perceive changes in the values attributed to the landscape). During the construction and operations there will be a range of activities which have the potential to change the existing landscape character and how various people will perceive the landscape. This Chapter identifies the various landscapes and visually sensitive receptors within the Project Study Area and undertakes an assessment of predicted impacts to these during construction and operation. Where appropriate, mitigation, management and monitoring measures required to reduce residual impacts to an acceptable level are developed for implementation.

This assessment has been undertaken primarily as a desktop study drawing upon limited site analysis and is based upon the ERM Landscape Visual Impact Assessment Standard.

11.2 ASSUMPTIONS AND LIMITATIONS

The assessment of potential impacts related to waste in this section is based on the environmental baseline data (presented within ***Chapter 5***), socio-economic baseline data (presented within ***Chapter 6***) and the information available from the Sponsor at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. It is noted that no quantitative modelling, viewshed analysis, stakeholder engagement or photomontage development has been undertaken with regards to any elements of the landscape and visual impact assessment. It is based purely on information readily available as secondary sources (primarily online mapping databases) and information gathered during site visits for the purposes of gaining purely quantitative environmental data (e.g. water quality, soil quality, air quality baseline). No direct on-ground identification of the landscape and visual baseline is therefore available. Additionally, no stakeholder engagement was undertaken to determine the various values that particular visual sensitive receptors place on various elements of the landscape.

11.3 SCOPE OF ASSESSMENT

Based on the IFC Scoping Study[1] and the Project Description in ***Chapter 2***, the key potential impacts to the landscape and visual amenity identified arise from the following activities.

(1) Myingyan IPP Project – Environmental & Social Consultancy Services in Support of Transaction Advisory Service's for Private Sector Participation Scoping Report – Rev 4, 18 May 2015

Construction Phase

- Power Plant
  - The construction phase will result in an initial change to the Project site, including clearance of existing vegetation, disturbance of soil for excavation and foundation works, civil infrastructure works and associated laydown areas (if any);
- 230kV Overhead Transmission Line (Project part)
  - Limited clearance of vegetation will be undertaken to establish the corridor for the transmission line, with construction pads developed at the site of each pole.
- Gas Supply Pipeline
  - Limited clearance of vegetation will be undertaken to establish the corridor for the gas supply line, which will be primarily following existing linear infrastructure in the area
  - The gas supply pipeline will be installed sub-surface which will require the excavation of a trench.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - Limited clearance of vegetation will be undertaken to establish the corridor for raw water supply.
  - There will limited excavation works required as well as the development of an area for the new pumping station.

Operation Phase

- Power Plant
  - The long term operational presence of the power plant facility will change the nature of the existing landscape and visual amenity.
- 230kV Overhead Transmission Line
  - The transmission line will introduce a series of poles and lines into an otherwise flat landscape, thus changing the nature of the existing landscape and visual amenity.
- Gas Supply Pipeline
  - As the gas supply pipeline will be located underground there will be no visual impacts.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - As the water supply pipeline and water discharge pipeline will be buried or at ground level, it will have minimal landscape and visual impacts.

11.4 LEGISLATION REQUIREMENTS

This landscape and visual impact assessment is based upon the international guidelines which have been reviewed, discussed and presented in detail within ***Chapter 3***.

11.5 SUMMARY OF BASELINE CONDITIONS

11.5.1 *Landscape Baseline*

One of the fundamental tools for evaluating landscape and visual impacts is the nature and sensitivity of each Landscape Character Unit (LCU) within the Project

Study Area. An LCU generally comprises of a pattern or agglomeration of natural elements such as soil types, landforms, vegetation and water, as well as human elements such as disturbance, development and cultural significance that combine to create specific patterns and images of places that are distinctive to particular localities. The sensitivity of each LCU is assessed in the context of the extent to which the landscape could accommodate change of a particular type and scale without unacceptable adverse effects on the existing landscape character.

LCU 1 – Agricultural Plains

Agricultural areas which are characterised by flat terrain with gentle undulating slope. This area is predominately rural composing of agricultural land, generally devoid of structures and is heavily modified as a result of human activity. Vegetation is dominated by agricultural crops. Agriculture is the primary source of income for large portions of the local population and it is reasonable to assume that this LCU would have a high importance to the local population. However, there are no indications that this would have any broader local or regional significance other than as the land which provides a key livelihood to the local people. The sensitivity of the LCU was assessed as follows:

- This LCU is considered locally important in relation to the primary function of agricultural production, with key considerations being the social and economic values of agricultural land to the local population
- The LCU is considered to have low rarity
- As the LCU has undergone extensive human modifications it is considered to have a large ability to accommodate change
- Due to the local importance, coupled with its high ability to accommodate change, this LCU is considered to have a low sensitivity to change.

The general nature of LCU 1 is shown within the below photos.



Agriculture Land



Agriculture Land

LCU 2– Industrial Complex Area

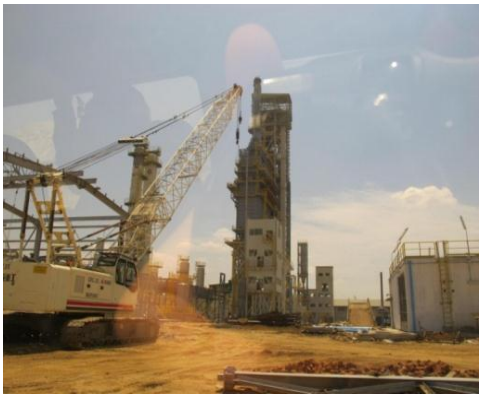
The site of the power plant facility is located immediately to the north of the existing Myingyan steel mill, which in itself is undergoing extensive expansion at the moment. This integrated industrial complex area is considered as a distinct LCU. This LCU is a combination of a range of existing industrial buildings (the steel mill, existing MOGE gas receiving station, temporary gas-fired power plant) and a large undeveloped area

which will form the footprint of the Power Plant facility. This area is predominately disused cultivated land presently supporting grassland, low shrub and minimal tree coverage and is therefore considered as highly modified. As industrial development represents a key source of alternative employment this may mean that it holds a high importance to the local people. The sensitivity of the LCU was assessed as follows:

- This LCU is considered locally important in relation to the employment opportunities that it may potentially generate to local people, as well as a future source of power;
- The LCU is considered to have low rarity;
- As the LCU has undergone extensive human modifications it is considered to have a large ability to accommodate change.
- Due to the local importance, coupled with its high ability to accommodate change this LCU is considered to have a low sensitivity to change.



Site Looking Towards Steel Mill



Steel Mill

LCU 3 - Villages

There are a range of small villages scattered throughout the Project Study Area, the closest of which is Sa Khar located 700m to the north of the site. These are considered a distinct LCU. This LCU is characterised by the basic single story housing types prevalent within the area. In addition to these, these villages contain a number of religious/sacred sites as detailed within the below table.

Table 11.1 Religious and Sacred Sites within LCU 3

Religious/ Historical/ Sacred sites	Proximity to the Project's Direct Footprint of the Land that will be Used
A large Pagoda complex, Buddhist monastery, and burial site	Located near Sa Khar village, 0.7 km to the north
Pagoda complex and Buddhist monastery for young monks	Located in Hnan Ywa village, 1.7 km to the southeast
Pagoda complexes and Buddhist monastery for young monks	Located in Nyaung Kan, 3.6 km to the southwest
Pagoda complexes	Located in Gyoke Pin village, approximately2 km to the northwest
Pagoda complex (i.e. shrines, courtyards and garden)	Approximately 2 km to the north

As these villages represent connection to place, the daily life cycle of all of the residents as well as holding a number of important religious items, it is assumed that it holds high importance to the local people. The sensitivity of this LCU was assessed as follows:

- This LCU is considered locally important in relation to the daily lives of the people who reside in them, as well as regionally important with respect to the various pagoda and monastery complexes situated within the villages;
- The LCU is considered to have low rarity as such villages are typical of the area;
- The LCU is considered to have low rarity;
- As the LCU has undergone extensive human modifications it is considered have a large ability to accommodate change, however structures and usage associated with the religious sites general have limited ability to accommodate change;
- Due to the local importance, coupled with its limited ability to accommodate change, this LCU is considered to have a medium sensitivity.

Typical elements of this LCU are shown within the below photos.



Sa Khar Village



Pagoda Complex

11.5.2 Visual Baseline

The assessment of visual effects includes changes in the character of available views resulting from the project and changes in the visual amenity of visual receptors. Visually sensitive receptors (VSR's) may include local residents, transient groups, users of particular facilities (e.g. temples), transient visitors and tourists, workers and other groups of viewers. For the purposes of this assessment, the sensitivity of a particular group to changes in the landscape has been based upon exclusively the "typical" values held by individuals and communities, i.e. views from residences are often considered locally important. Perception studies on landscape values and beliefs held by people toward the landscape have not been specifically undertaken for this Landscape and Visual Impact Assessment (LVIA); however it is noted that during informal interviews with members of the local community key concerns did not include anything relating to visual amenity. Indeed, concerns relating to new electricity transmission towers where whether they would pose any electric shock or

risk to cattle or people, and also the expectation that the project would bring about improved access to electricity.

VSR 1 – Inhabitants of Villages

The longstanding residents of the villages have a high level of association with the landscape, particularly LCU 1 – Agricultural Plains. All areas of LCU 1 are accessible to these people, and it is highly likely that they place great value on this landscape due to the high contribution it makes to livelihoods in the area. With regards to changes to the landscape of LCU 2 – Industrial Complex, it is unlikely they would place high sensitivity over a change in this landscape; however this has not been specifically confirmed. With regards to LCU 3 – Villages, given that this is their home and contains many religious buildings they would have a high sensitivity in this regard. Therefore they would have a high sensitivity to changes in LCU 1 and LCU 3, and moderate sensitivity to LCU 2.

VSR 2– Recreational Visitors and Tourists

No studies have been undertaken with regards to the tourism and recreational aspects of the Project area, however the areas within Myingyan and Mandalay experience large amounts of tourist traffic and therefore it is perceivable that some tourists may visit the area. Tourists and recreational visitors typically have a high level of vested interest in the landscape and visual amenity, particularly the agricultural areas (LCU 1) and villages which contain a variety of temples and other religious features (LCU 3). It is therefore likely that they would have at least a moderate sensitivity to change of these landscapes.

11.6 ASSESSMENT METHODOLOGY

The impact assessment has been undertaken having regard for the methodology developed within ***Chapter 4***, taking into account the limitations noted in the above sections.

11.7 ASSESSMENT OF IMPACTS

11.7.1 Construction Phase

During the construction phase, land development of the main site will require extensive works to be undertaken on the Project site, as well as off site for the development of associated linear infrastructure such as the raw water supply pipeline, the electricity transmission line and the gas pipeline. These works will be undertaken within each of the LCU's. The construction phase will comprise primarily of two distinct phases: (a) civil construction work which would require a minimum of one year for completion; and (b) mechanical and electrical work for plant commissioning. During the first year, impacts would be similar across all LCU's – particularly relating to removing vegetation and structures, excavation of soil and erection of construction fences, scaffolding etc. During the second phase of the works, the mechanical works would essentially be similar as operational visual impacts. Therefore, the impacts to LCU's and VSR's for the first 12 months of construction are considered in the following:

- Landscape impacts due to the construction of the power plant; and
- Visual impacts due to the construction of linear infrastructure.

Landscape Impacts during Construction Phase

The Power Plant is located within LCU 2 – Industrial Complex which has a low sensitivity. The initial construction will directly impact the character of this area through the removal of all remaining vegetation across the site, and substantial earthworks and associated supporting infrastructure. The effect of this construction would be a large change resulting in a significant contrast with the existing nature of the site.

Presently, the Project Sponsors responsibility with regards to the linear infrastructure is development of a 230kV overhead transmission line 2.5km in length. This will be contained entirely within LCU-2 and join the switchyard at the Power Plant with the upgraded Myingyan Steel Mill sub-station. However, the connection beyond this substation will be the responsibility of GOM and it is likely that it will make its way through LCU-1 and/or LCU-3 depending on the final selected alignment. This is also the case with the water supply pipeline and the gas supply pipeline. Impacts have therefore been assessed based on an assumption that there will be construction of linear infrastructure within LCU-1 and LCU-3.

The impacts of these changes to the landscape are assessed in the below table.

Table 11.2 Landscape Impacts during Construction Phase

Impact	Landscape Impacts during Construction Phase				
Nature	**Negative**	Positive	Neutral		
	Construction of the Power Plant will directly affect the character of LCU 2 with the removal of vegetation across the site and excavation of large areas of soil Construction of the transmission line, raw water intake and gas supply line will require the removal of vegetation across various elements of LCU-1, as well as excavations within both LCU 1 and LCU 3 in various places.				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts would be direct				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	The construction phase which would have the most distinctive impacts to LCU 1, LCU2 and LCU3 would all occur during the initial 12 month period and impacts are therefore considered to be temporary.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be limited to the footprint where the construction works are being undertaken at any given time.				
Scale	The removal of all vegetation and soil excavation within LCU 2 would result in the removal of the last undeveloped sections within this LCU. Works would occur across this part of the LCU for the duration of construction, which would likely be occurring in conjunction with the ongoing expansion of the adjoining steel mill. Works within LCU 1 and LCU 3 will generally be restricted to a very refined corridor, and would not occur along the entire length of this corridor at any one time, thereby reducing the overall scale.				
Frequency	It is likely that this impact will occur only once.				
Magnitude	Positive	Negligible	**Small**	**Medium**	Large
	Construction of the power plant in LCU 2 will have a small impact magnitude as it is within a low sensitivity landscape and the scale of works are confined within an area being extensively developed. Construction of the linear infrastructure within LCU 1 and LCU 3 will have a medium				

	impact as these activities will contrast significantly with the surrounding environment which is either rural or residential in nature.			
Receptor/ Resource Sensitivity	**Low**	**Medium**	High	
	The sensitivity of LCU2 where the power plant is being developed is considered to be low, whereas for LCU 1 and LCU3 (site of the linear infrastructure) this is considered to be medium.			
Significance	**Negligible**	**Minor**	Moderate	Major
	For the construction of the power plant, the combination of a Small Impact Magnitude and a Low Receptor sensitivity means that there will be a **Negligible Impact**. For the construction of the linear infrastructure, the combination of a Medium Impact Magnitude and a Medium Receptor Sensitivity means that there will be a **Moderate Impact.**			

Mitigation and Management Measures

In order to reduce all impacts to negligible level, the following measures are to be adopted for works within all LCU's:

- The extent of the construction areas (including any laydown areas) is to be limited to minimum extent necessary;
- The design for earthworks and cut and fill (particularly for linear infrastructure within LCU 1 and LCU 3) should ensure that it is blended with the landscape as much as possible;
- Cut and fill slopes as well as areas disturbed by construction activity are to be suitably top soils and revegetated as soon as is possible after shaping;
- All existing large trees, if any, that fall outside the earthworks areas must be retained;
- Felled trees should be replaced where possible and the perimeter to the power plant site should be replanted with native trees;
- Hoarding is to be but in place around the power plant construction site. The colour of this hoarding should blend in with the surrounding environment as much as possible; and
- Laydown areas which will no longer be required for the operation stage are to be landscaped with suitable vegetation after the construction work is completed.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance can be reduced to **negligible** for all LCU's.

Visual Impacts during Construction Phase

Construction of the Project will result in a change to the visual character of the landscape. The predicted impacts may vary dependent upon the project component (i.e. whether the power plant site, or any of the linear infrastructure) however all elements will result in changes to each LCU. Whilst view shed analysis has not been undertaken, given the generally flat nature of the landscape, the proximity of villages to both the power plant construction site and areas where linear infrastructure will be installed, as well as the fact that VSR's will be able to gain direct access to the landscape where linear infrastructure is being developed (LCU1 and LCU 3) means that they will be able to directly view all construction works. The

impacts of these changes on the visual amenity of VSR 1 and VSR 2 are assessed in the table below.

Table 11.3 Visual Impacts during Construction Phase

Impact	Visual Impacts during Construction Phase			
Nature	**Negative**	Positive	Neutral	
	Construction of the Power Plant will not directly affect areas traversed by either VSR1 or VSR2, however it will cause a change in the visual amenity of the area due to the introduction of construction activities. Construction of the transmission line, raw water intake and gas supply line will be directly in areas utilised by VSR1 and possibly VSR2 and therefore alter the views and visual amenity for these VSRs.			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts would be direct			
Duration	**Temporary**	Short-term	Long-term	Permanent
	The construction phase which would have the most distinctive impacts to the VSR's would all occur during the initial 12 month period and impacts are therefore considered to be temporary.			
Extent	**Local**	Regional	International	
	Impacts will be restricted to those VSR's in the immediate area who are able to view the construction works being undertaken.			
Scale	The removal of all vegetation and soil excavation within LCU 2 would result in the removal of the last undeveloped sections within this LCU. Works would occur across this part of the LCU for the duration of construction, which would likely be occurring in conjunction with the ongoing expansion of the adjoining steel mill. Works within LCU 1 and LCU 3 will generally be restricted to a very refined corridor, and would not occur along the entire length of this corridor at any one time, thereby reducing the overall scale.			
Frequency	It is likely that this impact will occur only once.			
Magnitude	Positive	Negligible	Small	**Medium**	Large
	The precise impact magnitude to VSR 1 (Villages) and VSR 2 (Tourists) is uncertain, however as it assumed that all elements of construction will be visible in views at intermediate distances from areas which they frequent – this includes villages and agricultural areas. In particular the construction of linear infrastructure will be visible across a large area of the landscape. Based on this, the impact magnitude is considered to be medium.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	The sensitivity of VSR1 is considerate to be medium, whilst VSR2 is considered to have High sensitivity			
Significance	Negligible	Minor	**Moderate**	Major
	For VSR1 – Villages, the combination of a Medium Impact Magnitude and a Medium Receptor Sensitivity means that there will be a **Moderate Impact**. For VSR 2 – Tourists, the combination of a Medium Impact Magnitude and a Medium Receptor Sensitivity means that there will be a **Moderate Impact**.			

Mitigation and Management Measures

In order to reduce all impacts to negligible level, the measures outlined above are to be adopted for works within all LCU's. In addition to this, specific consultation with people from the surrounding villages (who make up VSR-2) with regards to any specific management and mitigation measures they may want to put in place with regards to any linear infrastructure works undertaken within LCU-3 Villages, particularly near any of the temples or pagodas. This should be undertaken as part of broader project consultation activities.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance can be reduced to Minor for all LCU's.

11.7.2 Operation Phase

The operation phase is expected to continue for up to 22 years. From a landscape and visual perspective, this will mean that there is the permanent presence of a power plant in LCU-2, as well as above ground (electricity transmission poles and wires), on ground (raw water supply pipeline) and below ground (the gas supply pipeline) within LCU-1 and LCU-3. The long term presence of these are anticipated to have impacts upon both the landscape and visual amenity, therefore the follow impacts have been identified and assessed:

- Landscape impacts during the operations phase; and
- Visual impacts during the operations phase.

Based on the current plans, gas pipeline will be underground and the water pipeline directly on the surface, which will essentially have nil landscape and visual impacts during the operations phase.

Landscape Impacts during Operation Phase

The presence of the power plant will add another industrial component into LCU-1, which already contains an existing steel mill (undergoing expansion). The effect of introducing this into the already degraded LCU-2 will likely have minimal impacts. As within the construction phase impacts, the path of linear infrastructure through LCU-1 and LCU-3 is not yet confirmed and will not be the responsibility of the Project Sponsor. However, for the purposes of this impact assessment it has been assumed that the electricity transmission poles and wires will go through both at various times.

The above ground infrastructure within LCU-1 and LCU-3, being electricity transmission poles and wires, is being introduced into a landscape which has limited such features. However, given the low sensitivity of this LCU, its large expanse (meaning it has large capacity to absorb landscape impacts) and the critical nature of this infrastructure also means that it will likely have minimal impacts.

The precise nature of landscape impacts is assessed in the below table.

Table 11.4 Landscape Impacts during Operation Phase

Impact	Landscape Impacts during Operation Phase			
Nature	**Negative**	Positive	Neutral	
	Potential impacts the landscapes would be negative			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to the landscapes due to development of the power plant and associated facilities will be direct.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase of the Project is approximately 22 years. As there is the capacity/potential to remove all elements of the project after this period, it is considered as long term.			
Extent	**Local**	Regional	International	
	Potential impacts would likely be limited to the location where the new elements of the Project are constructed.			
Scale	The introduction of a new power plant into an already industrialised LCU-2 would generally be considered small scale, however when taken into the fact that it will encompass approximately half of this space it can be considered as medium There are presently no existing electricity transmission poles within the LCU-1 and LCU-3 and therefore despite their relatively small scale and general commonality in other regions, it can also be considered as a medium scale impact.			
Frequency	The impacts would occur only once			
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Construction of the power plant in LCU 2 will have a small impact magnitude as it is within a low sensitivity landscape and the scale of works are confined within an area being extensively developed. Construction of the linear infrastructure within LCU 1 and LCU 3 will have a medium magnitude as these activities will contrast significantly with the surrounding environment which is either rural or residential in nature.			
Receptor/ Resource Sensitivity	**Low**	**Medium**	High	
	Both LCU-1 and LCU-2 are noted as being low sensitivity receptors, however LCU-3 is noted as being a medium sensitivity receptors.			
Significance	Negligible	Minor	**Moderate**	Major
	For the construction of the power plant, the combination of a Small Impact Magnitude and a Low Receptor sensitivity means that there will be a **Negligible Impact** to LCU-2. For the construction of the linear infrastructure, the combination of a Medium Impact Magnitude and a Low Receptor Sensitivity means that there will be a **Minor Impact** to LCU-1. For the construction of linear infrastructure, the combination of a Medium Impact Magnitude and a Medium Receptor Sensitivity, means that there will be a **Moderate Impact** to LCU-3.			

Mitigation and Management Measures

Presently, only impacts associated with LCU-2 (which are already at **negligible** level) are reasonably within the Project Sponsors capacity to mitigate. It is not considered to undertake any additional mitigation.

Impacts associated with the electricity transmission line remain at **minor** and **moderate** level and could only be mitigated further subject to the agreement of the GOM. As visual impact mitigation is likely to be a high priority for the GOM in providing electricity infrastructure for its population, at this stage it is not considered necessary to develop further additional mitigation measures.

Visual Impacts during Operations Phase

As established, the Project will result in a change in the visual character of the landscape by the introduction of large new, non natural elements. The predicted impacts may vary dependent upon project component, however all elements will result in changes to all LCUs. Whilst viewshed analysis has not been undertaken (nor have photomontages been developed), given the generally flat nature of the landscape, and the proximity of villages to both the power plant and likely linear infrastructure corridors VSR's will be able to directly view all operational elements of the Project. The impacts of these changes on visual amenity of VSR-1 and VSR-2 and are assessed in the table below.

Table 11.5 Visual Impacts during Operations Phase

Impact	Visual Impacts during Construction Phase				
Nature	**Negative**	Positive	Neutral		
	Operation of the Power Plant will not directly affect areas traversed by either VSR1 or VSR2, however it will cause a change in the visual amenity of the area. Construction of the transmission line will be directly in areas utilised by VSR1 and possibly VSR2 and therefore alter the views and visual amenity for these VSRs.				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts would be direct				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase of the Project is approximately 22 years. As there is the capacity/potential to remove all elements of the project after this period, it is considered as long term.				
Extent	**Local**	Regional	International		
	Impacts will be restricted to those VSR's in the immediate area who are able to view elements of the Project Directly.				
Scale	The introduction of a new power plant into an already industrialised LCU-2 would generally be considered small scale, however when taken into the fact that it will encompass approximately half of this space it can be considered as medium There are presently no existing electricity transmission poles within the LCU-1 and LCU-3 and therefore despite their relatively small scale and general commonality in other regions, it can also be considered as a medium scale impact.				
Frequency	It is likely that this impact will occur only once.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	The precise impact magnitude to VSR 1 (Villages) and VSR 2 (Tourists) is uncertain, however as it assumed that all elements of the project will be visible in views at intermediate distances from areas which they frequent – this includes villages and agricultural areas. In particular the construction of linear infrastructure will be visible across a large area of the landscape. Based on this, the impact magnitude is considered to be medium.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	The sensitivity of VSR1 and VSR-2 is considerate to be medium.				
Significance	Negligible	Minor	**Moderate**	Major	
	For VSR1 – Villages, the combination of a Medium Impact Magnitude and a Medium Receptor Sensitivity means that there will be a **Moderate Impact.** For VSR 2 – Tourists, the combination of a Medium Impact Magnitude and a Medium Receptor Sensitivity means that there will be a **Moderate Impact**.				

Mitigation and Management Measures

In order to reduce all impacts to negligible level, the measures outlined above are to be adopted for works within all LCU's. In addition to this, specific consultation with people from the surrounding villages (who make up VSR-2) with regards to any specific management and mitigation measures they may want to put in place with regards to any linear infrastructure works undertaken within LCU-3 Villages, particularly near any of the temples or pagodas. This should be undertaken as part of broader project consultation activities.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance can be reduced to **minor** for all LCU's.

12 SOIL AND GROUNDWATER

12.1 INTRODUCTION

During the construction and operation phases, different activities have the potential to generate wastewater, accidental spills, which could lead to impacts on the quality of groundwater due to leaching. In addition, groundwater use for the Project could impact the availability of groundwater for users in surrounding communities. In the Project Study Aarea, the groundwater aquifers are primarily Irrawadian and Peguan aquifers. Changes to in-situ groundwater levels, groundwater quality and any changes to soil structure and quality due to Project activities may lead to impacts to ecological receptors, as well as any future groundwater users. Therefore, understanding potential changes to the groundwater elevations, flow patterns, groundwater quality, and associated changes in soil quality, is considered essential in forming an overall understanding of Project impacts. In this regard, this Chapter presents an evaluation of the potential impacts on groundwater levels and quality and issues pertaining to quality of the in-situ soils. Impacts relating to topsoil loss due to surface water flows are discussed and assessed in-depth within the Surface Water Quality (***Chapter 9***). This is primarily due to the fact that management of surface water is related to ensuring that topsoil does not become mobilised as suspended solids.

This Chapter also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures are presented and will form part of the overall environmental and social management plan for the Project.

12.2 ASSUMPTIONS AND LIMITATIONS

The assessment of potential impacts related to groundwater and soils in this section is based on the environmental baseline data (presented within ***Chapter 5***), socio-economic baseline data (presented within ***Chapter 6*****)** and the information available from the Sponsor at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. It is noted that no quantitative modelling has been undertaken with regards to any elements of the ground water impact assessment. Should there be significant changes in factors such as assumed input data or assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may need to be amended to reflect these changes.

The environmental parameters sampled in the baseline survey, data from which have been used in the assessment, are commonly found contaminants and were selected based on extensive analysis suites provided by internationally recognized laboratories. Contaminants outside the analysis suite used under this ESIA were not assessed.

12.3 SCOPE OF ASSESSMENT

Based on the IFC Scoping Study and the Project Description (presented in ***Chapter 2***), the key potential impacts on soils and groundwater identified arise from the following activities.

Construction Phase

- Power Plant
  - Accidental events (spills, leaks and uncontrolled releases) associated with the storage, handling and disposal of hazardous materials, including fuels;
  - Soil disturbing activities and excavation during initial site preparation activities;
  - Wastewater Discharges and Run-off;
  - Storage and disposal of hazardous and non-hazardous waste;
  - Groundwater abstraction; and
  - Hydrotest discharges associated with Pre-commissioning & Testing.
- Gas Supply Pipeline
  - Accidental events (spills, uncontrolled releases) associated with the storage, handling and disposal of hazardous materials, including fuels;
  - Storage and disposal of hazardous and non-hazardous waste;
  - Soil disturbing activities and excavation associated with pipeline development; and
  - Pre-commissioning and testing liquids being directly discharged to the environment and eventually the groundwater aquifers.
- 230kV Overhead Transmission Line
  - Accidental events (spills, uncontrolled releases) associated with the storage, handling and disposal of hazardous materials, including fuels;
  - Storage and disposal of hazardous and non-hazardous waste; and
  - Soil disturbing activities and excavation associated with pole installation and development of access roads.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - Accidental events (spills, uncontrolled releases) associated with the storage, handling and disposal of hazardous materials, including fuels;
  - Storage and disposal of hazardous and non-hazardous waste; and
  - Soil disturbing activities and excavation associated with pipeline installation and associated access roads.

Operation Phase

- Power Plant
  - Accidental events (spills, uncontrolled releases) associated with the storage, handling and disposal of hazardous materials, including fuels; and
  - Storage and disposal of hazardous and non-hazardous waste.
- All linear infrastructure
  - Accidental events (leaks, uncontrolled releases).

12.4 LEGISLATION REQUIREMENTS

The groundwater impact assessment is based on international guidelines. The requirements of these international guidelines have been reviewed and discussed in detail in ***Chapter 3***.

12.5 SUMMARY OF BASELINE CONDITIONS

Chapter 5 provides the details of the baseline conditions for soil and groundwater in the Project Area of Influence. The Project area is underlain by the Irrawadian and Peguan aquifers, with the regional data supplemented by soil and groundwater sampling.

The key findings were:

- The soils on and around the Project site were generally sandy clays with a silty clay subsoil. Analysis was undertaken for a range of heavy metals and hydrocarbons with all sampled species well below the relevant WBG/IFC/WHO guidelines.
- Whilst no specific hydrogeological assessment was undertaken, the area was noted to overlay two aquifers. The first of which is the Irrawadian aquifer which is generally suitable for domestic use and irrigation purposes, with the Peguan aquifer generally suitable only for irrigation purposes. Given the nature of the soils, these aquifers are prone to leaching during monsoon seasons which can lead to rising groundwater levels, saturation of soils and very high pore-water pressure in slopes in sedimentary deposits.
- Groundwater in the region is very dependent upon natural recharge, particularly from the Ayeyarwady River and its upper watershed. Declining groundwater levels and quality in the region have been noted, particularly due to environmental degradation of water sources and uncontrolled excessive pumping of wells. The groundwater depth within the immediate vicinity of the project is approximately 39 to 41m, based on the sampling conducted
- Sampling of groundwater from wells of various depths in the area showed high sulphate and COD levels across most of the wells, with two of those sampled showing Total Coliform Bacteria levels of 16,000 to 17,000 MPN/100/ml.

12.6 ASSESSMENT METHODOLOGY

Potential impacts on groundwater associated with the construction and operation of the Project have been reviewed in ***Chapter 4***. Based on this review, potential sources of groundwater impact that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined considering the factors of the nature and magnitude of impacts and sensitivity of the groundwater and soils.

There are a number of intrusive activities that occur throughout the lifecycle of the Project which, if not managed effectively, may cause impacts to the soils and groundwater in the vicinity of the Project. The temporal and spatial spread of activities will mean that actual impacts will be dependent on the specific activities. Accordingly, to enable clearer identification of impacts and development of

management and mitigation measures specific to each activity, the potential surface water impacts are described on an activity basis. During the scoping for impacts, potential construction and operation related groundwater impacts were identified.

12.7 RECEPTOR IDENTIFICATION AND SENSITIVITY

Within the area, groundwater is not generally relied upon as a source of irrigation water for the widespread cereal crops, with flood irrigation from surface water sources the preferred method. However, it was noted within ***Chapter 6*** – Description of Socio-Economic Baseline that the people of the villages are nearly wholly reliant upon groundwater as their source of domestic and drinking water. Presently, there are no other technically or economically feasible options for sourcing this domestic water and based upon this and the high potential that the quality and quantity of this groundwater source can easily be modified (as noted by the high levels of COD, sulphate and Total Coliforms in some of the sampled wells) means that the sensitivity of the groundwater as a receptor is considered to be **high**.

12.8 ASSESSMENT OF IMPACTS

12.9 CONSTRUCTION PHASE

Construction of the Power Plant will be carried out by the construction contractor appointed by the Sponsor. The construction phase for the Project will comprise of primarily two distinct phases: (a) civil construction work that would require a minimum of one year for completion; and (b) mechanical and electrical work for Plant commissioning. The entire construction phase is expected to continue for approximately 22.5 months. The approximate number of workers for both civil and mechanical works is expected to be around 600 - 900. The workers will be sourced both locally as well as externally. Impacts during the construction phase are noted as being similar across all aspects of the Project (i.e. Power Plant and all linear infrastructures) and are thus assessed collectively. Based upon this, during the construction phase the following impacts are identified as potentially occurring:

- Loss of soil structure, quantity and quality due to improper management during site clearance activities;
- Changes to groundwater levels during development due to abstraction/dewatering (if necessary);
- Soil and groundwater contamination due to potential leaks, spills and contaminated fill materials during all phases of Project construction;
- Soil and groundwater contamination due to improper construction waste storage and disposal; and
- Soil and groundwater contamination due to improper discharge of waste water discharges and runoff.

It is noted that soil and groundwater contamination due to improper construction waste storage and disposal would be the result of contaminated surface water run-off being discharged from waste storage and disposal areas. The production and discharge of this contaminated surface water is assessed extensively within ***Chapter 9***. It is considered that this impact has therefore already been covered and will not be re-assessed within the context of impacts to soil and groundwater. This is also the case with the impacts due to improper discharge of waste water and runoff which if direct to either a surface water, groundwater or soil receptor would

all be subject to similar impacts and thus mitigation, management and monitoring measures.

Loss of Soil due to Improper Management during Site Clearance Activities

Soil works, including vegetation clearance, potential grading and levelling, compaction, construction of various structures must be carried out at the Power Plant site, access roads, and for the laying of the right of way for the gas pipeline and transmission line. Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of top soil. The anticipated volume of spoil to be removed due to excavation activities is 20,000m^3, while the volume of material to be used for levelling is 30,000m^3. The material for levelling will be a combination of excavated soil on site, as well as additional soil brought in from an adjacent site. This phase of the Project is generally the most intensive in terms of potential for topsoil loss. Poor topsoil management can lead to a loss of topsoil through either the air (as dust) or as sediment entrained within surface water flows. Soil erosion can also result from poor management of stockpiled soils, excavated areas and general construction areas.

Additionally, soil will be compacted at the Power Plant site and access roads, permanent operator housing and the lay down area to ensure soil stability. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure. This compaction of the soil may potentially result in changed hydrological characteristics, such as reduced permeability and water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

Soils near the Project are mostly degraded, and are therefore prone to erosion. If compaction and erosion are not managed, associated potential impacts could include excessive sedimentation of local waterways, loss of topsoil and reduction in soil fertility, and detrimental changes to site hydrology. However, soil compaction erosion due to construction activities will only be limited to the vicinity of the transmission line, gas pipeline route, and the Project. Additionally, soil erosion is mostly a concern during periods of high rainfall, and the Project area is located in the Dry Zone, which experiences relatively low annual rainfall quantities.

Loss of topsoil, if not controlled, can result in a waste of valuable topsoil resource which can be used in rehabilitation activities and or/agriculture. Presently there are no mitigation, management and monitoring measures directly associated with topsoil management. The impacts are assessed in ***Table 12.1*** below.

Table 12.1 Assessment of Topsoil Loss during Construction

Impact	Loss of topsoil resources during construction			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to groundwater would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impact on topsoil is direct			
Duration	Temporary	Short-term	**Long-term**	Permanent
	Impacts are considered long term as a loss of topsoil may occur over a period longer than the construction phase			
Extent	**Local**	Regional	International	
	Impact is expected to be limited to the project footprint only, and therefore the extent is considered local.			
Scale	The scale of this impact is expected to be small given that it will occur over a relatively small area compared to the rest of the landscape. It will also only occur in valuable agricultural land in areas where the linear infrastructure goes directly through these areas. Based on current plans, it is proposed that these follow existing disturbed corridors as much as possible.			
Frequency	This impact will occur throughout the construction phase, with the most intensive time being during the clearance of the power plant site.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts associated with topsoil loss are anticipated to be small based upon the limited extent and scale.			
Receptor/ Resource Sensitivity	Low	**Medium**	High	
	The resource sensitivity (being the topsoil) is considered to be medium as it a valuable asset which can be easily lost due to inappropriate management practices.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Mitigation and/or Management Measures

During soil disturbing activities, the mitigation measures developed with regards to surface water quality (***Chapter 9***) will serve to prevent soil loss through limiting TSS loading in surface water bodies. Additionally, mitigation measures developed within ***Chapter 7*** (Air Quality), particularly those aimed at dust prevention, will also minimise soil losses. Other mitigation measures to be implemented include:

- Delineation of clearance boundaries to limit the areas to be cleared;
- Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;
- Revegetation areas with temporary land use, conducting progressive rehabilitation;
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers;
- Reuse topsoil as much as possible within rehabilitation activities;
- Control erosion through diversion drains, sediment fences, and sediment retention basins; and
- Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied:
  - Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well;
  - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion;

- Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and
- Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.

Residual Impacts

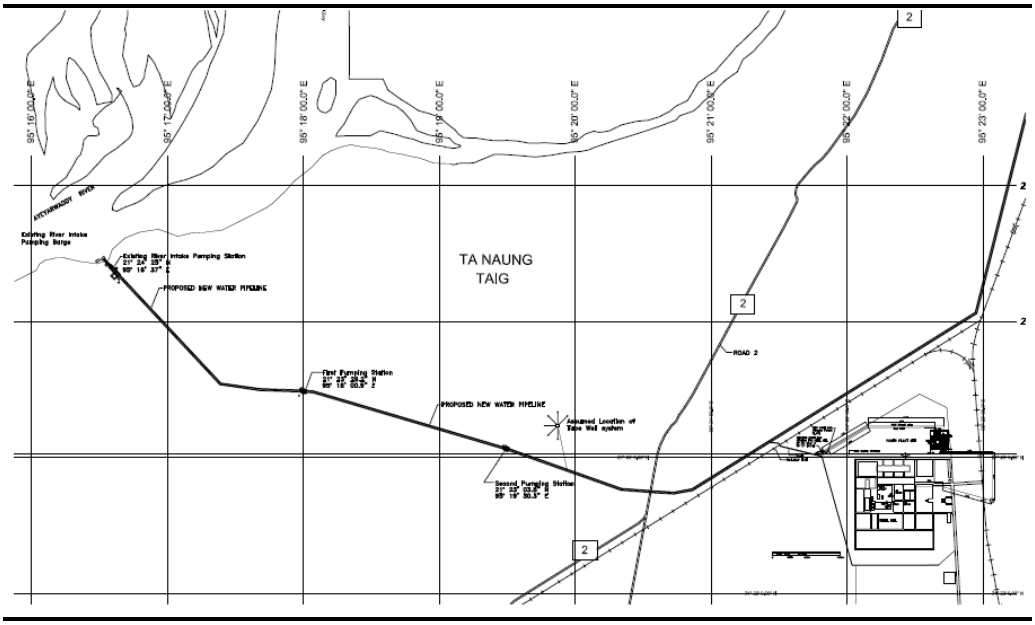
Based upon the implementation of the above management and mitigation measures, the residual impact level can be reduced to **negligible**. This is due to the fact that all topsoil would be retained and/or reused, thus reducing the scale even further and the magnitude to negligible.

Changes to Groundwater Levels during Construction as a result of Abstraction and Dewatering Activities

Some groundwater abstraction will be undertaken via a tube well during the construction phase, until the water pipeline from the Ayeyarwady River is operational. Groundwater abstraction activities during the construction phase may lead to temporary lowering of the groundwater table, adversely impacting groundwater availability.

The planned location of the tubewell for groundwater abstraction is shown in ***Figure 12.1***. The Sponsor estimates that an average of 700m^3/month will be required, with a total consumption of 15,000m^3 during the construction phase. The quantity of groundwater abstracted and associated draw down will be monitored.

Figure 12.1 Location of Tube Well during Construction



The significance of potential impacts to groundwater due to groundwater abstraction during the construction phase is assessed in the following table, and mitigation measures are presented.

Table 12.2 ***Impacts to Groundwater due to Groundwater Abstraction during Construction Phase***

Impact	Draw-down from extraction of onsite groundwater wells could potentially impact groundwater levels.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to groundwater would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to groundwater would be direct impacts from Project activities.				
Duration	Temporary	**Short-term**	Long-term	Permanent	
	The construction phase will last approximately 22.5 months. However, groundwater abstraction will only be required until the water pipeline is operational. The duration of impacts is therefore short-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the aquifer in the Project area and neighbouring area, and hence would be considered to be local.				
Scale	An average of 700 m^3/month of groundwater will be required, with a total consumption of 15,000 m^3 during the construction phase.				
Frequency	Groundwater abstraction would take place throughout the duration of the construction phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	The quantities of groundwater that will be used are comparatively low. Potential impacts to groundwater levels due to groundwater abstraction are expected to be of small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Given the high dependency of the local community on groundwater for domestic purposes, the resource sensitivity is determined to be Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and/or Management Measures

The following additional mitigation, management and monitoring measures will be implemented to reduce the impacts:

- Monitor the quantity of groundwater abstracted and associated draw down;
- Address and respond to any community complaints regarding Project impacts on groundwater availability.

Residual Impacts

Based upon the implementation of the above measures, residual impacts would remain Minor. This is due to the fact that they are aimed at directly monitoring the impact. Should community complaints be addressed through measures that directly reduce the scale or extent of the impact (such as providing alternative sources of water) then it may be reduced to **negligible**.

<u>Soil and Groundwater Contamination due to Potential Leaks, Spills and Use of Contaminated Fill Material during Project Construction</u>

Soil and groundwater contamination may occur on all parts of the Project (power plant, electricity transmission line, river water supply pipeline and gas supply

pipeline) during the construction phase due to accidental leaks or spills of chemicals or hazardous materials such as oils, lubricants or fuel from heavy equipment, and improper chemical/fuel storage. Spills and leaks may occur during vehicle/equipment operation, fuelling, and maintenance. Temporary storage of fuels, oils, lubricants and other hazardous waste types is also a source of spills and leaks. Any such spills can impact groundwater quality due to leaching through soil during periods of rainfall. This is particularly the case during the initial phases of construction where machinery will be undertaken works on exposed soils. Contaminated or polluted soil can directly affect human health through direct contact with soil, or via the infiltration of soil contamination into the aquifers known to occur under the site. Given that the surrounding communities rely on groundwater sources exclusively for all their domestic uses, they are particularly sensitive to any changes in groundwater quality.

Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:

- 30,000 L/month diesel fuel (intermittent, not stored continuously)
- Small, infrequent quantities of lubricants, oil

The significance of potential impacts to groundwater due to contamination from accidental spills and leaks during the construction phase are assessed in the following table, and mitigation measures are presented.

Table 12.3 Soil and Groundwater Contamination due to Potential Leaks, Spills and Use of Contaminated Fill Material during Project Construction

Impact	Soil and Groundwater Contamination due to Potential Leaks, Spills and Use of Contaminated Fill Material during Project Construction			
Nature	**Negative**	Positive	Neutral	
	Potential impacts to soil and groundwater would be considered to be adverse (negative).			
Type	**Direct**	Indirect	Induced	Cumulative
	Impacts to soil and groundwater would be direct impacts from Project activities.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The construction phase will last approximately 22.5 months. However, if a groundwater aquifer is impacted, it may take a long time for natural recovery, unless active measures are taken to remove the contaminants. The duration is therefore long-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the aquifer in the Project area and neighbouring area, and hence would be considered to be local; however substances could have the potential to be transmitted within the aquifer via groundwater movement.			
Scale	Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include: • 30,000 L/month diesel fuel • Small, infrequent quantities of lubricants, oil The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence. The amounts of fuels, oil, chemicals or waste spills/leaks, if they occur are expected to be small and are already reduced with the existing controls.			
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.			

Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential reduction of groundwater quality in Project area is expected to be of Small magnitude, given that any spills of fuels, oil, chemicals or wastes, if they occur are expected to be very localised and small.				
Receptor/ Resource Sensitivity	Low	Medium	**High**		
	Given the high dependency of the local community on groundwater for domestic purposes, the resource sensitivity is determined to be High.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a High Resource Sensitivity and Small Impact Magnitude will result in an overall Moderate Impact.				

Additional Mitigation and/or Management Measures

Measures are to be put in place specifically to ensure that spills and leaks of equipment do not occur. These measures include:

- Unloading and loading protocols will be developed to ensure that staff are able to undertake these tasks in a manner that minimises the risks of spills occurring;
- Fuel tanks and chemical storage areas will be sited on sealed hardstand areas, provided with locks to prevent unauthorised entry where appropriate.
- Secondary containment, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any hazardous spills and to exclude surface water run-off from entering the contained area. The containment capacity of these areas is to accommodate 110% of the volume of the largest container;
- Any refuelling activities will only take place within a designated hard stand area with spill kits present.
- All mobile equipment is to be equipped with spill or drip trays to contain spills and leaks;
- Equipment and vehicle maintenance scheduling is to be undertaken such that they are continually monitored for potential or actual leaks;
- Storage of all inert concrete waste will be undertaken in a dedicated laydown area near the concrete batching plant, and reuse of these wastes under floors or roads;
- A dedicated storage area for construction material will be developed to minimise the potential for damage or contamination of the material.
- Sufficient space will be left between all waste containers so as to identify any spills or leaks.
- Mobile toilets are to be provided throughout the construction are for use by workers. No sanitary effluent is to be disposed of on, or adjoining the site.
- A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency procedures and practices related to contamination events;
- A construction materials inventory management system will be implemented to minimise over supply of and construction materials (hazardous and non-hazardous), which may lead to disposal of the surplus materials at the end of the construction period;
- Appropriate management, storage and disposal of all waste streams will be implemented in accordance with the measures developed within ***Chapter 13*** – Waste and ***Chapter 9*** – Surface Water Quality;
- A Hazardous Materials Management Plan and a Construction Waste Management Plan will be developed to integrate all these measures.

Should any of the above measures fail to prevent spills or leaks occurring, the follow are also to be in place to ensure that any contamination is swiftly cleaned:

- Specific guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals is to be developed;
- A site specific Emergency Response Plan will be prepared for soil clean-up and decontamination;
- All mobile vehicles are to be equipped with spill control kits to contain and clean small spills and leaks;
- For any spills or leaks, once the initial emergency response has been implemented, an appropriate mean up and monitoring plan is to be developed. This is to take into account the type of spill and its extent. It is also to include provisions for monitoring of soil and groundwater quality to track potential or actual migration of the contamination through the soil and groundwater profiles.

Residual Impacts

Based upon the implementation of the above measures, it is considered that impacts can be reduced to **negligible**, as the frequency (prevention of spills and leaks), scale (detailed measures for spill clean up to prevent spread) and thus extent would all be considerably reduced. This would reduce the magnitude to negligible and thus lower the overall impact to **negligible** regardless of the fact that the receptor/resource sensitivity remains high.

12.10 OPERATION AND MAINTENANCE PHASE

The operation phase is expected to continue for approximately 22 years. The average number of permanent workers present during operation is expected to be approximately 80. The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the Power Plant. During the operation phase, potential groundwater impacts may arise from inappropriate waste storage and disposal, and accidental spills and leaks.

- Loss of soil due to increased erosion potential during operations;
- Soil and groundwater contamination due to potential leaks, spills and leaks;
- Soil and groundwater contamination due to improper construction waste storage and disposal; and
- Soil and groundwater contamination due to improper discharge of waste water discharges and run-off.

As for the construction impacts, it is noted that soil and groundwater contamination due to improper construction waste storage and disposal would be the result of contaminated surface water run-off being discharged from waste storage and disposal areas. The production and discharge of this contaminated surface water is assessed extensively within ***Chapter 9*** – Surface Water Quality. It is considered that this impact has therefore already been covered and will not be re-assessed within the context of impacts to soil and groundwater. This is also the case with the impacts due to improper discharge of waste water and runoff which if direct to either a surface water, groundwater or soil receptor would all be subject to similar impacts and thus mitigation, management and monitoring measures.

Loss of soil due to increased erosion potential during operations

During the operation phase, the physical footprint of the Power Plant and gas supply pipeline will increase the impermeable area of the Project, resulting in changed hydrological characteristics, such as reduced water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

The total area of the Project's footprint will be as follows:

- Main Power Plant: 8.6 ha
- River Water Pipeline : 14 km x 2 m = 3 ha
- Gas Line : 1 km x 1.5 m = 0.15 ha
- Transmission Line : 2.524 km x 21 m = 5.3 ha

As discussed in ***Chapter 9*** regarding impacts to surface water, the increased impervious surfaces from the Project footprint are expected to cause maximum rainfall runoff rates of 0.58 m^3/hr. This increased flow rate has the potential to cause soil erosion and sedimentation. However, if the drainage channel surrounding the Project is designed with enough capacity to accommodate this increased flow rate, then the potential impacts can be minimized.

The significance of potential impacts to soil due to erosion from increased run-off from impervious surfaces during the operation phase are assessed in the following table, and mitigation measures are presented.

Table 12.4 Loss of Soil due to Increased Erosion Potential during Operations

Impact	Potential for soil erosion due to altered hydrology due to an increase in impervious surfaces in the Project area.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Type	Direct	**Indirect**	Induced	Cumulative	
	Impacts to soil would be indirect impacts due to the presence of the Project footprint.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
Scale	The estimated runoff from Project surfaces for a worst case 15-minute duration storm with a return period of 100 years, would be approximately 0.000162 m^3/s, or 0.58 m^3/hr.				
Frequency	Impacts to soil due to erosion from increased rainwater runoff would occur during rainfall events, and will be more frequent during the rainy season.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to soil in the Project area due to increased rainfall runoff from impervious surfaces are expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Existing soil quality in the Project area is generally fair, but soil is susceptible to erosion. Overall sensitivity is rated as Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Additional Mitigation and/or Management Measures

- Ensure that drainage channel and irrigation canal have enough capacity to accommodate the increased rainfall runoff from the Project's impervious surfaces.

Residual Impact Level

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Soil and groundwater contamination due to potential leaks and spills

Accidental releases from operational activities and SF6 insulant chemicals from operation of the transmission line, have the potential to impact surrounding soil and surface water, which could subsequently impact groundwater. In addition, there is the potential for deoxygenation of the soil and groundwater due to natural gas leaks from the gas supply pipeline. Leakage from chemical storage facilities may also result in contamination. A further risk to groundwater during the operational phase is from a potential spill of back up fuel (should this be used to provide a backup fuel supply during breaks in the gas supply). These discharges may have a direct impact on the soil quality and surface water, which in turn may cause secondary impacts to groundwater.

The significance of potential impacts to groundwater due to contamination from accidental spills and leaks during the operation and maintenance phase are assessed in the following table, and mitigation measures are presented.

Table 12.5 Soil and Groundwater Contamination due to Potential Leaks and Spills during Operations

Impact	Soil and groundwater contamination due to potential leaks and spills during operations.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to groundwater would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to groundwater would be direct impacts from Project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the aquifer in the Project area and neighbouring area, and hence would be considered to be local; however substances could have the potential to be transmitted within the aquifer via groundwater movement.				
Scale	Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include: • 4,000 L/month diesel fuel • Small, infrequent quantities of lubricants, oil • Hydrostatic testing chemicals The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.				
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.				
Magnitude	Positive	Negligible	**Small**	Medium	Large

	Potential impacts to groundwater quality in the Project area due to accidental releases are expected to be of Small magnitude.			
Receptor/ Resource Sensitivity	Low	Medium	**High**	
	Given the high dependency of the local community on groundwater for domestic purposes, the resource sensitivity is determined to be High.			
Significance	Negligible	Minor	**Moderate**	Major
	The combination of a High Resource Sensitivity and Small Impact Magnitude will result in an overall Moderate Impact.			
Mitigation Measures	Periodic soil monitoring programme, as specified in HSEMS.			
Residual Significance	**Negligible**	Minor	Moderate	Major
	If the recommended mitigation measures are implemented, residual impact significance would be Negligible.			

Additional Mitigation and/or Management Measures

The measures outlined for management of spills and leaks during the construction phase are to be directly carried across into the operations phase (as appropriate) and embodied within the following plans:

- Hazardous Materials Management Plan;
- Hazardous Waste Management Plan;
- Emergency Response Plan; and
- Guidelines and Procedures are to be developed specifically in relation to spills and leaks management and clean-up.

In addition to the above, the following measures specific to the operations phase are to be put in place:

- To minimise use of antifouling and corrosion inhibiting chemicals, appropriate depth of water intake will be maintained, and use of screens will be ensured.
- Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed.
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.
- As part of the facility-wide HSEMS, SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis.
- Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation.
- A groundwater monitoring plan (including groundwater wells installed at strategic locations) is to be developed and implemented through the life of the Project to detect any changes in groundwater quality that may be contributed to spills and leaks from the Project

Residual Impacts

Based upon the implementation of the above measures, it is considered that impacts can be reduced to **negligible**, as the frequency (prevention of spills and leaks), scale (detailed measures for spill clean up to prevent spread) and thus extent would all be considerably reduced. This would reduce the magnitude to negligible and thus lower

the overall impact to **negligible** regardless of the fact that the receptor/resource sensitivity remains high.

13 WASTE

13.1 INTRODUCTION

During the construction and operation phases, there are a range of activities which have the potential to generate a range of liquid and solid hazardous and non-hazardous waste streams. This Chapter identifies in detail the various types of waste that will be generated, potential impacts associated with their generation and disposal, and identifies appropriate mitigation, management and monitoring measures required to reduce residual impacts to an acceptable level.

Based on the outcomes of the IFC Scoping Study (outlined in ***Chapter 5***), all liquid waste streams during both construction and operations phase have been identified.

Impacts associated to all liquid waste streams (both planned and unplanned) were noted as occurring to a range of receptors such as surface water, groundwater and soils. Due to this, the impact screening undertaken has meant that all impacts associated with the generation, storage and disposal of all liquid hazardous and non-hazardous waste streams are assessed elsewhere. Specifically:

- Wastewater discharges from on-site sanitary facilities during construction are assessed within ***Chapter 9***;
- Surface water containing unconsolidated sediment generated during construction is assessed within ***Chapter 9***;
- Waste water generated from washing of equipment on-site, as well from the concrete batching plant is assessed within ***Chapter 9***;
- Contaminated surface water discharged due to inappropriate waste storage and disposal is assessed within ***Chapter 9*** for construction and operations; and
- Wastewater generated during the operations phase is treated within the Industrial Wastewater Treatment System (IWTS), the Sanitary Wastewater Treatment System (SWTS), Storm water Drainage System and Oily Water Treatment System. All impacts associated with the management and discharge of these liquid waste streams are identified and assessed within ***Chapter 9***.

This Chapter is exclusively focused upon impacts associated with the generation and management of solid waste.

13.2 ASSUMPTIONS AND LIMITATIONS

The assessment of potential impacts related to waste in this section is based on the environmental baseline data (presented within ***Chapter 5***), socio-economic baseline data (presented within ***Chapter 6***) and the information available from the Sponsor at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. Should there be significant changes in factors such as assumed input data, engineering design of waste management and treatment components of the Project, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

As stated within ***Section 13.1***, this Chapter does not focus on waste in the context where it impacts upon soil, surface water, or groundwater as the receptors.

13.3 SCOPE OF ASSESSMENT

Based on the IFC Scoping Study and the Project Description, the key potential impacts due to solid waste generation identified arise from the following activities.

Construction Phase

- Power Plant
  - Solid waste generation (primarily steel pipes, steel plates, structural steel, and wooden crates), storage & disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of;
  - Biomass from clearance activities is also required to be stored and disposed of.
- 230kV Overhead Transmission Line
  - Solid waste generation (primarily steel, excess cables etc.) storage and disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
- Gas Supply Pipeline
  - Solid waste generation (primarily steel and other metal scraps), storage and disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - 20,000m^3 of excess soil requiring to be disturbed and relocated within the site;
  - Solid waste generation (primarily steel and other metal scraps), storage and disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.

Operation Phase

- Power Plant
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste materials such as steel, excess cables etc associated with routine and non-routine maintenance.
- 230kV Overhead Transmission Line
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste materials such as steel, excess cables etc associated with routine and non-routine maintenance.

- Gas Supply Pipeline
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste materials such as steel, excess cables etc associated with routine and non-routine maintenance.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste material such as steel, excess cables etc associated with routine and non-routine maintenance.

13.4 LEGISLATION REQUIREMENTS

This waste impact assessment is based upon the international guidelines which have been reviewed, discussed and presented in detail within Chapter 3. In particular, IFC PS3 Pollution Prevention and Abatement and ADB SPS which adopts the WBG Environment Health and Safety Guidelines are of relevance to this assessment. This standard requires an assessment of the waste generated and avoidance and minimisation measures proposed to be utilised as part of the basic project description. This includes an assessment of the measures on how to best avoid or minimise all waste stream, put in place resource recovery, recycling and/or reuse measures where avoidance is not feasible, and as a final resort how remaining waste will be treated and disposed of in an environmentally sound manner.

13.5 SUMMARY OF BASELINE CONDITIONS

13.5.1 *Existing Waste Generators*

The existing baseline information is based upon the amounts of waste generated. The overall generation of waste within the area of influence is a mixture of domestic, agricultural and industrial waste.

Waste generated within the villages of Sa Khar, Hnan Ywa, Hpet Taw, Nyaung Kan and Gyoke Pin and surrounding agricultural areas consists primarily of domestic solid waste and some liquid sanitary waste. Based on observations of the area, littering and waste dumping are prevalent, with burning of waste piles being undertaken regularly.

The Mandalay City Development Committee is the agency responsible for waste management in the Mandalay region. Issues with the existing Municipal Waste Management system include a lack of equipment and personnel, improper collection and management of disposal sites and a complete lack of recycling facilities within Myanmar. Formal, centralised waste management within the Project Study Area (including the aforementioned villages) is extremely limited.

13.6 ASSESSMENT METHODOLOGY

Potential impacts associated with the generation and management of solid waste during the construction and operation phase have been reviewed in ***Chapter 5***. Based upon this review, potential sources of impacts associated with solid waste that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined considering the factors of the nature and magnitude of impacts. The temporal and spatial spread of activities will mean that the actual volumes and types of solid waste generated will be dependent on the specific activities being undertaken at the time. Accordingly, to identify clearer identification of impacts and development of management and mitigation measures specific to each activity, the potential soil impacts are described on an activity basis.

13.7 RESOURCES AND RECEPTORS

The resources (physical, biological, human or cultural environment) and receptors) that may be impacts in relation to solid waste generation and management are detailed within ***Table 13.1*** below.

Table 13.1 Resources and Receptors for Waste Management

Resources	Receptors
• Physical environment including land, air quality and water resources (addressed elsewhere). • Biological environment, primarily being the terrestrial environment. • Human environment including subsistence resources, community health, welfare, amenity and safety, employment and incomes, business and economic activity, existing government services, land use and traffic	• Construction workers • Full time and temporary workers during operation • Contractors and visitors to the site • Residents within the area of influence • Adjoining industrial facilities • Workers in or near waste disposal locations • Residents near waste disposal locations • Government bodies/businesses providing waste management services

13.8 ASSESSMENT OF IMPACTS

13.8.1 Construction Phase

Construction of the Power Plant will be carried out by the construction contractor appointed by the Sponsor. The construction phase for the Project will comprise of primarily two distinct phases: (a) civil construction work that would require a minimum of one year for completion; and (b) mechanical and electrical work for Plant commissioning. The entire construction phase is expected to continue for approximately 22.5 months. The approximate number of workers for both civil and mechanical works is expected to be around 600 - 900. During the construction phase, potential impacts will likely arise associated with the generation, storage and disposal of solid waste. Based on the outcomes of the IFC Scoping Study (***Chapter 5***) and the above sections, the following impacts are anticipated during the construction phase:

- Impacts due to improper storage and disposal;

- Impacts associated with the removal of potentially contaminated soils from the site; and
- Impact associated with the generation, storage and disposal of solid hazardous and non-hazardous waste.

Impacts due to Improper Biomass Storage and Disposal

Whilst the site can be described as generally sparsely vegetated, there are small trees, shrubs and groundcover scattered throughout the site which will need to be removed prior to soil disturbing works commencing. Impacts direct to terrestrial biodiversity are addressed within ***Chapter 14***, however the removed vegetation represents a solid waste stream which needs to be disposed of. Presently, it is estimated that up to 800m^3 of biomass such as trees, shrubs and grass will be removed. In cases where there are limited municipal waste options, often the removed vegetation is gathered into piles and burnt. The generation of smoke, when combined with the already degraded air-shed due to the Steel Mill, can lead to human health impacts.

The significance of potential impacts to improper disposal of biomass during the construction phase is assessed in the following table, and mitigation measures are presented.

Table 13.2 Potential Impacts Due to Improper Disposal of Removed Biomass

Impact	Potential impacts due to improper disposal of removed biomass				
Nature	**Negative**	Positive	Neutral		
	Potential impacts associated with improper disposal of biomass (i.e. burning) are considered to be negative				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts would be direct				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	The construction phase will last approximately 22.5 months, however any impacts associated with biomass management would be experienced within the initial phases and possibly only for 1 to 2 days.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be limited to the location where biomass is stored and disposed of				
Scale	• The anticipated volume of biomass to be removed and requiring management is in the order of 800m^3. • The impact would initially be limited to the footprint of where the biomass is stored, with any smoke from burning likely to be very locally restricted.				
Frequency	It is likely that this impact will occur only once.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Improper disposal of biomass, particularly through vegetation, can result in a small change in air quality when measured at nearby receptors.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	The receptors in the event that the vegetation is burnt will be the local communities situated within 1km of the site.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- No vegetation is to be disposed of by burning under any circumstances
- Generally biomass such as trees, shrubs and grass are utilised by the local community for a variety of purposes. The Sponsor will engage with the local community to ensure that they are provided with priority access to all of the biomass. In order to ensure public safety and limit access to the site (given its proximity to the steel mill), the Sponsor will first clear of the biomass and store it in a designated area (most likely the north-east corner of the site closest to the village of Sa Khar) where the local community are easily able to access it.
- Any biomass not taken by the local community biomass is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Impacts of Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network

During the construction phase, a range of waste materials will be generated either due to the daily activities of the construction workforce (e.g. generation of putrescible waste) as well as a range of general construction waste such as concrete, steel pipes, plastic pipes, steel plates, structural steel and wooden crates during the civil works phase of construction. Whilst most of these are likely to be non-hazardous, some of these may be hazardous include used paint, engine oils, hydraulic fluids, spent solvents, spent batteries etc. As detailed within ***Chapter 12*** based on similar projects the total approximate quantities of hazardous and non-hazardous waste during construction (assuming an average of 600 workers per day) include:

- 600kg/day of solid (non-hazardous waste); and
- 135kg/month hazardous waste.

Based on data gathered and presented within the environmental and social baseline chapters, the municipal waste management network within the area is exceptionally limited. Therefore, any additional waste streams generated by the Project are likely to place additional stress on this already struggling waste management network. Whilst the Project plans to put in place contracts with local service providers to collect the waste, this may simply be exporting impacts off site. These impacts could include soil and groundwater impacts (depending on the nature of the final disposal site), human health impacts, impacts to surface water and indirect impacts to community health and safety due to contamination of drinking water or food.

Additionally, it is noted that the improper storage of waste on-site can also give rise to a number of impacts. These include:

- Indirect impacts to community and work health and safety due to contamination of drinking water or food; accidental leaks or spills of oil, fuel or other hazardous materials could potentially pollute surface waters; and
- Soil may be contaminated by pollution from spills or leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored.

As discussed within ***Section 13.1***, these impacts associated with improper storage are related directly to management of impacts to soils, groundwater and surface water and are therefore addressed separately and in an integrated manner within these chapters.

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous and non-hazardous waste streams from the project construction phase are assessed in the following table, and mitigation measures are presented.

Table 13.3 Potential Impacts Due to Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network

Impact	Impacts of Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to the existing waste management network would be direct				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 22.5 months. Impacts from the Project could potentially last longer than the duration of the construction phase. The duration of impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area				
Scale	Construction activities will take place within the Project area. Based on experience with similar projects, the total approximate quantities of waste that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include: • 600 kg/day of solid waste • 135 kg/month hazardous waste The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area				
Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to soil quality in Project area due to inappropriate waste disposal is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	Medium	**High**		
	The existing waste network in the area is almost non-existent and is therefore very sensitive with regards to accepting additional waste streams.				
Significance	Negligible	**Minor**	**Moderate**	Major	
	The combination of a High Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- All waste collection and storage measures as detailed within ***Chapter 9*** and ***Chapter 12*** (Surface Water, Soil and Groundwater) will be implemented;
- Prior to construction commencing, the Sponsor is to engage with local authorities and other stakeholders (such as the Steel Mill) to determine the capacity of the local waste management network to absorb the new waste streams during construction;
- A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;
- Education of all workers on site shall be undertaken to avoid, reduce and reuse wastes generated;
- Waste disposal facilities shall be sited and signposted throughout the construction site;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site. All waste collected should be managed and disposed of in accordance with the accepted best practice for waste collection and disposal;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing IFC and ADB requirements;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis on any cross-boundary transport of waste.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be Negligible.

13.9 OPERATION AND MAINTENANCE PHASE

The operation phase is expected to continue for approximately 22 years. The average number of permanent workers present during operation is expected to be approximately 80. The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the Power Plant. During the operation phase, the plant is expected to produce limited additional waste streams than those anticipated within the construction phase. These waste streams would be mainly materials generated either due to the daily activities of the workforce (e.g. generation of putrescible waste) or a range of general construction waste such as paper from offices and scraps of steel/plastic during maintenance activities. Whilst most of these are likely to be non-hazardous, some of these may be hazardous, for example, used paint, engine oils, hydraulic fluids, spent solvents, spent batteries etc. Whilst these volumes are anticipated to be lower than the

construction phase, there is still the matter of the capacity of the existing waste management network in the region to absorb the additional waste being generated. An additional waste stream during operation is the generation of sludge from process operations. Myingyan municipality will be engaged for appropriate disposal of the dried sludge from process wastewater, and disposal will be by a licensed waste contractor.

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous and non-hazardous waste streams from the project operation and maintenance phase are assessed in the following table, and mitigation measures are presented.

Table 13.4 Potential Impacts of Solid Waste Generation, Storage and Disposal during Operations

Impact	Impacts of Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network during Operation and Maintenance				
Nature	**Negative**	Positive	Neutral		
	Potential impacts would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to the existing waste management network would be direct				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 22 years. The duration of impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Scale	Operation activities will take place within the Project area. The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area.				
Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the operation phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to soil quality in Project area due to inappropriate waste disposal is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	Medium	**High**		
	The existing waste network in the area is almost non-existent and is therefore very sensitive with regards to accepting additional waste streams.				
Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a High Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- All waste collection and storage measures as detailed within ***Chapter 9*** and ***Chapter* 12** (Surface Water and Soil and Groundwater) will be implemented;
- Prior to construction commencing, the Sponsor is to engage with local authorities and other stakeholders (such as the Steel Mill) to determine the capacity of the local waste management network to absorb the new waste streams during construction;
- A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;

- Education of all workers on site shall be undertaken to avoid, reduce and reuse wastes generated;
- Waste disposal facilities shall be sited and signposted throughout the site;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis on any cross-boundary transport of waste.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

14 TERRESTRIAL & MARINE BIODIVERSITY

14.1 INTRODUCTION

This Chapter presents an assessment of potential impacts to terrestrial and marine biodiversity and identifies whether any additional mitigation or management procedures are needed to manage residual impacts to an environmentally or socially acceptable level. Such measures are presented where appropriate and elaborated further within the ESMP (***Chapter 17***).

In accordance with the ADB sourcebook (Section V) the objectives of biodiversity impact assessment are to identify and quantify the potential project impacts; design measures to avoid, minimise or mitigate potential adverse impacts; and identify likely residual impacts. To achieve this; a five step process was undertaken. This included:

- Screening to determine the biodiversity features that require studying;
- Scoping to determine which direct and indirect biological impacts are likely to be significant in order to determine the focus issues of the impact assessment (***Section 14.3***);
- Baseline Studies to define the values of the habitats that will be affected on the Project area and in the area of influence (***Section 14.5***);
- Impact Analysis to assess impacts identified during scoping and baseline studies to determine the significance of the impacts (***Section 14.7***);
- Mitigation Measures are developed to avoid or reduce adverse impacts to biodiversity with a priority given to impacts on features with significant biodiversity values (***Section 14.7.2*** and ***Section 14.7.3***); and
- Biodiversity Offsets are determined to compensate for unavoidable residual harm caused to biodiversity (if required).

The vegetation within the Project area and surrounds is described in terms of modified and natural habitats in accordance with the ADB sourcebook.

14.2 ASSUMPTIONS AND LIMITATIONS

The assessment of potential impacts related to terrestrial and aquatic biodiversity in this Chapter is based on the environmental baseline data collected by ERM and the information available from the Sponsor at the time of writing; judgements have been made based on available data, professional knowledge and previous experience of ERM.

14.3 SCOPE OF ASSESSMENT

14.3.1 *Project and Associated Activities*

Impacts are evaluated in the context of the Project Facilities fully described in ***Chapter 2***, including details of planned construction and operation activities.

This assessment refers to the land development, construction and operation of the Power Plant including the main facilities and supporting facilities as described in ***Chapter 2***. The construction and operation of the Project are also considered.

Table 14.1 summarises the nature of impacts to biodiversity values related to these activities. These terms are used in the scoping of Project impacts on biodiversity values and relate to the identified threats from the activities.

Table 14.1 Nature of impacts on biodiversity values

Term	Description
Direct Impacts	Means direct physical displacement or impact from the Project on a species' habitat or lifecycle.
Indirect Impacts	Means a secondary impact resulting from a direct impact from the Project on a species' habitat or lifecycle.
Spatial Impacts	Means impacts on species' habitats or lifecycle including: isolation of populations or individuals; impacts on species endemism; impacts on the heterogeneity of species; environmental gradients; edaphic interfaces (derived from soil toils); connectivity between habitats and climate change adaptation importance.
Temporal Impacts	Means: • Temporary Impact means a reversible impact on a species' habitat or lifecycle; and • Permanent Impact means an irreversible impact on a species' habitat or lifecycle.

Source: ERM, 2015.

14.3.2 Resources and Receptors

For this assessment of impacts on terrestrial and aquatic biodiversity, the key resources and receptors identified are:

- Habitats and flora identified in the baseline assessment (See ***Chapter 5***);
- Terrestrial wildlife/fauna identified in the baseline including avifauna, mammals and herpetofauna; and
- Aquatic fauna.

Note ***Chapter 15*** assesses Project impacts on socio-economic receptors and is the main chapter to consider provisioning ecosystem services such as social implications of Project impacts on wild capture fisheries, aquaculture, productive land (e.g. rice fields), and standing crops (e.g. Acacia spp. and fruit trees).

14.3.3 Project Study Area

The Project Study Area for Terrestrial and Aquatic Biodiversity is within a 500 m buffer area from the Complex and water pipeline described in ***Chapter 5***. This area was determined based on the likelihood of impacts to species by the Project Facilities, based on the construction and operational activities that are described in the project description. Likely impacts within this area could include: permanent loss of habitat from clearing activities; disturbance/displacement of species from construction and operation; light and noise impacts from construction and operation; alteration of surface flow regimes; and air and water pollution discharges. Based on the species determined likely to be present (noting that no highly mobile, sensitive or conservation significant species were identified) it was determined that the 500 metres would be sufficient to characterize the likelihood of impacts.

The Project Area of Influence was determined based on the proximity of sensitive biodiversity receptors and relevant geographic boundaries that influence the movement of species within the landscape.

14.4 LEGISLATION REQUIREMENTS

1. **IFC Performance Standard 6** – Biodiversity Conservation and Sustainable Management of Living Natural Resources
2. **ADB Safeguard Policy Statement 8**— Biodiversity Conservation and Sustainable Natural Resource Management

14.5 SUMMARY OF RELEVANT BASELINE CONDITIONS

Chapter 6 provides further details on the baseline conditions for the terrestrial and aquatic biodiversity in the Project Study Area and makes an evaluation as to whether each habitat is natural or modified as well as specifically assessing whether they should be considered 'Critical Habitat' (CH). This section provides a summary of the information in ***Chapter 5***, *Section 5.10* Terrestrial and Aquatic Biodiversity.

The Project site resides within the dry zone of central Myanmar located in the Irrawaddy Dry Forests Ecoregion. It is predominately comprised of disused cultivated land used for informal grazing, supporting grassland, low shrubs and minimal tree cover, therefore the area is a highly modified habitat.

In recent years the larger mammal fauna have been hunted to the brink of extinction. The conversion of forests to agricultural land and illegal cutting of timber causes loss and fragmentation of the habitat, while intense poaching of protected animals and the lack of political will to conserve this and other ecoregions in Myanmar leaves the remaining forests devoid of wildlife.

Myanmar currently has a total of 57 Protected Areas, which account for only 4% of the country's total surface area. Only three are within 60km from the Project site, the closest being 43km away. There are also few species of conservation significance. Only four critically endangered species are known to the ecoregion, which include the Long-billed Vulture and White-bellied Heron.

Table 14.2 below summarises the biodiversity value/sensitivity given to each habitat type.

Table 14.2 Area of Habitats found in the Study Area

	Habitat		Area (hectares)
Power Station	Modified Habitat		9
230 kV Overhead Transmission Line	Modified Habitat		5
Water Supply Pipeline and Wastewater Discharge Pipeline	Modified Habitat		2
		Total	16

No species that are considered of conservation interest were recorded during the baseline surveys.

14.6 ASSESSMENT METHODOLOGY

The impact assessment is based on the baseline terrestrial and aquatic biodiversity conditions and sensitivities as detailed in ***Chapter 5*** and summarised below. ***Chapter 4*** describes the overall approach used for the assessment of impacts and the

identification of mitigation options. Similar to the other biophysical topics, evaluation of the significance of impacts on terrestrial and aquatic biodiversity, including direct, indirect and induced impacts, takes the following two factors into consideration.

14.6.1 Sensitivities of Terrestrial and Aquatic Biodiversity Resources/ Receptors

Chapter 5 provides and overall evaluation of baseline resources (habitats) and receptors (species). Data for this evaluation was collected during surveys to the Project Study Area and included mapping of habitat types.

14.6.2 Assessment Criteria

The impact magnitude is a function of a range of considerations including extent (e.g. local, regional or national), impact duration (e.g. temporary, short-term, long-term or permanent), scale (i.e. size of the impact), frequency (i.e. constancy or periodicity of the impact), and likelihood (for unplanned events only, e.g. unlikely, possible, or likely).

By considering all of the above characteristics, magnitudes of impacts to terrestrial and aquatic biodiversity are defined into the following qualitative scales as outlined in ***Figure 14.1*** for habitats and ***Figure 14.2*** for species.

Figure 14.1 Magnitude Criteria for Effect on Baseline Habitats

Habitat Sensitivity/Value		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
Low	Habitats with no or local designation/recognition; habitats of significance for species of Least Concern; habitats which are common and widespread within the region.	Negligible	Negligible	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas; habitats of significant importance to globally Vulnerable, Near Threatened or Data Deficient species; habitats of significant importance for nationally restricted range species; habitats supporting nationally significant concentrations of migratory species and/or congregatory species; nationally threatened or unique ecosystems.	Negligible	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of importance to globally Critically Endangered or Endangered species; habitats of importance to endemic and/or globally restricted-range species; habitats supporting globally significant concentrations of migratory species and/ or congregatory species; highly threatened and/or unique ecosystems, areas associated with key evolutionary species (In accordance with ADB Critical Habitat definition)	Negligible	Moderate	Major	Critical

Magnitude of Effect Definition	
Negligible	*Effect is within the normal range of variation*
Small	*Affects a small area of habitat, but without the loss of viability/function of the habitat*
Medium	*Affects a sufficient proportion of the habitat that the viability/function of part of the habitat or the entire habitat is reduced, but does not threaten the long-term viability of the habitat or species dependent on it.*
Large	*Affects the entire habitat or a significant proportion of the habitat to the extent that the viability/function of the entire habitat is reduced and the long-term viability of the habitat and the species dependent on it are threatened.*

Figure 14.2 Magnitude Criteria for Effect on Baseline Species

Species Sensitivity/Value		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
Low	Species which are included on the IUCN Red List of Threatened Species as Least Concern (LC) (IUCN 2011).	Not significant	Not significant	Minor	Moderate
Medium	Species included on the IUCN Red List of Threatened Species as Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD) (IUCN 2011). Species protected under national legislation. Nationally restricted range species. Nationally important number of migratory or congregatory species.	Not significant	Minor	Moderate	Major
High	Species included on the IUCN Red List of Threatened Species as Critically Endangered (CR) or Endangered (EN) (IUCN 2011). Species having a globally Restricted Range (i.e. plants endemic to a site or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km^2. Internationally important numbers of migratory or congregatory species. Key evolutionary species.	Not significant	Moderate	Major	Critical

Magnitude of Effect Definition	
Negligible	*Effect is within the normal range of variation.*
Small	*Affects a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself*
Medium	*Affects a sufficient proportion of a species population that it may bring about a substantial change in abundance and /or reduction in distribution over one or more generations, but does not threaten the long term viability of that population or any population dependent on it.*
Large	*Affects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond with natural recruitment (reproduction, immigration from unaffected areas) may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.*

14.7 ASSESSMENT OF IMPACTS

Table 14.3 summarises the threats to biodiversity values related to the activities during construction. These threats to biodiversity are derived from IFC 6 and relate to the activities that are likely to occur during Project construction. ***Table 14.4*** provides an assessment of significance for the modified habitats within the Project area. A number of the threats relate to both construction and operation activities and as such an assessment of significance has been undertaken in this section.

Table 14.3 Threats to biodiversity values during Construction

Term	Description
Permanent Loss of Habitat	Permanent loss of habitat or species due to permanent or temporary site activities for the Project
Disturbance and Displacement of Species	Disturbance to, or displacement/exclusion of a species from foraging habitat due to construction activities, de-commissioning activities, and operational and maintenance activities.
Edge Effects on Habitats	Disturbance or damage to adjacent habitat and species caused by movement of vehicles and personnel, potential mobilisation of sediment, artificial lighting, dust, spillage of fuels and chemicals, emissions and noise, and subsidence.
Alteration of Water Flow Regimes	Effects on downstream habitats caused by alterations to natural flow regime.
Light/Noise Impacts	Effects on species caused by permanent alterations in night time light conditions;
Alien Species (Plants and Animals)	Introduction or spreading of alien species during the construction works.
Air/Water Pollution	Contamination of the environment that has a direct or indirect impact on a species either through exposure to harmful substances.
Mortality	Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during clearing activities.

Table 14.4 Assessment of Impacts to Habitats during Construction

Impact	Description	Comment	Sensitivity	Magnitude	Significance
Temporary loss of habitat	Temporary disturbance of terrestrial and aquatic habitat in areas required to facilitate construction. Temporary disturbance will mainly be associated with access roads to construction areas, laydown areas and construction camps as well as waterway crossings and in-stream infrastructure construction (bridges).	Construction activities will require clearing of modified vegetation to facilitate the construction process which will remove habitat. The habitats are common and widespread within the region (low sensitivity) and the loss will be limited to that necessary for construction. The areas to be temporarily disturbed are considered unlikely to impact the viability or functioning of adjacent ecosystems (small magnitude). Where possible topsoil will be managed locally and natural regeneration or rehabilitation using native species will be undertaken in areas not required for the operation of the Project. For waterway crossings, water exclusion dams may be required during construction leading to a loss of habitat locally and restriction of movement by aquatic species.	Low	Small	Negligible
Permanent loss of habitat	Permanent loss of 16 ha of habitat within the infrastructure footprint and inundation areas. Habitat loss includes 16 ha of modified habitat. These areas will be cleared or inundated during construction.	The construction activities will result in the loss of 16 hectares of habitat. The habitats are common and widespread within the region (low sensitivity) and the loss will be limited to that necessary for construction. The areas to be disturbed are considered unlikely to impact the viability or functioning of adjacent ecosystems (small magnitude). Where possible topsoil will be managed locally and natural regeneration or rehabilitation using native species will be undertaken in areas not required for the operation of the Project. For waterway crossings, water exclusion dams may be required during construction leading to a loss of habitat locally and restriction of movement by aquatic species.	Low	Small	Negligible
Temporary disturbance to fauna behaviors	Disturbance and displacement of resident fauna due to noise, light and/or vibration as a result of construction activities (excavation, blasting, clearing, spoil disposal, camps, plant and vehicle movement).	Noise and light disturbances have the potential to influence fauna breeding, roosting or foraging behaviour of native fauna. The consequences of these influences are dependent on the extent of disturbance but in extreme cases these factors can influence local populations if breeding and communication is inhibited. Excessive noise can impede fauna communication and deter the use of habitats nearby. Similarly, introducing light sources has the potential to deter foraging and dispersal activities of nocturnal species. The impact is likely to be small and localised (low sensitivity) and unlikely to impact significantly on fauna (small magnitude).	Low	Small	Negligible

Impact	Description	Comment	Sensitivity	Magnitude	Significance
Edge effects degrading habitat	The construction and inundation associated with the Project will generate newly disturbed forest edges around the margins of the reservoir, along access roads, the transmission line and at the infrastructure locations.	Edge effects are an indirect impact of land clearing. Where vegetation clearing occurs, adjacent vegetation and habitats are exposed to increased noise, light, dust and wind environment as well as increased competition from predators and invasive species. In extreme cases some of these effects have potential to alter the habitat characteristics of the ecotone and influence suitability for native flora and fauna. 'New' habitat edges will be created where infrastructure is located in natural habitat areas, not previously disturbed. In general, the habitats that may be impacted are common and widespread within the region (Low sensitivity) and the impact is not likely to impact the viability/function of adjacent habitats (Small magnitude).	Low	Small	Negligible
Degradation of habitat	Introduction of alien species and competition with native communities	Invasive or alien species have the potential to be introduced or spread throughout the Project area through increased movement of people, vehicles, machinery, vegetation and soil. An increase in the prevalence of weeds or other pests has the potential to reduce the quality of habitat for some native flora and fauna, including threatened species (Sensitivity medium). Invasive flora species can rapidly germinate in disturbed areas whereby affecting the ability of native vegetation communities to re-establish. Alien animals also have the potential to be introduced or increased in abundance. These animals may adversely impact native fauna as a result of increased competition for resources, predation or habitat degradation. Two invasive plant species have identified in the project area including *Acacia catechu* and *Leucaena glauca*. Vehicle movement and activities which introduce a risk of invasion will be focussed along the access track and construction areas (Magnitude small).	Medium	Small	Minor
	Accidental release of hazardous substances stored or used during construction phases.	The Project components include the storage and handling of hazardous materials, including refuelling. Accidental release or spill of these materials can be toxic to flora and fauna locally and downstream if substances are released into the aquatic environment. Such that impacts are likely to be localised (magnitude small) and the Area of Influence does not contain habitats or species of significance (Sensitivity medium).	Medium	Small	Minor

Impact	Description	Comment	Sensitivity	Magnitude	Significance
Water Quality Impacts	Erosion and runoff at waterways crossings leading to downstream degradation of water quality, and aquatic habitats.	A range of Project activities have the potential to lead to indirect dust and runoff impacts to native flora, fauna and habitat during the construction phase as well as longer term edge effects and noise impacts. During construction, land preparation has the potential to generate dust which may settle on vegetation adjacent to the construction area. Excessive dust deposition on flora may act to suppress growth through limiting photosynthesis and the dusted foliage may also become unpalatable to foraging fauna. The construction activities will be temporary and short lived, and dust generation is likely to be localised to active work areas. Rainfall will generally remove dust from foliage. Land preparation will create exposed bare earth areas that are vulnerable to erosion (wind and/or runoff) until infrastructure construction or replanting is completed to stabilise the surface. Erosive processes transport and deposit sediment to downstream habitats (both aquatic and terrestrial). The indirect impact has potential to degrade downstream habitat areas or change habitat characteristics, and as such influencing suitability for native flora and fauna communities. Impacts are likely to be localised (magnitude small) and no species of conservation significance were detected (Sensitivity medium).	Medium	Small	Minor
Fauna mortality		Fauna mortality can occur during vegetation clearing activities in the event individuals are struck by vehicles and machinery. Animals that are unable to disperse during clearing activities are vulnerable to being injured or destroyed through interaction with machinery or falling debris. It is likely that most individuals will disperse (Sensitivity low) from clearing locations into adjacent habitats however some less mobile species may experience a localized reduction (Magnitude small) in abundance during this period, such as amphibians, reptiles and small mammals.	Low	Small	Negligible

14.7.1 *Avoidance/ Minimisation of Impacts*

The mitigation hierarchy aims to achieve the best possible outcome to minimise effects on biodiversity and should be applied sequentially to: avoid or minimise; mitigate; rehabilitate/ restore and finally to compensate/ offset if required.

14.7.2 *Construction Phase*

Disturbance to habitat in modified and natural habitat areas during construction has the potential to impact the local and downstream biodiversity as well as impacts to priority biodiversity values. Mitigation measures can be implemented to manage the disturbance during construction such that biodiversity values are not significantly impacted or impacts are reduced by the application of the mitigation hierarchy (avoid, minimise, mitigate and compensate through offsets).

To further mitigate potential impacts to biodiversity values, the remainder of the mitigation hierarchy principle was applied. The impact assessment (***Table 14.4***) identified potential impacts to both modified habitats. Modified habitat types were not identified to play a significant role in habitat suitability for priority biodiversity values.

Management measures specific to managing the natural environment will be incorporated into the Project Construction Management Plans and these will include (but not be limited to) those identified in ***Table 14.5***. These general environmental management measures will assist in reducing the potential for degradation of habitat, behaviour disturbance, fauna mortality and habitat fragmentation for native species.

In addition to the general measures for the management of potential impacts to the natural environment, measures specific to managing potential impacts to conservation significant values are also considered. Throughout the baseline assessment, no priority biodiversity values have been identified and hence it is not necessary to assess candidates for critical habitat in accordance with ADB SPS.

Table 14.5 Mitigation and Management Measures, Construction Phase

Nature of Impact	Overview of Measures
Loss of habitat	• The design and layout plan will be prepared to minimise tree cutting and protected area disturbance where possible. The Project owner shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning these restrictions, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; • The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing; and • Project will utilize or upgrade existing roads where possible to minimize unnecessary clearing requirements.
Disturbance to fauna behaviour	• Construction vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation; • Arrangement of transportation schedules will aim to avoid peak hours of road usage to minimise heavy traffic through habitat areas; • Traffic signs will be installed on all roads throughout construction areas depicting speed limits;

Nature of Impact	Overview of Measures
	• For construction areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible; and • Commitment will be made to raise awareness of the construction work force and make arrangements for restriction of poaching.
Barrier to movement and habitat fragmentation	• The Project shall implement landscaping and re-vegetation after completion of construction in suitable areas to establish a suitable riparian corridor; • In-stream works will be carried out in low-flow conditions where possible; and • The transmission line will not be fenced.
Edge effects	• Dust suppression techniques will be utilised during construction, to control the dispersion of dust created by clearing lands at the construction sites; • The Project shall implement landscaping and re-vegetation after completion of construction using native species where possible; • To avoid/minimize releasing sediment load into the river, erosion control measures will be implemented and maintained e.g. using silt fence and temporary re-vegetation to minimize sediment transport from steep slope releasing to the river and smaller waterways; and • Weed and pest management measures should be implemented in accordance with a Project weed and pest management plan to avoid introduction of weeds to natural and modified habitat areas.
Degradation of habitat	• Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction areas; • For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed surfaces; • Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; • Weed and pest management measures should be implemented in accordance with a Project weed and pest management plan to avoid introduction of weeds to natural and modified habitat areas; • Speed limits to maximum of 20 km/hr for construction vehicles will be enforced to limit noise and dust generation; • Construction materials and chemicals will be appropriately secured and locked down during flood season to avoid accidental release to the natural environment; • Engineering works will be designed to comply with the agreed water quality standards; • Water quality monitoring will begin as soon as possible after the Project begins, in order to control the quality of discharge water; and • Emergency response plan and procedures will be prepared and implemented for the construction activities of the Project. This will include emergency drills and education of Project workers.
Fauna mortality	• Speed limits to maximum of 20 km/hr for construction vehicles will be enforced to minimise potential for fauna strike; • Commitment will be made to raise awareness of values of natural habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection; • Hunting wild animals will be strictly prohibited to apply for all staff; and • Fishing and using of illegal fishing gear anywhere along the river will be prohibited;

Table 14.6 Summary of the Significance of Site Development Activities

Impact	Site Development and Construction of Power Station, Transmission and Water Pipelines				
Impact Nature	**Negative**	Positive	Neutral		
	The impact on the terrestrial and aquatic biodiversity is negative				
Impact Type	**Direct**	**Indirect**	Induced		
	Direct terrestrial habitat loss in the Project Footprint in areas to be developed. Indirect effects on remnant/ isolated habitats.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Although construction is estimated to take 22.5 months, the loss/ conversion of habitats will be permanent.				
Impact Extent	**Local**	Regional	International		
	The impact is expected to be local for habitats.				
Impact Scale	It is anticipated that the Project will cover a land area of approximately 16 ha.				
Frequency	Construction occurs only once.				
Impact Magnitude	Positive	**Negligible**	**Small**	Medium	Large
	Considering the magnitude of impacts to each habitat discussed above, the overall magnitude of this impact is **Negligible to Small**.				
Receptor Sensitivity	**Low**	Medium	High		
	Given the large proportion of the area affected is covered by habitats with medium sensitivity, the overall sensitivity is considered **Low**.				
Impact Significance	**Negligible**	**Minor**	Moderate	Major	Critical
	The significance of this impact is **Negligible to Minor**.				

14.7.3 Operation Phase

Approach to Assessment of Impacts

The approach for the assessment of impacts used for this section is the same as that used in "*6.2.3 Construction Impacts on Biological Environment*".

Impacts to Biodiversity Values

Table 14.7 summarises the threats to biodiversity values related to the activities during operation. These threats to biodiversity are derived from IFC 6 and relate to the activities that are likely to occur during Project operation. ***Table 14.8*** provides an assessment of significance for modified habitats within the Project area.

Table 14.7 Assessment of Impacts to Habitats during Operation

Impact	Description	Comment	Sensitivity	Magnitude	Significance
Disturbance	Disturbance to, or displacement/exclusion of a species from foraging habitat due to operational and maintenance activities.	Operational activities that have potential to disturb native fauna include the use of night lighting at infrastructure and facility locations. Lighting required for operation and safety at the facilities can influence nocturnal foraging behaviours as well as disrupt sleep patterns of crepuscular species.	Low	Small	Negligible
Fauna mortality	Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during transmission line maintenance vegetation clearing activities.	Fauna mortality can occur during vegetation clearing activities in the event individuals are struck by vehicles and machinery. Vegetation clearing or lopping will be required to maintain the safe vegetation height beneath the transmission line. Animals that are unable to disperse during clearing activities are vulnerable to being injured or destroyed through interaction with machinery or falling debris. It is likely that most individuals will disperse (Sensitivity low) from clearing locations into adjacent habitats however some less mobile species may experience a localized reduction (Magnitude small) in abundance during this period, such as amphibians, reptiles and small mammals.	Low	Small	Negligible

Table 14.8 Mitigation and Management Measures, Operation Phase

Nature of Impact	Overview of Measures
Disturbance to fauna behaviour	• Vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation; • For areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible; and • Speed limits to maximum of 20 km/hr for vehicles will be enforced to minimise potential for fauna strike.
Fauna mortality	• Commitment will be made to raise awareness of values of natural habitat areas and arrangements will be made for restriction of poaching and forest product collection; • Hunting wild animals will be strictly prohibited to apply for all staff; and • Fishing and using of illegal fishing gear anywhere along the river will be prohibited.

Source: ERM, 2015.

Table 14.9 Summary of the Significance of Site Development Activities

Impact	Site Development and Construction of Power Station, Transmission and Water Pipelines.				
Impact Nature	**Negative**	Positive	Neutral		
	The impact on the terrestrial and aquatic biodiversity is negative				
Impact Type	**Direct**	**Indirect**	Induced		
	Direct terrestrial habitat loss in the Project Footprint in areas to be developed. Indirect effects on remnant/ isolated habitats. Direct aquatic habitat loss through and road and river crossings.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	The loss/ conversion of habitats will be permanent.				
Impact Extent	**Local**	Regional	International		
	The impact is expected to be local for habitats. (Further discussion of impacts on the wildlife/ fauna that may utilize the habitats are found in the following sections)				
Impact Scale	It is anticipated that the Project will cover a land area of approximately 16 ha.				
Frequency	Operation is continuous.				
Impact Magnitude	Positive	**Negligible**	**Small**	Medium	Large
	Considering the magnitude of impacts to each habitat discussed above, the overall magnitude of this impact is Negligible to Small.				
Receptor Sensitivity	**Low**	Medium	High		
	Given the small proportion of the area affected and the area is modified habitats, the overall sensitivity is considered Low.				
Impact Significance	**Negligible**	**Minor**	Moderate	Major	Critical
	The significance of this impact is **Negligible.**				

14.7.4 Residual Impacts on Biodiversity Values

There are no residual impacts to biodiversity values identified that require offsetting or compensating following mitigation.

15 SOCIAL IMPACT ASSESSMENT

This Chapter describes the predicted socio-economic impacts associated with construction and operation of the Project. It is based on the baseline data presented in ***Chapter 6*** and the impact assessment methodology detailed in ***Chapter 4***.

15.1 ASSESSMENT METHODOLOGY

15.1.1 Socio-economic Receptors

A Project's area of influence (AoI) generally includes the following:

- Direct footprint of the land that will be used, including the Project site, water supply pipeline route and 230kV overhead transmission line route;
- A physical distance around the direct footprint at a scale depending on the emissions related to a particular activity;
- A physical distance around the direct footprint at a scale depending on the indirect effects of a particular activity; and
- Associated facilities. As per the approach adopted for this ESIA, impacts from associated facilities will be assessed in the context of the Cumulative Impact Assessment (***Chapter 17***).

Impacts are described in the context of the effect that a Project or a Project's activities will have on a receptor. In this instance, the Project receptors are the villagers located within the area of influence that may be impacted or influenced by the Project (as a result of their proximity to the Project site and/ or Project associated infrastructure). This includes villagers located in:

- Sa Khar village,
- Hnan Ywa village,
- Hpet Taw village,
- Nyaung Kan village,
- Gyoke Pin village,
- Thien Ywa, and
- Tha Pyay Thar village (***Figure 15.1***).

It also includes the individuals and families living in the temporary accommodation facilities adjacent to the Project site. (The accommodation has been constructed by the nearby steel mill to house a small portion of its workforce on a temporary basis. The aim is for the workers to be moved to the steel mill's permanent accommodation by 2018.) In addition, there is a government run school located near the Project site. It services local villages, including Sa Khar village and Hnan Ywa village - the students and staff are potential receptors.

Figure 15.1 Project Site and Receptors

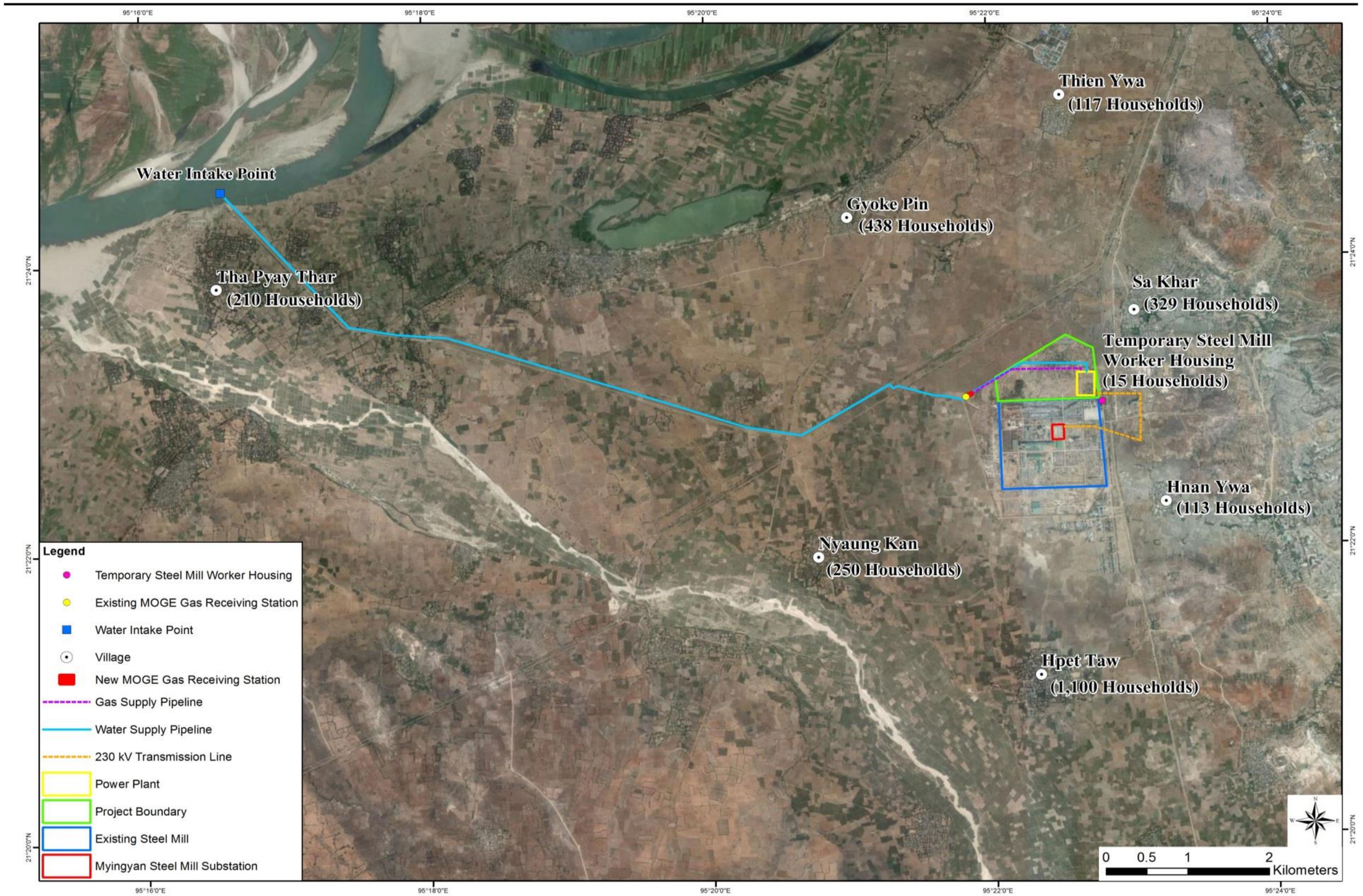


Table 15.1 summarises the socio-economic impacts that were identified during the scoping study and through engagement with relevant stakeholders. By and large, the impacts are expected to be limited to the local villages. However, there are a few activities that may impact the wider region – i.e. the Myingyan Township – such as employment opportunities and impacts associated with an increase in traffic.

Table 15.1 Impacts and Receptors

Potential Impacts	Receptors and Stakeholders
Employment and Economy	
• Increase in local employment opportunities • Increase in business development opportunities	• Local government • Local villagers • Local businesses
Community Health	
• Increase in communicable diseases, including vector borne diseases and sexually transmitted infections	• Local villagers • Project workforce (including contractors) • Local government • Local health care providers and infrastructure
Community Safety and Security	
• Increased potential for traffic accidents and incidents • Increased potential for safety issues associated with the presence of new infrastructure • Increased potential for contamination, including surface and groundwater, associated with the management and disposal of hazardous materials and waste	• Local villages • Construction workers (including contractors) • Local government • Regional villages located along the transport routes
Environmental Emissions	
• Increase in noise leading to disruptions in community activities • Increase in vibrations impacting community infrastructure • Increase in dust leading to health implications	• Local villagers • Project workforce (including contractors) • Local government
Community Infrastructure and Services	
• Increased pressure on community infrastructure and services	• Local villagers • Project workforce (including contractors) • Local government • Local infrastructure providers
Social Networks	
• Increase in disposable income increasing the use of alcohol and drugs • Introduction of new people to the area leading to conflict and changes in social structures • Change in the availability of skilled workers	• Local villagers • Project workforce (including contractors) • Local government • Local service providers
Land Acquisition and Involuntary Resettlement	
• Permanent economic and/ or physical displacement • Temporary economic and/ or physical displacement of activities	• Local villagers • Local service providers • Local government
Cultural Heritage	
• Impacts on cultural heritages within the Project area • Impacts on archaeological resources	• Local villagers • Project workforce (including contractors) • Local government

15.1.2 *Assumption and Limitations*

The Project is still in the early stages of development and hence some aspects of the Project have not yet been finalized. This includes the number of people likely to be employed during construction and operation of the Project from the local area – the numbers that have been provided are only indicative. It is understood that employment figures will continually be refined as the Project design is further developed and discussions are held with the prospective EPC Contractor regarding construction.

15.2 *ASSESSMENT OF IMPACTS*

This section describes the potential impacts and consequences of interaction between the Project activities and receptors. Where significance of the impacts is assessed as moderate to major, mitigation measures, management and monitoring are proposed. The proposed mitigation and management measures will be implemented by Sembcorp and its contractors.

Often, large scale projects result in in-migration – i.e. people moving to the project area to capitalize on employment and business development opportunities. (For example, people may move to Sa Khar to seek employment opportunities directly with the Project or within its supply chain). There are a host of impacts associated with in-migration. Rather than assessing in-migration separately, where in-migration is a contributing or driving factor for a particular impact, this is noted in the sections below.

15.2.1 *Impacts on Employment and the Economy*

Description

The Project will generate a range of employment opportunities. During construction, it is expected that approximately 660 direct employment opportunities will exist. This includes 190 skilled, 220 semi-skilled, and 250 unskilled workers. (However, estimates indicate that during peak construction number of required workers may reach 900.)

The number of people employed by the Project will decrease at the end of the construction phase. It is anticipated that approximately 80 direct employment opportunities will be created during the operation phase. An additional, 90 workers will be required every three years for a 30 day period to undertake maintenance.

In addition, the Project will require goods and services throughout its lifecycle. There are opportunities for local businesses to provide these goods and services (e.g. construction equipment, food for the accommodation camp). As a result, existing local businesses may expand or new businesses may be established locally to meet these demands – providing employment opportunities. This is referred to as indirect employment.

Potential Impact

Sembcorp has committed to capitalizing on local content opportunities, which will help to ensure that where feasible opportunities are provided to local people and businesses.

The Project will generate skilled and unskilled positions, with the number of unskilled positions dropping substantially after the construction period. Given that much of the local population is employed in the agricultural sector, this may limit the opportunity to employ local people, particularly during the operation phase given the skills required during the operation phase. It will be important to capitalize on the skills that are transferrable from the agricultural sector to the Project in order to maximize local employment.

In terms of indirect employment, the realization of opportunities will depend not only on the Project, but also on the initiative and business acumen of local entrepreneurs. Given the limited number of existing businesses, it is anticipated that the number of opportunities to create business development opportunities and/ or indirect employment will be limited.

The resulting impacts (e.g. increase in employment opportunities, increase in income for local people employed by the Project) were assessed as a positive – i.e. beneficial to the local villages. For this reason, the impact significance was not assessed (***Table 15.2*** and ***Table 15.3***).

Table 15.2 Assessment of Impacts to Employment and Economy – Construction

Impact	Impact to Employment and Economy				
Impact Nature	Negative	**Positive**	Neutral		
	An increase in employment opportunities and demand for goods and services are **positive**.				
Impact Type	**Direct**	Indirect	Induced		
	It directly impacts local villages.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact is **short-term** because it occurs during the construction phase.				
Impact Extent	Local	**Regional**	Global		
	The Project will provide employment opportunities for local villages, and possibly villages from within the surrounding areas (e.g. in-migration). Therefore, the impact is **regional**.				
Impact Scale	The impact scale is small to **medium**.				
Impact Frequency	Throughout the construction of the Project.				
Impact Magnitude	**Positive**	Negligible	Low	Medium	Large
	The impact is **positive.**				

Table 15.3 Assessment of Impacts to Employment and Economy - Operation

Impact	Impact to Employment and Economy				
Impact Nature	Negative	**Positive**	Neutral		
	An increase in employment opportunities and demand for goods and services are **positive**.				
Impact Type	**Direct**	Indirect	Induced		
	It directly impacts local villages.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact is **long-term** because it happens during operation phase.				
Impact Extent	Local	**Regional**	Global		
	The Project will provide employment opportunities for local villages, and possibly villages from within the surrounding areas (e.g. in-migration). Therefore, the impact is **regional**.				
Impact Scale	The impact scale is small to **medium**.				
Impact Frequency	Throughout the construction of the Project.				
Impact Magnitude	**Positive**	Negligible	Low	Medium	Large
	The impact is **positive.**				

Mitigation and/or Management Measures

The following measures are proposed to enhance the potential Project benefits:

- Develop and implement a local content plan. The plan should establish measures to facilitate local recruitment and procurement. This should include targets so that performance can be tracked and evaluated. Development of the plan should involve consultation with relevant stakeholders, including government authorities and local villagers;
- Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the Project. This should include a skills audit to determine what skills will be required by the Project and what skills are available within the local villagers. This will need to be undertaken as early as possible so that a training program can be developed and implemented and villagers are able to meaningfully contribute to the Project;
- Inform local villagers of job opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate;
- Inform local businesses of contracting opportunities in a timely manner. Ensure that the process is locally and culturally appropriate;
- Continue to engage stakeholders about employment and other economic opportunities in order to manage expectations about the benefits that can and will be delivered by the Project. This should form a part of the stakeholder engagement plan; and
- Develop an internal standard to guide labour practices in line with international standards, and apply this to the Project's supply chain. This should include development and implementation of an internal grievance mechanism for direct employees and contractors, and ongoing monitoring to ensure that the standard is consistently implemented across the Project.

15.2.2 Impacts on Community Health

Description

The Project will employ a range of people during construction and operation. There is potential for the workforce to introduce and/ or increase the rate of spread of

communicable diseases in the Project area. This includes the introduction of a new disease and/ or a more virulent strain of an existing disease.

However, the workforce is not the only factor that may contribute to the transmission of communicable diseases. The Project is also likely to result in in-migration. Similar to the workforce, there is potential for in-migration to introduce and/ or increase the rate of spread of communicable diseases in the Project area.

There are a number of communicable diseases prevalent in the Project area, which are contributing to the current rates of morbidity and mortality. This includes TB which has been identified as a key contributor in the local villages to rates of morbidity, and to a lesser extent mortality.

Vector Borne Diseases

Another factor that will influence the prevalence and rates of communicable diseases is the creation of vector habitat during construction and potentially operation. Standing water (i.e. vector habitat) can be created in a variety of ways, such as alterations to drainage patterns during earth moving activities and establishment of trenches (which can fill with water during rainy periods).

Vector habitat is of particular note in a location such as Myanmar – where heavy rainfall occurs during the wet season creating large areas of standing water. This could be exacerbated by the Project – e.g. if trenches are filled with water during the wet season.

There are a number of vector borne diseases likely to exist in the Project area given their prevalence within the country. Of particular note is malaria, although not identified within the local area by villagers, if workers come from outside the local area this may be an issue. Malaria is prevalent in much of the country – this includes the multi-drug resistant form of malaria.

Sexually Transmitted Infections

An increase in the commercial sex trade is often associated with large scale developments, particularly when a large (often mainly male) workforce is required for a short period of time. If appropriate precautions are not taken, this too can increase the rates of communicable diseases in the Project area.

This includes sexually transmitted infections such as HIV/ AIDS. Myanmar has one of the highest rates of HIV/ AIDS infection in Southeast Asia, which increases the risk of HIV/ AIDS being transmitted.

Other Related Issues

The transmission of diseases can be exacerbated by a number of factors. Health care facilities are limited in the Project area. At present, most villages either receive a monthly visit from a doctor or need to drive to the next closest village in order to access health care.

The facilities that do exist are largely set up to address day to day health issues. Capacity (e.g. availability of diagnostic equipment, availability of medicine) to respond to an increase in the transmission of communicable diseases is limited.

In addition, it appears that there is generally a limited awareness and understanding within the Project area villages about the routes of transmission as well as symptoms of communicable diseases. This too can increase the risk of transmission - as people are less likely to take precautions to reduce the transmission of communicable diseases and/ or seek care once infected/ ill.

Potential Impacts

An increase in the transmission of communicable diseases may occur as the result of the introduction of workers into the area, creation of vector habitat, and/ or the presence of commercial sex workers.

In terms of communicable diseases, of particular note and concern are tuberculosis, malaria, and HIV/ AIDS, given their current prevalence within the country and local area. The receptors located closest to the Project site are likely to be most affected by an increase in vector habitat – including Sa Khar, Hnan Ywa and Tha Pyay Thar villages and the steel mill workers.

If left untreated communicable diseases can lead to long-term health issues and/ or in some instances death. In other words, the impact can be characterized as being long-term and in some instances permanent.

The existing local health care facilities have limited capacity to respond to an increase in the transmission of communicable diseases, leaving the local villagers vulnerable to an increase in the presence of communicable diseases. This is exacerbated by the fact that few villagers recognize the symptoms – which is what drives someone to seek treatment.

To minimize the impact, a number of steps can be taken – most of the measures largely center around (1) reducing the interaction between the workforce and local villagers and (2) minimizing the creation of vector habitat. Sembcorp has committed to establishing a camp to accommodate its workforce during construction. This will help to reduce the interaction between workers and local villagers. In terms of vector habitat, it may be difficult to minimize habitat during the wet season.

Given the existing management measures, the local extent and scale of the impact, the impact was assessed as **moderate** and **negative**. The impact would have been assessed as minor, however, the duration (and consequence) of the impact was identified as potentially long-term – i.e. long-term health issues and in some cases death (***Table 15.4***).

The workforce will be larger during construction, when compared to the operation phase. This increases the potential for the impact to occur (i.e. as there are more potential disease carriers) during the construction phase. This would typically increase the impact rating for the construction phase; however, the existing management measures (i.e. accommodating the workforce at a camp) will help

reduce the potential of the impact occurring, for this reason the construction and operation phases were both assessed as moderate and negative.

Table 15.4 Assessment of Impacts on Community Health

Impact	Impact on Community Health				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of communicable diseases in the local area is **negative**.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct**.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact could be long lasting, even permanent, if left untreated.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	Medium	**High**		
	The vulnerability of receptor is likely to be **high.**				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **moderate.**				

Mitigation and/or Management Measures

Based on the above assessment, a community health management plan should be developed to address potential health risks to local villagers. The plan should include the following elements:

- Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project area villages – e.g. through the training of workers that have been sourced from the local villages;
- Establish amenities at the camp to help minimize the interaction between the workforce (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure;
- Establish a workforce code of conduct. Include in the code specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers;
- Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases;
- Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite;
- Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities;
- Emergency management procedures should a health issue escalate and require a rapid response; and

- Explore opportunities to invest in local health infrastructure and services. This includes potential education programs focused on disease transmission and symptoms in conjunction with relevant local stakeholders (e.g. local health care providers).

Where appropriate the community health management plan should be implemented in close coordination with government authorities and local health care providers.

In addition to the community health plan it is recommended that a complementary occupational health and safety plan be developed – to focus on managing potential issues that may affect the Project workforce. The plan should include measures to minimize the potential for the workforce to contract a communicable disease. This will help reduce the potential for the workforce to contract a communicable disease and subsequently introduce the disease in their home village/ community.

Significance of Residual Impact

Once management measures have been implemented, it is predicted that the impact will be reduced to **minor** and **negative** during construction and operation. However, on-going monitoring and evaluation of the management measures and community health situation will be needed. If monitoring indicates an increase in the transmission of communicable diseases, the management measures will need to be revised. This includes monitoring Sembcorp's direct activities as well as Project contractors and in-migration.

15.2.3 Impacts on Community Safety and Security

Description

There are a number of safety related issues that are likely to arise as a result of the Project. This includes:

- Traffic accidents. An increase in traffic can lead to an increase in congestion, leading to frustration on the part of local villagers. However, given the low level of current road use, this is unlikely to occur. Instead, the key issue is likely to be the potential for an increase in accidents or incidents, which can lead to injuries and/ or fatalities;
- The presence of new infrastructure. There are often safety issues with the establishment of new infrastructure – e.g. community members falling in unsecured trenches or interacting with unsecured equipment. This can lead to onsite accidents and injuries; and
- The management of hazardous materials and waste. There are a number of Project activities that will generate hazardous waste – e.g. chemical cleaning of equipment during the pre-commissioning process. It is particularly important that these materials are managed appropriately so as not to contaminate the surrounding water sources, as many local villagers use groundwater and surface water for drinking and/ or other household activities.

The Project will increase the number of vehicles using local roads and waterways through the transport of workers, goods, materials and machinery to and from the Project site.

Heavy cargo (e.g. gas turbine, gas turbine generator, steam turbine) will be transported via the Ayeyarwady River. A barge will carry cargo from Thilawa Port in Yangon to Nyaung Hla Jetty, from which point it will be transported along the Nyaung U-Myingyan Road to the Project site. The Nyaung Hla Jetty and the Nyaung U-Myingyan Road (at the point where it crosses the Sintelwa River) will be reinforced to accommodate the cargo. (This will not involve the acquisition of land.)

Materials (such as structure steel, piping, and electrical equipment) will be transported from Mandalay to the Project site using existing roads No. 39 and No. 18.

With an increase in vehicles, particularly heavy haulage vehicles, comes the increased potential for accidents and injuries to occur. This can be exacerbated by people living immediately adjacent to roads networks, and not being accustomed to the presence of large vehicles and heavy traffic. The limited understanding and awareness of traffic can increase the likelihood of an accident occurring – e.g. crossing the road without looking either way. This is of particular concern for Sa Khar and Tha Pyay Thar, given their proximity to the transport routes.

There is also potential, as briefly mentioned earlier, for contamination to occur as a result of a spill or leak. This could occur during routine activities onsite as well as during the transport of goods/materials to the site. This may be exacerbated by the poor quality of the existing road infrastructure – e.g. hitting a substantial pothole could jostle cargo.

At present, local villages heavily rely on ground and surface water for a variety of household uses including drinking water. Given the reliance on existing water sources, it is unlikely that the local villages would have the ability to adapt to any sort of contamination – i.e. be able to find an alternative drinking water source.

In addition, the Project will require security. Security personnel will be employed during construction and operation. It is anticipated that a total of 12 people will be required during the operation phase; the number required during construction has not yet been determined. If conflict arises, there is potential for security personal, as has been seen in other development Projects, to use excessive force.

Potential Impacts

Impacts to community safety and security can result from an increase in traffic, the establishment of onsite infrastructure and the management of hazardous materials. To a lesser extent, given the small number of security personnel required, the presence of security forces could also present a risk to the community.

There are measures in place to ensure that hazardous materials are managed and disposed of appropriately by the Project. This will help minimize the potential for local water sources to be contaminated.

In addition, the Project site will be fenced, while any activities outside the main footprint (such as the buried pipeline) will be appropriately sign posted. (A new fence will be constructed, given the existing fence has deteriorated over time.) This will help ensure that accidents associated with new infrastructure will be minimized.

Given this, the issue to which the local villagers are most vulnerable is the increase in traffic – as villagers live immediately adjacent to the existing roads and are unaccustomed to heavy vehicles traversing the area. This can lead to accidents, injuries and, in some instances, fatalities. The potential outcome of the impact is an injury and in some instances a fatality.

Due to the existing management measures, the local extent and scale of the impact, the impact was assessed as **moderate** and **negative** during construction, while **minor** and **negative** during operation (***Table 15.5*** and ***Table 15.6***). The impact would have been assessed as minor, however, the duration (and consequence) of the impact was identified as potentially long-term – i.e. the outcome of a traffic accident can have long-term implications.

The vehicle movements/ transport requirements will be greater during construction, when compared to the operation phase. This increases the potential for the impact to occur (i.e. as there are more potential disease carriers) during the construction phase and increases the impact rating.

Table 15.5 Assessment of Impacts on Community Safety and Security - Construction

Impact	Impact on Community Safety and Security				
Impact Nature	**Negative**	Positive	Neutral		
	The potential increase in safety and security risks in the local area is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impact has the potential to have a lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **medium.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **moderate.**				

Table 15.6 Assessment of Impacts on Community Safety and Security – Operation

Impact	Impact on Community Safety and Security				
Impact Nature	**Negative**	Positive	Neutral		
	The potential increase in safety and security risks in the local area is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impact has the potential to have a lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the operation phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **Small.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Mitigation and/or Management Measures

Based on the above assessment, the following management measures associated with community safety and security are suggested:

- Develop and implement a traffic management plan. The plan should set out measures to minimize the risks associated with transporting materials, goods, and workers to and from site. This includes fatigue management, busing workers to and from the Project site, and ensuring all employees observe recommended speed limits;
- The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be notified in advance of the Project commencing of traffic routes that will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities;
- Ensure all employees complete training prior to driving any Project vehicle. The content of the training should be tailored to the employee's role;
- Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic;
- Provide appropriate training for security personnel and monitor implementation of the training over time (to minimize any potential use of excessive force); and
- Develop and implement waste management plan. The plan should set out procedures for appropriately managing and disposing of hazardous materials and other forms of waste.

Residual Impacts

Assuming that the above management measures will be implemented and monitored over time, the residual impact was assessed as **minor** and **negative**. Ongoing monitoring should occur to track implementation and evaluate the management measures. This includes monitoring Sembcorp's direct activities as well as Project contractors.

15.2.4 *Impacts from Environmental Emissions*

Description

The construction and operation of the Project will generate:

- Noise, which can result from a variety of onsite activities (e.g. construction of infrastructure, reversing sensors on large vehicles). Noise can lead to hearing loss and disrupt community activities (such as sleep). Ongoing disruptions have been linked to increases in depression and anxiety;
- Vibrations, which can result from construction activities (e.g. piling, drilling, operation of compressors and generators). Vibrations if strong enough can damage the foundation of nearby infrastructure (e.g. businesses, community centers); and
- Dust, which can be generated through vegetation clearing, site grading, driving on dry, dirt roads. This can impact the surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating existing respiratory illnesses).

Potential Impacts

In terms of noise, the closest receptors are Sa Khar Village (located 980 meters from the nearest noise source) and Hnan Ywa Village (located 1,960 metres to the southeast of a noise source). It is anticipated that during construction and operation the noise generated will not exceed applicable noise criteria at either receptor location. For this reason, the impact is expected to be **negligible**. Further details are provided in ***Chapter 10***.

In terms of vibrations, given the distance to the nearest receptor, no impact is expected. Further details are provided in ***Chapter 10***.

In terms of dust, the closest receptors are the steel mill workers located at the temporary accommodation facility (10 m away), while the next closest are the Sa Khar villagers (630 m away). Dust can reduce the amenity of the area and exacerbate existing respiratory illnesses (e.g. asthma).

It is not anticipated that the receptors will experience impacts associated with the generation of dust. This is largely due to the management measures that will be put in place. The Project will establish site hoardings, sufficient set-backs, and implement other dust suppression techniques to minimize fugitive dust. (Further details are provided in ***Chapter 7***.) In addition, respiratory illnesses were not identified as an issue within the local villages. Given the short-term nature of the impacts, the impacts associated with dust are expected to be **minor** (***Table 15.7***).

Table 15.7 Assessment of Impacts from Environmental Emissions

Impact	Impact from Environmental Emissions				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of environmental emissions has the potential to result in **negative** impacts in the local area.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact is likely to be temporary (i.e. while the emissions is occurring).				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Mitigation and/or Management Measures

Management measures have been proposed in ***Chapter 7*** and ***Chapter 10***. These measures will need to be followed in order to ensure that the impact is negligible.

Sembcorp will need to develop and implement a stakeholder engagement plan as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving). This will ensure stakeholders anticipate (and can appropriately respond to) the disruption associated with noise.

15.2.5 Impacts on Community Infrastructure and Services

Description

An increase in population in the local area (due to employment opportunities and in-migration) is likely to place additional pressure on existing infrastructure and services (e.g. health care, roads). This often results in a reduction in capacity of existing infrastructure and services to meet the needs of the local villagers (as well as the additional population added by the Project); leading to longer wait times and diminished quality of services as well as reduced access to and increased wear and tear on infrastructure. For example, an increase in road traffic can speed up the wear and tear experienced by roads, requiring roads to be fixed earlier than typically required. This creates a new cost sooner than anticipated for those involved in maintaining (and repairing) road infrastructure.

Potential Impacts

The construction period is expected to last 22.5 month. During this time, it is anticipated that the workforce will peak at 900 workers.

Although effects will be made to source workers from the local area, it is anticipated that a number of workers will be brought in from outside the area. It is the workers

from outside the area (as well as the influx associated with in-migration) that contributes to the pressure that is experienced by community infrastructure and services.

However, during construction the workforce will be accommodated at a camp – which will have a range of on-site amenities. This will minimize the need for the workforce to utilize (or rely on) local infrastructure – i.e. minimizing the pressure that may be experienced by community infrastructure and services. (It is expected that at the conclusion of the construction phase, the workers brought in from outside the area will leave.)

However, traffic may still create an issue – particularly during construction when transport needs are higher (when compared to the operation phase). An increase in traffic along the Ayeyarwady River will potentially displace current users. This means that river users may need to modify their activities (i.e. during specific points in the construction phase). This is expected to be a very temporary situation – as only a handful of cargo shipments will be required during the construction phase.

An increase in traffic along key roads may increase wear and tear – including No 39, No 18 and Nyaung U-Myingyan. Given the poor quality of the existing road infrastructure, this will mean that upgrades may be required sooner than planned along the existing roads.

In terms of the operation phase, it is anticipated that approximately 80 people will be employed. It is assumed that some of these workers will come from outside the local area (however, the breakdown in terms of the number of people from outside the local area is unknown). (Accommodation arrangements have not yet been determined for the workers that will be employed from outside the area.) Given the duration of the Project, it is anticipated that the operational workforce will relocate to the Project area, bringing their families with them. These workers may place some additional pressure on the local infrastructure. However, given the small workforce, and assuming that some will be sourced from the local area, it is anticipated that this additional pressure can be accommodated.

In addition, during both the construction and operation phase, the Project may place additional pressure on existing health care infrastructure – e.g. should a worker get sick, should an incident occur on site resulting in an injury. However, there is limited capacity for the existing health care infrastructure to respond to this demand (due to the limited number of health care workers, facilities and diagnostic equipment). For this reason, if health care is required, workers will likely need to utilize facilities outside the local area. The proposed community health management plan, occupational health and safety plan and emergency response plan will help reduce any pressure that may be placed on local health care facilities.

In terms of the construction phase, the key issue is the impact that road infrastructure may experience. However, this impact is expected to be local in terms of the extent and scale and occur over a short period of time. In addition, the Project is expecting to upgrade a number of existing roads, which will help address the impact. For these reasons, the impact was assessed as **minor** and **negative** (***Table 15.8***).

In terms of the operation phase, there is potential to impact more widely on community infrastructure (e.g. schools, community centers). This assumes that workers will be brought in from outside the local area and bring with them their families. This may occur, but is expected to result in only a handful of families moving into the area. As a result, the extent and scale of the impact is likely to be local and the overall impact is likely to be small. For these reasons, the impact was assessed as **minor** and **negative** (***Table 15.9***).

The above impacts may be greater depending on the degree of in-migration that occurs. This will need to be monitored closely – and the impact revisited should this become an issue.

Table 15.8 Assessment of Impacts on Community Infrastructure and Services - Construction

Impact	Impact on Community Infrastructure and Services				
Impact Nature	**Negative**	Positive	Neutral		
	An increase in population may put additional pressure on community infrastructure and services – which is a **negative** impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community infrastructure and services.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact is likely to be temporary.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the local villages.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Table 15.9 Assessment of Impacts on Community Infrastructure and Services - Operation

Impact	Impact on Community Infrastructure and Services				
Impact Nature	**Negative**	Positive	Neutral		
	An increase in population may put additional pressure on community infrastructure and services – which is a **negative** impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community infrastructure and services.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impact is likely to be short-term.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the local villages.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the operation phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Mitigation and/or Management Measures

Based on the above assessment, the following management measures are suggested:

- Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services;
- Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be notified in advance of the Project commencing of traffic routes that will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities;
- Develop and implement a social investment/ corporate social responsibility plan/ program in consultation with local stakeholders. As part of the plan, Sembcorp should explore opportunities to enhance community infrastructure and services; and
- Develop and implement a community health management plan and an occupational health and safety plan in consultation with relevant stakeholders (e.g. local health practitioners). These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.

Residual Impacts

Assuming that the above management measures will be implemented and monitored over time, the residual impact was assessed as **negligible** and **negative**. Ongoing monitoring should occur to track implementation and evaluate the management measures. This includes monitoring Sembcorp's direct activities as well as Project contractors.

15.2.6 Impacts on Social Networks

Description

Although employment opportunities bring positive economic benefits, they also can result in social issues. These are largely associated with the following:

- The movement of skilled workers. Often large scale projects, offer better pay and benefits (when compared to local jobs). The result is a movement of workers from their existing positions to the employment opportunities offered by the Project. This can reduce the local skills pool;
- An increase in disposable income within the local villages. Although this can have positive benefits such as improvement in nutrition and education (e.g. as education outside the community becomes affordable). It often results in negative impacts, such as an increase in the use of drugs and alcohol, an increase in the price of commodities and food, and an increase in high fatty and sugary foods. (These types of foods can be introduced to an area to cater for the workforce.) The induced impacts are an increase in non-communicable diseases (e.g. due to drug and alcohol consumption);
- The introduction of new people in an area. This can lead to conflict within local communities. This stems from a variety of issues including differences in ethnicity and/ or religious values as well as jealousy that 'outsiders' have

successfully secured positions within the Project. Such situations are likely to create tension and conflict between local men and the workers in question; and

- The introduction of new people can also change the social structures and networks, including the leadership structures.

Potential Impacts

Although employment is a positive economic benefit, it can also result in a number of potential negative social impacts. This includes a reduction in the local skills pool, an increase in disposable income, and changes in social interactions.

The potential impacts during construction will be minimized as the workforce will largely reside within the workforce accommodation camp – reducing the interaction between the workforce and local villagers and the potential for community conflict.

Although the impact will be reduced, some impact will still occur, as a portion of the construction workforce will be sourced from local villages. This will increase disposable income and may result in a shift in skilled workers from existing industries.

It is anticipated that this impact will be **minor** and **negative**. This is largely because the extent, scale and duration of the impact will be small (i.e. localized impact over a short period of time) during construction. The impact is minor instead of negligible given the vulnerability of the local villagers.

In terms of operation, although the operation phase occurs over a longer period of time, the extent and scale of the impact is still expected to be small. This is largely due to the relatively small size of the workforce. In addition, Sembcorp's commitment to employing locally will help reduce the introduction of new people into the local area.

The above impacts may be greater depending on the degree that in-migration occurs. This will need to be monitored closely – and the impact revisited should this become an issue.

Table 15.10 Assessment of Impacts on Social Networks – Construction

Impact	Impact on Social Networks				
Impact Nature	**Negative**	Positive	Neutral		
	The Project has the potential to impact on social networks, which is a **negative** impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impact is likely to be short-term.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium** given the potential consequences.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Table 15.11 Assessment of Impacts on Social Networks – Operation

Impact	Impact on Social Networks				
Impact Nature	**Negative**	Positive	Neutral		
	The Project has the potential to impact on social networks, which is a **negative** impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impact has the potential to have a lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the operation phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium** given the potential consequences.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Mitigation and/or Management Measures

Based on the above assessment, the following management measures are suggested:

- Develop and implement a workforce code of conduct that addresses issues such as anti-social behavior and drug and alcohol consumption;
- Provide an introduction for workers moving into the area (even temporarily) – so that workers understand local culture and customs; and
- Develop and implement a local content plan. A key aspect should be providing local employment opportunities (to reduce the number of workers being brought into the local area from outside).

Residual Impacts

Assuming that the above management measures will be implemented and monitored over time, the residual impact was assessed as **minor** and **negative**. Ongoing monitoring should occur to track implementation and evaluate the management measures. This includes monitoring Sembcorp's direct activities as well as Project contractors.

15.2.7 Impacts from Land Acquisition and Involuntary Resettlement

Description

The construction of new infrastructure often requires the acquisition of land and can lead to (physical and/ or economic) displacement and/ or disruption of communities. Displacement can be permanent, in which land is procured by the Project and existing uses can no longer occur, or temporary, in which existing land uses can resume once the Project activity causing the displacement has finished.

Physical and/ or economic displacement of community activities or infrastructure is likely to occur as a result of the Project due to the following activities:

- Installation of the water supply pipeline;
- Installation and operation of the 230kV overhead transmission line; and
- Development of the infrastructure at the Project site.

Water supply pipeline

The Project will require the installation of a water supply pipeline. The pipeline will run alongside an existing irrigation channel between the Project site and the Ayeyarwady River. It will be located within an existing 15m right of way, which is owned by the Ministry of Irrigation and Agriculture. Construction is expected to take approximately 11 months.

Although the land is owned by the Ministry of Agriculture, it is currently used by local villagers. Much of the pipeline route is used for seasonal crop production – it typically forms a part of a larger plot of land under cultivation. In addition, an initial survey of the pipeline route indicates that there are approximately 8 to 10 squatters that have established infrastructure within the right of way. This includes approximately 3 shops and 5 houses.

Agriculture is the primary employer/ source of income in local villages, with most villagers involved in the cultivation of crops and a smaller number involved in rearing livestock for sale.

230kV Overhead Transmission line

A 230kV overhead transmission line will be constructed at the Project site. The line, which will be approximately 2.5 km in length, will extend from the generator at the power plant to a sub-station located within the steel mill complex. Connection beyond the sub-station is the responsibly of the GOM. Construction is expected to take approximately 7 months.

Although a transmission line will be established, the route has not yet been determined. An initial land use survey is underway and will help to identify existing land uses and potential constraints.

Project site

Land for the Project site was acquired a number of years ago. At the time it had not yet been determined that the Project would be constructed at the site, nor was Sembcorp identified as the potential operator. Compensation was provided to the land owners that were involved in the acquisition process.

At present a small number of villagers, mostly from Sa Khar, by-pass the security fence, which extends around the perimeter of the Project site, to collect firewood. Firewood is the primary source of fuel for cooking in local villages and is largely sourced from surrounding farmland or is purchased from the local village leader. Establishment of the power plant, and supporting infrastructure, will prevent villagers from accessing the site in the future. (Based on recent interviews with local stakeholders, the site is used for firewood collection and no other purposes.)

Potential Impacts

Based on the existing Project activities the following impacts may arise:

- Loss of land (or access to land). Although the land along the water supply pipeline is owned by the Ministry of Irrigation and Agriculture, it is currently used by local villagers for growing crops. Current users will lose access to this land during installation of the pipeline. However, the pipeline will be buried – it is assumed that existing land uses to continue after the pipeline has been installed. The pipeline is expected to take up to 11 months to construct, which means that land users will potentially lose a full year of crops, if not longer depending on how quickly crops can be reestablished post-construction. Most local villagers are reliant on the agricultural sector for income – and there are limited alternative employment options.
- Loss of crops. In addition to losing access to land for income generation, local villagers may lose their crops – i.e. the crops currently being grown. Much of the land that will be used by the water pipeline is subject to seasonal crops. These crops will be removed during construction, which will mean a loss of income:
- Loss of housing and business infrastructure. There are approximately 5 houses and 3 shops located along the water supply pipeline route that have been constructed by squatters. This infrastructure may need to be relocated as a result of the pipeline and/ or be disrupted (e.g. lack of access to shops) during construction. ; and
- Loss of community resources. The Project site is currently used by a handful of villagers from Sa Khar for firewood collection. This activity will no longer be able to occur as the Project site will be fenced, and for safety purposes access will no longer be allowed. However, nearby areas, such as those contained within the steel mill complex will still be accessible to the local communities.

Those using land along the water supply pipeline will be impacted by the Project. However, it is anticipated that the impact will be temporary. Although the impact will be limited to the squatters located along the route, these land users are dependent on land for income (i.e. either agriculture or shops). Given this vulnerability, it is anticipated that the impact will be **moderate** and **negative** for this undertaking agricultural activities; however, the impact on those that will be resettled is expected to be **high** and **negative** (***Table 15.12***).

In addition, villagers will no longer be able to access the Project site to collect firewood. It is anticipated that, given the small number of people currently accessing the site, there are viable alternative sites for the collection of firewood. It is anticipated that the impact will be **minor** and **negative**.

Once the 230kV overhead transmission route has been finalized, the potential impacts arising from its installation (e.g. displacement of existing land uses) will need to be reviewed.

Table 15.12 Assessment of Impacts on from Land Acquisition and Involuntary Resettlement

Impact	Impact from Land Acquisition and Involuntary Resettlement				
Impact Nature	**Negative**	Positive	Neutral		
	An increase in physical and economic displacement in the local area is a **negative** impact.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct**. Villagers may be physically and/ or economically displaced – meaning that they may be required to move and/ or lose income as a result of the Project.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impact has the potential to be short-term for those involved in agriculture; however, the impact may be long-lasting for the five households that may need to be resettled.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **small.**				
Vulnerability of Receptors	Low	Medium	**High**		
	The vulnerability of receptor is likely to be **high**.				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **moderate.**				

Mitigation and/or Management Measures

In instances where displacement occurs, research has shown that resettlement frequently results in the impoverishment of those affected; however, impoverishment is not an inevitable consequence. With appropriate management, livelihoods can be restored post-relocation, and the process can contribute to the long-term development of the community or individuals relocated.

As MEPE is leading the land acquisition process for the water pipeline and transmission line, however, the acquisition process has not yet started. Discussions

are still underway as to the routes that will be taken. For the water pipeline the routing process has involved an initial land use survey – to identify what land uses currently exist. By understanding local land uses, the route can be modified to minimize the impacts experienced by local villagers. A similar process will be followed for the transmission line.

Prior to commencement of the land acquisition process, Sembcorp will work with MEPE to identify (and if required fill) any gaps between the process that the MEPE is undertaking and the requirements set-out in the IFC performance standards and the ADB safeguards.

Sembcorp is committed to minimizing the impacts associated with land acquisition/ land use required as part of the Project. In instances where impacts cannot be avoided, compensation (cash or in-kind) will be provided.

The following steps are suggested in order to minimize the likely impacts associated with the Project:

- Work with MEPE during the river water supply pipeline and 230kV overhead transmission line right of way land acquisition process, so that the process and outcome is consistent with IFC and ADB requirements;
- Establish plans based on a resettlement framework; and
- Consultation with stakeholders that may be impacted by the Project, to ensure that stakeholders are clear about the potential impacts and proposed mitigation measures.

Residual Impacts

Assuming that the above management measures will be implemented it is anticipated that the impacts will be temporary, and mitigated through compensation (cash or in-kind). For these reasons, the residual impact is expected to be **moderate** and **negative**.

15.2.8 Impacts on Cultural Heritage

No known archaeological resources; three items of ancient above ground resources (i.e. HT1, SK1 and SK3) and 16 items of living heritage sites were identified within the cultural heritage study area. None of them were located within the Project's footprint. Therefore, no direct impact during the construction and operation phases is anticipated.

Indirect impact on the tangible cultural heritage resources identified is minimal due to the large separation distance between the Project's footprint and the items. TPT1 and TPT3 are the only two items with distance to the proposed water intake pipeline less than 100m. However, as they were surrounded by soft ground (i.e. agricultural land), potential adverse impact (e.g. vibration and settlement) during both construction and operational phases is also considered minimal.

No significant intangible cultural heritage was identified and no adverse impact is anticipated through interview with villagers and stakeholder's meeting. However, as most of the festivals and ceremonies take place at the pagoda complex and monasteries, traffic impact may be an issue on the track along the proposed water

intake pipeline where TPT1 and TPT3 located nearby. Transport will increase during construction phase for transferring cargos from Ayeyarwady River to plant site, which may potentially influence the accessibility to TPT1 and TPT3 during festivals or ceremonies period. However, the impact is expected to be temporary and avoidable by better logistic arrangement planning, as only a handful of cargo shipments will be required during the construction phase. No adverse impact on intangible cultural heritage is anticipated during operational phase.

15.3 SUMMARY

The impact assessment identified a number of positive and negative impacts that are likely to occur during construction and operation of the Project. Significance of these impacts before and after management is summarized in ***Table 15.13***.

Table 15.13 Summary of Impact Significance Before and After Mitigation

Sections	Impacts	C/ O	Significance of Impacts		
			Impact Direction	Before Mitigation*	With Mitigation**
15.2.1	Employment and economy	C/ O	Positive		
15.2.2	Community health	C/ O	Negative	Moderate	Minor
15.2.3	Community safety and security	C	Negative	Moderate	Minor
		O	Negative	Minor	Minor
15.2.4	Environmental emissions	C/ O	Negative	Negligible	Negligible
15.2.5	Community Infrastructure and services	C/ O		Minor	Minor
15.2.6	Social networks	C/ O	Negative	Minor	Minor
15.2.7	Land acquisition and involuntary resettlement	C/O	Negative	Moderate to High	Moderate
15.2.8	Cultural heritage	C/O	Negative	Negligible	Negligible

Note: C = Construction phase, O= Operation phase
(*) with in-place/existing controls but without mitigation measures/management suggested from ERM.
(**) with mitigation measures/management suggested from ERM.

16 STAKEHOLDER ENGAGEMENT

This Chapter describes the stakeholder engagement activities undertaken during development of the ESIA. This includes key issues raised by stakeholders and how each of these issues has been addressed in the ESIA.

16.1 INTRODUCTION

The Project team is committed to undertaking a process that delivers an inclusive and continuous dialogue with the Project stakeholders. This includes:

- Providing relevant information to stakeholders in a timely manner;
- Facilitating two-way discussions to cover stakeholder issues and priorities as well as concerns and needs of the Project;
- Ensuring engagement is in a language and format that is understandable and accessible to local stakeholders, including vulnerable groups, and is culturally appropriate;
- Feeding stakeholder issues, concerns and priorities into Project decision-making processes, and demonstrating how decisions may have changed as a result; and
- Providing a mechanism for grievances to be raised and resolved.

16.2 STAKEHOLDER IDENTIFICATION

The first step in establishing a dialogue is identifying the Project stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project, and those who may have interests in and/ or the ability to influence a project's outcomes (either positively or negatively).

A stakeholder mapping exercise was undertaken to identify the Project stakeholders as well as issues likely to be of concern to the stakeholders. A key part of this process was identifying individuals and groups who may find it difficult to participate as well as those who may be differentially or disproportionately affected by the Project because of their marginalised or vulnerable status.

The mapping exercise included the following steps:

- Step 1: Development of a draft list of stakeholders. The initial list was developed based on a desktop review of maps detailing the Project site and surrounding land uses/ activities, data gathered during early site visits, and the scoping reporting that was prepared for the Project; and
- Step 2: An internal workshop to confirm and prioritize the draft list of stakeholders and identify likely issues of concern. This included key issues such as impacts associated with air and noise emissions. Stakeholders were prioritized based on their level of interest in the Project and power or ability to influence the Project. The workshop was conducted with key members of the ESIA Project team.

By identifying the Project stakeholders early, the ESIA team was able to tailor the engagement approach to meet the needs and expectations of the stakeholders – e.g. address the issues of most concern to stakeholders during meetings.

A range of stakeholders were identified that may be impacted by the Project or have an interest in or ability to influence the outcome of the Project. ***Table 16.1*** provides the list of Project stakeholders that were identified during the mapping exercise. This includes villages located in close proximity to the Project site and/ or its associated facilities.

Table 16.1 List of Project Stakeholders

Stakeholder group	Stakeholder*
Union government	Ministry of Electric Power Ministry of Electric Power Enterprise
Region government (Mandalay)	Ministry of Electricity and Industry
Township government (Myingyan and Taung Thar)	General Administration Department (GAD) Department of Livestock, Fisheries and Rural Development Department of Irrigation and Agriculture Department of Electric Power Department of Industry and Trade Department of Social Welfare, Relief and Resettlements Department of Labor Water Utilization Department Municipal Department Tax and Revenue Department Development Committee
Villages and potentially affected persons	Village Tract Leaders Local villagers - Sa Khar, Hnan Ywa, Hpet Taw, Nyaung Kan, Gyoke Pin, Thien Ywa, and Tha Pyay Thar Farmers within local villages Fishermen within local villagers Women's group representatives within local villages Youth representatives within local villages Healthcare workers within local villages and regional health care facilities Community based organisations General manager at the steel mill Steel mill workers Vulnerable groups (e.g. landless, poor) within the local villages

*Note: The stakeholder mapping exercise did not identify any Indigenous peoples or non-governmental organisations in the Project area. This was confirmed during a site visit.

16.3 SUMMARY OF STAKEHOLDER ENGAGEMENT ACTIVITIES

Project stakeholders have been engaged at a number of points during development of the ESIA. The focus of the engagement activities has been to:

- Introduce the Project and provide ongoing updates as the design of the Project is further refined;
- Provide an overview of the likely impacts and proposed management measures and corresponding monitoring activities;
- Gather stakeholder insights and input, including feedback on the identified impacts, proposed management measures and monitoring activities; and
- Respond to key issues raised by stakeholders.

Table 16.2 provides an overview the stakeholder engagement activities that have been undertaken as part of the ESIA, including face-to-face meetings with representatives from the Township GADs, public meetings in each of the nearby villages, and focus group discussions with the steel mill workers (located in the temporary accommodation adjacent to the Project site) in July, August and September.

Table 16.2 Summary of Engagement Activities

Method of engagement	Purpose	Stakeholders	Date
Face-to-face meeting	• Disclose Project information • Gather stakeholder feedback	Myingyan GAD	15 July 2015
		Taung Thar GAD	16 July 2015
	• Provide a Project update • Respond to key issues raised in July • Present the outcomes of the impact assessment process, including management measures and proposed monitoring • Gather stakeholders feedback	Myingyan GAD	2 September 2015
		Taung Thar GAD	3 September 2015
	• Disclose Project information • Gather stakeholder feedback	Ministry of Electricity and Industry	14 July 2015
	• Disclose Project information • Gather stakeholder feedback	Ministry of Electric Power	15 July 2015
	• Disclose Project information • Gather stakeholder feedback	Myingyan Township Development Committee	20 August 2015
	• Disclose Project information • Gather stakeholder feedback	Myingyan Township Water Utilisation Department	27 August 2015
	• Disclose Project information • Gather stakeholder feedback	Myingyan Township Municipal Department	28 August 2015
Public meeting	• Disclose Project information • Gather stakeholder feedback	Sa Khar villagers	18 July 2015
		Hnan Ywa villagers	16 July 2015
		Hpet Taw villagers	17 July 2015
		Nyaung Kan villagers	17 July 2015

Method of engagement	Purpose	Stakeholders	Date
		Gyoke Pin villagers	19 July 2015
		Thien Ywa villagers	18 July 2015
		Tha Pyay Thar villagers	19 July 2015
	• Respond to key issues raised in July • Present the outcomes of the impact assessment process, including management measures and proposed monitoring • Gather stakeholder feedback	Sa Khar villagers	19 August 2015
		Hnan Ywa villagers	19 August 2015
		Hpet Taw villagers	19 August 2015
		Nyaung Kan villagers	19 August 2015
		Gyoke Pin villagers	18 August 2015
		Thien Ywa villagers	18 August 2015
		Tha Pyay Thar villagers	18 August 2015
	• Provide an update on key issues raised in July and August • Present the outcomes of the impact assessment process, including management measures • Gather stakeholder feedback	Sa Khar villagers	4 September 2015
		Hnan Ywa villagers	4 September 2015
		Hpet Taw villagers	3 September 2015
		Nyaung Kan villagers	5 September 2015
		Gyoke Pin villagers	5 September 2015
		Thien Ywa villagers	5 September 2015
		Tha Pyay Thar villagers	2 September 2015
Focus group meeting	• Disclose Project information • Present the outcomes of the impact assessment process, including management measures and proposed monitoring • Gather stakeholder feedback	Steel mill workers (located in temporary accommodation), including General Manager	19 August 2015
	• Provide an update on key issues raised in July and August • Present the outcomes of the impact assessment process, including management measures • Gather stakeholder feedback	Steel mill workers (located in temporary accommodation)	4 September 2015

In addition to the activities described in ***Table 16.2*** key informant interviews, focus group discussions and household surveys were undertaken to collect primary data for the social baseline (***Chapter 6***). As part of the data collection process, stakeholders were asked about their views and concerns relating to the Project. This information has been analysed and fed into development of the ESIA.

16.3.1 *Engagement materials*

To help guide the engagement process, and ensure a consistent message was being delivered, presentations were prepared in advance of each engagement. The presentations were initially prepared in English and then translated to Myanmar for the local audience. Copies of the presentations can be found in ***Annex F***. Photos from the engagement meetings can be found in ***Annex G***.

In preparing for the engagement activities, consideration was given to the following:

- Local community sensitivities and structures to ensure that the engagement approach aligns with cultural norms;
- Community representation. When inviting village members to meetings, consideration was given to the cross section of members that might attend to ensure that women and vulnerable groups were represented. The participation of women and vulnerable community members has been encouraged, for example by organising focus group discussions;
- Potential language barriers. Engagement activities were conducted in Myanmar (i.e. the local language); and
- Literacy rates. Literacy rates vary by village, as a result, where possible consultation was conducted using face-to-face communication.

16.4 SUMMARY OF KEY STAKEHOLDER FEEDBACK

Stakeholders were encouraged to ask questions and raise concerns throughout the engagement process. For those stakeholders not comfortable speaking up or who identified concerns after the stakeholder meetings, alternative methods for raising issues were provided. This included:

- A suggestion box. Villagers were able to write down their concerns and anonymously drop them into the box. One box was left in each village; in addition, boxes were left at the Myingyan GAD and Taung Thar GAD offices. The boxes were distributed in July and collected in August – allowing over a month for stakeholders to provide feedback. Over 100 comments were received through this method. To the extent possible, these comments were addressed at the September stakeholder engagement meeting. Copies of the comments are contained in ***Annex H***;
- A questionnaire. Following the meetings in September, a questionnaire was distributed to attendees. The purpose was to elicit feedback, specifically on the predicted impacts, proposed management measures, and preferences regarding future engagement. A copy of the questionnaire and the results are contained in ***Annex I***; and
- A local contact. The details of a local point of contact were provided to stakeholders. To the extent possible, concerns raised with the local point of contact were addressed during the September stakeholder engagement meeting.

A range of issues and concerns have been raised by stakeholders, which are summarised in ***Table 16.3***.

Table 16.3 Summary of Stakeholder Feedback

Date	Issues Raised	Stakeholders	Response Provided	Chapter
July 2015	Air emissions: There is concern that the power plant will generate air emissions during operation, which may have health implications.	Hpet Taw village	The power plant will generate air emissions during operation in line with World Health Organisation standards.	7.9, 15.2
	Water: There is concern that potential impacts may arise from the discharge of wastewater.	Taung Thar GAD	Wastewater will be collected and treated on site in line with international standards. Drainage systems will be maintained and run-off will be minimized.	9.7
	Water: There is concern that use of river water will reduce the amount of water available for use by local villagers.	Nyaung Kan village Hpet Taw village	A water intake point will be established on the Ayeyardwady River. Treated wastewater will be discharged to the irrigation channel.	9.7
	Water: There is concern that groundwater, which is used by villagers for drinking, will be negatively be impacted – e.g. as a result of potential leaks or spills and improper handling of effluent and waste.	Hnan Ywa village Nyaung Kan village	Waste will be properly disposed. Chemicals and fuels will be properly stored and handled. A site specific emergency response plan will be developed and implemented.	12.8, 15.2
	Employment: The Project will generate employment and economic opportunities. Stakeholders were interested in access to these opportunities.	Myiangyan GAD Hnan Ywa village Nyaung Kan village Sa Khar village Gyoke Pin village Tha Pyay Thar village	There will be some job opportunities available and but this will depend on the skills required by the Project and skill available in the local villages. In addition, a corporate social responsibility plan will be developed.	15.2
	Social networks: There is concern that there may be a change in social networks as a result of the Project.	Hpet Taw village Sa Khar village	A social management plan will be developed. This will include a grievance mechanism – so that local villagers can raise concerns throughout the construction and operation of the Project.	15.2
	Health: An increase in population may contribute to an increase in communicable disease transmission.	Hnan Ywa village	The workforce camp will minimize the interaction between the workforce and the villages – reducing the potential for diseases to be passed on to villagers. A workforce code of conduct will be established, and pre-employment screening will be undertaken.	15.2
	Noise: There is concern that noise will be generated during construction and operation due to the gas and steam turbines, steam generators and the cooling tower.	Sa Khar village	During construction, noise generated from piling is limited (i.e. less than 3 months). Construction will only be carried out during day time hours. During operation, the noise levels not exceed 70 dba at the plant boundary, which is in line with the World Bank Group regulations.	10.10
	Vibrations: There is concern that vibrations will be generated during construction and operation through the use of machinery at the Project site.	Sa Khar village	Given the distance between the site and nearest village, no impact from vibrations is anticipated.	10.11

Date	Issues Raised	Stakeholders	Response Provided	Chapter
	Safety: There is concern that the Project will include the potential for accidents. Particular reference was made to gas explosions.	Hpet Taw Village	A site specific emergency response plan will be developed and implemented.	15.2
	Heat: There is concern that the Project will generate heat – resulting in impacts to nearby crops.	Sa Khar village	Given the distance between the site and nearest village, no impact from heat is anticipated. The stack is 40 m high, which means that any heat in the flue gas will be dispersed into the atmosphere and will not be felt at the ground.	7.9, 17.5
	Access to electricity: Villagers would like access to electricity generated by the Project.	Myiangyan GAD Nyaung Kan village Tha Pyay Thar village	The Project will produce and sell electricity to MEPE; and MEPE in turn will be responsible for distribution of electricity.	15.2
	Traffic: There is concern that an increase in traffic movements and the management of hazardous materials present safety risks.	Hnan Ywa Village	A traffic management plan will be implemented. It will include requirements to bus workers between the camp and the site.	15.2
August 2015	Employment: The Project will generate employment and economic opportunities. Stakeholders were interested in access to these opportunities.	Tha Pyay Tha village Gyoke Pin village Hpet Taw village Hnan Ywar village	There will be some job opportunities available but it will depend on the skills required by the Project and skills available in the local villages.	15.2
	Access to electricity: Villagers would like access to electricity generated by the Project.	Nyaung kan village	The Project will produce and sell electricity to MEPE; and MEPE in turn will be responsible for distribution of electricity.	15.2
	Heat: There is concern that the Project will generate heat – resulting in impacts to nearby crops.	Sa Khar village	Given the distance between the site and nearest village, no impact from heat is anticipated. The stack is 40 m high, which means that any heat in the flue gas will be dispersed into the atmosphere and will not be felt at the ground.	17.5
	Water: There is concern about the impacts that may arise from the discharge of wastewater.	Sa Khar village	Wastewater will be generated from the plant. All treated wastewater will be discharged to the irrigation canal.	9.7, 12.8
	Air emissions: There is concern that the power plant will generate air emissions during operation, which may have health implications.	Hpet Taw village Sa Khar village	The power plant will generate air emissions during operation in line World Health Organisation standards.	7.9
	Noise: There is concern that noise will be generated during construction and operation due to the gas and steam turbines, steam generators and the cooling tower.	Hpet Taw village Sa Khar village	During construction, noise generated from piling is limited (i.e. less than 3 months). Construction will only be carried out during day time hours. During operation, the noise levels not exceed 70 dba, which is in line with the World Bank Group regulations.	10.10
	Management: There were inquiries about management of impacts – e.g. who is responsible for handling negative impacts?	Hpet Taw village	A grievance mechanism will be available to all stakeholders. If you have an issue or concern, there will be an opportunity to raise it with Sembcorp through the grievance mechanism.	18.5

Date	Issues Raised	Stakeholders	Response Provided	Chapter
	Corporate social responsibility: There is interest in knowing more about Sembcorp's corporate social responsibility plan.	Nyaung kan village Hpet Taw village	Key areas of focus will likely be education/ skills development, healthcare and water – however, the details of the corporate social responsibility plan are still being determined.	15.2
	Displacement/ resettlement: Villagers would like to better understand how the installation of the water supply pipeline may affect their farmland.	Nyaung kan village	The water supply pipeline will extend for 14 km – from the Ayeyarwady River to the Project site. The routing is designated by Ministry of Agriculture/MEPE. The pipeline will be buried to minimise the impact.	15.2
	Safety: There is concern that the Project will include the potential for accidents. Particular reference was made to gas explosions.	Sa Khar village	A site specific emergency response plan will be developed and implemented. A health, safety and environment management system will be in place.	15.2
September 2015	Employment: The Project will generate employment and economic opportunities. Stakeholders were interested in access to these opportunities.	Myingyan GAD Taung Thar GAD	There will be some job opportunities available but it will depend on the skills required by the Project and skill set of the local villagers. Contractors will be appointed during construction and the skill set of the local community will be assessed post-ESIA to determine job opportunities.	15.2
	Access to electricity: Villagers would like access to electricity generated by the Project.	Taung Thar GAD	The Project (Sembcorp) will produce and sell electricity to MEPE; and MEPE in turn will be responsible for distribution of electricity. In accordance with Sembcorp's contract with MEPE, Sembcorp is not able to influence where the electricity is distributed.	15.2
	Heat: There is concern that the Project will generate heat – resulting in impacts to nearby crops.	Myingyan GAD Taung Thar GAD Tha Pyay Tha village Hpet Taw village Sa Khar village	Given the distance between the site and nearest village, no impact from heat is anticipated. The stack is 40 m high, which means that any heat in the flue gas will be dispersed into the atmosphere and will not be felt at the ground. In addition, machinery that generates heat is enclosed and therefore additional heat should not be felt outside the boundary of the Project.	7.9, 17.5
	Water: There is concern about the impacts that may arise from the discharge of wastewater.	Myingyan GAD Taung Thar GAD	Wastewater will be generated from the power plant. The current plan is to discharge treated wastewater to the irrigation canal. Wastewater will be treated at an onsite wastewater treatment plant. It is currently proposed that the wastewater be treated to the Food and Agriculture Organisation standards. The Project has been unable to find local standards for wastewater discharge to irrigation canals.	9.7, 12.8

Date	Issues Raised	Stakeholders	Response Provided	Chapter
	Air emissions: There is concern that the power plant will generate air emissions during operation, which may have health implications.	Myingyan GAD Hpet Taw village	The power plant will generate air emissions during operation; the emissions will align with World Health Organisation standards. Based on recent air quality monitoring nitrogen dioxide is an issue - as background levels already exceed the World Health Organisation standards in the Project area. Through the design of the stacks and the technology being employed the additional nitrogen dioxide generated by the power plant (and emitted to the atmosphere) is considered acceptable according to international standards. In addition, gas is one of the cleanest forms of fossil fuels; although greenhouse gases will be generated – by comparison to other fossil fuels (e.g. coal) the emissions are not as significant. A continuous emissions monitoring system will be installed at the plant, which will continually monitor stack emissions to ensure they are in accordance with International Finance Corporation / World Bank Guidelines.	7.9
	Air emissions: Construction activities, including transportation, may generate dust. This may occur at the Project site as well as along access roads.	Taung Thar GAD	A variety of techniques will be used to minimize dust during construction, including spraying of exposed areas (such as roads) and covering dusty materials and equipment.	7.9
	Noise: There is concern that noise will be generated during construction and operation due to the gas and steam turbines, steam generators and the cooling tower.	Myingyan GAD Hnan Ywar village Sa Khar village	During construction, noise generated from piling is limited (i.e. less than 3 months). The majority of construction activities will be carried out during day time hours to avoid noise impacts. During operation, the noise levels will not exceed the International Finance Corporation / World Bank Guidelines. The guideline is 55 dB(A) during daytime and 45 dB(A) at night. It should be noted that at some locations that background levels already exceed these guidelines. Therefore, in accordance with the guidelines the noise levels from the power plant should not increase current background levels greater than 3 dB(A) at these locations.	9.7
	Management: There were inquiries about management of impacts – e.g. who is responsible for handling negative impacts?	Hpet Taw village	A grievance mechanism will be available to all stakeholders. If you have an issue or concern, there will be an opportunity to raise it with Sembcorp through the grievance mechanism. The grievance mechanism will be explained during future consultation (i.e. post-ESIA). In the meantime a local community liaison officer (Mr U Aung Lwin Oo) is available to handle any concerns or queries associated with the Project.	18.5
	Corporate social responsibility: There is interest in knowing more about Sembcorp's corporate social responsibility plan.	Hpet Taw village	Sembcorp will develop a corporate social responsibility plan. Key areas of focus will likely be education/ skills development, healthcare and water – however, the details of the corporate social responsibility plan are still being determined and will be explained during future consultation (i.e. post-ESIA).	15.2

Date	Issues Raised	Stakeholders	Response Provided	Chapter
	Displacement/ resettlement: Villagers would like to better understand how the installation of the water supply pipeline may affect their farmland.	Taung Thar GAD Tha Pyay Tha village	The water supply pipeline will extend for 12 km – from the Ayeyarwady River to the Project site. The routing is designated by Ministry of Irrigation and Agriculture and MEPE. The pipeline will be buried to minimise any impacts.	15.2
	Vibrations: There is concern that vibrations will be generated during construction and operation through the use of machinery at the Project site.	Myingyan GAD	Given the distance between the site and nearest village, no impact from vibrations is anticipated. In addition, the piling depth of the power plant takes the load which will prevent significant vibrations.	10.11
	Soil: Impacts may arise as a result of potential leaks or spills of oil.	Hpet Taw village	Chemicals and fuels will be properly stored and handled in bunded (enclosed) areas to avoid potential leakages to soils. Soil investigations be undertaken following plot finalisation to determine soil suitability for pile driving.	12.8
	Safety: There is concern that the Project will include the potential for accidents. Particular reference was made to gas explosions.	Steel mill workers	A site specific Emergency Response Plan will be developed and implemented. In addition, a Traffic Management Plan will be implemented, which will include measures to control vehicle speed – e.g. speed limit enforcement, signs and speed humps.	15.2

Key issues included:

- Employment. Most of the villages indicated that they would like to benefit from the employment opportunities that will be created by the Project;
- Availability and quality of surface and ground water. Stakeholders expressed concern that Project activities (e.g. discharge of waste water, use of water from the Ayeyarwady River) may impact the quality of water and/ or reduce the amount of water available for use by local villagers;
- Access to electricity. Many of the Project area villages do not have access to reliable electricity. There is a keen interest from villagers to be address this issue through the Project. (It will be the responsibility of the MEPE to distribute the electricity generated by the Project. Sembcorp is not responsible for or have influence over how the electricity is distributed.);
- Air emissions and health implications. Stakeholders indicated that they were concerned about the health implications associated with air emissions that will be generated by the Project during construction and operation, and the potential for an increase in the transmission of communicable diseases; and
- Noise. Stakeholders expressed concern about the noise that will be generated by the Project, as it may disrupt local village activities.

During discussions, fresh in the minds of many stakeholders was construction and operation of the nearby steel mill (and associated temporary 95MW gas engine). In particular, villagers from Sa Khar, as they are located closest to the Project site, raised concerns that their crops have been impacted by the heat generated from the steel mill and associated temporary gas engine – i.e. the adjacent crops have died and the land is no longer viable. In addition, nearby stakeholders indicated that the noise generated by the steel mill was an issue. There is concern that similar impacts may arise as a result of the Project. This concern has been fed into the design of the Project - due to the height of the stacks on site it is not anticipated that there will be any significant heat discharged and noise management measures will be put in place.

16.4.1 *Incorporation in ESIA*

The issues and concerns captured during the stakeholder engagement activities have been incorporated into development of the ESIA. The information has been used to inform the impact identification and assessment process as well as the identification of management measures and monitoring activities. ***Table 16.3*** includes reference to the chapters within the ESIA where each of the issues or concerns has been addressed.

16.5 FUTURE STAKEHOLDER ENGAGEMENT ACTIVITIES

Engagement will continue to occur throughout construction and operation of the Project, in line with Sembcorp's Stakeholder and Community Engagement Policy, the IFC performance standards and ABD safeguards.

Engagement will be guided by a stakeholder engagement plan (SEP). The objectives of the SEP are to ensure:

- Stakeholders continue to be provided relevant Project information in a timely manner;
- Stakeholders continue to have an opportunity to share their views and concerns about the Project;
- Stakeholder expectations are managed. This includes expectations associated with benefits that are likely to be generated by the Project;
- Positive working relationships are built and maintained with stakeholders over time; and
- Engagement continues to be transparent, inclusive and appropriate. This includes being accessible to vulnerable groups. This involves considering issues such as language and illiteracy rates when engagement materials are developed – e.g. where possible include visual examples as well as text.

The SEP will include:

- An engagement action plan (***Section 16.5.1***);
- Clear roles and responsibilities for implementation of the SEP. A community liaison officer (CLO) has been appointed and is based in Myanmar. The CLO will oversee implementation of the SEP, with support from other relevant Project representatives;
- Indicators against which the SEP can be monitored and evaluated over time;
- A stakeholder database to track engagement activities; and
- A grievance mechanism to receive and respond to concerns raised by stakeholders (***Section 16.5.4***).

16.5.1 *Action Plan*

The SEP will include an action plan that sets out the engagement activities that will be undertaken during construction. The action plan will be revisited prior to the end of construction so that an action plan can be designed specific to the operation phase.

An initial action plan is provided in ***Table 16.4.*** The focus is on:

- Ensuring stakeholders are kept up to date on progress of the Project;
- Gaining input during the development and implementation of key management plans, including the traffic management plan, the corporate social responsibility plan, the community health management plan, and the social management plan; and
- Managing stakeholder expectations, particularly regarding the benefits that will be generated by the Project. This includes direct benefits (e.g. employment) as well as benefits created through the corporate social responsibility plan.

As part of the action plan, engagement on key issues (e.g. air emissions, noise emissions, employment opportunities) will need to continue. In addition, the action plan should consider opportunities to engage interested stakeholders in monitoring activities (e.g. air and noise emissions), which may occur during construction and operation.

Table 16.4 Stakeholder Action Plan for Construction

Stakeholder group	Actions	Timing
Union government	Progress updates via email or telephone	Bi-monthly*
	Progress updates via a face-to-face meeting	Quarterly
Region government	Progress updates via email or telephone	Monthly
	Progress updates via a face-to-face meeting	Quarterly
Township government	Progress updates via email or telephone or via the appropriate committee representative	Monthly
	Progress updates via a face-to-face meeting	Quarterly
	Seek input on relevant management plans	As required
	Notification in advance of undertaking noisy activities (e.g. pile driving)	As required
	Notification in advance of transportation of heavy machinery	As required
Villagers	Progress updates via information distributed to the village tract leaders and/ or the relevant committee representative	Monthly
	Progress updates via a face-to-face meeting	Quarterly
	Seek input on relevant management plans	As required
	Notification in advance of undertaking noisy activities (e.g. pile driving)	As required
	Notification in advance of transportation of heavy machinery	As required
Steel mill workers	Progress updates via email or telephone or via the appropriate committee representative	Monthly
	Progress updates via a face-to-face meeting	Quarterly
	Seek input on relevant management plans	As required
	Notification in advance of undertaking noisy activities (e.g. pile driving)	As required

* Bi-monthly means once every two months.

In terms of government, this includes: the Ministry of Electric Power Enterprise, Department of Irrigation and Agriculture, Water Utilisation Department, Myingyan GAD, Taung Thar GAD, and the township management and development committees.

In terms of villages, this includes: Sa Khar, Hnan Ywa, Hpet Taw, Nyaung Kan, Gyoke Pin, Thien Ywa, and Tha Pyay Thar. Now that the pipeline route has been delineated, three additional villages have been identified that will need to be engaged as part of the Project moving forward. This includes: Ayea, Hla Nuang Tang, and Kaing Taung.

16.5.2 *Stakeholder Committee*

In addition to the activities set out in the action plan, a stakeholder committee will be established. Key stakeholder groups will be represented on the committee, including, at a minimum, representatives from each of the surrounding villages, the Myingyan and Taung Thar GADs, and the Project team.

The committee will provide an avenue to:

- Build on the relationships already established between local stakeholders and the Project;
- Gain a better understanding of village priorities and concerns as they relate to the Project;
- Receive ongoing input regarding management and monitoring of impacts; and
- Provide regular Project updates to key stakeholders.

It will be the responsibility of the committee members to disseminate the information provided at the committee meetings to their villages. This will be one of a number of ways in which information will be relayed to local villages.

Stakeholders will have the opportunity to raise Project related issues and concerns with committee members. It will be the responsibility of committee members to relay the issues and concerns to Sembcorp and to raise them during the committee meetings for discussion.

The committee will meet monthly during construction. At the end of the construction period, the frequency at which the committee meets will be reviewed.

16.5.3 *Stakeholder Database*

Implementation of the SEP will be supported by a stakeholder database. The stakeholder database will track the following information:

- The stakeholder – i.e. an organisation or individual;
- A contact person's name and position or title;
- Contact details (address, telephone, email, website);
- The main interests/issues/ concerns of the organisation as they may relate to the Project; and
- Details of engagement activities – i.e. date, location, attendees and key issues raised – and responses/actions agreed.

The database will help ensure that issues and concerns are captured and can be fed into decision-making process and that commitments that are made are met.

16.5.4 *Grievance Mechanism*

A grievance mechanism will be established as part of the SEP to ensure that grievances are promptly heard, analysed and, to the extent possible, resolved.

The aim is to resolve disagreements or stakeholder concerns before they evolve into grievances through ongoing engagement. This includes informal negotiations and discussions; any agreements reached through informal channels will be voluntarily signed by all parties involved in the negotiation.

If, despite engagement efforts, grievances still arise, they will be processed via the grievance mechanism. A variety of methods will be available through which stakeholders can lodge grievances. This will include:

- Face-to-face meetings with the member of the committee, the CLO or other relevant Project representative;
- Written communication (e.g. email, letter) directed to a committee member, a CLO or other relevant Project representative or left in a feedback box, which will be located in each village and at the Myingyan and Taung Thar GAD offices. Villagers may choose to speak to their village tract leader or committee representative to help facilitate a written complaint; and
- Telephone call placed to a committee member, the CLO or other relevant Project representative.

It is anticipated that the committee will be the first point of contact for villagers to raise grievances (and other issues and concerns). However, the CLO will also be available to receive grievances.

In all instances, grievances will be logged using the template contained in ***Annex J***. This will ensure a consistent approach is taken to collecting data (associated with the grievance). If a written grievance is received, a follow-up phone call or meeting may be required to ensure that the grievance is understood and sufficient information has been obtained from the complainant.

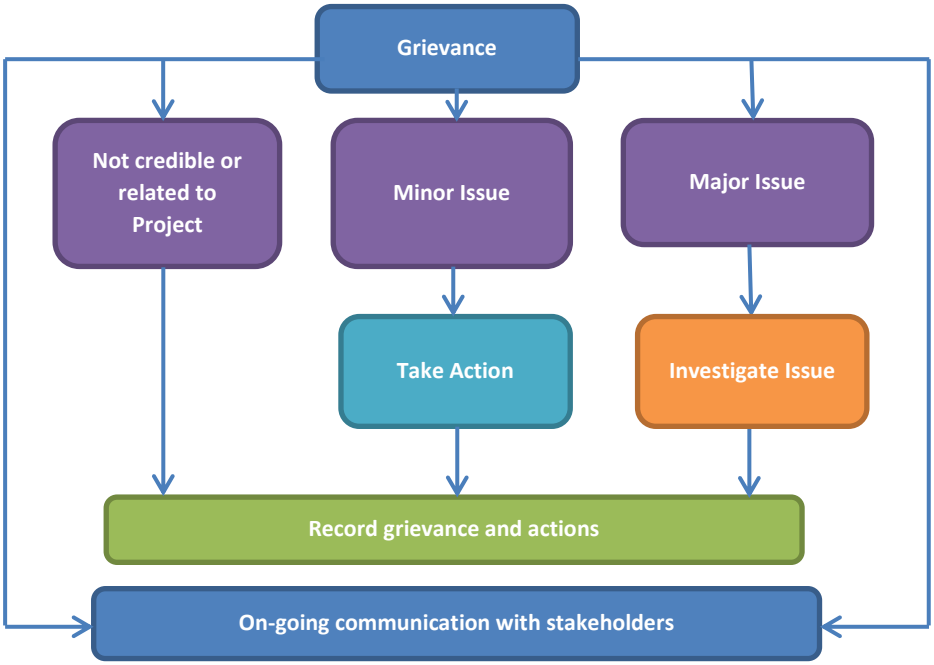
Grievances will be forwarded and reviewed in the first instance by the CLO. The CLO will determine if:

- The grievance is not valid (e.g. does not relate to the Project). If it is decided that a grievance is not valid, the grievance will be dismissed and advice of the decision and the reasons for dismissal will be provided to the complainant in writing (and in person if required);
- The grievance is a minor issue (e.g. a request for information or clarification). A response will be provided in writing (and in person if required); and
- The grievance is a major issue (e.g. repetitive or sensitive issue, related to compensation, group complaints). Major issues will involve investigation prior to a response being developed. The Project CEO will need to sign-off on responses for all grievances considered to be major (***Figure 16.1***).

All grievances will be reported to the committee, including those that have been deemed to be invalid. This will include an overview of the grievance and the response provided by the Project.

The grievance mechanism will address all grievances raised by stakeholders impacted or affected by the Project. This includes grievances associated with land acquisition, compensation, livelihood restoration, and environmental and social matters. A separate grievance mechanism will be developed to address internal grievances relating to employment matters.

Figure 16.1 Overview of the Grievance Management Process



All grievances will be recorded in the stakeholder database. This will include a summary of the grievance, the resolution or agreement on proposed actions (between the Project and the complainant), and monitoring of actions taken in response to the grievance. In addition, the grievance log will be stored in the database.

A grievance management procedure will be developed that sets out the grievance management process and provides further detail on the steps involved.

16.5.5 *Monitoring and Evaluation*

A key part of the SEP will be establishing indicators against which performance can be monitored and evaluated over time. At a minimum the SEP will be reviewed every 6 months during construction and annually during operation. The outcomes will be used to update and refine the SEP. ***Table 16.5*** provides a list of indicators for assessing performance.

Table 16.5 Draft Stakeholder Action Plan

Objective	Performance Indicators
Stakeholders are provided information about the Project in a timely manner	• Frequency in which timely and accurate Project information is distributed to stakeholders • Stakeholder feedback received regarding information dissemination • Number and type of grievances lodged by stakeholder members

Objective	Performance Indicators
Stakeholders have an opportunity to share their views and concerns	• Number and type of engagement opportunities provided • Percentage of stakeholders taking part in engagement opportunities (throughout the year) • Frequency in which stakeholders receive feedback on how their input is used • Number and type of grievances lodged by stakeholders
Positive working relationships are built and maintained over time	• Number and type of grievances lodged by stakeholders • Number of satisfactorily closed out grievances • Stakeholder willingness to engage with the Project • Percentage of stakeholders taking part in engagement efforts • Frequency in which stakeholders receive feedback on how their input has been used
Engagement continues to be transparent, inclusive and appropriate	• Frequency in which timely and accurate Project information is distributed to stakeholders • Stakeholder feedback received about the engagement activities • Representation of vulnerable groups in engagement activities • Number and type of grievances lodged by community members • Timely resolution of grievances lodged by community members • Number of satisfactorily closed out grievances

17 CUMULATIVE IMPACT ASSESSMENT

17.1 INTRODUCTION

The cumulative impact assessment (CIA) for the Project is undertaken in accordance with the IFC Performance Standards, the IFC's *Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for Private Sector in Emerging Markets* (the "IFC Handbook") and ADB's Safeguards Policy Statement 2009.

Cumulative impacts are generally considered as those, which are additive or interactive in nature that arises as a result of an impact from the Project interacting with an impact from another activity to create significant adverse and/or beneficial impact that would not be expected on a stand-alone project.

In order to gain an understanding of the Projects overall contribution to impacts within Myingyan Township and the broader Mandalay region, a cumulative impact assessment (CIA) is required to be undertaken. Whilst total cumulative impacts due to multiple projects within a given area should be identified within government led spatial planning efforts (generally as part of a Strategic Environmental Assessment), the Sponsor needs to determine the degree to which it is contributing to these overall cumulative impacts on Valued Environmental and Social Components (VEC). In this regards, the objectives of the CIA are:

- Use the outcomes of the preceding chapters of this ESIA to determine spatial and temporal boundaries, identify VEC's and all development and external natural and social stressors affecting them;
- Recognise and identify how the project, along with other existing and future projects may contribute to cumulative impacts on the predicted future condition of the identified VEC's; and
- Develop measures to ensure these are avoided and/or minimised to the greatest extent possible.

To achieve these objectives and gain an understanding of the complexities of cumulative impacts, this Chapter presents a Rapid Cumulative Impact Assessment (RCIA), which has been undertaken largely in accordance with the IFC's *Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for Private Sector in Emerging Markets* (the "IFC Handbook"). This has been supplemented by other guidance such as:

- The European Union's "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" (1999);
- The Canadian Environmental Assessment Agency's "Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act" (2012);
- The USA NEPA Council on Environmental Quality's "Considering Cumulative Effects under the National Environmental Policy Act" (1997); and
- ADB Environmental Assessment Guidelines (2003).

This CIA has also been used to assess impacts related to associated facilities described within ***Chapter 2***. The Sponsor has limited capacity to influence the

environmental and social performance of these facilities (as they are being developed directly by the GOM) and also have limited access to information such as final alignment, land acquisition processes, regulatory EIA documents and details of contractor measures. In this regards, the approach has been taken to include them within the CIA to ensure that their impacts are considered and allow the Sponsor to identify any high-level mitigation measures, which it may reasonably be able to enforce.

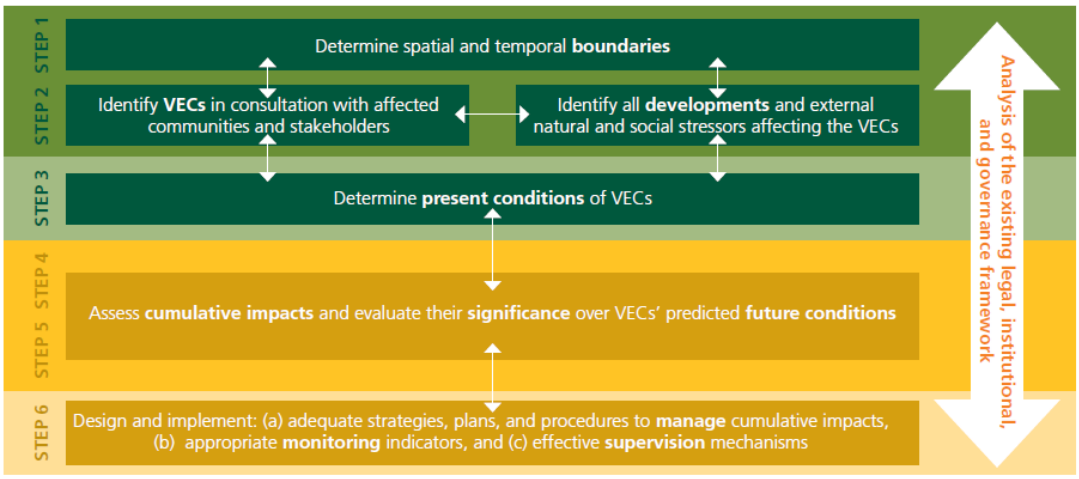
17.2 METHODOLOGY

17.2.1 Overview

This chapter presents a rapid cumulative impact assessment (RCIA) in accordance with the IFC Handbook and therefore has been undertaken having regard for the six-step process outlined below. As this RCIA forms part of the overall ESIA, the general conditions and trends of the VEC's are already known (established during environmental and social baseline condition assessments), as are the impacts from the Project (as part of the impact assessment) and the proposed mitigation, management and monitoring measures. Given this, VEC's and impacts have been established, with an emphasis able to be placed on the steps pertaining to cumulative impact assessment and management.

As this RCIA forms part of a largely high level ESIA, the data available to pursue a quantitative cumulative impact assessment (such as determining numerical thresholds for various VEC's) has not been undertaken. Emphasis in developing the methodology has therefore been placed upon following a largely qualitative approach, allowing for identification of general trends and developing appropriate management, mitigation and monitoring measures. Given this approach, the majority of the methodology relies upon the use of professional judgements, complemented by ERM's understanding of the Project, experience with similar projects in similar settings, and the elements of the ESIA based on quantitative assessment.

Figure 17.1 – General RCIA Methodology (Source: IFC Handbook, 2013)



17.2.2 *Determine Spatial and Temporal Boundaries and VECs*

The methodology used in the setting of the spatial and temporal boundaries is largely qualitative and based upon the general "rules of thumb" suggested within Box 7 ('*Rules of Thumb – How to set Geographical and temporal boundaries*') of the IFC Handbook. The following factors have been set within the methodology:

- Temporal boundaries have been set based on desktop review of available information pertaining to other proposed Projects within the area (see below), the present Project schedule, understanding of Government strategy with regards to the long term development of the area, and the continual nature of some of the external stressors; and
- Geographic boundaries are a composite of the location of the identified VEC's (see section 17.2.3 below), assessed impacts of the Project and the degree to which they may overlap with other external projects and stressors to impact upon an identified VEC.

17.2.3 *Identify VEC's and their Present Conditions*

As this RCIA is part of an ESIA, the identification of VEC's is able to be largely drawn upon work already undertaken, supplemented by stakeholder engagement. VEC's are defined as follows:

- Those defined as sensitive receptors within the ESIA. An example of this is any village, house or hospital identified as a sensitive receptor for the purposes of air quality modelling;
- Any particular resource or ecosystem service identified as being utilised by sensitive receptors. An example of this would be a groundwater resource used by the local community for domestic purposes; and
- Those identified as part of stakeholder engagement, regardless of whether or not they meet either of the above definitions.

17.2.4 *Identify all Developments and External Natural and Social Stressors Affecting the VECs*

External developments known as reasonably foreseeable future actions. are also identified utilising knowledge gained through the ESIA process (including field observations), stakeholder engagement and the interpretation of readily available external data. The outcomes of these considerations will be a simple binomial decision, i.e. yes the project is likely and therefore will be included within the CIA, or no, it is unlikely and therefore will not be included within the CIA.

The second step is to determine the extent of the various impacts of these projects. This allows for a decision to be made as to whether there is the potential for an overlap in Project impacts that could lead to a measurable cumulative impact. Key to this are the following elements:

- **Identification of appropriate geographical/spatial boundaries**. Where potentially interacting projects are not located close enough, or sufficiently linked through various ecological and social processes, for relevant impacts to overlap, cumulative impacts are less likely;

- **Identification of temporal boundaries**. Where the schedules of various components of projects do not overlap in time, particularly with regards to the construction phase of large projects, cumulative impacts are less likely. Additionally, where projects are going to be short term, cumulative impacts will generally be of limited duration;
- **Consideration of impact type**. Whilst there may be no direct geographical overlap in project boundaries, there is the possibility that their offsite impacts may directly overlap elsewhere and cause offsite cumulative impacts. Examples are sediment discharges into river systems, air pollutant emissions, and social impacts associated with overall migration influx;
- **Determination of any "aggravating factors"** that may be evident within a particular project identified for inclusion within the CIA. This includes elements such as the size of the project, environmental management performance, and the regulatory regime under which it operates; and
- **Identification of potential externalities**, that is a project ability to influence (either positively or negatively) the behaviours of other operations in the area.

The other element identified as part of this scope is external natural and social stressors which aren't related to a single project or source. As these are ongoing stressors it has been assumed that they have already been captured as part of the Project baseline conditions (refer to Chapter's 5and 6) and the impact assessment. Specific additional identification and assessment of these is therefore not considered necessary as part of this RCIA.

17.2.5 Identification and Assessment of Impacts

Impact scoping and identification needs to be in alignment with those assessed throughout the main body of the ESIA, and needs to include those which are recognised as important on the basis of genuine scientific concerns and the views of affected communities and other stakeholders. This allows for impacts to be appropriately grouped and added to impacts identified as likely to occur from other projects.

A largely qualitative approach was taken for the RCIA. This is to enable a focus upon identification of trends across the various projects in the area, their temporal and spatial interactions and how these are likely to impact upon VEC's. Whilst impacts arising from the Project have been defined and assessed in isolation, it can be difficult to accurately quantify cumulative impacts as there can be a high degree of uncertainty in interactions with other projects and activities that may be occurring in the area as well as a lack of confirmed project information. Therefore, the impacts are to be assessed qualitatively based on the identified trends and grouped according to impact type, rather than VEC, in accordance with the overall methodology adopted for the ESIA. The RCIA is also based on the assumption that all assessed residual impact levels within the ESIA are achievable.

It is recognised at this stage that this approach may not be accurately able to define the cumulative impacts from a purely VEC-centred perspective (i.e. proposed actions impact on VEC + other past, present and future impacts on VEC = Cumulative Impacts). However, given the clustered nature of the human VEC's (refer to section

17.3), the large scale extent of the environmental VEC's (such as the groundwater system, which is also heavily relied upon by human VEC's) it is considered safe to assume that all impacts will accumulate to each VEC. Therefore, attempting to address impacts by nature is a suitable approach and is able to produce effective management, mitigation and monitoring measures.

17.2.6 Development of Management, Mitigation and Monitoring Measures

Based upon identification of broad impact trends, broad scale mitigation measures will need to be developed. Generally, these are based upon:

- Effective application of, and adherence to, the mitigation hierarchy in environmental and social management of the specific contributions by the project expected cumulative impacts. This is generally achieved through stringent implementation of the measures developed specifically for the project; and
- Development of best efforts to engage in, enhance and/or contribute to a multi-stakeholder, collaborative approach to implementing management actions which are beyond the capacity of an individual project proponent.

Any measures developed to address concerns identified within this CIA will take into account these general concepts. There also needs to be scope to develop these measures further when detailed information regarding projects becomes available.

17.3 IDENTIFICATION OF VEC'S AND THEIR PRESENT CONDITIONS

The ESIA identifies and describes the current condition of a range of Sensitive Receptors, defined as VEC's for the purposes of this RCIA. These are:

- Representative air sensitive receptors (ASR's) identified within ***Chapter 7***;
- Representative noise sensitive receptors (NSR's) identified within ***Chapter 10***;
- In general, the inhabitants of the villages of Sa Khar, Hnan Ywa, Hpet Taw, Nyaung Kan, Gyoke Pin, Thien Pin, Thien Ywa and Tha Pyay Thar. It is noted that the ASR's and NSR's are included within these villages;
- Given the high dependency of the local community on groundwater for domestic purposes, the entire groundwater resource is defined as having high sensitivity within the ESIA and is therefore defined as a VEC; and
- Visually sensitive receptors were identified, being VSR 1 – Inhabitants of Villages, and VSR 2 – Recreational Visitors and Tourists.

The following are considered as resources directly utilised by those defined as sensitive receptors and are therefore considered as VEC's:

- Soils are an important commodity within the agricultural setting, which is the core livelihood type for the aforementioned villages. Given this, all soils have been defined as a VEC; and
- Given the high reliance of the local community on surface water sources throughout the area (including the irrigation canal to which wastewater will be discharged, and the Ayeyarwady River itself which is the source of water for the irrigation canal), all surface water bodies have been defined as VEC's.

No specific additional VEC's were identified during stakeholder engagement. Given the highly modified state of the area, there are no biodiversity features or species considered to be VECs (refer to ***Chapter 14***).

17.4 IDENTIFICATION OF ALL DEVELOPMENTS AND EXTERNAL NATURAL AND SOCIAL STRESSORS

17.4.1 Associated Facilities

As described within ***Chapter 2*** of this ESIA, there are two associated facilities, the 230KV overhead transmission Line beyond the upgraded Myingyan Steel Mill sub-station to the broader national electricity grid and the new MOGE Gas Receiving Station. All other elements of the Project, including the Power Plant, gas supply pipeline, water supply pipeline and the 230kV overhead transmission line connecting the power plant to the upgraded Myingyan Steel Mill substation are all to be developed by the Sponsor and have had their impacts assessed throughout the ESIA.

The degree to which the 230kV overhead transmission line past the sub-station can be influenced by the Project and likely impacts considered for inclusion within the CIA are outlined within ***Table 17.1*** below.

17.4.2 Projects External to the Sponsor

The power plant site is situated in a small cluster of industrial facilities within a broader rural environment. Based upon a desktop review of readily available online information and site investigations, the following Projects are either existing, under construction or planned within the immediate Project area:

- Existing No (4) Steel Plant Myingyan which produces billets and slabs from recycled material such as scrapped metals and cars;
- Aggreko temporary gas fired power plant on the north of the Project site boundary;
- The MOGE gas receiving station on the east of the Project site; and
- An expansion of the No (4) Steel Plant Myingyan, which based upon existing information is presently under construction.

Based upon revision of available documents, and the nature of the remainder of the area (small villages scattered amongst valuable agricultural land), it is concluded that it is unlikely to be more large projects planned in the area which need to be taken into account within the CIA.

Table 17.1 Assessment of Impacts

Project Name	Comments	Anticipated Impact Types
Myingyan Steel Mill – Phase One	Located directly to the south of the Project Site, it is presently producing 200,000 tonnes of steel billet and slab products per year, primarily from pig iron and scrap products from elsewhere. Large volumes of scrap steel are stored around the perimeter of the site. The precise technology utilised for this steel mill is unknown. Given its proximity to the site, it is likely that measurable cumulative impacts would occur during the period in which the Project is operational. This is particularly the case for environmental impacts such as air quality, greenhouse gases, noise, surface water and groundwater. Additionally, steel mills can produce large amounts of waste, which would need to be disposed of within the same waste management network the Project would utilise.	Operational impacts relating to Air Quality, Greenhouse Gases, Noise, Surface Water, Soil, Groundwater and Waste
Myingyan Steel Mill – Phase Two	A large scale expansion of the steel mill is presently under construction. Based on available information a Direct Reduction Plant (DRP) is being developed to produce different sizes of hot roll sheets, colour sheets, and corrugated zinc shields. The overall production will increase from 200,000 to 400,000 tonnes per year. Whilst detailed information regarding the construction schedule is unknown, based on observations made on site it would appear likely that there will be some overlap in the construction schedule with the Project. This would therefore likely lead to cumulative construction related impacts in regards to noise, air quality, traffic, surface water, soils and groundwater and socio-economic impacts (both positive associated with job creation, as well as negative such as those to community health and safety due to increased traffic volumes and a migrant workforce interacting with the local community). This upgraded/expanded mill will be operational at the same time as the Project and given its proximity it is likely that measurable cumulative impacts will occur for air quality, greenhouse gases, noise, surface water and groundwater. Additionally, steel mills can produce large amounts of waste, which would need to be disposed of within the same waste management network the Project would utilise.	Construction impacts relating to noise, air quality, traffic, surface water, soils and groundwater, and socio-economics Operational impacts for air quality, greenhouse gases, noise, surface water, soils and groundwater and waste.
Aggreko Gas Fired Power Plant	This is a temporary 95MW gas fired power plant, which is intended to be decommissioned immediately once the new Power Plant is online. Therefore, there will be no cumulative impacts aside from some minor noise and traffic generation as it is being decommissioned. It has, therefore been removed from further consideration in the CIA.	None
230kV Overhead Transmission line	This is to be developed by MEPE and will link the upgraded substation with the broader electricity network. As the final option/alignment has not yet been chosen, it is being assessed within the CIA based on an understanding of the surrounding area and typical impacts associated with transmission infrastructure development.	Impacts in relation to land acquisition, livelihoods restoration and construction related impacts such as noise, air quality, surface water and groundwater and soils.

Project Name	Comments	Anticipated Impact Types
	Generally it is not common practice for the entire width of the corridor to be acquired and therefore land acquisition issues (particularly within agricultural areas) will be likely refined to the actual footprint of the poles, and the likely installation of a narrow one land road for maintenance access. Construction related impacts would be extremely similar for the other linear infrastructure being developed by the Project and therefore cumulative impacts can be looked at in this context. Operational impacts for the transmission line would be negligible (particularly if full access to the corridor is allowed for agricultural purposes) and therefore not considered within the CIA.	

17.5 SUMMARY OF TRENDS, VEC'S AND SCOPE REFINEMENT

17.5.1 Summary of Trends

Some basic key trends and issues have been identified through investigating the nature of existing and proposed development within the area. These trends and issues, which will be used for qualitative cumulative impact assessment, are:

- Industrial style development is entirely restricted to the Project site and the Steel Mill. It is unlikely that development further afield will occur which would spread cumulative impacts further, however this should be confirmed based upon engagement with the GOM (at local and regional level) to confirm if there is any plans for future intensive development in the area;
- There will be an overlap in construction activities of the Project, 230kV overhead transmission line (associated facility) and the Steel Mill expansion;
- Given the proximity of the site to the Steel Mill, operation impacts will generally all be cumulative in nature; and
- Given the high reliance of the local community on groundwater and surface water bodies for domestic and agricultural purposes, these are core VEC's which may be impacted by all elements of the Project, plus any other external Projects in the area. Limiting cumulative impacts to these is considered to be high priority.

Based on this, the scope of the cumulative impact assessment will be limited to this area only, plus a very general overview of impacts associated with transmission line development.

17.5.2 Scope Finalisation

Table 17.2 presents the outcomes of scoping, based upon identified VEC's, assessed project impacts, the identified external projects, and the summary of trends. The core outcome of this table is that cumulative impacts will be assessed with regards to the following key impact types:

- Air quality;
- Noise;
- Surface water;
- Soil and groundwater; and
- Socio-economic impacts divided into economic development (being those classified as positive impacts), physical and economic displacement, and influx.

The remainder of impacts either have already been assessed in a cumulative manner within the ESIA, or the Project will only have negligible impacts and therefore will not contribute to any broader cumulative impacts to VEC's.

Table 17.2 – Scoping for RCIA

Impact Type	VEC's Likely to be Impacted	Existing Assessment in ESIA	RCIA Scope
Air quality impacts during construction and operation	Representative air sensitive receptors identified within Table 7.5;	Chapter Seven presents the outcomes of detailed air quality modelling during both construction and operation phases. It is based upon baseline data capturing existing external projects such as the steel mill. This methodology captures only the predicted future emissions from the Project plus the existing baseline (which is noted to be defined as a degraded airshed).	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative air quality impacts may occur and appropriate mitigation strategies to adopt.
Greenhouse Gases	In regards specifically to greenhouse gases and the nature of their impacts, none of the identified VEC's are likely to be impacted directly by either the Project or the external projects identified.	Chapter Eight of the ESIA considers the greenhouse gas emissions from the Project in the overall context of Myanmar	No further assessment required as the existing impact assessment in Chapter 8 is already considered cumulative.
Noise during construction and operation	In general, the villages of Sa Khar, Hnan Ywa, Hpet Taw, Nyaung Kan, Gyoke Pin, Thien Pin, Thien Ywa and Tha Pyay Thar	Chapter Eight presents the outcomes of detailed noise modelling during both construction and operations phase. It is based upon baseline data capturing existing external projects such as the operating steel mill, plus the construction activities. This methodology captures only the predicted additional noise emissions from the Project, plus the existing baseline and therefore does not accurately assess all future cumulative impacts to the VECs.	A qualitative assessment will be undertaken focusing on identification of ways in which cumulative noise impacts may occur in the future and appropriate mitigation strategies to adopt.
Surface Water	Given the high dependency of the local community on a range of surface water bodies for domestic and agricultural purposes (particularly the irrigation canal which channels water from the Ayeyarwady River to within 500m of the site), all surface water bodies are considered as VEC's.	Chapter Nine presents the surface water impact assessment during both construction and operations phase. It is largely a qualitative assessment based on the existing baseline (i.e. factors in existing external stressors), looking at the impacts of the Project in isolation.	A qualitative impact assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to surface water VEC's, and develop appropriate mitigation strategies.
Soils and Groundwater	Soils are an important commodity within the agricultural setting, which is the core livelihood type for the aforementioned villages. Given this, all soils have been defined as a VEC; Given the high dependency of the local	Chapter 10 presents the soils and groundwater impact assessment for both construction and operations phase. It is largely quantitative, based on the existing baseline (i.e. factors in existing external stressors), looking at the impacts of the Project in isolation.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to surface water VEC's, and develop appropriate mitigation strategies.

Impact Type	VEC's Likely to be Impacted	Existing Assessment in ESIA	RCIA Scope
	community on groundwater for domestic purposes, the groundwater in general has been defined as a VEC.	The ESIA noted the nexus between soil quality and groundwater quality, thus developing management and mitigation measures for the protection of these in an integrated manner.	
Landscape and Visual	Two broad types of VSR's were identified and are thus considered as VEC's for the purpose of this RCIA.	The visual impact assessment undertaken was highly qualitative and took into account all existing projects in establishing visual baseline. Given this, it is considered to largely already have been undertaken on a cumulative basis.	No further assessment required
Waste	No VEC's are likely to be impacted by waste.	Waste has also not been considered in the CIA as the impact assessment and associated mitigation, management and monitoring measures specifically took into account the fact that the Project's waste stream would already be adding to the waste streams from all surrounding current and future developments.	No further assessment required
Terrestrial and Marine Biodiversity	No VEC's are likely to be impacted.	Chapter 14 presents a detailed biodiversity impact assessment, based on Project impacts only	No further assessment is required as no VEC's defined based upon biodiversity values were identified.
Socio-Economics: Community Health and Safety	The VEC's likely to be impacted are those people residing in the various villages listed.	Chapter 15 presents a detailed assessment of impacts relating to community health and safety during construction and operations phase. None of these were considered cumulatively.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VEC's, and develop appropriate mitigation strategies.
Socio-Economics: Land acquisition	The VEC's likely to be impacted are those people residing in the various villages listed	The SIA has addressed the impacts associated with the acquisition of the project site, plus all associated facilities and therefore essentially addressed impacts in a cumulative manner.	No further assessment is required within this RCIA.
Socio-Economics: Employment and Business Opportunities	The VEC's likely to be impacted are those people residing in the various villages listed	Positive social impacts from the Project include impacts to employment and economy during both the construction and operation phases, were assessed as part of Chapter 15. None of these were considered cumulatively.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VEC's, and develop appropriate mitigation strategies to ensure that positive impacts are maximised.

17.6 AIR QUALITY CUMULATIVE IMPACT ASSESSMENT

17.6.1 Project Impacts

With regards to construction, changes to air quality as a result of fugitive dust emissions were noted to be minor. This was due to the distance between the site and the nearest ASR (Sa Ka village 600m to the north-east of the Project site) and the fact that fugitive dust is localized within 100m of disturbed areas due to the relatively large particle size. Specific measures have been developed to ensure that dust is appropriately managed at all times.

Operational air quality modelling for stack emissions of NO_2, SO_2, PM_{10} and $PM_{2.5}$ at the identified air sensitive receptors (VEC's) demonstrated that for Project contributions for all short-term and long-term impacts during normal combined cycle and simple cycle operations the Project contribution for all pollutants was very low. The highest project contribution to air quality standards at any of the ASR's is about 1.6% for 1-hour averaged NO_2.

The background NO_2 levels at the Project site area were noted to already exceed the air quality standard for annual NO_2 and was considered a degraded air shed, which would likely be the direct result of the operations of the Steel Mill Details have been discussed in ***Chapter 7***. The Project has proposed additional Built-in dry low NO_x burners to reduce NO_x emission at stack to below 25ppm at all times.

17.6.2 Relevant Cumulative Impacts with Other Projects

With regards to air quality impacts during the construction phase, there will likely be an overlap in the soil disturbing/exposing phase of all elements of the Project with both the construction of Phase 2 of the Myingyan Steel Mill and the 230kV overhead transmission line associated facility. Given the proximity of these features to each other, air quality impacts related to dust and other airborne particulates will likely accumulate.

Section 7.9.3 of the ESIA presents an assessment of cumulative operational impacts of the Project in the context of the modelled contributions of the Project and the general background air quality of the site – which includes emissions from the existing steel mill and temporary power plant. The cumulative impact in this case was assessed to be **Minor** for operations based on the existing situation in the area. Building on from this, the expansion of the steel mill will likely lead to increased emissions, which will further degrade the air shed. When added to the existing modelled emission, they may increase the overall impact on air quality and the overall human health of the identified VEC's. This may be mitigated slightly by the fact that the existing 95MW power plant (which is closer to the nearest ASR than both the Project and steel mill) will be decommissioned and therefore its contributions to the air shed will be eliminated. The date of decommissioning has not yet been defined.

17.6.3 Specific Mitigation Measures for Cumulative Impacts

Given the likelihood for cumulative air quality impacts during the construction phase, the Projects management of its own emissions become highly important, particularly

during construction of linear infrastructure, which may at times be in close proximity to VEC's. This fact needs to be effectively communicated to all EPC Contractors. In addition to this, the following mitigation measures will need to be applied during the construction phase:

- Communicate, to the degree possible, with the contractors undertaking development of the Steel Mill expansion and installation of the additional 230kV overhead transmission line through MEPE to determine when will be the period of greatest overlap in soil disturbing/exposing activities. Based on the information provided by contractors this will then be disclosed as part of regular stakeholder engagement activities;
- Ongoing air quality monitoring data should be shared between projects should a large increase in NO_2, SO_2, TSP, $PM_{2.5}$ or PM_{10} levels be noted; and
- The Project's grievance response plan will include provisions to identify where the cause of the grievance originates from an adjoining Project, means to communicate this to the relevant Project owner, and if possible, a way to cooperatively ensure that the grievance is responded to and closed out.

For operational air quality impacts, it is unlikely that the Sponsor can have any influence over the technology adopted in the expanded steel mill and therefore cannot easily influence management of future cumulative air quality impacts. The limit of what can reasonably be undertaken is to identify which VEC's are likely to be exposed to elevated levels of emissions once both the Project and expanded steel mill are operational and incorporate these locations into the monitoring program (refer to ***Chapter 18***). Should the operation of the expanded steel mill significantly add to the already negative cumulative air quality, the monitoring program will be able to detect these immediately. Given the absence of air quality standards in Myanmar, it is difficult to enforce any emission standards directly on the Steel Mill. In this case, there are three options available to the Sponsor to assist in mitigating cumulative impacts:

- Continually share monitoring data and information regarding health impacts to works and the community with the operators of the Steel Mill. As it is already operational, it is unlikely that the operators would agree to retrofitting any pollution reduction measures. However, the Sponsor should seek to provide a continual example of best practice in pollution prevention and abatement;
- Where air quality monitoring and human health data (nominally gathered from local clinics) starts to indicate a rise in impacts to levels impacting human health of the VEC's, the Sponsor will work with the Steel Mill owners and GOM to determine if acquisition of land/houses in certain issues is an option to avoid impacts; and
- The Sponsor will work with the GOM to ensure that spatial planning in the area excludes the construction of any new sensitive receptors any closer than existing houses in the area.

17.7 NOISE CUMULATIVE IMPACT ASSESSMENT

17.7.1 Project Impacts

Noise levels during the construction phase were noted to be well within the adopted criteria for both day-time and night-time periods. Noise mitigation measures were considered necessary to mitigate the construction noise impact, which includes the construction of a noise barrier. The outcome of this is that all construction noise impacts from the Project would be mitigated. Detailed noise modelling for power plant operations were noted to be within the adopted noise criteria – being a maximum increase in background levels of not more than 3dB(A).

17.7.2 Relevant Cumulative Impacts with Other Projects

During the construction phase, there will be an overlap in noise generating activities (earth moving equipment, heavy trucks, traffic, generators, machinery, civil works etc.) with that of the Steel Mill expansion. However, as the noise modelling was based upon baseline monitoring undertaken during a period in which construction activities were already underway at the Steel Mill site, these contributions to overall noise levels have already been accounted for in the model.

Similarly with the operations phase, noise modelling and compliance (background plus 3dB(A)) was based upon noise baseline data which already takes into account the existing operations of the steel mill. However, the future expansion of the steel mill was not taken into account. The modelled noise levels for operation at the NSR's were between 39dB(A) and 45dB(A) (well below adopted operational noise criteria detailed within Table 5.17) and it is therefore unlikely that these levels would be exceeded with the introduction of another large scale noise source.

17.7.3 Specific Mitigation Measures for Cumulative Impacts

Given the above, no specific measures to manage cumulative noise impacts are recommended. The Projects grievance response plan will include provisions to monitor noise impacts and respond to noise related complaints accordingly, including cooperating with the steel mill owners should this be required.

17.8 SURFACE WATER CUMULATIVE IMPACT ASSESSMENT

17.8.1 Project Impacts

The Project was identified to have a number of potential impacts to surface water VEC's, particularly with regards to surface water quality of bodies to be used by the local community (also defined as VEC's). To mitigate these impacts, during both construction and operation, a range of mitigation measures have been developed to ensure an integrated approach to surface water quality management.

17.8.2 Relevant Cumulative Impacts with Other Projects

During the construction phase, the Steel Mill and 230kV overhead transmission line (associated facility) will also be under construction. There is the potential that surface water laden with TSS and other contaminants (particularly from improperly managed waste and hazardous materials) will be discharged to surface water flows (and

eventually groundwater) from a variety of sources. Where these directly overlap with the Project, they may further elevate surface water impacts if not adequately controlled.

The steel mill, both the current and expanded versions, has potential to be a source of contaminated surface water runoff. This can result from a number of sources, specifically relating to the storage of scrap steel throughout the site which may leach contaminants directly into the soil, and through spills and leaks of other hazardous materials used on site. As this directly adjoins the Project Site, then this issue when combined with the Project may cumulatively contribute to degradation in surface water flows and eventually impact upon soil and groundwater quality.

17.8.3 Specific Mitigation Measures for Cumulative Impacts

For the construction phase, the Sponsor has committed to a large range of surface water management measures, which will greatly minimise the overall contribution that it will make to cumulative surface water impacts. In addition to this, the following measures will be implemented to ensure that the construction of the steel mill expansion and the 230kV overhead transmission line will also be undertaken in a manner that limits cumulative impacts:

- Ensuring that both projects comply with at least local regulatory standards for surface water discharge is essential in minimising overall cumulative impacts. In this regards, the Sponsor should, to the degree possible, work with local regulatory authorities to ensure that relevant regulations are being complied with; and
- The Sponsors grievance response plan will include provisions to identify where the cause of grievance originates from another Project, means to communicate this to the relevant project owner and, if possible, a way to cooperatively ensure that the grievance is responded to and closed out.

During operations phase, appropriate monitoring points are to be established as part of the regular surface water monitoring programme to determine the contribution of upstream water discharges to background levels.

17.9 SOIL AND GROUNDWATER CUMULATIVE IMPACT ASSESSMENT

17.9.1 Project Impacts

Impacts associated with soil loss were noted within the soil and groundwater impact assessment. A range of mitigation measures, closely related to surface water and air quality were proposed to reduce this impact to negligible. Given the silty nature of the soils and the high reliance of the local community of the groundwater resources, any importation of contaminated fill material to site during construction, and spills and leaks during operation could result in changes to the quality of soil and groundwater throughout the area. A range of measures to prevent contamination, respond to spills and leaks immediately and then monitor clean-up efforts have been recommended to limit these impacts.

17.9.2 *Relevant Cumulative Impacts with Other Projects*

The steel mill, both the current and expanded versions, has potential to be a source of soil and groundwater contamination. This can result from a number of sources, specifically relating to the storage of scrap steel throughout the site which may leach contaminants directly into the soil, and through spills and leaks of other hazardous materials used on site. As this directly adjoins the Project Site, then this issue when combined with the Project may cumulatively contribute to soil and groundwater quality degradation. Soil and groundwater sampling undertaken for baseline purposes only indicate that at present there is unlikely to be any plumes of subsurface contamination from the steel mill making their way offsite. This was based upon the results gathered from sampling in groundwater wells (GW-6, GW-7 and GW-8) in the Steel Mill site, which would be the logical source of any soil or groundwater contamination in the area. However, a sampling program specifically designed to detect sources of contamination, taking into account the specific hydrogeological characteristics of the area and likely contaminant types based on review of all activities within the steel mill, would need to be implemented to confirm this fact.

Likewise, poor spill and leak prevention and management during construction of the 230kV overhead transmission line outside of the Projects influence may also increase impact areas.

17.9.3 *Specific Mitigation Measures for Cumulative Impacts*

There are no specific mitigation measures proposed with regard to cumulative soil and groundwater impacts. The measures contained within ***Chapter 12*** are considered sufficient for the Project to reduce its own contribution to overall groundwater emissions. The Project will give consideration to sharing of monitoring data with adjoining project owners should changes in groundwater quality be noted, and which may not be directly attributable to the Project – the Project has committed to taking samples from monitoring wells on/near the steel mill site throughout the construction and operations phase.

17.10 *SOCIO-ECONOMIC CUMULATIVE IMPACT ASSESSMENT – COMMUNITY HEALTH AND SAFETY*

17.10.1 *Project Impacts*

The impact assessment noted a number of impacts to community health and safety, which would be caused by the Project, particularly during the construction phase. These include:

- An increase in vehicles, particularly construction vehicles, leading to an increased potential for accidents to occur This is exacerbated by the fact that people living immediately adjacent to roads and not being used to the presence of large vehicles and heavy volumes of traffic. An increase in traffic volumes may also lead to increased exposure of the community to noise levels and potentially dust.
- The presence of new infrastructure, particularly the linear infrastructure, can lead to safety issues such as community members falling in unsecured trenches or interacting with unsecured equipment.

- An increase in communicable diseases may occur as the result of the introduction of a large construction workforce into the area, creation of vector habitat and/or the presence of commercial sex works; and
- The existing local healthcare facilities have limited capacity to respond to an increase in volumes or an increase in the transmission of communicable diseases, leaving the local villagers vulnerable.

The Sponsor will implement a range of mitigation measures to reduce these impacts, including:

- Training for workers;
- Provision of a site medical facility for basic medical and first aid treatment. The facility shall be manned by clearly identifiable qualified first-aid personnel for all hours during which activity is taking place on the work site. Any requirement for treatment beyond first aid shall be referred to the nearest public hospital; and
- The development and implementation of a traffic management plan to minimise risks associated with transporting materials and workers to and from the site.

17.10.2 Relevant Cumulative Impacts with other Projects

There will be considerable overlap in the construction phase of the Project with the steel mill expansion and associated facilities. Therefore, all of the impacts caused by the Project will likely also be caused by other projects at the same time. This would mean that impacts caused by the Project, particularly with regards to traffic, in-migration and community health would be cumulative with the precise same impacts with the steel mill in particular.

17.10.3 Specific Mitigation Measures for Cumulative Impacts

The Sponsor is planning to implement a range of measures to comprehensively address its own impacts to community health and safety. The best approach to manage cumulative impacts in this regard is through a collaborative approach between the Sponsor, the adjoining steel mill, and the GOM. Consideration should be given to expanding the training for workers and traffic management measures to the steel mill.

17.11 SOCIO-ECONOMIC CUMULATIVE IMPACT ASSESSMENT – EMPLOYMENT AND BUSINESS OPPORTUNITIES

17.11.1 Project Impacts

During the construction of the Project, it is estimated that up to 660 direct employment opportunities would be created, including 190 skilled, 220 semi-skilled and 250 unskilled workers. During operations, there would be 80 direct employment opportunities. In addition, it was also identified that there would be opportunities for local businesses to provide goods and services both directly and indirectly to the Project.

The Project therefore has the opportunity to capitalise on local content opportunities to provide local people employment and business opportunities, all of which are positive impacts. The Project has committed to putting in a range of measures to enhance these benefits, such as a local content plan, a skills training program and implementation of an internal standard to guide labour practices and supply chain management.

17.11.2 Relevant Cumulative Impacts with other Projects

The Project, when added to the existing and expanded steel mill, will provide a significant boost to the local and regional economics. There will be substantial opportunities for skilled and unskilled labour with both of these projects.

17.11.3 Specific Mitigation Measures for Cumulative Impacts

The Sponsor to give consideration to sharing information regarding its local content plan and skills training program with the Steel Mill developers and operators. A collaborative and integrated approach can lead to better outcomes rather than each project undertaking their own separate activities and ensure that potential cumulative positive economic impacts are realised and appropriately distributed throughout the local population.

17.12 CONCLUSION AND RECOMMENDATIONS

This RCIA has been prepared based upon the impact assessment presented within the ESIA, plus an understanding of external projects and natural stressors. Whilst presented qualitatively, it has identified a number of cumulative impacts (grouped by impact type) on a range of VEC's. Management and mitigation measures have been developed to mitigate these impacts. These rely upon the Project meeting all of its commitments with regards to implementation of the ESMP, plus adopting a collaborative approach to management of impacts with adjoining developments. This recognizes the fact that the Project owner, being committed to complying with international best practice, is well placed to try to positively influence the practices of other users in the area.

18 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Through a systematic assessment, the ESIA has identified a number of significant environmental and social impacts which may potentially result from the construction and operation of the Project. In order to manage and mitigate these impacts, a range of measures have been developed to reduce the overall residual impacts to acceptable levels and as low as reasonably practicable. Implementing and tracking the effect of these management and mitigation measures is an essential element to ensuring that the assessed residual impact levels are confirmed.

18.1 OBJECTIVES

The key objectives of this Environmental and Social Management Plan (ESMP) are to:

- Collate the various mitigation and management measures developed throughout the ESIA into a single point;
- Identify all of the detailed management plans which will need to be developed for implementation throughout the various phases of the Project;
- Define monitoring requirements to determine the efficacy of all mitigation and management measures; and
- Provide clarity to all stakeholders as to what impacts have been identified, how they will be mitigated and managed, and through what means.

18.2 SCOPE OF THIS ESMP

The scope of this ESMP covers both construction and operation phases of the Project, which have the potential to affect, positively or negatively, the environment and communities in which the Sponsor and/or its contractors/sub-contractors will operate.

As required by this ESMP, a range of detailed management plans will be developed and implemented for each specific phase of the Project. The responsibility for the implementation of these plans will lay variously with the Sponsor, contractors and sub-contractors. It is noted that this is only a framework ESMP into which the full range of management and monitoring activities will eventually fit into.

In addition, it is to be noted that environmental, social and governance (ESG) considerations are embedded in the Sponsor's business decisions and processes. The ESMP for the Project will also align with the Sustainability and HSE Policies of the Sponsor, which are presented in ***Box 18.1*** and ***Box 18.2***, respectively. The Project will also follow these policies and specific actions will be planned to align with them.

Box 18.1 Sustainability Policy of the Sponsor

Sembcorp's Sustainability Policy

Sembcorp, as a member of the international business community, recognises that our business activities have varying direct and indirect impacts on the societies in which we operate. We commit to manage these in a responsible manner, believing that sound and appropriate performance in this area is linked to business success.

For Sembcorp, being a responsible corporate citizen is reflected in the following principles:

Standards of Business Conduct

We ensure that our business is conducted according to rigorous ethical, professional and legal standards, through maintaining robust corporate governance and an Employee Code of Conduct for staff.

Health, Safety and the Environment

Management of our health, safety and environmental responsibilities is our first priority. We are committed to continuously improving our HSE performance and managing health, safety and environmental risks associated with our activities, products and services. We integrate health, safety and environmental considerations into all aspects of our business operations and processes with the aim of preventing accidents, injuries, occupational illnesses and pollution and conserving natural resources.

Employees

We aim to be a fair and caring employer offering our staff equitable opportunities to develop and grow.

Community

We act as a responsible corporate citizen through support for community care initiatives, community partnerships and philanthropic and charitable causes, in particular causes supporting children and youth, education and the environment.

Sembcorp's operations throughout the world are committed to these principles. The stage and level of implementation varies according to each operation and maturity of business.

Source: http://www.sembcorp.com/en/esg-sustainability.aspx

Box 18.2 Health, Safety and Environment Policy of the Sponsor

Sembcorp's Health, Safety and Environmental Policy

Sembcorp manages health, safety and environment responsibilities as our first priority. We are committed to continuously improving our HSE performance and managing HSE risks associated with our activities, products and services. We are committed to continuously improving our HSE performance and managing HSE risks associated with our activities, products and services.

Sembcorp has established and will maintain a HSE management system, and integrate HSE considerations into all aspects of our business operations by implementing the following policy which aims to prevent accidents, injuries, occupational illnesses and pollution as well as conserve natural resources:

- Stress to all employees and contractors their responsibility and accountability for safe performance and set appropriate objectives and targets to continually improve HSE performance
- Educate employees to be aware of and understand the safety risks and health hazards associated with their job and the potential impact on the environment
- Make available this policy to all interested parties upon request
- Build, design, operate and maintain facilities and conduct operations in a manner that safeguards people, property and the environment, and minimises waste
- Comply with all HSE laws and regulations and other HSE requirements applicable to Sembcorp's activities, products and services
- Offer assistance to and influence suppliers, contractors and other interested parties to improve their HSE performance where necessary
- Review and evaluate operations to measure progress and ensure compliance with this policy via periodic system audits and management reviews
- Prepare for, and respond quickly to, accidents or other emergency situations to mitigate adverse impact on people, property and the environment

Source: http://www.sembcorp.com/en/esg-health-safety-and-environment.aspx

18.3 SUMMARY OF IMPACTS AND MITIGATION/ MANAGEMENT MEASURES

Key environmental and social impacts have been identified and reported in the following chapters:

- Chapter 7: Air Quality;
- Chapter 8: Greenhouse Gas;
- Chapter 9: Surface Water Quality;
- Chapter 10: Noise and Vibration;
- Chapter 11: Landscape and Visual;
- Chapter 12: Soil and Groundwater;
- Chapter 13: Waste;
- Chapter 14: Terrestrial and Marine Biodiversity;
- Chapter 15: Social Impact Assessment; and
- Chapter 16: Cumulative Impact Assessment.

A summary of mitigation measures identified for the construction and operation phases of the Project is presented in ***Table 18.1***. This also identifies lead responsibility for implementing the mitigation measures and sources of funds for such implementation. Many of the mitigation measures suggested during the construction phase of the Project are associated with good construction and housekeeping practices. Most of the mitigation measures for the operation phase (such as those for air emissions and noise generation) of the Project are already incorporated into the Project design specifications.

The construction phase of the Project is anticipated to start in the first quarter of 2016 and be completed in the region of 22.5 months, whereas the operation phase of the Project is 22 years, as per the Power Purchase Agreement.

The Sponsor will be responsible for ensuring that the mitigation measures in the ESMP are implemented throughout the life span of the Project.

18.4 DETAILED MANAGEMENT PLAN

Based upon the outcomes of the ESIA, detailed management plans are required to guide the Sponsor and its contractors in the implementation of all mitigation and management measures. This is essential to ensure that the key outcomes of the impact assessment process are put in place throughout the life of the Project, and their overall efficacy tracked. These detailed management plans will be leveraged by EPC contractors in developing their own management plans.

As identified with the summary of impacts and mitigation and management measures, the following detailed management plans are considered necessary to effectively implement the outcomes of the ESIA throughout the life of the Project:

- Air Quality Management Plan;
- Plant and Vehicle Management and Maintenance Plan;
- Traffic Management Plan;
- Noise and Vibration Management Plan;

- Surface Water Management Plan;
- Soil and Groundwater Management Plan;
- Biodiversity Action Plan;
- Waste Management Plan (Hazardous Waste);
- Waste Management Plan (Non Hazardous Waste);
- Oil and Chemical Spill Contingency Management Plan;
- Emergency Response Plan (including Community Emergency Response Plan);
- Worker Occupational Health and Safety Management Plan;
- Stakeholder Engagement Plan (including Grievance Management Plan);
- Community Development Plan (CDP);
- Community Health Management Plan;
- Workers' Accommodation Management Plan;
- Local Recruitment and Procurement Plan;
- Influx Management Plan;
- Worker Training Plan(including Induction Training Program);
- Cultural Heritage Chance Find Procedure; and
- Security Plan.

It is intended that these documents will be prepared to cover the site clearance and construction phases of the Project. Prior to operation commencing documents will be developed to cover the operation phase.

Specific plans will be disclosed to stakeholders at the appropriate time.

It is to be noted that commitments and framework for the implementation of Emergency Response Plan (ERP) and Stakeholder Engagement Plan (SEP), including Grievance Management Plan, have been disclosed to the relevant staeholders during the public consultation during 2nd – 5th September 2015.

18.5 ENVIRONMENTAL AND SOCIAL MONITORING PROGRAMME

Monitoring is a means verifying overall effectiveness of the management and mitigation measures contained within the management plans listed above. Key objectives of the monitoring process are to:

- Confirm effectiveness of management and mitigation measures;
- Ensure compliance with Applicable Standards (i.e. ADB SPS, IFC Performance Standards and IFC EHS Guidelines) and the Sponsor's objectives;
- Monitoring the status of, and impacts on, identified sensitive receptors;
- Provide an early warning that any of the control measures or practices are failing to achieve their desired performance and ensure changes can be implemented to remedy these practices;
- Determine whether environmental and social changes are attributable to Project activities, or as a result of other activities or natural variation; and
- Provide a basis for continual review and improvements to Project design and execution.

18.5.1 *Performance Indicators and Monitoring Schedule*

Physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator has been prepared for all phases of the Project and is presented in ***Table 18.1***.

This includes the tentative parameters to be measured, methods to be utilised, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

However, it is to be noted that the detailed and specific monitoring measures will be developed and included within the relevant management plans. The monitoring components of the various management plans will be refined and finalised during plan development.

Impact monitoring will be undertaken during the life of the Project to verify the predicted levels of residual impacts from the Project and the effectiveness of the various management plans.

18.5.2 *Reporting Mechanism for Environmental and Social Monitoring Programme*

A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will ensure regular flow of information from the Project site to the Project headquarters and, as necessary, to regulatory authorities and funding agencies. The reporting system will provide a mechanism to ensure that the measures proposed in the Project's ESMP are implemented.

Prior to the commencement of the construction activities, the Sponsor will finalise the format and frequency for reporting on the status and progress of environmental and social monitoring.

During construction phase, it is recommended that the report shall be submitted to the relevant authorities and funding agencies on a regular basis during construction and operation. Frequency will be agreed with relevant authorities and funding agencies.

However, it is recommended that the Sponsor shall submit the report to the relevant authorities and funding agencies on six-monthly basis during construction and on annually basis during operation.

The format will be designed to meet all the compliance conditions associated with the local and international requirements. The contractor will be required to submit the duly filled up reporting form on the agreed frequency to the Sponsor.

Table 18.1 Environmental and Social Management Plan of the Project

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
A	***Site Preparation and Construction Phase***							
1.1	Air Quality	Operation of heavy machinery and transport vehicles	Exhaust Emissions	• A speed limit of 20 km/hr will be enforced on the construction site/access road. • Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NO_x, PM_{10} and SO_2. • Where available use low sulphur diesel (LSD) in HGVs and diesel powered equipment. • Implement best practice procedures to control vehicle / equipment air emissions (such as turning off equipment when not in use). • Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts will be serviced/ replaced.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost
1.2	Air Quality	Overall construction activities	Dust	• Erection of minimum 2m high site hoardings around the site boundary. • Water spraying of or covering all exposed areas and stockpiles. • Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust. • Minimizing the size of exposed areas and material stockpiles and the periods of their existence. • Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time. • Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions. • Cleaning wheels and the lower body parts of trucks at all exits of the construction site. • Cleaning the entire construction work sites at least once per week. • Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary. • Watering the main haul road regularly to suppress dust emissions during truck movement. • Prohibiting the burning of waste or vegetation on site. • Compacting the reclaimed land immediately to avoid fugitive dust emissions. • Maintaining and checking the construction equipment regularly. • Switching off engines when idling. • Using ultra-low sulphur diesel for trucks and diesel-fuelled construction equipment if available.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost
1.3	Air Quality	Concrete Batching Plant (CBP)	Dust	• Using grid electricity for the operation of the CBP to minimize the potential air emissions from diesel burning. • Equipping all vent exhausts with dust suppression measures such as dust filter or scrubber, etc., to reduce dust emissions as much as possible. • Carrying out in such a manner that dust emissions will be prevented or minimized during loading, unloading, handling, transfer or storage of other raw materials which may generate airborne dust emissions such as crushed rock, sand, stone aggregates. • Enclosing all receiving hoppers and belt conveyor systems totally. • Storing all aggregates with a nominal size of less than or equal to 5 millimetres and cement in an enclosed area. • Wetting all access roads and routes within the CBP. • Maintaining a high standard of housekeeping always. All spillages or deposits of materials on ground, support structures or roofs will be cleaned up promptly. • Any dumping of materials in open areas will be prohibited.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost
1.4	Air Quality*	Monitoring		• Monthly on-site inspection is recommended to ensure proper implementation of the proposed mitigation and management measures.	EPC Contractor	Designated EHS team on site	Monthly monitoring report to the Sponsor	EPC Contractor Cost
2.1	Greenhouse Gas	Construction activities including Operation of heavy machinery and transport vehicles	GHG emissions	• A speed limit of 20 km/hr will be enforced on the construction site/access road. • Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NO_x, PM_{10} and SO_2. • Where available use low sulphur diesel (LSD) in HGVs and diesel powered equipment. • Implement best practice procedures to control vehicle / equipment air emissions (such as turning off equipment when not in use). • Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts will be serviced/ replaced.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				• Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency. • Develop vehicle maintenance plan.				
3.1	Surface Water Quality	Wastewater Discharges and Runoff	Impacts to surface water due to wastewater discharges and sediment-laden runoff	• Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system. • Implement adequate sanitary facilities, (one toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce. • Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge. • Septic tanks will be provided to treat sanitary discharge. • Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation. • Open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms. • Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including wheel cleaning facilities. • Provision of channels, earth bunds or sand bag barriers on site to direct stormwater to silt removal facilities. • Design drainage pipes and culverts for the controlled release of storm flows. • Protect temporary trafficked areas on-site with coarse stone ballast or equivalent. • Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times. • Provide measures to reduce the ingress of site drainage into excavations. If trenches have to be excavated during the wet season, excavate and backfill them in short sections wherever practicable. Discharge any water pumped out from trenches or foundation excavations into storm drains via silt removal facilities. • Mulch to stabilise exposed areas, where practicable and appropriate. • Re-vegetate areas promptly, where practicable and appropriate. • Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage system of open stockpiles of construction materials. • Install onsite wastewater treatment facilities or processes such as filtration, flocculation or biochemical treatment before discharge to river. • Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the stormwater system. • Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater. • Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost
3.2	Surface Water Quality	Waste Storage and Disposal	Impact to surface water contamination from inappropriate waste management	• Implement the same mitigation measures to minimize impacts to Waste Management (See 6.1 and 6.2). • Provide training to labourers for waste disposal in designated areas and use of sanitation facilities. • Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials. • Implement construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period. • Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance). • Store wastes in closed containers away from direct sunlight, wind and rain. • Store waste systematically to allow inspection between containers to monitor leaks or spills. • Ensure that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container. • Dispose of waste by licensed contractors.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
3.3	Surface Water Quality	Accidental Spills and Leaks. Potentially from fuelling and operation of heavy machinery, transport vehicles and Storage and handling of chemicals	Impact to surface water due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuel storage	• Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal. • Hazardous waste storage areas will comply with best practice/ international standards. • Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the early stages of the Project implementation. • Carry out land contamination assessments and identification of legacy contaminated land sites. • Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks. • Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals. • A site specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination. • Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry. • Use of spill or drip trays to contain spills and leaks. • Use of spill control kits to contain and clean small spills and leaks. • The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters. • Contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events. • Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period; • Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials. • Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types' generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance). • Store wastes in closed containers away from direct sunlight, wind and rain. • Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills. • Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container. • Storage of inert concrete waste in a laydown area near the concrete batching plant and reuse of these wastes under floors or roads. • Dispose of hazardous waste including bitumen by licensed contractors. • Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage). • Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost
3.4	Surface Water Quality	Barge transport	Impact on Ayeyarwady River due to routine discharges of oily bilge and ballast water from barges; dumping of non-biodegradable solid waste and accidental oil/ cargo spills or toxics	• Only barge operators that comply with the relevant local and international standards and are permitted to operate barges for transportation purposes will be engaged. • Barges used for Project material transport will be independently inspected and audited by the Project EHS Management Team. Each barge will be inspected at least once every 6 months and records maintained. If any continued non-compliance is observed over two (2) audit inspections, the Project will terminate the services of the barge transporter.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor containing relevant records and details	EPC Contractor Cost
3.5	Surface Water Quality*	Monitoring of surface water quality		• Monthly on-site inspection is recommended to ensure proper implementation of the proposed mitigation and management measures. • Monitoring of surface water quality of at Nyaung Hla Jetty for turbidity, pH, DO, Total dissolved solids, oil and grease, total coliform, heavy metals, once in every month by using standard analytical methods for the duration of the usage of the jetty. • Please refer to ***Table 18.2*** for details.	EPC Contractor through 3rd Party Environmental Consultant	On site Project Management team and designated EHS team	Monitoring report to the Sponsor	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
4.1	Noise	Overall construction activities inc. heavy machinery operations for construction works	Increase in ambient noise levels	• Install noise barriers at the Project Site boundary. In accordance with BS 5228-1:2009, the barrier material shall have a mass per unit of surface area in excess of about 7 kg/m2 and no gaps at the joints. The minimum height of barriers is typically such that no part of the noise source will be visible from the noise sensitive receiver; • Well-maintained equipment to be operated on-site; • Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; • Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use; • Reduce the number of equipment operating simultaneously as far as practicable; • Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; • Locate noisy plant as far away from receptors as practicable; • Avoid transportation of materials on- and off-site through existing community areas; and • Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Sponsor	EPC Contractor Cost
4.2	Noise	Increased traffic	Increase in ambient noise levels	• Vehicles should be regularly maintained. • Avoid transportation of materials on- and off-site through existing community areas.	Appointed EPC Contractor	On site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
5.1	Landscape and Visual	Construction activities	Visual impacts due to construction activities and the construction of linear infrastructure	• The extent of the construction areas (including any laydown areas) is to be limited to minimum extent necessary. • The design for earthworks and cut and fill should ensure that it is blended with the landscape as much as possible. • Cut and fill slopes as well as areas disturbed by construction activity are to be suitably top soils and revegetated as soon as is possible after shaping. • All existing large trees, if any, that fall outside the earthworks areas must be retained. • Felled trees, if any, should be replaced where possible and the perimeter to the power plant site should be replanted with native trees. • Hoarding is to be but in place around the power plant construction site. The colour of this hoarding should blend in with the surrounding environment as much as possible. • Laydown areas which will no longer be required for the operation stage are to be landscaped with suitable vegetation after the construction work is completed.	Appointed EPC Contractor	On site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
6.1	Waste	Disposal of Removed Biomass	Impacts due to improper disposal of removed biomass	• No vegetation is to be disposed of by burning under any circumstances. • Generally biomass such as trees, shrubs and grass are utilised by the local community for a variety of purposes. The Sponsor will engage with the local community to ensure that they are provided with priority access to all of the biomass. In order to ensure public safety and limit access to the site (given its proximity to the steel mill), the Sponsor will first clear of the biomass and store it in a designated area (most likely the north-east corner of the site closest to the village of Sa Khar) where the local community are easily able to access it. • Any biomass not taken by the local community biomass is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities.	Appointed EPC Contractor	On site Project Management team	Report to the Sponsor during site clearance	EPC Contractor Cost
6.2	Waste	Solid Waste Generation, Storage and Disposal	Impacts to community and worker health and safety due to contamination of drinking water or food Accidental leaks or spills of oil, fuel or other hazardous materials could potentially pollute surface waters Soil may be contaminated by pollution from spills or	• Waste collection and storage measures will be implemented. • Prior to construction commencing, the Sponsor is to engage with local authorities and other stakeholders (such as the Steel Mill) to determine the capacity of the local waste management network to absorb the new waste streams during construction. • A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. • Education of all workers on site shall be undertaken to avoid, reduce and reuse wastes generated. • Waste disposal facilities shall be sited and signposted throughout the construction site. • Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site. All waste collected should be managed and	Appointed EPC Contractor	On site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
			leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored.	disposed of in accordance with the accepted best practice for waste collection and disposal. • Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations. • Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations. • The appointed waste contractor shall report on an annual basis on any cross-boundary transport of waste.				

7.1	Soil Quality	Site clearing and preparation, Laying of gas pipeline, use of heavy loaders from the temporary jetty site	Soil compaction	• Delineation of clearance boundaries to limit the areas to be cleared.
				• Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds.
				• Revegetation areas with temporary land use, conducting progressive rehabilitation.
				• Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers.
				• Reuse topsoil as much as possible within rehabilitation activities.
				• Control erosion through diversion drains, sediment fences, and sediment retention basins.
				• Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied:
				  • Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well.
				  • To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion.
				  • Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible.
				  • Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.
					Appointed EPC Contractor	On site Project Management team	Route plans and top soil management inventory submitted to EHS and Project Management team	EPC Contractor Cost

7.2	Soil and sediment Quality	Sourcing of backfill material. Fuelling and operation of heavy machinery and transport vehicles. Unloading and loading activities near the temporary jetty.	Soil and sediment contamination through spills and leaks and use of potentially contaminated fill material	• Unloading and loading protocols will be developed to ensure that staff are able to undertake these tasks in a manner that minimises the risks of spills occurring.
				• Fuel tanks and chemical storage areas will be sited on sealed hardstand areas, provided with locks to prevent unauthorised entry where appropriate.
				• Secondary containment, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any hazardous spills and to exclude surface water run-off from entering the contained area. The containment capacity of these areas is to accommodate 110% of the volume of the largest container.
				• Any refuelling activities will only take place within a designated hard stand area with spill kits present.
				• All mobile equipment is to be equipped with spill or drip trays to contain spills and leaks.
				• Equipment and vehicle maintenance scheduling is to be undertaken such that they are continually monitored for potential or actual leaks.
				• Mobile toilets are to be provided throughout the construction are for use by workers. No sanitary effluent is to be disposed of on, or adjoining the site.
				• A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency procedures and practices related to contamination events;
				• Should any of the above measures fail to prevent spills or leaks occurring, the follow are also to be in place to ensure that any contamination is swiftly cleaned.
				  • Specific guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals is to be developed.
				  • A site specific Emergency Response Plan will be prepared for soil clean-up and decontamination.
				  • All mobile vehicles are to be equipped with spill control kits to contain and clean small spills and leaks.
					Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Plans submitted to EHS division for approval and monthly reports to the Sponsor	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				• For any spills or leaks, once the initial emergency response has been implemented, an appropriate mean up and monitoring plan is to be developed. This is to take into account the type of spill and its extent. It is also to include provisions for monitoring of soil and groundwater quality to track potential or actual migration of the contamination through the soil and groundwater profiles.				
7.3	Soil Quality	Storage, handling and disposal of construction waste	Soil contamination	• Storage of all inert concrete waste will be undertaken in a dedicated laydown area near the concrete batching plant, and reuse of these wastes under floors or roads. • A dedicated storage area for construction material will be developed to minimise the potential for damage or contamination of the material. • Sufficient space will be left between all waste containers so as to identify any spills or leaks. • Appropriate management, storage and disposal of all waste streams will be implemented in accordance with the measures developed within 6.1 and 6.2 above. • A Hazardous Materials Management Plan and a Construction Waste Management Plan will be developed to integrate all these measures. • A construction materials inventory management system will be implemented to minimise over supply of and construction materials (hazardous and non-hazardous), which may lead to disposal of the surplus materials at the end of the construction period.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Plans submitted to EHS division for approval and monthly reports to the Sponsor	EPC Contractor Cost
7.4	Soil Quality	Generation of sanitary effluent	Soil contamination	• Adequate sanitary facilities, (one toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce. • Liquid effluents arising from construction activities will be treated to the standards specified in the applicable IFC guideline prior to discharge. • Septic tanks will be provided to treat sanitary discharge.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Plans submitted to EHS division for approval and monthly reports to the Sponsor	EPC Contractor Cost
8.1	Ground Water Quality	Fuelling and operation of heavy machinery and transport vehicles	Contamination of groundwater	• See 7.2	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
8.2	Ground Water Quality	Generation of sanitary effluent	Contamination of groundwater by sanitary effluent	• See 7.4	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
8.3	Ground Water Quality	Storage and handling of chemicals	Contamination of groundwater	• See 7.2	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
8.4	Groundwater Quantity (Drawdown)	Groundwater use for construction operations	Draw-down from extraction of onsite groundwater wells could potentially impact groundwater levels.	• Monitor the quantity of groundwater abstracted and associated draw down. • Address and respond to any community complaints regarding Project impacts on groundwater availability.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
9.1	Terrestrial and Marine Biodiversity	Site Preparation and Construction activities	Loss of habitat	• The design and layout plan will be prepared to minimise tree cutting and protected area disturbance where possible. The Project owner shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning these restrictions, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations. • The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing. • Project will utilise or upgrade existing roads where possible to minimise unnecessary clearing requirements.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
9.2	Terrestrial and Marine Biodiversity	Site Preparation and Construction activities	Disturbance to fauna behaviour	• Construction vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation. • Arrangement of transportation schedules will aim to avoid peak hours of road usage to minimise heavy traffic through habitat areas. • Traffic signs will be installed on all roads throughout construction areas depicting speed limits. • For construction areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible. • Commitment will be made to raise awareness of the construction work force and make arrangements for restriction of poaching.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
9.3	Terrestrial and	Site Preparation and	Barrier to movement and	• The Project shall implement landscaping and re-vegetation after completion of construction in	Appointed EPC	EHS Division of the Sponsor and on	Monthly report to	EPC

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
	Marine Biodiversity	Construction activities	habitat fragmentation	suitable areas to establish a suitable riparian corridor. • In-stream works will be carried out in low-flow conditions where possible. • The transmission line will not be fenced.	Contractor	site Project Management team	the Sponsor	Contractor Cost
9.4	Terrestrial and Marine Biodiversity	Site Preparation and Construction activities	Edge effects	• Dust suppression techniques will be utilised during construction, to control the dispersion of dust created by clearing lands at the construction sites. • The Project shall implement landscaping and re-vegetation after completion of construction using native species where possible. • To avoid/minimize releasing sediment load into the river, erosion control measures will be implemented and maintained e.g. using silt fence and temporary re-vegetation to minimize sediment transport from steep slope releasing to the river and smaller waterways. • Weed and pest management measures should be implemented in accordance with a Project weed and pest management plan to avoid introduction of weeds to natural and modified habitat areas.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
9.5	Terrestrial and Marine Biodiversity	Site Preparation and Construction activities	Degradation of habitat	• Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction areas. • For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed surfaces. • Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors. • Weed and pest management measures should be implemented in accordance with a Project weed and pest management plan to avoid introduction of weeds to natural and modified habitat areas. • Speed limits to maximum of 20 km/hr for construction vehicles will be enforced to limit noise and dust generation. • Construction materials and chemicals will be appropriately secured and locked down during flood season to avoid accidental release to the natural environment. • Engineering works will be designed to comply with the agreed water quality standards; • Water quality monitoring will begin as soon as possible after the Project begins, in order to control the quality of discharge water. • Emergency response plan and procedures will be prepared and implemented for the construction activities of the Project. This will include emergency drills and education of Project workers.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
9.6	Terrestrial and Marine Biodiversity	Site Preparation and Construction activities	Fauna mortality	• Speed limits to maximum of 20 km/hr for construction vehicles will be enforced to minimise potential for fauna strike. • Commitment will be made to raise awareness of values of natural habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection. • Hunting wild animals will be strictly prohibited to apply for all staff. • Fishing and using of illegal fishing gear anywhere along the river will be prohibited.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
10.1	Transportation	Transportation of personnel by road	Disturbance to existing road users through increase in road traffic	• Accommodation for the migrant construction workforce and Sponsor personnel shall be provided in the vicinity of the Project site to minimise the distance travelled. • Road safety initiatives will be implemented to minimise risks to other users, including: o Emphasizing safety aspects among drivers, particularly with regard to safe driving speed of 20 km/hr; o Ensuring that only licensed drivers are employed by the Project; o Avoiding peak hours where possible; o Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure; o Driving and road safety procedure will be developed; and o Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
11.1	Occupational Health and Safety	General construction activities	Health and safety of construction workforce	• The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, plant utilisation, construction sequence and safety arrangements. o Measures will be implemented to reduce the likelihood and consequence of the potential	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost

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				hazards. This shall include (but not limited to) the following hazards: falling from height; ○ falling into water; ○ entanglement with machinery; ○ tripping over permanent obstacles or temporary obstructions; ○ slipping on greasy walkways; ○ falling objects; ○ asphyxiation; ○ explosion; ○ contact with dangerous substances; ○ electric shock; ○ variable weather conditions; ○ lifting excessive weights; and ○ traffic operations. • A Permit to Enter system will be established to ensure that only authorised persons gain entry to the site. • Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted. • All persons working on site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor. • The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, plant utilisation, construction sequence and safety arrangements. • All workers will be properly informed, consulted and trained on health and safety issues. • Personal Protective Equipment (PPE) shall be worn at all times on the Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips. • Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus will be tested at regular intervals in the manner specified by the manufacturer. • All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded. • All scaffolding will be erected and inspected in conformity with the Factories Act (1951) and the appropriate records maintained by the Contractor. • Safety hoops or cages will be provided for ladders with a height in excess of two metres. • When there is a risk of drowning lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the temporary jetty site). • All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used. • Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards. • The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations.				
11.2	Occupational Health and Safety	Labour and working conditions	• Working conditions • Terms of employment • Child/ forced labour	• The EPC contractor will comply with the IFC Performance Standard 2 and ADB SPS, Safeguard Requirement 1: Environment for labour and working conditions. • Develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
11.3	Occupational	Monitoring and review of		• Daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous	Appointed EPC	EHS Division of the Sponsor and on	Monthly report to	EPC

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	Health and Safety	accidents/ incidents due to construction activities; workers' health		occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plant, which will be prepared by the EPC contractor.	Contractor	site Project Management team	the Sponsor	Contractor Cost
12.1	Community Health	Influx of construction workers	Increased prevalence of disease	• Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project area villages – e.g. through the training of workers that have been sourced from the local villages. • Establish amenities at the camp to help minimize the interaction between the workforce (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure. • Establish a workforce code of conduct. Include in the code specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers. • Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases. • Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite. • Provision of onsite health care, to ensure that medical attention can be sought should a worker present with the symptoms of a communicable disease and facilities for workers to reside if ill. This will also help reduce the potential pressure on local health care facilities. • Emergency management procedures should a health issue escalate and require a rapid response.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
13.1	Community Safety and Security	Construction activities, construction material transportation	Community disturbance and potential safety hazard due to road traffic	• Develop and implement a traffic management plan. The plan should set out the measures to minimize the risks associated with transporting materials, goods, and workers to and from site. This includes fatigue management, busing workers to and from the Project site, and ensuring all employees observe recommended speed limits. • Ensure all employees complete training prior to driving any Project vehicle. The content of the training should be tailored to the employee's role. • Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic. • Provide appropriate training for security personnel and monitor implementation of the training over time (to minimize any potential use of excessive force). • Develop and implement waste management plan. The plan should set out procedures for appropriately managing and disposing of hazardous materials and other forms of waste.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
13.2	Community Safety and Security			• Monitoring and review of community disturbance and potential safety hazard due to road traffic as well as accidents, incidents and complaints around the project activity areas, based on occurrence. • Please refer to ***Table 18.2*** for details.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
14.1	Community Infrastructure and services			• Develop and implement a social management plan. As part of this plan, Sembcorp will need to track in-migration. If in-migration occurs additional management measures will need to be established. As Sembcorp will have limited influence on in-migration, these measures will need to be developed in conjunction with local stakeholders (e.g. village representatives, government) so that there is a comprehensive response. • Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services; • Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. • Develop and implement a social investment/ corporate social responsibility plan/ program. As part of the plan, Sembcorp should explore opportunities to enhance community infrastructure and services. • Develop and implement a community health management plan and an occupational health and safety plan. These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
15.1	Employment and Economy	Construction activities	Employment Opportunities and opportunities for local	• Develop and implement a local content plan. The plan should establish measures to facilitate local recruitment and procurement. This should include targets so that performance can be tracked and	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor

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			business	evaluated. Development of the plan should involve consultation with relevant stakeholders, including government authorities and local villagers. • Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the Project. • Inform local villagers of job opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate. • Inform local businesses of contracting opportunities in a timely manner. Ensure that the process is locally and culturally appropriate. • Develop an internal standard to guide labour practices, and apply this to the Project's supply chain. This should include development and implementation of an internal grievance mechanism for direct employees and contractors, and ongoing monitoring to ensure that the standard is consistently implemented across the Project.				Cost
16.1	Social Network	Construction activities	Overall social impacts	• Develop and implement a social management plan. As part of this plan, Sembcorp will need to track in-migration. If in-migration occurs additional management measures will need to be established. As Sembcorp will have limited influence on in-migration, these measures will need to be developed in conjunction with local stakeholders (e.g. village representatives, government) so that there is a comprehensive response. • Develop and implement a workforce code of conduct that addresses issues such as anti-social behavior and drug and alcohol consumption. • Provide an introduction for workers moving into the area (even temporarily) – so that workers understand local culture and customs. • Develop and implement a local content plan. A key aspect should be providing local employment opportunities (to reduce the number of workers being brought into the local area from outside).	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
17.1	Physical Cultural Resources	Construction activities	Damage to cultural resources	• Develop a chance find procedure for managing cultural heritage, and implement this procedure if any cultural heritage is discovered during construction.	Appointed EPC Contractor	EHS Division of the Sponsor and on site Project Management team	Monthly report to the Sponsor	EPC Contractor Cost
18.1	Grievance	Public concerns		• Continuous monitoring and review of complaints received from neighbouring communities around the Project activity areas as per the grievance redress mechanism.	the Sponsor	the Sponsor	Monthly report to the Sponsor	EPC Contractor Cost
19.1	Displacement	Construction Activities	• Loss of land (or access to land) • Loss of crops • Loss of housing and business or community structures • Loss of community resources	• Work with MEPE during the river water supply pipeline and 230kV overhead transmission line right of way land acquisition process, so that the process and outcome is consistent with IFC and ADB requirements; • Establish plans based on a resettlement framework; and • Consultation with stakeholders that may be impacted by the Project, to ensure that stakeholders are clear about the potential impacts and proposed mitigation measures.	the Sponsor	the Sponsor	Monthly report to the Sponsor	EPC Contractor Cost
20.1	General	Inspection of mitigation compliance		• Daily visual inspection of all active work areas within the project activity areas[(1)] and construction workers camp to ensure general compliance with mitigation measures presented in the ESMP and as specified in EPC Contractor Manual.	EHS Team of EPC Contractor	On site Project Management Team and Designated EHS team on site	Monthly report to the Sponsor	EPC Contractor Cost

(1) Activity areas are defined as Project site, access road and gas/ water pipeline alignment.

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B	***Operation Phase***							
1.1	Air Quality	Stack emissions	Impact on ambient air quality	• Two air emission stacks – main and by-pass stacks of 40m and 30m height respectively will be constructed - to disperse the air pollutants such that ground level concentration of air pollutants do not exceed the relevant standards in the IFC EHS Guidelines for Thermal Power Plant (2008) . • Built-in dry low NOx burners to reduce NOx emission at stack to below 25ppm at all times. • Monitor ambient air quality in and around the Project site as per the Environment Monitoring Program formulated for the Project.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to top management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
1.2	Air Quality*	Monitoring of emissions		• Continuous emission monitoring (CEM) systems will be installed common for both main stack and bypass stack for real-time data collection on emission status from the Plant to monitor emission concentrations of NOx as NO2, PM, SO2, O2, moisture content. • Annual CEM validation for NOx, CO, PM2.5 and O2 at Main Stack and Bypass Stack by using standard methods. • Monitor ambient air quality as per the Monitoring Programme formulated for the Project. Please refer to ***Table 18.2*** for details.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to top management and reports to regulatory authorities/lenders as required.	Installation of CEM systems included in EPC Cost Monitoring and maintenance in O&M cost
2.1	Greenhouse Gases	Plant emissions	GHG emissions from the plant may add to larger global warming issue	• Implement CCGT power generation technology, which is an efficient form of power generation. • Use natural gas as fuel to generate electricity, which provides more efficiency than coal because of higher operating temperatures. • Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO2e unit.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
3.1	Surface Water Quality*	Wastewater Discharges and Runoff	Impacts to surface water due to wastewater discharges during plant operation.	• Install oil/water separators to treat surface run-off prior to discharge to the storm water system. • Implement adequate sanitary facilities for onsite personnel. • Liquid effluents arising from operations will be treated to the applicable IFC guideline prior to discharge. • Design drainage pipes and culverts for the controlled release of storm flows. • Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater. • Conduct monitoring of temperature at the cooling water discharge point at a frequency of once every 15 days. Please refer to ***Table 18.2*** for details. • Implement discharge system shutdown in event that discharge temperature of effluent exceeds standard. • Efforts to be made to increase the cycle of concentration to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower. • Storm water drainage and wastewater will be treated in accordance to the applicable World Bank Group environmental requirements and World Bank/IFC guidelines. • Additionally, where applicable (i.e. to irrigation canal), the Project will, as much as possible, control the effluent discharged to the irrigation canal to be below the “Severe” restriction on use according to the FAO Guidelines for Interpretations of Water Quality for Irrigation. • Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream. The treated de-oiled water will be discharged with the plant wastewater. The Project will study the possibility to transfer to cooling water basin and used as part of cooling water stream during detailed engineering. • The sewage from the entire plant area will be collected and treated in a sewage treatment plant (STP). No untreated sewage will be directly discharged into the Ayeyarwady River or the irrigation canal near the site, or disposed of on land, for the duration of the project life cycle. • The treated effluent will comply with IFC Guidelines before discharge outside the plant premises. • In order to monitor STP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of STP. • The stormwater drainage system will be periodically inspected for blockages and cleaned at least	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost

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				once before the monsoon season each year. • Operating personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.				
3.2	Surface Water Quality	Waste Storage and Disposal	Impact to surface water contamination from inappropriate waste management.	• Implement the same mitigation measures to minimize impacts to Waste Management (See 6.1). • Provide training to all staff for waste disposal in designated areas and use of sanitation facilities. • Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance). • Store wastes in closed containers away from direct sunlight, wind and rain. • Store waste systematically to allow inspection between containers to monitor leaks or spills. • Ensure that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container. • Dispose of waste by licensed contractors.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
3.3	Surface Water Quality	Water Intake	• Impact on downstream agricultural water users. • Impact on downstream fishing activity having negative impact on fisherman's livelihood.	• The Project commits to comply with following IFC EHS guideline measures or equivalent of them that are pertinent to river water intake systems: o Reduction of intake flow to such a level that there is sufficient flow in the river to maintain resource use (i.e., irrigation and fisheries) as well as biodiversity during annual mean low flow conditions.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
3.4	Surface Water Quality	Cooling Water Discharge	Surface water impacts from discharge of cooling water.	• Comply with WBG/IFC EHS Guidelines for TPP regarding the cooling water discharge standards. • Cooling water discharge will be regularly monitored for temperature at the outfall point. • Monitor surface water quality in the irrigation canal per the Environment Monitoring Program formulated for the Project.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Incorporate the cooling water discharge requirements and installation appropriate system included in EPC Cost Monitoring and maintenance in O&M cost
3.5	Surface Water Quality	Increased Impervious Surfaces	Surface water impacts from altered hydrology due to an increase in impervious surfaces in the Project area.	• Ensure that drainage channel or irrigation canal has enough capacity to accommodate the increased rainfall runoff from the Project's impervious surface.	the Sponsor	Designated Team comprising of representation from EHS and Operations	Relevant Records as required by regulatory authorities/ lenders	EPC Contractor Cost
3.6	Surface Water Quality	Accidental Spills and Leaks	Impacts to surface water due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuel storage.	• To optimize use of antifouling and corrosion inhibiting chemicals, appropriate depth of water intake will be maintained, and use of screens will be ensured. • Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed. • Waste storage areas will be equipped with secondary containment and spill control measures (similar to the hazardous material storage areas) to limit impact to ground. • Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas. • All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground. • Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal. • Hazardous waste storage areas will comply with best practice/ international standards. • Store and handle all hazardous substances in accordance with their MSDS.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost

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				• Keep a register for all hazardous substances on site and relevant Material Safety Data Sheets (MSDSs) readily accessible for reference. • Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry. • Use of spill or drip trays to contain spills and leaks. • Use of spill control kits to contain and clean small spills and leaks. • The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters. • Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills. • Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container. • Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage) • Guidelines and procedures should be established for immediate clean up actions following any spillages of oil, fuel or chemicals. • As part of the facility-wide HSEMS, SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis. • Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation. • The spill prevention and response guidance of the General IFC EHS Guidelines (2007) will be followed and implemented.				
3.7	Surface Water Quality*	Monitoring of surface water quality		• Conduct monitoring of temperature at the cooling water discharge point at a frequency of once every 15 days. • In order to monitor STP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of STP. • Cooling water discharge will be regularly monitored for temperature at the outfall point. • Monitor surface water quality at the wastewater discharge point as per the Environment Monitoring Program formulated for the Project.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
4.1	Noise*	Operation of fixed plant and machinery during operational phase	Increase in ambient noise levels	• Select quieter equipment. • Install silencers, mufflers or acoustic enclosures to reduce sound power level of noisy equipment at all times. • Installing acoustic enclosures or other applicable control measures to ensure a maximum of 85 dB(A) at 1m away from the noise emitting equipment; • Re-locate noise sources to less sensitive areas to take advantage of distance and shielding; • Site permanent facilities away from community areas if possible. • Take advantage of the natural topography as a noise buffer during facility design.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Installation of appropriate equipment included in EPC Cost Monitoring and maintenance in O&M cost
5.1	Landscape and Visual	Presence of the Project and Operation activities	Visual impacts during the operations phase	• No further mitigation required.				
6.1	Waste	Solid Waste Generation, Storage and Disposal	Impacts to community and worker health and safety due to contamination of drinking water or food Accidental leaks or spills of oil, fuel or other hazardous materials could potentially pollute surface waters	• Waste collection and storage measures will be implemented. • Prior to construction commencing, the Sponsor is to engage with local authorities and other stakeholders (such as the Steel Mill) to determine the capacity of the local waste management network to absorb the new waste streams during construction. • A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. • Education of all workers on site shall be undertaken to avoid, reduce and reuse wastes generated. • Waste disposal facilities shall be sited and signposted throughout the site. • Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost

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			Soil may be contaminated by pollution from spills or leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored.	or unused materials from the construction site. All waste collected should be managed and disposed of in accordance with the required regulations. • Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations. • Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations. • The appointed waste contractor shall report on an annual basis on any cross-boundary transport of waste.				
7.1	Soil*			• Monitoring of soil quality in the event of any leakage or spillage of hazardous substances, with the parameters to be sampled based upon the likely chemical compositions of the material. Locations, parameters and frequency to be defined on a case by case basis. • The measures outlined for management of spills and leaks during the construction phase are to be directly carried across into the operations phase (as appropriate) and embodied within the following plans: o Hazardous Materials Management Plan. o Hazardous Waste Management Plan. o Emergency Response Plan. o Guidelines and Procedures are to be developed specifically in relation to spills and leaks management and clean-up. • To minimise use of antifouling and corrosion inhibiting chemicals, appropriate depth of water intake will be maintained, and use of screens will be ensured. • Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed. • All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground. • As part of the facility-wide HSEMS, SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis. • Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
8.1	Groundwater*			• See 7.1 • A groundwater monitoring plan (including groundwater wells installed at strategic locations) is to be developed and implemented through the life of the Project to detect any changes in groundwater quality that may be contributed to spills and leaks from the Project.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS and Operations	Relevant Records maintained. Monthly internal reports to senior management and reports to regulatory authorities/lenders as required.	Plant O&M Cost
9.1	Terrestrial and Marine Biodiversity	Plant Operations	Disturbance to fauna behaviour	• Vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation. • For areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible. • Speed limits to maximum of 20 km/hr for vehicles will be enforced to minimise potential for fauna strike.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS /Operations	Relevant Records maintained and internal report to senior management.	Plant O&M Cost
9.2	Terrestrial and Marine Biodiversity	Plant operations	Fauna mortality	• Commitment will be made to raise awareness of values of natural habitat areas and arrangements will be made for restriction of poaching and forest product collection. • Hunting wild animals will be strictly prohibited to apply for all staff. and • Fishing and using of illegal fishing gear anywhere along the river will be prohibited.	Plant EHS Team and Operations	Designated Team comprising of representation from EHS /Operations	Relevant Records maintained and monthly internal report to senior management and report to regulatory authorities as required.	Plant O&M Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
10.1	Labour Welfare -Occupational Health and Safety	Plant operations	• The health and safety impacts particular to operation of the power plant include the following: ○ Non-ionizing radiation ○ Heat ○ Noise ○ Confined spaces ○ Electrical hazards ○ Fire and explosion hazards ○ Chemical hazards • Exposure to fugitive emissions of natural gas and VOCs at diesel/oil storage areas	• Comply with Occupational health and safety guidelines presented in Section 2.0 of the General EHS Guidelines published by IFC. • Comply with Occupational health and safety guidelines presented in Section 1.2 of the EHS Guidelines for Thermal Power Plants published by IFC for the health and safety impacts particular to operation of combined cycle power plants.	Plant EHS Team	Designated Team comprising of representation from EHS /Operations	Relevant Records maintained and monthly internal report to senior management.	Plant O&M Cost
10.2	Labour Welfare -Occupational Health and Safety	Labour and working conditions	• Working conditions • Terms of employment • Child/ forced labour	• The management system will comply with the IFC Performance Standard 2 for labour and working conditions and the same will be implemented during the operation phase. • Develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed during operation phase.	The Sponsor/Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	Plant O&M Cost
11.1	Community Health	Plant operations	Increased prevalence of disease	• Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project area villages – e.g. through the training of workers that have been sourced from the local villages. • Establish amenities at the camp to help minimize the interaction between the workforce (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure. • Establish a workforce code of conduct. Include in the code specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers. • Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases. • Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite. • Provision of onsite health care and medical facility, to ensure that basic medical and first aid treatment can be sought for all hours during which activity is taking place on the work site. This will also help reduce the potential pressure on local health care facilities. • Emergency management procedures should a health issue escalate and require a rapid response.	The Sponsor/Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	Plant O&M Cost
12.1	Community Safety and Security	Plant operations	Community disturbance and potential safety hazard due to road traffic	• Develop and implement a traffic management plan. The plan should set out the measures to minimize the risks associated with transporting materials, goods, and workers to and from site. This includes fatigue management, busing workers to and from the Project site, and ensuring all employees observe recommended speed limits. • Ensure all employees complete training prior to driving any Project vehicle. The content of the training should be tailored to the employee's role. • Explore opportunities to work with local stakeholders to increase awareness within local villages	The Sponsor/Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders	Plant O&M Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				about the hazards associated with traffic. • Provide appropriate training for security personnel and monitor implementation of the training over time (to minimize any potential use of excessive force). • Develop and implement waste management plan. The plan should set out procedures for appropriately managing and disposing of hazardous materials and other forms of waste.			as required.	
12.2	Community Safety and Security	Plant operations		• Monitoring and review of community disturbance and potential safety hazard due to road traffic as well as accidents, incidents and complaints around the Project activity areas, based on occurrence. Please refer to ***Table 18.2*** for details.	The Sponsor/Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	Plant O&M Cost
13.1	Community Infrastructure and services	Plant operations		• Develop and implement a social management plan. As part of this plan, Sembcorp will need to track in-migration. If in-migration occurs additional management measures will need to be established. As Sembcorp will have limited influence on in-migration, these measures will need to be developed in conjunction with local stakeholders (e.g. village representatives, government) so that there is a comprehensive response. • Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services. • Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. • Develop and implement a social investment/ corporate social responsibility plan/ program. As part of the plan, Sembcorp should explore opportunities to enhance community infrastructure and services. • Develop and implement a community health management plan and an occupational health and safety plan. These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.	The Sponsor /Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	Plant O&M Cost
14.1	Employment and Economy	Plant operations	Employment Opportunities and opportunities for local business	• Develop and implement a local content plan. The plan should establish measures to facilitate local recruitment and procurement. This should include targets so that performance can be tracked and evaluated. Development of the plan should involve consultation with relevant stakeholders, including government authorities and local villagers. • Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the Project. • Inform local villagers of job opportunities in a timely manner. Ensure that the advertising process is locally and culturally appropriate. • Inform local businesses of contracting opportunities in a timely manner. Ensure that the process is locally and culturally appropriate. • Develop an internal standard to guide labour practices, and apply this to the Project's supply chain. This should include development and implementation of an internal grievance mechanism for direct employees and contractors, and ongoing monitoring to ensure that the standard is consistently implemented across the Project.	The Sponsor/Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	Plant O&M Cost
15.1	Social Network	Plant operations	Overall social impacts	• Develop and implement a workforce code of conduct that addresses issues such as anti-social behavior and drug and alcohol consumption. • Provide an introduction for workers moving into the area (even temporarily) – so that workers understand local culture and customs. • Develop and implement a local content plan. A key aspect should be providing local employment opportunities (to reduce the number of workers being brought into the local area from outside).	The Sponsor/Plant Management/Plant EHS Team	Designated Team comprising of representation from relevant departments as Administration and HR.	Relevant Records maintained. Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	Plant O&M Cost
16.1	Physical Cultural Resources	Operational activities	Impact on cultural heritage	• Develop a chance find procedure for managing cultural heritage, and implement this procedure if	Plant EHS Team	Designated Team comprising of representation from EHS	Relevant Records maintained and	Plant O&M Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				any cultural heritage is discovered. • Project commits, in line with IFC PS 8 objectives, to protect cultural heritage from the adverse impacts of project activities and support its preservation and to promote the equitable sharing of benefits from the use of cultural heritage.		/HR/Administration	internal report to senior management.	
17.1	Displacement	Construction Activities	• Loss of land (or access to land) • Loss of crops • Loss of housing and business or community structures • Loss of community resources	• Work with MEPE during the river water supply pipeline and 230kV overhead transmission line right of way land acquisition process, so that the process and outcome is consistent with IFC and ADB requirements; • Establish plans based on a resettlement framework; and • Consultation with stakeholders that may be impacted by the Project, to ensure that stakeholders are clear about the potential impacts and proposed mitigation measures.	MEPE	the Sponsor	Monthly report to the Sponsor	MEPE
18.1	General	Inspection of mitigation compliance		• Daily visual inspection of all active work areas within the Project activity areas[(1)] and construction workers camp to ensure general compliance with mitigation measures presented in the ESMP and operational manual	Plant EHS Team	Designated Team comprising of representation from EHS /HR/Administration/logistics	Relevant Records maintained and internal report to senior management.	Included in operation and maintenance (O&M) cost
19.1	Community Health and Safety and Risk of Industrial Accidents, Fire related accidents from gas leakage or transfer of HSD	Project Operation Phase	• Conflict with community • Management & labour relation	• Developing a Risk and Disaster Management Plan (RDMP) to charter proper protocol to be followed in the event of a disaster in order to limit the impact on the local community. • Disclose potential disasters and potential risks from the plant to the local community as well as the plan of action on emergency protocol in the event of these accidents. • Disclose and generate awareness on the RDMP as well the measures and protocols prescribed by the same. • Train employees and plant personnel on health and safety as well as handling and managing disasters and emergency events. • Maintain harmonious relation with community and create a feedback system. • Maintain sound labour and management relation to avoid conflict and disruption in operation.	Plant Management	Designated Team comprising of representation from EHS /HR/Administration/Emergency Management	Relevant Records maintained and internal report to senior management.	Plant O&M Cost

(1) Activity areas are defined as Project site, access road and gas/ water pipeline alignment.

* Criteria for Air Quality, Noise, Surface Water, Groundwater and Soil monitoring is included in Annex K for reference.

Table 18.2 Environmental and Social Monitoring Programme (Construction and Operation Phase)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Site Preparation and Construction Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and as specified in EPC Contractor Manual	Project activity areas(1) and construction workers camp	Visual inspection of all active work areas	Daily	EHS Team of EPC Contractor	EPC Contractor Cost
Noise	Increase in ambient noise levels*	Noise levels in Leq, Leq day, Leq night and hourly Leq	Identified NSRs within 500 m from the Project boundary	24-hour	Quarterly	EPC Contractor	EPC Contractor Cost
	Workers Health*	Noise levels in Leq	Identified location within the construction area	24-hour	Monthly	EPC Contractor	EPC Contractor Cost
Soil	Contamination of soil*	pH, salinity, NH_4^+, total P, heavy metals, oil & grease	Construction site or laydown area or spill area	Standard analytical methods**	In the event of any leakage or spillage of hazardous substances, oil, or toxic chemicals	3rd Party Environmental Consultant	EPC Contractor Cost
Surface Water	Contamination of surface water*	Turbidity, pH, DO, TSS, Total dissolved solids, oil & grease, total coliform, heavy metals	Ayeyarwady River (upstream and downstream) and Nyaung Hla Jetty	Standard analytical methods**	Half Yearly	EPC Contractor	EPC Contractor Cost

(1) Activity areas are defined as Project site, access road and gas/ water pipeline alignment.

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Groundwater	Groundwater availability due to abstraction	Quantity of groundwater abstracted and associated draw down	Tube well used during construction	Standard analytical methods**	Monthly	EPC Contractor	EPC Contractor Cost
Soil	Soil quality*	Monitoring of soil quality in the event of any leakage or spillage of hazardous substances, with the parameters to be sampled based upon the likely chemical compositions of the material.	Locations, to be defined on a case by case basis.	Standard analytical methods**	Frequency to be defined on a case by case basis.	3rd Party Environmental Consultant	EPC Contractor Cost
Occupational Health and Safety	Accidents or incidents due to construction activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	As defined in construction phase Health & Safety Plan to be prepared by EPC contractor	As defined in H&S Plan	EHS Team of EPC Contractor	EPC Contractor Cost
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Access Road connecting site	Incidents, accidents and community complaints	Based on occurrence	EHS and/or Community Liaison Officer of EPC Contractor	EPC Contractor Cost
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Project Company	EPC Contractor Cost
Operation Phase							
General	Inspection of mitigation	General compliance with mitigation	Project activity areas	Visual inspection of all active work areas	Daily	Plant EHS Team	Included in operation and maintenance

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
	compliance	measures presented in the ESMP and operational manual					(O&M) cost
Air Emissions	Stack emissions*	NOx as NO_2, PM, SO_2, O_2, moisture content	Main stack and by-pass stack	CEMS Annual stack emission test : following USEPA method or equivalent	Continuous and Annually	Plant EHS Team	Installation included in EPC Cost Monitoring and maintenance in O&M cost
Air Emissions	Ambient air quality*	• 1-hour and 24-hour averaged NO_2 and SO_2 • 24-hour averaged PM, PM10 and PM2.5	• One village house at Hnan Ywa village (ASR3) • One village house at Sa Ka village (ASR4) • One village house at Gyoke Pin village (ASR5) • One village house at Nyaung Kan village (ASR14)	Method published by International Organization for Standardization, or USEPA or European Committee for Standardization or equivalent	Monthly (year 1 – first 3 months of operation) Quarterly (year 1 – after first 3 months)[1]	Plant EHS Team	O&M Cost
GHG Emissions	Climate change	GHG generation	Plant control room	Natural gas consumption Pollutant release inventory	Annually	Plant EHS Team	No cost
Noise	Increase in ambient noise levels*	Noise levels in Leq, Leq day, Leq night and hourly Leq	Identified NSRs within 500 m from the Project boundary	24-hour	Quarterly	Plant EHS team	O&M Cost
	Workers Health*	Noise levels in Leq	Identified location within the construction area	24-hour	Monthly	Plant EHS team	O&M Cost

[1] As outlined in the IFC EHS Guidelines for Thermal Power Plants (2008), the effectiveness of the ambient air quality monitoring program should be reviewed regularly. If compliance is shown from the monitoring in year 1 monitoring may be stopped in year 2.

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Surface Water	Surface Water Quality*	Temperature	At cooling water discharge point	Standard analytical method**	Bi-weekly	Plant EHS Team	O&M Cost
	Surface Water Quality*	Turbidity, pH, DO, TSS, Total dissolved solids, oil & grease, total coliform, heavy metals, salnity, conductivity, sodium, chloride, boron, and nitrogen.	At wastewater discharge point	Standard analytical method**	Quarterly	Plant EHS team	O&M Cost
Soil	Soil and Sediment Contamination*	pH, salinity, NH_4^+, total P, heavy metals, oil & grease, TSS	Accidental spillage area, waste storage area, and Ayeyarwady River	Standard analytical methods**	Half Yearly	3rd Party Environmental Consultant	O&M Cost
Waste	Soil and Groundwater contaminatiion	Monitoring of waste segregation, transportation and disposal	Project activity areas, disposal site.	As to be defined in the Waste Management Plan to be prepared for the Project	As defined in Waste Management Plan	Plant EHS Team	O&M Cost
	Inappropriate waste disposal by waste contractor	Monitoring of appointed waste contractors using chain-of custody documentation	Project site Waste contractor documentation	Chain of custody documentation	As defined in Waste Management Plan	Plant EHS Team	O&M Cost
Occupational Health and Safety	Accidents or incidents due to operation and maintenance activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas	As to be defined in the H&S Plan to be prepared for the Project	As defined in H&S Plan	Plant EHS Team	O&M Cost
Community Health and Safety	Community disturbance and potential safety	Accidents, incidents and complaints	Access Road	Incidents, accidents and community complaints	Based on occurrence	EHS and/or Community Liaison Officer of the	O&M Cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
	hazard due to road traffic					Sponsor	
	Discharge of effluent and cooling water	Accidents, incidents and complaints	Adjoining Channel	Incidents, accidents and community complaints	Based on occurrence	EHS and/or Community Liaison Officer of the Sponsor	O&M Cost
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Community Liaison Officer of the Sponsor and Plant Manager	O&M Cost
CSR Activities	Community Development	Activities/ Programmes and No. of beneficiaries	Local communities around the Project activity areas	No. of beneficiaries and outcome of the activities	Periodic and need based	Admin/ HR Manager and Plant Manager	CSR Budget

* Criteria for Air Quality, Noise, Surface Water, Groundwater and Soil monitoring is included in Annex K for reference.

** Standard analytical methods for Air Quality, Noise, Surface Water, Groundwater and Soil monitoring are included in Annex L for reference.

18.6 INSTITUTIONAL SETTING AND IMPLEMENTATION ARRANGEMENTS

18.6.1 Construction Phase

The ESMP will be included in the construction contract and the contractor will be responsible for implementation of the measures associated with design and construction. The Sponsor's staff, specifically the EHS Officer and Site Engineer, will monitor the implementation of these mitigation measures by the contractors at the site. These officers will be responsible for the field level monitoring of the Project.

The roles and responsibilities of the Sponsor and EPC Contractor for implementation and monitoring have been outlined in ***Table 18.3***.

Table 18.3 Roles and Responsibilities of Sponsor and EPC Contractor

Sponsor	EPC Contractor
Obtaining statutory clearances required during pre-construction stage of the Project	Obtaining permits required during the construction stage
Overall Project co-ordination and management through EPC Contractor and supported by the third party environmental consultants	Joint verification with Sponsor and Third Party Environmental Consultant for review of ESMP implementation
Interaction and reporting to the respective department of GOM	Interaction with Sponsor and appointed supervision consultant, if any
Interaction and reporting to lenders	Filling of reporting formats as per the reporting schedule and submission to Sponsor
Effective implementation of ESMP and monitoring of ESMP implementation	Environmental monitoring through Third Party Environmental Laboratory
Carryout verification/ supervision exercises during the construction phase of the Project for implementation of ESMP	Preparation of various plans for effective implementation of ESMP by the Sponsor
Keeping records of all permits obtained by EPC Contractor	Identification of site for labour camp, batch mix plant, laydown areas
Overall supervision of ESMP implementation	Management of labour camp and to provide drinking water, sanitation facility
Approval of plans prepared by EPC Contractor	
Addressing grievances of local community and information dissemination	
Environmental monitoring through laboratory	

While the contractor or a particular party is responsible for physical implementation of the mitigating measures, the whole implementation process requires supervision, checking, documentation and verification so that problems are identified and properly addressed before they get out of hand. In order to ensure proper execution of the ESMP, implementation reviews will be conducted by the Project engineer such as the weekly construction meetings, construction log book, monthly and other construction reports etc. Records of these minutes of the weekly meeting, monthly reports and special reports on implementation of the mitigating measures will also be maintained and available for review by the Project management. It is suggested to identify documents and records that require templates and accordingly suitable templates shall be developed, which shall include but not limited to policies, procedures and work instructions, meeting minutes, monitoring results, training attendance records, emergency contract lists, action plans etc. Further, all these

templates shall be communicated to all potential users. All these records will be archived at the Project office and will be maintained by the EHS officer. All documents and records shall be archived with a unique identifier so that they can be distinguished from any other material and can be easily retrieved. The Sponsor will document the process for creating, allocating and approving unique identifiers and will communicate this to relevant staff.

18.6.2 Operation Phase

During Operation Phase, the Sponsor, especially the EHS team and operation team will be fully responsible for implementation of the ESMP. The Sponsor's staff, specifically the EHS Officer and Plant Engineer, will monitor the implementation of these mitigation measures.

18.7 TRAINING

18.7.1 Construction Phase

Prior to commencement of major civil works at site, a suitably qualified in-house/ external expert will be appointed by the EPC contractor in consultation with the Sponsor to develop and deliver a training program on implementation of the ESMP, monitoring and reporting will be conducted in line with the applicable reference framework for the Project. The training will include the following topics:

- Environment, Health and Safety Policy of the EPC contractor;
- Environment and fundamentals of environmental pollution in relation to the Project;
- EHS management plans prepared by the EPC Contractor;
- Do's and Don'ts for the construction workers;
- Safety procedures and guidelines;
- Internal reporting and response system;
- Hazardous chemicals and waste handling;

In addition, specific training will be provided to the team involved in environmental and social monitoring and reporting, which will include:

- Applicable environmental and social guidelines and standards;
- Sampling site selection guidelines in line with environmental monitoring plan;
- Sample collection, storage, transportation and analysis procedures;
- Solid and hazardous waste management;
- Quality assurance and quality control;
- Environmental monitoring report preparation

The training will help in capacity building and implementation of the ESMP during the construction phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project. The timeframe for reporting and verification during the construction phase will be agreed between the Sponsor, the relevant authorities and the Lenders.

18.7.2 *Operation Phase*

Prior to the commencement of the Plant operation, a suitably qualified in-house/ external environmental expert will be engaged by the Sponsor to develop and deliver a training program on operation phase environmental and social monitoring and reporting. The topics will be mostly same as that during the construction phase. However, it will also include following modules, which are specific to the operation phase:

- Continuous emission monitoring;
- Hazardous chemicals and waste management;
- Occupational health and safety programs;

The training will help in capacity building and implementation of the ESMP during the operation phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project. The timeframe for reporting and verification during the construction phase will be agreed between the Sponsor, the relevant authorities and the Lenders.

18.8 PLANS FOR CONSTRUCTION AND OPERATION PHASE OF THE PROJECT

18.8.1 *Construction Phase*

Prior to the beginning of major site works, the EPC contractor in cooperation with Sponsor will develop the following plans:

18.8.1.1 *Emergency Response Plan*

A site specific emergency response plan will be prepared for soil clean-up, decontamination and any accidental spill management in Ayeyarwady River.

18.8.1.2 *Health and Safety Plan*

The EPC Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, plant utilisation, construction sequence and safety arrangements. Measures will be implemented to reduce the likelihood and consequence of the following hazards:

- falling from height;
- falling into water;
- entanglement with machinery;
- tripping over permanent obstacles or temporary obstructions;
- slipping on greasy or oily walkways;
- falling objects;
- asphyxiation;
- explosion;
- contact with dangerous substances;
- electric shock;
- variable weather conditions;
- lifting excessive weights; and
- traffic operations.

18.8.1.3 *Construction Environmental and Social Management Plan (Site Specific Plan)*

The EPC Contractor will prepare and implement a Construction Environmental and Social Management Plan prior to commencing work to manage the construction related environmental and social aspects.

18.8.1.4 *Traffic Management Plan*

The EPC Contractor will prepare and implement Traffic Management Plan prior to commencing work to manage the construction traffic. This will be required towards prevention of local traffic disruptions, avoid peak hours rush and prevent accidents. Movement of all heavy equipment and vehicles from Jetty to project site needs to be coordinated with the logistics team of Sponsor.

Additionally, it is to be noted that the detailed management plans as specified in ***Section 18.4*** will also be developed prior commencing activities in relation to such plans.

18.8.2 *Operation Phase*

During the operation phase of the Project, the Sponsor will develop the following plan/ management systems for effective operation of the Plant:

18.8.2.1 *HSE and Social Management System*

The Sponsor will develop and implement an HSE and Social Management System (HSE&SMS) to international guidelines for the entire Plant premises and its impact zones (project area of influence as defined under IFC PS) within two (2) years of commissioning the Plant.

18.8.2.2 *Waste Management Plan*

For effective segregation, handling, storage and disposal of solid and hazardous wastes generated from the Plant operations, a waste management plan will be developed by the Sponsor.

18.8.2.3 *Spill Response and Emergency Plan*

The Sponsor will prepare a spill response and emergency plan to address accidental spillages or release of hazardous wastes.

18.8.2.4 *Emergency Response and Disaster Management Plan*

Based on the outcome of the consequence analysis as well as detailed quantitative risk assessment of the Project after finalisation of project design, an emergency response and disaster management plan will be developed by the Sponsor. This will define protocols to be followed in the event of emergencies or disasters in order to limit the impact on the employees and the local community. The plan will address both on-site and off-site emergency situations due to the operation of the project. The plan will disclose potential disasters and potential risks from the plant to the local community as well as the plan of action on emergency protocol in the event of

any such eventuality. This will also include awareness programs for the Plant personnel, local community and local administration.

Additionally, it is to be noted that the detailed management plans as specified in ***Section 18.4*** will also be developed prior commencing activities in relation to such plans.

18.8.3 Budget

The EPC Contractor and the Sponsor will allocate separate budget for environmental and social management plan implementation, training, environmental monitoring, analysis and reporting, verification monitoring and capacity building. It should be noted that costs for many in-built mitigation measures, such as, acoustic enclosures for noise control, water and wastewater treatment, CEM, etc., are already included in the EPC contract cost estimate and/or operating cost estimates. In addition, separate budget will be allocated for CSR activities, which will be conducted by the Sponsor for community development.

18.9 UPDATING OF ESMP

This ESMP will be updated, revised and reviewed internally on regular basis to ensure particularly that ESMP continuing suitability, adequacy and effectiveness regarding the Project commitment to continual improvement. The ESMP of the Project will be monitored and reviewed on half yearly basis.

Furthermore, in the event of an unanticipated impact and design change with respect to the Project Standards (including Myanmar Government, ADB and IFC requirements), the ESMP would be updated as necessary.

19 DISASTER RISK PLAN

19.1 INTRODUCTION

A Risk and Disaster Management Plan (RDMP) has been prepared for the Project (refer to Annex M). The purpose of the RDMP is to:

- Demonstrate that accident prevention policy has been provided and a safety management system has been put in place to implement the policy;
- Demonstrate that major accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences;
- Demonstrate that safety and reliability have been incorporated into the design & construction, operation & maintenance of those installations related to its operation, and which are linked to major accident hazards within the management plan; and
- Demonstrate that emergency plans have been drawn up and that the operator is supplying information to enable the off-site plan to be drawn up in order to take the necessary measures in the event of a major accident.

19.2 FINDINGS AND RECOMMENDATIONS

The RDMP identified and highlighted the potential risks associated with the natural gas (Fuel Gas), the risk mitigation and management techniques and the systems that are in place to control and manage the installations in the safe way. The risks of the fuel gas facilities were evaluated both qualitatively and quantitatively.

A major accident prevention policy has been provided and a safety management system has been put in place to implement the policy. As the CCGT Power Plant project is in the preliminary design stage, preliminary hazard identification has been performed on the power plant. Studies such as HAZID, HAZOP and QRA studies will be performed as the project proceeds into the EPC stage. Some measures have been put in place to minimize the risk of hazardous events; general recommendations have been made to further supplement the measures currently considered. Safety and reliability have been considered in the design, construction, operation and maintenance of the CCGT power plant. Emergency plans have been developed as detailed in project documents and some recommendations have been made to the plans.

The RDMP provides the following recommendations:

- Recommendation 1: all pipes and equipment should be suitably coated against external corrosion. Also, lagging should be provided with removable panel to facilitate routine inspection of the condition of the pipework surface.
- Recommendation 2: Area around the gas supply pipeline and valve stations should be zone-classified and access-controlled to eliminate any source of ignition.
- Recommendation 3: Consider implementing a HEMP (Hazard and Effects Management Process) to identify and manage the major accidental hazards.

- Recommendation 4: a Quantitative Risk Assessment (QRA) needs to be performed during EPC stage for the Power Plant in order to evaluate the risk due to the explosion events to the On-site, Off-site population as well as the adjacent facilities. The Emergency Response Plan needs to be updated in order to take into account these explosion events.
- Recommendation 5: a HAZID for commissioning/ start-up can be performed during EPC stage in order to identify all potential risk due to these operations.
- Recommendation 6: Layout study should be conducted to assess adequacy of separation distances from major hazard installations to sensitive equipments, buildings and emergency assembly area locations.
- Recommendation 7: Comprehensive soil investigation survey is recommended to investigate ground settlement / subsidence risk.
- Recommendation 8: The design of the Power Plant should be such that the impacts due to severe earthquakes are minimized.
- Recommendation 9: Ensure sufficient coverage of Fire & Gas Detectors. Ensure sufficient coverage of fire fighting system such as hydrants, monitors, etc.
- Recommendation 10: Primary emergency communication system should be available with emergency response teams and local authority personnel involved with emergency response. Secondary / alternative emergency communication system should also be available for emergency response.
- Recommendation 11: Safety and reliability of the CCGT power plant should be review regularly during the design, construction, and operational phases.

20 CONCLUSION AND RECOMMENDATION

This Environmental and Social Impact Assessment (ESIA) report has been prepared based on the technical information provided by the Sponsor, existing studies and reports relevant to the Project, site visit, baseline environmental monitoring and the stakeholder engagement.

Through this process an assessment has been conducted of the potential environmental and social impacts attributable to the construction and operation phases of the Project. Environmental and social impacts during decommissioning of the Project have not been considered in the impact assessment, as these will depend on the options available at the time of expiry of the Power Purchase Agreement. Qualitative and quantitative (where possible) assessments of impacts have been presented, significance of each potential impact has been identified, and mitigation measures to minimise and reduce the impacts have been recommended.

Cumulative environmental impacts particularly on air quality and community health and safety have also been assessed taking into consideration the existing Steel Mill facilities. The environmental and social assessment of the Project ascertains that the Project is unlikely to cause any significant environmental and social impacts. Many of the impacts are localised and short-term or temporary in nature and can be readily addressed by some embedded control measures in the engineering design of the Project as well as additional mitigation measures as suggested in the Environmental and Social Management Plan (ESMP).

It is to be noted that the results from baseline air quality monitoring shows that the existing conditions are considered as degraded airshed, this is possibly due to the operation of the existing Steel Mill. However, the built-in dry low NOx burners will be installed in order to reduce NOx emission at stack to below 25ppm at all times. Therefore, the impacts from the stack emissions at identified air sensitive receivers (ASRs), during normal combined cycle operation or simple cycle operation, is considered negligible as the Project contribution is less than 10% of relevant air quality standards for degraded airshed.

In terms of social aspect, the results from initial stakeholder engagement indicate that the Project has received favourable support from local people and other stakeholders. Stakeholders appreciated that in addition to providing a reliable power supply to the region, the Project will have several other benefits such as supporting economic growth in the region, potential employment (direct and indirect) and improving local infrastructure.

In addition, the ESMP has been prepared as part of this report to manage and mitigate such impacts, a range of measures have been developed to reduce the overall impacts to acceptable levels and as low as reasonably practicable.

The effective implementation of the ESMP and adherence with the ADB SPS and IFC guidelines will assist in minimising the environmental impacts to acceptable levels.

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Annex A

Quantitative Risk Assessment

QRA REPORT

Sembcorp Industries Limited

QRA Study for Fuel Gas Pipeline from MOGE Gas Station to a green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar: QRA Report

September 2015

Reference: 0284993

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QRA Study for Fuel Gas Pipeline from MOGE Gas Station to a green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar: QRA Report

September 2015

Reference 0284993

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For and on behalf of ERM-Hong Kong, Limited	
Approved by:	Herve Bonnel
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This report has been prepared by ERM-Hong Kong, Limited with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

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This page is a record of all revisions in this document. All previous issues are hereby superseded.

Revision	Date	Description	Prepared	Reviewed	Approved
Revision 2	1/9/2015	Issue for Approval	AAY/TW	KT	HB
Revision 1	10/8/2015	Issue for Review	AAY/TW	KT	HB

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ANNEX A ASSUMPTION REGISTER

Environmental Resources Management (ERM) has been commissioned by **Sembcorp Industries Limited** (**Sembcorp)** to carry out a Quantitative Risk Assessment (QRA) study to assess the risks posed by the Fuel Gas Pipeline from the MOGE Gas Station to a newly constructed green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar.

The objective of the QRA Study is to demonstrate the risks generated by the Fuel Gas Pipeline from the MOGE Gas Station to a newly constructed green-field Combined Cycle Gas Turbine Power Plant (CCGTP) in Myingyan, Myanmar are confined to the "As Low As Reasonably Practicable" (ALARP) region.

The scope of work for the QRA Study:

- 1 km Fuel Gas Pipeline
- Operating pressure: 30 barg
- Pipeline Nominal Diameter: 300 mm

The main hazard associated with Fuel Gas Pipeline is loss of containment leading to an accidental gas leak. The gas is flammable and explosive due to the presence of methane and other trace hydrocarbons.

The Fuel Gas consists of light hydrocarbons with methane (>99.5 mol%) as the major component. The Fuel Gas is considered non-toxic and pure methane was assessed for consequence modelling in this QRA study.

The failure rates based on application of the EGIG data and US data to the Fuel Gas pipeline show that failure rates are 2.70 x 10-4 and 1.69 x 10^{-4} per km per year respectively. Both EGIG and US failure rates data are at the same order of magnitude of 1x10^{-4}.

As the gas pipelines concerned are new pipelines with no historical failure record. Therefore, a conservative approach is adopted with the application of the pipeline failure frequency from the EGIG data is considered in this assessment. So the failure frequency for Fuel Gas pipelines used in this report is 2.70 x 10^{-4} per km-year.

DNV Phast Risk v6.7 was used to model the gas dispersion consequence due to various failure scenarios as well as modelling of risk summation of the consequence and failure frequencies.

International risk criteria UK HSE and BS PD 8010 Part 3 were adopted in this study for evaluating the individual risks and societal risks associated with Fuel Gas Pipeline. The individual risk criteria of 1 x 10^{-6} was adopted to ensure the risks to off-site population is broadly acceptable accordingly to UK HSE Risk Framework.

Two cases, base case and comparison case, have been analysed for assessment of societal risks associated with the Fuel Gas Pipeline.:

- Base Case applied the average population density of Myanmar
- Comparison Case assumes the population density of an urban area. The population density of Yangon was selected as a representative.

The purpose of modelling 2 different cases is to understand the impact of population growth on the societal risks associated with the Fuel Gas Pipeline.

It is found that:

1) The maximum individual risk contour generated by both Base Case and Comparison Case is 1×10^{-7} per year which is broadly acceptable and compliant with the UK HSE Risk Criteria.

2) **Base Case** (Year 2017, Average Population Density for Myanmar):

   The societal risk is confined within the "Acceptable" region based on BS PD 8010 Part 3.

   Comparison Case (Year 2017, Urban Population Density)

   The societal risk is confined within the "Acceptable" region based on BS PD 8010 Part 3.

Therefore, it could be concluded that the Individual Risk and the Societal Risk associated with the Fuel Gas Pipeline is compliant with the risk criteria determined in UK HSE Risk Guidelines and BS PD 8010 Part 3 respectively [10].

1 INTRODUCTION

Environmental Resources Management (ERM) has been commissioned by **Sembcorp Industries Limited** (**Sembcorp)** to carry out a Quantitative Risk Assessment (QRA) study to assess the impact of the risks of the Fuel Gas Pipeline which starts from the MOGE Gas Station to a newly constructed green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar.

1.1 SCOPE OF WORK AND OBJECTIVES

The objective of the QRA Study is to demonstrate the risks generated by the Fuel Gas Pipeline from the MOGE Gas Station to a newly constructed green-field Combined Cycle Gas Turbine Power Plant (CCGTP) in Myingyan, Myanmar are confined to the "As Low As Reasonably Practicable" (ALARP) region.

The scope of work for the QRA Study:

- 1 km Fuel Gas Pipeline;
- Operating pressure: 30 barg;
- Pipeline Nominal Diameter: 300 mm;
- The detailed tasks include:
    - To identify all potential hazards to the off-site public associated with the Fuel Gas Pipeline;
    - To carry out a QRA study expressing population risks in terms of both Individual Risk and Societal Risk;
    - To compare Individual and Societal Risks with UK HSE Risk Framework and BS PD 8010 Code of practice for pipelines Part 3 [10]; and
    - To identify and assess practicable and cost effective risk mitigation measures, if required, to comply with the "As Low As Reasonably Practicable (ALARP)" principle used in the UK HSE Risk Framework and BS PD 8010 Code of practice for pipelines Part [10].

1.2 TERMS OF DEFINITIONS

ALARP	As Low As Reasonably Practicable
CCGTP	Combined Cycle Gas Turbine Power Plant
CO_2	Carbon Dioxide
ERM	Environmental Resources Management
FN	F-N
IR	Individual Risk
LFL	Lower Flammability Limit
MOGE	Myanma Oil and Gas Enterprise
PIR	Personal Individual Risk
PLL	Potential Loss of Life
QRA	Quantitative Risk Assessment
UK HSE	United Kingdom Health and Safety Executive

2 PROJECT DESCRIPTION

2.1 FUEL GAS PIPELINE

The Fuel Gas Pipeline from the MOGE Gas Station to a newly constructed green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar was assessed in this QRA Study.

As per BS PD 8010 Code of practice for pipelines Part 3 [10], the highest risk 1 km section of Fuel Gas Pipeline should be selected to compare with the PD 8010 Part 3 F-N criterion envelope. The Fuel Gas Pipeline running from the MOGE Gas Station to a newly constructed green-field Combined Cycle Gas Turbine Power Plant (CCGTP) in Myingyan, Myanmar with a total pipeline length of 1 km was selected for analysis in the QRA Study.

Figure 2.1 shows the section of the proposed pipeline alignment.

Figure 2.1 Proposed Pipeline Alignment (Fuel Gas Source)



2.2 PHYSICAL PROPERTIES

2.2.1 Physical Properties of Fuel Gas Pipelines

The pipeline network is designed to supply the newly constructed green-field CCGTP with Fuel Gas. The composition of Fuel Gas and other physical properties is given in *Table 2.1* and *Table 2.2.*

Table 2.1 Gas Composition & Other Physical Property Data of Fuel Gas

Component	Mole Percent	BTU Gross	Relative Density
C6 + 47/35/17	0.0199	1.05	0.0007
Propane	0.0297	0.75	0.0005
i-Butane	0.0109	0.36	0.0002
n-Butane	32.2 ppm	0.11	0.0001
i-Pentane	49.7 ppm	0.20	0.0001
n-Pentane	0.0000	0.00	0.0000
Nitrogen	0.2218	0.00	0.0021
Methane	99.5529	1007.81	0.5514
Carbon Dioxide	0.0491	0.00	0.0007
Ethane	0.1073	0.00	0.0011
TOTAL	100.0000	1012.18	0.5570

Table 2.2 Fuel Gas Pipeline Parameters

Component	Descriptions
Gas flow range	33068 kg/h
Pressure range	30 barg
Pipe Diameter (Nominal)	300 mm
Temperature range	20 Degree Celsius

2.3 POPULATION CONSIDERED

The risk of residential population surrounding Fuel Gas Pipeline considered in this study from Myingyan Power Plant was assessed.

2.3.1 Study Zone

The study zone for Fuel Gas Pipeline is defined as 300 m from the pipeline alignment based on 1% fatality thermal radiation distance. The approach to determine the study zone is consistent with IGEM/TD/2 [7] and PD 8010 Part 3 [10].

The population data within the study zone was estimated based on population density.

2.3.2 Land and Building Population

The population within the study zone was based on the following data:

- Local Population Data.

Population within or extended partly into the study zone were included in the assessment. The analysis was performed for population density based on averages Myanmar population projected to year 2017 [9].

Population Density of Residential Population

As there are no local population data available for the region, the average population density of Myanmar and the average population density of the major city Yangon [9][11] were applied in the Base Case and Comparison Case respectively. The population density applied in this study has been summarised in Table 2.3.

Table 2.3 Local Population Density Assessed in the Study

Case	Population Density (persons / km^2)	Notes
Base Case	101	The population density for base case is obtained from the average Myanmar population density projected to year 2017 [9].
Comparison Case	723	The population density in the comparison case is the population density of Yangon obtained from the Population and Housing Census of Myanmar [11]. The purpose of the comparison case was to evaluate the worst case scenario of the risks associated with the fuel gas pipeline for a case of Urban population density.

2.4 METEOROLOGICAL DATA

Wind speed, wind stability and direction data received from Lakes Environmental were used for the QRA Study.

Probability of each weather state for each direction during the day and night are shown in *Table 2.4.* Estimated based on raw data provided by Lakes Environmental was used for this study.

The wind speeds are quoted in units of meters per second, (m/s). The atmospheric stability classes refer to:

A – Turbulent

B – Very Unstable

C – Unstable

D – Neutral

E – Stable

F – Very Stable

Atmospheric stability suppresses or enhances the vertical element of turbulent motion. The vertical element of turbulent motion is a function of the vertical temperature profile in the atmosphere. The greater the rate of decrease in temperature with height, the greater the level of turbulent motion. Category D is neutral and neither enhances nor suppresses turbulence.

Table 2.4 Table of Meteorological Data

In consistency with other sections of the ESIA Report, wind speed, wind direction, daytime incoming solar radiation and night time cloud cover were obtained from Lakes Environmental. The daytime incoming solar radiation and night time cloud cover have been further analysed and converted into the Pasquill stability class.

Day	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Total
1.5B	18.365	5.673	2.950	2.024	2.974	4.729	5.934	7.573	7.071	5.717	6.681	15.483	**85.173**
2D	0.077	0.034	0.019	0.034	0.058	0.149	0.212	0.193	0.130	0.053	0.043	0.063	**1.065**
4D	1.012	0.328	0.193	0.202	0.713	2.381	3.172	2.400	1.215	0.434	0.255	0.569	**12.875**
7D	0.000	0.000	0.000	0.000	0.010	0.039	0.415	0.304	0.087	0.034	0.000	0.000	**0.887**
3.5E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1.5F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
Total	**19.454**	**6.035**	**3.162**	**2.261**	**3.755**	**7.298**	**9.732**	**10.469**	**8.503**	**6.237**	**6.980**	**16.114**	**100.0**

Night	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Total
1.5B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
4D	0.132	0.033	0.070	0.113	0.559	1.297	0.959	1.838	0.606	0.141	0.042	0.047	**5.837**
7D	0.005	0.000	0.000	0.000	0.019	0.061	0.038	0.108	0.028	0.014	0.009	0.014	**0.296**
3.5E	1.448	0.484	0.357	0.503	1.570	5.306	9.226	15.035	5.687	1.100	0.409	1.382	**42.506**
1.5F	3.816	3.412	2.834	3.064	4.080	7.139	7.839	6.279	3.722	2.298	2.632	4.244	**51.361**
Total	**5.400**	**3.929**	**3.262**	**3.680**	**6.227**	**13.804**	**18.062**	**23.260**	**10.044**	**3.553**	**3.093**	**5.687**	**100.0**

3 HAZARD IDENTIFICATION

3.1 MAIN HAZARDS FROM FUEL GAS PIPELINE

The main hazard associated with Fuel Gas Pipeline is loss of containment leading to an accidental gas leak. The gas is flammable and explosive due to the presence of methane and other trace hydrocarbons.

3.2 FLAMMABLE & TOXIC EFFECTS OF FUEL GAS

3.2.1 *Flammable effects*

Fuel Gas consists of light hydrocarbons with methane (>99.5mol %) as the major component. The lower flammability limits (LFL) for methane is given below:

LFL for methane : 5.3% (vol)

As methane is the major flammable component in Fuel Gas, pure methane was assessed for consequence modelling in this QRA study.

Consequence considered: Jet Fire, Flash Fire, Fireball, and Vapour Cloud Explosion

It is noted that while Vapour Cloud Explosion (VCE) is a possible scenario of a gas release, the event of accidental leak of Fuel Gas trapped and accumulated in a congested area in vicinity of the Fuel Gas Pipeline leading to a VCE scenario is very unlikely according to the plot plan of the pipeline and surrounding areas. Therefore, VCE was not considered as a possible scenario in this QRA study.

3.2.2 *Toxicity*

Carbon dioxide is usually considered as a simple asphyxiant, although it is also a potent stimulus to respiration and both a depressant and excitant of the central nervous system. Only under high concentrations of 20 to 30% carbon dioxide would result in unconsciousness and convulsions within 1 minute of exposure [1].

As the carbon dioxide concentration in Fuel Gas is around 5% of the total gas, Fuel Gas is therefore considered as non-toxic gas.

4 FREQUENCY ANALYSIS

Approach to frequency analysis was based on the application of world-wide historical data for similar systems modified suitably to reflect local factors.

4.1 CAUSES OF LOSS OF CONTAINMENT

4.1.1 Fuel Gas Pipeline

The principal causes for loss of containment of pipeline, based on an analysis of wide incident database, are:

- Corrosion – internal and external;
- Third party interference during road construction, due to work on other underground utilities, construction work on adjoining areas, etc;
- Material defect;
- Construction defect;
- Improper operations;
- Defect caused by pressure cycling; and
- External – flooding, subsidence, etc.

The contributions of the above causes have been included in the overall failure frequency. The assumptions made in this study have been summarised in Annex A.

4.2 REVIEW OF PIPELINE INCIDENTS AND FAILURE RATE FOR FUEL GAS PIPELINE

The Consultants undertook a review of major international failure/accident databases to identify past incidents involving transmission gas pipelines. The databases review included:

- US Gas Pipeline Incident Database, 1984 to 2013 [3]; and
- European Gas Pipeline Incident database, EGIG 1970 to 2013 [4].

The operating km-years for US gas transmission pipeline between 1984 to 2013 is 14.0 million km-years while for European gas pipelines between 1970 to 2013, it is 3.98 million-km years. These databases are based on the operating experience world-wide and therefore are more representative in terms of inclusion of various possible failure modes.

The Consultants have conducted an extensive review and analysis of these databases to derive failure rates appropriate to the Fuel Gas pipeline under

study. A brief description of the databases is included in the following paragraphs.

4.2.1 *Analysis of US Gas Failure Data*

The US Department of Transportation Research and Special Administration maintain databases for pipelines incidents (reportable) in the United States and pipeline mileage data. Under the reporting requirements, events involving a gas release that causes death, injury or damage in excess of US$50,000 needs to be reported. Due to the nature of reporting, it is possible that minor incidents of leaks are underrepresented.

The US gas database has been filtered to consider only onshore transmission pipelines and only those failures involving the body of the pipeline. There have been 2359 incidents involving loss of containment during the period 1984 to 2013. The total pipeline km-years during this period is 1.4×10^7. This gives a failure rate of 1.69×10^{-4} per km per year.

A breakdown of the 2,359 pipeline incidents according to cause of failure is given in *Table 4.1.*

Table 4.1 Summary of US Gas Onshore Transmission Pipeline Incidents by Cause 1984-2013

Cause of Failure	Description of Cause	No. of Incidents	%
1 EXTERNAL FORCE		**918**	**38.9%**
1.1 Weather		188	8.0%
1.1.1 Earth Movement	Subsidence, landslides, earthquake	109	4.6%
1.1.2 Temperature		11	0.5%
1.1.3 Heavy Rain/Flood		34	1.4%
1.1.4 Lightning		19	0.8%
1.1.5 High Wind		11	0.5%
1.1.6 Cold Weather	Thermal stress, frozen components, frost heave	4	0.2%
1.2 Excavation Damage		613	26.0%
1.3 Other forces damage	Previous damaged pipe, vandalism, Damage by fire/explosion, vehicle not engaged in excavation, previous mechanical and intentional damage	117	5.0%
2 CORROSION		**453**	**19.2%**
2.1 External	Failure of coating/ CP	273	11.6%
2.2 Internal		180	7.6%
3 WELDS, MATERIALS & EQUIPMENT FAILURE	Environment-cracking related, body of pipe, pipe seam, butt & fillet weld, joint, fitting or component, malfunction of control/relief equipment, threaded connection or coupling failure, non-threaded connection failure	**529**	**22.4%**

4 INCORRECT OPERATIONS	Includes incorrect valve position	**47**	**2.0%**
5 OTHER	Miscellaneous and unknowns	**412**	**17.5%**
TOTAL		**2359**	**100%**

4.2.2 Analysis of EGIG Data

The EGIG is an industry group of nine companies comprising all of the major gas transmission system operators in Western Europe.

The EGIG database for the period 1970 to 2013 includes 1,309 incidents against the total exposure of 3.98 x 10^6 km-years [4].

Table 4.2 EGIG Incidents Breakdown by Causes

Cause	Proportion (1970 to 2013)
External interference	28%
Corrosion	26%
Construction defects/material failure	16%
Ground movement	16%
Hot tap	6%
Others	8%

External interference remains the main cause of incidents with gas leakage.

As the diameter and wall thickness of the pipeline considered in this study are 300 mm, the accident involving pipelines in the category of 11 to 17 inches are considered. The frequency associated with the category 11 to 17 inches is 2.70 x 10^{-4} per km per year as derived from the EGIG data.

4.2.3 Conclusions on Failure rate for Fuel Gas Pipeline

The failure rates based on application of the EGIG data and US data to the Fuel Gas pipeline show that failure rates are *2.70 x 10^{-4}* and *1.69 x 10^{-4}* per km per year respectively. Both EGIG and US failure rates data are at the same order of magnitude of 1x10^{-4}.

As the gas pipelines concerned are new pipelines with no historical failure record. Therefore, a conservative approach is adopted with the application of the pipeline failure frequency from the EGIG data is considered in this assessment. The proposed failure frequency for Fuel Gas pipelines is as follows:

Fuel Gas Pipeline Failure Rate: 2.70 x 10^{-4} per km-year

4.3 PIPELINE HOLE SIZE DISTRIBUTION

4.3.1 Pipeline Hole Size Distribution to be adopted in QRA Study

For process equipment, interconnection piping, and pipelines, the following representative failure sizes were considered in this study following the leak

frequency distribution for above ground transfer pipeline adopted in UK HSE [8]:

- Rupture (> 110 mm) 2.4%
- Large Hole (>75 - ≤ 110 mm) 12.4%
- Small Hole (> 25 - ≤ 75 mm) 25.1%
- Pin Hole (≤ 25 mm) 60.0%

Table 4.3 summarises the assumption for failure frequency of above ground pipeline hole size distribution adopted in this study.

Table 4.3 Hole Size Distribution for Fuel Gas Pipeline

Category	Hole Size (inch)	Proportion
Rupture	Full bore	2.4%
Large Leak	100 mm	12.4%
Small Leak	50 mm	25.1%
Pinhole Leak	25 mm	60.0%

4.4 EVENT TREE ANALYSIS (ETA)

An event tree analysis was performed to model the development of each event from the initial release to the final outcome. The event tree takes into consideration whether there is immediate ignition, delayed ignition or no ignition. Orientation of the release is also considered. A generic event tree for above ground gas releases is shown in *Figure 4.1*. The possible outcomes include jet fires, flash fires, and fireballs.

The various branches in the event trees are discussed in the following sections.

4.4.1 Orientation of Release

The consequences of a gas release are dependent on the release rate and the orientation of the release. Failures that occur on the top portion of the pipeline result in vertical jet releases (unobstructed) and are governed by momentum jet dispersion/ momentum jet fires. Failures that occur from the bottom portion of the pipeline lose momentum due to impingement/ obstruction with the surrounding earth (for buried sections of pipeline) and therefore are governed by buoyant plume rise followed by Gaussian dispersion. For releases from flanges and valves, the release may be horizontal or inclined in addition being vertical. The probability of orientation of releases to be considered in the assessment is listed in *Table 4.4*.

Table 4.4 Probability of Orientation of Release

Equipment/ Pipework	Vertical	Horizontal	Inclined (45°)
Pressurized Gas Pipeline (above ground)	0.5	0.25	0.25

4.4.2 *IGNITION SOURCES*

In order to calculate the risk from flammable materials, information is required on the ignition sources which are present in the area over which a flammable cloud may drift. The probability of a flammable cloud being ignited as it moves downwind over the sources can be calculated. The ignition source has three factors:

Presence factor is the probability that an ignition source is active at a particular location;

Ignition factor defines the "strength" of an ignition source. It is derived from the probability that a source will ignite a cloud if the cloud is present over the source for a particular length of time; and

The ignition sources are site specific. This allows the position of the source relative to the location of each release to be calculated. The results of the dispersion calculations for each flammable release are then used to determine the size and mass of the cloud when it reaches the source of ignition. The typical ignition sources are road vehicles and the population nearby.

Roads are line ignition sources in Phast Risk v6.7. The presence factor for a line source is determined based on traffic densities, average speed along the road and the length of the road element. The location of the line source is drawn onto the site map in Phast Risk v6.7. Probability of ignition for a vehicle is taken as 0.4 in 60 seconds [6].

Phast Risk v6.7 will automatically allow for people acting as ignition sources. These are based on the population data. The presence of such sources (e.g. cooking, smoking, heating appliances, etc.) is derived directly from the population densities in the area of concern.

4.4.3 *Ignition Probability*

The potential for ignition depends not only on the presence of ignition sources but it is also a function of release rate and duration of release. Larger releases are more likely to ignite than smaller releases. Similarly, releases that continue for a longer duration have a higher probability of ignition than short duration releases.

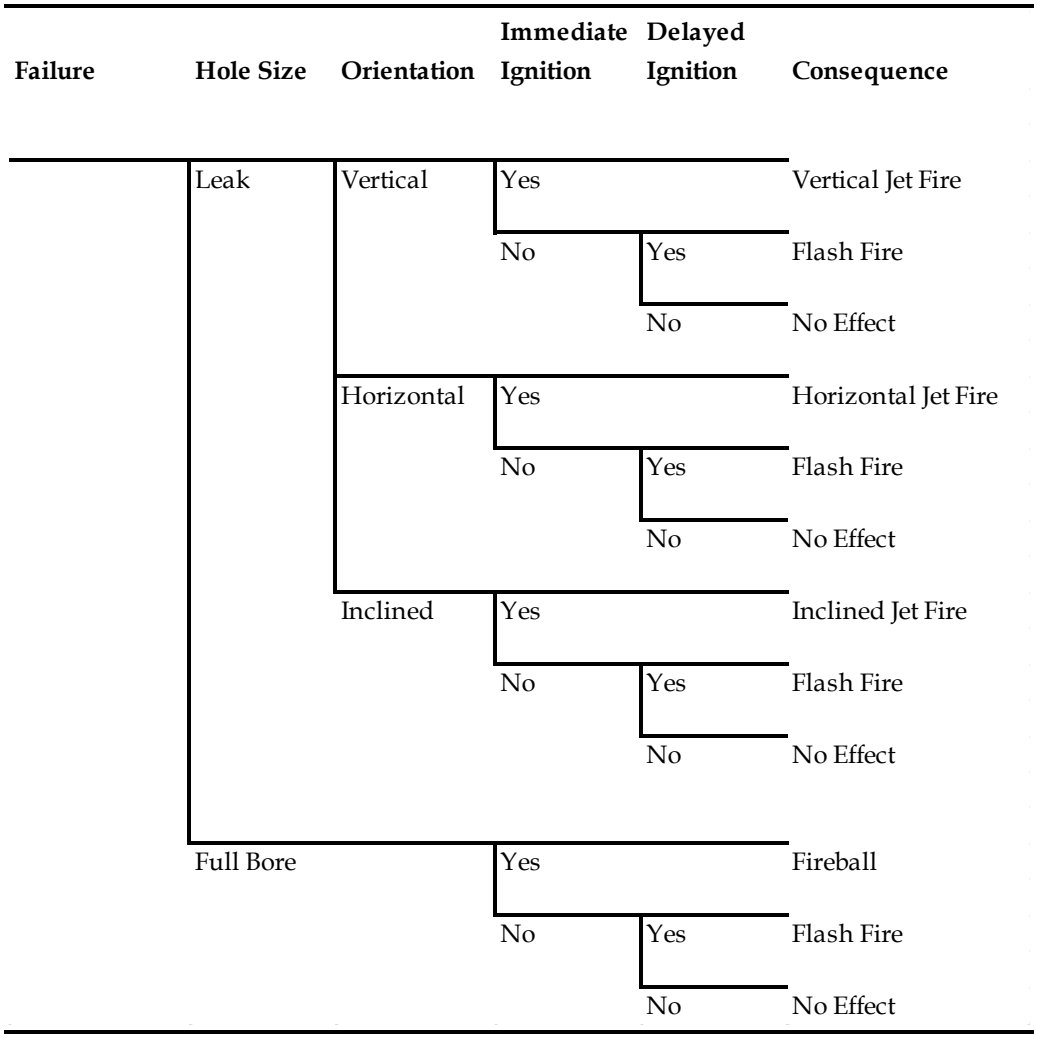
Based on a number of sources, Cox et al. [2] estimate an ignition probability based on spill size for gas and liquid releases as given in *Table 4.5*.

A factor of 0.4 was assumed for delayed ignition of all release.

Table 4.5 Ignition Probability for Plant Releases

Leak Size	Probability of Ignition	
	Gas	Liquid
Minor (<1kg/s)	0.01	0.01
Major (1 to 50kg/s)	0.07	0.03
Massive (>50kg/s)	0.3	0.08

Figure 4.1 Event Tree for Gas Release from Above Ground Pipeline



4.5 *EVENT OUTCOME FREQUENCIES*

Combining the failure rates with leak size distribution and probabilities for release orientation and ignition allows the frequency of each event outcome to be calculated.

5 CONSEQUENCE ANALYSIS

Consequence analysis was involved the following steps:

- Source term modelling; and
- Physical effects modelling.

The source term modelling comprises the application of appropriate discharge rate models to define the release rate, duration and the quantity of release. The source term modelling output forms the inputs to physical effects modelling such as the dispersion and fire modelling.

5.1 SOURCE TERM

The gas dispersion modelling of *Phast Risk v6.7* should be adopted to estimate the release rates, which was used to determine the immediate ignition probability.

Physical Effects Modelling

The scenarios following a release may include:

- Fire ball;
- Jet fire; and
- Flash fire

5.1.1 *Fireball Effects*

Immediate ignition of releases caused by a rupture in the pipeline may give rise to a fireball upon ignition.

The consequence analysis for fireball scenario was conducted by *Phast Risk v6.7* [5] with Roberts (HSE) method as the calculation method, which adopts the following equation for estimation of fireball diameter.

$R = AxM^{1/3}$

where:
R is radius of fireball;
A is substance-specific factor;
M is mass of the fireball.

The Probit equation given by Purple Book [6] is used for estimation of fatalities due to thermal radiation effects. The Probit equation is given below:

$Pr = -36.38 + 2.56 \times \ln(Q^{4/3} \times t)$

where

Pr Probit corresponding to the probability of death (-)
Q heat radiation (W m^{-2})
t exposure time (s)

Assuming an exposure time of 30 seconds (corresponding to the time taken to escape to a safe area), the radiation level of fireball effect corresponding to 1% fatality is estimated as 12.5 kW/m^2 based on Eisenberg probit, which is adopted in this study.

Persons caught in the open within the fireball diameter are assumed to be 100% fatally injured.

5.1.2 Jet Fire Effects

Jet fires result from ignited releases of pressurized flammable gas or superheated/ pressurized liquid. The momentum of the release carries the materials forward in form of a long plume entraining air to give a flammable mixture. Combustion in a jet fire occurs in the form of a strong turbulent diffusion flame that is strongly influenced by the momentum of the release.

Assuming an exposure time of 30 seconds (corresponding to the time taken to escape to a safe area), the radiation level of jet fire effects corresponding to 1% fatality is estimated as 12.5 kW/m^2 based on Eisenberg probit, which is adopted in this study.

5.1.3 Flash Fire Effects

In the event that a release is not ignited immediately, the gas will disperse with the wind and may subsequently ignite if it reaches an ignition source. Portions of the cloud within flammability limits will then burn in a flash fire. The dispersion distance to the Lower Flammability Limit (LFL) was used as the hazard footprint. Dispersion modelling was performed using *Phast Risk v6.7* for the representative weather conditions at a particular site surrounding.

In summary, referring to *Figure 4.1,* the scenarios of Flash Fire, Jet Fire and Fireball were considered in this QRA study.

5.2 RESULTS

The results of the consequence analysis for each operating pressure conditions was modelled by *Phast Risk v6.7* for risk summation.

6 RISK SUMMATION & EVALUATION

The scenarios, frequency, meteorological data and suitable modelling parameters identified was input into *Phast Risk v6.7*. All risk summation should be modelled using *Phast Risk v6.7*. The inputs to the software comprise of:

- Release cases file detailing all identified hazardous events, and their frequencies and probabilities;
- Release location of hazardous events either at given points or along given routes;
- Weather frequencies file that details the local meteorological data according to a matrix of weather class (speed/stability combinations) and wind directions;
- Population data with the number of people and polygonal shape as well as indoor faction; and
- Ignition sources with ignition probabilities in a given time period.

6.1 RISK MEASURES

The two types of risk measures considered in this QRA study are societal and individual risks.

6.1.1 Societal Risk

Societal risk is defined as the risk to a group of people due to all hazards arising from a hazardous installation or activity. The simplest measure of societal risk is the Rate of Death or Potential Loss of Life (PLL), which is the predicted equivalent fatality per year. The PLL is calculated as follows:

$$PLL = f_1N_1 + f_2N_2 + f_3N_3 + ... + f_nN_n$$

where f_n is the frequency and N_n the number of fatalities associated with the n^{th} hazardous outcome event.

Societal risk can also be expressed in the form of an FN curve, which represents the cumulative frequency (F) of all event outcomes leading to N or more fatalities. This representation of societal risk highlights the potential for accidents involving large numbers of fatalities.

6.1.2 Individual Risk

Individual risk may be defined as the frequency of fatality per individual per year due to the realization of specified hazards. Individual Risk (IR) may be derived for a hypothetical individual present at a location 100% of time or a named individual considering the probability of his presence etc. (the latter

case is known as Personal Individual Risk (PIR)). This study focuses on IR only.

6.2 *RISK EVALUATION*

The risks derived for the Fuel Gas Pipeline from the MOGE Gas Station to the CCGTP is evaluated by compar

ing against the risk criteria (guidelines) for BS PD 8010 Part 3 [10].

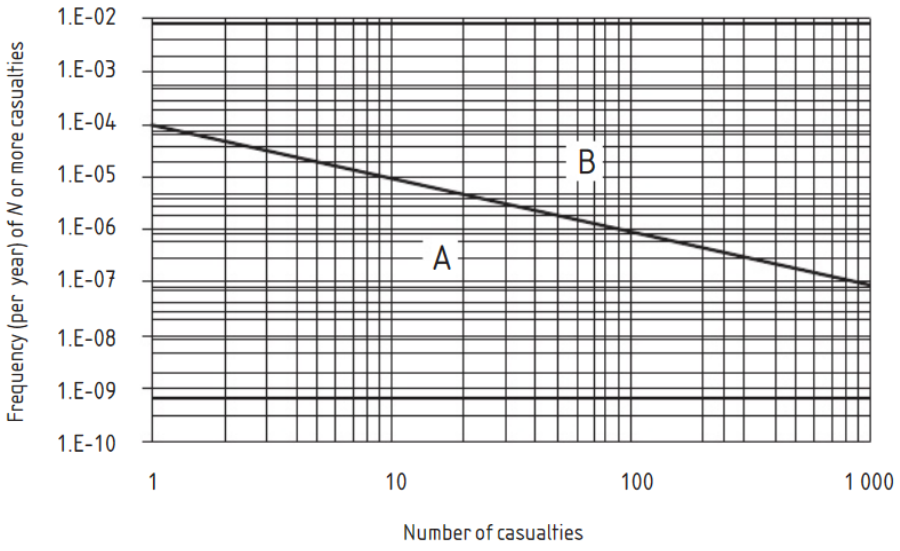
6.2.1 *UKHSE & BS PD 8010 Part 3 Guidelines*

The individual risk (IR) criteria specify that the risk of fatality to an individual is broadly acceptable if the risks are lower than 1×10^{-6} per year.

The societal risk guidelines in PD 8010 Part 3 are shown in *Figure 6.1*. There are two regions indicated on the figure:

- Unacceptable region;
- ALARP region where risk is tolerable providing it has been reduced to a level As Low As Reasonably Practicable; and
- Acceptable region where risk is broadly acceptable.

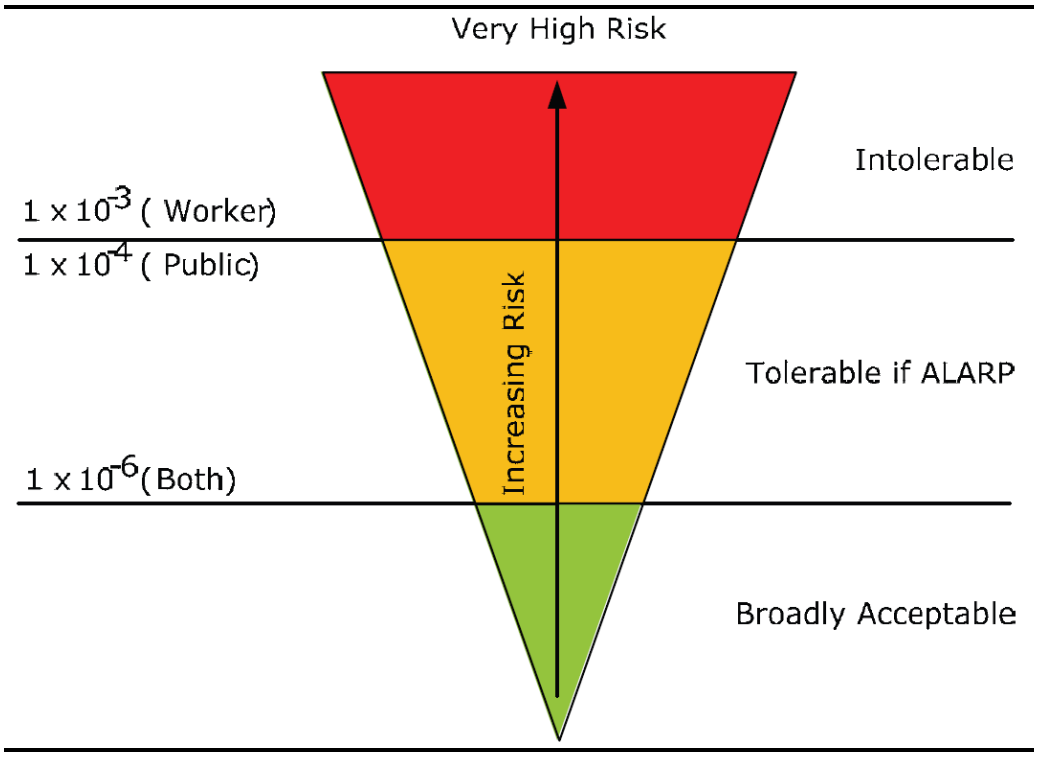
Figure 6.1 ***Societal Risk Guidelines for Acceptable Risk Levels – BS PD 8010 Part 3 Guidelines***



Key
A Broadly acceptable
B Tolerable if ALARP

From an analysis of the above risk results, the dominant contributors to risk were identified and measures to mitigate them may be specified. Such measures may either seek to reduce the likelihood of hazardous events occurring or to reduce the impact of the events should they occur, to As Low As Reasonably Practicable (ALARP).

Figure 6.2 HSE Framework for Tolerability of Risk [10]



6.3 INDIVIDUAL RISK RESULTS

6.3.1 Fuel Gas Pipeline at Base Case

The Individual Risk Contours from 1×10^{-7} to 1×10^{-9} per year for Fuel Gas Pipeline at **Base Case** are depicted in *Figure 6.3*. The maximum individual risk contour generated is 1×10^{-7} per year.

The Individual Risk Contour of 1×10^{-9} per year is well confined within the study zone of the Fuel Gas Pipeline. It should be noted that all hazardous scenarios at credible frequency of 1×10^{-9} per year have been considered for the off-site population within the study zone.

It was conservatively assumed as 100% exposure factor to be applied for surrounding population of Fuel Gas Pipeline in this QRA Study. The maximum individual risk contour for the Fuel Gas pipeline is lower than 1×10^{-7}; therefore, the individual risk associated with the Fuel Gas pipeline is broadly acceptable to the off-site population and it could be concluded that the individual risk of the Fuel Gas pipeline is in compliance in UK HSE Guidelines [10] at **Base Case**.

Figure 6.3 Individual Risk for the Fuel Gas Pipeline (Base Case)



6.4 SOCIETAL RISK RESULTS

6.4.1 Potential Loss of Life

As there are no local population data available for the region, the average population density of Myanmar and the average population density of the major city Yangon were applied in the **Base Case** and **Comparison Case** respectively.

The societal risks for **Base Case** and the **Comparison Case** were expressed in terms of Potential Loss of Life (PLL) as summarized at *Table 6.1*.

The PLL has been increased significantly from **Base Case** to **Comparison Case** due to the increase in population, however it is noted that both are within or below the magnitude of 1×10^{-6} which is lower than the individual risk criteria for broadly acceptable from UK HSE.

Table 6.1 ***Societal Risk - PLL Results***

	PLL (per year)	
	Base Case	**Comparison Case**
Total	6.47E-07	4.87E-06

6.4.2 FN Result

The FN results for Fuel Gas Pipeline for **Base Case and Comparison Case** are presented in *Figure 6.4* and *Figure 6.5* respectively.

As shown in the figures, the societal risk for **Base Case and Comparison Case** are confined within "Acceptable" region based on BS PD 8010 Part 3.

Since the purpose of the comparison case is to understand if the societal risks associated with the Fuel Gas Pipeline are still in compliance with the societal risk guideline of BS PD 8010 Part 3 when the nearby population density has grown into the scale of the most populated city in Myanmar, it could be concluded that the societal risk associated with the Fuel Gas Pipeline is in compliance with BS PD 8010 Part 3 because both Base Case and Comparison Case are confined within the "Acceptable " region.

Figure 6.4 FN Curve for Fuel Gas Pipeline (Base Case)

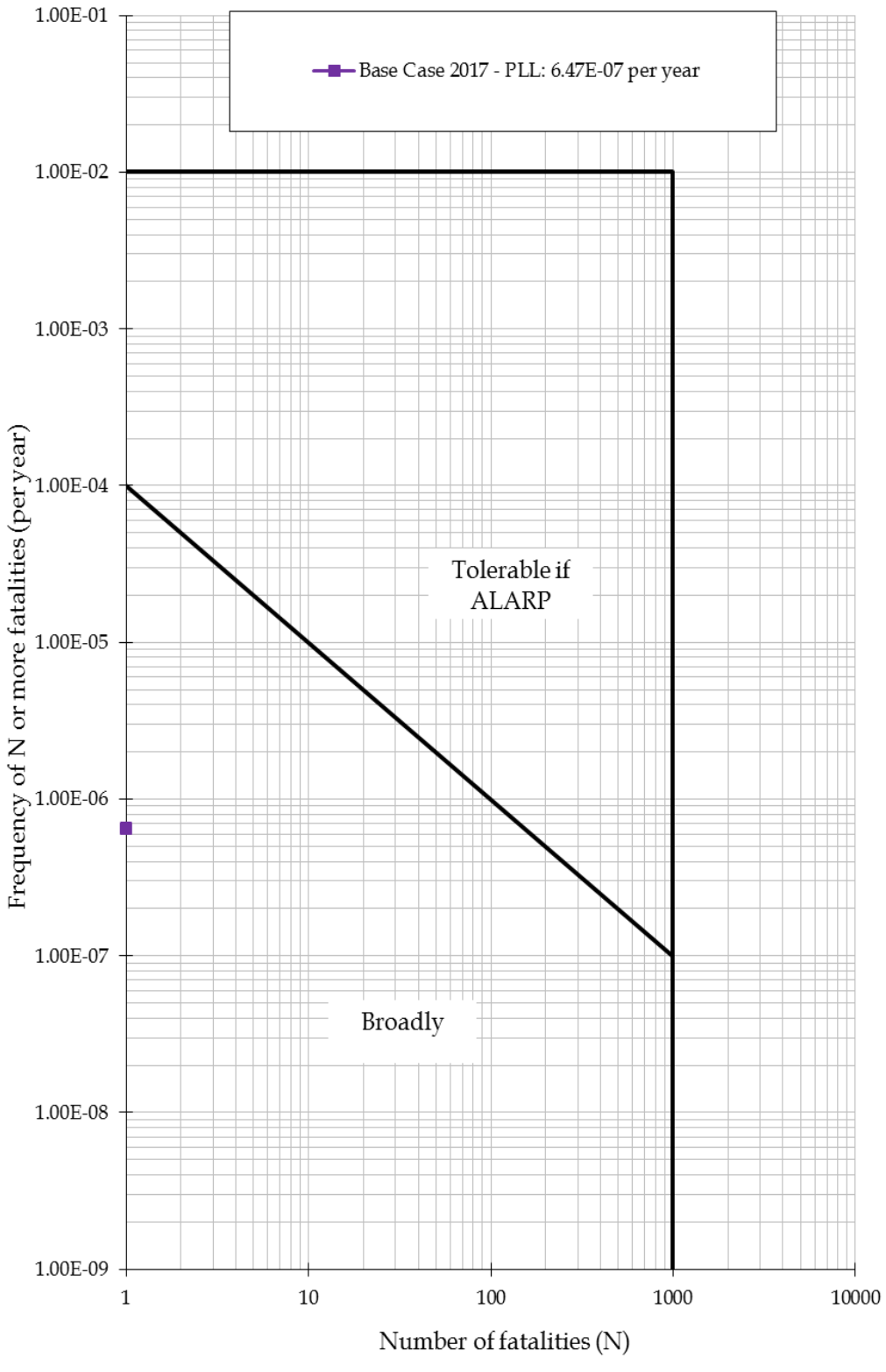
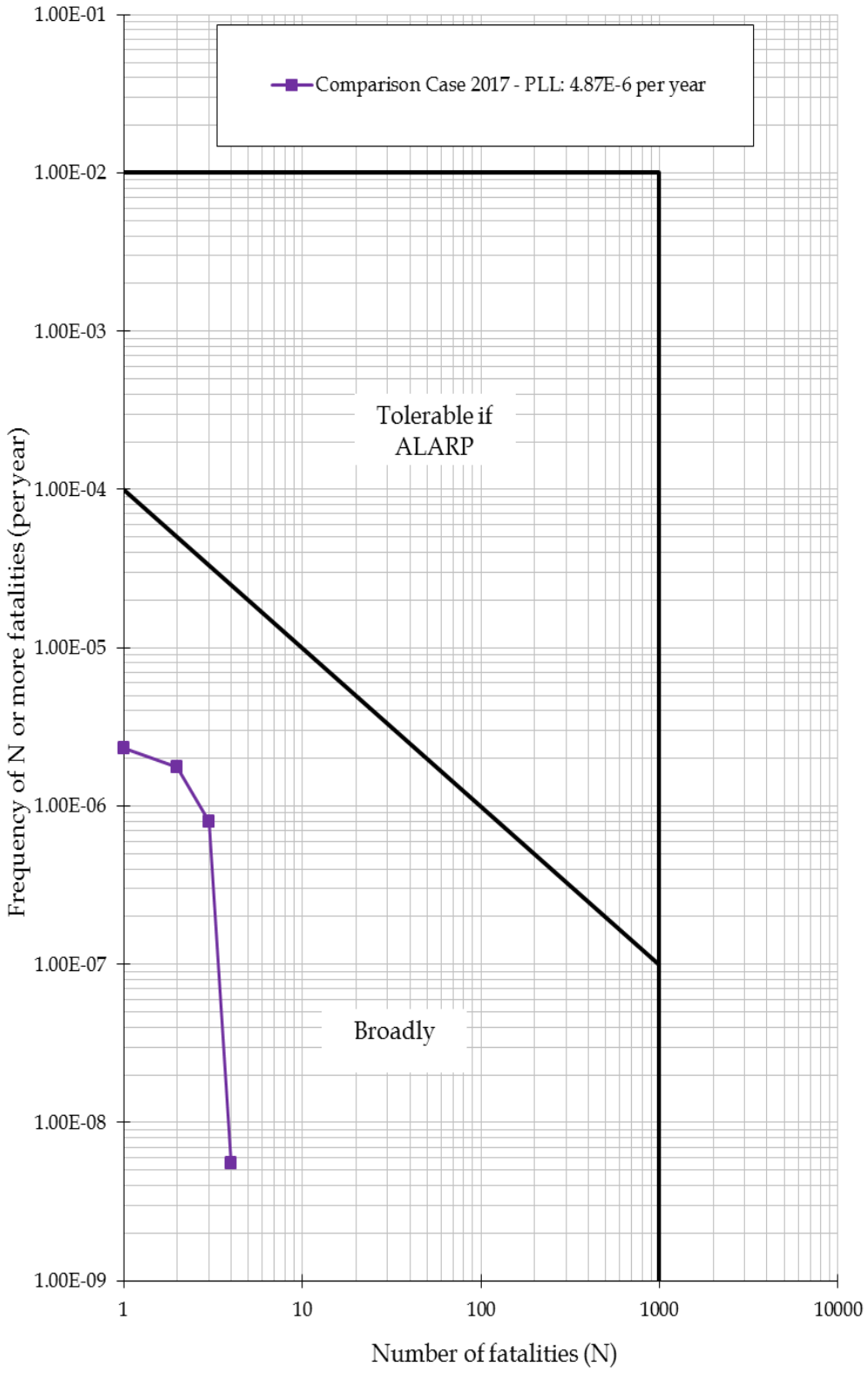


Figure 6.5 FN Curve for Fuel Gas Pipeline (Comparison Case)



7 CONCLUSIONS & MITIGATION

A Quantitative Risk Assessment (QRA) has been conducted for the Fuel Gas Pipeline to assess the risks posed by the Pipeline on surrounding population.

It is found that the maximum individual risk contour generated by Base Case and Comparison Case are 1×10^{-7} per year.

Base Case (Year 2017, Average Population Density of Myanmar):

The societal risk is confined within the "Acceptable" region based on BS PD 8010 Part 3.

Comparison Case (Year 2017, Average Population Density of Yangon)

The societal risk is confined within the "Acceptable" region based on BS PD 8010 Part 3.

Therefore, it could be concluded that the Individual Risk and the Societal Risk associated with the Fuel Gas Pipeline is compliant with UKHSE Guidelines and BS PD 8010 Part 3 respectively [10].

7.1 GENERAL RECOMMENDATIONS

1. Consider hot tapping as a high risk activity that is a likely cause of gas leakage. Ensure that all hot tapping activities are carried out only by trained and authorized personnel.

2. Consider implementing crash barriers and control of vehicle access, onsite speed limits and driver training programme to reduce risk of gas leakage incident arising from vehicle striking piping or equipment.

3. Consider implementing routine corrosion monitoring to reduce risk of gas leakage due to internal corrosion of pipeline.

4. Consider implementing routine inspection of coating integrity to reduce risk of gas leakage due to damaged coating.

8 REFERENCE

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[7] Assessing the risks from high pressure natural gas pipeline, IGEM/TD/2 Edition 2.

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[9] World Bank Indicators - Myanmar – Density & Urbanization, http://www.tradingeconomics.com/myanmar/population-density-people-per-sq-km-wb-data.html, July 2016

[10] BSI, PD 8010-3:2009+A1:2013, Code of practice for pipelines Part 3, 2013

[11] Summary of the Provisional Results, The Population and Housing Census of Myanmar, 2014, Republic of the Union of Myanmar Department of Population, Ministry of Immigration and Population, August 2014

Annex A

Assumption Register

A. ASSUMPTIONS FOR QRA METHODOLOGY

A.1 SURROUNDING DATA ANALYSIS

A.1.1 Meteorological Data

Assumption Number: A.1.1

As per Appendix 4.B of "Guidelines For Quantitative Risk Assessment, CPR 18E (Purple Book)", at least six representative weather classes are recommended to be used in QRA study, covering the stability conditions of stable, neutral and unstable, low and high wind speed. At least the following six weather classes have to be covered in terms of Pasquill classes.

Stability class	Wind speed (1)
B	Medium
D	Low
D	Medium
D	High
E	Medium
F	Low

(1): Low wind speed corresponding to 1 – 2 m/s
Medium wind speed corresponding to 3 – 5 m/s
High wind speed corresponding to 8 – 9 m/s

Several rules were applied to classify the observations in the six weather classes:

1. Observations in the Pasquill stability classes A, A/B, B and B/C are grouped to class B while the wind speed of the weather class is equal to the average wind speed of the observations.

2. Observations in the Pasquill stability classes C, C/D, D are grouped to class D while the wind speed of the weather class is equal to the average wind speed of the observations. Wind speeds below 2.5 m/s, between 2.5 m/s and 6 m/s and above 6 m/s are classified as the wind speed categories low, medium and high respectively.

3. Observations in the Pasquill stability classes E and F are allocated on the basis of the wind speed. Wind speeds below 2.5 m/s and above 2.5 m/s are classified as weather classes F and E respectively. The wind speed in each weather class is equal to the average wind speed of the observations in the weather class.

Assumption Number: A.1.1

The allocation of six representative weather classes is shown in following figure.

Wind speed	A	B	B/C	C	C/D	D	E	F
< 2.5 m/s	B medium			D low			F low	
2.5-6 m/s				D medium			E medium	
>6 m/s				D high				

The atmospheric pressure, ambient temperature and relative humidity are 1.013 bar, 28°C, and 70% respectively.

A.1.2 Surface Roughness

Assumption Number: A.1.2

The roughness parameter reflects the average roughness over which cloud is dispersing. For consequence modelling conducted using *Phast Risk 6.7*, a value of 50 cm should be selected representing a conditions of parkland, bushes, and numerous obstacles.

A.2 FREQUENCY ANALYSIS

A.2.1 Failure Frequency Database

Assumption Number: A.2.1

Regarding Fuel Gas Pipeline, the failure frequency is assumed as 2.7×10^{-4} per km per year to be used in this QRA Study.

A.2.2 Release Hole Size Distribution

Assumption Number: A.2.2

The following representative leak sizes of Natural Gas Pipeline are proposed to consider in this QRA methodology:

Rupture (> 110 mm)	2.4%
Large Hole (>75 - ≤ 110 mm)	12.4%
Small Hole (> 25 - ≤ 75 mm)	25.1%
Pin Hole (≤ 25 mm)	60.0%

A.2.3 Release Orientation Probability

Assumption Number: A.2.3

The consequences of a release from the pipeline depend on the orientation of release. Failures that occur on the top portion of the pipeline result in vertical jet release (unobstructed) and are governed by momentum jet dispersion/ momentum jet fires.

Failures that occur from the bottom portion of the pipeline lose momentum due to impingement/ obstruction with the surrounding earth (for buried sections of pipeline) and therefore are governed by buoyant plume rise followed by Gaussian dispersion, which is considered as inclined orientation release.

The probability of orientation of release from hole up to 100 mm size to be considered in this QRA methodology study is listed in following table.

Orientation of release may not be relevant for full bore failures, which are more likely to result in an upward release following the displacement of each cover. Therefore, full bore failures are considered to be completely unobstructed.

Equipment/ Pipeline	Vertical	Horizontal	Inclined (45°)
Pressurized Gas Pipeline (above ground)	0.5	0.25	0.25

A.2.4 Ignition Probability

Assumption Number: A.2.4

The potential for ignition depends not only on the presence of ignition sources but it is also function of release rate and duration of release. Larger releases are more likely to ignite than smaller release. Similarly, release that continue for a longer duration have a higher probability of ignition than short duration releases.

Based on Cox, Lees, Ang et al the ignition probability is estimated based on spill size for gas and liquid release as given in following table. The immediate ignition is estimated based on release rate from Cox et al.

A factor of 0.4 is assumed for delayed ignition of all release when the cloud is not ignited by ignition sources.

Leak Size	Probability of Ignition	
	Gas	Liquid
Minor (< 1 kg/s)	0.01	0.01
Major (1 to 50 kg/s)	0.07	0.03
Massive (> 50 kg/s)	0.30	0.08

A.2.5 Probability of delayed ignition

Assumption Number: A.2.5

As per Appendix 4.A of "Guidelines For Quantitative Risk Assessment, CPR 18E (Purple Book)", the probability of ignition a time interval of one minute for a number of sources is listed as following table:

Source	Probability of Ignition in one minute
1. Point Source	
motor vehicle	0.4
flare	1.0
outdoor furnace	0.9
indoor furnace	0.45
outdoor boiler	0.45
indoor boiler	0.23
ship	0.5
ship transporting flammable materials	0.3
fishing vessel	0.2
pleasure craft	0.1
diesel train	0.4
electric train	0.8
2. Line Source	
transmission line	0.2 per 100 m
road	Note 1
railway	Note 1
3. Area Source	
chemical plant	0.9 per site
oil refinery	0.9 per site
heavy industry	0.7 per site
light industrial warehousing	as for population
4. Population Source	
residential	0.01 per person
employment force	0.01 per person

Note 1:
The ignition probability for a road or railway near the establishment or transport route under consideration is determined by the average traffic density. The average traffic density, d, is calculated as:
$d = NE/v$
where:
N: number of vehicles per hour (h^{-1})
E: length of a road or railway selection (km)
v: average velocity of vehicle (km h^{-1})

A.3 CONSEQUENCE ANALYSIS

A.3.1 Source Term Modelling

Assumption Number: A.3.1

Most leak sources are at ground level or near ground level. However, taking into account that most release consists of light ends which are buoyant, 1.0 m is considered an accurate representative height for modelling purposes in this QRA methodology study.

The averaging time to be considered for dispersion modelling is 18.75 s.

A.3.2 Fireball Effect

Assumption Number: A.3.2

With regard to fireball, a 100% fatality is assumed for any person outdoors within the fireball radius.

A.3.3 Jet Fire Effect

Assumption Number: A.3.3

Fatality rates due to exposure to thermal radiation from Jet Fire to persons without protective clothing should be determined by "Guidelines For Quantitative Risk Assessment, CPR 18E (Purple Book)" Probit function, as follows:

$Pr = -36.38 + 2.56 \times \ln(Q^{4/3} \times t)$

where

Pr Probit corresponding to the probability of death (-)

Q heat radiation (W m^{-2})

t exposure time (s)

The exposure time, t, is limited to maximum of 20 s.

A.3.4 Flash Fire Effect

Assumption Number: A.3.4

With regard to flash fires, a 100% fatality is assumed for any person outdoors within the flash fire envelope. The extent of the flash fire is considered to be the distance to 100% of LFL (Lower Flammability Limit).

Annex B

Laboratory Reports

STS GREEN CO., LTD.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani 12150, Thailand
Tel: +66 2153 7001-6 Fax: +66 2153 7007
E-mail: green@sts.co.th http://www.sts.co.th

TEST REPORT

Client	:	ERM Siam CO., LTD.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	Environmental Monitoring Section/ STS GREEN COMPANY LIMITED.	**Sampling Date**	:	February 17, 2015
Work Request No.	:	063/15	**Sample Received Date**	:	February 20, 2015
Report No.	:	071/15	**Reported Date**	:	March 11, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
200215/1	MWQ- 1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	February 20-25, 2015	0.6	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	February 23, 2015	20.8	mg/L	Clear, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	February 24, 2015	<5.0	mg/L	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	February 25, 2015	0.023	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	February 23, 2015	7.0	mg/L	Clear, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114-C)	March 10, 2015	0.0010	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	February 24, 2015	0.00008	mg/L	Clear, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	February 24, 2015	0.0010	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	February 23, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	February 23, 2015	0.30	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	February 23, 2015	0.0030	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	February 26, 2015	0.0006	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	February 23, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	February 20-23, 2015	7.8	MPN/ 100 mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remark : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
March 11, 2015

KasidA Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
March 11, 2015

Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project Name : Myingyan IPP Project
Location : Ayeyarway River, Mandalay District, Myanmar
P/O :
Receipt No :

Lot ID: 158807
Date Received : Feb 20, 2015
Date Reported : Mar 13, 2015
Report Number : 536148-1 Rev. No.1

Reference Number	158807-1
Sampling Date	Feb 17, 2015
Sample Description	Surface Water
Location	MWQ-1
Condition of Sample	contained in one plastic bottle (client container), refrigerated
Date of Analysis	Feb 21, 2015

Analyte		Unit	LOD	LOQ	Result	Method
Water Testing						
Nitrate	as N	mg/L	0.06	0.2	Not Detected	Based on APHA (2012), 4110 B
Nitrite *	as N	mg/L	0.03	0.1	Not Detected	Based on APHA (2012), 4110 B
Residual Free Chlorine *		mg/L	-	0.01	0.07	Based on APHA (2012), 4500-Cl(B)
Total Kjeldahl Nitrogen	as N	mg/L	0.15	0.5	Not Detected	Based on US EPA, Method 351.2
Total Nitrogen *	as N	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Note:
This Analysis test report is reissued to supersede report No. 536148-1, Date Reported : Feb 25, 2015

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

The above results are valid only for the analyzed/tested sample(s) as indicated in this report. No part of this report or certificate may be reproduced in any from without written consent from the Laboratory. ALS Laboratory Group (Thailand) strongly recommends that this report is not reproduced except in full.

Approved by
Narin Saiseng
Supervisor

Quality Control Report

Client : STS Green Co., Ltd.
Lot ID : 158807-1
Received Date : February 20, 2015

Analyte	Method Blank		Duplicate (%RPD)		Spike Sample (%Recovery)	
	Result	Criteria	Result	Criteria	Result	Criteria
Water Testing						
Nitrate as N	<0.06	<0.06	n/a	10	92	85-115
Nitrite as N	<0.03	<0.03	n/a	10	89	85-115
TKN	<0.15	<0.15	n/a	10	97	90-110
Residual Free Chlorine	<0.01	<0.01	n/a	10	-	-
Total Nitrogen	<1.0	<1.0	-	-	-	-

Remark

n/a = %RPD is not applicable for results less than Limit of Quantitative (no RPD is reported).

Approved By

Yupaporn Chanpleng
Senior Manager

STS GREEN CO., LTD.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani 12150, Thailand
Tel: +66 2153 7001-6 Fax: +66 2153 7007
E-mail: green@sts.co.th http://www.sts.co.th

TEST REPORT

Client	:	ERM Siam CO., LTD.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	Environmental Monitoring Section/ STS GREEN COMPANY LIMITED.	**Sampling Date**	:	February 28, 2015
Work Request No.	:	076/15	**Sample Received Date**	:	March 6, 2015
Report No.	:	085/15	**Reported Date**	:	March 18, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
060315/1	MWQ- 1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	March 6-11, 2015	0.8	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	March 11, 2015	<5.0	mg/L	Clear, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	March 6, 2015	<5.0	mg/L	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	March 7, 2015	0.011	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	March 7, 2015	4.4	mg/L	Clear, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114-C)	March 10, 2015	<0.0002	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	March 7, 2015	<0.00005	mg/L	Clear, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	March 16, 2015	0.0011	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	March 10, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	March 7, 2015	0.31	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	March 11, 2015	0.0118	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	March 15, 2015	<0.0003	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	March 7, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	March 6-9, 2015	4.5	MPN/ 100 mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
March 18, 2015

Kasidit Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
March 18, 2015

Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project Name : Myingyan IPP Project
Location : Ayeyarway River, Mandalay District, Myanmar
P/O :
Receipt No :

Lot ID: 1511047
Date Received : Mar 06, 2015
Date Reported : Mar 13, 2015
Report Number : 540389-1 Rev. No.1

Reference Number	1511047-1
Sampling Date	Feb 28, 2015
Sample Description	Surface Water
Location	MWQ-1
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Mar 09, 2015

Analyte		Unit	LOD	LOQ	Result	Method
Water Testing						
Nitrate	as N	mg/L	0.06	0.2	Not Detected	Based on APHA (2012), 4110 B
Nitrite *	as N	mg/L	0.03	0.1	Not Detected	Based on APHA (2012), 4110 B
Residual Free Chlorine *		mg/L	-	0.01	<0.01	Based on APHA (2012), 4500-Cl(F)
Total Kjeldahl Nitrogen	as N	mg/L	0.15	0.5	Not Detected	Based on US EPA, Method 351.2
Total Nitrogen *		mg/L	-	-	<1.0	Based on APHA (2012), Calculated

Note:
This Analysis test report is reissued to supersede report No. 540389-1, Date Reported : Mar 11, 2015

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

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Approved by
Narin Saiseng
Supervisor

Quality Control Report

Client : STS Green Co., Ltd.
Lot ID : 1511047-1
Received Date : March 6, 2015

Analyte	Method Blank		Duplicate (%RPD)		Spike Sample (%Recovery)	
	Result	Criteria	Result	Criteria	Result	Criteria
Water Testing						
Nitrate as N	<0.06	<0.06	n/a	10	92	85-115
Nitrite as N	<0.03	<0.03	n/a	10	91	85-115
TKN	<0.15	<0.15	0.0	10	97	90-110
Residual Free Chlorine	<0.01	<0.01	n/a	10	-	-
Total Nitrogen	<1.0	<1.0	-	-	-	-

Remark

n/a = %RPD is not applicable for results less than Limit of Quantitative (no RPD is reported).

Approved By

Yupaporn Chanpleng
Senior Manager

STS GREEN CO., LTD.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani 12150, Thailand
Tel: +66 2153 7001-6 Fax: +66 2153 7007
E-mail: green@sts.co.th http://www.sts.co.th

TEST REPORT

Client	:	ERM Siam Co.,Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	March 14, 2015
Work Request No.	:	103/15	**Sample Received Date**	:	March 18, 2015
Report No.	:	103/15	**Reported Date**	:	March 25, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
180315/1	MWQ- 1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	March 19-24, 2015	1.2	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	March 22, 2015	9.2	mg/L	Clear, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	March 20, 2015	<5.0	mg/L	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	March 22, 2015	0.025	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	March 19, 2015	8.6	mg/L	Clear, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	March 22, 2015	0.0006	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	March 24, 2015	<0.00005	mg/L	Clear, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	March 23, 2015	0.0005	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	March 19, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	March 19, 2015	0.34	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	March 17, 2015	<0.0020	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	March 21, 2015	<0.0003	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	March 20, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	March 18-21, 2015	7.8	MPN/ 100 mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
March 25, 2015

Kasidit Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
March 25, 2015

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Tel: +66 2153 7001-6 Fax: +66 2153 7007
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TEST REPORT

Client	:	ERM Siam CO., LTD.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	March 28, 2015
Work Request No.	:	188/15	**Sample Received Date**	:	April 2, 2015
Report No.	:	110/15	**Reported Date**	:	April 20, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
020415/9	MWQ- 1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	April 3-8, 2015	0.6	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	April 2, 2015	17.5	mg/L	Clear, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	April 3, 2015	<5.0	mg/L	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	April 3, 2015	0.039	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	April 2, 2015	5.6	mg/L	Clear, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114-C)	April 17, 2014	0.0010	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	April 9, 2015	<0.00005	mg/L	Clear, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	April 10, 2015	<0.0005	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	April 2, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	April 8, 2015	0.22	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	April 9, 2015	<0.0020	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	April 16, 2015	<0.0003	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	April 5, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	April 10, 2015	<1.8	MPN/100mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
April 20, 2015

Kasidit Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
April 20, 2015

Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project Name : Myingyan IPP Project
Location : Ayeyarway River, Mandalay District, Myanmar
P/O :
Receipt No :

Lot ID: 1513368
Date Received : Mar 18, 2015
Date Reported : Mar 27, 2015
Report Number : 545381-1 Rev. No.1

Reference Number	1513368-1
Sampling Date	Mar 14, 2015
Sample Description	Surface Water
Location	MWQ-1
Condition of Sample	contained in one plastic bottle, refrigerated (client container)
Date of Analysis	Mar 19, 2015

Analyte		Unit	LOD	LOQ	Result	Method
Water Testing						
Nitrate	as N	mg/L	0.06	0.2	Not Detected	Based on APHA (2012), 4110 B
Nitrite *	as N	mg/L	0.03	0.1	Not Detected	Based on APHA (2012), 4110 B
Residual Free Chlorine *		mg/L	-	0.01	<0.01	Based on APHA (2012), 4500-Cl(F)
Total Kjeldahl Nitrogen	as N	mg/L	0.15	0.5	Not Detected	Based on US EPA, Method 351.2
Total Nitrogen *		mg/L	-	-	<1.0	Based on APHA (2012), Calculated

Note:
This Analysis test report is reissued to supersede report No. 545381-1, Date Reported : Mar 24, 2015

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

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Approved by
Narin Saiseng
Supervisor

Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project Name : Myingyan IPP Project
Location : Ayeyarway River, Mandalay District, Myanmar
P/O :
Receipt No :

Lot ID: 1516311
Date Received : Apr 02, 2015
Date Reported : Apr 10, 2015
Report Number : 550803-1 Rev. No.1

Reference Number 1516311-1
Sampling Date Mar 28, 2015
Sample Description MWQ-1
Condition of Sample contained in one plastic bottle (client container), refrigerated
Date of Analysis Apr 03, 2015

Analyte		Unit	LOD	LOQ	Result	Method
Water Testing						
Nitrate	as N	mg/L	0.06	0.2	Not Detected	Based on APHA (2012), 4110 B
Nitrite *	as N	mg/L	0.03	0.1	Not Detected	Based on APHA (2012), 4110 B
Residual Free Chlorine *		mg/L	-	0.01	0.05	Based on APHA (2012), 4500-Cl(F)
Total Kjeldahl Nitrogen	as N	mg/L	0.15	0.5	Not Detected	Based on US EPA, Method 351.2
Total Nitrogen *	as N	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Note:
This Analysis test report is reissued to supersede report no. 550803-1, Date Reported : Apr 08, 2015

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

The above results are valid only for the analyzed/tested sample(s) as indicated in this report. No part of this report or certificate may be reproduced in any from without written consent from the Laboratory. ALS Laboratory Group (Thailand) strongly recommends that this report is not reproduced except in full.

Approved by
Narin Saiseng
Supervisor

Quality Control Report

Client : STS Green Co., Ltd.
Lot ID : 1516311-1
Received Date : April 2, 2015

Analyte	Method Blank		Duplicate (%RPD)		Spike Sample (%Recovery)	
	Result	Criteria	Result	Criteria	Result	Criteria
Water Testing						
Nitrate as N	<0.06	<0.06	0.8	10	92	85-115
Nitrite as N	<0.03	<0.03	1.2	10	89	85-115
TKN	<0.15	<0.15	0.0	10	95	90-110
Residual Free Chlorine	<0.01	<0.01	n/a	10	-	-
Total Nitrogen	<1.0	<1.0	-	-	-	-

Remark

n/a = %RPD is not applicable for results less than Limit of Quantitative (no RPD is reported).

Approved By

Yupaporn Chanpleng
Senior Manager

STS GREEN CO., LTD.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani 12150, Thailand
Tel: +66 2153 7001-6 Fax: +66 2153 7007
E-mail: green@sts.co.th http://www.sts.co.th

TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	April 11, 2015
Work Request No.	:	225/15	**Sample Received Date**	:	April 27, 2015
Report No.	:	228/15	**Reported Date**	:	May 8, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
270415/19	MWQ- 1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	April 29-May 4, 2015	2.4	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	April 30, 2015	<5.0	mg/L	Clear, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	April 28, 2015	<5.0	mg/L	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	April 28, 2015	0.016	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	April 28, 2015	18.8	mg/L	Clear, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	May 7, 2015	0.0003	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	April 28, 2015	<0.00005	mg/L	Clear, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	April 29, 2015	0.0021	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	April 28, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	April 28, 2015	0.62	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	April 29, 2015	<0.0020	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	May 7, 2015	<0.0003	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	April 28, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	April 27-30, 2015	4.5	MPN/100mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
May 8, 2015

Kasidit Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
May 8, 2015

LABORATORY ACCREDITATION
BLA-DSS

TESTING
No.0009

Analysis / Test Report

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project Name : Myingyan IPP Project
Location : Ayeyarway River, Mandalay District, Myanmar
P/O :
Receipt No :

Lot ID: 1519837
Date Received : Apr 28, 2015
Date Reported : May 04, 2015
Report Number : 558394-1

Reference Number	1519837-1
Sampling Date	Apr 14, 2015
Sample Description	Surface Water
Location	MWQ-1
Condition of Sample	contained in one plastic bottle (client container), refrigerated
Date of Analysis	Apr 29, 2015

Analyte		Unit	LOD	LOQ	Result	Method
Water Testing						
Nitrate	as N	mg/L	0.06	0.2	Not Detected	Based on APHA (2012), 4110 B
Nitrite *	as N	mg/L	0.03	0.1	Not Detected	Based on APHA (2012), 4110 B
Residual Free Chlorine *		mg/L	-	0.01	0.02	Based on APHA (2012), 4500-Cl(F)
Total Kjeldahl Nitrogen	as N	mg/L	0.15	0.5	Not Detected	Based on US EPA, Method 351.2
Total Nitrogen *		mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

The above results are valid only for the analyzed/tested sample(s) as indicated in this report. No part of this report or certificate may be reproduced in any from without written consent from the Laboratory. ALS Laboratory Group (Thailand) strongly recommends that this report is not reproduced except in full.

Approved by

Nanthawadee Somboon
Scientist (4)

Quality Control Report

Client : STS Green Co., Ltd.
Lot ID : 1519837-1
Received Date : April 28, 2015

Analyte	Method Blank		Duplicate (%RPD)		Spike Sample (%Recovery)	
	Result	Criteria	Result	Criteria	Result	Criteria
Water Testing						
Nitrate as N	<0.06	<0.06	0.0	10	91	85-115
Nitrite as N	<0.03	<0.03	0.0	10	88	85-115
TKN	<0.15	<0.15	0.0	10	95	90-110
Residual Free Chlorine	<0.01	<0.01	n/a	10	-	-
Total Nitrogen	<1.0	<1.0	-	-	-	-

Remark

n/a = %RPD is not applicable for results less than Limit of Quantitative (no RPD is reported).

Approved By

Yupaporn Chanpleng
Senior Manager

STS GREEN CO., LTD.
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Tel: +66 2153 7001-6 Fax: +66 2153 7007
E-mail: green@sts.co.th http://www.sts.co.th

TEST REPORT

Client	:	ERM Siam Co.,Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	April 25, 2015
Work Request No.	:	233/15	**Sample Received Date**	:	April 30, 2015
Report No.	:	229/15	**Reported Date**	:	May 8, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300415/5	MWQ- 1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	April 30-May 5, 2015	2.4	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	May 6, 2015	8.0	mg/L	Clear, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	May 4, 2015	<5.0	mg/L	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	April 30, 2015	0.006	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	April 30, 2015	20.6	mg/L	Clear, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	May 7, 2015	0.0004	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	May 4, 2015	<0.00005	mg/L	Clear, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	May 6, 2015	0.0020	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	May 6, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	May 6, 2015	0.83	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	May 4, 2015	<0.0020	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	May 7, 2015	0.0010	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	May 7, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	April 30-May 3, 2015	110	MPN/ 100 mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee H.
(Ms. Darunee Wichanphet)
Chemist
May 8, 2015

Kasidit Y
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
May 8, 2015

Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project Name : Myingyan IPP Project
Location : Ayeyarway River, Mandalay District, Myanmar
P/O :
Receipt No :

Lot ID: 1520654
Date Received : May 04, 2015
Date Reported : May 14, 2015
Report Number : 559991-1

Reference Number	1520654-1
Sampling Date	Apr 25, 2015
Sample Description	MWQ-1
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	May 06, 2015

Analyte		Unit	LOD	LOQ	Result	Method
Water Testing						
Nitrate	as N	mg/L	0.06	0.2	Not Detected	Based on APHA (2012), 4110 B
Nitrite *	as N	mg/L	0.03	0.1	Not Detected	Based on APHA (2012), 4110 B
Residual Free Chlorine *		mg/L	-	0.01	0.02	Based on APHA (2012), 4500-Cl(F)
Total Kjeldahl Nitrogen	as N	mg/L	0.15	0.5	Not Detected	Based on US EPA, Method 351.2
Total Nitrogen *		mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

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Approved by

Narin Saiseng
Supervisor

Quality Control Report

Client : STS Green Co., Ltd.
Lot ID : 1520654-1
Received Date : May 4, 2015

Analyte	Method Blank		Duplicate (%RPD)		Spike Sample (%Recovery)	
	Result	Criteria	Result	Criteria	Result	Criteria
Water Testing						
Nitrate as N	<0.06	<0.06	0.0	10	90	85-115
Nitrite as N	<0.03	<0.03	0.0	10	91	85-115
TKN	<0.15	<0.15	0.0	10	92	90-110
Residual Free Chlorine	<0.01	<0.01	n/a	10	-	-
Total Nitrogen	<1.0	<1.0	-	-	-	-

Remark

n/a = %RPD is not applicable for results less than Limit of Quantitative (no RPD is reported).

Approved By

Yupaporn Chanpleng
Senior Manager

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/6	MSW-1						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	June 29 - July 4, 2015	0.6	mg/L	Turbid, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	6.4	mg/L	Turbid, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Turbid, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.026	mg/L	Turbid, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	11.5	mg/L	Turbid, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114-C)	July 7, 2015	<0.0002	mg/L	Turbid, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Turbid, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	0.0012	mg/L	Turbid, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Turbid, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 21, 2015	2.38	mg/L	Turbid, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Turbid, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Turbid, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Turbid, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	July 3-6, 2015	130	MPN/ 100 mL	Turbid, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee N.
(Ms. Darunee Wichanphet)
Chemist
July 13, 2015

Kasidit Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
July 13, 2015

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Surface water			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/7	MSW-2						
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification (5210 B)	June 29 - July 4, 2015	0.2	mg/L	Turbid, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	12.7	mg/L	Turbid, Sediment
		Oil and Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Turbid, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.032	mg/L	Turbid, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	74.0	mg/L	Turbid, Sediment
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114-C)	July 7, 2015	<0.0002	mg/L	Turbid, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Turbid, Sediment
		Chromium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	0.0039	mg/L	Turbid, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Turbid, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 21, 2015	4.50	mg/L	Turbid, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	0.0033	mg/L	Turbid, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Turbid, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Turbid, Sediment
		Total Coliform Bacteria	Multiple Tube Fermentation Technique (9221 B)	July 3-6, 2015	68	MPN/ 100 mL	Turbid, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
July 13, 2015

Kasidit Y.
(Mr. Kasidit Yasongkram)
Laboratory Supervisor
July 13, 2015

Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-1
Sampling Date	Jun 17, 2015
Project Name	Myingyan IPP Project
Sample Description	Surface Water
Location	MSW-1
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Residual Free Chlorine *	mg/L	-	0.01	<0.01	Based on APHA (2012), 4500-Cl(F)
Total Nitrogen *	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Technical Management

Nanthawadee Somboon
Scientist (4)
ทะเบียนเลขที่ ว-204-จ-4716

Approved by

Yupaporn Chanpleng
Senior Manager
ทะเบียนเลขที่ ว-204-ค-4700

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Analysis / Test Report

TESTING
No.0009

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-2
Sampling Date	Jun 17, 2015
Project Name	Myingyan IPP Project
Sample Description	Surface Water
Location	MSW-2
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Residual Free Chlorine *	mg/L	-	0.01	<0.01	Based on APHA (2012), 4500-Cl(F)
Total Nitrogen *	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Technical Management

Nanthawadee Somboon
Scientist (4)
ทะเบียนเลขที่ ว-204-จ-4716

Approved by

Yupaporn Chanpleng
Senior Manager
ทะเบียนเลขที่ ว-204-ค-4700

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Tel: +66 2153 7001-6 Fax: +66 2153 7007
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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/61	**MS-1T (Top soil)**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.52	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	46.19	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	28.22	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	19.00	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	34,363	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	5.32	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	562.14	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	0.13	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	87.89	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
July 13, 2015

Keesidt Y.
(Ms. Patthama Bunsi)
Laboratory Supervisor
July 13, 2015

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/62	**MS-1B (Bottom soil)**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.53	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	44.21	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	33.55	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	22.12	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	36,311	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	5.50	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	744.63	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	78.42	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

Remarks : Reported results refer to submitted samples only. This analytical report will not be reproduced in part for such purposes.

Darunee W.
(Ms. Darunee Wichanphet)
Chemist
July 13, 2015

Kusolit Y.
(Ms. Patthama Bunsi)
Laboratory Supervisor
July 13, 2015

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Tel: +66 2153 7001-6 Fax: +66 2153 7007
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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 18, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/63	MS-2T (Top soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.47	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	30.03	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	22.68	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	0.14	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	12.81	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	22,012	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	516.65	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	56.46	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/64	**MS-2B (Bottom soil)**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.63	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	64.53	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	33.69	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	23.40	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	35,831	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	5.62	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	837.21	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	81.98	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 18, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/65	MS-3T (Top soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.50	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	39.69	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	26.37	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	15.17	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	27,496	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	532.60	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	59.01	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

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Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 18, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/66	MS-3B (Bottom soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.56	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	28.71	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	31.00	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	0.19	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	18.25	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	28,472	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	687.80	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	66.22	mg/kg dry-weight	-

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/67	**MS-4T (Top soil)**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.71	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	48.68	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	36.88	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	21.15	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	28,962	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	5.35	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	713.52	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	81.14	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/68	MS-4B (Bottom soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.63	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	36.55	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	26.56	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	16.23	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	24,282	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	660.60	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	67.80	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
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Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/69	MS-5T (Top soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.63	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	33.38	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	28.83	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	23.19	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	33,875	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	5.02	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	666.93	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	99.15	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/70	MS-5B (Bottom soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.74	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	41.56	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	33.38	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	22.42	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	34,176	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	618.48	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	79.89	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

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Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/71	MS-6T (Top soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.81	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	37.51	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	29.73	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	17.03	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	29,418	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	610.36	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	61.85	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

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Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 19, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/72	MS-6B (Bottom soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.50	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	31.21	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	27.52	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	13.39	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	25,437	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	534.03	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	<0.10	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	55.02	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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Chemist
July 13, 2015

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(Ms. Patthama Bunsi)
Laboratory Supervisor
July 13, 2015

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 18, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/73	MS-7T (Top soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.86	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	45.03	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	34.52	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	24.10	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	34,913	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	691.41	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	0.42	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	85.93	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client : ERM Siam Co., Ltd.
Address : 179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120
Project Name : Myingyan IPP Project
Sample Type : Soil
Sampling By : ERM Siam Co., Ltd. **Sampling Date** : June 19, 2015
Work Request No. : 388/15 **Sample Received Date** : June 30, 2015
Report No. : 390/15 **Reported Date** : July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/74	MS-7B (Bottom soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.89	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	52.75	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	38.27	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	28.63	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	39,723	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	815.65	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	0.33	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	98.36	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.
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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 18, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/75	MS-8T (Top soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.97	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	50.05	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	42.51	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	25.16	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	35,984	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	<5.00	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	716.34	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	0.61	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	84.24	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Soil			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 18, 2015
Work Request No.	:	388/15	**Sample Received Date**	:	June 30, 2015
Report No.	:	390/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
300615/76	MS-8B (Bottom soil)						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	0.37	mg/kg dry-weight	-
		Barium	Direct Nitrous Oxide-Acetylene Flame Method	July 5, 2015	39.89	mg/kg dry-weight	-
		Cadmium and compounds	Direct Air-Acetylene Flame Method	July 3, 2015	<1.00	mg/kg dry-weight	-
		Chromium	Direct Air-Acetylene Flame Method	July 3, 2015	29.38	mg/kg dry-weight	-
		Hexavalent Chromium	Akaline Digestion, Colorimetric Method	July 4, 2015	<0.10	mg/kg dry-weight	-
		Copper	Direct Air-Acetylene Flame Method	July 3, 2015	26.62	mg/kg dry-weight	-
		Iron	Direct Air-Acetylene Flame Method	July 2, 2015	33,344	mg/kg dry-weight	-
		Lead	Direct Air-Acetylene Flame Method	July 4, 2015	5.54	mg/kg dry-weight	-
		Manganese and compounds	Direct Air-Acetylene Flame Method	July 4, 2015	746.77	mg/kg dry-weight	-
		Mercury and compounds	Cold-Vapor Atomic Absorption Spectrometric Method	July 3, 2015	0.38	mg/kg dry-weight	-
		Nickel, soluble salts	Direct Air-Acetylene Flame Method	July 2, 2015	<2.00	mg/kg dry-weight	-
		Selenium	Hydride Generation Atomic Absorption Spectrometric Method	July 7, 2015	<0.01	mg/kg dry-weight	-
		Silver	Direct Air-Acetylene Flame Method	July 5, 2015	<1.50	mg/kg dry-weight	-
		Zinc	Direct Air-Acetylene Flame Method	July 3, 2015	94.02	mg/kg dry-weight	-

Method : United State Environmental Protection Agency.

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MS-1T (Top Soil)	TYG0003-01	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-1B (Bottom Soil)	TYG0003-02	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-2T (Top Soil)	TYG0003-03	Soil	18-Jun-15 12:00	01-Jul-15 13:20
MS-2B (Bottom Soil)	TYG0003-04	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-3T (Top Soil)	TYG0003-05	Soil	18-Jun-15 12:00	01-Jul-15 13:20
MS-3B (Bottom Soil)	TYG0003-06	Soil	18-Jun-15 12:00	01-Jul-15 13:20
MS-4T (Top Soil)	TYG0003-07	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-4B (Bottom Soil)	TYG0003-08	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-5T (Top Soil)	TYG0003-09	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-5B (Bottom Soil)	TYG0003-10	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-6T (Top Soil)	TYG0003-11	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-6B (Bottom Soil)	TYG0003-12	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-7T (Top Soil)	TYG0003-13	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-7B (Bottom Soil)	TYG0003-14	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-8T (Top Soil)	TYG0003-15	Soil	19-Jun-15 12:00	01-Jul-15 13:20
MS-8B (Bottom Soil)	TYG0003-16	Soil	19-Jun-15 12:00	01-Jul-15 13:20

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Kerosene HC (C10-C14), Diesel HC (C15-C28) & Heavy Oil HC (C29-C36) by EPA 8015 (modified)

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-1T (Top Soil) (TYG0003-01) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	22.5	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	22.5	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	89.8	"	"	"	"	"	"	
Surrogate: 4-FBP	*71.8 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*73.8 %*	*50-150*			"	"	"	"	
MS-1B (Bottom Soil) (TYG0003-02) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	22.4	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	22.4	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	89.6	"	"	"	"	"	"	
Surrogate: 4-FBP	*68.7 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*68.8 %*	*50-150*			"	"	"	"	
MS-2T (Top Soil) (TYG0003-03) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	22.5	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	22.5	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	89.8	"	"	"	"	"	"	
Surrogate: 4-FBP	*66.6 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*65.3 %*	*50-150*			"	"	"	"	
MS-2B (Bottom Soil) (TYG0003-04) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	23.8	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	23.8	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	95.3	"	"	"	"	"	"	
Surrogate: 4-FBP	*70.4 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*72.1 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Kerosene HC (C10-C14), Diesel HC (C15-C28) & Heavy Oil HC (C29-C36) by EPA 8015 (modified)

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-3T (Top Soil) (TYG0003-05) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.7	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.7	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	86.7	"	"	"	"	"	"	
Surrogate: 4-FBP	*64.3 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*85.9 %*	*50-150*			"	"	"	"	
MS-3B (Bottom Soil) (TYG0003-06) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.1	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.1	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	84.4	"	"	"	"	"	"	
Surrogate: 4-FBP	*55.1 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*54.0 %*	*50-150*			"	"	"	"	
MS-4T (Top Soil) (TYG0003-07) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.5	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.5	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	86.0	"	"	"	"	"	"	
Surrogate: 4-FBP	*66.7 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*67.8 %*	*50-150*			"	"	"	"	
MS-4B (Bottom Soil) (TYG0003-08) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.1	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.1	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	84.5	"	"	"	"	"	"	
Surrogate: 4-FBP	*66.2 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*56.8 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Kerosene HC (C10-C14), Diesel HC (C15-C28) & Heavy Oil HC (C29-C36) by EPA 8015 (modified)

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-5T (Top Soil) (TYG0003-09) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.6	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.6	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	86.5	"	"	"	"	"	"	
Surrogate: 4-FBP	*82.6 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*81.6 %*	*50-150*			"	"	"	"	
MS-5B (Bottom Soil) (TYG0003-10) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	22.3	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	22.3	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	89.0	"	"	"	"	"	"	
Surrogate: 4-FBP	*84.2 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*92.4 %*	*50-150*			"	"	"	"	
MS-6T (Top Soil) (TYG0003-11) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	20.8	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	20.8	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	83.1	"	"	"	"	"	"	
Surrogate: 4-FBP	*81.5 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*75.4 %*	*50-150*			"	"	"	"	
MS-6B (Bottom Soil) (TYG0003-12) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.7	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.7	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	86.7	"	"	"	"	"	"	
Surrogate: 4-FBP	*87.3 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*83.1 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Kerosene HC (C10-C14), Diesel HC (C15-C28) & Heavy Oil HC (C29-C36) by EPA 8015 (modified)

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-7T (Top Soil) (TYG0003-13) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.3	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.3	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	85.1	"	"	"	"	"	"	
Surrogate: 4-FBP	*72.0 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*74.4 %*	*50-150*			"	"	"	"	
MS-7B (Bottom Soil) (TYG0003-14) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	22.8	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	22.8	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	91.4	"	"	"	"	"	"	
Surrogate: 4-FBP	*95.1 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*95.3 %*	*50-150*			"	"	"	"	
MS-8T (Top Soil) (TYG0003-15) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	20.8	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	20.8	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	83.3	"	"	"	"	"	"	
Surrogate: 4-FBP	*93.6 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*92.1 %*	*50-150*			"	"	"	"	
MS-8B (Bottom Soil) (TYG0003-16) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Kerosene Range Hydrocarbons	ND	21.2	mg/kg dry	1	15G0010	02-Jul-15	08-Jul-15	EPA 8015M	
Diesel Range Hydrocarbons	ND	21.2	"	"	"	"	"	"	
Heavy Oil Range Hydrocarbons	ND	84.7	"	"	"	"	"	"	
Surrogate: 4-FBP	*54.7 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*53.8 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-1T (Top Soil) (TYG0003-01) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	16.7	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.223	"	"	"	"	"	"	
Toluene	ND	0.223	"	"	"	"	"	"	
Ethylbenzene	ND	0.223	"	"	"	"	"	"	
Xylenes (total)	ND	0.668	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*111 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*106 %*	*50-150*			"	"	"	"	
MS-1B (Bottom Soil) (TYG0003-02) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	15.2	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.203	"	"	"	"	"	"	
Toluene	ND	0.203	"	"	"	"	"	"	
Ethylbenzene	ND	0.203	"	"	"	"	"	"	
Xylenes (total)	ND	0.608	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*103 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*105 %*	*50-150*			"	"	"	"	
MS-2T (Top Soil) (TYG0003-03) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	16.5	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.220	"	"	"	"	"	"	
Toluene	ND	0.220	"	"	"	"	"	"	
Ethylbenzene	ND	0.220	"	"	"	"	"	"	
Xylenes (total)	ND	0.659	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*109 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*109 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-2B (Bottom Soil) (TYG0003-04) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	16.6	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.221	"	"	"	"	"	"	
Toluene	ND	0.221	"	"	"	"	"	"	
Ethylbenzene	ND	0.221	"	"	"	"	"	"	
Xylenes (total)	ND	0.664	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*107 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*109 %*	*50-150*			"	"	"	"	
MS-3T (Top Soil) (TYG0003-05) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	16.1	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.215	"	"	"	"	"	"	
Toluene	ND	0.215	"	"	"	"	"	"	
Ethylbenzene	ND	0.215	"	"	"	"	"	"	
Xylenes (total)	ND	0.644	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*100 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*102 %*	*50-150*			"	"	"	"	
MS-3B (Bottom Soil) (TYG0003-06) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	14.3	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.191	"	"	"	"	"	"	
Toluene	ND	0.191	"	"	"	"	"	"	
Ethylbenzene	ND	0.191	"	"	"	"	"	"	
Xylenes (total)	ND	0.572	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*118 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*107 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-4T (Top Soil) (TYG0003-07) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	16.1	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.215	"	"	"	"	"	"	
Toluene	ND	0.215	"	"	"	"	"	"	
Ethylbenzene	ND	0.215	"	"	"	"	"	"	
Xylenes (total)	ND	0.645	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*134 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*125 %*	*50-150*			"	"	"	"	
MS-4B (Bottom Soil) (TYG0003-08) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	15.4	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.206	"	"	"	"	"	"	
Toluene	ND	0.206	"	"	"	"	"	"	
Ethylbenzene	ND	0.206	"	"	"	"	"	"	
Xylenes (total)	ND	0.618	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*114 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*109 %*	*50-150*			"	"	"	"	
MS-5T (Top Soil) (TYG0003-09) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	13.9	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.185	"	"	"	"	"	"	
Toluene	ND	0.185	"	"	"	"	"	"	
Ethylbenzene	ND	0.185	"	"	"	"	"	"	
Xylenes (total)	ND	0.555	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*122 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*123 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-5B (Bottom Soil) (TYG0003-10) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	14.4	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.193	"	"	"	"	"	"	
Toluene	ND	0.193	"	"	"	"	"	"	
Ethylbenzene	ND	0.193	"	"	"	"	"	"	
Xylenes (total)	ND	0.578	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*109 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*125 %*	*50-150*			"	"	"	"	
MS-6T (Top Soil) (TYG0003-11) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	13.6	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.181	"	"	"	"	"	"	
Toluene	ND	0.181	"	"	"	"	"	"	
Ethylbenzene	ND	0.181	"	"	"	"	"	"	
Xylenes (total)	ND	0.544	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*94.6 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*140 %*	*50-150*			"	"	"	"	
MS-6B (Bottom Soil) (TYG0003-12) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	14.5	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.194	"	"	"	"	"	"	
Toluene	ND	0.194	"	"	"	"	"	"	
Ethylbenzene	ND	0.194	"	"	"	"	"	"	
Xylenes (total)	ND	0.581	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*86.7 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*113 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-7T (Top Soil) (TYG0003-13) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	15.5	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.207	"	"	"	"	"	"	
Toluene	ND	0.207	"	"	"	"	"	"	
Ethylbenzene	ND	0.207	"	"	"	"	"	"	
Xylenes (total)	ND	0.621	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*81.5 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*103 %*	*50-150*			"	"	"	"	
MS-7B (Bottom Soil) (TYG0003-14) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	16.0	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.213	"	"	"	"	"	"	
Toluene	ND	0.213	"	"	"	"	"	"	
Ethylbenzene	ND	0.213	"	"	"	"	"	"	
Xylenes (total)	ND	0.640	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*93.5 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*106 %*	*50-150*			"	"	"	"	
MS-8T (Top Soil) (TYG0003-15) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	14.3	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.191	"	"	"	"	"	"	
Toluene	ND	0.191	"	"	"	"	"	"	
Ethylbenzene	ND	0.191	"	"	"	"	"	"	
Xylenes (total)	ND	0.573	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*64.2 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*88.8 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-8B (Bottom Soil) (TYG0003-16) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Gasoline Range Hydrocarbons	ND	13.7	mg/kg dry	50	15G0003	01-Jul-15	02-Jul-15	EPA 8015M/8021B	
Benzene	ND	0.183	"	"	"	"	"	"	
Toluene	ND	0.183	"	"	"	"	"	"	
Ethylbenzene	ND	0.183	"	"	"	"	"	"	
Xylenes (total)	ND	0.550	"	"	"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*90.8 %*	*50-150*			"	"	"	"	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*85.7 %*	*50-150*			"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Conventional Chemistry Parameters in Soils and Solids

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-1T (Top Soil) (TYG0003-01) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**853**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-1B (Bottom Soil) (TYG0003-02) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**329**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-2T (Top Soil) (TYG0003-03) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**363**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-2B (Bottom Soil) (TYG0003-04) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	ND	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-3T (Top Soil) (TYG0003-05) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	ND	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-3B (Bottom Soil) (TYG0003-06) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**317**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-4T (Top Soil) (TYG0003-07) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**380**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-4B (Bottom Soil) (TYG0003-08) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**239**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-5T (Top Soil) (TYG0003-09) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**252**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	

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Phone: 662-245-9660 fax: 662-245-9662

STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Conventional Chemistry Parameters in Soils and Solids

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-5B (Bottom Soil) (TYG0003-10) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	ND	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-6T (Top Soil) (TYG0003-11) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	ND	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-6B (Bottom Soil) (TYG0003-12) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**231**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-7T (Top Soil) (TYG0003-13) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	ND	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-7B (Bottom Soil) (TYG0003-14) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**282**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-8T (Top Soil) (TYG0003-15) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	ND	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	
MS-8B (Bottom Soil) (TYG0003-16) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
Oil & Grease (HEM)	**205**	200	mg/kg dry	1	15G0040	06-Jul-15	08-Jul-15	EPA 1664A mod.	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Physical Parameters by APHA/ASTM/EPA Methods

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-1T (Top Soil) (TYG0003-01) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**89.1**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**10.9**	0.1	"	"	"	"	"	"	
MS-1B (Bottom Soil) (TYG0003-02) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**89.3**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**10.7**	0.1	"	"	"	"	"	"	
MS-2T (Top Soil) (TYG0003-03) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**89.1**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**10.9**	0.1	"	"	"	"	"	"	
MS-2B (Bottom Soil) (TYG0003-04) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**84.0**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**16.0**	0.1	"	"	"	"	"	"	
MS-3T (Top Soil) (TYG0003-05) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**92.3**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**7.7**	0.1	"	"	"	"	"	"	
MS-3B (Bottom Soil) (TYG0003-06) Soil Sampled: 18-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**94.8**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**5.2**	0.1	"	"	"	"	"	"	
MS-4T (Top Soil) (TYG0003-07) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**93.0**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**7.0**	0.1	"	"	"	"	"	"	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Physical Parameters by APHA/ASTM/EPA Methods

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MS-4B (Bottom Soil) (TYG0003-08) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**94.7**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**53.2**	0.1	"	"	"	"	"	"	
MS-5T (Top Soil) (TYG0003-09) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**92.5**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**7.5**	0.1	"	"	"	"	"	"	
MS-5B (Bottom Soil) (TYG0003-10) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**89.8**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**10.2**	0.1	"	"	"	"	"	"	
MS-6T (Top Soil) (TYG0003-11) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**96.3**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**3.7**	0.1	"	"	"	"	"	"	
MS-6B (Bottom Soil) (TYG0003-12) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**92.3**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**7.7**	0.1	"	"	"	"	"	"	
MS-7T (Top Soil) (TYG0003-13) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**94.0**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**6.0**	0.1	"	"	"	"	"	"	
MS-7B (Bottom Soil) (TYG0003-14) Soil Sampled: 19-Jun-15 12:00 Received: 01-Jul-15 13:20									
% Solids	**87.6**	0.1	% by Weight	1	15G0055	13-Jul-15	14-Jul-15	EPA 1684	
% Moisture	**12.4**	0.1	"	"	"	"	"	"	

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Thundathorn Sukanan

Thundathorn Sukanan, Project Management Manager

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Kerosene HC (C10-C14), Diesel HC (C15-C28) & Heavy Oil HC (C29-C36) by EPA 8015 (modified) - Quality Control
ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 15G0010: Prepared 02-Jul-15 Using EPA 3550C										
Blank (15G0010-BLK1)										
Kerosene Range Hydrocarbons	ND	20.0	mg/kg wet							
Diesel Range Hydrocarbons	ND	20.0	"							
Heavy Oil Range Hydrocarbons	ND	80.0	"							
Surrogate: 4-FBP	*11.9*		"	*17.646*		*67.3*	*50-150*			
Surrogate: Octacosane	*10.2*		"	*17.646*		*57.6*	*50-150*			
LCS (15G0010-BS1)										
Diesel Range Hydrocarbons	59.6	20.0	mg/kg wet	66.534		89.5	70-130			
Surrogate: 4-FBP	*13.6*		"	*17.681*		*77.0*	*50-150*			
Surrogate: Octacosane	*13.9*		"	*17.681*		*78.4*	*50-150*			
LCS Dup (15G0010-BSD1)										
Diesel Range Hydrocarbons	63.7	20.0	mg/kg wet	66.269		96.2	70-130	6.74	30	
Surrogate: 4-FBP	*14.0*		"	*17.611*		*79.8*	*50-150*			
Surrogate: Octacosane	*12.2*		"	*17.611*		*69.2*	*50-150*			
Matrix Spike (15G0010-MS1)					**Source: TYG0003-01**					
Diesel Range Hydrocarbons	75.5	22.5	mg/kg dry	73.838	ND	102	62.7-127			
Surrogate: 4-FBP	*15.9*		"	*19.623*		*80.9*	*50-150*			
Surrogate: Octacosane	*19.0*		"	*19.623*		*96.9*	*50-150*			
Matrix Spike Dup (15G0010-MSD1)					**Source: TYG0003-01**					
Diesel Range Hydrocarbons	75.8	22.5	mg/kg dry	73.838	ND	103	62.7-127	0.389	50	
Surrogate: 4-FBP	*15.7*		"	*19.623*		*79.9*	*50-150*			
Surrogate: Octacosane	*18.8*		"	*19.623*		*95.8*	*50-150*			

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID - Quality Control
ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 15G0003: Prepared 01-Jul-15 Using EPA 5035 Mod.										
Blank (15G0003-BLK1)										
Gasoline Range Hydrocarbons	ND	15.0	mg/kg wet							
Benzene	ND	0.200	"							
Toluene	ND	0.200	"							
Ethylbenzene	ND	0.200	"							
Xylenes (total)	ND	0.600	"							
Surrogate: 1-Chloro-4-fluorobenzene:FID	*2.67*		"	*2.5000*		*107*	*50-150*			
Surrogate: 1-Chloro-4-fluorobenzene:PID	*2.58*		"	*2.5000*		*103*	*50-150*			
LCS (15G0003-BS1)										
Benzene	2.88	0.200	mg/kg wet	3.0000		95.9	75-125			
Toluene	2.93	0.200	"	3.0000		97.8	75-125			
Ethylbenzene	2.84	0.200	"	3.0000		94.5	75-125			
Xylenes (total)	8.14	0.600	"	9.0000		90.4	75-125			
Surrogate: 1-Chloro-4-fluorobenzene:PID	*2.83*		"	*2.5000*		*113*	*50-150*			
LCS (15G0003-BS2)										
Gasoline Range Hydrocarbons	171	15.0	mg/kg wet	150.00		114	75-125			
Surrogate: 1-Chloro-4-fluorobenzene:FID	*2.53*		"	*2.5000*		*101*	*50-150*			
Matrix Spike (15G0003-MS1)					**Source: TYG0003-01**					
Benzene	2.67	0.223	mg/kg dry	3.3414	ND	80.0	51-144			
Toluene	3.21	0.223	"	3.3414	ND	96.2	55-125			
Ethylbenzene	3.10	0.223	"	3.3414	ND	92.9	59.1-130			
Xylenes (total)	8.42	0.668	"	10.024	0.0539	83.5	59-125			
Surrogate: 1-Chloro-4-fluorobenzene:PID	*3.31*		"	*2.7845*		*119*	*50-150*			
Matrix Spike (15G0003-MS2)					**Source: TYG0003-02**					
Gasoline Range Hydrocarbons	125	15.2	mg/kg dry	151.94	9.49	75.7	51.4-134			
Surrogate: 1-Chloro-4-fluorobenzene:FID	*2.60*		"	*2.5324*		*103*	*50-150*			

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Gasoline Hydrocarbons (2-Methylpentane to 1,2,4-Trimethylbenzene) and BTEX by GC/FID & GC/PID - Quality Control
ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 15G0003: Prepared 01-Jul-15 Using EPA 5035 Mod.										
Matrix Spike Dup (15G0003-MSD1)					**Source: TYG0003-01**					
Benzene	3.03	0.223	mg/kg dry	3.3414	ND	90.7	51-144	12.5	40	
Toluene	3.17	0.223	"	3.3414	ND	94.8	55-125	1.47	19	
Ethylbenzene	3.16	0.223	"	3.3414	ND	94.5	59.1-130	1.76	18.6	
Xylenes (total)	9.51	0.668	"	10.024	0.0539	94.3	59-125	12.1	40	
Surrogate: 1-Chloro-4-fluorobenzene:PID	*3.14*		*"*	*2.7845*		*113*	*50-150*			
Matrix Spike Dup (15G0003-MSD2)					**Source: TYG0003-02**					
Gasoline Range Hydrocarbons	135	15.2	mg/kg dry	151.94	9.49	82.7	51.4-134	8.19	23.3	
Surrogate: 1-Chloro-4-fluorobenzene:FID	*2.64*		*"*	*2.5324*		*104*	*50-150*			

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Conventional Chemistry Parameters in Soils and Solids - Quality Control

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 15G0040: Prepared 06-Jul-15 Using EPA 3550C Sonication										
Blank (15G0040-BLK1)										
Oil & Grease (HEM)	ND	200	mg/kg wet							
LCS (15G0040-BS1)										
Oil & Grease (HEM)	1210	200	mg/kg wet	1333.3		91.0	70-130			
LCS Dup (15G0040-BSD1)										
Oil & Grease (HEM)	1190	200	mg/kg wet	1333.3		89.3	70-130	1.94	20	
Duplicate (15G0040-DUP1)					**Source: TYG0003-11**					
Oil & Grease (HEM)	58.9	200	mg/kg dry		48.5			19.4	20	
Matrix Spike (15G0040-MS1)					**Source: TYG0003-11**					
Oil & Grease (HEM)	1270	200	mg/kg dry	1385.0	48.5	88.0	45.3-119			
Matrix Spike Dup (15G0040-MSD1)					**Source: TYG0003-11**					
Oil & Grease (HEM)	1290	200	mg/kg dry	1385.0	48.5	89.5	45.3-119	1.63	25	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

ncalabs co., ltd.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 15G0055: Prepared 13-Jul-15 Using Solids										
Blank (15G0055-BLK1)										
% Solids	100	0.1	% by Weight							
% Moisture	ND	0.1	"							
Duplicate (15G0055-DUP1)					**Source: TYF0032-BU**					
% Solids	51.6	0.1	% by Weight		51.5			0.175	5.58	
% Moisture	48.4	0.1	"		48.5			0.186	20	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	14-Jul-15 15:33

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Sample Analysis Report

Department of Silviculture

Faculty of Forestry, Kasetsart University

Tel. 02-5790171, Fax. 02-9428112

รายงานเลขที่ 41/58

วันที่ออกรายงาน 20/07/58

ดินตัวอย่างของ บริษัท เอส ที เอส กรีน จำกัด

Sample Name	Extractable S (mg/kg)					Remark
MS-1T	43.09					
MS-1B	130.21					
MS-2T	141.45					
MS-2B	818.73					
MS-3T	145.85					
MS-3B	652.45					
MS-4T	0.94					
MS-4B	1.22					
MS-5T	115.69					
MS-5B	365.80					
MS-6T	1.06					
MS-6B	1.41					
MS-7T	199.62					

Sample Analysis Report

Department of Silviculture

Faculty of Forestry, Kasetsart University

Tel. 02-5790171, Fax. 02-9428112

รายงานเลขที่ 41/58

วันที่ออกรายงาน 20/07/58

ดินตัวอย่างของ บริษัท เอส ที เอส กรีน จำกัด

Sample Name	Extractable S (mg/kg)					Remark
MS-7B	261.83					
MS-8T	0.41					
MS-8B	80.19					

รับรองผลโดยห้องปฏิบัติการปฐพีวิทยาป่าไม้

ภาควิชาวนวัฒนวิทยา คณะวนศาสตร์ มหาวิทยาลัยเกษตรศาสตร์

(ผศ.ดร.รุ่งเรือง พูลศิริ)

หัวหน้าห้องปฏิบัติการปฐพีวิทยาป่าไม้

STS GREEN CO., LTD.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani 12150, Thailand
Tel: +66 2153 7001-6 Fax: +66 2153 7007
E-mail: green@sts.co.th http://www.sts.co.th

TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/8	MGW-1						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	494	mg/L as $CaCO_3$	Clear, Sediment
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.2	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	11.1	mg/L	Clear, Sediment
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	<1.0	mg/L	Clear, Sediment
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.44	mg/L	Clear, Sediment
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	<0.010	mg/L	Clear, Sediment
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	1.19	mg/L	Clear, Sediment
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Clear, Sediment
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	355	mg/L	Clear, Sediment
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Clear, Sediment
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	996	mg/L	Clear, Sediment
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	395	mg/L as $CaCO_3$	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	<0.005	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/8	MGW-1						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	<0.0002	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Clear, Sediment
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	72.04	mg/L	Clear, Sediment
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Clear, Sediment
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	59.34	mg/L	Clear, Sediment
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Clear, Sediment
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0063	mg/L	Clear, Sediment
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	3.98	mg/L	Clear, Sediment
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	291.01	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	17,000	MPN/ 100 mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/9	**MGW-2**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	345	mg/L as $CaCO_3$	Yellow, Sediment
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.4	mg/L	Yellow, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	<5.0	mg/L	Yellow, Sediment
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	<1.0	mg/L	Yellow, Sediment
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.52	mg/L	Yellow, Sediment
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	<0.010	mg/L	Yellow, Sediment
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	0.426	mg/L	Yellow, Sediment
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Yellow, Sediment
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	164	mg/L	Yellow, Sediment
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Yellow, Sediment
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	456	mg/L	Yellow, Sediment
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	243	mg/L as $CaCO_3$	Yellow, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.028	mg/L	Yellow, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Yellow, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/9	MGW-2						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	<0.0002	mg/L	Yellow, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Yellow, Sediment
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	47.27	mg/L	Yellow, Sediment
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Yellow, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Yellow, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Yellow, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Yellow, Sediment
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	21.05	mg/L	Yellow, Sediment
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	0.21	mg/L	Yellow, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Yellow, Sediment
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0033	mg/L	Yellow, Sediment
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	19.37	mg/L	Yellow, Sediment
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	108.76	mg/L	Yellow, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Yellow, Sediment
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	4.0	MPN/ 100 mL	Yellow, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/10	**MGW-3**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	529	mg/L as $CaCO_3$	Clear
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.4	mg/L	Clear
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	12.7	mg/L	Clear
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	<1.0	mg/L	Clear
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.50	mg/L	Clear
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	<0.010	mg/L	Clear
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	1.20	mg/L	Clear
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Clear
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	162	mg/L	Clear
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Clear
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	660	mg/L	Clear
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	203	mg/L as $CaCO_3$	Clear
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	<0.005	mg/L	Clear
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Clear

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/10	**MGW-3**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	<0.0002	mg/L	Clear
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Clear
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	28.52	mg/L	Clear
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Clear
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Clear
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Clear
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Clear
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	39.28	mg/L	Clear
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Clear
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Clear
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0032	mg/L	Clear
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	1.59	mg/L	Clear
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	171.56	mg/L	Clear
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Clear
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	130	MPN/ 100 mL	Clear

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/11	**MGW-4**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	279	mg/L as $CaCO_3$	Yellow, Clear
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.3	mg/L	Yellow, Clear
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	6.4	mg/L	Yellow, Clear
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	1.4	mg/L	Yellow, Clear
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.45	mg/L	Yellow, Clear
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	0.024	mg/L	Yellow, Clear
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	3.07	mg/L	Yellow, Clear
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Yellow, Clear
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	444	mg/L	Yellow, Clear
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Yellow, Clear
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	844	mg/L	Yellow, Clear
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	390	mg/L as $CaCO_3$	Yellow, Clear
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.024	mg/L	Yellow, Clear
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Yellow, Clear

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/11	**MGW-4**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	<0.0002	mg/L	Yellow, Clear
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Yellow, Clear
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	80.17	mg/L	Yellow, Clear
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Yellow, Clear
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Yellow, Clear
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	0.43	mg/L	Yellow, Clear
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Yellow, Clear
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	45.36	mg/L	Yellow, Clear
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Yellow, Clear
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Yellow, Clear
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0050	mg/L	Yellow, Clear
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	4.12	mg/L	Yellow, Clear
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	199.14	mg/L	Yellow, Clear
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Yellow, Clear
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	<1.8	MPN/ 100 mL	Yellow, Clear

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Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/12	**MGW-5**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	203	mg/L as $CaCO_3$	Clear, Sediment
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.2	mg/L	Clear, Sediment
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	12.7	mg/L	Clear, Sediment
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	44.6	mg/L	Clear, Sediment
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.56	mg/L	Clear, Sediment
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	<0.010	mg/L	Clear, Sediment
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	0.695	mg/L	Clear, Sediment
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Clear, Sediment
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	452	mg/L	Clear, Sediment
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Clear, Sediment
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	856	mg/L	Clear, Sediment
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	454	mg/L as $CaCO_3$	Clear, Sediment
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.018	mg/L	Clear, Sediment
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	10.0	mg/L	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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July 13, 2015

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July 13, 2015

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/12	**MGW-5**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	<0.0002	mg/L	Clear, Sediment
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Clear, Sediment
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	78.75	mg/L	Clear, Sediment
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Clear, Sediment
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Clear, Sediment
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Clear, Sediment
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Clear, Sediment
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	57.51	mg/L	Clear, Sediment
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Clear, Sediment
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Clear, Sediment
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0039	mg/L	Clear, Sediment
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	3.02	mg/L	Clear, Sediment
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	90.75	mg/L	Clear, Sediment
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Clear, Sediment
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	16,000	MPN/ 100 mL	Clear, Sediment

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/13	**MGW-6**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	767	mg/L as $CaCO_3$	Clear
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.1	mg/L	Clear
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	15.9	mg/L	Clear
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	<1.0	mg/L	Clear
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.61	mg/L	Clear
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	0.016	mg/L	Clear
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	2.70	mg/L	Clear
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Clear
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	407	mg/L	Clear
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Clear
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	1,176	mg/L	Clear
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	253	mg/L as $CaCO_3$	Clear
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.010	mg/L	Clear
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Clear

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/13	**MGW-6**						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	0.0004	mg/L	Clear
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Clear
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	26.68	mg/L	Clear
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Clear
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Clear
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Clear
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Clear
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	36.75	mg/L	Clear
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Clear
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Clear
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0067	mg/L	Clear
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	3.08	mg/L	Clear
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	422.16	mg/L	Clear
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Clear
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	13	MPN/ 100 mL	Clear

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/14	**MGW-7**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	671	mg/L as $CaCO_3$	Clear
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.1	mg/L	Clear
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	8.0	mg/L	Clear
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	<1.0	mg/L	Clear
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.84	mg/L	Clear
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	0.019	mg/L	Clear
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	3.94	mg/L	Clear
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Clear
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	402	mg/L	Clear
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Clear
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	1,120	mg/L	Clear
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	295	mg/L as $CaCO_3$	Clear
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.006	mg/L	Clear
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Clear

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/14	MGW-7						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	<0.0002	mg/L	Clear
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Clear
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	33.79	mg/L	Clear
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Clear
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Clear
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Clear
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Clear
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	42.61	mg/L	Clear
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Clear
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Clear
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0073	mg/L	Clear
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	2.65	mg/L	Clear
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	347.59	mg/L	Clear
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Clear
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	40	MPN/ 100 mL	Clear

Method : Standard Methods for Examination of Water and Wastewater 22nd Edition 2012 (AWWA, APHA, WEF)

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/15	**MGW-8**						
		Alkalinity	Titration Method (2320 B)	July 5, 2015	668	mg/L as $CaCO_3$	Clear
		Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method (5210 B)	June 29 - July 4, 2015	0.2	mg/L	Clear
		Chemical Oxygen Demand	Open Reflux Method (5220 B)	July 4, 2015	<5.0	mg/L	Clear
		Chloride	Mercuric Nitrate Method (4500-Cl^- C)	July 3, 2015	<1.0	mg/L	Clear
		Fluoride	SPADNS Method (4500-F^- D)	July 5, 2015	0.85	mg/L	Clear
		Nitrogen (Ammonia)	Phenate Method (4500-NH_3 F)	July 4, 2015	0.024	mg/L	Clear
		Nitrogen (Nitrate)	Cadmium Reduction Method (4500-NO_3^- E)	June 30, 2015	1.88	mg/L	Clear
		Oil & Grease	Liquid-Liquid, Partition-Gravimetric Method (5520 B)	July 4, 2015	<5.0	mg/L	Clear
		Sulfate	Turbidimetric Method (4500-SO_4^{2-} E)	July 2, 2015	402	mg/L	Clear
		Sulfide	Iodometric Method (4500-S^{2-} F)	June 30, 2015	<1.0	mg/L	Clear
		Total Dissolved Solids	Dried at 180 °C Method (2540 C)	June 30, 2015	1,218	mg/L	Clear
		Total Hardness	EDTA Titrimetric Method (2340 C)	July 4, 2015	185	mg/L as $CaCO_3$	Clear
		Total Phosphorus	Acid digestion, Ascorbic Acid Method (4500-P B&E)	June 29, 2015	0.017	mg/L	Clear
		Total Suspended Solids	Dried at 103-105 °C Method (2540 D)	June 30, 2015	<2.5	mg/L	Clear

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TEST REPORT

Client	:	ERM Siam Co., Ltd.			
Address	:	179 Bangkok City Tower, 24th Floor, South Sathorn Road, Tungmahamek, Sathorn, Bangkok, 10120			
Project Name	:	Myingyan IPP Project			
Sample Type	:	Groundwater			
Sampling By	:	ERM Siam Co., Ltd.	**Sampling Date**	:	June 17, 2015
Work Request No.	:	381/15	**Sample Received Date**	:	June 29, 2015
Report No.	:	393/15	**Reported Date**	:	July 13, 2015

ID.No.	Sample Name	Parameters	Analytical Methods	Analytical Date	Results	Units	Sample Description
290615/15	MGW-8						
		Arsenic	Hydride Generation Atomic Absorption Spectrometric Method (3114 C)	July 7, 2015	0.0007	mg/L	Clear
		Cadmium	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.00005	mg/L	Clear
		Calcium	Direct Nitrous Oxide-Acetylene Flame Method (3111 D)	July 5, 2015	17.24	mg/L	Clear
		Hexavalent Chromium	Extraction, Air-Acetylene Flame Method (3111 C)	June 30, 2015	<0.01	mg/L	Clear
		Copper	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.03	mg/L	Clear
		Iron	Direct Air-Acetylene Flame Method (3111 B)	July 2, 2015	<0.05	mg/L	Clear
		Lead	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 5, 2015	<0.0020	mg/L	Clear
		Magnesium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	28.19	mg/L	Clear
		Manganese	Direct Air-Acetylene Flame Method (3111 B)	July 4, 2015	<0.02	mg/L	Clear
		Mercury	Cold-Vapor Atomic Absorption Spectrometric Method (3112 B)	July 1, 2015	<0.0003	mg/L	Clear
		Nickel	Electrothermal Atomic Absorption Spectrometric Method (3113 B)	July 2, 2015	0.0069	mg/L	Clear
		Potassium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	2.44	mg/L	Clear
		Sodium	Direct Air-Acetylene Flame Method (3111 B)	July 5, 2015	401.54	mg/L	Clear
		Zinc	Direct Air-Acetylene Flame Method (3111 B)	July 3, 2015	<0.01	mg/L	Clear
		Total Coliform Bacteria	Multiple-Tube Fermentation Technique Method (9221 B)	July 3-6, 2015	21	MPN/ 100 mL	Clear

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	16-Jul-15 12:46

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MGW-1	TYG0001-01	Water	16-Jun-15 12:00	01-Jul-15 13:20
MGW-2	TYG0001-02	Water	16-Jun-15 12:00	01-Jul-15 13:20
MGW-3	TYG0001-03	Water	16-Jun-15 12:00	01-Jul-15 13:20
MGW-4	TYG0001-04	Water	16-Jun-15 12:00	01-Jul-15 13:20
MGW-5	TYG0001-05	Water	16-Jun-15 12:00	01-Jul-15 13:20
MGW-6	TYG0001-06	Water	20-Jun-15 12:00	01-Jul-15 13:20
MGW-7	TYG0001-07	Water	20-Jun-15 12:00	01-Jul-15 13:20
MGW-8	TYG0001-08	Water	20-Jun-15 12:00	01-Jul-15 13:20

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Thundathorn Sukanan

Thundathorn Sukanan, Project Management Manager

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a TestAmerica Company

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	16-Jul-15 12:46

Metals (ICP) Total Recoverable

TestAmerica Tacoma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MGW-1 (TYG0001-01) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-2 (TYG0001-02) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-3 (TYG0001-03) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-4 (TYG0001-04) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-5 (TYG0001-05) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-6 (TYG0001-06) Water Sampled: 20-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-7 (TYG0001-07) Water Sampled: 20-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	
MGW-8 (TYG0001-08) Water Sampled: 20-Jun-15 12:00 Received: 01-Jul-15 13:20									
Tin	ND	0.10	mg/L	1	194586	10-Jul-15	13-Jul-15	6010C	

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Thundathorn Sukanan, Project Management Manager

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Level 10, P.M. Tower, 731 Asoke-Din Daeng Rd.
Din Daeng, Bangkok 10400 Thailand
Phone: 662-245-9660 fax: 662-245-9662

STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	16-Jul-15 12:46

Organic Carbon, Total (TOC)

TestAmerica Tacoma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MGW-1 (TYG0001-01) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	ND	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-2 (TYG0001-02) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	**1.9**	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-3 (TYG0001-03) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	ND	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-4 (TYG0001-04) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	ND	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-5 (TYG0001-05) Water Sampled: 16-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	ND	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-6 (TYG0001-06) Water Sampled: 20-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	**1.2**	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-7 (TYG0001-07) Water Sampled: 20-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	**1.2**	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	
MGW-8 (TYG0001-08) Water Sampled: 20-Jun-15 12:00 Received: 01-Jul-15 13:20									
Total Organic Carbon	**1.1**	1.0	mg/L	1	194642	10-Jul-15	10-Jul-15	SM 5310B	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	16-Jul-15 12:46

Metals (ICP) Total Recoverable - Quality Control
TestAmerica Tacoma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 194586: Prepared 10-Jul-15 Using 3005A										
Blank (194714-36)					**Source:**					
Tin	ND	0.10	mg/L				-			
LCS (194714-37)					**Source:**					
Tin	4.70	0.10	mg/L	5.00		94	80-120			
LCS Dup (194714-38)					**Source:**					
Tin	4.76	0.10	mg/L	5.00		95	80-120	1	20	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	16-Jul-15 12:46

Organic Carbon, Total (TOC) - Quality Control

TestAmerica Tacoma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 194642: Prepared 10-Jul-15 Using NA										
Blank (194642-1)					**Source:**					
Total Organic Carbon	ND	1.0	mg/L				-			
LCS (194642-2)					**Source:**					
Total Organic Carbon	10.1	1.0	mg/L	10.0		101	85-115			
Matrix Spike Dup (514231D)					**Source: TYG0001-01**					
Total Organic Carbon	12.2	1.0	mg/L	10.0	ND	113	85-115	6	20	
Matrix Spike (514231S)					**Source: TYG0001-01**					
Total Organic Carbon	11.4	1.0	mg/L	10.0	ND	106	85-115			
Duplicate (514231X)					**Source: TYG0001-01**					
Total Organic Carbon	ND	1.0	mg/L		ND		-	NC	20	

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STS Green Co., Ltd	Project: Myingyan IPP Project	
3/23 Moo 5, Phahonyothin-Lumlukka Rd., Lad Sawai	Project Number: 5258051M	**Reported:**
Lumlukka, Pathumthani, Thailand 12150	Project Manager: Wichit Patcha	16-Jul-15 12:46

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

ncalabs co., ltd. (Thailand)

Level 10, PM Tower 731 Asoke-Dindaeng Rd.
Dindaeng, Bangkok Thailand 10400
Phone: 662-245-9660-1

TEST REPORT

Report :	NCA-TYG0001	**Report Date :**	July 16, 2015
Customer :	STS Green Co., Ltd	**Received Date :**	July 02, 2015
Address :	3/23 Moo 5, Phahonyothin-Lumlukka Road	**Analytical Date :**	July 06, 2015
	Lad Sawai, Lumlukka	**Sample Description :**	Water Sample Matrix
	Pathumthani, Thailand	**Sampling by :**	Customer
Project :	Myingyan IPP Project	**Project Manager :**	Wichit Patcha

Analytical Report for Samples

Laboratory ID	Parameter Total Cyanide	Reporting Limit	Unit	Method of Analysis
TYG0001-01 (MGW-1)	<0.001 (H)	0.001	mg/L	APHA, 22nd edition, 2012, 4500-CN⁻ C,E
TYG0001-02 (MGW-2)	<0.001 (H)	0.001	mg/L	
TYG0001-03 (MGW-3)	<0.001 (H)	0.001	mg/L	
TYG0001-04 (MGW-4)	<0.001 (H)	0.001	mg/L	
TYG0001-05 (MGW-5)	<0.001 (H)	0.001	mg/L	
TYG0001-06 (MGW-6)	<0.001 (H)	0.001	mg/L	
TYG0001-07 (MGW-7)	0.001 (H)	0.001	mg/L	
TYG0001-08 (MGW-8)	0.001 (H)	0.001	mg/L	

Analytical Report for Quality Control

Quality Control	Total Cyanide
Blank, mg/L	<0.001
Duplicate (TYG0001-08), % RPD	0.00
Matrix Spike (TYG0001-01), % Recovery	101.67

Remark **:**

1. *Total Cyanide analysis performed by Analytical Laboratory Service Co., Ltd. (ว.026/1)*
2. *All samples analysis on July 06, 2015 : 09.00 am.*
3. *All samples analysis performed part method specified holding time*

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Thundathorn Sukanan

Thundathorn Sukanan
Project Management Manager

NCAlabs Co., Ltd.

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TESTING
No.0009

Analysis / Test Report

Report to : STS Green Co., Ltd.
3/23 Moo 5, Lat Sawai, Lam Luk Ka, Pathum Thani Thailand 12150
Attn : Siriwan Hudnaked
Phone : 0-2153-7001 - 6
Fax : 0-2153-7007
Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-3
Sampling Date	Jun 16, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-1
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	1.1	Based on APHA (2012), Calculated

Technical Management

Nanthawadee Somboon
Scientist (4)
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Approved by

Yupaporn Chanpleng
Senior Manager
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Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-4
Sampling Date	Jun 16, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-2
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Technical Management

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Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-5
Sampling Date	Jun 16, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-3
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Technical Management

Nanthawadee Somboon
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ทะเบียนเลขที่ ว-204-จ-4716

Approved by

Yupaporn Chanpleng
Senior Manager
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Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-6
Sampling Date	Jun 16, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-4
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	2.9	Based on APHA (2012), Calculated

Technical Management

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Approved by

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Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-7
Sampling Date	Jun 16, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-5
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	<1.0	Based on APHA (2012), Calculated

Technical Management

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Approved by

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Email : siriwan.hudnaked@gmail.com
Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-8
Sampling Date	Jun 20, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-6
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	2.3	Based on APHA (2012), Calculated

Technical Management

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Cc.Email : green@sts.co.th ; siriwan.h@sts.co.th

Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-9
Sampling Date	Jun 20, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-7
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	4.4	Based on APHA (2012), Calculated

Technical Management

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Approved by

Yupaporn Chanpleng
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ทะเบียนเลขที่ ว-204-ค-4700

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Project :
Location :
P/O :
Receipt No :

Lot ID: 1531081
Date Received : Jun 30, 2015
Date Reported : Jul 03, 2015
Report Number : 582782-1

Reference Number	1531081-10
Sampling Date	Jun 20, 2015
Project Name	Myingyan IPP Project
Sample Description	Ground Water
Location	MGW-8
Condition of Sample	contained in one plastic bottle (client container)
Date of Analysis	Jul 01, 2015

Analyte	Unit	LOD	LOQ	Result	Method
Water Testing					
Total Nitrogen *	mg/L	-	1.0	1.5	Based on APHA (2012), Calculated

Remark :
1. LOD : Limit of Detection
2. "<" : Lower than LOQ (Limit of Quantitation)
3. Analyte(s) marked * is/are not included in scope of Accreditation.

Technical Management

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Approved by

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Quality Control Report

Client : STS Green Co., Ltd.
Lot ID : 1531081-1 to 10
Received Date : June 30, 2015

Analyte	Method Blank		Duplicate (%RPD)		Spike Sample (%Recovery)	
	Result	Criteria	Result	Criteria	Result	Criteria
Water Testing						
Residual Free Chlorine	<0.01	<0.01	n/a	10	-	-
Total Nitrogen	<1.0	<1.0	-	-	-	-

Remark

n/a = %RPD is not applicable for results less than Limit of Quantitative (no RPD is reported).

Approved By

Yupaporn Chanpleng
Senior Manager

Annex C

Checklist of Invasive Species

Annex C List of Invasive Species

Scientific Name	Common Name	Native Range	Distribution	Impacts
Acacia longifolia	Sallow wattle	Australia	Argentina, Brazil, Colombia, Dominican Republic, India, Israel, Italy, Java, Kenya, La Réunion, Mauritius, Myanmar, New Zealand, Portugal, South Africa, Spain, Sri Lanka, USA, Uruguay	Impacts include reduction in native biodiversity, ecosystem change, habitat alteration and changes in hydrology and fire regimes (le Maitre et al. 2002; van Wilgen et al. 2004, Marchante et al. 2003)
Acacia mangium	Hickory wattle	Australia (Queensland), Molluccan Islands, Papua New Guinea, Indonesia (Irian Jaya)	Mayotte, French Guiana, New Caledonia and other Pacific islands: American Samoa, Cook Islands, Federated States of Micronesia, Guam, Palau, Samoa, Solomon Islands (PIER, 2007). China, Indonesia, Lao PDR, Malaysia, Myanmar, Thailand, the Philippines and Vietnam, Bangladesh, Brazil, Cameroon, Costa Rica, Hawaii and Nepal (Royal Botanic Gardens, Kew, 2011)	Threat to indigenous flora
Aedes aegypti	Yellow fever mosquito	Africa	American Samoa, Anguilla, Antigua & Barbuda, Argentina, Aruba, Australia, Bahamas, Barbados, Belize, Brazil, Bolivia, British Virgin Islands, Cambodia, Cayman Islands, China, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Fiji, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Hawaii, Honduras, India, Indonesia, Laos, Malaysia, Martinique, Mexico, Monsterrat, Myanmar, Netherlands Antilles, New Caledonia, Nicaragua, Niue, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Puerto Rico, St. Barthelemy, St. Kitts & Nevis, St. Lucia, St. Martin, St. Vincent & the Grenadines, Samoa, Singapore, Solomon Islands, Sri Lanka, Suriname, Thailand, Timor-Leste, Trinidad & Tobago, Tokelau, Tonga, Turks & Caicos Islands, Tuvalu, United States, Uruguay, Vanuatu, Venezuela, Vietnam, Virgin Islands, Wallis & Futuna. (Gubler 1998)	A. aegypti is the domestic vector of the yellow fever virus, caused epidemics of yellow fever in the Americas (before the 1940's) and recently in West Africa, and is responsible for 'urban yellow fever' - direct transmission of the virus between humans
Alternanthera philoxeroides	Alligator weed	South America	Asia, Australasia-Pacific, Europe, North America (Coventry et al. 2002; Julien et al. 1995; USDA-NRCS, 2004)	Gunasekera (1999) states that, "Alternanthera philoxeroides is considered to be one of the worst aquatic weeds in the world. The aquatic form of the plant has the potential to become a serious

				threat to waterways, agriculture and the environment. The terrestrial form grows into a dense mat with a massive underground rhizomatous root system. The canopy can smother most other herbaceous plant species."
Brontispa longissima Gestro	Coconut hispid beetle	Melanesia (PestNet 2002), Indonesia (Aru Islands, Maluku Province, Papua Province, formerly Irian Jaya) and Papua New Guinean including the Bismarck Archipelago (Aminath 2004)	Many islands in the Pacific Ocean including Vietnam, the Maldives and the Philippines	Attacks palm leaf fronds (as the name suggests) especially those of the coconut tree
Cardamine flexuosa	Woodland bittercress	Unclear due to its widespread distribution	North America, Australia and central Asia. Asian range includes: Bangladesh, Bhutan, India, Indonesia, Japan, Kashmir, Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sikkim, Thailand and Vietnam (eFlora, 2010)	Flowers vigorously and forms dense understory root mats (South Georgia Newsletter, 2004). These could potentially alter successional processes and displace native plant species. C. flexuosa is also known as a common agricultural weed in paddy fields, crop gardens and orchards (Kudoh et al., 1993).
Chromolaena odorata	Bitter bush	South America and Central America	South Africa, India, China, Indonesia, East Timor and the Philippines	Forms dense stands preventing establishment of other species, both due to competition and allelopathic effects. When dry, C. odorata becomes a fuel which may promote wild bushfires (PIER 2003). C. odorata may also cause skin complaints and asthma in allergy-prone people. It is a major weed in plantations and croplands, including plantations of rubber, oil palm, forestry and coffee plants.
Clarias gariepinus	African sharptooth catfish	Pan-Africa, Jordan, Lebanon, Israel, Syria and Turkey	Parts of Africa, Europe and Asia	Threat to endemic aquatic fish, particularly in South Africa and India
Ctenopharyngodon idella	Grass carp	China, Russian Federation	Afghanistan, Algeria, Argentina, Albania, Algeria, Armenia, Azerbaijan, Bangladesh, Belarus, Belgium, Bhutan, Bolivia, Brazil, Brunei Darsm, Cambodia, Canada, Colombia, Cote d' Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Egypt, Ethiopia, Fiji, Finland, Guyana, Hawaii,	Known to completely eliminate aquatic plants in introduced habitats altering trophic structure and inflicting widespread detrimental effects on ecosystems. They may also feed selectively on softer plants thereby enhancing development of tougher plants. Grass carp remove macrophyte

			Honduras, Hong Kong, Hungary, India, Indonesia, Iraq, Islamic Republic of Iran, Israel, Italy, Jamaica, Japan, Kazakhstan, Kenya, Democratic People's Republic of Korea, Kyrgyzstan, Laos, Latvia, Malaysia, Mauritius, Mexico, Republic of Moldova, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Netherlands, New Zealand, Nigeria, Pakistan, Panama, Peru, Philippines, Puerto Rico, La Réunion, Romania, Rwanda, Serbia and Montenegro, Singapore, Slovakia, Slovenia, South Africa, Sri Lanka, Sudan, Sweden, Taiwan, Tanzania, Thailand, Tunisia, Turkey, Turkmenistan, United Kingdom, Ukraine, United Arab Emirates, Uruguay, United States, Uzbekitsan, and Vietnam (FishBase, 2008).	cover, eliminate spawning substrate, disturb sediment and muddy waters, reduce water quality, increase nutrients in waters accelerating eutrophication, decrease oxygen levels, and promote alagal bloom. They compete with native invertebrates and fish for food and other important resources.
Cyprinus carpio	Carp	Europe in rivers around the Black Sea and the Aegean basin, especially the Danube. Prior to human influence the common carp was found in the Black, Caspian and Aral Sea drainages, east into Siberia and China and west as far as the Danube River (Balon 1995, in Aguirre & Poss, 2000).	Tropical, subtropical and temperate freshwaters throughout the world and today occurs on every continent except Antarctica	On every continent where it has been introduced it has reduced water quality and degraded aquatic habitats
Eichhornia crassipes	Water hyacinth	Amazon basin and the extensive lakes and marshes of the Pantanal region of western Brazil	Near worldwide distribution throughout the tropics and has spread to more than 50 countries on five continents	One of the world's worst weeds (Holm et al. 1977, in Room and Fernando 1992). People have spread it to most tropical and subtropical regions in the world where it forms thick mats that cover rice paddies, clog irrigation channels, impede navigation, halt fishing, sweep away buildings during floods and foster breeding by disease-transmitting mosquitoes (Carter 1950, Chow et al. 1955, Williams 1956, Kotalawala 1976, in Room and Fernando 1992).

Gambusia affinis	Mosquito fish	Southern USA and northern Mexico	Near pan-global distribution and is thought to be the most widely introduced freshwater fish in the world	Extremely aggressive and attack other fish, shredding fins and sometimes killing them. Selective predation by mosquito fish has also been shown to alter zooplankton, insect and crustacean communities (McDowall, 1990). Mosquito fish are potential hosts of helminth parasites, which have been transmitted to native fishes (FishBase, 2003).
Hypophthalmichthys nobilis	Bighead carp	China and Russia	Africa, Asia, Australasia-Pacific, North America, and South America	USGS-NAS (2005) reports that, "Because bighead carp are planktivorous and attain a large size, Laird and Page (1996) suggested these carp have the potential to deplete zooplankton populations. A decline in the availability of plankton can lead to reductions in populations of native species that rely on plankton for food, including all larval fishes, some adult fishes, and native mussels." H. nobilis is also a carrier of several different fish diseases that can be spread through its escape and introduction (FIGIS, 2005).
Imperata cylindrica	Cogon grass	Southeast Asia, Australia, China, Japan, the Philippines, and East Africa	Widely distributed in Africa, Australia, southern Asia, and the Pacific Islands	Increases in I. cylindrica concern ecologists because this species displaces native plant and animal species and alters fire regimes (Lippincott 1997 2000, in Brewer & Cralle 2003). Dense swards of I. cylindrica create an intense competitive environment for commercially important species (Bryson and Carter 1993, Kuusipalo et al. 1995, Premalal et al. 1995, Dozier et al. 1998).
Leucaena leucocephala	Leucaena	Mexico and Central America	Widely introduced across the tropics in the 1970s and 1980s and is now very widely cultivated throughout the tropics and subtropics	It is a weed of open, often coastal or riverine habitats, semi-natural, and other disturbed or ruderal sites and occasionally in agricultural land. It can form dense monospecific thickets which are reported to be replacing native forest in some areas and threatening endemic species of conservation concern in some areas. Dense thickets, even if not of immediate conservation concern can render extensive areas of disturbed ground unusuable and inaccessible.
Limnocharis flava	Sawah-lettuce	America (North Western Mexico,	Southeast Asia (Malaysia, Indonesia, Thailand, South Myanmar, Srilanka, India and Vietnam), and	Very invasive environmental weed of streams and wetlands. It has become a serious weed in rice

		Nicaragua, Costa Rica, Panama, Cuba, Haiti, Dominican Republic, Windward Islands, Colombia, Venezuela, Ecuador, West Indies, Peru and Brazil)	Australia	fields, irrigation canals and wetlands in South-East Asia (Waterhouse, 2003). Clumps of the weed provide a congenial breeding sites for disease-vectors, including mosquitoes, which encourages the spread of diseases such as Japan fever and dengue fever (Abhilash, 2004).
Oreochromis aureus	Blue tilapia	Cameroon, Chad, Egypt, Israel, Jordan, Mali, Niger, Nigeria, Saudi Arabia, Senegal	Antigua and Barbados, Bahamas, Brazil, China, Coasta Rica, Cote d'Ivoire, Cuba, Cyprus, Dominica, Dominican Republic, El Slavidor, French Polynesia, Guatemala, Gulf of Mexico, Haiti, Japan, Kuwait, Mexico, Myanmar, Neth Antilles, Nicaragua, Pakistan, Panama, Peru, Philippines, Puerto Rico, Russian Federation, Singapore, South Africa, Syrian Arab Republic, Taiwan, Thailand, Turkey, Uganda, United Arab Emirates, United States, Zambia	Competes with native fishes for food, spawning area, and space, and exhibits aggressive behavior. They have become the dominant species in many of their introduced ranges. Several introductions have correlated with and are believed to cause reductions in abundance of native fishes and even molluscs. Blue tilapia structure phytoplankton communities by their feeding preference of specific algae, having significant effects on the entire community ecology. Some reports maintain certain introduced areas have lost most and nearly all native fishes (McDonald, 1987; GSMFC, 2003; FishBase, 2007; Nico, 2007).
Oreochromis spp.	Tilapia	Africa and the Middle East	Introduced to the Far East in the 1940s for farming purposes. It was quickly disseminated by humans throughout Central and South America	Tilapia is usually farmed using semi-intensive farming, which generally has a greater impact on the environment than either small-scale subsistence operations or large commercial operations. The preferred form of culture is cage culture, which is the most risky in terms of environmental impact as it directly interfaces with the natural environment
Paratrechina longicornis	Crazy ant	Africa and Asia	Australasia-Pacific Region, Europe, North America, and South America	Its ability to invade a varying degree of habitats makes it serious threat. It occurs in large numbers in homes or outdoors. They forage long distances away from the nest, making them hard to find and subsequently make it difficult to control.
Poecilia reticulata	Guppy	Brazil, Guyana, Venezuela, and the Caribbean Islands	Asia, Australasia-Pacific, Europe, North America, and South America	Considered a hazard to native cyprinids and killifishes in the United States. It has been implicated in the decline of native fishes in Nevada and Wyoming, and of native damselflies in Hawaii. It is a known carrier of trematode parasites, which may affect native fish populations

				(Nico, 2001).
Prosopis spp.	Mesquite	Arid and semi-arid zones of the Americas, Africa and Asia	Africa (the Sahel region, Sudan, Ethiopia, Kenya, Namibia, South Africa, Eritrea), India, Australia, St Helena (Ascension), and Brazil	A declared weed over millions of square kilometres of arid and semiarid lands, where it drastically reduces the production of forage plants, threatening the livelihoods of ranchers (Pasiecznik 2001).
Rattus exulans	Pacific rat	Southeast Asia	India, Indonesia, Japan, Malaysia, Myanmar/Burma, Philippines, Taiwan, USA, Chile, Australia, New Zealand, Papua New Guinea, American Samoa, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuata, Wallis and Futuna, and US minor outlying islands. It has dispersed with humans across the western and central Pacific. They occur from the Asiatic mainland south to New Guinea and New Zealand, and east to the Hawai'ian Islands and Easter Island	Major agricultural pest and threat to flora and fauna
Solenopsis geminata	Fire ant	Present continuously from southeast USA to northern South America	Almost world-wide	Disrupt native communities and impose competitive pressure on native ants. Can have a large effect on vulnerable ecosystems
Tapinoma melanocephalum	Black-headed ant	It has not been established if this species is of African or Oriental origin	Australasia-Pacific, Europe, North America, and South America	Household Pest. It infests buildings in large numbers and has established in temperate locations. It has become established in heated greenhouses where it can become a problem, especially if it defends honeydew producing, plant pests against introduced biological control organisms. T. melanocephalum is capable of transporting pathogenic microbes in hospitals. Some people suffer a slight, red irritation of the skin following contact with this ant (Harris et al. 2005; Nickerson et al. 2003).
Trogoderma granarium	Khapra beetle	Established within an area broadly limited north by the 35° parallel, south by the Equator, west by West	Has been introduced into areas of similar climatic conditions elsewhere, especially the alternative route between India and Europe around Africa	No direct effects on the environment. The indirect effects however, are loss of stored grain and the effect of fumigation agents on the environment.

		Africa and east by Myanmar		
Ziziphus mauritiana	Ber	Central Asia	Tropical Africa to Afghanistan and China, and also through Malaysia, northern Australia, some Pacific archipelagoes such as the Philippines, and in parts of the Caribbean region	It forms impenetrable thickets which seriously hamper livestock management and reduces pasture production and accessibility (Land Protection, 2001). It is also likely to have significant environmental effects on tropical and subtropical woodlands and savannas. (Grice, pers.comm. 2002)

Annex D

Household Survey Questionnaire

Household Socio Economic Profile

Instructions to the Project Company Staff: Greet the respondent and please introduce yourself briefly to the respondent.

We are conducting a survey of people who are located near the project site. The data collected will be used as part of the Environmental and Social Impact Assessment (ESIA) for the project. The information collected provides a starting point for us to assess the potential changes that may occur as a result of the project.

There are no right or wrong answers. We assure that these details will be kept confidential. The interview may take 40 to 45 minutes. We seek your cooperation in this regard.

May we proceed? .....Thank you.

Please tick/circle the appropriate option in the section below

1.	Role of the respondent in household					
2.	Respondent Relationship with owner –(this survey form)					
3.	Village		Village Tract			
4.	Township		District/ Region			
5.	Number of Household Members	**a. Males**		**b. Females**		
6.	Religion (Please Tick mark)	a. Muslim	b. Buddhist	c. Christian	d. Others	
7.	Ethnicity Languages speaker?					
8.	Anybody over the age of 65 years?					
9.	Anybody disabled in the HH?	i. Yes ii. No	a. Type of Disability			

Fill up Demographic Profile provided in the end of the survey

SECTION A HH Expenditure (in kyat)

10.	**Expenditure items** □□□□□□□□□□□□□□□□□□□□	**a. Expenditure in Kyat** □□□□□□ □□□□	**b. Unit (Weekly/ Monthly/ Yearly)** □□□□□□□□ □□□□□ □□□□□□□	**c. No. of times in a year** □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□
i.	Cooking fuel (in Kyat OR number of units) □□ (□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□ □□□□)			
ii.	Fire wood □□□□			
iii.	Education □□□□□□			
iv.	Diesel/petrol □□□□□□□□□□□			
v.	Transport (when public transport) □□□□□□□□□□□□□□□□(□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□)			
vi.	Telephone/mobile phone □□□□□□□□□□□ □□□□□□□□□□□□□□□			
vii.	Entertainment □□□□□□□□□□□			
viii.	Healthcare/ Medical Expenditure □□□□□□□□□□□□□□□□□□ □□□□□□□□ □□□□□□□□□□□□□□□□□□ □□□□□□□□□			
ix.	Agriculture Input Investment (Seeds, Fertiliser, etc.) □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□ (□□□□□□□□□□□□□□□□□□ □□□□□□□□□)			
x.	Annual maintenance of House □□□□□□□□□□□□□□□□□□ □□□□□□□□□□			
xi.	Loan repayment □□□□□□□□□□□□			
xii.	Cultural/religious expenses (festivals/marriages) □□□□□□□□□□□□□□□□□□ □□□□ □□□□□□□□□□ □□□□□□□□□□□(□□□□□□ □□□□□□□□□□ □□□□□□□□□□□)			
xiii.	Ration □□□□□□□□□□□□			
xiv.	**Other (specify)** □□□□□□□□□□□□□□□□□□ □□□□□□□ **e.g. boat, computer, radio etc.**			
xv.	**Total (System Generated)** □□□□□□□□□□□□□□□□□□ □□□□□			

	SECTION B SOURCES OF INCOME □□□□□□□ (□)□□□□□□□□□□□□□□□□□□□			
11.	**Sources of Income**	a. Amount (in Kyat)	b. Unit- Monthly/	c. Remarks

	□□□□□□	□□□□ (□□□□□□□□ □□□□)	Yearly □□□□□□□□□ □□□□□□□□□	□□□□□□□□
i.	Service □□□□□□□□□□□□□□			
ii.	Agriculture/ Farming □□□□□□□□□□□□□□□□□□□□□□□			
iii.	Casual work □□□□□□□□□□□			
iv.	Business □□□□□□□□□□			
v.	Pension (Widow/ Soldier/service etc) □□□□□□□(□□□□□□□□□□□□□□□ □□□□□□□□)			
vi.	Rent from land & property □□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□			
vii.	Remittance from family member □□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□			
viii.	Other: ..... □□□□□			
ix.	Other: ..... □□□□□			
x.	Other: ..... □□□□□			
	Total – Annual Income (system generated) □□□□□□□□□□□□□□□□□			

SECTION B.1 Land and Agriculture □□□□□□□□(□□□) □□□□□□□□□□□□□□□□□□□□□□□□□□□		
12.	Size of total land holding? Major crops? Planting season? Location of site? □□□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□	
13.	Total number of titled plots owned by the HH (mention area too if possible) □□□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□ (□□□□□□□□□□□□□□□□□□□□□□)	
14.	Total number of plots farmed by the HH (mention area too if possible) □□□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□(□□□□□□□□□□□ □□□□□□□□□	
15.	Is any plot of land likely to be affected by the project? □□□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□	
16.	Are there additional dependents on the land in the form of workers/labourers etc.? □□□□□□□□□□□□□□□□□□□□□□□□□□□ □□	

SECTION B.2 FISHING □□□□□□□□□□□□□□□□		
17.	Is fishing practiced in the area? If yes, then which social groups undertake the activity □□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□	

18.	Are there any months/seasons in which fishing activities are NOT undertaken , if yes, then specify □□□□□□□□□□□□□□□□□□□□□□(□□□□) □□□□□□□/□□□□	
19.	Are there facilities such as ice box and cold storage etc. available with the HHs or commonly owned by HHs? □□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□/□□□□	
20.	Are there any community level regulation mechanism governing the activity, if yes, then specify □□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□/□□□□	
21.	Is there any group or union formed. If yes, what is the role of the union/group in the activities □□□□□□□□□□□□□□□□□□□□□□□□ □□ /□□□□ □□□□□□□□□□□□□□□□□□□□□□□□ □□□	

SECTION B.3 LIVESTOCK □□□□□□□(□□□) □□□□□□□□□□				
22.	Does the household own any livestock? If yes □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□	a. Yes □□□□□□□□□□□□□□□□□ b. No □□□□□□□□□□□□□□□		
23.	Type □□□□□ □□□□□	a. How many? □□□□□□□□□□□□□□	b. Sold for income or used for personal consumption? Yes/No/both –self and sale □□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□ □ □□□□□□□□□□□□□□□□□ □□ □□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□	c. Total income from livestock (per day/month) □□□□□□□□□□□□ □□□□□□□□□□□□□□ □□□ □□□□□□□□□□□□□□ □□□□
i.	Cow □□□□			
ii.	Buffalo □□□□			
iii.	Goat □□□□			
iv.	Poultry □□□□			
v.	Pigs □□□			
vi.	Horse □□□□□			
vii.	Other □□□□□			

SECTION C – ACCESS TO SERVICE □□□□□□□(□) □□□□□□□□□□□□□□□□□□□□		
	Fill below with ref to codes:	**a.Source:** 1. River, marshland

	□□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □	□□□□□□□□□□ □□ □□□□□□□□□□□□□□□□□□ 2. Hand dug well □□□□□□□□□□□□□□ 3. Hand Pump □□□□□□ 4. Natural spring / Creek □□□□□□□□□□□□□ □□□□□□□ 5. Piped water supply (individual taps at every household) □□□□□□□□□□□□ (□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□) 6. Piped water supply (community taps) □□□□□□□□□□□□ (□□□□□□□□□□□□) 7. Other ..... □□□□□ **b.Availability:** 1. Seasonal □□□□□□ □□□□□□□□□□□ 2. Perennial □□□□□□□□□□□□□ **c.Distance**: 1. HH level 2. <10 2. <50 3. <100 m 4. <1 Km □□□□□□□□ □□□□□□□□□□□□□□□□ **d.Quality:** 1. Good 2. Bad (smelly, turbid, hard) 3. No complaint □□□□□□□□□□ □□□□□□ □□□□ (□□□□□□□□□□□□□□□□) □□□□□□□□□				
		Season □□□□□□ □□□□	a. Source □□□□□ □□□	b. Availability □□□□□□	c. Distance □□□□□□ □□	d. Quality □□□□□□ □□□
24.	Describe your drinking water? □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□	i. Summer □□□□ □□□				
		ii. Winter □□□□ □				
25.	Source of water for other household consumption □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□	i. Summer □□□□ □□□				
		ii. Winter □□□□ □				
26.	Do you face periods of water scarcity? If so, when? □□□□□□□□□□□□ □□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□	a. No. of Months_____ □□□□□□□		b. From_____to_____ □□ ..... □□□.....		
27.	What type of latrine do you use? □□□□□□□□□□□□ □□□□	a. Dry pit Latrine □□□□□□□□□□□ b. Pour flush latrine(septic tank) □□□□□□□□□□□□□□ c. Flush latrine (u/g sewer connection) □□□□□□□□□□□ (□□□□□□□□□□□□□□□□□□□□) d. Open defecation □□□□□□□□□□□□□□□□				
28.	Reason for open defecation □□□□□□□□□□□□ □□□□□□□□□□ □□□□□□□□□□□□	a. Lack of running water b. Habit c. Bad smell d. Children scared to use □□□□□□□□□□ □□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□□ b. Other _____ □□□□□				
29.	Electricity connection/ If no, what source of fuel do you use? □□□□□□□□□□□□ □□□□□	a. Yes/ Annual cost? □□□□□□□□□□		b. No/ what is it used for? □□□□□□□□		
30.	Cooking fuel kind □□□□□□□□□□□□ □□□□□□□	Source (rank: 1-6 most to least important) □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ □ □□ □ □□□□□□□□□□□□				
		a. Firewood □□□□□□□	b. LPG/ natural Gas □□□□□□□□□□□□	c. BioGas		

		□□□□□□□□□□ d. Dung cakes e. Solar f. Others _____ □□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□		
31.	Firewood Collection □□□□□□□□□□□□ □□□□□□□□	a. Source? □□□□□□□□□□□□□□□□□□ □□□□□		
		b. How far is the area for collection? □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□		
		c. Consumption per month per HH □□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□		
32.	Major problems associated with firewood collection □□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□□□□□□ □			
33.	Access to Credit Facility □□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□	Source □□□□□□□□□	a. Available (Yes/ No) □□□□□□ (□□□□□ □□□□□□□□)	b. _____% per _____ (period : year, month) · No interest □□□□□□□□ □□□□□□□□□□□ □□ □□□□□□□□□□□
		1. Family □□□□□□□		
		2. In laws □□□□□□□□□□		
		3. Friends/ Neighbours □□□□□□□□□□□ □□□□□□□□□□□ □□□□□		
		4. Store keeper □□□□□□□□□□□□□□		
		5. Bank □□□□□		
		6. Informal credit □□□□□□□□□□□□□ □□□□□□□□□□□		
		7. Self Help groups □□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□□□		
		8. Other (specify): □□□□□ _____		
34.	Why do you borrow money? □□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□□□	1. Buying seeds 2. Buying food 3. For Field preparation □□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□ □□□□□□□□□ 4. Medical facilities 5. For Marriage 6. For house construction □□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□ □□□□□□□□□□□□ 7. For Business 8. Others _____ □□□□□□□□□□□ □□□□□		

35.	Are you under loan Presently and for what? □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□		
36.	Market Facility □□□□□□□□□□□□ □□□□□□□□□□□□ □	a. For Daily needs □□□□□□□□□□□□□□□□ □□□□□□	b. For Buying and selling □□□□□□□□□□□□□□□□ □□□□□□□□□□□□□
	Location □□□□□□□	1. Same village 2. Other village □□□□□□□□□ □□□□□□□□ 3. Nearby village □□□□□□□□□□□□□□□□	1. Same village 2. Other village □□□□□□□□□ □□□□□□□□ 3. Nearby village □□□□□□□□□□□□□□□□
	Distance to market □□□□□□□□□□□□ □□□□□□□	.....(in travel time) □□□□□□□□□□□□□□□□□□	.....(in travel time) □□□□□□□□□□□□□□□□□□

SECTION C.4 – ACCESS TO HEALTH SERVICE □□□□□□□ (□.□) □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□		
37.	What is the preferred health facility amongst the HH – private and public □□□□□□□□□□□□ □□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□	i. Private □□□□□□□□□□□□ ii. Public □□□□□□□□□□□□ iii. Traditional □□□□□□□□□□□□□□
38.	Is the preferred facility available within the village or outside □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□	a. Within □□□□□□□□ b. outside □□□□□□□
39.	What illness have occurred in the family in the last one year? □□□□□□□□□□□□□□□□□□□□

ii.					
iii.					
iv.					

Kindly put the number from the list of diseases mentioned

□□□

	□□				
viii.	Low Interest Micro Credit group □□□□□□□□□□ □□□□□□□□ □□□□□□□□□□ □□□□□□□□□□ □□□				
ix.	Other (specify) □□□□□				

Non-governmental Organizations Operational in the community
□□□□□□□□□

47.	Are there any pending issues or legacy claims in regards to the previous land acquisition □□□□

SECTION A.1. INFORMATION ABOUT THE MEMBERS OF THE HOUSEHOLD (USE EXTRA SHEET FOR BIGGER HHS)												
	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.	65.
Sl. No.	Name □□□□	Relationship with HOH □□□□□□□□□□ □□□□□□□□□□	Gender □□□□/□	Age □□□□	Marital Status □□□□ □□□□ □□□□/ □□□□	Residential Status □□□□□ □□□□□ □	Education □□□□□ □	Main occupation □□□□□□ □□ □□□□□□ □□□□□□ □□□	Part time occupation □□□□□□ □□□□□□ □ □□□□	Skill □□□□□ □□□□□	Monthly Income (in INR) □□□□□□ □□□□	Bank account Yes/ No □□□□□□ □□□ □□□□□□ □□□ □□□□□□
								(only for people above 18 years of age) □□□□ □□ □□□□□□□□□□□□□□□□□□□□□□□□				(adults) □□□□□□
1												
2												
3												
4												
5												
6												
7												
8												
9												

RELATION WITH HOH □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□		**MARITAL STATUS** □□□□□□ □□□□□□/ □□□□	**EDUCATION** □□□□□□	**RESIDENTIAL STATUS** □□□□□□□□□ □	**MAIN AND PART TIME OCCUPATION** □□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□		**SKILL** □□□□□□□□□□
H=HoH □□□□□ □□□□□	GC =Grandchild □□□□	1=Married □□□□□□ □□□□□□	0=Illiterate □□□□□□	1=Permanent □□□□□□□□□ □□□□□□□□□	U= Unemployed □□□□□□□□□□□□ □□□	H:=Housewife □□□□□□□□ □	M: Mechanic (Auto) □□□□□□□

W=Wife □□□□□ □	N= Nephew/niece □□□ □□□	2=Single □□□□□□	1= Too young to study □□□□□□□□□□□ □□□□□□	3= Come for vacation □□□□□□	A= Agriculture □□□□□□□□□□□□ □	AL= Agri labourer □□□□□□□	C: Building and Construction □□□□□□□□□□□□
S= Son □□□	SL= Son in law or □□□□□□	3=Divorced □□□□□□ □□	2= Nursery □□□□□□	4= working & Living elsewhere in Myanmar □□□□□□□□□ □□□□□□□□□ □□□□□□□□□ □□□	GS= Govt. Service □□□□□□□□□□□□ □	E: Electrician □□□□□□□□ □□□□□□□	T: Technical □□□□□□□□□□□
D=Daughter □□□□	DL=Daughter in law □□□□□□	4=Widow(er) □□□□□□ □	3= Primary School □□□□□□□	5= Migrating □□□□□□□□□ □□□□□□	PS= Private Service □□□□□□□□□□□□ □□	S=Store keeper □□□□□□□□ □□□□□□□	HS: Household Services (plumbing, electrician) □□□□□□□□□□□□□□ □ (□□□□□□□□□□□□□□
F= Father □□□	O= Other Situation □□□□□□□□□□ □□□□□	5=Other □□□□□	4= Middle School □□□□□□□□		B= Business □□□□□□□□□□	Ca=Carpenter □□□□□□□	TC: Textile and Clothing □□□□□□□□□□□□□□ □□□□□□□
M= Mother □□□	GENDER □□□□□□□□□□ □		5= Secondary □□□□□□□□□□□ □□□□	6= Any other □□□□□	RP= Retd. Pensioner □□□□□□□□□	P: Plumber □□□□□□□□ □□□□□	TW: Tailoring and Weaving □□□□□□□□□□□□□□
B= Brother	M= Male ;		6= University (Graduation)		AG= Aged	Mo= Mobile repairmen	BANK ACCOUNT
	F= Female		7= Vocational Training		S= Student	D: Driver	Y: Yes
			8= Post Graduate & Above		CW= Contract worker	O= Other	N: No
			9 = Buddhist Religious School				J: Joint

Annex E

Air Quality Results Summary

Annex E1 - Summary of Predicted Maximum Ground Level Concentrations at ASRs from 2010 to 2014 (Project Only)

Summary of the Predicted Maximum Ground Level Concentrations at ASRs in 2010 (Project only)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration (µg/m³)								Maximum Ground Level Concentration (µg/m³)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
ASR1	746279.5	2364781.29	Steel Mill Worker Camp	7.571	0.512	0.739	0.085	0.082	0.017	0.082	0.017	2.324	-	0.227	0.024	0.023	-	0.023	-
ASR2	745333.4	2364353.17	Monastery and Pagoda	5.706	0.278	0.557	0.045	0.044	0.009	0.044	0.009	1.633	-	0.159	0.016	0.015	-	0.015	-
ASR3	747539.2	2365154.24	Hnan Ywa	7.887	0.472	0.692	0.058	0.056	0.016	0.056	0.016	2.621	-	0.256	0.030	0.029	-	0.029	-
ASR4	747040.9	2367600.63	Sa Ka Village	7.752	0.774	0.757	0.139	0.135	0.026	0.135	0.026	2.809	-	0.274	0.039	0.038	-	0.038	-
ASR5	743821.6	2368914.27	Gyoke Pin	5.306	0.190	0.518	0.035	0.034	0.006	0.034	0.006	1.979	-	0.193	0.016	0.016	-	0.016	-
ASR6	741171.8	2368065.66	Hta Naung Taing	7.103	0.121	0.693	0.029	0.029	0.004	0.029	0.004	1.594	-	0.156	0.015	0.014	-	0.014	-
ASR7	746154.9	2369881.9	Thein	7.813	0.228	0.762	0.038	0.037	0.008	0.037	0.008	1.889	-	0.184	0.014	0.013	-	0.013	-
ASR8	746347.6	2371618.89	Ywar Si (North)	8.289	0.163	0.809	0.035	0.034	0.005	0.034	0.005	1.537	-	0.150	0.012	0.011	-	0.011	-
ASR9	748378.3	2371378.65	Ywar Si (South)	5.391	0.206	0.526	0.034	0.033	0.007	0.033	0.007	1.403	-	0.137	0.015	0.014	-	0.014	-
ASR10	749757.3	2368956.92	Ku	5.131	0.234	0.501	0.036	0.035	0.008	0.035	0.008	1.917	-	0.187	0.014	0.014	-	0.014	-
ASR11	748625	2361995.32	Kan Sint	5.730	0.232	0.559	0.045	0.044	0.008	0.044	0.008	2.133	-	0.208	0.020	0.020	-	0.020	-
ASR12	747339.1	2360828.5	Hpa Yar Hla	5.709	0.232	0.557	0.037	0.036	0.008	0.036	0.008	1.911	-	0.186	0.020	0.020	-	0.020	-
ASR13	746060.7	2363202.22	Hpet Taw	6.933	0.298	0.677	0.050	0.048	0.010	0.048	0.010	1.930	-	0.188	0.017	0.017	-	0.017	-
ASR14	743398.4	2364596.44	Nyaung Kan	6.089	0.162	0.594	0.040	0.039	0.005	0.039	0.005	1.991	-	0.194	0.019	0.018	-	0.018	-
ASR15	744751.5	2361090.44	Unknown Village	4.962	0.165	0.484	0.030	0.029	0.005	0.029	0.005	1.543	-	0.151	0.015	0.014	-	0.014	-
ASR16	742144.4	2363405.88	Ta Pin Kan Ywar Ma	4.930	0.120	0.481	0.030	0.029	0.004	0.029	0.004	1.491	-	0.145	0.018	0.018	-	0.018	-
ASR17	741642.2	2362413.07	Ta Pin Kan (South)	5.111	0.108	0.499	0.024	0.024	0.004	0.024	0.004	1.521	-	0.148	0.016	0.015	-	0.015	-
ASR18	746698	2366662	Steel Mill Worker Housing	21.562	1.525	2.104	0.375	0.364	0.050	0.364	0.050	2.697	-	0.263	0.052	0.050	-	0.050	-
ASR19	746795	2365139	Government Technical High School	9.137	0.718	0.892	0.100	0.097	0.024	0.097	0.024	2.259	-	0.220	0.043	0.042	-	0.042	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Project contribution to criterion	**10.78%**	**3.81%**	**0.42%**	**0.30%**	**0.24%**	**0.07%**	**0.49%**	**0.14%**	**1.40%**	**-**	**0.05%**	**0.04%**	**0.03%**	**-**	**0.07%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

Summary of the Predicted Maximum Ground Level Concentrations at ASRs in 2011 (Project only)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
ASR1	746279.5	2364781.29	Steel Mill Worker Camp	6.800	0.538	0.664	0.068	0.066	0.018	0.066	0.018	2.245	-	0.219	0.022	0.021	-	0.021	-
ASR2	745333.4	2364353.17	Monastery and Pagoda	7.745	0.278	0.756	0.055	0.053	0.009	0.053	0.009	1.798	-	0.175	0.022	0.021	-	0.021	-
ASR3	747539.2	2365154.24	Hnan Ywa	10.651	0.543	1.039	0.089	0.086	0.018	0.086	0.018	2.604	-	0.254	0.025	0.024	-	0.024	-
ASR4	747040.9	2367600.63	Sa Ka Village	7.686	0.671	0.750	0.200	0.194	0.022	0.194	0.022	2.884	-	0.281	0.052	0.050	-	0.050	-
ASR5	743821.6	2368914.27	Gyoke Pin	6.754	0.194	0.659	0.039	0.038	0.006	0.038	0.006	1.541	-	0.150	0.017	0.017	-	0.017	-
ASR6	741171.8	2368065.66	Hta Naung Taing	6.356	0.119	0.620	0.031	0.030	0.004	0.030	0.004	1.581	-	0.154	0.017	0.016	-	0.016	-
ASR7	746154.9	2369881.9	Thein	5.590	0.267	0.546	0.058	0.056	0.009	0.056	0.009	2.231	-	0.218	0.021	0.021	-	0.021	-
ASR8	746347.6	2371618.89	Ywar Si (North)	5.239	0.186	0.511	0.042	0.041	0.006	0.041	0.006	1.626	-	0.159	0.020	0.020	-	0.020	-
ASR9	748378.3	2371378.65	Ywar Si (South)	7.770	0.193	0.758	0.041	0.039	0.006	0.039	0.006	1.991	-	0.194	0.015	0.014	-	0.014	-
ASR10	749757.3	2368956.92	Ku	7.146	0.214	0.697	0.037	0.036	0.007	0.036	0.007	1.763	-	0.172	0.015	0.014	-	0.014	-
ASR11	748625	2361995.32	Kan Sint	5.716	0.273	0.558	0.044	0.042	0.009	0.042	0.009	2.598	-	0.254	0.025	0.024	-	0.024	-
ASR12	747339.1	2360828.5	Hpa Yar Hla	6.231	0.252	0.608	0.045	0.044	0.008	0.044	0.008	2.185	-	0.213	0.025	0.025	-	0.025	-
ASR13	746060.7	2363202.22	Hpet Taw	6.169	0.312	0.602	0.045	0.044	0.010	0.044	0.010	2.825	-	0.276	0.020	0.019	-	0.019	-
ASR14	743398.4	2364596.44	Nyaung Kan	5.250	0.161	0.512	0.027	0.026	0.005	0.026	0.005	1.914	-	0.187	0.014	0.014	-	0.014	-
ASR15	744751.5	2361090.44	Unknown Village	4.579	0.164	0.447	0.032	0.031	0.005	0.031	0.005	1.985	-	0.194	0.018	0.018	-	0.018	-
ASR16	742144.4	2363405.88	Ta Pin Kan Ywar Ma	4.401	0.119	0.429	0.022	0.022	0.004	0.022	0.004	1.570	-	0.153	0.012	0.011	-	0.011	-
ASR17	741642.2	2362413.07	Ta Pin Kan (South)	4.771	0.106	0.466	0.029	0.028	0.004	0.028	0.004	1.406	-	0.137	0.013	0.013	-	0.013	-
ASR18	746698	2366662	Steel Mill Worker Housing	21.359	1.525	2.084	0.322	0.313	0.050	0.313	0.050	2.808	-	0.274	0.041	0.040	-	0.040	-
ASR19	746795	2365139	Government Technical High School	10.509	0.785	1.026	0.108	0.104	0.026	0.104	0.026	2.401	-	0.234	0.045	0.044	-	0.044	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Project contribution to criterion	**10.68%**	**3.81%**	**0.42%**	**0.26%**	**0.21%**	**0.07%**	**0.42%**	**0.14%**	**1.44%**	**-**	**0.06%**	**0.04%**	**0.03%**	**-**	**0.07%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

Summary of the Predicted Maximum Ground Level Concentrations at ASRs in 2012 (Project only)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
ASR1	746279.5	2364781.29	Steel Mill Worker Camp	6.476	0.436	0.632	0.062	0.060	0.014	0.060	0.014	2.177	-	0.212	0.028	0.027	-	0.027	-
ASR2	745333.4	2364353.17	Monastery and Pagoda	5.798	0.235	0.566	0.049	0.048	0.008	0.048	0.008	2.326	-	0.227	0.021	0.020	-	0.020	-
ASR3	747539.2	2365154.24	Hnan Ywa	9.499	0.414	0.927	0.065	0.063	0.014	0.063	0.014	3.056	-	0.298	0.026	0.025	-	0.025	-
ASR4	747040.9	2367600.63	Sa Ka Village	7.715	0.839	0.753	0.175	0.170	0.028	0.170	0.028	2.874	-	0.280	0.039	0.038	-	0.038	-
ASR5	743821.6	2368914.27	Gyoke Pin	4.290	0.170	0.419	0.040	0.039	0.006	0.039	0.006	1.530	-	0.149	0.012	0.012	-	0.012	-
ASR6	741171.8	2368065.66	Hta Naung Taing	4.342	0.102	0.424	0.032	0.031	0.003	0.031	0.003	1.619	-	0.158	0.018	0.018	-	0.018	-
ASR7	746154.9	2369881.9	Thein	6.478	0.262	0.632	0.063	0.061	0.009	0.061	0.009	1.906	-	0.186	0.015	0.015	-	0.015	-
ASR8	746347.6	2371618.89	Ywar Si (North)	5.572	0.199	0.544	0.039	0.038	0.007	0.038	0.007	1.515	-	0.148	0.013	0.013	-	0.013	-
ASR9	748378.3	2371378.65	Ywar Si (South)	4.803	0.248	0.469	0.034	0.033	0.008	0.033	0.008	1.807	-	0.176	0.017	0.016	-	0.016	-
ASR10	749757.3	2368956.92	Ku	6.623	0.252	0.646	0.040	0.038	0.008	0.038	0.008	1.807	-	0.176	0.018	0.017	-	0.017	-
ASR11	748625	2361995.32	Kan Sint	7.216	0.214	0.704	0.045	0.044	0.007	0.044	0.007	2.127	-	0.208	0.023	0.022	-	0.022	-
ASR12	747339.1	2360828.5	Hpa Yar Hla	5.785	0.211	0.565	0.036	0.035	0.007	0.035	0.007	1.773	-	0.173	0.018	0.018	-	0.018	-
ASR13	746060.7	2363202.22	Hpet Taw	6.783	0.261	0.659	0.043	0.042	0.009	0.042	0.009	1.944	-	0.190	0.016	0.016	-	0.016	-
ASR14	743398.4	2364596.44	Nyaung Kan	7.503	0.135	0.732	0.058	0.056	0.004	0.056	0.004	1.746	-	0.170	0.015	0.015	-	0.015	-
ASR15	744751.5	2361090.44	Unknown Village	6.032	0.143	0.589	0.033	0.032	0.005	0.032	0.005	1.754	-	0.171	0.015	0.014	-	0.014	-
ASR16	742144.4	2363405.88	Ta Pin Kan Ywar Ma	6.789	0.099	0.663	0.051	0.049	0.003	0.049	0.003	1.407	-	0.137	0.016	0.015	-	0.015	-
ASR17	741642.2	2362413.07	Ta Pin Kan (South)	6.254	0.089	0.610	0.047	0.045	0.003	0.045	0.003	1.587	-	0.155	0.018	0.018	-	0.018	-
ASR18	746698	2366662	Steel Mill Worker Housing	21.946	1.455	2.142	0.322	0.312	0.048	0.312	0.048	2.986	-	0.291	0.044	0.042	-	0.042	-
ASR19	746795	2365139	Government Technical High School	7.439	0.628	0.726	0.114	0.111	0.021	0.111	0.021	2.870	-	0.280	0.040	0.039	-	0.039	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Project contribution to criterion	**10.97%**	**3.64%**	**0.43%**	**0.26%**	**0.21%**	**0.07%**	**0.42%**	**0.14%**	**1.53%**	**-**	**0.06%**	**0.03%**	**0.03%**	**-**	**0.06%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

Summary of the Predicted Maximum Ground Level Concentrations at ASRs in 2013 (Project only)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
ASR1	746279.5	2364781.29	Steel Mill Worker Camp	8.800	0.346	0.859	0.056	0.054	0.011	0.054	0.011	2.014	-	0.197	0.024	0.023	-	0.023	-
ASR2	745333.4	2364353.17	Monastery and Pagoda	7.930	0.216	0.774	0.040	0.039	0.007	0.039	0.007	1.909	-	0.186	0.017	0.016	-	0.016	-
ASR3	747539.2	2365154.24	Hnan Ywa	9.080	0.366	0.886	0.059	0.057	0.012	0.057	0.012	2.703	-	0.264	0.024	0.023	-	0.023	-
ASR4	747040.9	2367600.63	Sa Ka Village	7.733	1.064	0.755	0.184	0.179	0.035	0.179	0.035	3.112	-	0.304	0.038	0.036	-	0.036	-
ASR5	743821.6	2368914.27	Gyoke Pin	4.487	0.177	0.438	0.034	0.033	0.006	0.033	0.006	2.038	-	0.199	0.013	0.013	-	0.013	-
ASR6	741171.8	2368065.66	Hta Naung Taing	4.878	0.102	0.476	0.028	0.027	0.003	0.027	0.003	1.502	-	0.147	0.011	0.011	-	0.011	-
ASR7	746154.9	2369881.9	Thein	3.959	0.305	0.386	0.051	0.050	0.010	0.050	0.010	1.880	-	0.183	0.016	0.015	-	0.015	-
ASR8	746347.6	2371618.89	Ywar Si (North)	4.081	0.230	0.398	0.037	0.036	0.008	0.036	0.008	1.770	-	0.173	0.014	0.014	-	0.014	-
ASR9	748378.3	2371378.65	Ywar Si (South)	5.094	0.299	0.497	0.049	0.047	0.010	0.047	0.010	1.924	-	0.188	0.015	0.014	-	0.014	-
ASR10	749757.3	2368956.92	Ku	5.722	0.255	0.558	0.040	0.039	0.008	0.039	0.008	2.144	-	0.209	0.016	0.016	-	0.016	-
ASR11	748625	2361995.32	Kan Sint	6.617	0.178	0.646	0.033	0.032	0.006	0.032	0.006	2.331	-	0.228	0.016	0.015	-	0.015	-
ASR12	747339.1	2360828.5	Hpa Yar Hla	5.277	0.158	0.515	0.035	0.034	0.005	0.034	0.005	2.032	-	0.198	0.020	0.019	-	0.019	-
ASR13	746060.7	2363202.22	Hpet Taw	5.913	0.207	0.577	0.036	0.035	0.007	0.035	0.007	2.004	-	0.196	0.019	0.018	-	0.018	-
ASR14	743398.4	2364596.44	Nyaung Kan	6.104	0.137	0.596	0.043	0.042	0.005	0.042	0.005	1.878	-	0.183	0.016	0.016	-	0.016	-
ASR15	744751.5	2361090.44	Unknown Village	7.718	0.123	0.753	0.033	0.032	0.004	0.032	0.004	1.888	-	0.184	0.014	0.014	-	0.014	-
ASR16	742144.4	2363405.88	Ta Pin Kan Ywar Ma	6.634	0.102	0.647	0.039	0.038	0.003	0.038	0.003	1.807	-	0.176	0.014	0.014	-	0.014	-
ASR17	741642.2	2362413.07	Ta Pin Kan (South)	6.475	0.091	0.632	0.038	0.037	0.003	0.037	0.003	1.701	-	0.166	0.013	0.013	-	0.013	-
ASR18	746698	2366662	Steel Mill Worker Housing	22.135	1.328	2.160	0.311	0.302	0.044	0.302	0.044	2.768	-	0.270	0.042	0.041	-	0.041	-
ASR19	746795	2365139	Government Technical High School	8.493	0.466	0.829	0.109	0.106	0.015	0.106	0.015	2.561	-	0.250	0.033	0.032	-	0.032	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Project contribution to criterion	**11.07%**	**3.32%**	**0.43%**	**0.25%**	**0.20%**	**0.06%**	**0.40%**	**0.13%**	**1.56%**	**-**	**0.06%**	**0.03%**	**0.03%**	**-**	**0.05%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

Summary of the Predicted Maximum Ground Level Concentrations at ASRs in 2014 (Project only)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
ASR1	746279.5	2364781.29	Steel Mill Worker Camp	7.906	0.477	0.772	0.076	0.074	0.016	0.074	0.016	1.808	-	0.176	0.023	0.022	-	0.022	-
ASR2	745333.4	2364353.17	Monastery and Pagoda	7.919	0.254	0.773	0.062	0.060	0.008	0.060	0.008	2.047	-	0.200	0.020	0.019	-	0.019	-
ASR3	747539.2	2365154.24	Hnan Ywa	10.248	0.477	1.000	0.068	0.066	0.016	0.066	0.016	2.951	-	0.288	0.027	0.026	-	0.026	-
ASR4	747040.9	2367600.63	Sa Ka Village	10.097	0.868	0.985	0.176	0.171	0.029	0.171	0.029	2.930	-	0.286	0.041	0.040	-	0.040	-
ASR5	743821.6	2368914.27	Gyoke Pin	5.642	0.185	0.551	0.038	0.037	0.006	0.037	0.006	1.747	-	0.170	0.016	0.016	-	0.016	-
ASR6	741171.8	2368065.66	Hta Naung Taing	5.300	0.111	0.517	0.024	0.023	0.004	0.023	0.004	1.204	-	0.118	0.015	0.015	-	0.015	-
ASR7	746154.9	2369881.9	Thein	6.165	0.303	0.602	0.054	0.053	0.010	0.053	0.010	2.108	-	0.206	0.017	0.016	-	0.016	-
ASR8	746347.6	2371618.89	Ywar Si (North)	6.206	0.221	0.606	0.036	0.035	0.007	0.035	0.007	1.757	-	0.172	0.017	0.017	-	0.017	-
ASR9	748378.3	2371378.65	Ywar Si (South)	5.076	0.231	0.495	0.032	0.031	0.008	0.031	0.008	1.657	-	0.162	0.012	0.012	-	0.012	-
ASR10	749757.3	2368956.92	Ku	5.863	0.252	0.572	0.034	0.033	0.008	0.033	0.008	1.781	-	0.174	0.014	0.014	-	0.014	-
ASR11	748625	2361995.32	Kan Sint	6.272	0.256	0.612	0.052	0.051	0.008	0.051	0.008	2.041	-	0.199	0.022	0.021	-	0.021	-
ASR12	747339.1	2360828.5	Hpa Yar Hla	6.216	0.238	0.607	0.042	0.041	0.008	0.041	0.008	1.843	-	0.180	0.020	0.020	-	0.020	-
ASR13	746060.7	2363202.22	Hpet Taw	6.892	0.288	0.673	0.060	0.059	0.010	0.059	0.010	1.984	-	0.194	0.022	0.021	-	0.021	-
ASR14	743398.4	2364596.44	Nyaung Kan	5.560	0.149	0.543	0.027	0.026	0.005	0.026	0.005	1.186	-	0.116	0.013	0.013	-	0.013	-
ASR15	744751.5	2361090.44	Unknown Village	5.734	0.156	0.560	0.038	0.037	0.005	0.037	0.005	1.863	-	0.182	0.018	0.017	-	0.017	-
ASR16	742144.4	2363405.88	Ta Pin Kan Ywar Ma	6.361	0.110	0.621	0.027	0.026	0.004	0.026	0.004	1.162	-	0.113	0.009	0.009	-	0.009	-
ASR17	741642.2	2362413.07	Ta Pin Kan (South)	6.036	0.097	0.589	0.025	0.025	0.003	0.025	0.003	1.166	-	0.114	0.008	0.008	-	0.008	-
ASR18	746698	2366662	Steel Mill Worker Housing	21.650	1.738	2.113	0.279	0.271	0.058	0.271	0.058	2.759	-	0.269	0.036	0.035	-	0.035	-
ASR19	746795	2365139	Government Technical High School	8.771	0.678	0.856	0.117	0.113	0.022	0.113	0.022	2.448	-	0.239	0.028	0.027	-	0.027	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Project contribution to criterion	**10.83%**	**4.35%**	**0.42%**	**0.22%**	**0.18%**	**0.08%**	**0.36%**	**0.16%**	**1.48%**	**-**	**0.06%**	**0.03%**	**0.03%**	**-**	**0.05%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

Annex E2 - Summary of Cumulative Maximum Ground Level Concentrations at ASRs from 2010 to 2014 (Project Contribution and Background)

Summary of Cumulative Maximum Ground Level Concentrations at ASRs in 2010 (Project Contribution and Background)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
			Background Concentration [e]	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**
ASR1	746280	2364781	Steel Mill Worker Camp	61.5	54.5	6.9	6.2	43.4	43.3	26.8	26.7	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR2	745333	2364353	Monastery and Pagoda	59.7	54.2	6.7	6.2	43.4	43.3	26.7	26.7	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR3	747539	2365154	Hnan Ywa	61.1	54.4	6.8	6.2	43.4	43.3	26.7	26.7	56.6	-	6.4	6.2	43.3	-	26.7	-
ASR4	747041	2367601	Sa Ka Village	61.7	54.7	6.9	6.3	43.4	43.3	26.8	26.7	56.8	-	6.4	6.2	43.3	-	26.7	-
ASR5	743822	2368914	Gyoke Pin	59.3	54.2	6.7	6.2	43.3	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR6	741172	2368066	Hta Naung Taing	61.1	54.1	6.8	6.2	43.3	43.3	26.7	26.7	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR7	746155	2369882	Thein	61.8	54.2	6.9	6.2	43.3	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR8	746348	2371619	Ywar Si (North)	62.3	54.1	7.0	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR9	748378	2371379	Ywar Si (South)	59.4	54.2	6.7	6.2	43.3	43.3	26.7	26.7	55.4	-	6.3	6.2	43.3	-	26.7	-
ASR10	749757	2368957	Ku	59.1	54.2	6.7	6.2	43.3	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR11	748625	2361995	Kan Sint	59.7	54.2	6.7	6.2	43.4	43.3	26.7	26.7	56.1	-	6.4	6.2	43.3	-	26.7	-
ASR12	747339	2360829	Hpa Yar Hla	59.7	54.2	6.7	6.2	43.3	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR13	746061	2363202	Hpet Taw	60.9	54.3	6.8	6.2	43.4	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR14	743398	2364596	Nyaung Kan	60.1	54.1	6.7	6.2	43.3	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR15	744752	2361090	Unknown Village	58.9	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR16	742144	2363406	Ta Pin Kan Ywar Ma	58.9	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR17	741642	2362413	Ta Pin Kan (South)	59.1	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR18	746698	2366662	Steel Mill Worker Housing	75.5	55.5	8.3	6.5	43.7	43.4	27.0	26.7	56.7	-	6.4	6.2	43.4	-	26.7	-
ASR19	746795	2365139	Government Technical High School	63.1	54.7	7.0	6.3	43.4	43.3	26.8	26.7	56.2	-	6.4	6.2	43.4	-	26.7	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Cumulative Impact to criterion	**38%**	**139%**	**2%**	**5%**	**29%**	**62%**	**36%**	**76%**	**28%**	**-**	**1%**	**5%**	**29%**	**-**	**36%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

e) Averaged background pollutant concentrations have been included.

Summary of Cumulative Maximum Ground Level Concentrations at ASRs in 2011 (Project Contribution and Background)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation) Maximum Ground Level Concentration (μg/m³)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation) Maximum Ground Level Concentration (μg/m³)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
			Backcround Concentration [e]	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**
ASR1	746280	2364781	Steel Mill Worker Camp	60.8	54.5	6.8	6.2	43.4	43.3	26.7	26.7	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR2	745333	2364353	Monastery and Pagoda	61.7	54.2	6.9	6.2	43.4	43.3	26.7	26.7	55.8	-	6.3	6.2	43.3	-	26.7	-
ASR3	747539	2365154	Hnan Ywa	64.6	54.5	7.2	6.2	43.4	43.3	26.8	26.7	56.6	-	6.4	6.2	43.3	-	26.7	-
ASR4	747041	2367601	Sa Ka Village	61.7	54.6	6.9	6.3	43.5	43.3	26.9	26.7	56.9	-	6.4	6.2	43.4	-	26.7	-
ASR5	743822	2368914	Gyoke Pin	60.7	54.2	6.8	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR6	741172	2368066	Hta Naung Taing	60.3	54.1	6.8	6.2	43.3	43.3	26.7	26.7	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR7	746155	2369882	Thein	59.6	54.2	6.7	6.2	43.4	43.3	26.7	26.7	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR8	746348	2371619	Ywar Si (North)	59.2	54.2	6.7	6.2	43.4	43.3	26.7	26.7	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR9	748378	2371379	Ywar Si (South)	61.7	54.2	6.9	6.2	43.3	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR10	749757	2368957	Ku	61.1	54.2	6.8	6.2	43.3	43.3	26.7	26.7	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR11	748625	2361995	Kan Sint	59.7	54.2	6.7	6.2	43.4	43.3	26.7	26.7	56.6	-	6.4	6.2	43.3	-	26.7	-
ASR12	747339	2360829	Hpa Yar Hla	60.2	54.2	6.8	6.2	43.4	43.3	26.7	26.7	56.2	-	6.4	6.2	43.3	-	26.7	-
ASR13	746061	2363202	Hpet Taw	60.1	54.3	6.8	6.2	43.4	43.3	26.7	26.7	56.8	-	6.4	6.2	43.3	-	26.7	-
ASR14	743398	2364596	Nyaung Kan	59.2	54.1	6.7	6.2	43.3	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR15	744752	2361090	Unknown Village	58.5	54.1	6.6	6.2	43.3	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR16	742144	2363406	Ta Pin Kan Ywar Ma	58.4	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR17	741642	2362413	Ta Pin Kan (South)	58.7	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.4	-	6.3	6.2	43.3	-	26.7	-
ASR18	746698	2366662	Steel Mill Worker Housing	75.3	55.5	8.2	6.5	43.6	43.4	27.0	26.7	56.8	-	6.4	6.2	43.3	-	26.7	-
ASR19	746795	2365139	Government Technical High School	64.5	54.8	7.2	6.3	43.4	43.3	26.8	26.7	56.4	-	6.4	6.2	43.4	-	26.7	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Cumulative Impact to criterion	**38%**	**139%**	**2%**	**5%**	**29%**	**62%**	**36%**	**76%**	**28%**	**-**	**1%**	**5%**	**29%**	**-**	**36%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

e) Averaged background pollutant concentrations have been included.

Summary of Cumulative Maximum Ground Level Concentrations at ASRs in 2012 (Project Contribution and Background)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
			Background Concentration [e]	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**
ASR1	746280	2364781	Steel Mill Worker Camp	60.4	54.4	6.8	6.2	43.4	43.3	26.7	26.7	56.1	-	6.4	6.2	43.3	-	26.7	-
ASR2	745333	2364353	Monastery and Pagoda	59.8	54.2	6.7	6.2	43.4	43.3	26.7	26.7	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR3	747539	2365154	Hnan Ywa	63.5	54.4	7.1	6.2	43.4	43.3	26.7	26.7	57.0	-	6.4	6.2	43.3	-	26.7	-
ASR4	747041	2367601	Sa Ka Village	61.7	54.8	6.9	6.3	43.5	43.3	26.8	26.7	56.8	-	6.4	6.2	43.3	-	26.7	-
ASR5	743822	2368914	Gyoke Pin	58.3	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR6	741172	2368066	Hta Naung Taing	58.3	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR7	746155	2369882	Thein	60.4	54.2	6.8	6.2	43.4	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR8	746348	2371619	Ywar Si (North)	59.5	54.2	6.7	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR9	748378	2371379	Ywar Si (South)	58.8	54.2	6.6	6.2	43.3	43.3	26.7	26.7	55.8	-	6.3	6.2	43.3	-	26.7	-
ASR10	749757	2368957	Ku	60.6	54.2	6.8	6.2	43.3	43.3	26.7	26.7	55.8	-	6.3	6.2	43.3	-	26.7	-
ASR11	748625	2361995	Kan Sint	61.2	54.2	6.9	6.2	43.4	43.3	26.7	26.7	56.1	-	6.4	6.2	43.3	-	26.7	-
ASR12	747339	2360829	Hpa Yar Hla	59.8	54.2	6.7	6.2	43.3	43.3	26.7	26.7	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR13	746061	2363202	Hpet Taw	60.7	54.2	6.8	6.2	43.4	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR14	743398	2364596	Nyaung Kan	61.5	54.1	6.9	6.2	43.4	43.3	26.7	26.7	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR15	744752	2361090	Unknown Village	60.0	54.1	6.7	6.2	43.3	43.3	26.7	26.7	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR16	742144	2363406	Ta Pin Kan Ywar Ma	60.8	54.1	6.8	6.2	43.4	43.3	26.7	26.7	55.4	-	6.3	6.2	43.3	-	26.7	-
ASR17	741642	2362413	Ta Pin Kan (South)	60.2	54.1	6.8	6.2	43.4	43.3	26.7	26.7	55.6	-	6.3	6.2	43.3	-	26.7	-
ASR18	746698	2366662	Steel Mill Worker Housing	75.9	55.4	8.3	6.5	43.6	43.4	27.0	26.7	57.0	-	6.4	6.2	43.4	-	26.7	-
ASR19	746795	2365139	Government Technical High School	61.4	54.6	6.9	6.3	43.4	43.3	26.8	26.7	56.8	-	6.4	6.2	43.3	-	26.7	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Cumulative Impact to criterion	**38%**	**139%**	**2%**	**5%**	**29%**	**62%**	**36%**	**76%**	**29%**	**-**	**1%**	**5%**	**29%**	**-**	**36%**	**-**

Notes:

a) Reference to UK Air Quality Assessment Guidelines - short-term (1-hour) NO_2 = 50% of NO_x; long-term (annual) NO_2 = 100% of NO_x

b) A general factor of 1.43 is used to convert hourly SO_2 model results to 10-min averaged results

c) For conservative approach, emissions of PM_{10} and $PM_{2.5}$ are assumed to be the same. Therefore, modelling results of PM_{10} and $PM_{2.5}$ are identical.

d) WHO Interim Target 1 for 24-hr SO_2, 24-hr PM_{10}, 24-hr $PM_{2.5}$, Annual PM_{10} and Annual $PM_{2.5}$. WHO Guideline value for 1-hr NO_2, Annual NO_2 and 10-min SO_2.

e) Averaged background pollutant concentrations have been included.

Summary of Cumulative Maximum Ground Level Concentrations at ASRs in 2013 (Project Contribution and Background)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation)							
				Maximum Ground Level Concentration ($\mu g/m^3$)								Maximum Ground Level Concentration ($\mu g/m^3$)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
			Background Concentration [e]	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**
ASR1	746280	2364781	Steel Mill Worker Camp	62.8	54.3	7.0	6.2	43.4	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR2	745333	2364353	Monastery and Pagoda	61.9	54.2	6.9	6.2	43.3	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR3	747539	2365154	Hnan Ywa	63.0	54.3	7.0	6.2	43.4	43.3	26.7	26.7	56.7	-	6.4	6.2	43.3	-	26.7	-
ASR4	747041	2367601	Sa Ka Village	61.7	55.0	6.9	6.3	43.5	43.3	26.8	26.7	57.1	-	6.5	6.2	43.3	-	26.7	-
ASR5	743822	2368914	Gyoke Pin	58.5	54.1	6.6	6.2	43.3	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR6	741172	2368066	Hta Naung Taing	58.8	54.1	6.6	6.2	43.3	43.3	26.7	26.7	55.5	-	6.3	6.2	43.3	-	26.7	-
ASR7	746155	2369882	Thein	57.9	54.3	6.5	6.2	43.4	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR8	746348	2371619	Ywar Si (North)	58.1	54.2	6.5	6.2	43.3	43.3	26.7	26.7	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR9	748378	2371379	Ywar Si (South)	59.1	54.3	6.6	6.2	43.4	43.3	26.7	26.7	55.9	-	6.3	6.2	43.3	-	26.7	-
ASR10	749757	2368957	Ku	59.7	54.2	6.7	6.2	43.3	43.3	26.7	26.7	56.1	-	6.4	6.2	43.3	-	26.7	-
ASR11	748625	2361995	Kan Sint	60.6	54.1	6.8	6.2	43.3	43.3	26.7	26.7	56.3	-	6.4	6.2	43.3	-	26.7	-
ASR12	747339	2360829	Hpa Yar Hla	59.2	54.1	6.7	6.2	43.3	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR13	746061	2363202	Hpet Taw	59.9	54.2	6.7	6.2	43.3	43.3	26.7	26.7	56.0	-	6.3	6.2	43.3	-	26.7	-
ASR14	743398	2364596	Nyaung Kan	60.1	54.1	6.7	6.2	43.4	43.3	26.7	26.7	55.8	-	6.3	6.2	43.3	-	26.7	-
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ASR16	742144	2363406	Ta Pin Kan Ywar Ma	60.6	54.1	6.8	6.2	43.3	43.3	26.7	26.7	55.8	-	6.3	6.2	43.3	-	26.7	-
ASR17	741642	2362413	Ta Pin Kan (South)	60.4	54.1	6.8	6.2	43.3	43.3	26.7	26.7	55.7	-	6.3	6.2	43.3	-	26.7	-
ASR18	746698	2366662	Steel Mill Worker Housing	76.1	55.3	8.3	6.5	43.6	43.4	27.0	26.7	56.7	-	6.4	6.2	43.4	-	26.7	-
ASR19	746795	2365139	Government Technical High School	62.5	54.4	7.0	6.3	43.4	43.3	26.8	26.7	56.5	-	6.4	6.2	43.3	-	26.7	-
			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
			Maximum % of Cumulative Impact to criterion	**38%**	**138%**	**2%**	**5%**	**29%**	**62%**	**36%**	**76%**	**29%**	**-**	**1%**	**5%**	**29%**	**-**	**36%**	**-**

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e) Averaged background pollutant concentrations have been included.

Summary of Cumulative Maximum Ground Level Concentrations at ASRs in 2014 (Project Contribution and Background)

ASR	X	Y	Description	Combined Cycle Mode (Main stacks S1 and S3 in operation) Maximum Ground Level Concentration (µg/m³)								Simple Cycle Mode (Bypass stacks S2 and S4 in operation) Maximum Ground Level Concentration (µg/m³)							
				1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]	1-hr NO_2 [a]	Annual NO_2 [a]	10-min SO_2 [b]	24-hr SO_2	24-hr PM_{10} [c]	Annual PM_{10} [c]	24-hr $PM_{2.5}$ [c]	Annual $PM_{2.5}$ [c]
			Backgrround Concentration [e]	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**	**54.0**	**54.0**	**6.2**	**6.2**	**43.3**	**43.3**	**26.7**	**26.7**
ASR1	746280	2364781	Steel Mill Worker Camp	61.9	54.4	6.9	6.2	43.4	43.3	26.7	26.7	55.8	-	6.3	6.2	43.3	-	26.7	-
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ASR3	747539	2365154	Hnan Ywa	64.2	54.4	7.2	6.2	43.4	43.3	26.7	26.7	56.9	-	6.4	6.2	43.3	-	26.7	-
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			Assessment Criteria (WHO AQGs)[d]	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**	**200**	**40**	**500**	**125**	**150**	**70**	**75**	**35**
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e) Averaged background pollutant concentrations have been included.

Annex F

Stakeholder Engagement Presentations

Stakeholder Engagement Meeting

July 2015



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ERM

Why are we here?

- Sembcorp has been selected by the Ministry of Electric Power (MOEP) to develop a 225MW Combined Cycle Gas Turbine (CCGT) power plant in Myingyan Township, in the Mandalay region in Myanmar.

- Environmental Resources Management (ERM), with Resources Environment Myanmar (REM), to undertake an Environmental and Social Impact Assessment (ESIA).

- The “ESIA” will be undertaken to understand potential environmental and social impacts and opportunities in accordance with international standards.

- Purpose of the meeting is to provide an overview of the Project and better understand local views of the Project .

Who is Sembcorp?

- Sembcorp Industries is a leading energy, water and marine group with operations across six continents worldwide.

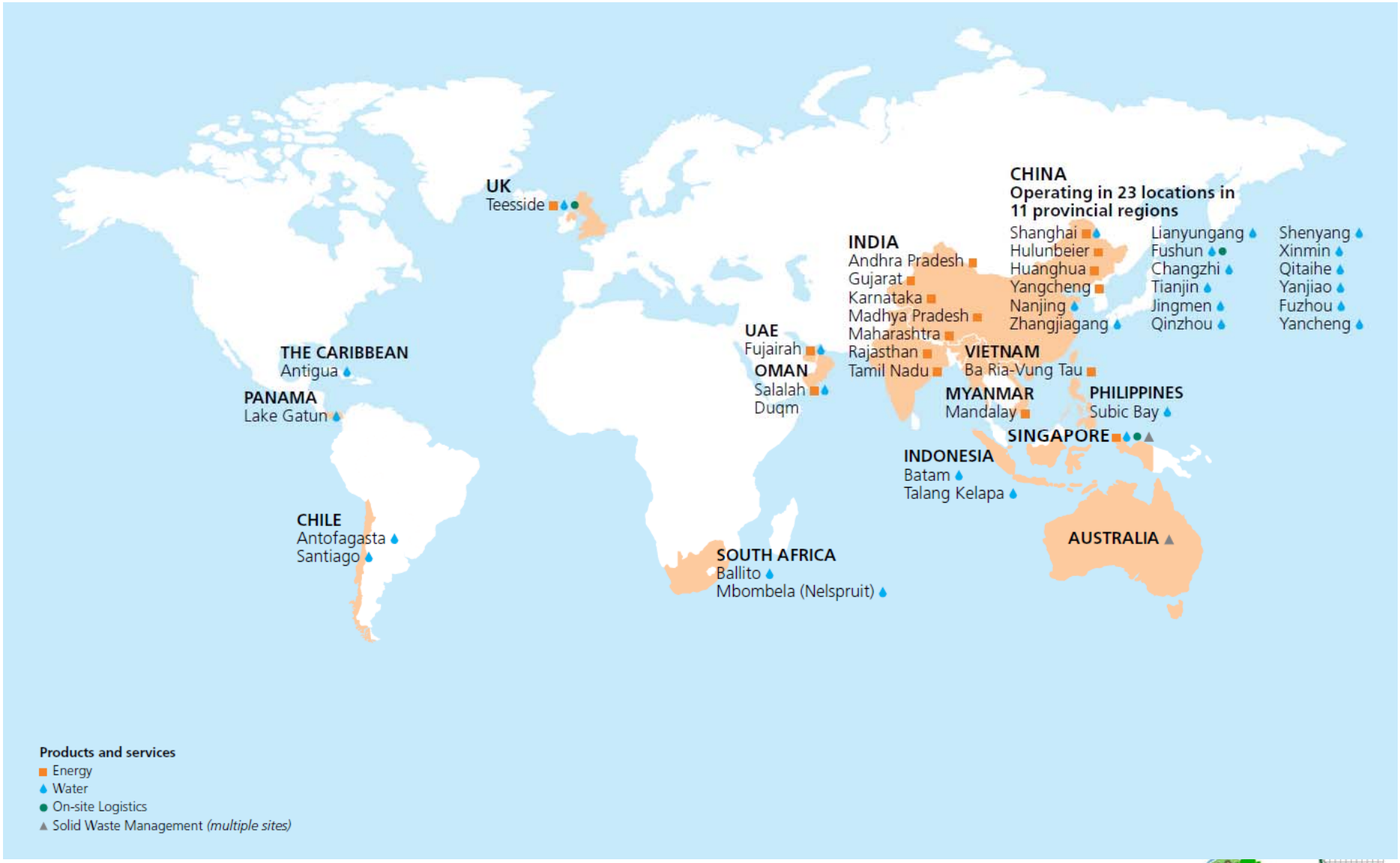
- With facilities of over 8,200 megawatts of gross power capacity and over nine million cubic metres of water per day in operation and under development, Sembcorp is a trusted provider of essential energy and water solutions to both industrial and municipal customers.

- The proposed Project is the first Independent Power Producer (IPP) Project in Myanmar.



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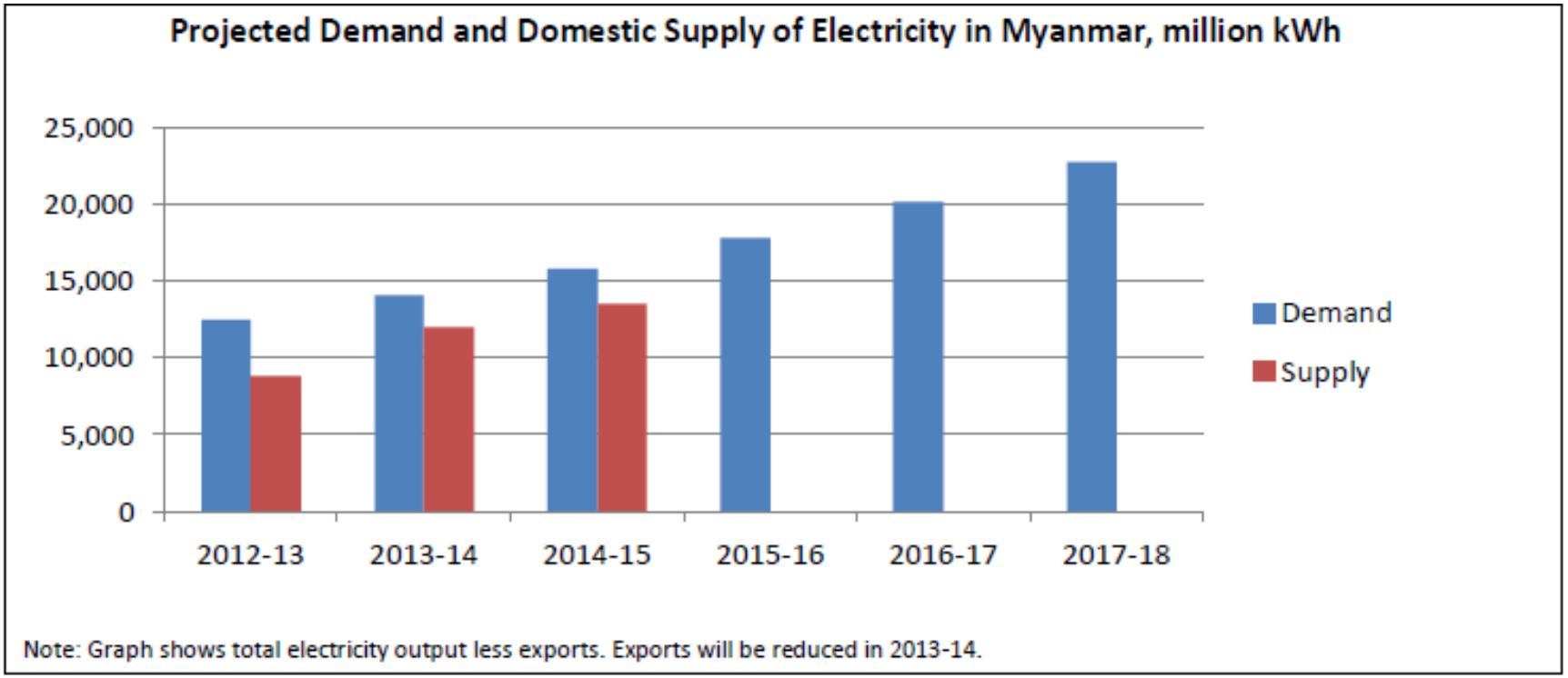
Utilities Global Footprint



ERM

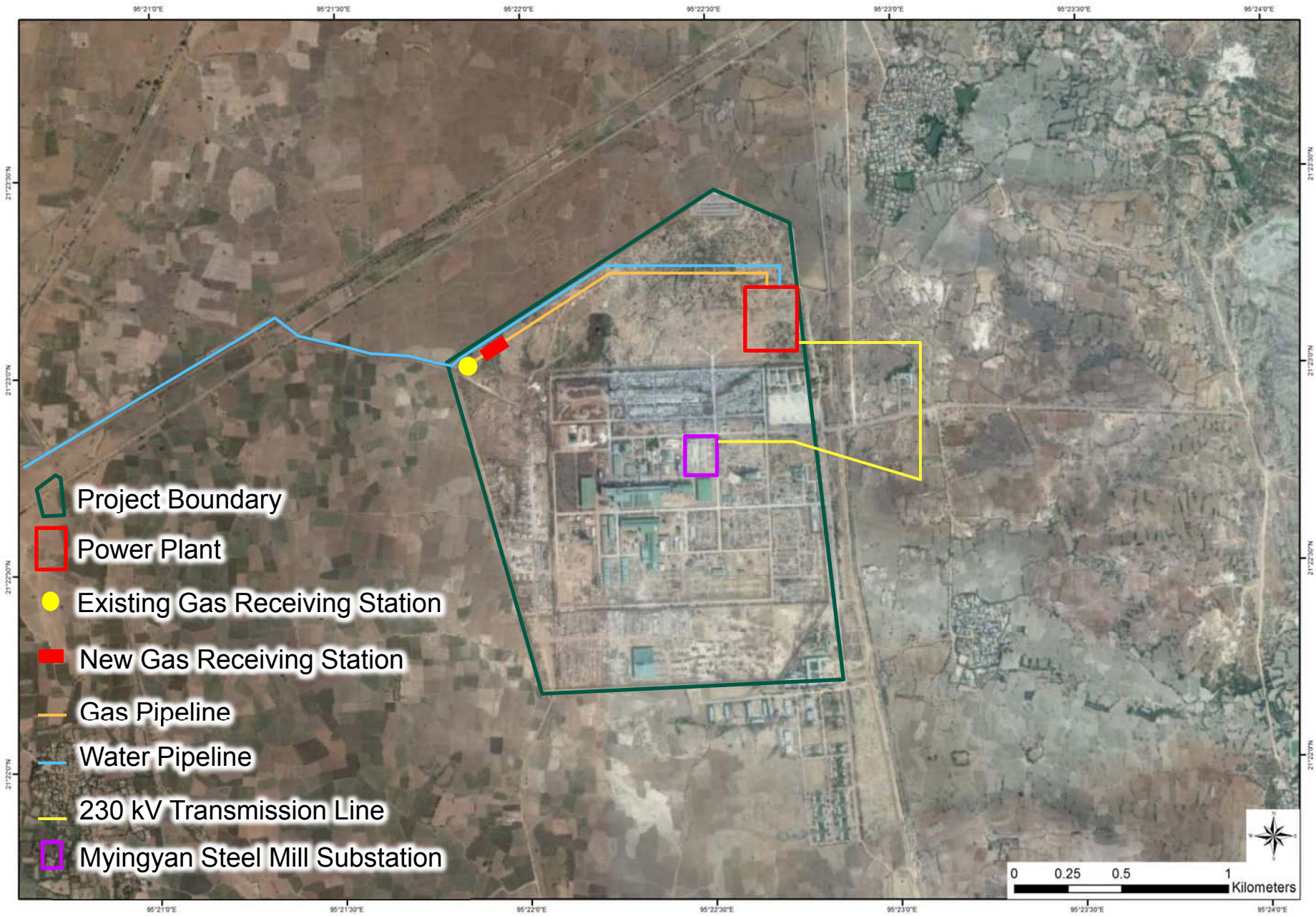
Local Context

- It is recognized that demand for energy will grow, particularly as the area develops. However, demand will exceed current supply. The proposed Project will help respond to this gap between demand and supply.

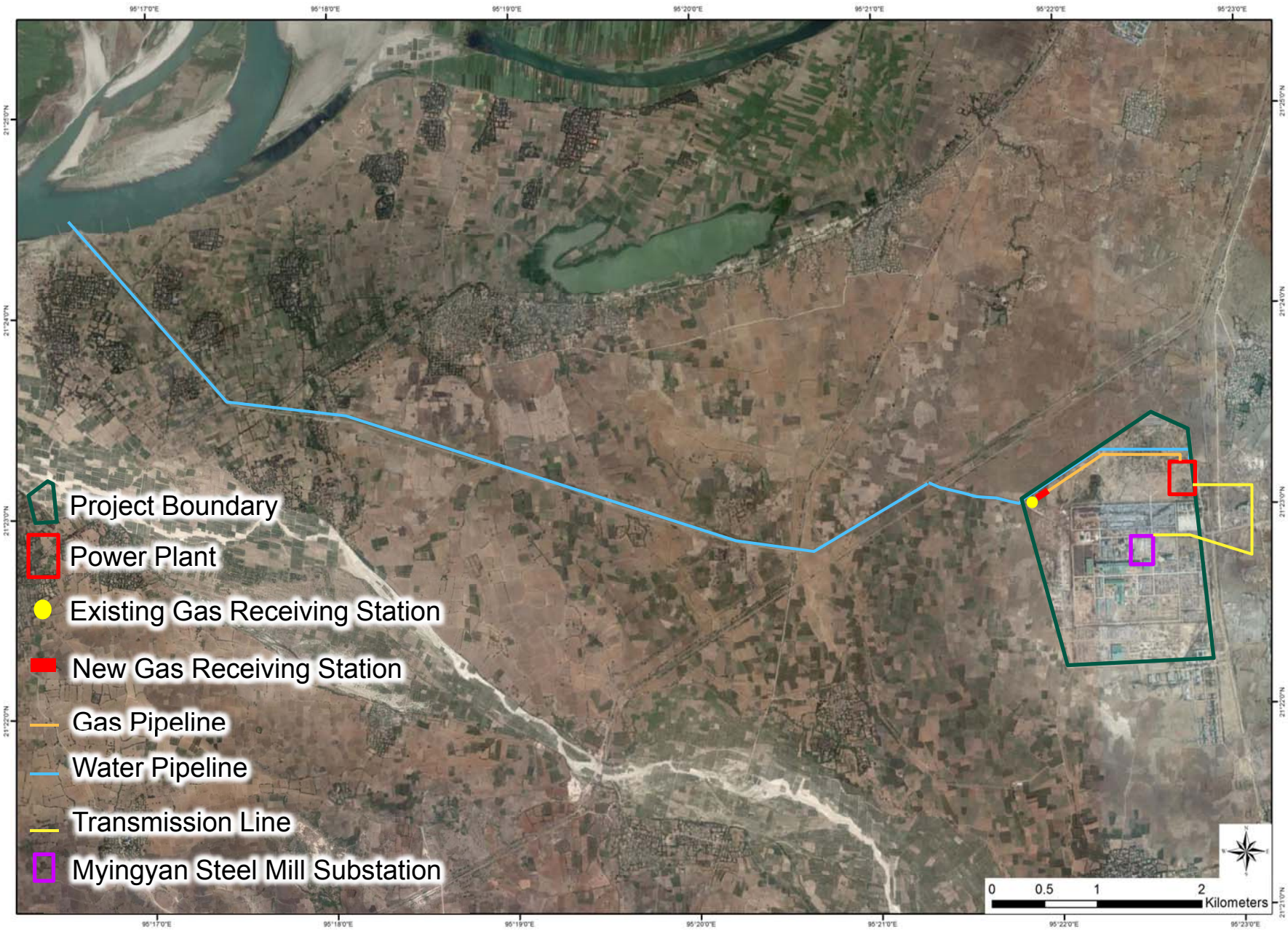


Source: David Dapice, 2012

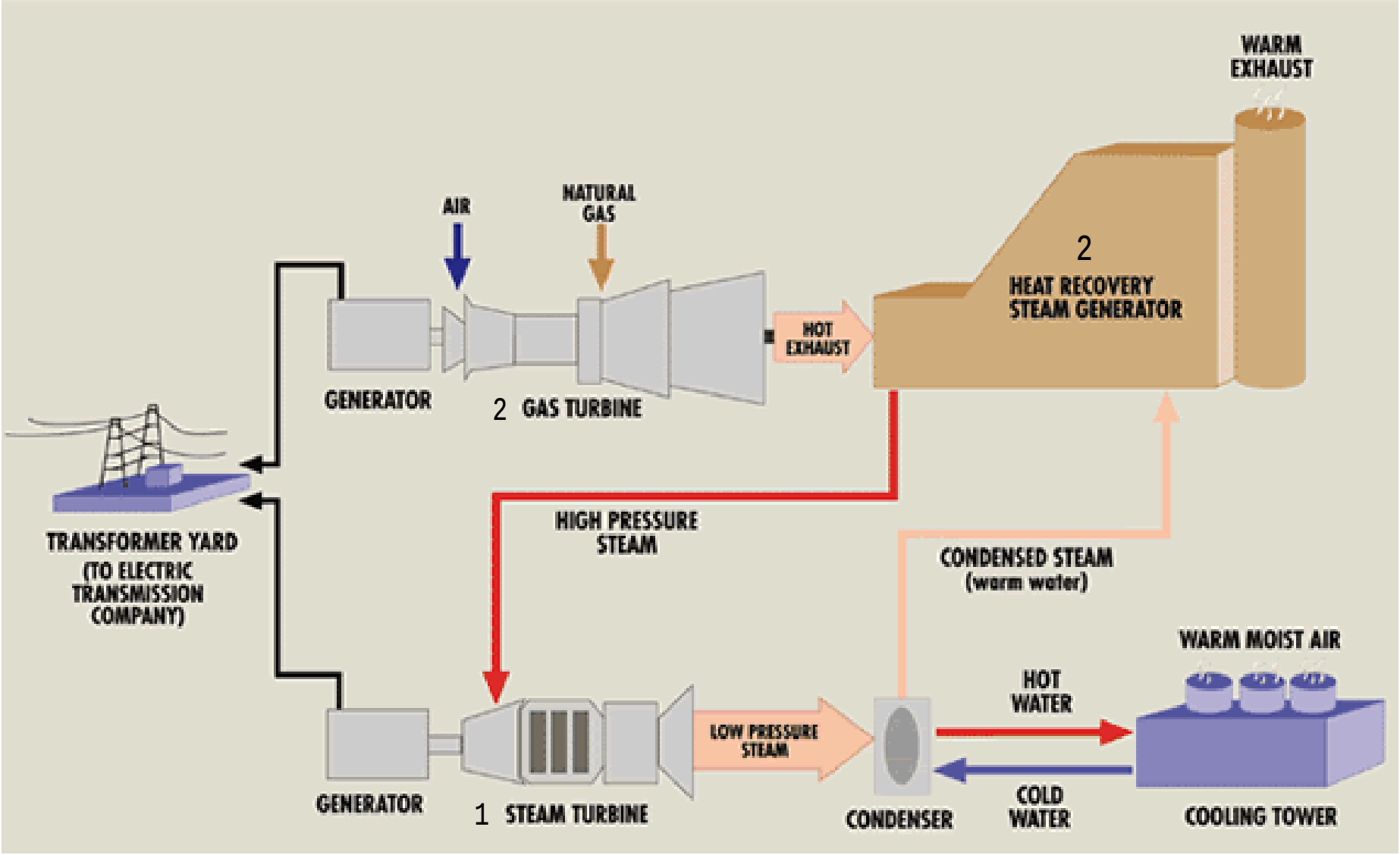
Project Location & Project Components



Project Location & Project Components

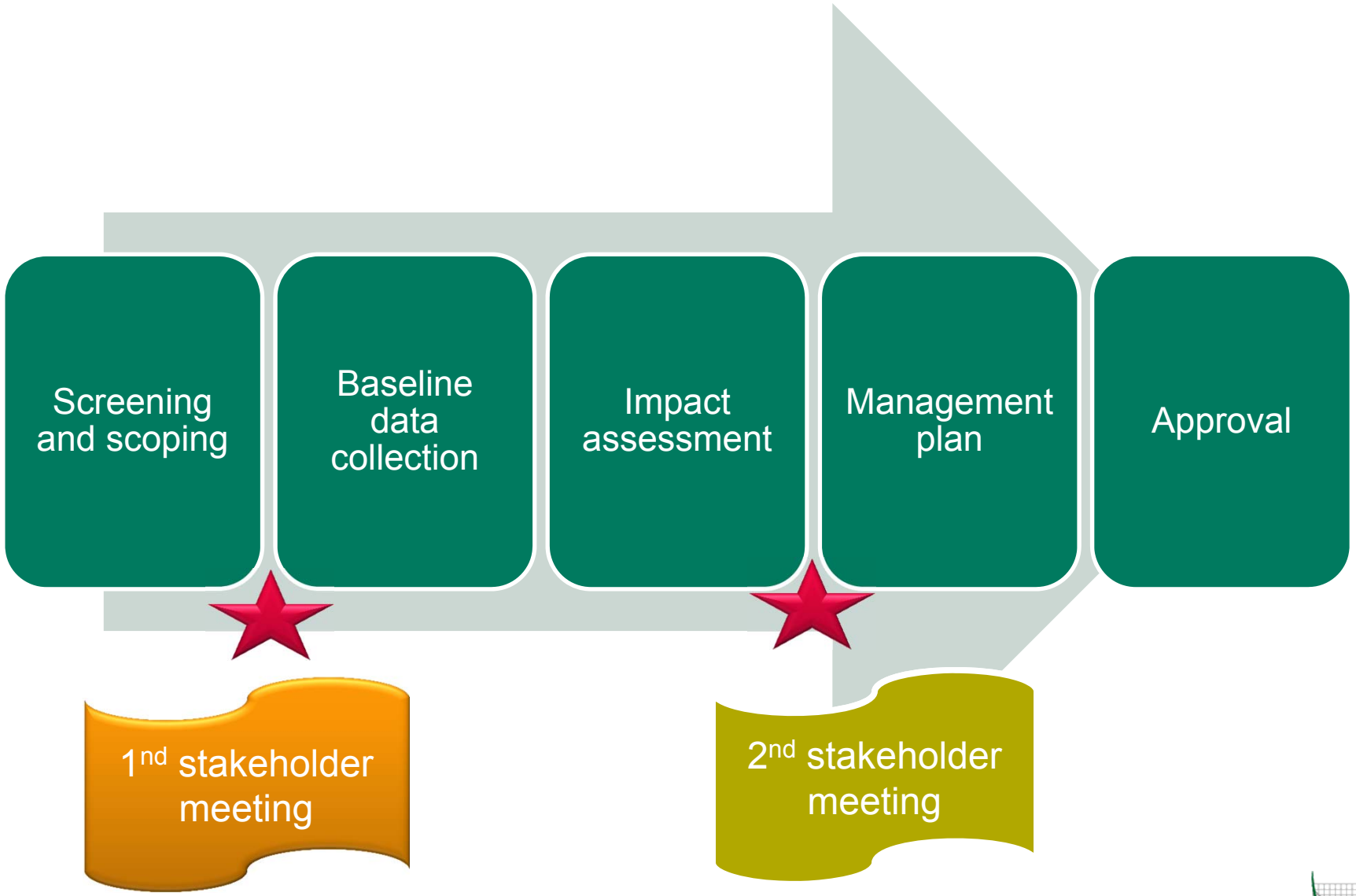


Overview of the project



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Impact Assessment and Management Process



ERM

Project Schedule

- Completion of ESIA: Third Quarter of 2015
- Start of Construction: First Quarter of 2016
- Start of Operation: First Quarter of 2018



Schedule for Township and Village Visits

Date	Day	Activity
15th July	Wednesday	Myingyan GAD meeting (Township)
16th July	Thursday	Taungthar GAD meeting (Township)
		Hnan Ywa Village - Taungtha Township
17th July	Friday	Nyaung Kan Village - Taungtha Township
		Hpet Taw Village - Taungtha Township
18th July	Saturday	Sa Khar Village - Myingyan Township
		Thien Village - Myingyan Township
19th July	Sunday	Gyoke Pin - Myingyan Township
		Tha Pyay Thar - Myingyan Township

- The township and villages are proposed for the stakeholder consultation as they are nearby the Project area.

How to contact us

Comments, concerns, queries and questions on the above

and the Project in general are welcomed.

Contact details for queries.

Resource and Environment Myanmar Co., Ltd.

B702 Delta Plaza, Shwegondaing Rd., Bahan Tsp., Yangon,
Republic of the Union of Myanmar

Contact phone number: 09-73013448

Impact Assessment Overview

August 2015

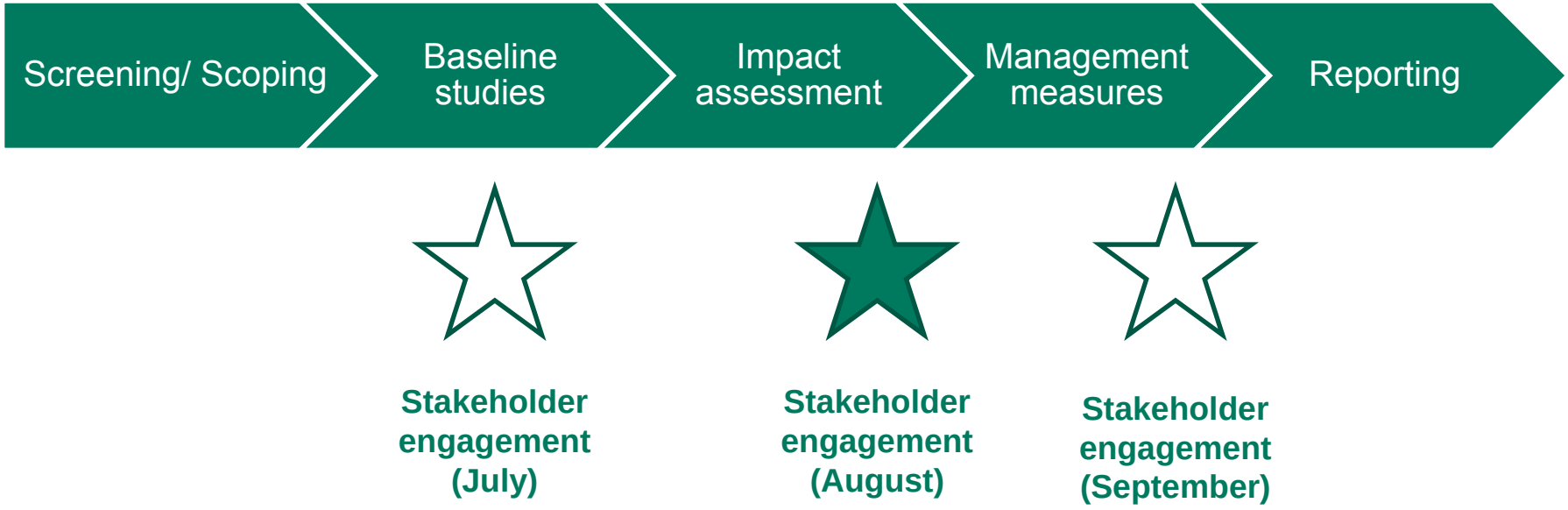


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Impact Assessment Process

To better understand the likely impacts associated with the Project an environmental and social impact assessment is being completed. The assessment is being completed in line with international standards.



Impact Assessment Process



- The **baseline studies** are undertaken to establish an understanding of the existing environment.
- The **impact assessment** identifies what impacts are likely to occur as a result of the Project – i.e. how will the baseline change.
- The **management measures** are designed to minimise the likely negative impacts and enhance the positive benefits.
- The management measures will be **monitored** to ensure they are effective in minimising the impacts.

Purpose and Objectives

The purpose of today is to:

- Provide an update on key issues raised in July
- Present the results of the impact assessment process
- Gather your insights and feedback on the assessment and proposed management

In September we will provide further information on management measures and proposed monitoring.

Project Overview



ERM

Utilities: Singapore

SembCogen CCP 3 @ Banyan



Project Schedule

- Completion of ESIA: Third Quarter of 2015
- Start of Construction: First Quarter of 2016
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Air Quality

Impact Description	Proposed Management
Construction activities, including site clearing, may generate dust.	A variety of techniques will be used to minimize emissions during construction, including spraying of exposed areas including roads and covering dusty materials and equipment. Air emissions will be monitored monthly during construction.
The power plant will generate air emissions during operation. Given existing activities in the area, air quality is already degraded – i.e. the area is considered to be a degraded airshed.	A variety of mechanisms will be used to reduce emissions – including dry low NOx burners. The emission stacks will be continuously monitored. Emissions outside of the site will be monitored monthly. A monitoring station will be established at Sa Khar village.

Surface Water Quality

Impact Description	Proposed Management
Potential impacts may arise from the disposal of waste, discharge of wastewater, surface water runoff, and erosion and sedimentation. A water intake point will be established on the Ayeyardwady River. Cooling water will be discharged to the Ayeyarwady River. The pipeline from the water intake point to the Project site will be buried to minimize the impacts.	Wastewater will collected and treated on site in line with international standards. Solid and non-hazardous wastes will be collected and segregated at the point of generation and appropriately disposed. Drainage systems will be maintained and run-off will be minimized. The water intake point and discharge point will meet international standards. Temperature will be monitored bi-weekly and sedimentation will be monitored quarterly.

Soil and Groundwater Quality

Impact Description	Proposed Management
Impacts may arise as a result of potential leaks or spills of oil, lubricants, fuels or chemicals and improper handling of effluent and waste.	Waste will be properly disposed. Chemicals and fuels will be properly stored and handled. A site specific emergency response plan will be developed and implemented. Groundwater will be monitored annually at the site boundary, and at Sa Kha village twice a year.

Community

Potential Impacts	Proposed Management
Economic: The project will generate employment and economic opportunities. An accommodation camp will be established to house construction workers.	A local content plan will be implemented. The plan will determine what types of opportunities may exist for local villagers in terms of employment. In addition, a corporate social responsibility plan will be developed. A health and safety plan will developed to protect the health and safety of the workforce. The actions set out in the plan will be monitored daily and will be reviewed monthly.

Community

Potential Impacts	Proposed Management
Social networks: There may be a change in social networks as a result of the project.	A social management plan will be developed. This will include a grievance mechanism – so that local villagers can raise concerns throughout the construction and operation of the Project. Further details regarding the grievance mechanism will be provided in September.
Displacement: Those currently using the Project site will no longer be able to use the site. Burying the water pipeline will temporarily displace agricultural activities that occur within the right of way.	The current level of activity at the Project site and along the water pipeline and transmission line are being reviewed to better understand the potential impact. Measures will be implemented to minimize the impact associated with displacement.

Community

Potential Impacts	Proposed Management
Health: An increase in population may contribute to an increase in communicable disease transmission.	The workforce camp will minimize the interaction between the workforce and the villages – reducing the potential for diseases to be passed on to villagers. A workforce code of conduct will be established, and pre-employment screening will be undertaken. Vector (e.g. mosquito) habitat will be minimized on site – such as standing water. Healthcare services will be provided on site for workers. Health and safety incidents will be monitored and recorded as they occur.

Community

Potential Impacts	Proposed Management
Safety: An increase in traffic movements, the presence of the facility and the management of hazardous materials presents safety risks.	A traffic management plan will be implemented. It will include requirements to bus workers between the camp and the site. Hazardous materials will be stored and disposed of appropriately (as described earlier). Security personnel will receive training and their activities will be monitored. A disaster management plan will be developed to ensure appropriate protocols are in place in the event of a disaster. Health and safety incidents will be monitored and recorded as they occur.

Noise and Vibrations

Potential Impacts	Proposed Management
Noise: Noise will be generated during construction and operation as a result of construction activities (e.g. pile driving, foundation works) and operation of the gas and steam turbines, steam generators and the cooling tower.	Measures will be implemented to minimize the noise. This includes the establishment of noise barriers and regular maintenance of equipment. Noise will be monitored monthly at the site, and quarterly 500 meters from the site.
Vibrations: Vibrations will be generated during construction and operation through the use of machinery on site.	Given the distance between the site and nearest village, no impact from vibrations is anticipated.

Cultural Heritage

Potential Impacts	Proposed Management
Cultural heritage sites and values may be impacted during construction of the Project.	A chance find procedure will be developed to minimize the impact. The procedure will ensure that if any sites of cultural significance are identified during construction of the Project (including the water pipeline), work will stop and appropriate actions will be taken to ensure that the heritage site is protected.

Greenhouse Gas Emissions

Impact Description	Proposed Management
Greenhouse gas emissions will be generated during construction and operation.	During construction emissions are considered to be insignificant. However, during operation, the estimated emissions from the Project will exceed relevant international thresholds – which means that the Project will be considered a 'significant emitter' of greenhouse gas emissions. The Project will implement measures to reduce greenhouse gas emissions, and report annually the emissions that are generated.

Marine and Terrestrial Environment

Potential Impacts	Proposed Management
Land clearing is required during construction which may impact on the natural environment (e.g. dust, disturbance to animals). Animals may be impacted when crossing roads due to an increase in traffic. Night lighting during operation may disturb animals.	Measures will be implemented to minimize the impact. This includes measures to reduce dust, measures to ensure appropriate handling of waste, and traffic management measures (as discussed earlier).

How to contact us

Comments, concerns, queries and questions on the above and the Project in general are welcomed.

Sembcorp:

Address: 30 Hill Street #02-01,
Singapore 179360

Email: dennis.foo@sembcorp.com

Local contact details in Myanmar will be provided in the stakeholder engagement in September.

Stakeholder Engagement Meeting

September 2015



The world's leading sustainability consultancy

ERM

Purpose and Objectives

The purpose of today is to:

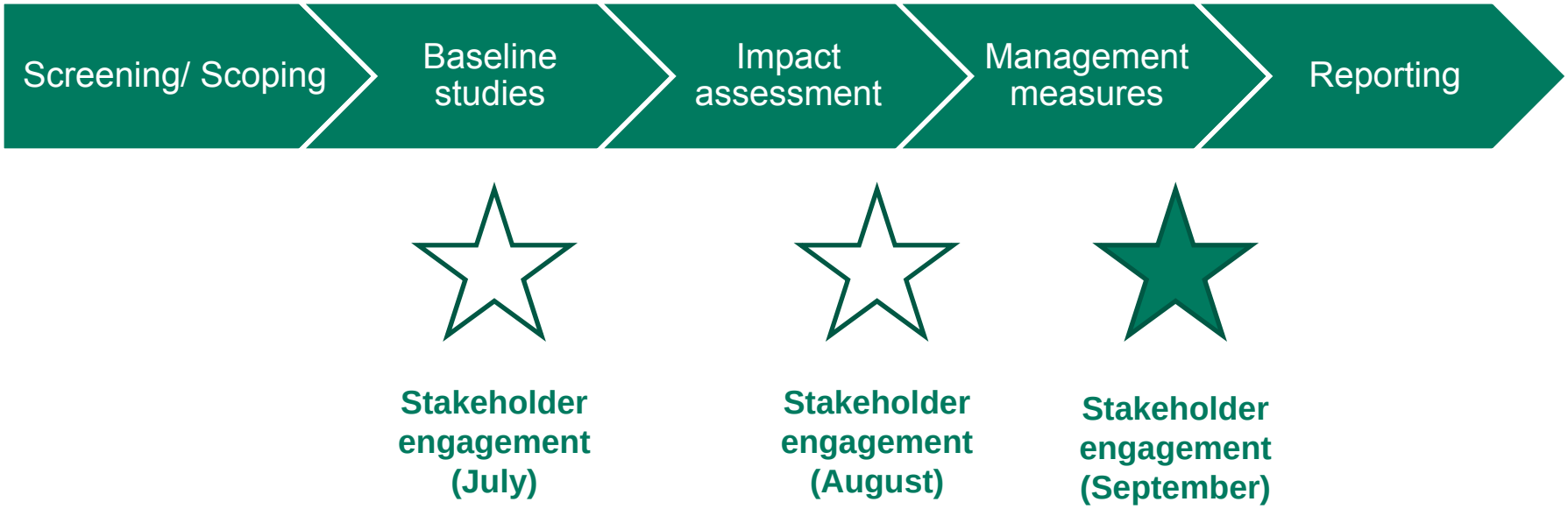
- Provide an update on key issues raised in July and August
- Present the outcomes of the impact assessment process
- Gather your insights and feedback on the project

You can ask questions/ raise your concerns during this meeting or provide feedback at the end of the meeting.

Although this is the last engagement meeting associated with the impact assessment, there will be opportunities throughout the project to provide feedback.

Impact Assessment Process

An environmental and social impact assessment is being undertaken to better understand the likely impacts associated with the project. The assessment is being undertaken in line with international standards.



ERM

Impact Assessment Process



- The **baseline studies** are undertaken to establish an understanding of the existing environment.
- The **impact assessment** identifies what impacts are likely to occur as a result of the Project – i.e. how will the baseline change.
- The **management measures** are designed to minimise the likely negative impacts and enhance the positive benefits.
- The management measures will be **monitored** to ensure they are effective in minimising the impacts.

Project Overview



ERM

An Example of an Existing Facility



Employment/ Economic

Construction and operation

- Impact: The project will create employment opportunities.

  There will be some job opportunities available and it will depend on the skills required by the Project and available in the local villages.

  During the construction phase, a temporary camp will be constructed to accommodate the construction workforce.

- Mitigation measure: A local content plan will be developed so that some job opportunities are made available to local villagers. However, this will depend on the skills required by the Project.

Activities

There will be a number of activities resulting from the Project.

- The water pipeline. The pipeline will extend for 14 km – from the Ayeyarwady River to the Project site. The routing is designated by Ministry of Agriculture/MEPE. The pipeline will be buried to minimise the impact.
- The 230 kV transmission line. The routing is designated by MEPE.
- Heavy machinery are transported to the site via the Nyaung Hla landing place.

Please note that the Project will produce and sell electricity to MEPE; and MEPE in turn will be responsible for distribution of electricity.

Water Pipeline and Transmission Line



ERM

Air Quality

Construction:

- Impact: Construction activities, including site clearing, may generate dust. This may occur at the Project site as well as along the water pipeline route.
- Mitigation measures: A variety of techniques will be used to minimize dust during construction, including spraying of exposed areas (such as roads) and covering dusty materials and equipment.

Air Quality

Operation:

- Impact: The power plant will generate air emissions during operations that meets the World Health Organisation standards.
- Mitigation measure: A variety of mechanisms will be used to further reduce emissions – including dry low NOx burners.
- Monitoring: Online monitoring system will be installed on the stack to monitor air emissions.

Waste Water Discharge

- Impact: Waste water will be generated from the plant.

  All treated waste water will be discharged to the irrigation canal.

- Mitigation measure: Wastewater will collected within the plant and treated within the plant on site in line with World Bank Group standards and will be discharged to the irrigation channel.

- Monitoring: The water intake point and discharge point will meet international standards. Temperature will be monitored bi-weekly and sedimentation will be monitored quarterly.

Soil and Groundwater Quality

- Impacts: Impacts may arise as a result of potential leaks or spills of oil, lubricants, fuels or chemicals and improper handling of effluent and waste.
- Mitigation Measures: Waste will be properly disposed. Chemicals and fuels will be properly stored and handled.

  A site specific emergency response plan will be developed and implemented.

Community Health and Safety

- Impact: An influx of workers may contribute to an increase in the transmission of communicable disease.

  An increase in traffic movements, the presence of the facility and the management of hazardous materials presents safety risks.

- Mitigation measures: A range of management measures will be implemented. This includes a workforce camp, a workforce code of conduct, appropriate storage and disposal of hazardous materials.

  In addition, an emergency response plan will be developed and a traffic management plan will be developed.

Noise and Vibrations

- Impacts: Noise will be generated during construction and operation as a result of construction activities (e.g. pile driving, foundation works) and operation of the gas and steam turbines, steam generators and the cooling tower.

  Vibrations will be generated during construction and operation through the use of machinery on site.

- Mitigation measures: During construction, noise generated from the piling is limited for less than 3 months and the construction will only be carried out during day time. During operation, the design of the noise level will be up to 70 dba, which is in line with the World Bank Group regulations.

Ongoing Engagement

Engagement will continue throughout the life of the Project.

Next steps include:

- Appointment of a community liaison officer who will be the local point of contact
- Establishment of a grievance mechanism
- Continuation of progress updates, including notifications in advance of starting construction activities
- Further engagement on development of the Corporate Social Responsibility plan

Grievance Management

A part of the engagement process, a grievance mechanism will be established.

- The grievance mechanism will be available to all stakeholders.
- If you have an issue or concern, there will be an opportunity to raise it with Sembcorp through the grievance mechanism.
- Further information will be distributed once the grievance mechanism has been finalised.

Corporate Social Responsibility

Sembcorp will be developing a Corporate Social Responsibility plan.

- Key areas of focus will likely be education/ skills development, healthcare and water – we are still working on the details of the plan.
- Further engagement will be undertaken after the plan is developed.

Contact Details

Comments, concerns, queries and questions are welcomed.

Sembcorp

Point of Contact: U Aung Lwin Oo

Email Address: alo.mdy70@gmail.com

Contact phone number: 09972608080

Annex G

Photographs from Stakeholder Engagement



Photo 1: Face-to-face meeting with Ministry of Electricity and Industry, Mandalay Region



Photo 2: Face-to-face meeting with Ministry of Electricity and Industry, Mandalay Region



Photo 3: Face-to-face meeting with Ministry of Electricity and Industry, Mandalay Region



Photo 4: Face-to-face meeting with Ministry of Electricity and Industry, Mandalay Region



Photo 5: Face-to-face meeting with Ministry of Electricity and Industry, Mandalay Region



Photo 6: Face-to-face meeting with Ministry of Electricity and Industry, Mandalay Region



Photo 7: Public meeting in Myingyan GAD (Township)



Photo 8: Public meeting in Myingyan GAD (Township)



Photo 9: Public meeting in Myingyan GAD (Township)



Photo 10: Public meeting in Myingyan GAD (Township)

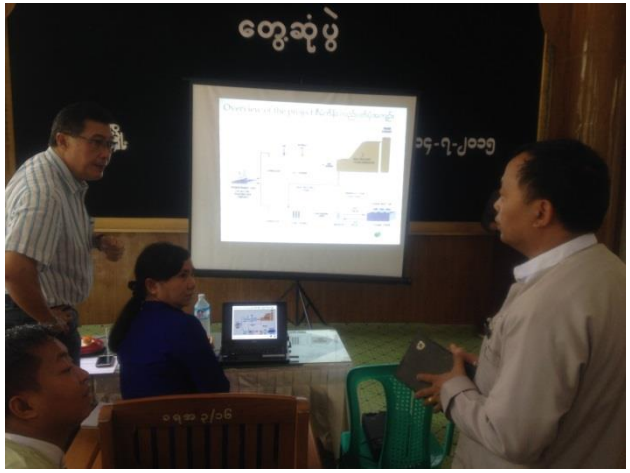


Photo 11: Public meeting in Myingyan GAD (Township)



Photo 12: Public meeting in Myingyan GAD (Township)



Photo 13: Public meeting in Taung Thar GAD (Township)



Photo 14: Public Meeting in Taung Thar GAD (Township)



Photo 15: Public Meeting in Taung Thar GAD (Township)



Photo 16: Public Meeting in Taung Thar GAD (Township)



Photo 17: Public Meeting in Taung Thar GAD (Township)



Photo 18: Public Meeting in Taung Thar GAD (Township)



Photo 19: Public Meeting in Hnan Ywa (village)



Photo 20: Public Meeting in Hnan Ywa (village)



Photo 21: Public Meeting in Hnan Ywa (village)



Photo 22: Public Meeting in Hnan Ywa (village)



Photo 23: Public Meeting in Hnan Ywa (village)



Photo 24: Public Meeting in Hnan Ywa (village)



Photo 25: Public Meeting in Nyaung Kan (village)



Photo 26: Public Meeting in Nyaung Kan (village)



Photo 27: Public Meeting in Nyaung Kan (village)



Photo 28: Public Meeting in Hpet Taw (village)



Photo 29: Public Meeting in Hpet Taw (village)



Photo 30: Public Meeting in Hpet Taw (village)



Photo 31: Public Meeting in Sa Khar (village)



Photo 32: Public Meeting in Sa Khar (village)



Photo 33: Public Meeting in Sa Khar (village)



Photo 34: Public Meeting in Thien Ywa (village)



Photo 35: Public Meeting in Thien Ywa (village)



Photo 36: Public Meeting in Thien Ywa (village)



Photo 37: Public Meeting in Gyoke Pin (village)



Photo 38: Public Meeting in Gyoke Pin (village)



Photo 39: Public Meeting in Gyoke Pin (village)



Photo 40: Public Meeting in Tha Pyay Thar (village)



Photo 41: Public Meeting in Tha Pyay Thar (village)



Photo 42: Public Meeting in Tha Pyay Thar (village)



Photo 43: Public Meeting in Tha Pyay Thar (village)



Photo 44: Public Meeting in Tha Pyay Thar (village)



Photo 45: Public Meeting in Gyoke Pin (village)



Photo 46: Public Meeting in Gyoke Pin (village)



Photo 47: Public Meeting in Thien Ywa (village)



Photo 48: Public Meeting in Thien Ywa (village)



Photo 49: Public Meeting in Nyaung Kan (village)



Photo 50: Public Meeting in Hpet Taw (village)



Photo 51: Public Meeting in Sa Khar (village)



Photo 52: Public Meeting in Sa Khar (village)



Photo 53: Public Meeting in Hnan Ywa (village)



Photo 54: Focus group meeting with steel mill workers



Photo 55: Public meeting in Myingyan GAD (Township)



Photo 56: Public meeting in Myingyan GAD (Township)



Photo 57: Public meeting in Myingyan GAD (Township)



Photo 58: Public Meeting in Tha Pyay Thar (village)



Photo 59: Public Meeting in Tha Pyay Thar (village)



Photo 60: Public Meeting in Tha Pyay Thar (village)



Photo 61: Public meeting in Taung Thar GAD (Township)



Photo 62: Public meeting in Taung Thar GAD (Township)



Photo 63: Public meeting in Taung Thar GAD (Township)



Photo 64: Public Meeting in Hpet Taw (village)



Photo 65: Public Meeting in Hpet Taw (village)



Photo 66: Public Meeting in Hpet Taw (village)



Photo 67: Public Meeting in Hnan Ywa (village)



Photo 68: Public Meeting in Hnan Ywa (village)



Photo 69: Public Meeting in Sa Khar (village)



Photo 70: Public Meeting in Sa Khar (village)



Photo 71: Focus group meeting with steel mill workers



Photo 72: Focus group meeting with steel mill workers



Photo 73: Public Meeting in Nyaung Kan (village)



Photo 74: Public Meeting in Nyaung Kan (village)



Photo 75: Public Meeting in Gyoke Pin (village)



Photo 76: Public Meeting in Gyoke Pin (village)



Photo 77: Public Meeting in Thien Ywa (village)



Photo 78: Public Meeting in Thien Ywa (village)

Annex H

Stakeholder Suggestion Box Comments

Voice of the Sa khar Village People

1. We request the President and the minister to come and see the difficulties of our village. There are two factories near our village, No.1 Steel factory and an electric power station generated by gas. Bad odour, heat wave and loud noises emitted by factories give us much trouble to our health and economy. We have 50 to 100 acres of farmland around the factories. However we cannot cultivate crop on the farmland because of strong heat and bad odour emitted by the factories. We request and hope that the President and minister would and help us solve the problems.

   A villager

2. I am a farmer living in Sakha village. Half of my farmland is occupied by the steel factory. Heat from the electric power station makes my health poor. My eye are now in bad condition. I can grow or cultivate no crops on my farm land because of the strong heat wave emitted by the factory and station. So I hope fully request the elder to give me help so that I can cultivate crops on my plot of land, for livelihood.

   U Kyi Win, farmer

3. I have a few acres of farmland on the north of the gas station. I cannot cultivate crops such as peas, sesame and corn on the farm because of the strong heat coming out all-time from the power station. I respect fully request the elders to come and see our difficulties.

   Daw Khin Shein

4. I have a few acres of the farmland on the north of the gas station, which always emits strong heat to the near farm. I grow crops on my farm. But harvest none because the crop plants died of strong heat before bean flowers or fruits. So I request the elders to see our conduction.

   U Myint Zaw

5. There are about 50 acres of farmland on the north of the gas turbine station. Farms could not cultivate crops on the land because the strong heat from the station dried the plants. Even men, cows and goats cannot go across the farmland always covered by heat. Moreover, the strong heat and bad smell emitted by the factories affected our health. So we eagerly request our elders to come and see poor lives.

   U Kaw Yin

6. We are elders of the village. We have to make no objection for the present running factories near our village, the steel factory and electric power plant. We understand that electricity is essential for the development of our country. According to the explanation of the company we believe that there will not side affects by building a new power plant, so we would like urge or request the stakeholders to build a new power plant as early as possible.

   U Kaw Yin, U Tun Ngwe, U Than Shein, U Aye Ko

7. Many acres of farmland own by Sakar village farmers were occupied by the No.1 steel factory. We can grow no crops on the rest of farmland because of the heat wave always blowing on our farmland. Now a new electric power plant in hoped to build near our village. It will also give us trouble by its heat wave. Thus we can grow no crops on our farmland. We have to relieve on the farmland for our livelihood. So we urge the elders to close down the running gas turbine and object the plan to build a new power station that will also emit bad smell, strong heat and loud noise.

Daw Khin Myo Swe

Suggestions and Voice of the villagers (Tha Pyay Thar Village)

1. I talk pride for the successful achievement of the power plant project for the people. I wish the project to be able to achieve more and more success to promote the status of the state.

   Maung Aung Kyaw Min
   Tha Pyay Thar Village

2. I wish for the success of building and generating the electric power plant in this area.

   No Name

3. I would like to request the company authorities to build good roads or tracks for the development of communication.

   No Name

4. I wish your company to be a successful one. We hope to get help for the development of our village.

   No Name

5. I wish your company will make good progress and prosperity of all citizens.

   No Name

6. I wish for the progress of your company. I hope your company will help us for all round development of our village.

   No Name

7. Our village is poor, we hope to get job opportunities. A library is necessary for our village so that we can get much knowledge.

   Tin Aung Lin

8. I wish for the success of your company in aspects. In return I hope that you would try your best to give our village essential electric power.

   Tin Maung Ngwe

9. I eagerly hope for the successful implementation of the power plant. We would like to request you to provide us necessary measures for health, education and electrification.

   No Name

10. We all wish your company a successful one. We wish you good luck and good health. We want to get your help for the completion of our village monastic building.

    No Name

11. We are glad to know that your company is going to build a electrical power plant near our village. We hope you to look forward and provide for the development our village.

    No Name

12. We wish for the prosperity of your company. May you be able to do your best for the people and for the country.

No Name

13. My thanks are due to you and your company for coming to our region to build a power plant. May your company be famous or prominent not only in Myanmar but also in the world.

No Name

14. Our village need to electricity supply and upgrade the education e system so we want the provider. We are welcome to your company and for coming and provide for our village . We wish for the prosperity of your company.

No Name

15. We wish for prosperity of Resource and Environment Myanmar company. Our village need hospital, bridge, High School and good transportation.

Ma Swe SweMyint

16. We wish for the success of Resource and Environment Myanmar Company. We expect that when the project is finish your company will provide 24 hours electricity supply and rural health center.

Ma Mya Mya Lay

17. Our village need 24 hours and upgrade the educeation system. We wish you all are healthy and wealthy.

No Name(Sign)

18. Our village will upgrade transportation, communication, economy and social when your project is compete. If you need the worker please employ from our village.

U Win Naing

19. We wish for the prosperity of your company. We want to get your help for the completion of our village monastic building, medical clinic and septic tank for villagers.

No Name

20. We wish for the prosperity of your company. Our village needs electricity, build good road and upgrade our village primary school to middle school.

Ma Mya Mya Mon

21. We are pride for your support and we wish for success of your company. Education is very important for next generation actually we need educational supporting program. If your company will provide, we believe that our village education will upgrade.

Ko Thet Naing

22. We would like to support for your project and if your company need we are ready to help. Many thanks for your kind donation and wish for success of your company.

Maung Wyne

23. If your company project will develop our region will also develop in economy, transportation, etc. Project needs the labor could you call our villagers.

U Kyaw Tun

24. Power plant project is implemented I would like to employment in your company.

U Win Naing

25. We heartily welcome the project to build an electrical power plant in Myingyan township by a company. We hope that we will be able to use electricity and it will give us good benefits in education. We wish the project to build the electric power station success.

Ma Moe Moe Khaing

26. We hope to get electric light after completion the steam engine power plant. It will uplift the standard of living of our village especially in economics and education.

No Name

27.We all "Tha Pyay Thar" villagers wish your company and your project success.

No Name

28. We hope to get electricity after the completion of the power plant project.

U Moe, Father's Name-U Bo Thein
Tha Pyay Thar village,Linn Gye Village Tract
MyinGyan Township, Mandalay Region.

29. We hope to get the electricity from the power plant as early as possible.

U Win Myint, Father's Name-U Taw Toe
Tha Pyay Thar village,Linn Gye Village Tract
MyinGyan Township, Mandalay Region.

30. I am glad to hear that an electric power station will be built in our region. It will develop our country, our region and our village.

Maung Aung Kyaw Lin, Village Farmer.

31. For the development of our village we hope to get a health center, a middle school and electricity for the development our village. We wish you and your company success.

No Name

32. We need electricity, a village health center and good communication. We request you to give us help for the development of our village. We want job opportunities. Thank you for the project.

No Name

33. For the development of our village we need good communication, electric light and job opportunities. We wish for the success of the project.

No Name

34. I'm Daw Toe Kyi of Tha Pyay Tar village. When the project complete, we hope to get a health center, a primary school building and job opportunities.

Daw Toe Kyi

35. We want jobs, good communication, economic and social development. Wishing you and your company success.

Daw Aye Aye San

36. To promote the education standard of our village. We need 24 hours electric light. We believe that your company will fulfill our need.

U Kyaw Myint

37. I am U Kyaw Win. We need good communication and job opportunities.

No Name

38. We hope and believe that your company will be able to help us to get 24hours electric light and a Middle school.

U Phoe Toe

39. To promote the education standard we need all-time electricity supply.l Welcome your company and wish good luck and success.

No Name

40. We hope for the development of social, economic and commination of our village after the completion of your company project.

Daw Htay

No.41

Thank you for your orientation. Our village needs to have good transportation system, electricity and clinic however we do not know what will impact form this factory yet but we hope that it will overcome good things. Thank you.

No Name

No.42

I would like to request for our village needs are education, electricity, and social welfare. I wish that your company will be succeeding in future.

No Name

No.43

For our village needs to develop in several sectors like, economics, education and social that's why we would like to thanks for your coming. Wish to get a great succeed.

No Name

No.44

I am U Tun Shwe from Thapyaythar village. Our village needs are hospital, clinic and Middle school if it is possible we would like to request please fulfill our need as soon as possible.

U Tun Shwe

No.45

I am Ma Kyi Kyi Thin form Thapyaythar village. I wish that your company may success more and more on the other hand please fulfill our village's transportation system and roads to develop. Thank you very much.

Ma Kyi Kyi Thin

No.46

I wish that your company may success more and more and can donate to others need.

No Name

No.47

If this project will succeed, I believe that the electricity can distribute us. That's why education, economics and living standard will be developing in our villages.

No Name

No.48

I would like to propose to get electricity, if so students will able to study without difficultly. And we need to establish Thapyaythar Middle school and to develop village roads.

No Name

No.49

May I wish that your company will success more and more in the future and can support rural development in several ways.

No Name

No.50

I am U Kyaw Win form Thapyaythar village. I would like to propose to get electricity, if so students will able to study without difficultly. And we need to establish Thapyaythar Middle school and to develop village roads.

UKyaw Win

No.51

May I wish that your company will success more and more in the future and can support rural development in different ways.

No Name

No.52

I am very pleased that the factory will implement in our region and I believe that this project will give only benefits for us. Our village needs to have electricity and transportation system and we wish that this project can implement as soon as possible.

No Name

No.53

For my suggestion is our village needs to get electricity and I concern that this project is far from urban area that's why it will not impact significantly.

No Name

No.54

May I wish that Resource and Environment Co. Ltd will get a great succeeded.

No Name

No.55

Firstly I would like to thanks for your orientation. I would like to suggest that this region is essentially needs for electricity and if the electricity will get it may develop economics transportation system. That's why I agree this project. Thank you so much.

No Name

No.56

I am U Tin Ohn from Thapyaythar village. Our needs are Roads and Electricity. And we will help for this project as much as we can.

U Tin Ohn

No.57

I can not give any suggestion but I agree this project.

U Wai Lin Aung

No.58

I agree this project. If we want to develop our village, we need to do unitary in agriculture sector.

U Ngwe Thaung

No.59

I am U San Lu and I wish like to thanks for Middle school and Generator that you donated. If you need more labour forces please let us know and don't be hesitate to contact us.

U San Lu

No.60

Our essential need is clinic and Toilet (be hygienically).

U Win Khine

No.61

We need to have pour flush latrine in households and one of the monasteries is still in progress. That's why we would like to ask please fulfill our need.

U Kyaw Naing Min

No.62

For the village requirements we need to have the clinic because of the population density. Please concern for this issue. Many thanks.

U Hla Thaung

No.63

In our village there has a family who has social status, that's why please consider for them.

U Kyi Zaw

No.64

I would like to propose to get electricity, if so students will able to study without difficultly. And we need to establish Thapyaythar Middle school and to develop village roads.

U Kyaw Win

No.65

I wish that your company will success more and more in the future and can support rural development in different ways.

No Name

No.66

I am very pleased that this project will implement in our region.

U Phoe Shan

No.67

I would like to say that the company will succeed in the future and can give advantage for our country.

No Name

No.68

I would like to thanks for all and taking a suggestion from us. We need to get electricity if you would be consider about this it would be nice.

No Name

No.69

I would like to thanks for all and taking a suggestion from us. First priority is to have a clinic, second is the roads and I hope that you would be fulfill for our needs.

U Hla Min

No.70

In current situation, in our village there has not Middle School and the children from our village were going to school from another village by crossing the creek. That's why all we need to have is the Middle school.

U Myo Tun

No.71

I wish that your company will get more succeeded in the future.

No Name

Annex I

Stakeholder Engagement Questionnaire

Sembcorp Myanmar Combined Cycle Gas Turbine Power Plant
Notes from the September 2015 Stakeholder Engagement Meetings

Name of Participant:	**Date:**
Village/ Village Tract	**Township:**
District	**Region:**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

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2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

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3. What aspects of the Project would you like to receive more information about?

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4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

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Myingyan Final Meeting

1.

Name of Participant: U Tin Aung Soe	**Date:2 September 2015**
Village/ Village Tract: Myingyan	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   Positive impact for the country by the CCGT project.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   No.

3. What aspects of the Project would you like to receive more information about?

   No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Information should be discriminated via local medias.

2.

Name of Participant: Daw San Htay Yin	**Date:2 September 2015**
Village/ Village Tract: Township Planning Officer	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   The project will bring positive impacts on education, health and job opportunities.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

We are worried about that the environment will impact by the project. Is any impact on agriculture? Is there any impact on groundwater? We also worried about not to be finished the project after started.

3. What aspects of the Project would you like to receive more information about?

We want to know the followings: 1. Project commencement period, 2. Expected time frame to be finished, 3. Investment amount ( ), 4. If the project is successful, how many villages and population will be receiving benefits, 5. Yearly investment amount on project and 6. Report expressing how to implement the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Township planning department has to be submitted project related information to upper layer as a plan of township development, so we request your master plan to share the township administrative / township supporting committee.

3.

Name of Participant: U Shwe Bone	**Date:2 September 2015**
Village/ Village Tract: Quarter (1), Forest	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

a. Health impacts on family and villagers
b. Job opportunities
c. Negative Impacts due to project period (commencement, construction, operations)

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

a. Are there any alleviation plans for the local villagers?
b. Do you want to co-operate with government agencies?
c. Can SembCorp do to get good and clear water for project related villages?

3. What aspects of the Project would you like to receive more information about?

How will be using benefits from this project for the protection of environment and project effected villages?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

a. Communicate via telephone
b. Face to face meeting

4.

Name of Participant: U Win Shwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

If the project is successful, I myself, my family and my village will get positive impact on education, health and job opportunities.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

We understand that project will not impact negatively, so we don't worry about that.

3. What aspects of the Project would you like to receive more information about?

No Answer

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No Answer

5.

Name of Participant: U Zaw Zaw Lin	**Date:2 September 2015**
Village/ Village Tract: Land Record Department	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

   No

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   No

3. What aspects of the Project would you like to receive more information about?

   Environmental Impacts relating to project should be explained directly to public.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

6.

Name of Participant: Daw Nwe Nwe Sein	**Date:2 September 2015**
Village/ Village Tract: Quarter (2)	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   Public can use electricity fully.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   Environmental degradation

3. What aspects of the Project would you like to receive more information about?

   No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

7.

Name of Participant: U Kyaw Kyaw Hlaing	**Date:2 September 2015**
Village/ Village Tract: Thane / Ywasi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   No Answer

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   No Answer

3. What aspects of the Project would you like to receive more information about?
   Is the project will negatively impact to environment?

   We want to know updates information about project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

8.

Name of Participant: U Myint Soe	**Date:2 September 2015**
Village/ Village Tract: Thane / Ywasi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   We expected to have job opportunities for families of villages around project site and the living standard will be promoting.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   We are worried about whether project owner will be taking actions not to effect agricultural business due to the project activities or not.

3. What aspects of the Project would you like to receive more information about?
   We want to get information about not to damage the environment ongoing basis.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Face to face meeting

9.

Name of Participant: U Soe Win	**Date:2 September 2015**
Village/ Village Tract: Thane	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

We expected to have job opportunities for families of villages around project site and the living standard will be promoting.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

We want to know. Whether people around project site will be getting the job really or not? Is the project will impact environment negatively?

3. What aspects of the Project would you like to receive more information about?
We want to get information about not to damage the environment ongoing basis.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

10.

Name of Participant: U Aung Myo Kyaw	**Date:2 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

It will be good for young graduated people if they get jobs by project.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

Vibration from project activities will reduce the humidity of soil.

3. What aspects of the Project would you like to receive more information about?

No Answer

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
No Answer

11.

Name of Participant: U San Lwin	**Date:2 September 2015**
Village/ Village Tract: Thane/ Ywasi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

No effect for my family.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

We want to know. Can we get benefit when CCGT construction is finished?

3. What aspects of the Project would you like to receive more information about?

We want to get information about Natural disasters and risk control.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

12.

Name of Participant: U Toe Aung	**Date:2 September 2015**
Village/ Village Tract: Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

When project finished and if we can access electricity with reasonable price, especially in education sector will improve.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   a. Health problems due to disposal of Waste water and Gas emission
   b.Agricultural crops damages

3. What aspects of the Project would you like to receive more information about?

Sembcorp should explain project information at every meeting in order to understand about project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

13.

Name of Participant: U Aung Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

If the project was successful, our family and people from village might get the job.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?
No

3. What aspects of the Project would you like to receive more information about?

We want electricity after project was finished.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

14.

Name of Participant: U Lin Aung	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

If we get electricity, social status will be improved.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

NA

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
NA

15.

Name of Participant: Daw Kyi	**Date:2 September 2015**
Village/ Village Tract: Quarter (13)	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   I hope for positive impact because there is no direct positive impact to my family the whole area will get electricity and businesses will also boom.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   Is Present River pumping for agriculture will impact due to the taking water from Ayeyarwady river?

3. What aspects of the Project would you like to receive more information about?
   NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting and step by step discussion.

16.

Name of Participant: Aung Than Win	**Date:2 September 2015**
Village/ Village Tract: Ywasi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   If the project can create jobs for families, livelihood will be ok.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

Agricultural crops may damage due to the vibration from project.

3. What aspects of the Project would you like to receive more information about?
NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

17.

Name of Participant: U Kyaw Win	**Date:2 September 2015**
Village/ Village Tract: Ywasi/ Ywasi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

Project can create Job opportunities for families and livelihood will be ok.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

Due to vibration of power plant, plants can damage.

3. What aspects of the Project would you like to receive more information about?
NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

18.

Name of Participant: U Naing Lin	**Date:2 September 2015**
Village/ Village Tract: Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   If we get electricity, social status will be improved.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   No Answer

3. What aspects of the Project would you like to receive more information about?
   No Answer

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   No Answer

19.

Name of Participant: U Than Win	**Date:2 September 2015**
Village/ Village Tract: Saka	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   I thought that project will have positive impact on village. If more job opportunities for village will be more positive impact for the Saka village.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   a.High noise
   b.Bad smell or odour
   c.Not to effect nearby crops plantation by heat emissions that caused dry up the plants

3. What aspects of the Project would you like to receive more information about?
   The existing road nearby the steel mill need to be improved and need to be repaired.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Explain project to villager's face to face, asking opinions and meetings.

Thane Ywar Meeting

1.

Name of Participant: Aye Lwin Oo	**Date:2 September 2015**
Village/ Village Tract: Thane Ywar	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   OK

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?
   OK
3. What aspects of the Project would you like to receive more information about?
   OK
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   OK

2.

Name of Participant: Sein Myint Shwe	**Date:2 September 2015**
Village/ Village Tract: Thane Village	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

   I think there no impact will occur for us.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   I have concern about the weather changes according to this project.

3. What aspects of the Project would you like to receive more information about?

   NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   NA

3.

Name of Participant: Kyaw Kyaw Hlaing	**Date:2 September 2015**
Village/ Village Tract: Thane	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   I think that our family members will get job opportunities according to this project.If we will get job we will comfort in survival, education and also social activities.
2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?
   I would like to know about the environmental impacts about the project. I have concern the impact of air quality.
3. What aspects of the Project would you like to receive more information about?
   We want to get information about Natural disasters and risk control.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Face to face meeting

4.

Name of Participant: U San Lwin	**Date:5 September 2015**
Village/ Village Tract:Thain	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   I would like to get job opportunities concerning project.
2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   No Answer.

3. What aspects of the Project would you like to receive more information about?

   No Answer

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   No Answer

5.

Name of Participant: Soe Myint Than	**Date: 5 September 2015**
Village/ Village Tract: Thain	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

   I think that we will get good opportunities and will get electricity.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   I would like to know the impact to the natural environment or not.

3. What aspects of the Project would you like to receive more information about?

   I would like to know the project information to disclose the public.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

6.

Name of Participant: Naing Tun	**Date:5 September 2015**
Village/ Village Tract Thain	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

   .No Answer

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   NA

3. What aspects of the Project would you like to receive more information about?
   NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Face –to – face meetigs

7.

Name of Participant: Khin Lay Swe	**Date:2 September 2015**
Village/ Village Tract: Thain/ Ywa Si group	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   No Answer

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   I would like to know will there toxin from factory or not , will there heat and will there other impacts.

3. What aspects of the Project would you like to receive more information about?
   Will there have other impacts ? Will get good opportunities to the village? (eg job opportunities, electricity)

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

Thapyay Thar Meeting

1.

Name of Participant: U Kyaw Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

If the project is successful, local people will receive more benefits. It is better to give the job. Villagers are ready to work so can offer any time.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We want to know whether project will cause health problems to local people and may be suffered local people. The project owner will get more benefits.

3. What aspects of the Project would you like to receive more information about?

If positive impact let's continue otherwise prevent the negative impacts, as for information, the journey not far so It can be solved easily.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Please do come and inform updates every now and then.

Thapyay Thar Meeting

2.

Name of Participant: Daw Than I	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We like to judge whether benefit or not after the project was successful.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We want successful project but we afraid air pollution since we are living down-wind side.

3. What aspects of the Project would you like to receive more information about?

We cannot criticize since we have limited knowledge. We are public under the administration of village tract leader and township administrator, they might know more than us.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

I thought that communication will more concern with steel mill worker.

Thapyay Thar Meeting

3.

Name of Participant: U Moe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

If the project is accomplished, living standard of local people will be promoted for example quick transportation. I think every village may access electricity.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

I think if the project discharge waste water, it will be causing health problems to local people.

3. What aspects of the Project would you like to receive more information about?

We want to accomplish project and may project share the good benefits to the local people.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We are villagers, so you should communicate with village administrator.

Thapyay Thar Meeting

3.

Name of Participant: U Kyaw Tun	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impact for our village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Please explain about this project friendly. I would like you to explain villagers who have limited knowledge.

3. What aspects of the Project would you like to receive more information about?

I have no idea on this project. We pray for successful accomplishment of project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

I requested that our village has to access the electricity.

Thapyay Thar Meeting

4.

Name of Participant: U Win Naing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impact.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We don't have any concern.

3. What aspects of the Project would you like to receive more information about?

Be successful project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

5.

Name of Participant: U Hla Paw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We wish to be successful project and if you hire villagers, their livelihood will be getting better.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We would like to know and worried about gases emission from factory. However, there may no negative impact, we wish to the success of project.

3. What aspects of the Project would you like to receive more information about?

We think that information will be fetching by international easily, so we wish to success of projecgt.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Please share the updated information every now and then.

Thapyay Thar Meeting

6.

Name of Participant: Daw Nan Win Hlaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Job opportunities and electricity for village

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Air pollution and burning.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

7.

Name of Participant: U Win Naing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Job opportunities for my family.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

8.

Name of Participant: U Sein Tun	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Job opportunities and electricity

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Air pollution and burning

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

9.

Name of Participant: U San Aung	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We thinks that project will bring Positive Impact.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No

3. What aspects of the Project would you like to receive more information about?

Good information

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Positive impact.

Thapyay Thar Meeting

10.

Name of Participant: U Kyaw Sein Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It is likely to be sure to get jobs from project, if so our livelihood will be getting better.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

W are worried about industrial waste water so please manage not to affect negatively.

3. What aspects of the Project would you like to receive more information about?

The villagers may be delighted once the project successfully finished and their living standard will higher than ever before.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We understand through such kind of meeting held at the village.

Thapyay Thar Meeting

11.

Name of Participant: U Ngwe Baw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It is likely sure to get the jobs from project and my family's livelihood will be easy.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We would like to suggest to manage waste water properly.

3. What aspects of the Project would you like to receive more information about?

When project accomplished successfully, the villagers will be delighted.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Villagers are understand the project through meeting.

Thapyay Thar Meeting

12.

Name of Participant: U Kyaw Nyein	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Will water intake pipeline cause health problems to people?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We need transparency.

Thapyay Thar Meeting

13.

Name of Participant: U Hla Soe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We wish to be successful project.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

Transportation and communication should be easy.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We wish to be finish as soon as possible.

Thapyay Thar Meeting

14.

Name of Participant: Daw Khin Toe Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Our village needs jobs. We expect to get jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

15.

Name of Participant: U Hlaing Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Our village needs jobs. We expect to get jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

16.

Name of Participant: U Zaw Khat	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We need jobs for our village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about water related disasters.

3. What aspects of the Project would you like to receive more information about?

We want you to carry out village can access electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Information should discriminate via village head.

Thapyay Thar Meeting

17.

Name of Participant: U Tin Myo Aung	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

There is rare opportunity for job in our village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We would like you to explain about investment of this project.

3. What aspects of the Project would you like to receive more information about?

Even though we didn't receive information about project, we wish project shall be successful.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

18.

Name of Participant: U Win Soe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think there are no negative impact for the village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Even though we didn't receive information about project but we wish to the success of project.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

19.

Name of Participant: U Chit Oo Naing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impact to our village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Even though we didn't receive information about project but we wish to the success of project.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

20.

Name of Participant: U Toe Swe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impact.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We didn't hear any information about project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We wish to the success of project.

Thapyay Thar Meeting

21.

Name of Participant: Daw Hla Myint Aye	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't think any negative impact to village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We would like to know about the investment of this project.

3. What aspects of the Project would you like to receive more information about?

We didn't hear about this project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

22.

Name of Participant: Mg Tun Myint Naing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Job opportunities is important for all our families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

We want to access electricity through this project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Please inform via village administrator.

Thapyay Thar Meeting

23.

Name of Participant: U Zaw Moe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

That will be benefit for our family if we can access electricity.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concerns.

3. What aspects of the Project would you like to receive more information about?

It is really important to get jobs for villagers.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

24.

Name of Participant: U Khin Maung Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impact to our village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information about project. We wish to the success of project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

24.

Name of Participant: U Kyaw Maung	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't think any negative impact to village and families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information about project. We wish to the success of project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

26.

Name of Participant: U Kyaw Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't think any negative impact to village and families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information about project. We wish to the success of project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We wish to the success of project.

Thapyay Thar Meeting

27.

Name of Participant: Daw Myint Myint Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't think any negative impact to village and families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information about project. We wish to the success of project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

28.

Name of Participant: U Zaw Myo Thant	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We don't know.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We don't understand.

3. What aspects of the Project would you like to receive more information about?

We want to access electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

29.

Name of Participant: U Moe Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Jobs opportunity is really important for villagers and our families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We afraid of flood.

3. What aspects of the Project would you like to receive more information about?

We want electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

30.

Name of Participant: U Moe Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Jobs opportunity is really important for villagers and our families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We afraid of flood.

3. What aspects of the Project would you like to receive more information about?

We want electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want to get information via village administrator.

Thapyay Thar Meeting

31.

Name of Participant: U Paw Sein	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Our village and families want jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern on project.

3. What aspects of the Project would you like to receive more information about?

Our village wants electricity critically.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want to get information via village administrator.

Thapyay Thar Meeting

32.

Name of Participant: U Hla Aung	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

This is our honor for the visit of these organizations because we believe that they are doing development of our village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

33.

Name of Participant: U Mat	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

Be frankly and transparent.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

Thapyay Thar Meeting

34.

Name of Participant: U Htaw Bo	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that village will be developed.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

I think everything is good.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

I think everything will be completed.

Thapyay Thar Meeting

35.

Name of Participant: U Bo Min	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think that good benefit will be coming.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We want to get positive news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

By the good form.

Thapyay Thar Meeting

36.

Name of Participant: Daw Mya Mya Lay	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We, Thapay Thar village, want to get electricity, rural health center and to the completion of Government Primary School.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

37.

Name of Participant: U Min Htike	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impacts to village and families.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We didn't receive information about this project but we wish to the success of project.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

38.

Name of Participant: Daw Hla Maw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It will be good we got financial support from project owner.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We are fond of good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We wish to the success of factory and jobs should offer to villagers.

Thapyay Thar Meeting

39.

Name of Participant: U Thant Ko Ko	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We want to make remark benefit or not when project was successful.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We wish to the success of project but we afraid of air pollution or hazardous gas emission since we lived down-wind of factory.

3. What aspects of the Project would you like to receive more information about?

We cannot criticize since we have little knowledge but Myingyan Township Administrator may know more than us.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Communication only be about steel mill workers.

Thapyay Thar Meeting

40.

Name of Participant: Daw Than Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Education, Economics and Social are required.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

It is only good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want job through factory project.

Thapyay Thar Meeting

41.

Name of Participant: Daw Thaung Ngwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impacts.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We didn't receive any information about project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Be successful of 42roject.

Thapyay Thar Meeting

42.

Name of Participant: Daw Hnin Yee	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Because of this project, there may be job opportunity.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

43.

Name of Participant: Daw Mar Mar Htay	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Our villagers and families will have benefit because of the project.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

You can implement the project without concern since we don't have concern.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

44.

Name of Participant: U Ngwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It should be opportunity for over village and people.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Our concern is flood.

3. What aspects of the Project would you like to receive more information about?

Our village needs electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want information via village administrator.

Thapyay Thar Meeting

45.

Name of Participant: Daw Zarni Poe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We'd like to say whether benefit or not once the project was successful.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We wish to the success of project but we afraid of air pollution or hazardous gas emission since we lived down-wind of factory.

3. What aspects of the Project would you like to receive more information about?

We cannot criticize since we have little knowledge but Myingyan Township Administrator may know more than us.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Communication related to steel mill workers.

Thapyay Thar Meeting

46.

Name of Participant: U Myo Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We'd like to say whether benefit or not once the project was successful.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We wish to the success of project but we afraid of air pollution or hazardous gas emission since we lived down-wind of factory.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

47.

Name of Participant: U Win Zaw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It is required job opportunity for our village and villagers.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are afraid of flood.

3. What aspects of the Project would you like to receive more information about?

We want electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Information should come via village administrator.

Thapyay Thar Meeting

48.

Name of Participant: U Pyae Phyo Kyaw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It is required job opportunity for our village and villagers.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are afraid of flood.

3. What aspects of the Project would you like to receive more information about?

We want electricity.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Information should come via village administrator.

Thapyay Thar Meeting

49.

Name of Participant: U Sein Lin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think positive impact.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We think no concern.

3. What aspects of the Project would you like to receive more information about?

We want to get information about project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want to be keeping in touch and face to face.

Thapyay Thar Meeting

50.

Name of Participant: Daw Win Maw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that Project will fulfill the needs of village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

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3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Thapyay Thar Meeting

51.

Name of Participant: Daw Thein Shwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that Project will fulfill the needs of village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We think that project will affect positively to the village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings.

Thapyay Thar Meeting

52.

Name of Participant: Daw Win Kyi	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We think that more benefit.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We are concern.

Thapyay Thar Meeting

53.

Name of Participant: U Htay Naing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We think that more benefit.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We are concern.

Thapyay Thar Meeting

54.

Name of Participant: Daw Nyunt Tin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that project will fulfill the needs of village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

The project will benefit to the country and we don't worry about our country.

3. What aspects of the Project would you like to receive more information about?

We don't have question about this project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want to get information face to face meetings.

Thapyay Thar Meeting

55.

Name of Participant: U Hein Htoo	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Our livelihood will be getting better because of project. We need jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want information face to face meetings and keeping in touch.

Thapyay Thar Meeting

56.

Name of Participant: U Myint Lwin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We receive good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want information face to face and keeping in touch.

Thapyay Thar Meeting

57.

Name of Participant: Daw Khin Hnin Wai	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

If we receive financial support, if will be grantee for our children.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We received good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

If project successful, villagers will get jobs.

Thapyay Thar Meeting

58.

Name of Participant: Daw Ohn Mya	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

No

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

59.

Name of Participant: U Tin Maung Swe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I believe there may have more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

Received good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

I like face to face meetings.

Thapyay Thar Meeting

60.

Name of Participant: Daw Zin Thu Htet	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that we will have what our village needs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We think that more benefit will get.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

61.

Name of Participant: Daw Yee Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think it will be more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We received good news for village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We like face to face meeting.

Thapyay Thar Meeting

62.

Name of Participant: Daw Sann	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit will get.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

Thapyay Thar Meeting

63.

Name of Participant: Daw Hnin Soe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We believe that if project is successful, livelihood of local people will be high.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

Waste water may cause health problems.

3. What aspects of the Project would you like to receive more information about?

We want to be win-win project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We want information via village tract administrator.

Thapyay Thar Meeting

64.

Name of Participant: Daw Yee Cho	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We believed that requirements of village will be fulfilled.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We fond of face to face meeting.

Thapyay Thar Meeting

65.

Name of Participant: Daw Nu	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We believed that requirements of village will be fulfilled.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We fond of face to face meeting.

Thapyay Thar Meeting

66.

Name of Participant: Daw Wai Hlaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We believed that requirements of village will be fulfilled.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

Nothing to make question

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We fond of face to face meeting

Thapyay Thar Meeting

67.

Name of Participant: U Kyaw Naing Min	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We believed that requirements of village will be fulfilled.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We are fond of face to face meeting.

Thapyay Thar Meeting

68.

Name of Participant: U Min Zaw Moe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

It can be caused health and economic problems.

3. What aspects of the Project would you like to receive more information about?

No

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

69.

Name of Participant: U Win Shwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to receive good news for the village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

70.

Name of Participant: Daw Hnin Hnin Khaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

I think more benefit.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

71.

Name of Participant: U Sann Lin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

72.

Name of Participant: Daw Thet Thet Zin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

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Thapyay Thar Meeting

73.

Name of Participant: Daw Shwe Kyi	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think more benefit.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

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Thapyay Thar Meeting

74.

Name of Participant: Daw Ni	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I like face to face meeting.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

75.

Name of Participant: Daw Khaing Thazin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We believe that project will fulfill the requirements of village

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

The project will benefit to country.

3. What aspects of the Project would you like to receive more information about?

Nothing to ask.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

76.

Name of Participant: U Soe Pyine	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I believe that project will fulfill the requirements of village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern

3. What aspects of the Project would you like to receive more information about?

We want to get good news for village

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

77.

Name of Participant: U Myint Htay	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I believe that project will fulfill the requirements of village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern

3. What aspects of the Project would you like to receive more information about?

We want to get good news for village

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

78.

Name of Participant: Daw Yee Yee Myint	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

I think that every village can access electricity.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about health.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

79.

Name of Participant: Daw Kyawe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We believe that village will access electricity.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about waste water.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

80.

Name of Participant: Daw Aye San	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission blast.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

81.

Name of Participant: Daw Nyunt Kyi	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission line blast.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No..

Thapyay Thar Meeting

82.

Name of Participant: Daw Thida Aye	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

To get job

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission line blast.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

83.

Name of Participant: Daw Mya Hnin Khaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

To get job

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission line blast.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

84.

Name of Participant: Daw Tin Tin Nu	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think project will fulfill requirements of village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

No

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

85.

Name of Participant: Daw Win New	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We want to get jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We'd like to get good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

86.

Name of Participant: U Pho Thein	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We want to get jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We want to get good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

Thapyay Thar Meeting

87.

Name of Participant: Daw Tin New	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission line blasting.

3. What aspects of the Project would you like to receive more information about?

We want to get good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

Thapyay Thar Meeting

88.

Name of Participant: Daw Aye Khaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission line blasting.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

89.

Name of Participant: U Aung Than	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We are worried about transmission line blasting.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings.

Thapyay Thar Meeting

90.

Name of Participant: Daw Thin Khaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We want to get jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We want to get good news.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

Thapyay Thar Meeting

91.

Name of Participant: Daw Win Maw	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that project will fulfill the requirements of the village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

Thapyay Thar Meeting

92.

Name of Participant: U Min Aye	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We didn't see any negative impact.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

We don't know yet about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

We wish to the success of project.

Thapyay Thar Meeting

93.

Name of Participant: Daw Htay	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

Want to get success.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

94.

Name of Participant: Daw Tin Mar Khaing	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

Want to get success.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

95.

Name of Participant: Daw Nyo	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

To get job

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

96.

Name of Participant: Daw Khin San Nwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

Want to get success.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

97.

Name of Participant: Daw Tin Shwe	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

No.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

No.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

98.

Name of Participant: Daw Ei Ei Win	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We might get that health and social assistances from project.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

There will be air pollution due to the project.

3. What aspects of the Project would you like to receive more information about?

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4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No.

Thapyay Thar Meeting

99.

Name of Participant: Daw Chaw Khin	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

It is require getting jobs.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No

3. What aspects of the Project would you like to receive more information about?

No

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

No

Thapyay Thar Meeting

100.

Name of Participant: U Myint Htay	**Date:2 September 2015**
Village/ Village Tract: Thapyay Thar/ Lingyi	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

We think that project will fulfill the requirements of the village.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

No concern.

3. What aspects of the Project would you like to receive more information about?

We want to get good news for our village.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

Taung Tar Township Final Meeting

1.

Name of Participant: Daw War War Shwe	**Date:3 September 2015**
Village/ Village Tract: Taung Tar Township	**Township:Taung Tar Township**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?
Want to have regional development, job opportunities, education, medical healthcare etc.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

I worried about if the project will implement it may effect dust, pollutant water, emissions, and public health to our villagers.

3. What aspects of the Project would you like to receive more information about?
I want to get the information about this project and social consultation through project responsible person from village level office.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings,
information via village leaders)?
We want to get project information from village level project responsible person.

2.

Name of Participant: Daw Hmaw Hmaw Soe	**Date:3 September 2015**
Village/ Village Tract: Taung Tar Township	**Township: Taung Tar Township**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

If yes, what impacts do you think will occur?

Those items are that we hope from this project; job opportunities, education, health care and water supply, technical support, and rural development.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?
We wonder how to emit pollutant water and dust and also worried about public health. How will impact the environment because of the project?

3. What aspects of the Project would you like to receive more information about?
I want to get the information about this project and social consultation through project responsible person from village level office.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings,

information via village leaders)?

I want to get the information about this project and social consultation through project responsible person from village level office.

3.

Name of Participant: Daw Aye Aye Mon	**Date:3 September 2015**
Village/ Village Tract: Taung Tar Township	**Township: Taung Tar Township**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

If yes, what impacts do you think will occur?

This project will sell the electricity to MEPE that's why we can work with electricity, electricity cut off will lesser than before and getting electricity will more sufficient.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

However we are worried about that the electricity bill will rise than before because of the project.

3. What aspects of the Project would you like to receive more information about?

According to the company explanations, we would like to know that workers' health, accommodations, water and gas emission, those subject implement as they committed or not. We would like to have that's kind of data after finishing the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings,

information via village leaders)?

Face to face meeting is the best way to get information.

4.

Name of Participant: Daw Thandar Lwin	**Date:3 September 2015**
Village/ Village Tract: Taung Tar Township	**Township: Taung Tar Township**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

If yes, what impacts do you think will occur?

Because of the project, Local people can get electricity sufficiently that's why this project will give many advantages.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

We can get electricity is good things however we are worried about the electricity bills it may cost higher than before.

3. What aspects of the Project would you like to receive more information about?

According to the company explanations, we would like to know that workers' health, accommodations, water and gas emission, those subject implement as they committed or not. We would like to have that's kind of data after finishing the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings,

information via village leaders)?

About this project we would like to know from village leaders and face to face meeting in this way we can get the information properly.

5.

Name of Participant: Daw Thet Mar Khine	**Date:3 September 2015**
Village/ Village Tract: Taung Tar Township	**Township: Taung Tar Township**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

If yes, what impacts do you think will occur?

Take a real responsible of CSR programs it will be real beneficent on the household and get job opportunities.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

We worried about that discharge chemicals and oil are improper way and is pollutant water will affect our health after a long period?

3. What aspects of the Project would you like to receive more information about?
Could you please announce job descriptions and salaries for worker in operational period?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings,

information via village leaders)?

It should have a communication officer to contact with local communities. Want to get the information about CSR program and Grievance mechanism and please make sure that the grievance mechanism will be transparency and justice.

6.

Name of Participant: Daw Tin Tin Khine	**Date:3 September 2015**
Village/ Village Tract: Taung Tar Township	**Township: Taung Tar Township**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

If yes, what impacts do you think will occur?

Because of the project, we will get electricity sufficiently. Otherwise my family is run a photography business and garment that's why we will get more improvement than before.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

Nil

4. What aspects of the Project would you like to receive more information about?

Nil

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings,

information via village leaders)?

Nil

7.

Name of Participant:Lt. Mg Mg	**Date:4 September 2015**
Village/ Village Tract: Police organization	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1.Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

NIL

2.Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

Want to get long term benefits from the factory. Proposed project surroundings should be improvement.

3.What aspects of the Project would you like to receive more information about?
We wanted to know how many factories like that in Myanmar work in progress, finished and currently operation .

4.What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Via a village leader , pamphlet & discussion.

8.

Name of Participant: Kyaw Zayar Tun	**Date:3 September 2015**
Village/ Village Tract: High school	**Township: Taung Thar**
District : Myingyan	**Region:**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Local people will get good future. Rare water in this area thus to want to get purify water.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

I hope that the best will happen about vehicle, disease, road and waste from factory .

3. What aspects of the Project would you like to receive more information about?

How will be using benefits from this project for the protection of environment and project effected villages?
Want to upgrade the living standard & don't want to be unnecessary problems.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Project owner should know the opinion of local people and should implement mutual understanding each other.

9.

Name of Participant: Hla Myo Zaw	**Date:3 September 2015**
Village/ Village Tract	**Township:Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

Not only our family but also all local people need this project. If there will not negative impacts ,will good project.

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

Yes. I have concern about crops.

3. What aspects of the Project would you like to receive more information about?
NIL
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

10.

Name of Participant: U Shu Mg	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Sar Kha**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?
It is more prefer f f our village gets Electricity and job opportunities for youth .

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Want to know project information to public.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings

11.

Name of Participant: U Myint Naing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   This project can't get good benefit for our family.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   Crops.

3. What aspects of the Project would you like to receive more information about?
   Is the project will negatively impact to environment?

   NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

12.

Name of Participant: U Tint Sein	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   It will get benefits not only our family not also to the local people .
2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

We are farmers thus we have concern about crops due to the project..According to the waste water there will have soil damage and dangerous of insects.

3. What aspects of the Project would you like to receive more information about?
   We want to get information about not to damage the environment ongoing basis.

   Want to know prevention method during operation time if there will be dangerous situation.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Information via village leaders

13.

Name of Participant: U Chit San Maung	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   Want to get job opportunities.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   I haven't anxiety.
3. What aspects of the Project would you like to receive more information about?
   Want to know project information due to work in progress.
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Information vai leaders.

14.

Name of Participant: U Tin Maung Latt	**Date:3 September 2015**
Thain Village: Phet Taw	Township: Taung Thar
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   Want to get job opportunities and other facilities.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   I want to know how to use waste water and impacts on farmland due to waste water.
3. What aspects of the Project would you like to receive more information about?
   Want to know all good or bad data about the proposed project. How and where to use about electricity from the project,
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meetings and telephone.

15.

Name of Participant: U Mya Win	**Date:2 September 2015**

Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   I think that our family members will get job opportunities according to this project. If we will get job we will comfort in survival, education and also social activities.
2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   Want to get electricity for the village and Will there have noise or any dust? What aspects of the Project would you like to receive more information about?

   Will high heat temperature have?

3. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

16.

Name of Participant: U Aung Gyi	**Date:5 September 2015**
Village/ Village Tract: Hnan	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   Want to get electricity for the village and want to get job opportunities for the villagers.
2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

Can get purify water for village from the factory?

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Want to use pamphlet.

17.

Name of Participant: U Nyan Yin	**Date: 3 September 2015**
Village/ Village Tract: San Oo	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
If yes, what impacts do you think will occur?

NIL

2. Do you have any additional questions or concerns related to the Project?
If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

18.

Name of Participant: U Htun Kyi	**Date:3 September 2015**
Village/ Village Tract Thain	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   .Yes. Will get electricity with full watt power, will upgrade in education and helath.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   NA

3. What aspects of the Project would you like to receive more information about?

   NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Face –to – face meetigs

19.

Name of Participant: U Sein Mg	**Date:3 September 2015**
Village/ Village Tract: Min Su	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   To get electricity, job opportunities and other facilities.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   Concerns about waste water.

3. What aspects of the Project would you like to receive more information about?
   Want to get Irrigation water and drinking water.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

20.

Name of Participant: U Aung Than	**Date:3 September 2015**

Village/ Village Tract: Ward 5	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   To get electricity.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   Want to get purify water from waste water for long terms.

3. What aspects of the Project would you like to receive more information about?
   Want to know detail information which amount can use electric in local & when will finish the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Both face to face meeting and information via village leaders.

21.

Name of Participant: U Tin Myint	**Date:4 September 2015**
Village/ Village Tract: Ward (6)	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   To get electricity and job opportunities.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   NA

3. What aspects of the Project would you like to receive more information about?
   NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   NA

22.

Name of Participant: U Hein Htet	**Date:3 September 2015**
Village/ Village Tract:	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   I think yes.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   NIL
3. What aspects of the Project would you like to receive more information about?
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Explain project to villager's face to face, asking opinions and meetings

23.

Name of Participant: U Aung Kyi Myint	**Date:3 September 2015**
Village/ Village Tract: Township administrative Dept	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   To Get electricity. Please consider reduce in education when appointed in jobs

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?
   Should do coal tar road from factory to Bagan- Nyaung Oo- Myingyin. And then soil lane located in the west of the factory should be coal tar road.
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Important facts: Before building factory should repair the road to coal tar road. Since in the monsoon season there will not go because of waste water.

24.

Name of Participant: U Thein Zaw	**Date:3 September 2015**
Village/ Village Tract:	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
Hope to get electricity.
2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

25.

Name of Participant: U Thaung Hlaing	**Date:3 September 2015**
Village/ Village Tract: No. 4 Taung Thar	**Township: Taung Thar**
District : Myingyin	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Can more use electricity due the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. Waste water and high heat temperature

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

26.

Name of Participant: U Myo Nyunt	**Date:3 September 2015**
Village/ Village Tract: Taung Thar	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Hope to get electricity.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. Waste material especially chemical .

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

27.

Name of Participant: Daw Yi Yi Cho	**Date:4 September 2015**
Village/ Village Tract: NannMyint	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

To get powerful electric instead of compensation. We can do only agriculture thus job from the project will not fit for us.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. Health, dust .And should do systematically for waste matters

3. What aspects of the Project would you like to receive more information about?

Want to know job vacancy requirements in detail.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings

28.

Name of Participant: Daw Sandar Hlaing	**Date:3 September 2015**
Village/ Village Tract: Min Tee	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NIL

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

To get efficient electricity.

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings

29.

Name of Participant: Daw Thidar Aung	**Date:3 September 2015**
Village/ Village Tract: Kyauk Chaw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Hope to get electricity. How much in one unit?

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Want to know job vacancy requirements detail.

3. What aspects of the Project would you like to receive more information about?

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Information via village leaders.

30.

Name of Participant: Daw Khine Zin Htwe	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

I hope that our family will comfort in survival. Want to get job in the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. Air pollution

3. What aspects of the Project would you like to receive more information about?

Want to hear good information about the project.

Face to face meeting.

lated to the Project?

If so, what questions and/ or concerns do you have?

I have concern about Gas Leaking.

3. What aspects of the Project would you like to receive more information about?

We want to get project information every 3 months to the rural leader.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

Hpet Taw Meeting

1.

Name of Participant: Ma Aye Maw	**Date:5 September 2015**
Village/ Village Tract: Hpet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

There will have benefits due to the project. We get to promote the living standard of village.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Not receive more information about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

2.

Name of Participant: Ma Khin San Tint	**Date:3 September 2015**
Village/ Village Tract: Hpet Taw	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

   There will have benefits due to the project. We get to promote the living standard of village.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Not receive more information about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

3.

Name of Participant: Ma Khin Mar Kyi	**Date:5 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

There will have benefits due to the project. We get to promote the living standard of village.

2. Do you have any additional questions or concerns related to the Project?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

To supply electricity and to open rural health center.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

4.

Name of Participant: Daw San	**Date:5 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

There will have benefits due to the project. We get to promote the living standard of village.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Not receive more information about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

5.

Name of Participant: Khin Htwe Kyi	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

There will have benefits due to the project. We get to promote the living standard of village.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Not receive more information about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

6.

Name of Participant: Khin Htwe Kyi	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes because of job opportunities for my educated son and daughter.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Had received from stakeholder meeting.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

7.

Name of Participant: Ma Khin Maw	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**

District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

There will have benefits due to the project. We get to promote the living standard of village.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

Not receive more information about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

8.

Name of Participant: U Kyaw Soe	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes.I think we get more Educational support from the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. I worried about the control of project owner and authorities.

3. What aspects of the Project would you like to receive more information about?

I would like to receive actual information of the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Information via village leaders.

9.

Name of Participant: U Win Kyaing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes I think we get job opportunity from the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. I have concern in Gas emission and exploration.

3. What aspects of the Project would you like to receive more information about?

Not receive more information about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

10.

Name of Participant: Maung Kyaw Swar WIn	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

We need job opportunities.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

Want to be quick implement for the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

11.

Name of Participant: Kyaw Htay Naing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

No

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I have concern about soil pollution.

3. What aspects of the Project would you like to receive more information about?

Air pollution, Heat emission from the project and vibration.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings.

12.

Name of Participant: Soe Aung	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

We hope that we will get job opportunities.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

13.

Name of Participant: Kyaw Khaing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NIL

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

14.

Name of Participant: U Aye Chan	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

No answer.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

No answer.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get **information via village leaders.**

15.

Name of Participant: Aung Thar Lin	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NA

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

16.

Name of Participant:	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Soil pollution.

3. What aspects of the Project would you like to receive more information about?

We want to receive positive impacts from the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

17.

Name of Participant: U Min Naing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes. We think we get job opportunities. If we get job we will have many benefits for the family.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. But we received a lot of positive impact message from the last stakeholder meeting.

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leaders.

18.

Name of Participant: U Tin Maung Aye	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NIL

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Villagers want to be share holder to this project.

3. What aspects of the Project would you like to receive more information about?

Want to get irrigation water from the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

19.

Name of Participant: U Thaung Htay	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

No

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I have concern about Gas Leaking.

3. What aspects of the Project would you like to receive more information about?

We want to get project information every 3 months to the rural leader.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Get information via village leader

20.

Name of Participant: Khin Moe Lwin	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes. To upgrade the living standard.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

To get electricity for the whole rural. Want to upgrade the rural clinic.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting.

21.

Name of Participant: U Soe Tun	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes. We also have both positive and negative impacts from the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. I have concern about negative impacts.

3. What aspects of the Project would you like to receive more information about?

I would like to receive update project information promptly.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

To give education talk to the villagers and to send knowledge books.

22.

Name of Participant: Kyaw Thu Aung	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NIL

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meeting

23.

Name of Participant: U Win Naing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

There will have both positive and negative impacts.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. This stage is early stage.

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

24.

Name of Participant: U Win kyaing	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes. Job opportunities.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Yes. Gas line leaking and exploration.

3. What aspects of the Project would you like to receive more information about?

Want to get job information.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Both face to face meetings and information via leaders.

25.

Name of Participant: U Bo Tin	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes New genearation.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

Want to receive positive impacts.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

26.

Name of Participant: U Ohn Seint	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes New genearation.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

No.

3. What aspects of the Project would you like to receive more information about?

To get detail information.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

27.

Name of Participant: U Tint Sein	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes. Not only our family but also local people.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

No. But I need the waste water from the project to change in useful water for the near villages.

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

28.

Name of Participant: Nyein Nyein	**Date:3 September 2015**
Village/ Village Tract: Phet Taw	**Township\: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Yes . Will get electricity.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

Hnan Ywar Meeting

1.

Name of Participant: U Tun Htwe	**Date:2 September 2015**
Village/ Village Tract: Hnan	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

   If the project can create jobs for families, livelihood will be ok.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

   My wish is that the Farmland through pipe line may be current price.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   There will not have other information.

2.

Name of Participant: U Kyone Taing	**Date:4 September 2015**
Village/ Village Tract: Hnan	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?

   Can project create Job opportunities for the villagers and we want to get electricity for 33 KV and 1000 watt.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   We want to advice that the project should use the professional and there will not negative impacts to the public.

3. What aspects of the Project would you like to receive more information about?
   NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   No answer

3.

Name of Participant: U Kyi Hla	**Date:4 September 2015**
Village/ Village Tract: Hnan	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   No answer

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?
   NIL
3. What aspects of the Project would you like to receive more information about?
   No Answer
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Explain project to villager's face to face, asking opinions and meetings.

4.

Name of Participant: U San Win	**Date:5 September 2015**
Village/ Village Tract: Hnan	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   There will have positive and negative impacts.

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   We are worried about that the environment will impact by the project. We hope that will not have anxiety to the village.

3. What aspects of the Project would you like to receive more information about?
   We hope that the project information will be good for the country.
4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Face to Face meetings

Sa Khar Meeting

1.

Name of Participant: U Myint Lwin	**Date:4 September 2015**
Village/ Village Tract: Sa Khar	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   No Answer

2. Do you have any additional questions or concerns related to the Project? If so, what questions and/ or concerns do you have?

   Heat and air quality

3. What aspects of the Project would you like to receive more information about?

   No Answer

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face-to –Face meetings

Sa Khar Meeting

2.

Name of Participant: Mg Win	**Date:4 September 2015**
Village/ Village Tract;Sar Kha	**Township: Myingyan**
District : Myingyan	**Region: Sar Kha**

1. Do you anticipate the Project to generate any impacts for you and your household? If yes, what impacts do you think will occur?
   We can't tell just now.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

Yes, we have. We get smell of gas and noise.

3. What aspects of the Project would you like to receive more information about?

   How will be using benefits from this project for the protection of environment and project effected villages?

   NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Sa Khar Meeting

3.

Name of Participant: Nyo Nyo San	**Date:4 September 2015**
Village/ Village Tract;Sar Kha	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?

   No

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   Vibration

3. What aspects of the Project would you like to receive more information about?
   No

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   No

Sa Khar Meeting

4.

Name of Participant: Win Win Ei	**Date:4 September 2015**
Village/ Village Tract:Sar Khar	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   I think that all family members in rural will be getting good things according to this project.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

   NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Information vai village leaders

Sa Khar Meeting

5.

Name of Participant: Daw Khin Hnin Myint	**Date:4 September 2015**
Village/ Village Tract: Sar Khar	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   Survival for villagers will be comfort.

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?
   I haven't anxiety about the new factory.

3. What aspects of the Project would you like to receive more information about?
   Is the project will negatively impact to environment?

   No Answer

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?
   Good.

Sa Khar Meeting

6.

Name of Participant: Myo Min Than	**Date:4 September 2015**
Village/ Village Tract: Sa Khar	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?
   If yes, what impacts do you think will occur?
   No Answer

2. Do you have any additional questions or concerns related to the Project?
   If so, what questions and/ or concerns do you have?

   When operation time, there will have vibration and noise.

3. What aspects of the Project would you like to receive more information about?
   We want to get information about not to damage the environment ongoing basis.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

   Face to face meeting

Steel Mill Meeting

1.

Name of Participant: U Min Min Hteik	**Date:4 September 2015**
Village/ Village Tract: Steel Mill	**Township: Myingyan**
District :Myingyan	**Region:Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NIL

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

Nyaung Kan Meeting

Name of Participant: U Win Bo	**Date:5 September 2015**
Village/ Village Tract: Nyaung Kan	**Township: Taung Thar**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

No Answer

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Don't Worry, thank you so much for implementation of this project.

3. What aspects of the Project would you like to receive more information about?

NA

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NA

Gyoke Pin Meeting

1.

Name of Participant: Aung Ko Win	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

NIL

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I want to know what advantage will get for the village.

3. What aspects of the Project would you like to receive more information about?

When the project has successful can project provide the job opportunities for the youth whose will have many knowledge.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face- to- face meetings

2.

Name of Participant: U Soe Nyunt	**Date:4 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Want to be improved for the village according the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Will there have any benefits for the village?

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings

3.

Name of Participant: Mg Kyaw Tin	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Want to be improved for the village according the project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

To get job opportunities for the villagers.

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings

4.

Name of Participant: U Kyaw	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Hope to get wealthy.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

NIL

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

5.

Name of Participant: Mg Kyan Tun	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

I hope that villagers and also people in the country will get benefits.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Will there have any dangerous impacts to the villagers?

3. What aspects of the Project would you like to receive more information about?

NIL

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

6.

Name of Participant: Par Gyi	**Date:4 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**

District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

I am glad because of my family will get job.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

If any information has, I want to know.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

I want to know health information once every month.

7.

Name of Participant: U Myint Thein	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

Our village and other villages are improving because of this project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

Most of the educated youth are getting job due to this project.

3. What aspects of the Project would you like to receive more information about?

I wish that project more successful.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Shared the project information and other knowledge to the public, villagers get many general knowledge with grateful.

8.

Name of Participant: U Kyi Zaw	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

I am glad concerning project.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I haven't anxiety.

3. What aspects of the Project would you like to receive more information about?

I wish that project more successful.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

Face to face meetings

9.

Name of Participant: Yin Yin Win	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

I hope that our family will get good light for the future.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I have anxiety about the air pollution due to the project.

3. What aspects of the Project would you like to receive more information about?

I want to hear good news about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

10.

Name of Participant: Ma Wai	**Date:5 September 2015**
Village/ Village Tract: Gyoke Pin	**Township: Myingyan**
District : Myingyan	**Region: Mandalay**

1. Do you anticipate the Project to generate any impacts for you and your household?

I hope that our family will get good light for the future.

2. Do you have any additional questions or concerns related to the Project?

If so, what questions and/ or concerns do you have?

I have anxiety about the air pollution due to the project.

3. What aspects of the Project would you like to receive more information about?

I want to hear good news about the project.

4. What is your preferred way of receiving information about the Project (e.g. face-to-face meetings, information via village leaders)?

NIL

Annex J

Grievance Log Template

Grievance Log

PART 1 Contact and Details
Complaint number
Number: Date: Recorded by:
Complainant details
Name: Telephone number: Address: Preferred method of contact:
PART 2 **Description of grievance(s)**
Describe the grievance below.
PART 3 **Proposed action(s)**
Describe the proposed response.
Signatures
Recorder: Claimant: Date:

PART 4 Resolution
Describe the steps taken to resolve the grievance and the outcome.
Signatures
Complainant: Project representative: Date:

Annex K

Relevant Criteria and Standards

1 APPLICABLE TECHINCAL STANDARDS AND GUIDELINES

1.1 INTERNATIONAL TECHNICAL STANDARDS

1.1.1 Air Quality

Ambient Air Quality

The *IFC General EHS Guidelines: Air Emissions and Ambient Air Quality* require projects with the potential for significant ambient air quality impacts to prevent or minimise impacts by ensuring that emissions do not result in pollutant concentrations that reach or exceed relevant national legislated ambient air quality guidelines and standards.

According to the *IFC General EHS Guidelines: Air Emissions and Ambient Air Quality*, national air quality standards should be used as the primary assessment criterion ***(Table 1.1***). If the national air quality standard is absent, other international guidelines such as the WHO should be used instead.

Table 1.1 IFC Standards - relating to WHO Standards on Ambient Air Quality

Air Pollution	Averaging Period	Guideline Value in µg m^{-3} [b]
SO_2	24-hour	125 (interim target -1)
		50 (interim target -2)
		20 (guideline)
	10-minute	500 (guideline)
Nitrogen Dioxide	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter less than or equal to 10 microns (PM_{10})	1-year	70 (interim target -1)
		50 (interim target -2)
		30 (interim target -3)
		20 (guideline)
	24-hour [c]	150 (interim target -1)
		100 (interim target -2)
		75 (interim target -3)
		50 (guideline)
Particulate Matter less than or equal to 2.5 microns ($PM_{2.5}$)	1-year	35 (interim target -1)
		25 (interim target -2)
		15 (interim target -3)
		10 (guideline)
	24-hour	75 (interim target -1)
		50 (interim target -2)
		37.5 (interim target -3)
		25 (guideline)
Ozone (O_3)	8-hour daily maximum	160 (interim target -1)
		100 (guideline)

Notes: Extracted from *WBG EHS General Guidelines, Environmental Chapter, Section 1.1, Table 1.1.1 based on World Health Organization (WHO). Air Quality Guidelines Global Update, 2005*.
Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.
PM_{10} 24-hour value is the 99^{th} percentile.

Air emissions

IFC General EHS Guidelines: Construction and Decommissioning

The *IFC General EHS Guidelines: Construction and Decommissioning* recommends measures for controlling fugitive dust from construction works and air emissions from the operation of diesel powered construction equipment. They do not provide any emission standards for specific air quality parameters.

Applicable specific IFC guidelines for the project

IFC EHS Guidelines for Thermal Power Plants

For project uses natural gas as fuel, emissions guidelines in

Table 1.2 are applicable.

Table 1.2 Emission Guidelines for Combustion Turbine (in mg/Nm^3 or as indicated) [a]

Combustion Technology / Fuel	Particulate Matter (PM)		Sulphur Dioxide (SO_2)	Nitrogen Oxides (NO_x)	Dry Gas, Excess O_2 Content (%)
	NDA [b]	DA [b]	NDA/DA	NDA/DA	
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	51 (25 ppm)	15%

Notes:

(a) Extracted from IFC EHS General Guidelines for Thermal Power Plant, Table 6(B), p21 dated December 19, 2008.

(b) NDA: Non Degraded Airshed
DA: Degraded Airshed (poor air quality)
Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly. For detailed notes and explanation refer to IFC EHS General Guidelines for Thermal Power plants, Table 6(B).

1.1.2 Noise

The General EHS Guidelines: Environmental – Noise Management [1] and the General EHS Guidelines: Construction and Decommissioning [2] are relevant to the Project. In assessing noise according to IFC standards, measurements should be undertaken at the noise sensitive receptors located outside the project property boundary. ***Table 1.3*** below presents the prescribed IFC standards on noise impacts in the surrounding industrial and residential areas.

Table 1.3 IFC General EHS Guidelines for Noise Levels at Receptors

Area	Maximum Allowable Noise Level (1 hour) [a] dB(A)	
	Daytime 0700 – 2200 hours	Night-time 2200 – 0700 hours
Residential, institutional, educational	55	45
Industrial/commercial areas	70	70

IFC EH&S Guidelines: Noise Management (April 2007). Available from http://www.ifc.org/wps/wcm/connect/06e3b50048865838b4c6f66a6515bb18/1-7%2BNoise.pdf?MOD=AJPERES

IFC EH&S Guidelines: Construction and Decommissioning (April 2007). Available from http://www.ifc.org/wps/wcm/connect/3aa0bc8048855992837cd36a6515bb18/4%2BConstruction%2Band%2BDecommissioning.pdf?MOD=AJPERES

Note: Noise impacts should not exceed the levels presented in this table, or result in a maximum increase in background levels of 3dBA at the nearest receptor location off-site.

1.1.3 Water Quality

Effluent Standards

The relevant guidelines for properly managing the wastewater generated from project are *IFC General EHS Guidelines: Environmental – Wastewater and Ambient Water Quality* (*Section 1.3*); *construction and decommissioning* (*Section 4*), additional to the applicable specific IFC guidelines including *IFC EHS Guidelines for Thermal Power Plants*.

Table 1.4 IFC Effluent Guidelines Standards for Treated Sanitary Sewage Discharges[(a)]

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total Nitrogen	mg/l	10
Total Phosphorous	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPNb/100 ml	400

Note: [(a)] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[(b)] MPN = Most Probable Number

Table 1.5 IFC Effluent Guidelines Standards for Thermal Power Plants

Parameter	mg/L, except pH and temp.
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium – Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1
Zinc (Zn)	1
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants.

Water Quality for Irrigation

Guidelines for evaluation of water quality for irrigation are given in ***Table 1.6***.

Table 1.6 Guidelines for Interpretation of Water Quality for Irrigation

Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
Salinity(affects crop water availability)2							
	EC_w			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	TDS			mg/l	< 450	450 – 2000	> 2000
Infiltration (affects infiltration rate of water into the soil. Evaluate using ECw and SAR together)3							
SAR	= 0 – 3	and EC_w	=		> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6		=		> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12		=		> 1.9	1.9 – 0.5	< 0.5
	= 12 – 20		=		> 2.9	2.9 – 1.3	< 1.3
	= 20 – 40		=		> 5.0	5.0 – 2.9	< 2.9
Specific Ion Toxicity *(affects sensitive crops)*							
	Sodium (Na)4						
	surface irrigation			SAR	< 3	3 – 9	> 9
	sprinkler irrigation			me/l	< 3	> 3	
	Chloride (Cl)4						
	surface irrigation			me/l	< 4	4 – 10	> 10
	sprinkler irrigation			me/l	< 3	> 3	
	Boron (B)5			mg/l	< 0.7	0.7 – 3.0	> 3.0
	Trace Elements (see Table 21)						
Miscellaneous Effects *(affects susceptible crops)*							
	Nitrogen (NO3 - N)6			mg/l	< 5	5 – 30	> 30
	Bicarbonate (HCO_3)						
	(overhead sprinkling only)			me/l	< 1.5	1.5 – 8.5	> 8.5
	pH				Normal Range 6.5 – 8.4		

Source: FAO (1994) Retrieved from http://www.fao.org/DOCReP/003/T0234e/T0234E01.htm#ch1.4

Drinking Water

WHO guidelines for drinking water quality are given in ***Table 1.7***.

Table 1.7 WHO Guidelines for Drinking-Water Quality

Parameter	World Health Organization
1,2-dichloroethane	"
Acrylamide	"
Antimony	ns
Arsenic	10µg/l
Barium	700µg/l
Benzene	10µg/l
Benzo(a)pyrene	"
Boron	2.4mg/l
Bromate	"
Cadmium	3 µg/l
Chromium	50µg/l
Copper	"
Cyanide	"
Epichlorohydrin	"
Fluoride	1.5 mg/l
Lead	"
Mercury	6 µg/l

Parameter	World Health Organization
Nickel	"
Nitrate	50 mg/l
Nitrite	"
Pesticides (individual)	"
Pesticides — Total	"
Polycyclic aromatic hydrocarbons l	"
Selenium	40 µg/l
Tetrachloroethene and Trichloroethene	40µg/l

Note: Guidelines for Drinking-water Quality, Fourth Edition; World Health Organisation; 2011

1.1.4 Soil

There are no Myanmar soil or groundwater regulations/standards. In the absence of local country standards, it is ERM's practice to use globally recognized 'Dutch Ministry of Public Housing, Land-use and Environmental Guidelines - Soil and Groundwater Standards' to assess soil quality and to determine the need, if any, for remedial action.

Table 1.8 Dutch Standards for Soil Quality

Parameter	LOQ	Standard 1	Standard 2
Oil and Grease			
- Kerosene Range Hydrocarbons	20.8-23.8	N/A	N/A
- Diesel Range Hydrocarbons	20.8-23.8	N/A	N/A
- Heavy Oil Range Hydrocarbons	83.1-95.3	N/A	N/A
- Gasoline Range Hydrocarbons	13.6-16.6	N/A	N/A
- Benzene	0.181-0.221	1	0.01
- Toluene	0.181-0.221	130	0.01
- Ethylbenzene	0.181-0.221	50	0.03
- Xylenes (total)	0.544-0.664	25	0.1
Cadmium (Cd)	1.00	12	0.8
Chromium (Cr)	2.50	380	100
Hexavalent Chromium (Cr^{+6})	0.10	78	N/A
Lead (Pb)	5.00	530	85
Mercury (Hg)	0.10	10	0.3
Nickel (Ni)	2.00	210	35
Selenium (Se)	0.01	100	0.7
Silver (Ag)	1.5	15	N/A
Arsenic	0.0020	55	29
Barium (Ba)	5.00	625	160
Copper (Cu)	1.50	190	36
Iron (Fe)	2.50	N/A	N/A
Manganese (Mn)	1.00	N/A	N/A
Zinc (Zn)	0.50	720	140

Note: Standard 1 adopted are Intervention Values (from Annex A of Circular on Target Values and Intervention Values for Soil Remediation (*Dutch Standards, 2000*))
Standard 2 adopted are Target Values (from Annex A of Circular on Target Values and Intervention Values for Soil Remediation (*Dutch Standards, 2000*))

Annex L

Standard Analytical Methods

Table 1 Analytical Methods for Soil

Parameters	Analytical Method	MRL
pH	Electrometric Method	-
Organic Matter	Walky and Black Method	-
Soil Texture, % Silt, Sand, Clay	Sieve Analysis, Hydrometer Method	-
Available Phosphorous, Avail. P	Bray II Method	-
Exchangeable Potassium, Exch. K	Add NH_3 OAc and Flame AAS Method	-
Exchangeable Calcium, Exch. Ca	Add NH_3 OAc and Flame AAS Method	-
Exchangeable Magnesium, Exch, Mg	Add NH_3 OAc and Flame AAS Method	-
Electrical Conductivity, EC	Electrical Conductivity Method	0.5 dS/m
Salinity	Electrical Conductivity Method	0.0005 dS/m
Chloride, Cl^-	Mercuric Nitrate Method	1.0 mg/kg
Total Nitrogen	Dumas Method	-
Arsenic, As	Hydride Generation AAS Method	0.010 mg/kg
Barium, Ba	Direct Nitrous Oxide-Acetylene Flame Method	5.00 mg/kg
Cadmium, Cd	Direct Air-Acetylene Flame Method	1.00 mg/kg
Total Chromium, Cr	Direct Air-Acetylene Flame Method	2.50 mg/kg
Cr^{6+}	Colorimetric Method	0.10 mg/kg
Lead, Pb	Direct Air-Acetylene Flame Method	5.00 mg/kg
Mercury, Hg	Cold-Vapor AAS Method	0.10 mg/kg
Nickel, Ni	Direct Air-Acetylene Flame Method	2.00 mg/kg
Selenium, Se	Hydride Generation AAS Method	0.010 mg/kg
Silver, Ag	Direct Air-Acetylene Flame Method	1.50 mg/kg
Extractable Copper, Cu	Direct Air-Acetylene Flame Method	1.50 mg/kg
Extractable Iron, Fe	Direct Air-Acetylene Flame Method	2.50 mg/kg
Extractable Manganese, Mn	Direct Air-Acetylene Flame Method	0.15 mg/kg
Extractable Sulpher, S	Turbidimetric Method	-
Extractable Zinc, Zn	Direct Air-Acetylene Flame Method	0.50 mg/kg
TPH-Dext		
- Kerosene Range Hydrocarbons (C_{10}-C_{14})	Gas Chromatography Method	21.8-27.7 mg/kg
- Diesel Range Hydrocarbons (C_{15}-C_{28})	Gas Chromatography Method	21.8-27.7 mg/kg
- Heavy Oil Range Hydrocarbons (C_{29}-C_{36})	Gas Chromatography Method	87.1-111.0 mg/kg
TPH-Gas+BTEX		
- Gasoline Range Hydrocarbons (C_5-C_{12})	Gas Chromatography Method	15.6-19.8 mg/kg
- Benzene (C_6)	Gas Chromatography Method	0.208-0.264 mg/kg
- Toluene (C_7)	Gas Chromatography Method	0.208-0.264 mg/kg
- Ethylbenzene (C_8)	Gas Chromatography Method	0.208-0.264 mg/kg
- Xylenes (C_9)	Gas Chromatography Method	0.625-0.793 mg/kg
Polycyclic Aromatic Hydrocarbons (PAHs)		
- 1 –Methylnaphthalene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- 2-Methylnaphthalene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Acenaphthene	Gas Chromatography/Mass	5.3-7.4 µg/kg

Parameters	Analytical Method	MRL
	Spectrometry Method	
- Acenaphthylene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Anthracene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Benzo[a]anthracene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Benzo[a]pyrene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Benzo[b]fluoranthene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Benzo[g,h,i]perylene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Benzo[k]fluoranthene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Chrysene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Dibenz(a,h)anthracene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Fluoranthene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Fluorene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Indeno[1,2,3-cd]pyrene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Naphthalene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Phenanthrene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg
- Pyrene	Gas Chromatography/Mass Spectrometry Method	5.3-7.4 µg/kg

Note: MRL means Method Reporting Limit
dS/m means deciSiemens per metre
mg/kg on dry weight basis
µg/kg on dry weight basis

Table 2 Analytical Methods Ambient Air Quality

Parameters	Averaging Time	Sampling/Analytical Method	MRL
TSP	24-hour	High Volume Air Sampler, Gravimetric Method	0.1 mg
PM10	24-hour	Size Selective, High Volume Air Sampler, Gravimetric Method	0.1 mg
CO	8-hour	CO Analyzer, Non Dispersive Infrared Method	0.1 ppm
NO_2	1-hour	NO_2 Analyzer, Chemiluminescence Method	0.1 ppb
SO_2	24-hour	SO_2 Analyzer, Ultraviolet Fluorescense Method	0.1 ppb
SO_2	1-hour	SO_2 Analyzer, Ultraviolet Fluorescense Method	0.1 ppb
Wind Speed and Wind Direction		Wind Vane and Cup Anemometer	0.5 m/s

Note: MRL means Method Reporting Limit

Table 3 Analytical Methods Ambient Noise Quality

Parameter	Sampling Method	MRL
L_{eq} 1 hr	Integrated Sound Level Meter	28 db(A)
L_{eq} 24 hr		
L_{dn}		
L_{10}		
L_{90}		
L_{max}		

Note: MRL means Method Reporting Limit

Table 4 Analytical Methods for Surface Water Quality

Parameter	Container	Preservation Method	Analytical Method	Preserved Duration	MRL
Physical Properties					
Temperature	P, G	-	Field Method	in situ	-
pH	P, G	-	Electrometric Method	in situ	-
Electrical Conductivity (EC)	P, G	-	Electrical Conductivity Method	in situ	0.5 µS
Salinity	P, G	-	Electrical Conductivity Method	in situ	-
Total Dissolved Solids (TDS)	P, G	Stored cold at 4°C	Dried at 180 °C	7 days	50 mg/l
Total Suspended Solids (TSS)	P, G	Stored cold at 4°C	Dried at 103-105 °C	7 days	2.5 mg/l
Chemical Properties					
Biochemical Oxygen Demand (BOD)	P, G	Stored cold at 4°C	5-day BOD Test, Azide Modification Method	48 hours	-
Dissolved Oxygen (DO)	G	Preserved with $MnSO_4$ and AIA 2 ml	Azide Modification Method	8 hours	-
Inorganic Substances					
Alkalinity, HCO_3^-, CO_3^{2-}	P, G	Stored cold at 4°C	Tritation Method	14 days	1.0 mg/l as $CaCO_3$
Ammonia Nitrogen, NH_3-N	P, G	Add H_2SO_4 to pH<2 and store cold at 4°C	Phenate Method	28 days	0.010 mg/l
Chloride, Cl^-	P, G	-	Mercuric Nitrate Method	28 days	1.0 mg/l
Cyanide, CN^-	P, G	Add NaoH to pH>12 and store cold at 4°C	Pyridine Barbituric Acid Method	14 days	0.005 mg/l
Nitrate Nitrogen, NO_3^--N	P, G	Stored cold at 4°C	Cadmium Reduction Method	48 hours	0.010 mg/l
Phosphate, PO_4^{3-}	P, G	Add H_2SO_4 to pH<2 and store cold at 4°C	Ascorbic Acid Method	28 days	0.005 mg/l
Sulfate, SO_4^{2-}	P, G	Stored cold at 4°C	Turbidimetric Method	28 days	1.0 mg/l
Metals					
Calcium, Ca	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Nitrous Oxide-Acetylene Flame Method	6 Months	0.02 mg/l
Magnesium, Mg	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.003 mg/l
Potassium, K	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.01 mg/l
Sodium, Na	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.01 mg/l
Barium, Ba	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Nitrous Oxide-Acetylene Flame Method	6 Months	0.10 mg/l

Parameter	Container	Preservation Method	Analytical Method	Preserved Duration	MRL
Cadmium, Cd	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.00005 mg/l
Total Chromium, Cr	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.0005 mg/l
Copper, Cu	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.03 mg/l
Iron, Fe	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.05 mg/l
Lead, Pb	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.002 mg/l
Manganese, Mn	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.02 mg/l
Mercury, Hg	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Cold-Vapor AAS Method	28 days	0.0003 mg/l
Nickel, Ni	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.0005 mg/l
Zinc, Zn	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame Method	6 Months	0.01 mg/l
Arsenic, As	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Hydride Generation AAS Method	6 Months	0.0002 mg/l
Selenium, Se	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Hydride Generation AAS Method	6 Months	0.0002 mg/l
Total Petroleum Hydrocarbons					
- TPH-Dext					
- Kerosene Range Hydrocarbons (C_{10}-C_{14})	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	7 days	0.250 mg/l
- Diesel Range Hydrocarbons (C_{15}-C_{28})	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	7 days	0.250 mg/l
- Heavy Oil Range Hydrocarbons (C_{29}-C_{36})	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	7 days	0.500 mg/l
- TPH-Gas+BTEX					
- Gasoline Range Hydrocarbons (C_5-C_{12})	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	400 µg/l
- Benzene (C6)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	4.00 µg/l
- Toluene (C7)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	4.00 µg/l
- Ethylbenzene (C8)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	4.00 µg/l
- Xylenes (C9)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	12.0 µg/l

Parameter	Container	Preservation Method	Analytical Method	Preserved Duration	MRL
Biological Properties					
Total Coliform Bacteria, TCB	P, G	Store cold at 4°C	Multiple Tube Fermentation Technique Method	24 hours	1.8 M.P.N./100 ml
Fecal Coliform Bacteria, FCB	P, G	store cold at 4°C	Multiple Tube Fermentation Technique Method	24 hours	1.8 M.P.N./100 ml

Note : MRL means Method Reporting Limit
P means plastic bottle
G means glass bottle
G* means glass bottle with Teflon lined caps

Source: STS Green (2014)

Table 5 Analytical Methods for Groundwater Quality

Parameter	Container	Preservation Method	Analytical Method	Preserved Duration	MRL
Physical Properties					
Temperature	P, G	-	Field Method	in situ	-
pH	P, G	-	Electrometric Method	in situ	-
Electrical Conductivity, EC	P, G	-	Electrical Conductivity Method	in situ	0.5 µS
Salinity	P, G	-	Electrical Conductivity Method	in situ	-
Total Dissolved Solids, TDS	P, G	Stored cold at 4°C	Dried at 180 °C	7 days	50 mg/l
Total Suspended Solids, TSS	P, G	Stored cold at 4°C	Dried at 103-105 °C	7 days	2.5 mg/l
Chemical Properties					
Inorganic Substances					
Chloride, Cl^-	P, G	-	Mercuric Nitrate Method	28 days	1.0 mg/l
Cyanide, CN^-	P, G	Add NaoH to pH>12 and store cold at 4°C	Pyridine Barbituric Acid Method	14 days	0.005 mg/l
Metals					
Arsenic, As	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Hydride Generation AAS Method	6 Months	0.0002 mg/l
Barium, Ba	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Nitrous Oxide-Acetylene Flame AAS Method	6 Months	0.10 mg/l
Cadmium, Cd	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.00005 mg/l
Total Chromium, Cr	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.0005 mg/l
Copper, Cu	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame AAS Method	6 Months	0.03 mg/l
Iron, Fe	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame AAS Method	6 Months	0.05 mg/l
Lead, Pb	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.002 mg/l
Manganese, Mn	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Direct Air-Acetylene Flame AAS Method	6 Months	0.02 mg/l
Mercury, Hg	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Cold-Vapor AAS Method	28 days	0.0003 mg/l
Nickel, Ni	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Electrothermal AAS Method	6 Months	0.0005 mg/l
Selenium, Se	P, G	Add HNO_3 to pH<2 and store cold at 4°C	Hydride Generation AAS Method	6 Months	0.0002 mg/l
TPH-Dext					
- Kerosene Range Hydrocarbons (C_{10}-C_{14})	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	7 days	0.250 mg/l

Parameter	Container	Preservation Method	Analytical Method	Preserved Duration	MRL
- Diesel Range Hydrocarbons (C15-C28)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	7 days	0.250 mg/l
- Heavy Oil Range Hydrocarbons (C29-C36)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	7 days	0.500 mg/l
TPH-Gas+BTEX					
- Gasoline Range Hydrocarbons (C_5-C_{12})	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	400 µg/l
- Benzene (C_6)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	4.00 µg/l
- Toluene (C_7)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	4.00 µg/l
- Ethylbenzene (C_8)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	4.00 µg/l
- Xylenes (C_9)	G*	Add HCl to pH<2 and store cold at 4°C	Gas Chromatography Method	14 days	12.0 µg/l

Note : MRL means Method Reporting Limit
P means plastic bottle
G means glass bottle
G* means glass bottle with Teflon lined caps

Source: STS Green (2014)

Annex M

Risk and Disaster Management Plan

Sembcorp Industries Limited

Risk & Disaster Management Plan for a green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar

August 2015

Reference: 0284993

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Sembcorp Industries Limited

Risk & Disaster Management Plan for a green-field Combined Cycle Gas Turbine Power Plant in Myingyan, Myanmar

August 2015

Reference 0284993

Prepared by: Adrien Au-Yeung/ Thomas Wu
Checked by: Kim Tran

For and on behalf of ERM-Hong Kong, Limited	
Approved by:	Herve Bonnel
Signed:	Bonnel
Position:	Partner
Date:	28 August 2015

This report has been prepared by ERM-Hong Kong, Limited with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

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APPENDIX A QRA INPUT DATA

APPENDIX B QRA RECOMMENDATIONS

Sembcorp Industries Limited (Sembcorp) has been selected by the Ministry of Electric Power (MOEP) of the Government of Myanmar (GOM) as a private sector Independent Power Producer (IPP) to develop a 225 MW Combined Cycle Gas Turbine (CCGT) Power Plant on a Build, Operate and Transfer (BOT) basis in Myingyan Township, in the Mandalay region in Union Republic of Myanmar.

The Project Site is located approximately 8 km south of the Myingyan Township, on a predominately green field site adjacent to an existing steel mill (Myingyan Steel Mill No. 4) owned by the Ministry of Industry (MOI).

The Project Site was acquired by the GOM and the registered land owner is MOI. The Majority of this MOI-owned land is occupied by the existing steel mill infrastructure which was commissioned in 2007. The northern part was allocated for the Power Plant

Environmental Resources Management (ERM), and independent HSE consultancy, has been commissioned by Sembcorp to carry out an ESIA Study for the proposed CCGT Power Plant and relevant Project Facilities. This report presents the Risk and Disaster Management Plan (RDMP).

The Project will invest and establish an efficient form of CCGT Power Plant which was designed for high reliability and efficient operation with lower environmental impact, operating with Natural Gas as its only fuel. Project Facilities include:

- 225 MW CCGT Power Plant;
- Gas Supply Pipeline;
- 230 kV Overhead Transmission Line; and
- Water Supply Pipeline, Wastewater Discharge Pipeline and Water Intake Pumping Station.

There is also an existing 95 MW temporary Gas-fired Power Plant located within the Project Site boundary operated by Aggreko. The temporary Gas-fired Power Plant comprises of 92 gas engines rated at 1.3 MW each (119 MW in total), and the generated power is supplied is supplied to the Myingyan Township via the existing 132 kV Overhead Transmission Line. The temporary Gas-fired Power Plant will be decommissioned once the new CCGT Power Plant is in operation.

The purpose of the report is a document prepared by the operator with a management plan to

1. demonstrate that accident prevention policy has been provided and a safety management system has been put in place to implement the policy;

2. demonstrate that major accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences;

3. demonstrate that safety and reliability have been incorporated into the design & construction, operation & maintenance of those installations related to its operation, and which are linked to major accident hazards within the management plan; and

4. demonstrate that emergency plans have been draw up and that the operator is supplying information to enable the off-site plan to be drawn up in order to take the necessary measures in the event of a major accident.

This Risk and Disaster Management Plan identified and highlighted the potential risks associated with the natural gas (Fuel Gas), the risk mitigation and management techniques and the systems that are in place to control and manage the installations in the safe way. The risks of the fuel gas facilities were evaluated both qualitatively and quantitatively by ERM with the results included in this report.

The following conclusions are made in this Risk and Disaster Management Plan:

Conclusions

A major accident prevention policy has been provided and a safety management system has been put in place to implement the policy. As the CCGT Power Plant project is in the preliminary design stage, preliminary hazard identification has been performed on the power plant. Studies such as HAZID, HAZOP and QRA studies will be performed as the project proceeds into the EPC stage. Some measures have been put in place to minimize the risk of hazardous events; general recommendations have been made to further supplement the measures currently considered. Safety and reliability have been considered in the design, construction, operation and maintenance of the CCGT power plant. Emergency plans have been developed as detailed in project documents and some recommendations have been made to the plans.

Recommendations

Recommendation 1: all pipes and equipment should be suitably coated against external corrosion. Also, lagging should be provided with removable panel to facilitate routine inspection of the condition of the pipework surface. (Refer to *section 4.1.1*)

Recommendation 2: Area around the gas supply pipeline and valve stations should be zone-classified and access-controlled to eliminate any source of ignition. (Refer to *section 4.1.1*)

Recommendation 3: Consider implementing a HEMP (Hazard and Effects Management Process) to identify and manage the major accidental hazards. (Refer to *section 4.1.1*)

Recommendation 4: a Quantitative Risk Assessment (QRA) needs to be performed during EPC stage for the Power Plant in order to evaluate the risk due to the explosion events to the On-site, Off-site population as well as the adjacent facilities. The Emergency Response Plan needs to be updated in order to take into account these explosion events. (Refer to *section 4.1.2*)

Recommendation 5: a HAZID for commissioning/ start-up can be performed during EPC stage in order to identify all potential risk due to these operations. (Refer to *section 4.1.2*)

Recommendation 6: Layout study should be conducted to assess adequacy of separation distances from major hazard installations to sensitive equipments, buildings and emergency assembly area locations. (Refer to *section 4.1.3*)

Recommendation 7: Comprehensive soil investigation survey is recommended to investigate ground settlement / subsidence risk. (Refer to *section 4.2.4*)

Recommendation 8: The design of the Power Plant should be such that the impacts due to severe earthquakes are minimized. (Refer to *section 4.2.5*)

Recommendation 9: Ensure sufficient coverage of Fire & Gas Detectors. Ensure sufficient coverage of fire fighting system such as hydrants, monitors, etc. (Refer to *section 6.2.2* and *6.2.5*)

Recommendation 10: Primary emergency communication system should be available with emergency response teams and local authority personnel involved with emergency response. Secondary / alternative emergency communication system should also be available for emergency response. (Refer to *section 6.2.8*)

Recommendation 11: Safety and reliability of the CCGT power plant should be review regularly during the design, construction, and operational phases.

1 INTRODUCTION

1.1 BACKGROUND

Sembcorp Industries Limited (Sembcorp) has been selected by the Ministry of Electric Power (MOEP) of the Government of Myanmar (GOM) as a private sector Independent Power Producer (IPP) to develop a 225 MW Combined Cycle Gas Turbine (CCGT) Power Plant on a Build, Operate and Transfer (BOT) basis in Myingyan Township, in the Mandalay region in Union Republic of Myanmar.

The Project Site is located approximately 8 km south of the Myingyan Township, on a predominately green field site adjacent to an existing steel mill (Myingyan Steel Mill No. 4) owned by the Ministry of Industry (MOI).

The Project Site was acquired by the GOM and the registered land owner is MOI. The Majority of this MOI-owned land is occupied by the existing steel mill infrastructure which was commissioned in 2007. The northern part was allocated for the Power Plant

Environmental Resources Management (ERM), and independent HSE consultancy, has been commissioned by Sembcorp to carry out an ESIA Study for the proposed CCGT Power Plant and relevant Project Facilities. This report presents the Risk and Disaster Management Plan (RDMP).

Brief Facility Description

The Project will invest and establish an efficient form of CCGT Power Plant which was designed for high reliability and efficient operation with lower environmental impact, operating with Natural Gas as its only fuel. Project Facilities include:

- 225 MW CCGT Power Plant;
- Gas Supply Pipeline;
- 230 kV Overhead Transmission Line; and
- Water Supply Pipeline, Wastewater Discharge Pipeline and Water Intake Pumping Station.

Details of Project Facilities are provided in *Section 3*.

There is also an existing 95 MW temporary Gas-fired Power Plant located within the Project Site boundary operated by Aggreko. The temporary Gas-fired Power Plant comprises of 92 gas engines rated at 1.3 MW each (119 MW in total), and the generated power is supplied is supplied to the Myingyan Township via the existing 132 kV Overhead Transmission Line. The temporary Gas-fired Power Plant will be decommissioned once the new CCGT Power Plant is in operation.

The project site location and a Layout of the Project Facilities are provided in *Figure 1.1* and *Figure 1.2*.

1.2 BASIS OF THE REPORT

This Risk and Disaster Management Plan is written for the new CCGT Power Plant. This report has been prepared in accordance with "The Control of Major Accident Hazards Regulations 1999" (UK). The purpose of the report is a document prepared by the operator with a management plan to

1. demonstrate that accident prevention policy has been provided and a safety management system has been put in place to implement the policy;

2. demonstrate that major accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences;

3. demonstrate that safety and reliability have been incorporated into the design & construction, operation & maintenance of those installations related to its operation, and which are linked to major accident hazards within the management plan; and

4. demonstrate that emergency plans have been draw up and that the operator is supplying information to enable the off-site plan to be drawn up in order to take the necessary measures in the event of a major accident.

This Risk and Disaster Management Plan identified and highlighted the potential risks associated with the natural gas (Fuel Gas), the risk mitigation and management techniques and the systems that are in place to control and manage the installations in the safe way. The risks of the fuel gas facilities were evaluated both qualitatively and quantitatively by ERM with the results included in this report.

1.3 APPROACH

The above purpose is assessed in this report by the following approach:

1. Presenting information on the management plan with potential of causing major accidents;

2. Describing the major accident prevention policy, and the associated safety management system to implement the policy, in particular the following;

   (a) Safety management system organisation;

   (b) Safety goals and standards;

(c) The system for hazards identification;

(d) Operational control;

(e) Safety trainings to employees on-site;

(f) Emergency planning;

(g) Performance monitoring, audit and review

3. Demonstrating the major hazards have been identified, and measures have been provided to control or limit the consequences of hazards;

4. Demonstrating that emergency response measures have been planned to limit the consequences in case of a major accident hazards occurs.

This Risk and Disaster Management Plan is based on the studies, information and procedures which have been done throughout the development of the project and are presented in the following parts of this report.

During this Design Stage, some documents and studies are not available. This document will need to update in next stage in order to take into account the progress of the project.

1.4 STUDY BASIS

Study basis of this report has been listed as follows,

The following information forms the basis for this Risk and Disaster Management Plan:

- Project Emergency Preparedness & Response Plan for Proposed Development of the Myingyan Gas-fired Combined Cycle Power Project, Revision 0 [1]
- Project HSE Manual, Hazard / Aspect Identification, Risk / Impact Assessment and Risk Controls, P2-01, Revision 6[2]
- Health, Safety, Security and Environment Plan (HSSE Plan) for Proposed Development of Myingyan Gas-fired Combined Cycle Power Project – Myanmar [3]
- Project HSE Plan Rev.01 [4]
- Environmental Resources Management, Myingyan CCGT ESIA Chapter 2, Process Description and Alternatives [9]

Figure 1.1 Project Site Location [9]

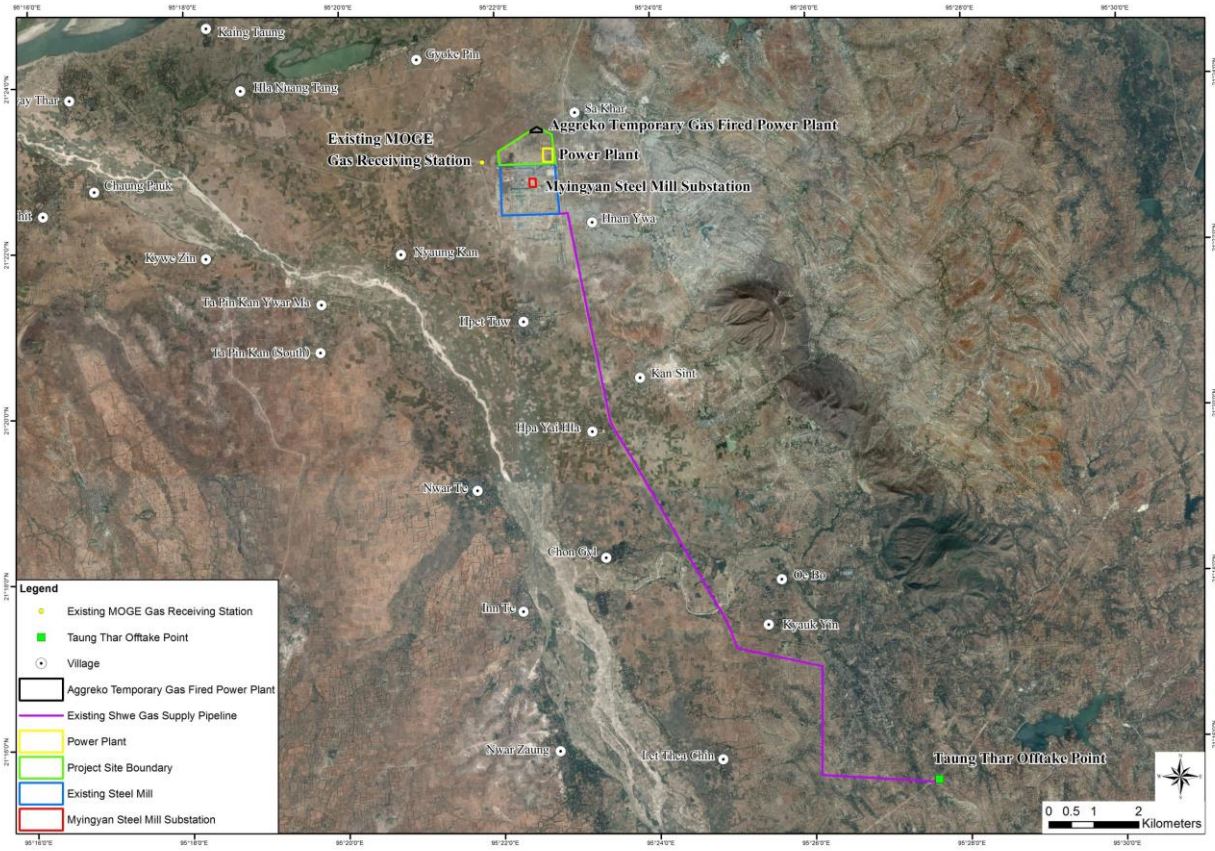
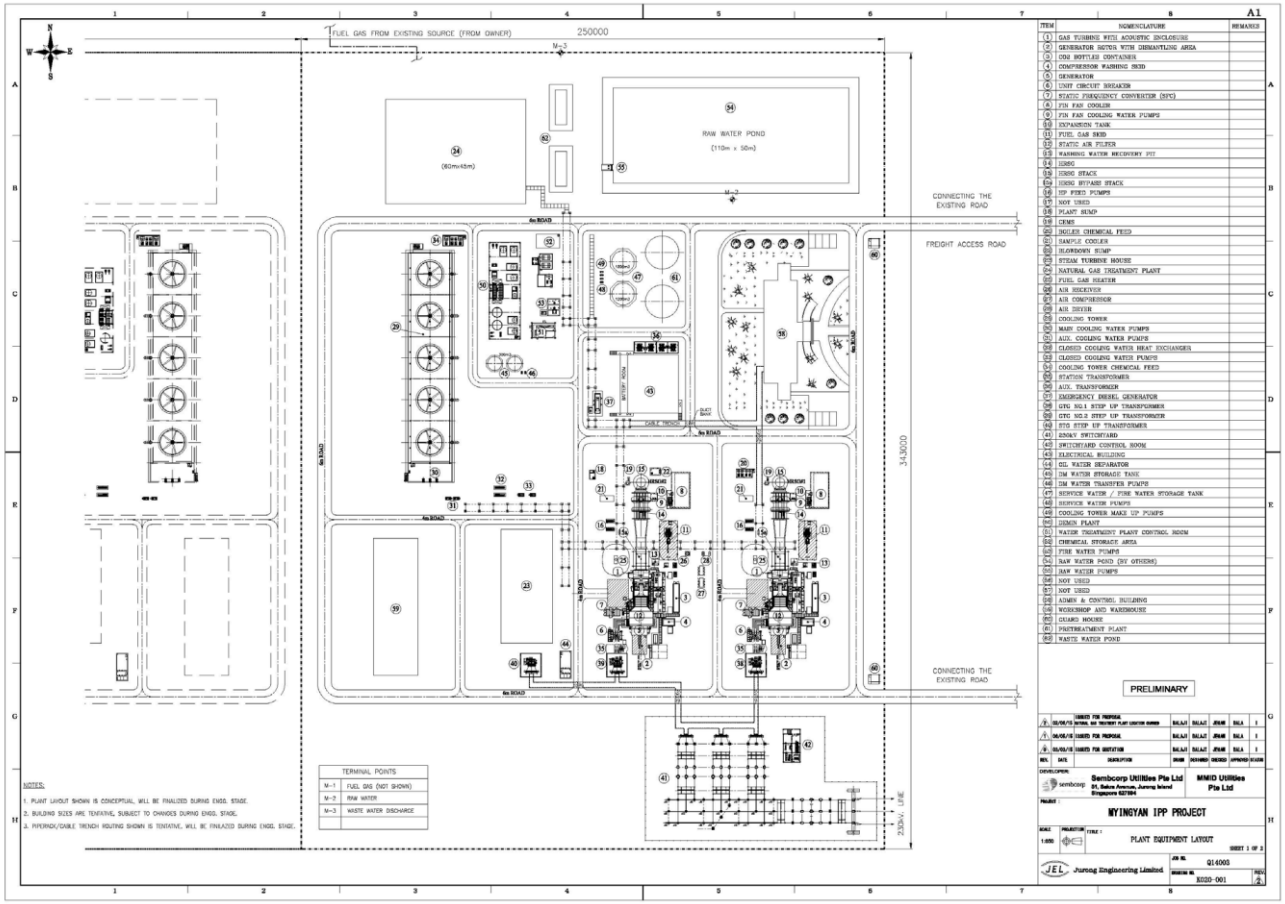


Figure 1.2 CCGT Power Plant Layout of Project Facilities [9]



2 *ABBREVIATIONS*

ALARP	As Low As Reasonably Practicable
BOT	Build Operate and Transfer
BU	Business Unit
CCGT	Combined Cycle Gas Turbine
COSHH	Control of Substances Hazardous to Health
ERM	Environmental Resources Management
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESIA	Environmental and Social Impact Assessment
GOM	Government of Myanmar
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HR	Human Resources
HRSG	Heat Recovery System Generator
HSE	Health, Safety and Environment
HSSE	Health, safety, security and environment
ID	Identification
IMS	Integrated Management System
IPM	Integrated Procedure Manual
IPP	Independent Power Producer
LOTO	Lock Out / Tag Out
LTIR	Lost Time Incident Rate
MOEP	Ministry of Electric Power
MOGE	Myanma Oil and Gas Enterprise
MOI	Ministry of Industry
MW	Mega Watts
OGP	International Association of Oil & Gas Producer
OHSAS	Occupational Health & Safety Advisory Services
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PM	Project Manager
PPE	Personal Protective Equipments
PTT	Pre-Task Talk
PTW	Permit-to-Work
QRA	Quantitative Risk Assessment
RA	Risk Assessment
RM	Risk Management
SDS	Safety Data Sheet
Sembcorp	Sembcorp Industries Limited
SOC	Safe Operations Committee
SWP	Safe Work Procedures
TRIR	Total Recordable Incident Rate
UK	United Kingdom
WMS	Work Method Statement
WSH	Workplace Safety and Health

3 OVERVIEW OF THE SEMBCORP GAS-FIRED CCGT POWER POINT

3.1 PROJECT LOCATION AND SURROUNDING ENVIRONMENT

The Project site is located approximately 8km, south of Myingyan Township, Mandalay region in the Union Republic of Myanmar as shown in Figure 3.1.

The Power Plant will be located on a predominately green field site. The Project site is located adjacent to an existing steel mill (Myingyan Steel Mill No.4), owned by Ministry of Industry (MOI).

The Project site was acquired by the GOM and the registered land owner is MOI. The majority of this MOI-owned land is occupied by the existing steel mill infrastructure which was commissioned in 2007. The northern part was allocated for the Power Plant as shown in Figure 1.1. The Project site was cultivated farmland prior to acquisition of the land by the GOM and is currently dominated by sparse shrubby vegetation.

The following 5 villages are located in close proximity (3km radius from the Project site boundary), as shown in Figure 1.1:

- Sa Khar village;
- Hnan Ywa village;
- Hpet Taw village;
- Nyaung Kan village; and
- Gyoke Pin village.

In addition, there are 2 villages located in close proximity to the proposed water intake pumping station, which are Thien Ywa and Tha Pyay Thar village.

The Ayeyarwady River is located approximately 14km west of the Project site boundary. There is an existing gas pipeline (Shwe Gas Supply Pipeline), approximately 18km in length which runs from the Taung Thar offtake point to an existing MOGE gas receiving station within the Project site boundary. The location of the Ayeyarwady River and Shwe Gas Supply Pipeline is shown in Figure 1.1. To the north, south and west of the Project site boundary is the agricultural area, to the east is an existing dirt road.

3.1.1 *Existing Steel Mill Facilities*

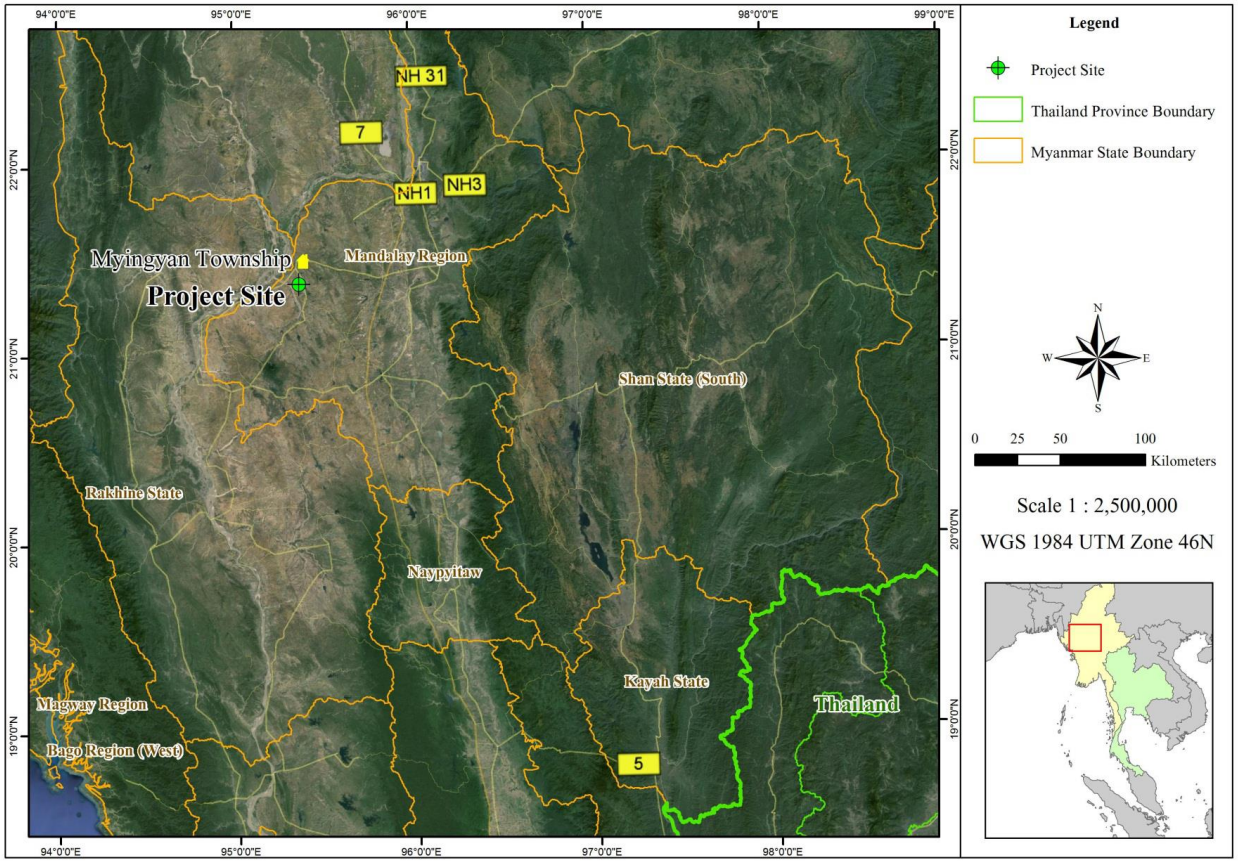
The existing Steel Mill produces approximately 200,000 tonnes per year of billets and slabs from recycled material such as scrapped metals and cars. It is currently undergoing expansion (Steel Mill Phase 2) to increase capacity with

upgraded sub-station (to be connected to both the steel mill and the Power Plant), melt shop, direct reducing plant and rolling mill.

3.1.2 Aggreko Temporary Gas-Fired Power Plant

In addition, there is an existing 95MW temporary gas-fired power plant located within the Project site boundary (see Figure 1.1) operated by Aggreko. The temporary gas-fired power plant began operation in April 2015 and comprises 92 gas engines rated at 1.3MW each (119MW total). The generated power is supplied to Myingyan town substation via the existing 132kV overhead transmission line. The temporary gas-fired power plant will be decommissioned once the CCGT Power Plant is in operation.

Figure 3.1 Location of the Project Site within Myanmar [9]



3.2 PROJECT FACILITIES AND ASSOCIATED FACILITIES

3.2.1 Project Facilities

The Project components are presented below and include Project Facilities (shown in *Figure 3.2*) and Associated Facilities. *A* total area of approximately 16 hectares (ha) is allocated for the Project facilities with the following facilities:

- ***225MW Combi*ned Cycle Gas Turbine *Power Plant*** (approx. 9 ha) comprising of the following main components:
    - 2 sets of Gas Turbine (GT) units;
    - 2 sets of Heat Recovery System Generator (HRSG);
    - 1 steam turbine generating unit with associated auxiliary equipment;
    - Switchyard area;
    - Cooling Water System;
    - Demineralised Water System; and
    - Wastewater Treatment Facility.
- ***Gas Supply Pipeline*** (approx. 0.2 ha) connecting the new MOGE gas receiving station to the Power Plant (approximately 1km in length). MEPE/MOGE will build the new MOGE gas receiving station and the Sponsor will build new gas supply pipeline from delivery point at the outlet of the MOGE gas skid to the Power Plant.
- ***230kV Overhead Transmission Line*** (approx. 5 ha) connecting the Power Plant to the upgraded Myingyan Steel Mill sub-station located within the steel mill complex (approximately 2.5km in length).
- ***Water Supply Pipeline and Wastewater Discharge Pipeline*** (approx. 2 ha) connecting the Power Plant to the water intake point and new Pumping Station at the Ayeyarwady River. The water supply pipeline will be approximately 14km in length. The wastewater discharge pipeline will connect the Power Plant to the existing irrigation canal (approximately 3km in length). The wastewater pipeline will be run in parallel with the water supply pipeline. Both pipelines will share the 2m easement.

3.2.2 Associated Facilities

The new MOGE gas receiving station (see *Figure 3.4*) to be installed by MEPE/MOEP for connection of the gas supply pipeline to the Power Plant is regarded as an associated facility.

In addition, the transmission connection beyond the upgraded Myingyan Steel Mill sub-station will be GOM's responsibility and therefore is classified as associated facility. The connection beyond the Myingyan Steel Mill sub-station transmission line is not known at this stage.

The Project components are described in the following sections.

3.2.3 225 MW CCGT Power Plant

The Power Plant is designed to operate continuously, either in simple cycle mode or in combined cycle mode. During simple cycle operation, the flue gas from the gas turbine will exit via the bypass stack to the atmosphere. During normal combined cycle operation, the heat of exhaust gas will be admitted to the HRSG where superheated steam will be produced which will drive the steam turbine to generate electrical power. The exhaust gas from the HRSG will be released from the main stack of the HRSG to the atmosphere.

The HRSG is designed for 3 pressures with reheat steam generation (High Pressure (HP), Intermediate Pressure (IP), Reheat (RH) and Low Pressure (LP)) used to maximize energy transfer from the exhaust gas of the gas turbine. The HP steam generated by the HRSG will be fed to the HP steam turbine and the reheat and LP steam will be fed to the LP steam turbine.

The power output is approximately 143MW during simple cycle and 225MW during combined cycle operation. The Power Plant will use natural gas as the only fuel.

The indicative layout of the Power Plant is shown in *Figure 3.2*. In addition, the Process Flow Diagram of the Power Plant is shown in *Figure 3.3*.

Gas Turbine

The GE 6F.03 heavy duty, multi-shaft gas turbine is selected for this Project. The configuration of this selected gas turbine is a multi-shaft, bolted rotor with the generator connected to the gas turbine through a speed reduction gear at the compressor or "cold" end. This feature provides for an axial exhaust to optimize the plant arrangement for combined cycle application.

The Power Plant will be operated based on grid dispatch instructions. The Power Plant will be declared available for full load in normal case. If one gas turbine is offline the other gas turbine in full load and steam turbine (50%) will be declared available. The Power Plant is capable for house load operation. In case of any trip, the Power Plant could be started within 2 hours any one of the gas turbines.

Two gas turbine units will be installed for the Project. The gas turbines will be installed within an acoustic, ventilated enclosure with fire detection and protection systems. The gas turbines will have all associated ancillary equipment and systems required for the safe, efficient and reliable operation of the unit under simple and combined cycle operation.

The gas turbine generator (GTG) specification for each unit is shown in *Table 3.1*.

Table 3.1 Gas Turbine Generator Specification

Feature	Specifications
Model/Type	GE 6F.03
Fuel system	Gas only
Starting Means	Static Frequency Converter
Air filtration	Static type
Compressor/Turbine Cleaning	On and Off-line Compressor Water Wash
Exhaust System	Axial
Emissions Control	Gas – Dry Low NOx
Fire Detection	Heat Detectors
Gas Leak Detection	Gas detectors
Fire Protection	High pressure CO2 System
Off-Base Acoustic Enclosure	Turbine and Load Gear Compartments
On-Base Acoustic Enclosure	Lube oil and Gas module Compartments

Source: Sembcorp, 2015

The GTG's will be installed outdoors as shown in *Figure 3.2*. The GTG's will be capable of operation with their exhaust gases passing into the associated heat recovery steam generator, or as simple open cycle turbine generators, exhausting directly to atmosphere via an exhaust gas damper and the bypass stacks associated with each gas turbine (30m in height), located on the exhaust ducting upstream of the heat recovery boiler.

All cooling requirements for the turbine shall be met using heat exchangers, fed from the Closed Circuit Water (CCW) system.

Control of emissions of NOx will be achieved by Dry Low NOx (DLN) burners.

Audible and visual alarms will be located in the supervised areas in the Local Packaged Electrical and Electronic Control Compartment (PEECC). In addition, a Fire Detection System (FDS) will be installed at each gas turbine.

Heat Recovery Steam Generator (HRSG)

As one of the main units in a CCGT power plant, the two HRSG's (boilers) will be a natural circulation horizontal type HRSG with a three pressure with reheat system and an integral deaerator with no duct burners. The HRSG's will be combined with the gas turbines. The HRSG's are designed for exhaust gas conditions of the gas turbines fuelled with natural gas.

Steam generated by the HRSG's will enter the steam turbine. The High Pressure (HP), Reheat (RH) and Intermediate Pressure (IP) steam from the

HRSG's is sent to the steam turbine. Exhaust steam from the steam turbine will then enter into the condenser. The exhaust gas leaving the HRSG's will be routed to the HRSG stacks (40m in height).

The HRSGs will be sized to operate over the full range of ambient temperatures specified. The HRSGs consists of an economizer, evaporator, and super-heater tube bank section(s) with finned tubing, as appropriate, to maximize heat transfer. No supplemental firing facilities will be installed.

All pressure parts will be designed, manufactured and will be tested in accordance with "ASME Boiler and Pressure Vessel Code, Section 1, Power Boilers" or equivalent standards.

The HRSG specification is provided in *Table 3.2*.

Table 3.2 HRSG Specification (at design condition)

Feature	Specifications
HP steam rating	85.0 t/h
HP steam pressure	14.4 MPa(a)
HP steam temperature	568 °C
IP steam rating	17.0 t/h
IP steam pressure	2.27 MPa(a)
IP steam temperature	300°C
LP steam rating	10.4t/h
LP steam pressure	0.4 MPa(a)
LP steam temperature	290°C
Feature	Specifications

Source: Sembcorp, 2015

Steam Turbine

The steam turbine is a separate High Pressure (HP) and Low Pressure (LP) cylinder structure. The selected steam turbines are:

- HP: multistage/bleeding/backpressure type; and
- LP: multistage/bleeding/condensing type.

Each rotor is composed with groups (drums) of reaction stages. Both turbines are equipped with 2 (two) inlet flanges positioned in the head. The live steam flows through the emergency stop valves and the mass flow is regulated by control valves, which throttle all the steam flow; such valves are directly bolted to, and installed inside, the inlet section of turbine external casing for HP turbine, or installed separately on steam piping for LP turbine.

HP steam turbine has a downward radial exhaust flange, and LP steam turbine has an axial exhaust discharge flange. The steam turbine exhaust and condenser configuration will be in accordance to manufacturer's standard design.

The Steam Turbine Generator (STG) will be of proven design and complete with all auxiliary oil and steam systems. The STG will be installed indoors for

environmental protection (e.g., dust and rains) and to provide acoustic attenuation. The STG building will include an overhead travelling crane suitable for lifting the maximum heavy load for normal maintenance activities and suitable indoor laydown areas for plant maintenance. The STG specifications are outlined in *Table 3.3*.

Table 3.3 Steam Turbine Generator Specifications

Feature	Specifications
Rated out power	90 MW (to be determined)
Rated power factor	0.8 (lagging)
Rated rotation	3000 r/min
Rated frequency	50 Hz
Phase number	3
Cooling mode	TEWAC (Totally Enclosed Water-To-Air Cooled)
Insulation class	Class F (temperature rise as per Class B)
Exciting mode	Static Excitation System

Source: Sembcorp, 2015

3.2.4 Gas Supply Pipeline

Currently, the existing Steel Mill facility offtakes the gas from the Shwe gas pipeline, which is a Government-built gas supply pipeline. The gas supply pipeline from Taung Thar offtake point (on Shwe gas supply pipeline) is approximately 18km in length and connects to an existing MOGE gas receiving station located to the northwest of the steel mill built by the Government. This existing MOGE gas receiving station has been used to receive and supply gas to the steel mill and the existing onsite Aggreko temporary gas-fired power plant.

MOGE will install a new gas receiving station adjacent to the existing MOGE gas receiving station to supply gas to the Power Plant. The Project will build a new gas supply pipeline approximately 1km in length from the outlet of the new MOGE gas receiving station to the Power Plant (see *Figure 3.4*).

Design of the gas pipeline will be as per ANSI B 31.8: Gas Transmission and Distribution Systems. The class rating will be as per the final discharge pressure from MOGE new gas receiving station and will be either ANSI Class 300 or Class 600. Welding of pipeline will be as per API Standard 1104. The gas supply pipeline will be buried and have a minimum cover of 1.0m on top of it. Cathodic protection will be in place for the buried section of the pipeline and the design will be based on soil resistivity.

A natural gas supply and treatment system will be installed at the Power Plant to meet the required gas quality and pressure specified by the gas turbine manufacturer. The natural gas system will include backup metering equipment and all necessary, gas filter-separators, isolation and control valves, safety valves, and other equipment. The gas analysis is provided in Table 2.4.

Table 3.4 Shwe Gas (Natural Gas) Composition

Component	Mole Percent	BTU Gross	Relative Density
C6 + 47/35/17	0.0199	1.05	0.0007
Propane	0.0297	0.75	0.0005
i-Butane	0.0109	0.36	0.0002
n-Butane	32.2 ppm	0.11	0.0001
i-Pentane	49.7 ppm	0.20	0.0001
n-Pentane	0.0000	0.00	0.0000
Nitrogen	0.2218	0.00	0.0021
Methane	99.5529	1007.81	0.5514
Carbon Dioxide	0.0491	0.00	0.0007
Ethane	0.1073	0.00	0.0011
TOTAL	100.0000	1012.18	0.5570

3.2.5 230kV Overhead Transmission Line

The proposed 230kV overhead transmission line alignment is approximately 2.5km in length and will be located between the generator transformer at the Power Plant and the upgraded Myingyan Steel Mill sub-station located within the steel mill complex. The proposed alignment is to the east of the Project boundary shown in *Figure 3.5*.

Connection beyond the upgraded Myingyan Steel Mill sub-station is GOM's responsibility. The connection beyond the upgraded Myingyan Steel Mill is not known at this stage.

3.2.6 Water Supply Pipeline and Waste water Discharge Pipeline

The proposed water supply pipeline alignment is approximately 14km in length and will run from the Power Plant along an existing irrigation channel connecting to the Ayeyarwady River for water intake (see *Figure 3.6*). The proposed alignment is surrounded by predominantly agricultural/modified land and some shrubs. The proposed alignment is expected to go underneath several existing dirt paths and roads including the Nyaung U-Myingyan highway.

Land required for the water supply pipeline would be minimal as the majority of the water supply pipeline will be located along the existing irrigation channel.

There is an existing floating pump house for supply of water for irrigation, located at the irrigation channel intake on the Ayeyarwady River. Due to capacity requirements, this pump house is considered to be unsuitable insufficient for supplying water to the proposed Project and a new pump house will be constructed by the Sponsor. The pumps will be located on a floating pontoon with shed.

In terms of social features, the proposed alignment avoids crossing existing villages. Near the outlets on the Ayeyarwady River the water supply pipeline is expected to have several communities of the Tha Pyay Thar village on either

side of the proposed alignment and pass through the south of Hla Naung Taung village (see Figure 2.2).

The proposed wastewater discharge alignment is approximately 3km in length and will run alongside the water supply pipeline from the Power Plant to the existing wastewater channel (see Figure 3.6).

3.3 PROJECT LIFE CYCLE

3.3.1 Construction Phase

Construction is expected to start in the first quarter of 2016 and be complete in the region of 22.5 months with commercial operation targeted at the first quarter of 2018.

Construction activities of the Project will include: mobilisation, site clearance, onshore construction of all Project components, Nyaung Hla jetty reinforcement and commissioning. Heavy equipment such as bulldozers, excavators, dump trucks, compactors, etc. will be used at the Project site.

The normal construction hours are anticipated to be 10 hours per day, 6 days per week.

3.3.2 Operational Phase

The start of operation is anticipated for the first quarter of 2018. Simple cycle operation will occur during the first five months of operation before the combined cycle plant is complete.

The anticipated workforce during operation is shown in *Table 3.5*

Table 3.5 Anticipated Workforce during Operation

Description	Staff Number
Permanent Staff	48
Security (external)	12
Contract staff: Cleaners, Gardeners and helpers	10
Contract staff: Technical hands	10
Maintenance (once every 3 years)	90 for 30 days

The operational working hours / shift structures will be as follows:

- 12 hours per shift with 4 shift teams;
- 2 days shift 1 day off, 2 nights shift 3 days off (including sleeping off);
- 1 shift charge, 1 unit controller and 2 field technicians per shift; and
- 18 staffs will be in the shift roaster

Emergency Diesel Generators

The Power Plant will have one emergency diesel generator with a capacity 800kWh that will be used during plant safe shutdown. The diesel will be transported appropriately to the Project site using Material Safety Data Sheets (MSDS) from diesel suppliers in Myanmar. The diesel generator will be the stationary emergency type and will consist of control gear, lubricating oil system, fuel day tank, cooling system, direct current (DC) starting power and synchronizing equipment, and electrical protection system equipment. Following an emergency shutdown at the power plant, the diesel generators will provide electrical power to maintain the turbine generator unit and its auxiliaries in safe conditions. The diesel generator will not exceed operation for more than 2 hours which is considered to be sufficient.

Fire Protection System

The Power Plants fire protection system will provide personnel safety and plant protection through prompt detection, alarm and suppression of a fire. The system will be designed for any single design basis fire and will be in accordance with all local applicable codes and standards. The primary source of water for the system shall be from the plant's water system.

Power Plant Maintenance

During operation, maintenance will be associated with the following:

- Breakdown Maintenance;
- Planned Preventive Maintenance;
- Routine Maintenance; and
- Scheduled Preventive Maintenance.

3.3.3 Decommissioning Phase

The design life of the power plant is estimated to be 25 years. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided the required retrofits and new emission rates meet the applicable standards and guidelines.

If retrofitting is not feasible and the operational life of the Power Plant expires, the Power Plant will be decommissioned according to the requirements of the authorities at that time according to best industry practices.

Figure 3.2 Project Facilities [9]



Figure 3.3 Process Flow Diagram of the CCGT Power Plant [9]

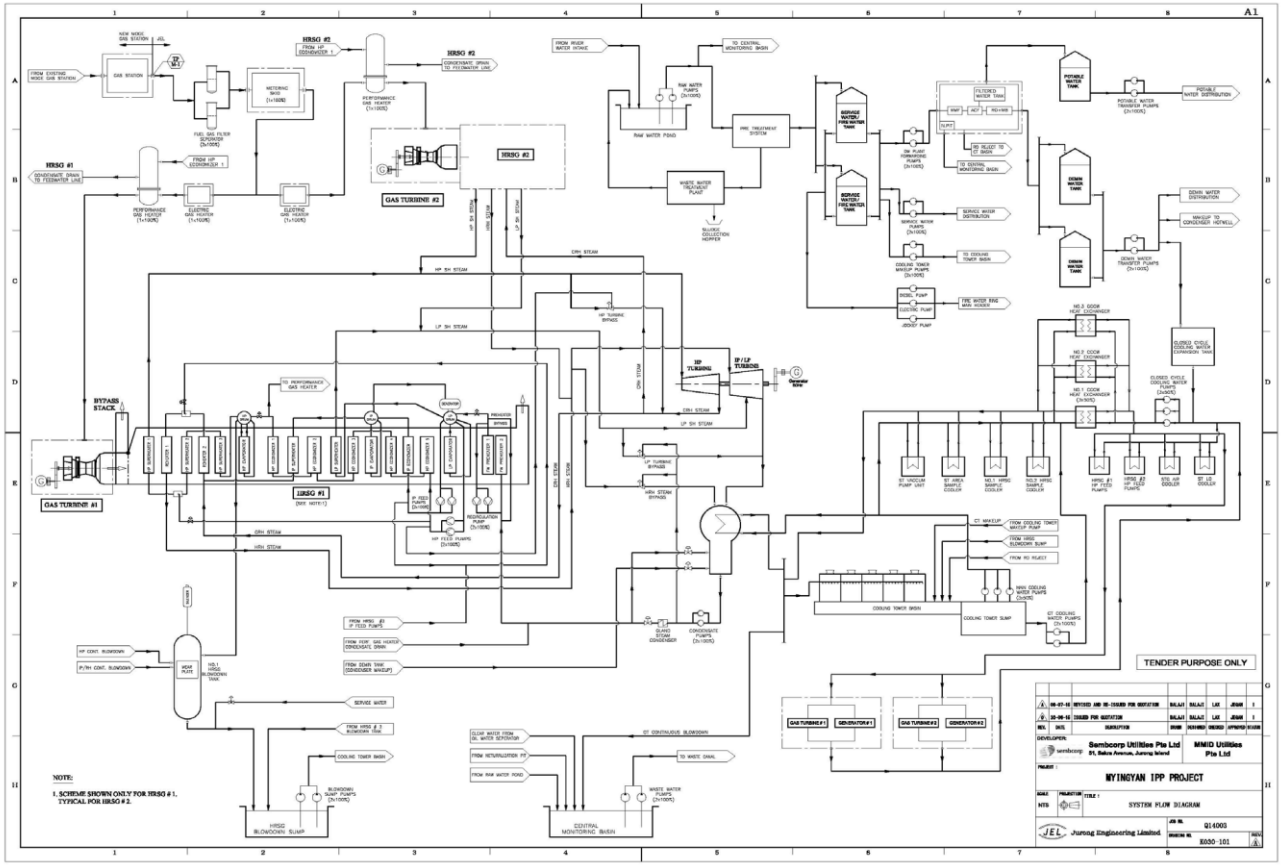


Figure 3.4 Proposed Alignment of Gas Supply Pipeline from New MOGE Gas Receiving Station to the Power Plant [9]

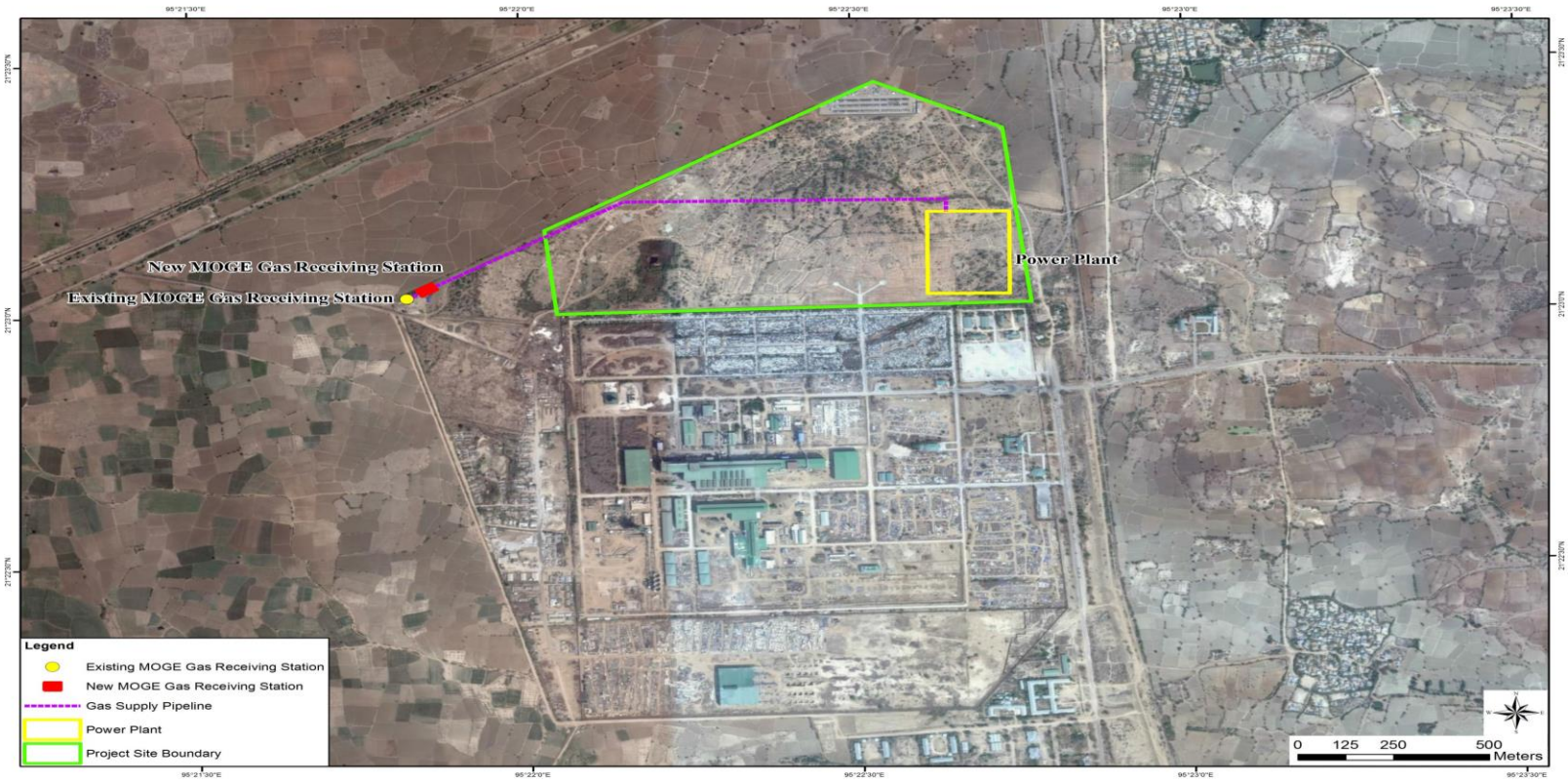


Figure 3.5 Proposed Alignment 230kV Overhead Transmission Line Route from Power Plant to Upgraded Myingyan Steel Mill sub-station [9]

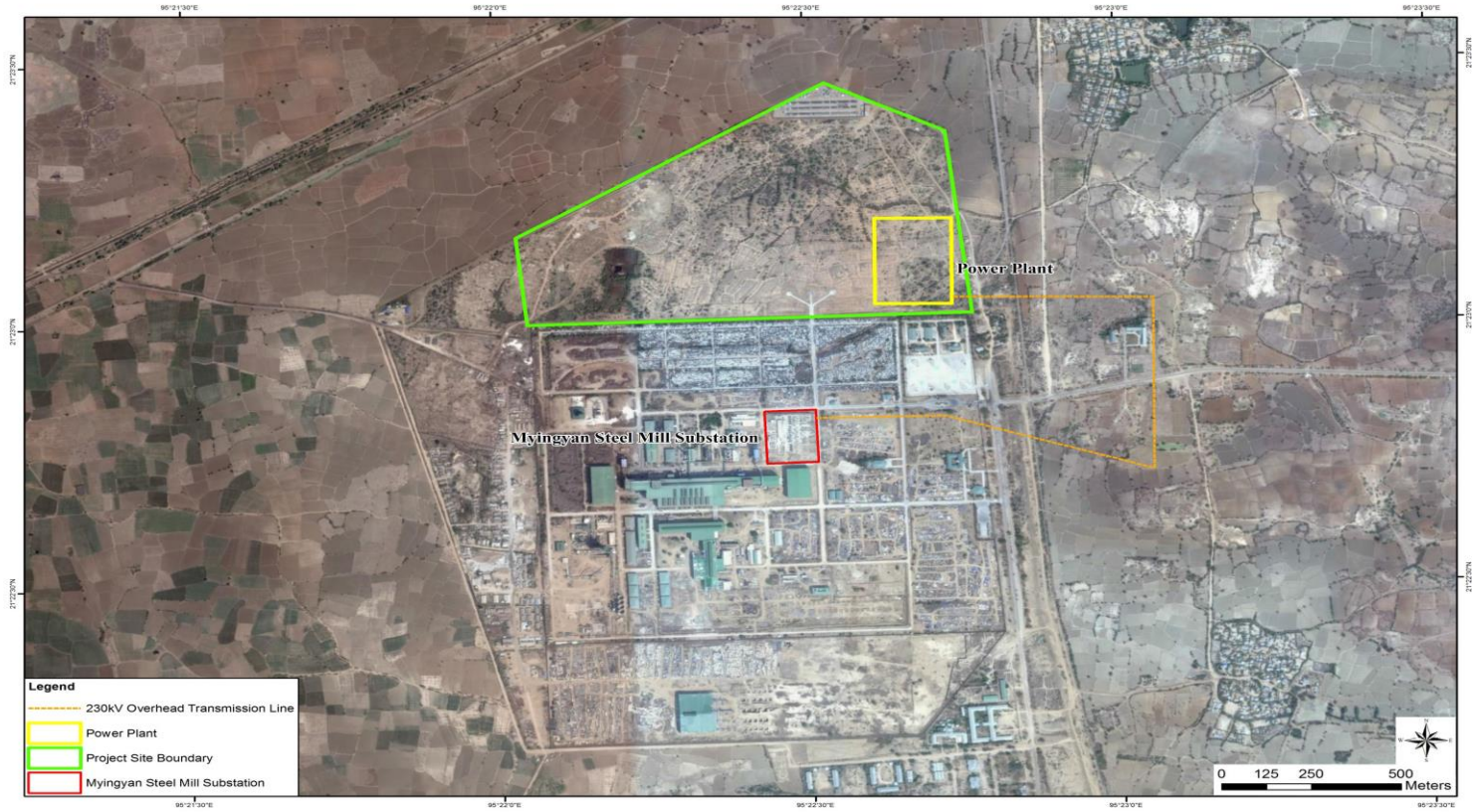


Figure 3.6 Proposed Alignment of Water Supply Pipeline from the Power Plant to the Ayeyarwady River Water Intake Point and Wastewater Discharge Pipeline [9]



3.4 DANGEROUS SUBSTANCES IN USE

The major dangerous substances (DS) on site had been identified to be:

- Shwe Gas (Natural Gas);
- Diesel Oil
- Various package dangerous substances (in Chemical Storage House, such as acids, alkalis, compressed gases, solvents, etc.)

The properties of natural gas and diesel oil are briefly described in *Table 3.6*.

Table 3.6 Properties of Natural Gas and Diesel Oil

	Natural Gas	**Diesel Oil**
Physical State	Gas	Liquid
Molecular weight	19.5	Varies
Density (kg/m^3)	0.7 – 0.9	820 – 950
Boiling Point	-161.	288 – 338
Flash Point	N.A.	>66
Flammable Limits (%)	5 – 15	1.6 - 6
Auto-ignition Temperature (°C)	580	210

3.4.1 *Natural Gas*

Hazards

Methane, the primary component of NG, is colourless, odourless, tasteless, and is an asphyxiant (meaning that if a significant quantity NG is present, there will be insufficient oxygen to breathe). NG is not easy to detect because it is odourless.

At a 5% concentration of gas in air, NG is at the Lower Flammability Limit (LFL). Below this gas/air ratio, the gas is too dilute for ignition, and fire or explosion cannot occur. Also, at a 15% concentration NG is at its Upper Flammability Limit (UFL). Above this gas/air ratio, the mixture is too rich to ignite.

3.4.2 *Diesel Oil*

Diesel Oil is stored onsite to provide an alternative fuel for emergency diesel engine generator, emergency diesel generator in the event of non-availability of NG. Diesel has a relatively high flash point (>52°C), which is above ambient temperature, and a high boiling point. Thus, evaporation from a liquid pool is expected to be minimal. The major hazard arising from diesel ignition is therefore considered to be pool fire. As the diesel oil is only used during emergency condition and the amount stored in the storage tank is not high, 4,000L/month, the likelihood and hazardous consequence is considered minimal.

3.4.3 *Other Dangerous Goods On-site*

In addition to natural gas and diesel oil, several dangerous substances are stored and handled at Sembcorp CCGT Power Plant. These are summarised in *Table 3.7.*

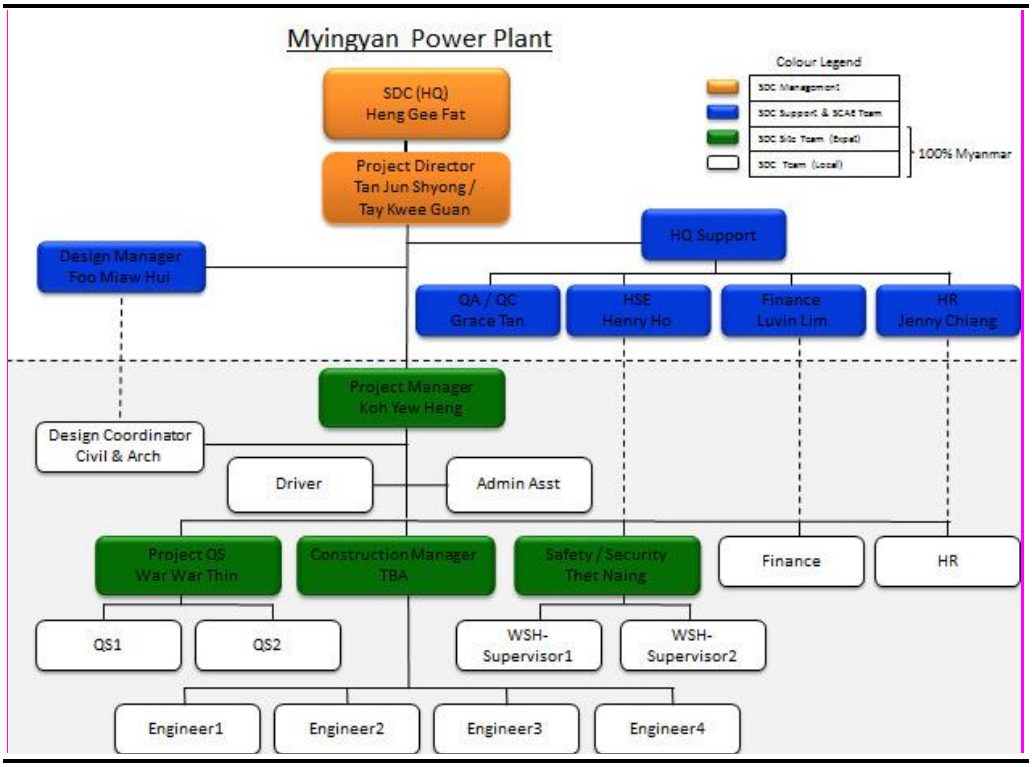
Table 3.7 Hazardous Materials during Operation

Hazardous Material	Hazardous Material	Hazardous Material	Hazardous Material
Oxygen Scavenger	Chemical Dosing System	Chemical Storage House	1m3
Phosphates	Chemical Dosing System	Chemical Storage House	1m3
Fouling Agent	Chemical Dosing System	Chemical Storage House	1m3
Anti-corrosion	Chemical Dosing System	Chemical Storage House	1m3
Biocides	Chemical Dosing System	Chemical Storage House	1m3
Hydrochloric Acid	Chemical Dosing System	Chemical Storage House	3m3
Sodium Hydroxide	Chemical Dosing System	Chemical Storage House	3m3
Sodium Hydroxide	Water Treatment System and Demineralised Water System	Chemical Storage House	10m3
Hydrogen Chloride	Water Treatment System and Demineralised Water System	Chemical Storage House	10m3

3.5 *ORGANISATION AND MANAGEMENT STRUCTURE OF SEMBCORP GAS-FIRED CCGT POWER PLANT*

At the moment of construction stage, Sembcorp gas-fired CCGT power plant is managed by the Sembcorp Design and Construction Pte (SDC) management team and is aided by the SDC support team and local SDC teams as shown in *Figure 3.7.* The organisation and management structure at the operation phase has not yet been formed as the project is in an early development stage.

Figure 3.7 Project Organisation Chart



4 POTENTIAL MAJOR ACCIDENT HAZARDS SCENARIOS

This section will identify the potential Major Accident Hazards (MAH) scenario that could happen in the CCGT Power Plant. The relevant hazards and current mitigation measures employed will be identified in general terms. Potential techniques to be used to further identify the specific accident scenarios and recommendations to mitigations measures will be provided.

4.1 ON-SITE MAJOR ACCIDENT HAZARDS

4.1.1 Leakage of Fuel Gas

Possible Incidents Involving Fuel Gas Leakages

The gas facilities may suffer a spontaneous failure or damage to gas pipework or equipment that results in a loss of containment of the fuel gas. Whenever there is a loss of containment of fuel gas, there is a danger of a fire or an explosion occurring if a source of ignition is present. To a certain extent, leaking gas will disperse naturally or can be dispersed by mechanical ventilation, but even a moderate leakage rate may generate a flammable gas cloud that can ignite. The downwind distance that flammable gas might reach depends on the volume of FG leaked, the rate of the leak, the prevailing weather conditions and source of ignition. Depending on these factors, the ignition of the gas may result in:

- A flash fire (a short duration fire of an isolated gas cloud);
- A jet fire (a fire that burns back to its source and continues burning); or
- An explosion.

Flash fires will injure personnel and can cause extensive damage, if within a confined or congested space. The effect of a flash fire on a person caught within it is often fatal. Flash fires may occur in unconfined clouds of FG. The combustion normally occurs only within portions of the cloud where the gas/air mixture is within the flammability limits, rather than the entire cloud. Where there is a continuing source of gas leakage the fire will normally flash back to the source of the leakage and continue to burn. Where this source of leakage is significant and gas is escaping at high velocity, a jet fire will result. This can burn intensely and, if it impinges on adjacent pipework or equipment, has the potential to cause considerable damage in a relatively short time.

Jet fires can cause severe damage, but generally only within the local area of the flame. There is a danger of secondary incidents arising as a result of damage to nearby equipment.

An explosion can result under certain conditions, but a specific gas and air mixture must exist and it is generally thought that a degree of confinement and congestion is necessary for a significant explosion to occur. Explosions are therefore less likely than fires.

Potential Areas or Processes of Gas Leakages

Gas incidents can arise in the following areas:

- Gas Supply Pipeline, Gas Treatment Plant and MOGE Gas Receiving Station

  This equipment is constructed in areas entirely within Sembcrop's control, and so third party damage is unlikely. Also, the equipment is remote from other parts of the plant, and unlikely to be affected by other incidents onsite. The equipment is designed and built to the ASME Code, and maintenance has been scheduled, thus equipment failure should be infrequent. Part of the feasible modes of failure have been analysed in the QRA study for gas supply pipeline, as described in *section 4.4.*

  The potential sources of leakage are joints on piping, valves and instruments. Spontaneous failure due to stress or fatigue in pipework is also possible. External corrosion is a possible cause of failure.

  However, as the fuel gas facilities operate at relatively high pressures (about 30 barg onshore), a sizable leak can potentially occur. Any fire that results from this will be intense and will damage adjacent facilities, and so escalate the events to a more serious situation.

- Gas equipment at CCGT Power Plant during opening for maintenance

  If equipment containing NG is opened, a flammable mixture of gas and air may be formed, posing a potential fire and explosion risk. The risk is particularly great in areas where ignition sources may be present.

  Conversely, NG equipment that has been opened and then closed up for returning to service will be contaminated with air. Thus, an explosive mixture may form inside when NG is reintroduced. These risks can be mitigated by purging.

- Turbine units

  This equipment is designed and constructed to the same standards to ASME code. Again, leakage from joints is the most likely scenario. However, secondary failure due to some other incident within the turbine halls is possible.

  Any significant leak will require immediate shutdown of the unit to minimize the risk of fire and explosion.

- Inventory of NG in the Processing Equipment

In the event of a leak within CCGT, once the processing equipment has been isolated (e.g. by operation of the ESD valves at the MOGE gas receiving station), the total inventory remains in the system may still lead to flammable effects as described above.

Recommendations

Based on the identified potential MAH, additional safeguards are recommended to enhance the mitigation means against MAH:

- Recommendation 1: all pipes and equipment should be suitably coated against external corrosion. Also, lagging should be provided with removable panel to facilitate routine inspection of the condition of the pipework surface.
- Recommendation 2: Area around the gas supply pipeline and valve stations should be zone-classified and access-controlled to eliminate any source of ignition.
- Recommendation 3: Consider implementing a HEMP (Hazard and Effects Management Process) to identify and manage the major accidental hazards.

4.1.2 Explosions

Incorrect operation or incidents during work on FG equipment poses a significant risk. Several possible scenarios are as follows:

- Internal explosion in the flare stack due to ingress of air and subsequent ignition;
- Internal explosion in the gas turbine combustor due to incorrect start-up procedures;
- Internal explosion in other parts of the plant due to gas ingress and subsequent ignition; or
- Vapour Cloud Explosion in congested areas from gas facilities.

Recommendations

- Recommendation 4: a Quantitative Risk Assessment (QRA) needs to be performed during EPC stage for the Power Plant in order to evaluate the risk due to the explosion events to the On-site, Off-site population as well as the adjacent facilities. The Emergency Response Plan needs to be updated in order to take into account these explosion events.
- Recommendation 5: a HAZID for commissioning/ start-up can be performed during EPC stage in order to identify all potential risk due to these operations.

4.1.3 Scenarios involving major accident hazards other than FG

Significant accidents may occur onsite as a result of fires involving Dangerous substances (DS), or due to failure of turbine blades. However, there is relatively little potential for such incidents to escalate into incidents involving FG. To confirm this, in terms of the scope of this Risk and Disaster Management Plan, consideration must be given as to whether:

- A DS fire incident can escalate into an FG incident by causing damage to FG equipment;
- A turbine blade can shear off and cause physical damage to nearby FG equipment; or
- A FG incident can escalate by causing a DS fire.

Escalation of a DS fire into a FG incident

The DSs onsite are stored away from the FG facilities such that there is little scope for a DS fire to cause damage to FG equipment. Thus, escalation is not a reasonably feasible scenario. If escalation could occur, the scenario would be similar in outcome to the spontaneous failure modes of FG facilities. Thus, mitigation measures developed for spontaneous failures may also apply to escalation scenarios.

Recommendations

- Recommendation 6: Layout study should be conducted to assess adequacy of separation distances from major hazard installations to sensitive equipments, buildings and emergency assembly area locations.

Turbine damage causing an FG incident

It is feasible that a turbine blade may shear off, damaging FG equipment and causing a gas leak which may be considered as a generic failure of FG equipment. The turbines at the CCGT are subject to regular maintenance and inspection. Therefore, the likelihood of catastrophic failure of the turbine blades is expected to be low.

Escalation of FG incidents by causing a DS fire

The most plausible scenario escalation of FG incidents by causing a DS fire is impingement of a FG jet flame from Gas Treatment Plant.

If a DS fire did break out, the nature and inventory of DSs onsite is such that no additional offsite impact is plausible—apart from a smoke plume.

Physical separation of FG and DS equipment means that escalation is less likely even for a jet fire incident.

4.2 EXTERNAL HAZARDS

There are hazards that are outside the control of Sembcorp Management, but could still pose a risk to the installation. These hazards are called "external" because they are independent from the onsite operation and can cause major accidents onsite. A number of plausible causes of hazards are listed as below:

- Third party damage to gas supply pipeline;
- Aircraft crash;
- Severe weather conditions;
- Subsidence;
- Earthquake;
- Flooding; and
- Vehicle impact

The cause and general consequences are described in the following sub-sections.

4.2.1 *Third Party Damage to Gas Supply Pipeline*

The Gas Supply Pipeline is possibly of damaged by a third party beyond the CCGT site boundary, which could result in a gas leak on the pipeline. A quantitative analysis of this risk has been carried out [5], and reviewed to confirm its validity for this Risk and Disaster Management Plan; see *section 4.4.* Cathodic protection against external corrosion will in place for the buried section of the pipeline designed based on soil resistivity [5].

4.2.2 *Aircraft Crash*

Most aircraft crashes occur during take-off or landing, within a limited 3km zone at either end of airport runways. CCGT power plant is outside this zone, and thus risk of aircraft crash on CCGT power plant is considered negligible.

4.2.3 *Severe Weather Conditions*

Lightning strike is believed to have contributed to major incidents at oil and gas facilities in a number of locations worldwide. Sembcorp is not especially prone to lightning, and relevant equipment should be protected with lightning conductors and the risk arising from lightning strike does not pose an exceptional hazard at CCGT Power Plant. However, if FG equipment is damaged during a storm, and a gas leak occurs, this will be detected and handled in the same way as a gas leak from any other cause. This has been addressed on design of the Power Plant.

4.2.4 *Subsidence*

Normal subsidence events will occur gradually over several days or even months in which appropriate mitigation measures can be taken to prevent the failures to damage pipework or vessels. Only sudden and severe subsidence could result in failure of pipework or vessels which can lead to the shutdown of gas facilities and isolation of the relevant equipment.

Recommendations

- Recommendation 7: Comprehensive soil investigation survey is recommended to investigate ground settlement / subsidence risk.

4.2.5 *Severe Earthquake*

Myanmar is lying in a major seismic belt which is indeed earthquake-prone and is vulnerable to hazards from moderate to large magnitude earthquakes including tsunami hazards along its long coastal areas [6]. The hazardous scenarios ranges from minor gas leak to catastrophic failure of gas facilities. Damage to pipework could occur due to ground movement or vibration leading to guillotine failure of pipes. Loss of containment from a storage vessel could result due to:

- Vessel structural support failure;
- Building roof/structure collapse; and
- Vibration induced stress failure.

The intensity of earthquake required to damage storage vessel or pipework would be in excess of Modified Mercali Intensity (MMI) VII [7].

Recommendations

- Recommendation 8: The design of the Power Plant should be such that the impacts due to severe earthquakes are minimized.

4.2.6 *Flooding*

Flooding is likely to occur in Myingyan as it is situated 14km east to the Ayeyarwady River [8] and it may cause equipment failure resulting to gas leak if FG equipment is damaged. Flooding in Myingyan shall also be taken into account in the plant design stage.

4.2.7 *Vehicle Impact*

The risk of a FG incident arising from a vehicle striking piping or equipment is possible which may lead to pipe leakage. Adequate control with crash barriers, restriction of access should be employed for authorized vehicles only, onsite speed limits and training are recommended to reduce this risk.

4.3 METHODOLOGY FOR IDENTIFYING HAZARDS AND GENERATING SCENARIOS

Selection of a method for a process hazard analysis depends on many factors such as the size of equipment, complexity of the process and existing knowledge on the process.

A hazard assessment study should comprise of the following elements:

- Identification of all hazardous scenarios associated with on-site transport (including piping), storage and handling of dangerous substances at the hazardous facility;
- Execution of a Quantitative Risk Assessment expressing population risks in both individual and societal terms;
- Comparison of individual and societal risks with the Criteria for Evaluating Hazard to Life in accordance with international guidelines/ standards.
- Identification and assessment of practicable and cost-effective risk mitigation measures

4.3.1 *Hazard and Operability Analysis (HAZOP)*

HAZOP is a well-defined, systematic technique for hazard identification. It can be applied to processes for which design information is available. This information commonly includes a piping and instrument diagram (P&ID), which is examined in small sections, such as individual items of equipment or pipes between them. For each of equipment or process, the possible significant 'deviations' (such as 'less flow') from each design intention, feasible 'causes' for those deviations, and potential 'consequences' are determined. It can then be decided whether existing, designed safeguards are sufficient, or whether additional actions are necessary to reduce risk to an acceptable level.

4.3.2 *Quantitative Risk Assessment (QRA)*

Quantitative Risk Assessment is a well-defined, detailed numerical analysis of risk. It requires calculations of two components of risk: the magnitude of the potential harm L, and the probability p that the harm will occur. Previous similar incidents or a model, which can be generated with modelling software, can be used to estimate the values of these two components. Results can be expressed in terms of the likelihood of harm to a single individual, in the form of a probability contour plot. In addition, the risk to an offsite population can be calculated, and expressed as a plot of number of fatalities vs. frequency of incident. Because of the complexity of QRA and the need to obtain failure rates of specific items of equipment, it is carried out when required by the Authority under normal circumstances.

4.4 ASSESSMENT OF MAJOR ACCIDENT SCENARIOS

As the project is still in the preliminary design stage, only the Quantitative Risk Assessment (QRA) on gas supply pipeline has been conducted. Hazard and Operability (HAZOP) studies and full Quantitative Risk Assessment (QRA) on the plant facilities are recommended to be conducted to identify major accident scenarios in the EPC stage when detailed design is available.

Key input data for gas supply pipeline QRA, such as process conditions, inventory and population has been reviewed and given in Appendix A. The conclusion state that the risk to offsite population is 'acceptable' for gas supply pipeline in terms of UKHSE Guidelines and guidelines from BS PD 8010 Part 3 "Code of practice for pipelines Part 3: Guide to the application of pipeline risk assessment to proposed developments in the vicinity of major accident hazard pipelines containing flammables".

A number of recommendations for improvement were made during the QRA study. These are listed in Appendix B.

5 MAJOR ACCIDENT PREVENT POLICY AND SAFETY MANAGEMENT SYSTEM

5.1 MAJOR ACCIDENT PREVENTION POLICY REVIEW

Risk Assessments

HSE Risk Register review shall be carried out by the RM/RA team comprising appropriate staff from relevant disciplines / departments once every 3 years or earlier as stipulated in this procedure, but not limited to:

- New or changes to activities, products, services and environment for all ongoing and new projects undertaken;
- New or revised legislations, regulations and other requirements applicable to the company;
- Results of the review shall be considered when formulation and completion of new HSE management programs;
- New equipment, material or chemical used;
- Results of management review;
- Corrective actions and preventive actions;
- Shut-down and start-up conditions;
- Inspections;
- Foreseeable emergency situations; and
- Findings from accidents, incidents and complaints or feedback (both internal and external) which is significant.

All job tasks require PTW shall accompanied with a RA.

The respective Head of Department (Manager) shall assign the competent functional Risk Management (RM) Team to conduct RA. Appointment letter shall be issued to competent personnel by Senior Management / Head of Department.

The team may include representatives from Operations, Maintenance, HSE, Project, HR / Admin, Materials and Services, Laboratory and other functions as appropriate.

Contractors / supplier representative shall be included in the RM team if they are involved in the work activity.

Workplace Safety and Health (WSH) professional or consultant may be engaged in assisting RM leader for conducting RA where RA experience and expertise is lacking.

Separate teams may be formed to evaluate particular groups of activities, products and services. The team may also call upon other individuals when needed.

The responsibilities of the team members are as follows:

Team Leader:

- Act as a focal point for co-coordinating RM including initiate review and update of P2-01-F1 HSE Risk Register at your respective BU / department.
- Prepare, review and update the HSE Risk Register(s) according to P2-01 Hazard / Aspect Identification, Risk / Impact Assessment and Risk Controls together with team members.
- Obtain Head of Department's endorsement & approval on the HSE Risk Register(s) and implementation of risk control measures.
- Provide regular updates to Head of Department on the effectiveness of the appropriate risk control measures after implementation.
- Assist Head of Department to ensure that the RA is prepared in accordance to Hazard / Aspect Identification, Risk / Impact Assessment and Risk Controls.
- Ensure his/her team members obtain the necessary prescribed competency.
- Update all members of any legal updates/changes affecting the RA.
- Provide update in monthly HSE committee meeting on the RA conducted and risk control measures implemented or in such other intervals as necessary.
- Assist to ensure that all employees under the concerned discipline are aware of the RA for the work activity they carry out.
- Maintain a list of updated HSE Risk Register(s) & its relevant records (including written description of safe work procedures) for at least three (3) years from the date of the assessment and produce to the regulatory personnel when requested.
- Assist to develop and implement safe work procedures for work which poses HSE risks to workers.

Team Members:

- Prepare, review and update the HSE Risk Register(s) according to procedure together with Team Leader(s).
- Assist Team Leader(s) in conducting & implementing RA and recommend appropriate risk control measures to reduce or eliminate the risks identified.
- Assist Head of Department in monitoring the effectiveness of risk control measures after their implementation.
- Assist to ensure that all employees under the concerned discipline are aware of RA for the work activity they carry out.
- Maintain a list of updated HSE Risk Register(s) & its relevant records (including written description of safe work procedures) for at least three (3) years from the date of the assessment and produce to the regulatory personnel when requested.
- Assist to develop and implement safe work procedures for work which poses HSE risks to workers.

Vehicle Restrictions

Only vehicles with proper approval and that are necessary for performance of the work shall be allowed on the work site. Personnel will comply with site policies on vehicle restriction and Site Traffic Plan. Vehicles shall only be parked in designated areas.

Hazardous materials and dangerous goods on-site

All hazardous materials and dangerous goods shall be kept, stored, used, handled or disposed of in such a manner so as not pose a risk to the health and safety of any person at work.

All hazardous materials and dangerous goods shall be placed under the control of a competent person who has adequate knowledge of the properties of the Hazardous Materials and Dangerous Goods and their dangers.

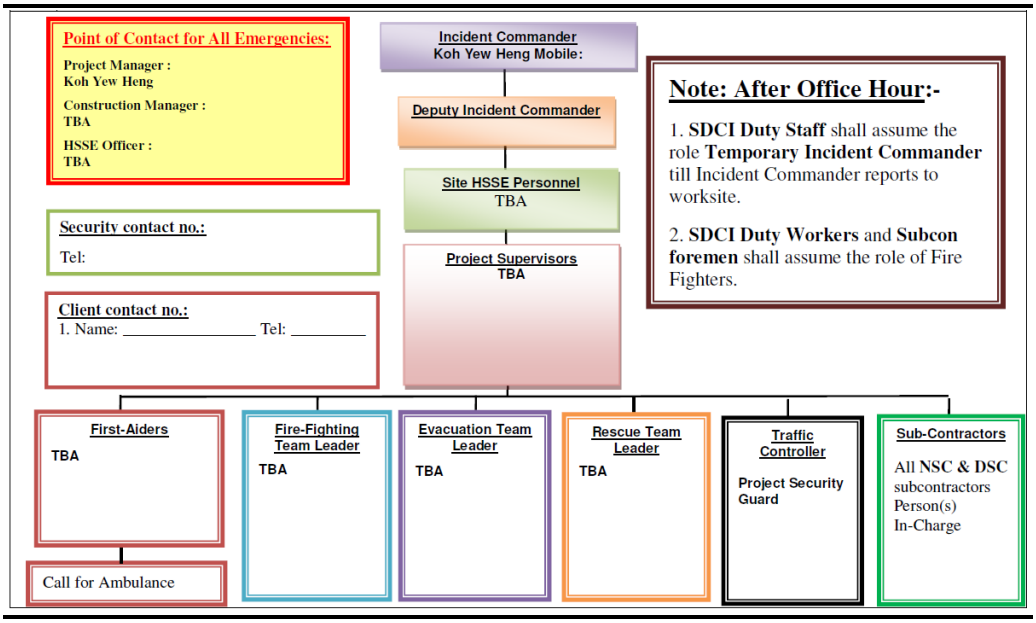
5.2 SAFETY MANAGEMENT SYSTEM

5.2.1 Organisation and Responsibilities of the Emergency Response Team (ERT)

Emergency Response Team (ERT)

According to the Project Emergency Preparedness and Response Plan, the Emergency Response Team (ERT) organisation chart is given below.

Figure 5.1 Emergency Response Team Organisation Chart



The Project Emergency Preparedness and Response Plan stating responsibilities and work tasks exclude or at least reduce risks during the operational phase of the CCGT Power Plant. It is the duty of all project participants.

Safety is a management and line responsibility throughout the entire organisation as shown in *Figure 5.1*. Each individual project participant is responsible for safety within his own area of responsibility and to report safety in the line organisation

5.2.2 Incident Commander

The responsibilities of the incident commander are:

1. Forming the Project Emergency Response Team (ERT).
2. Overall person in-charge in the event of an emergency situation.
3. Provision of adequate resources for the ERT (i.e. manpower, equipment, etc.).

4. In-charge of liaising with the Client's site representative (PCo) and project top management.

5. Assess the situation of the incident and activate the project ERT members for counter measures.

6. Direct all counter measures and emergency procedures to control and suppress the situation, decide on the evacuation of the construction site.

5.2.3 Deputy Incident Commander

The responsibilities of the deputy incident commander are:

1. Assist the Incident Commander on the coordination and execution of the project emergency response procedures.

2. To cover the duties of the Incident Commander when he is not at site.

3. Person in-charge of coordination and directing of the project ERT.

4. Collating and reporting the headcounts of the emergency evacuation to the Incident Commander.

5. Directing the search and rescue of missing personnel.

5.2.4 Site HSSE Personnel (HSSE Officer / HSSE Coordinator)

The responsibilities of the Site HSSE Personnel are:

1. To assist the Incident & Deputy Incident Commander on execution and directing of project emergency response procedures.

2. Assist in assembling and coordination with the project ERT.

3. Assist in coordinating work at the emergency evacuation assembly area.

5.2.5 Project Management Supervisors

The responsibilities of the Project Management Supervisors are:

1. Inform all personnel of the emergency situation.

2. Lock all office documents and shut down all electrical equipment if possible.

3. Evacuate from their respective work areas calmly upon activation of emergency evacuation.

4. Remove all sensitive documents with them during evacuation if possible.

5. Assist any personnel who require any help.

6. Assemble at the respective emergency assembly area.

7. Conduct headcount and report to the site HSSE personnel / Deputy Incident Commander.

5.2.6 Qualified First-Aiders

The responsibilities of the Qualified First-Aiders are:

1. Setting up of the first-aid treatment area at the project emergency evacuation assembly area.
2. Rendering first-aid to the injured.
3. Coordination, directing and reporting to the external professional medical personnel.
4. Reporting the status of injured personnel to the Incident Commander / Deputy Incident Commander.

5.2.7 Fire-Fighting Team

The responsibilities of the Fire-Fighting Team are:

1. Conducting fire-fighting in the event of a fire emergency.
2. Directing personnel to evacuate from the scene of fire.
3. Coordinating the rescue of personnel with the Rescue Team members from the scene of fire.
4. Remove any flammable materials.

5.2.8 Evacuation Team

The responsibilities of the Evacuation Team are:

1. Set up the project emergency evacuation assembly area upon activation.
2. Organise the evacuees according to their companies.
3. Liaise with the respective persons-in-charge from the different companies & work groups and collate the headcounts.
4. Reporting the headcounts to the Deputy to check the number of people present and missing and report the status to the Incident Commander.

5.2.9 Rescue Team

The responsibilities of the Rescue Team are:

1. Coordinating the evacuation & rescue of personnel.
2. Cooperating with the fire-fighting team on the rescue of personnel.
3. Cooperating with the respective persons-in-charge of the personnel on the rescue of missing personnel from their working areas.
4. Reporting to the Deputy Incident Commander on the status of their rescue.

5.2.10 Project Security Guards

The responsibilities of the Project Security Guards are:

1. Inform the Site HSSE Personnel on the workers and subcontractors manpower on site.
2. Control the site personnel and vehicle traffic movement.
3. Stop all personnel/ vehicles from entering the worksite in the event of an emergency.

5.2.11 Sub-Contractors / Person(s) In-Charge

The responsibilities of the Sub-Contractors / Person(s) In-Charge are:

1. Inform all their personnel of the emergency situation and carry out evacuation when instructed.
2. Ensure all personnel are evacuated from their work areas and assemble them at the emergency assembly area.
3. Ensure all machineries, equipment, etc. are shut down before leaving the work area.
4. Conduct headcount of their work personnel and report the headcount to the site HSSE personnel / deputy incident commander.
5. In the event of missing personnel, inform the rescue teams on the last know working area of the missing personnel.
6. Ensure their personnel assemble neatly at their respective positions and wait for further instructions from the site HSSE personnel / Incident or Deputy Incident Commander.

5.3 PROJECT HSE PLAN

5.3.1 Objectives and Targets

The project shall take a systematic approach to meet or exceed Sembcorp and Statutory requirements by setting the following objectives:
Promote and proactively pursue world class performance in HSE;

- Minimise health risks to workers and local residents;
- Comply with the environmental impact mitigation recommendations that minimises environmental impacts and support sustainability principles;
- Undertake early and systematic identification of potential hazards across all disciplines and areas of exposure using standardised hazards identification and hazards analysis tools;
- Record, track, and document all actions to mitigate identified hazards across all phases of project;

- Undertake site activities based on risk mitigation measures;
- Ensure that the subcontractor selection process includes examination of subcontractor historical HSE performance and proactive HSE initiatives;
- Emphasise the consistency and adequacy of contractor, vendor, and supplier HSE management systems; and
- Conduct regular senior management reviews, both internal and external audits of the effectiveness of the HSE management system in fulfilling the policy, objectives, and targets.

The HSE targets set by the project includes:

- No Fatalities;
- No Lost Time Injuries or Illness (LTIR 0.0);
- Total Recordable Injury Rate (TRIR < 0.3);
- No Fire & Explosion;
- No Reportable Environmental and Compliance Incident;
- No Vehicle Incidents;
- No Unplanned Interruptions to the Plant.

For the purpose of establishing the category of incident, Occupational Safety and Health Administration (OSHA) definitions shall be used. These objectives and targets will be cascaded throughout the project as part of the HSE Communications Procedure and be monitored as part of the Project HSE Management Review Procedure.

5.3.2 Risk Management

Work Method Statement (WMS)

Detailed Work Method Statements (WMS) shall be prepared by any person who is to carry out work on site, e.g. Contractors, Pre-commissioning engineers, etc.; for all work which has potential risks to HSE as determined by corresponding Risk Assessments (RA). This method statement will describe the work procedures, construction equipment to be used, sequence of operation and the controls necessary to achieve effective management of risks, and efficient execution of the works.

Detailed Work Method Statements shall be prepared for all critical tasks including but not limited to heavy lifts, general rigging and lifting, vessel entries, spading requirement, live line, welding, (hot taps), excavations, grating and handrail installation/ removal, and any erection work with specific risks.

Work that is deemed to be novel or unusual, any work that involves the handling of hazardous substances, unfamiliar or non-routine operation shall require to be reviewed by Safe Operations Committee (SOC).

The Work Method statement shall as a minimum describe:

- The job to be undertaken;
- The individual activities required to complete the job;
- The sequence of the various activities in the execution of the work;
- Plant, equipment, tools to be used in each activity;
- Substances/chemicals to be used in each activity (COSHH);
- Control measures and procedures to be used for each activity;
- Personal protective equipment required;
- Emergency resources/logistics required e.g. fire-watchers, fire extinguishers, fire blankets;
- Name of Task Supervisor for each activity;
- Name of Line Personnel in charge of the job;
- Novel procedures may require demonstration or training exercises; and
- Any specific or foreseeable identified hazards are to be listed.

Work method statements and the corresponding Risk Assessments shall be submitted to Sembcorp at least seven (7) working days prior to the anticipated commencement of the actual physical work at the site.

Risk Assessment (RA)

Any activities that present hazards to HSE needs to be identified. These hazards maybe identified at any stage of the project e.g. data, existing drawings, site survey investigations, design stage and constructability reviews, or may emerge during the construction or pre-commissioning/start-up phase.

Once potential hazards are identified after the development of WMS, the risks to HSE must be assessed. The assessment should characterize the risk in terms of severity and probability based on a "5-by-5 Matrix". From the WMS, a Risk Assessment shall be developed which at best would eliminate the risk or as a minimum, would contain the risk to a reasonable and/or acceptable level.

In accordance with the pro-active approach to safety, risk management techniques shall be adopted so that potential hazards are identified and evaluated prior to execution, thereby enabling either substitution or adoption of control techniques.

Any person who is to carry out work on site, e.g. Contractors, Vendors, self-employed persons, Pre-commissioning engineers, etc., shall carry out Risk Assessments, as necessary.

Construction Manager and Field Engineers with the support of Contractor shall conduct a 'Joint Pre-commencement Review of respective Contractor WMS/RA' of all key/significant construction activities thereby identifying their loss potential (in terms of probability, frequency and severity), ensuring

clear understanding and assuring that all the required materials, tools, equipment and PPE are available and 'fit for purpose'. The findings of this assessment, together with risk assessments submitted by contractors shall form an inventory of tasks from which additional method statements and work practices shall be developed by Contractors in conjunction with Sembcorp. All such assessments shall form the basis for the Pre-Task Talk discussions.

High Risk Activity Audits

The Site HSE Manager shall produce a schedule of audits to be performed by Sembcorp and Contractor Front Line Supervision which cover those activities identified by the risk assessment procedure as presenting significant hazards. As a minimum, these shall include and may not be limited to:

- Excavations;
- Work at Heights;
- Hot Work Activities;
- Scaffolding;
- Crane Operations and Lifting Equipment;
- Confined space entry;
- Electrical lock out/tag out (LOTO); and
- NDE/Radiation

These areas shall be supplemented by audits of individual "high risk" tasks and activities as against agreed Work Method Statements and Risk Assessments. These audits shall extend beyond investigation of mere physical conditions but shall also constitute a quality type audit that concentrates upon conformance to procedures, checks and controls, and operative awareness, all of which precede field performance.

HSE Procedures

Detailed Site-specific HSE procedures, Sembcorp Corporate HSE Procedures and Good Safety Practices providing the governing HSE standards for construction and pre-commissioning activities shall be made available at the work site. These procedures shall be made available to Contractors for reference and forms the basis of the Site HSE Management System.

5.3.3 Safety Training

Sembcorp recognises the critical impact of HSE training in achieving the optimum level of performance. Contractors in consultation with Sembcorp shall introduce a training programme that at all times meets the needs of the particular construction or pre-commissioning/start-up phase and its personnel. All such training shall be evaluated by the Site HSE Manager to ensure that it achieves its objectives.

Contractors shall identify and develop project-specific training modules with respect to scope of work and in compliance with applicable legal and other OSH requirements.

Construction Contractors and Pre-commissioning engineers shall be required to fully participate in the training programme. For certain key areas of work (confined space entry, work under permits) it shall be mandatory for contractor and commissioning supervision to have successfully attended any project-specific training.

Contractors shall also provide any necessary additional training so as to ensure that their personnel are at all times familiar with their tasks, legal and OSH requirements and also the preventative measures necessary to circumvent them. This is particularly necessary in relation to the handling of hazardous substances.

The foundation of any training programme shall be the project orientation and/or site HSE induction which shall be mandatory for all personnel prior to being allowed onto site unaccompanied.

HSE Induction

All site personnel shall be required to attend HSE induction before commencing work. The induction and the verification tests shall be conducted in the language conversant to the participants. Contractor may, if considered necessary, run refresher inductions for all site personnel.

Subjects covered in the inductions may include, depending on the applicable phase /scope of work at site the following:

- Induction video (where applicable);
- Overview of the programme and hazards addressed - project and plant specific;
- Issue and use of Site Identification cards;
- Driving on site;
- Personal Protective Equipment - minimum site requirements and legal considerations;
- Plant alarms, evacuation procedures and muster points;
- Smoking;
- Reporting of Accidents;
- First Aid Facilities;
- Fire Prevention and Suppression;
- Housekeeping (including cable management);
- Noise at Work;
- Legal requirements and other OSH requirements;

- Radiography;
- Permit-to-Work Systems;
- Work Method Statements/Risk Assessments;
- Pre Task /Mass Toolbox Talks;
- Scaffolding and tagging;
- Manual handling;
- Hot work including gas cylinders storage and use, spark containment;
- Respiratory Protection;
- Electrical Equipment;
- Working at heights, Safety harnesses, lifelines;
- Control of Substances Hazardous to Health, materials/contaminated land;
- Communications;
- Planning for safety - everyone's responsibilities;
- Drug and Alcohol Policy;
- Colour coding system for appliance, equipment and machines;
- Confined Spaces;
- Site Security;
- Site Prohibited items – explosives, firearms, etc.;
- Excavation; and
- Use of Hand phones on site.

The above list is not exhaustive and may be subject to revision due to the experience, trades, etc. of the audience. Site security will issue ID cards for access to the site upon successful completion of the HSE Induction.

Visitors

Visitor(s) shall liaise with their sponsor prior to entry to site. Visitor(s) shall be accompanied at all times whilst on site by their sponsor. The sponsor shall give visitor(s) who require access to construction areas an outline briefing of the site safety requirements.

Training Register

A HSE training register of all personnel that have been inducted, received additional training or re-training will be maintained by the Contractor. This register will include any statutory training and onsite training carried out by the contractors. The training register will be compared against the Site HSE Training Matrix to identify any gaps in HSE competency of all personnel

working in the project.

Certification of Personnel

Approved Persons and Qualified Persons e.g. crane drivers; fork lift drivers, mobile platform operators, confined space assessors, radiographers; scaffold erectors and first aid personnel shall be registered/certified by Statutory and its accredited testing/certification agencies demonstrating their competency to perform their works.

All operators of mobile equipment shall have at least 2 years of experience in operating the relevant equipment. Crane operators shall have at least 5 years' experience in crane operations. Newly appointed operators of mobile equipment without the necessary industrial experience shall be prominently identified.

Letter of Appointment

Specific functions such as Safety Supervisor, Lifting Supervisor, Signalmen, Rigger, Scaffold Supervisor, Formwork Supervisor, Forklift Operator etc., shall be issued with "Letter of Appointment" which, details the roles and responsibilities of each function.

5.3.4 HSE Meetings

Effective communications raise HSE awareness and are vital to the successful implementation of the HSE Plan. Communications take many forms but their common objective is to improve understanding of HSE matters and from this, to obtain the support, co-operation and commitment of all interested parties. An overall HSE Communication meeting matrix shall be developed.

Contractor Kick-off Meeting

Prior to site mobilisation a dedicated kick off meeting will be held and attended by the representatives of Sembcorp and the Contractor. Agenda may include, as applicable:

- Scope of work;
- Type and nature of work;
- Contractor's HSE Plan;
- Allowable working hours;
- Confirm that work can be safely executed within the proposed programme of works;
- HSE induction/training requirements;
- Personnel Protective Equipment/Clothing;
- Plant and equipment, standards and inspection requirements;
- Noise restriction including local requirements;
- Interfaces with other contractors;

- Auditing - participation and involvement;
- Legal requirement and other OSH requirements;
- Hazardous materials to be used;
- Reporting of incidents and accidents;
- Permit System - administration and requirements;
- Working on live operating plant;
- Work Method Statements/Risk Assessments;
- Any other specific anticipated hazards related to the work scope;
- Use of Hand phones on site;
- Environmental considerations.;
- Communication/Language; and
- Work Stoppages

Daily/Weekly Progress Meeting

A daily/weekly progress meeting will be held with each contractor. The HSE representatives of Sembcorp and Contractor will attend this meeting. HSE will be the first topic on the meeting agenda. HSE issues, progress and performance will be reported. Where necessary action plans will be produced and implemented.

HSE Committee Monthly Safety Review Meeting

A monthly safety review meeting will be held. The frequency and timing of this meeting may be adjusted accordingly.

Attendees will include:

- Project Manager
- Construction Manager (Sembcorp) – Chairman
- Site HSE Manager/Officer (Sembcorp) – Secretary
- Field Engineers (Sembcorp) - Rotating Basis
- Site Managers (Contractors)
- Safety Representatives (Contractors)
- Pre-Commissioning Manager

The agenda for the meeting will be structured around the following:

- Matters arising from last meeting;
- Accidents, incidents and near misses;
- Feedback on Site incidents;

- Publicity/promotion/initiatives;
- Monthly look ahead of activities;
- Anticipated concerns;
- Interface between Contractors; and
- Feedback from site personnel.

Chairman shall preside over the HSE Committee to achieve the purpose planned and has authority over members for the improvement of HSE Management System.

The Secretary will prepare the minutes of meeting. Presentation will be made to the Committee on the status of inspection reports, incident investigations and other related reports.

Members will assist the Chairman in the implementation of the Construction HSE Plan and provide constant surveillance in the field on all matters pertaining to health, safety, security, and environmental concerns on the construction work site.

Safe Operations Committee (SOC) Meeting

Safe Operations Committee (SOC) meetings may be called to address special circumstances such as:

- Work involving novel construction techniques;
- Work requiring special instructions and precautions; and
- Reporting the impact on HSE of any design work concurrent with the construction phase i.e. identifying potential hazards which were unknown at the contract award stage.

Toolbox/Pre-Task Talk (PTT)

Toolbox/Pre- Task Talks shall be conducted prior to commencement of any new task/location or when task/location conditions changes, and as minimum shall be done every morning and after lunch typically for 5 to 10 minutes. Contractor's Task Supervisor shall conduct safety instruction briefing and must be conducted in a language understood by the workforce. PTT shall be conducted at the immediate task locations or as close as possible. The basis for providing the safety instructions shall be the result of the last minute risk assessments.

A Toolbox/Pre-Task Talk form is developed and shall be accomplished by the Task Supervisors for every PTT and attendance signed by the members of the team.

Mass Safety Briefing

Mass "Safety Briefings" are mandatory and shall be held once each month, as a minimum. These will be conducted by the Contractors' Line Management, in the language understood by the workforce, and should address the

application of safety rules and procedures to the hazards of current work, and dissemination of key Project HSE information.

A roster of all attendees will be maintained by the Contractor, together with a record of the topics discussed which shall be circulated to the Site HSE Team.

5.3.5 Safety Rules and Regulations

Fire Prevention and Protection

Contractors are primarily responsible for fire prevention within all project construction work areas. All operations shall be conducted in a manner to minimise the risk of a fire.

This will be achieved by:

- Good housekeeping. All areas must be kept free from debris and waste material;
- Storing flammable materials in a systematic controlled way;
- Training on basic fire prevention and suppression;
- Containment methods to be employed at any potential sources of ignition e.g. fireproof blankets around welding operations or flame cutting operations. Fire-watchman equipped with fire extinguishers will be located at all hot work operations;
- Integrity of electrical equipment;
- Locating adequate fire protection equipment at areas of hot work;
- Isolating flammables from sources of ignition;
- Mobilising fire-fighting facility in the event of fire;
- Providing fire extinguishers adjacent to all mobile diesel driven weld sets, compressors, pumps etc.; and
- Utilising fire prevention surveillance systems, alarm, detectors, etc.

Authority to Stop Work

All training, group meetings, publicity, etc. shall be conducted in native language with translation to the necessary languages in order to ensure full comprehension amongst the workforce. This shall incorporate English as a minimum, as well as reflecting the multi-national compilation of the workforce. It is the primary responsibility of respective Contractors to ensure that the requirement for multi-lingual communications are addressed and effectively disseminated to all their personnel. Requirements for multilingual communication shall be available for critical operational control system such as Permit to Work.

5.4 *MEASURES TO PREVENT ACCIDENTS OR LIMIT THE CONSEQUENCES OF A MAJOR ACCIDENT*

The project is at the preliminary stage in which measures to prevent accidents or limit the consequence of major accidents still rely on the procedural measure to safeguard the plant from potential hazards. Physical measures and safety procedure for FG incidents prevention shall be provided in detail design stage. In this section, recommendations with respect to design construction, installation, commissioning, operation and emergency handling of fuel gas facilities at the CCGT power plant are discussed.

When the information is available during EPC stage, the following information will be combined and applied for the Emergency Response Plans:

- Zoning Classification
- Protection against static discharge
- Corrosion protection for pipelines
- Compliance with specific design codes
- Newly constructed equipment or plant procedures
- Maintenance attitude / procedures
- Inspection of Fire Service Installations and Equipment
- Purging of Fuel Gas Equipment
- Surveillance and Inspection of Fuel Gas Systems
- Plant Modifications
- Other Emergency Equipment

5.4.6 *Temp works*

Warning Signs during construction works

When systems are pre-commissioned and commissioned, these systems could be within an area where construction activities are still being carried out.

The resultant 'live' lines will present a potential hazard as:

a) Steam and condensate lines will be hot and under pressure.

b) Other utility lines will be under pressure.

All 'live' lines must be clearly identified and isolated and warning signs attached and additionally identified with tape. Signs must denote state of line i.e. 'HOT' and 'UNDER PRESSURE' etc.

5.4.7 Staff Training (various) / Demonstration of correctly designed, installed and maintained critical equipment / Drills and exercises

HSSE Training

The project management team shall ensure that all personnel are given the required health, safety, security and environment (HSSE) training to equip them with the HSSE knowledge, skill and attitudes that will enable them to perform their duties with due regards to HSSE, in accordance with the procedure for HSSE Training (SDCI-HSP-1002-05).

The project management team shall ensure that the mandatory HSSE training is provided for personnel in compliance with the relevant statutory and other local legal requirements, applicable standards and code of practices.

The project management team shall update the HSSE training received by all personnel in the HSSE Training Matrix.

The project management team shall ensure that the In-House HSSE Rules and Regulations are implemented on the project site, in accordance with the procedure for In-House HSSE Rules & Regulations (SDCI-HSP-1002-07).

No person shall work on the site prior to successfully completing the site HSSE induction.

Drills

The project management team shall ensure that the Project Emergency Response Drill is conducted at least once prior to work commencement and subsequently at every 6-monthly intervals.

5.4.8 First-Aid Rescue

First-Aid and rescue procedures have been documented in the Project Emergency Preparedness and Response Plan. Details are provided in *Section 6.2*.

6 COMMUNICATIONS AND EMERGENCY SYSTEM

6.1 COMMUNICATION

6.1.1 Alarms

Fire and Gas alarms are activated manually after event is discovered by project personnel. Vocal alarms as per emergency response are given immediately after discovery of event to alert workers. Details of emergency response are provided in *Section 6.2*.

6.1.2 Accident and Major Incident Reporting and Investigation Procedure

The Project Accident and Major Incident Reporting and Investigation Procedures are detailed in the Project Emergency Response Flowchart, which are provided in the Project HSE Manual [2].

As detailed in the Project HSE Plan, the procedures of incident investigation and analysis are provided in the following sections.

6.1.3 Injury and Near-Misses

All incidents resulting in injury or near-misses to employees of Sembcorp, Contractors, Sub-contractors, 3rd parties working on the project, or to any visitor must be reported immediately to the Sembcorp.

The relevant Construction Lead, Field Engineer and with the support of the Site HSE Manager/Officer shall investigate all injuries and near-misses immediately and the details recorded on the Accident/Incident Report Form. When causative factors have been established, remedial action shall be implemented without delay.

Where an injury requires offsite treatment, the Sembcorp Construction Manager shall initiate an impartial investigation and a detailed report as may be necessary shall be generated.

An incident management and protocol flowchart shall be developed and will form part of the Site Incident Management, Communication and Investigation process.

The analysis of Accident Reports and formal investigation will assist in the identification of trend processes and activities occasioning physical injury and will enable the preventive procedures to be revised if deemed necessary.

6.1.4 Statistics and Reporting Requirements

Contractor is responsible for informing the Local Authorities and Sembcorp of any reportable accidents or incidents in a timely manner.

An initial incident notification system for the reporting of accidents and incidents including near misses shall be operated.

Contractor shall keep records of all injuries at work site and will promptly report any reportable injury to Sembcorp and deal with the appropriate authority regarding any reportable injuries.

Contractor shall ensure that all accidents and incidents are investigated in accordance with Sembcorp requirements.

A monthly report shall be developed for Monthly HSE Reporting and copy provided to Sembcorp Group HSE. The project safety statistics shall include, but not limited to:

- Total Hours Worked;
- Statutory Reportable Cases;
- Fatalities;
- Lost Time Incidents;
- Restricted Work Cases;
- Medical Treatment Cases;
- First-aid Cases;
- Property Damages;
- Dangerous Occurrences;
- Environmental Incidences;
- Near-misses;
- Behavioural Based Safety Observations;
- Lost Time Injury Rate (based on 200,000 work hours); and
- Total Recordable Incident Rate (based on 200,000 work hours).

Monthly Health, Safety and Environmental Report

Sembcorp HSE Manager/Officer shall prepare a monthly HSE report; this report shall cover HSE activities up to the last day of the month. The full report shall be prepared and submitted to Owner and Group HSE by the 5th of each month to cover the previous month's activities.

The HSE report, which forms part of the monthly progress report shall include, for the reporting period:

- A tabulation of all accidents and near misses that occurred and their apparent cause;
- A tabulation of all hazards observed at the work site, a description of corrective action taken to deal with them, the individual to rectify the

shortfall;

- A summary of the contractors HSE activities, problem areas and corrective actions, government visits and HSE audits;
- A tabulation of hours worked for staff, supervision and labour, including lost time statistics; and
- Safety Training Course Schedule for the coming month.

Additionally, from the beginning of the construction phase, graphs and statistics shall be prepared, on a cumulative basis showing recordable injury rates and lost workday injury rates.

6.1.5 Emergency Contacts

Contact details for company and external organisations that may need to be contacted in the event of an emergency shall be provided in the pro-forma as shown in Project Emergency Preparedness & Response Plan [1].

6.2 EMERGENCY PLAN

6.2.1 On-site Emergency Response Procedures

The emergency response procedures for a number of scenarios have been provided in the Project Emergency Preparedness and Response Plan. Scenarios include fire outbreak, failure / collapse of structure, chemical spillage, water / gas pipe leak / burst, electrical power supply damage and worker injuries. A detail description as extracted from the aforementioned document is provided in the following sections. The organisation structure and responsibilities of the Emergency Response Team (ERT) members have been provided in *Section 5.2*. The Emergency Evacuation layout Plan and Emergency Response Flowchart have been provided in the Project Emergency Preparedness & Response Plan [1].

6.2.2 Fire Outbreak

1. The person(s) who spotted the fire shall raise the alarm by shouting "Fire! Fire! Fire!" or activating fire alarm /siren, etc. so as to alert nearby persons and get help.
2. The person(s) who spotted the fire shall inform the key project personnel and any of the project Emergency Response Team (ERT) members immediately.
3. If it is a small fire, the person(s) who spotted the fire may attempt to use a portable fire extinguisher to control the fire from spreading.
4. The person(s) shall check for any casualty. If there is casualty, the person(s) may attempt to rescue the casualty if it does not pose any danger to him / them.
5. Upon reaching the emergency location, the project ERT shall take over the control of the area and all other persons shall leave the area

immediately.

6. The First-Aid Team shall administer first-aid treatment to the injured if there are any injured personnel.

7. The project ERT shall call the Incident / Deputy Incident Commander and report the status of the emergency.

8. Based on the information given, the Incident / deputy incident commander shall assess the seriousness of the emergency incident and decide on the next course of action.

9. If the fire is beyond control or lives are endangered, emergency evacuation shall be activated. All personnel shall assemble at the emergency assembly area immediately.

10. In the event of the activation of emergency evacuation, the respective person(s) in-charge shall commence headcount of their personnel and ensure all their personnel are accounted for. The person(s) in-charge shall report their headcount and any missing personnel and their last known location to the site HSSE personnel / deputy incident commander immediately.

11. The Rescue team shall be informed and instructed to organise search and rescue of all reported missing personnel immediately.

12. The incident / deputy incident commander shall liaise with all relevant external parties (i.e. authorities, emergency services, etc.) involved.

13. The incident / deputy incident commander shall inform the Project Director and HOD (HSSE) of the emergency incident / situation and keep him/her informed of the status of the emergency.

14. After the incident, the incident / deputy incident commander shall compile an emergency incident report and submit the report to the Project Director and HOD (HSSE).

15. The incident / deputy incident commander shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

Recommendations

- Recommendation 9: Ensure sufficient coverage of Fire & Gas Detectors. Ensure sufficient coverage of fire fighting system such as hydrants, monitors, etc.

6.2.3 Failure / Collapse of Structure

1. Any person(s) who discovers the occurrence of the emergency situation shall raise the alarm by shouting "Help! Help! Help!".

2. The person(s) who discovered the emergency situation shall inform the project key personnel and any of the project ERT members immediately.

3. If the situation does not pose any danger, the person(s) shall remain at the emergency location and provide assistance such as helping the injured, warning unknowing personnel to stay away from the affected areas, etc. until the project ERT arrives.

4. Upon reaching the location of the emergency incident / situation, the project ERT shall take over the control of the area and all other persons shall leave the area immediately. The project ERT shall cordon off the affected area and instruct all personnel to keep away from the danger locations, except for project ERT members who are conducting rescue and/or evacuation of the personnel.

5. The project ERT shall call the Incident / Deputy Incident Commander and report the status of the emergency.

6. Based on the information given, the Incident / deputy incident commander shall assess the seriousness of the emergency incident and decide on the next course of action.

7. If the situation is beyond control and/or endangers the lives of personnel, emergency evacuation shall be activated.

8. If there is an outbreak of fire, the fire-fighting team shall commence to put out the fire.

9. The rescue team shall check for any casualty or persons trapped in the location and conduct rescue.

10. The first-aid team shall administer first-aid treatment to the injured if there is any.

11. The incident / deputy incident commander shall liaise with all relevant external parties (i.e. authorities, emergency services, etc.) involved.

12. In the event of the activation of emergency evacuation, the respective person(s) in-charge shall commence headcount of their personnel and ensure all their personnel are accounted for. The person(s) in-charge shall report their headcount and any missing personnel and their last known location to the site HSSE personnel / deputy incident commander immediately.

13. The incident / deputy incident commander shall inform the Project Director and HOD (HSSE) of the emergency incident / situation and keep him/her informed of the status of the emergency.

14. After the incident, the incident / deputy incident commander shall compile an emergency incident report and submit the report to the Project Director and HOD (HSSE).

15. The incident / deputy incident commander shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required

6.2.4 Chemical Spillage

1. The action to be taken in the event of oil or chemical spill depends on:
    a. The quantity spilled
    b. The environment affected (e.g. confined within project site, spillage to surrounding land, into the sea, etc.)
    c. The type of oil or chemical (e.g. hazardous or non-hazardous, poisonous, explosive, etc.)
2. In all cases, the project ERT shall be informed of any type of spillage of oil or chemical and they shall recommend the actions to be taken as according to the type and severity of the spillage.
3. If the oil / chemical spillage is non-hazardous and is confined within the boundary of the project site, the project ERT shall:
    a. Try to contain the oil / chemical spillage and prevent from spreading
    b. Isolate the source of the spill
    c. Ensure that the spillage do not flow into the public drainage system
    d. Clean up the spill with the appropriate clean-up measures stated in the oil / chemical's Safety Data Sheet (SDS)
    e. If the project does not have the capability to conduct cleaning up of the spillage, the project ERT shall contact external qualified cleaning contractors to carry out the clean-up operation.
4. In the event of non-hazardous oil or chemical spillage to public areas (e.g. public roads, drainage, etc.) the project ERT shall:
    a. Stop any further spillage from the project site by blocking all leakage points.
    b. Carry out spillage control using the most suitable method of containment, depending on the type of oil / chemical spillage and the estimate volume of spillage
    c. Prevent further flow of spillage into the public areas by blocking the entry points (at locations such as drains, creeks, water courses, sewers, etc.) by measures such as using sand bags, provide bunding around entry points, etc.
    d. Use the available types of spillage control / clean-up kit, sand, soil or other materials, etc. to further contain and clean up spillage.
    e. Ensure that all personnel involved in the spillage control work are issued with and attired in the appropriate personal

protective equipment to prevent control of the spillage materials with the personnel.

f. Ensure that contaminated material / waste are stored in sealed containers and properly labelled. All contaminated material / waste shall be disposed of properly in accordance to Myanmar Environment's regulations.

g. Arrange for immediate remediation of the affected areas, after the spillage is brought under control.

h. Contact the public emergency services such as police to control the situation if the measures to stop the spillage from the project site are not effective.

5. The PM or his designate shall liaise with all relevant external parties (i.e. authorities, emergency services, etc.) involved.

6. The PM or his designate shall inform the Project Director and HOD (HSSE) of the incident / situation and keep him/her informed of the status of the emergency.

7. The PM or his designate shall compile an incident report and submit the report to the HOD (HSSE).

8. The PM or his designate shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

9. If there is spillage into the public drainage, the incident / deputy incident commander and Project Director shall inform the relevant authority (i.e. PUB) and work closely with the authority to control and mitigate the spillage.

6.2.5 Water/Gas Pipe Leak

1. The person(s) discovering the water / gas leak shall raise the alarm by informing the parties responsible / involved in the source of the gas leak.

2. If the water / gas leak is controllable, the responsible party shall shut off the source of water / gas leak immediately (e.g. turn off the valves / mains of the water / gas supply, etc.).

3. If the water / gas leak is uncontrollable, such as due to the damaged / failure of its containment, damage or rupture of piping / valves, etc. the party responsible shall inform the key project personnel, any members of the project ERT.

4. The ERT shall response within ½ hour (2 hours after office hour) and assess the situation while work together with the Facilities Management representative for external help. And at the meantime, the plumber on standby at the site shall be activated.

5. If it is safe to do so, the responsible party shall assist in cordoning off the

affected area to prevent further unauthorised entry until the project ERT arrives and take over control of the emergency area.

6. For Gas Leak, the project ERT shall:

    a. Raise the emergency evacuation alarm / siren to alert all personnel to start evacuation to the emergency assembly area & ensure the smooth evacuate of all personnel in the immediate vicinity.

    b. Ensure all users of the gas source is informed of the emergency situation and to shut off all gas supply

    c. The responsible party shall inform the provider of the gas supply immediately

    d. Ensure all sources of ignition are removed or extinguished & try to isolate the source of the gas leak

    e. Ensure that the area is ventilated as much as possible

7. If there is an outbreak of fire, the fire-fighting team shall commence to put out the fire.

8. The rescue team shall check for any casualty in the location and conduct rescue.

9. The first-aid team shall administer first-aid treatment if there is any injured.

10. The project ERT shall contact the Incident / Deputy Incident Commander and report the status of the emergency.

11. Based on the information given, the incident / deputy incident commander shall assess the seriousness of the emergency incident and decide on the next course of action.

12. In the event of the activation of emergency evacuation, the respective person(s) in-charge shall commence headcount of their personnel and ensure all their personnel are accounted for. The person(s) in-charge shall report their headcount and any missing personnel and their last known location to the site HSSE personnel / deputy incident commander immediately.

13. The incident / deputy incident commander shall liaise with all relevant external parties (i.e. authorities, emergency services, etc.) involved.

14. The PM or his designate shall inform the Project Director and HOD (HSSE) of the incident / situation and keep him/her informed of the status of the emergency, compile an emergency incident report and submit the report to the Project Director and HOD (HSSE).

15. The PM or his designate shall ensure that all other official documentation required to be submitted to the relevant authorities are compiled and submitted as required.

Recommendations

- Recommendation 9: Ensure sufficient coverage of Fire & Gas Detectors. Ensure sufficient coverage of fire fighting system such as hydrants, monitors, etc.

6.2.6 Electrical Power Supply Cable Damage

1. The person(s) discovering the electrical power supply cable damage due to excavation work shall raise the alarm by informing the parties responsible and the site management personnel.
2. If the electrical cable damage is externally scratched, the responsible party shall inform the site management personnel immediately. The electrical contractor shall be activated to provide necessary protective cover.
3. If the electrical cable is damaged seriously and there is power failure, the party responsible shall inform the key project personnel, any members of the project ERT.
4. The ERT shall response within ½ hour (2 hours after office hour) and assess the situation while work together with the Client Management representative for external help. And at the meantime, the electrical jointer on standby shall be activate and await for further instructions.

6.2.7 Worker Injuries

1. Any person(s) who discovers the occurrence of the injured shall raise the alarm by shouting "Help! Help! Help!".
2. The person(s) shall inform the project key personnel and any of the project ERT members immediately.
3. If the situation does not pose any danger, the person(s) shall remain at the emergency location and provide assistance such as helping the injured, warning unknowing personnel to stay away from the affected areas, etc. until the project ERT arrives.
4. Upon reaching the incident location, the project ERT shall take over the control of the area. The project ERT shall cordon off the affected area and instruct all personnel to keep away from the danger locations, except for project ERT members who are conducting rescue and/or evacuation of the personnel.
5. The project ERT shall call the HSSE Officer /Coordinator and report the status of the injured worker.
6. For first aid treatment case, the first-aid team shall administer first-aid treatment to the injured or the injured walk to the first aid treatment room for basic treatment.
7. For minor injury case such as the injured is still conscious and is able to move with assistance, a transport is arranged to send the injured to

nearest clinic/ hospital and staff/ or subcontractor supervisor will accompany the injured.

8. For severe injury case such as injuries sustained are critical and Injured is either unconscious or is not able to move. The Project Manager/ or HSSE Officer /Coordinator shall give instructions to activate Project Security to lead Responders to the location.

9. Project Manager shall informs Management/ Client (PCo) Management and provide situation verbally report on regular interval if the severe injury is occurred.

10. Follow-up with Incident Reporting and Investigation when the injury is reportable case. The incident report shall send to the relevant parties.

6.2.8 Action by External Emergency Services

A list of external emergency contact has been developed and it will be updated as the project progress.

Recommendations

- Recommendation 10: Primary emergency communication system should be available with emergency response teams and local authority personnel involved with emergency response. Secondary / alternative emergency communication system should also be available for emergency response.

6.2.9 Emergency Evacuation Procedures

Emergency Evacuation Procedures as detailed in the Project Emergency Preparedness and Response Plan are as follows:

1. Everyone shall stop work immediately

2. Disconnect all power supply to machinery and equipment

3. Lower all suspended loads from the lifting machines onto a firm ground

4. All personnel shall take the nearest emergency exit / evacuation route and assemble at the designated emergency assembly area

5. Project ERT members shall also assemble at the emergency assembly area with their emergency response equipment.

6. All personnel shall assemble or queue up orderly at their respective designated location within the emergency assembly area.

7. The respective person(s) in-charge shall ensure all their personnel are assembled at the correct designated location.

8. The respective person(s) in-charge shall conduct head count of their personnel and record the headcount in the Project Emergency Evacuation Register.

9. The person(s) in-charge shall submit the emergency evacuation register to the Incident Commander / Deputy Incident Commander and report if

there is any missing personnel.

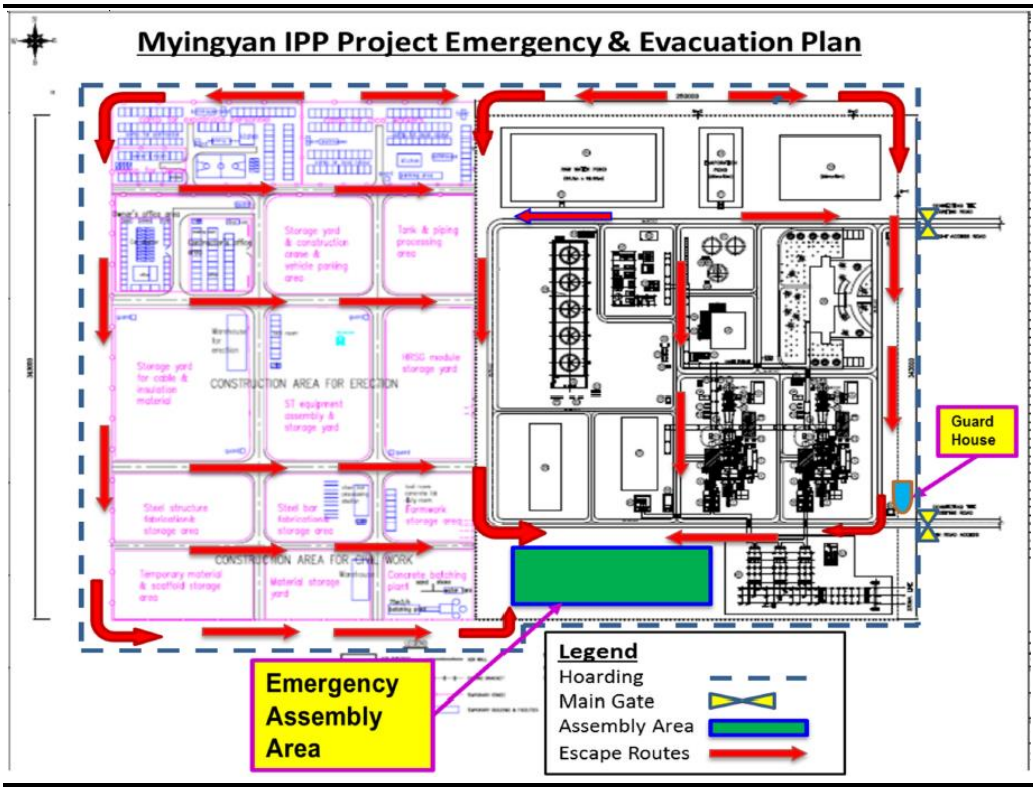
10. The Incident Commander or his deputy shall determine whether there is a need for further assistance from external emergency services agencies.

11. Re-entry into the immediate vicinity of the emergency incident / situation area shall be restricted to only authorised personnel (i.e. project ERT members and authorities, emergency services, etc.).

12. Clearance to re-enter the emergency incident site for the rest of the project personnel is subjected to the approval of the Incident Commander.

The emergency escape route and emergency assembly area are provided in *Figure 6.1.*

Figure 6.1 Project Emergency Evacuation Layout Plan



Recommendation

Recommendation 6: Layout study should be conducted to assess adequacy of separation distances from major hazard installations to sensitive equipments, buildings and emergency assembly area locations.

6.2.10 Ensure adequacy and effectiveness of Emergency Plan

HSE Audit

As per the Project HSE Plan, HSE audits will be performed and reported in the monthly HSE report.

The audit will cover the following aspects and others as deemed necessary by the Site HSE Manager:

- Excavations
- Work at Heights
- Hot Work Activities
- Scaffolding
- Crane Operations and lifting Equipment
- Confined Space Entry
- Electrical lock out / tag out
- NDE / Radiation

The HSE Audit is referred to in the Project HSE Plan, presented in *Section 5.3*.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

A major accident prevention policy has been provided and a safety management system has been put in place to implement the policy. As the CCGT Power Plant project is in the preliminary design stage, preliminary hazard identification has been performed on the power plant. Studies such as HAZID, HAZOP and QRA studies will be performed as the project proceeds into the EPC stage. Some measures have been put in place to minimize the risk of hazardous events; general recommendations have been made to further supplement the measures currently considered. Safety and reliability have been considered in the design, construction, operation and maintenance of the CCGT power plant. Emergency plans have been developed as detailed in project documents and some recommendations have been made to the plans.

7.2 RECOMMENDATIONS

Recommendation 1: all pipes and equipment should be suitably coated against external corrosion. Also, lagging should be provided with removable panel to facilitate routine inspection of the condition of the pipework surface. (Refer to *section 4.1.1*)

Recommendation 2: Area around the gas supply pipeline and valve stations should be zone-classified and access-controlled to eliminate any source of ignition. (Refer to *section 4.1.1*)

Recommendation 3: Consider implementing a HEMP (Hazard and Effects Management Process) to identify and manage the major accidental hazards. (Refer to *section 4.1.1*)

Recommendation 4: a Quantitative Risk Assessment (QRA) needs to be performed during EPC stage for the Power Plant in order to evaluate the risk due to the explosion events to the On-site, Off-site population as well as the adjacent facilities. The Emergency Response Plan needs to be updated in order to take into account these explosion events. (Refer to *section 4.1.2*)

Recommendation 5: a HAZID for commissioning/ start-up can be performed during EPC stage in order to identify all potential risk due to these operations. (Refer to *section 4.1.2*)

Recommendation 6: Layout study should be conducted to assess adequacy of separation distances from major hazard installations to sensitive equipments, buildings and emergency assembly area locations. (Refer to *section 4.1.3*)

Recommendation 7: Comprehensive soil investigation survey is recommended to investigate ground settlement / subsidence risk. (Refer to *section 4.2.4*)

Recommendation 8: The design of the Power Plant should be such that the impacts due to severe earthquakes are minimized. (Refer to *section 4.2.5*)

Recommendation 9: Ensure sufficient coverage of Fire & Gas Detectors. Ensure sufficient coverage of fire fighting system such as hydrants, monitors, etc. (Refer to *section 6.2.2* and *6.2.5*)

Recommendation 10: Primary emergency communication system should be available with emergency response teams and local authority personnel involved with emergency response. Secondary / alternative emergency communication system should also be available for emergency response. (Refer to *section 6.2.8*)

Recommendation 11: Safety and reliability of the CCGT power plant should be review regularly during the design, construction, and operational phases.

REFERENCES

[1] Project Emergency Preparedness & Response Plan for Proposed Development of the Myingyan Gas-fired Combined Cycle Power Project, Revision 0

[2] Project HSE Manual, Hazard / Aspect Identification, Risk / Impact Assessment and Risk Controls, P2-01, Revision 6

[3] Health, Safety, Security and Environment Plan (HSSE Plan) for Proposed Development of Myingyan Gas-fired Combined Cycle Power Project – Myanmar

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[9] Environmental Resources Management, Myingyan CCGT ESIA Chapter 2, Process Description an Alternatives, July 2015

Appendix A

QRA Input Data

A1 INTRODUCTION

This is a table of input data used in the QRA study for the gas facilities at Myingyan CCGT Power Plant Project.

The purpose of the listing is to confirm that all results derived from the QRA study remains valid.

Each item that may have an impact on the risk of a major accident is listed here. In order to remain within the scope of this study, only items directly related to Natural Gas or that may cause or result from escalation of a Natural Gas incident, are considered.

For each item, the table shows:

- The item considered during the QRA;
- The assessed value or significance of the item;
- How the assessment was derived, including source of information where appropriate; and
- Reference to the relevant QRA study report.

A2 QRA INPUT DATA

Gas Supply Pipeline QRA Input Data

Item number	Item	Assessment	How derived	Reference
1	Atmospheric conditions	The atmospheric pressure, ambient temperature and relative humidity are 1.013 bar, 28°C, and 70% respectively.	Information from Sembcorp	Gas Supply Pipeline QRA Report
2	Local meteorology.	Wind speed and stability data tabulated.	Information from Lakes Environment	Gas Supply Pipeline QRA Report
3	Offsite population.	Base Case (Local Area): 100 persons /km^2. Comparison Case (Urban Area): 723 persons / km^2	Myanmar Census and World Bank Indicators	Gas Supply Pipeline QRA Report
4	Literature: Relevant previous incidents.	Incidents reviewed up to 2013.	US Gas Pipeline Incident Database, 1984 to 2013 European Gas Pipeline Incident database, EGIG 1970 to 2013	Gas Supply Pipeline QRA Report
5	Hazards associated with onshore pipeline.	Nearby work; corrosion; defect in material or construction; improper operation; defect due to pressure cycling; external event e.g. flooding, subsidence.	European Gas Pipeline Incident database, EGIG 1970 to 2013	Gas Supply Pipeline QRA Report
6	Causes of spontaneous failure of gas equipment.	Material defect, construction defect, corrosion, erosion, vibration, stress, fatigue, impact, overload (e.g. overpressure).	ERM In-house Incident Database collected from wide range of international database such as European Gas Pipeline Incident database and US Gas Pipeline Incident Database.	Gas Supply Pipeline QRA Report

Appendix B

QRA Recommendations

B1 INTRODUCTION TO RECOMMENDATION LISTS

This is a table of recommendations arising in the previous QRA study.

Only recommendations having a significant risk reduction effect on major accident hazards are considered in detail here. Recommendations that are simple clarifications, drawing corrections and other minor issues are omitted for brevity.

The purpose of this list is to show that every significant residual risk arising in previous safety studies of the Myingyan CCGT Power Plant gas facilities has been addressed and adequately controlled. These recommendations are shown in *Section B2*.

For each item, the table shows the text of the recommendation, with additional clarification or explanation where needed.

B2 RECOMMENDATION LISTS

Gas Supply Pipeline QRA Report

Recommendation Number	Recommendation
1	Consider hot tapping as a high risk activity that is a likely cause of gas leakage. Ensure that all hot tapping activities are carried out only by trained and authorized personnel.
2	Consider implementing crash barriers and control of vehicle access, onsite speed limits and driver training programme to reduce risk of gas leakage incident arising from vehicle striking piping or equipment.
3	Consider implementing routine corrosion monitoring to reduce risk of gas leakage due to internal corrosion of pipeline.
4	Consider implementing routine inspection of coating integrity to reduce risk of gas leakage due to damaged coating.

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