

**MYANMAR WANBAO MINING COPPER LIMITED (MWMCL)
LETPADAUNG COPPER PROJECT**



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SCOPING STUDY

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SCOPING STUDY

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Environmental Risk Matrix

APPENDIX B

Sample Land Compensation Documents

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Workforce Grades

LIST OF ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
CSD	Community & Social Development
DENR	Department of Environment and Natural Resources
DIA	Direct Impact Area
DILG	Department of the Interior and Local Government
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECD	Environmental Conservation Department
ECP	Environmental Control Procedures
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ICC	Indigenous cultural community
IEC	Information, Education and Communication
IFC	International Finance Corporation
IIA	Indirect Impact Area
IP	Indigenous people
IPRA	Indigenous Peoples' Rights Act
IRR	Implementing rules and regulations
JBIC	Japan Bank for International Cooperation
LGU	Local government unit
NGO	Non-Governmental Organization
PAP	Project-affected person
RAP	Resettlement Action Plan
SDP	Social Development Programme
SOW	Scope of Work
TOR	Terms of Reference
WB	World Bank

1. INTRODUCTION

1.1 BACKGROUND

This scoping study for the Environmental and Social Impact Assessment (ESIA) for the Letpadaung Copper Mine Project (hereafter referred to as “the Project”) has been prepared to assist in developing the Terms of Reference (TOR) for the preparation of the ESIA. There has, as yet, been no stakeholder input into the TOR. Stakeholder input is considered good practice for a study of this nature and extent. The TOR can therefore only be finalised once the Myanmar Wanbao Mining Copper Ltd (MWMCL) Community and Social Development (CSD) Team in conjunction with the National Commission for Environmental Affairs (NCEA), the Ministry of Mines and the Planning and Work Inspection Department has conducted the requisite scoping meetings.

Knight Piésold understands that MWMCL has appointed consultants from Myanmar to undertake baseline studies in support of the ESIA. The scopes of work for each study should be checked against the TOR to ensure that all studies are included.

1.2 PROJECT LOCATION

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic centre of central Myanmar and 722 km north of Yangon.

Travel to Monywa from the project site can be undertaken by road or by river transport. From Monywa, ongoing travel and transport can be undertaken by road, rail and air. The Project location within Myanmar is shown at Figure 1.1.

The Project site is located around the geographic location 22°07' N, 95°02' E and occupies an area of 32.73 km². The site location is shown at Figure 1.2 and the project area is shown at Figure 1.3.

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).

1.3 PROJECT OWNERSHIP

Wanbao Mining Ltd. (Wanbao Mining) was established on 16 March 2005 and is a subsidiary company of China North Industries Corporation. Wanbao Mining is a professional mining company approved by the Chinese Government with a registered

capital of 1,300 million RMB. The headquarters is in Beijing and overseas subsidiaries are established to run overseas projects.

Myanmar Wanbao Mining Copper Ltd (MWMCL) is registered in Myanmar and wholly owned by Hong Kong Wanbao Mining Copper Ltd. which itself is a wholly owned subsidiary of Wanbao Mining Ltd. With a registered capital of USD 10 million, MWMCL is the operational entity to develop the Letpadaung Project.

The Myanmar partner in the project contributes the mining rights while Wanbao is responsible for project investment development and management. Both parties will share project benefits based on the production sharing contract for Letpadaung Copper Mine. The large scale mineral production permit for Letpadaung is currently held by Myanmar Economics Holding Limited (MEHL).

1.4 PROJECT HISTORY

Copper mining and smelting started in the Monywa copper district several centuries ago. The British discovered the mineral wealth of the Salingyi district in the 1930's and the Myanmar Geological Department visited and investigated this site in the 1950's together with a Yugoslavian geological team. This visit resulted in the implementation of an exploration programme. Myanmar Geological Bureau and relevant institutions of the United Nations (UN), Japan and Yugoslavia carried out a series of exploration programmes after the initial programme.

Mining Enterprise No 1 (ME-1) of Myanmar and BorInstitute of Yugoslavia signed an agreement in 1978 to jointly develop Sabetaung and Kyisintaung deposits and a processing plant with the capacity of 8000 t/d was built in 1984. Production was difficult to maintain and co-operation stopped soon afterwards due to low recovery and poor economic benefits.

ME-1 signed a Feasibility Study agreement with Ivanhoe Myanmar Holdings Limited in 1994 to jointly develop Sabetaung and Kyisintaung deposits. A 1 t/d copper pilot plant was built in 1995 and detailed exploration started. Myanmar Ivanhoe Copper Corporation Limited (MICCL) was formed in 1996. Mining only took place at Sabetaung and Sabetaung South while Kyisintaung and Letpadaung deposits remained untouched. MICCL design capacity was 25 kt/a cathode copper. The plant was put into production in 1998 and the capacity was expanded to 39 kt/a in 2004. The mine essentially ceased operating between April 2008 and August 2010, with only sporadic production continuing. Some production was resumed in September 2010 but only on a small scale.

Wanbao Mining Ltd. organised an expert group to visit the Monywa copper mines and investigate the resources and production there in July 2007. The expert group recommended purchase of the project following the visit.

Wanbao Mining Ltd. organised another expert group to visit the site in December 2008. Data relating to previous exploration programmes, feasibility study reports and mine production conditions were collected. The experts also collected 200 basic assay samples of drill core from the Kyisintaung and Letpadaung deposits and processed them in the MICCL laboratory to 75 micron size. One hundred grams of each sample was sent to The National Geologic Test Centre of China for testing and the test results confirmed the presence of a primary ore body.

Wanbao Mining Ltd. reached a draft co-operative development agreement with the Myanmar Government in March 2010 preliminarily acquiring the mining right of the Letpadaung deposit. The formal co-operative development agreement was signed on 3 June 2010. At present, Myanmar Wanbao Mining Copper Ltd. (MWMCL) is in the process of preparing to develop the Letpadaung deposit.

In May 2010, Myanmar Wanbao Mining Copper Ltd. selected China Nerin Engineering Co., Ltd. (NERIN) to complete the Feasibility Study, Basic Design and Detail Design for this project.

NERIN completed the Feasibility Study Report for the Myanmar Monywa Letpadaung Copper Project (100 kt/a cathode Cu) in September 2010 and completed the Project Application Report in October 2010. The Basic Design was submitted for review in February 2011 and was approved by MWMCL in May 2011.

1.5 THE SCOPING STUDY

This Scoping Study provides guidance for a comprehensive Environmental and Social Impact Assessment (ESIA) of the entire project, including, but not limited to, the mine production areas, infrastructure and support facilities, the proposed transport routes for supplies, reagents and copper product and addresses the construction, operation, and decommissioning of each project component in terms of its:

- Effects on biological diversity, wildlife and wildlife habitat, soil erosion and sedimentation, air quality, surface hydrology, sub-surface hydrogeology and water quality, and freshwater ecology.
- Effects on cultural and archaeological resources, local residents, livelihood, employment patterns and skill levels, human health, and land tenure, settlement, and use patterns.

- Effects on humans and local communities, including, dust, noise, vibration and loss of visual amenity.
- Waste management practices and materials handling and storage.
- Energy use in the mining and processing of ores extracted, its impact on local supply and the Greenhouse Gas emissions that will arise from the project.
- Transport, handling and storage of hazardous materials.
- Traffic along proposed roads and potential new access to remote areas and undisturbed forest areas by local residents.
- Seismic and geological risks, emergency response, and worker safety and protection.
- Indigenous peoples.
- Resettlement.

The ESIA will provide the foundation for an environmental and social management plan (ESMP) to facilitate mitigation of impacts and describe monitoring commitments during the design, construction, operation, and de-commissioning of the project components. The ESIA also will provide sufficient information on all aspects of the project for review by government resource agencies, donors, non-governmental organisations (NGO's), and other interested parties and affected groups.

1.6 STRUCTURE OF THIS DOCUMENT

This document is structured to provide details of the project structure, its component parts, the environment in which it is placed, the environmental and social risks associated with the project in this location, the investigations designed to determine the magnitude of those risks, and the potential for maximising benefits and minimising the impacts of the project.

Section 1 describes the project location, its ownership and history as well as describing the objectives of this study.

Section 2 describes the objectives of the Scoping Study and the ESIA.

Section 3 describes the legal and regulatory framework that applies to the ESIA as described under legal system in Myanmar.

Section 4 provides a detailed description of the project as presented in the basic Design (Nerin, 2011).

Section 5 presents a description of the natural environment.

Section 6 presents a description of the socio-economic environment.

Section 7 presents a description of the impacts on the natural environment.

Section 8 describes the social impacts identified when assessing the risks likely to arise from the Project.

Section 9 presents a conclusion and series of recommendations arising from the scoping study.

2. OBJECTIVES

ESIA is a systematic study and process to determine the effects of a project on the environment during its various phases of construction, commissioning, operation, and closure. As such, its objectives are to ensure that the project maximises the social and environmental benefit to be derived and that any issues of concern relating to the biological, physical, or socio-economic environments, or applicable national or international regulations or guidelines, are recognised early and considered in the project design. This allows the incorporation of appropriate mitigation measures designed to avoid, eliminate or compensate for adverse effects (impacts) into the project design, as well as including the costs of these measures into the project economics. It will include the preparation of an ESMP describing a comprehensive, on-going, environmental management and monitoring plan.

Certain social and environmental baseline data were collected at the mine site in support of the 1997 Feasibility Study Report for development of Letpadaung similar in nature to that being considered by MWMCL. At that time, the Project had the following summary characteristics:

- Natural environment
 - The area is subject to 3 seasons annually – cool-dry, hot-dry and wet.
 - Most of the area is very flat plains with a few prominent hills, such as Letpadaung, rising from the plain.
 - Rock in the area contains leachable metals and a high potential for acid generation.
 - The project area borders a seismically active zone.
 - Soils are erosion prone and nutrient deficient.
 - The quality of groundwater is low with high total dissolved solids (TDS) and high levels of trace metals such as arsenic, copper, chromium, iron and manganese.
 - The hills rising above the plain have a cover of modified vegetation with little remnant natural vegetation remaining on the flat plain.
 - The flora of the region has been highly modified by human activity but is widespread across the region.
 - The high parasite load in aquatic fauna indicates physiological stress as a result of activities in the Chindwin River catchment.
 - The existing site conditions provide poor habitat for terrestrial wildlife, which is reflected in the species abundance and diversity observed.

- Socio-economic environment
 - Myanmar people represent the majority of the local population.
 - The principal local religion is Theravada Buddhism and a number of sites of religious significance occur on the project area.
 - The local economy is predominantly based on agriculture. Some 3,500 people are actively reprocessing tailings from the mining undertaken prior to the 1990's.
 - Wood is the primary fuel source
 - There is little local skilled labour or trained health workers.

These existing baseline data will be integrated into the overall environmental and social baseline for the whole project. However, it will be necessary to collect additional more recent baseline data in the proposed mine area, and to establish baseline data along the transport route, port area, and the downstream. The social and environmental baselines form the basis of the impact assessment and mitigation/management process and will require field work. The data should be collected over a sufficient period of time to allow capture of seasonal variations, where applicable. One objective of the ESIA will be to confirm the previous conditions still exist and to determine the extent to which any change in those conditions has occurred.

Stakeholder engagement managed and conducted by a Community and Social Development (CSD) Team will provide input into and help identify and evaluate potential impacts of the proposed project and formulate measures to avoid, reduce, or compensate for such impacts. Stakeholder engagement is a key to a successful ESIA, as it is the basis for obtaining social approval of project plans. It will be necessary for the company collecting environmental and social baseline data to interact closely and co-operatively with the MWMCL CSD Team, and with the consultants carrying out the impact assessment field studies so as to ensure the appropriate baseline data are collected. Any data collected and impact analysis will have to be able to stand up to rigorous scientific assessment.

It should also be noted that Myanmar environmental legislation is not well developed. Thus guidelines from overseas institutions, such as those provided by the International Finance Corporation (IFC) and World Bank, will be used to provide guidance regarding data collection and analysis.

3. LEGAL AND REGULATORY FRAMEWORK FOR ESIA

This section reviews the administrative and legal structures set up to protect the environment, as well as ongoing activities by the government and civil society organisations based inside and outside Myanmar that are intended to promote sustainable development and environmental protection.

3.1 EXISTING ENVIRONMENTAL LEGISLATION

The information for the following sections describing the Myanmar legislation with reference to environmental assessment was provided by Myanmar Legal Services Limited (2013).

Though Myanmar does have some legislation related to protecting people and the environment, the country lacks the necessary adequate administrative and legal structures, standards, safeguards and political will to enforce such provisions. In addition, while Myanmar is party to several international treaties such as the Convention on Biological Diversity (CBD), in the past, Myanmar has not incorporated the provisions contained in these agreements into domestic law. For example, national laws did not require specific environmental and social impact assessments (ESIA) or public participation by local communities in the decision-making processes of large-scale development projects. However, to address the environmental expectations of the laws described below, an ESIA would be required to establish the mechanisms for preventing such actions from occurring. There are no laws that comprehensively regulate pollution, no standards to adequately protect biodiversity, develop resettlement plans, or provide compensation. There are, however, the 1995.

Community Forest Instructions (CFI), the March 2012 Environmental Conservation Law, the November 2012 Foreign Investment Law, Rules of the Conservation of Water Resources and Rivers Law (2013) and the Land Acquisition Act that, if systematically enforced, would improve environmental protection and the land-based rights of local populations. Myanmar became a party to the CBD in 1994. Article 14(1)(a) of the Convention requires an EIA and Article 8(j) mandates indigenous participation where there is a significant impact on biodiversity.

3.2 THE ENVIRONMENTAL CONSERVATION LAW 2012 (ECL)

3.2.1 Objectives

The ECL, the landmark law specifically dedicated to address environmental conservation, was enacted:

- a) to implement the national environmental policy;

- b) to lay down basic principles and provide guidance to systematically integrate environmental conservation matters with the sustainable development works;
- c) to build a healthy and clean environment and to conserve natural and cultural heritage for the benefit of current and future generations;
- d) to restore the deteriorating and disappearing ecosystem to the fullest extent possible;
- e) to enable to manage and implement for the decrease and loss of natural resources and for enabling the benefits of sustainable use;
- f) to enable promotion of public awareness and cooperation in the matters of environmental conservation;
- g) to enable promotion of international, regional, and bilateral cooperation in the matters of environmental conservation; and
- h) to co-operate with the government departments and organisations, international organisations, non-governmental organisations and private individuals on environmental conservation matters.¹

3.2.2 Current Position

Though the ECL paves the way for the use of EIA and/or SIA in evaluation of issuing a prior permission for prescribed businesses, the prior permission scheme itself is discretionary and there is currently no basis in the law for the Ministry to determine whether or not to issue a permit, and whether to impose environmental compliance conditions on the user. Also, some of the Ministry of Environmental Conservation and Forestry's (MOECF) broad powers granted under the law require the approval of the Union Government and the Environmental Conservation Council (ECC) but without the clear power and basis of the approval.

There are no regulatory guidelines and rules specified to enable the ECL to be operable: such as setting the environmental quality standards, emission standards, and classes of hazardous waste and substances. In addition, there is a need to cover the non-point sources of pollution that is not discussed in the ECL.

The ECL provides for integration with sectoral policies and co-ordination amongst the Ministries and departments.²

The maximum monetary fine imposable under the law is only Kyats 2,000,000 or about USD 2,300.

¹ ECL Section 3

² ECL Section 18

3.2.3 Obligations of Business Owners and Occupiers

The polluter at source has obligations to clean, discharge, dispose, or keep pollutants in accordance with the prescribed standards³.

The owner or occupier of business activities, materials or places that are source of the pollution must install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If this is not possible, it must be arranged to dispose the wastes in accordance with environmentally sound methods⁴.

The individuals or organisations carrying on the businesses in the industrial zones, or special economic zones or businesses set by the government ministries have responsibilities to contribute either in cash or in kind and carry out the management of pollutants and environmental conservations including the treatment of wastes collectively⁵; must give the fees for the usage and expenses incurred in connection with management of environmental conservation by the relevant industrial zones, special economic zones and business organisations⁶; and must comply with the environmental conservation directives published by the relevant industrial zone, special economic zone or the business organisations⁷.

3.2.4 Insurances

The person who has obtained the necessary prior permission to carry out the business concerned must obtain the environmental accident insurance in accordance with the existing laws⁸.

3.2.5 Prohibitions, Offences and Penalties

No one is allowed to operate business, worksite, factory, or workshop which is required to obtain a prior permission without the prior permission from the Ministry⁹. The violation of this prohibition constitutes an offence punishable by imprisonment with a term not exceeding 3 years, fines with an amount not smaller than Kyats 100,000 and not greater than Kyats 1,000,000, or both¹⁰.

³ ECL Section 14

⁴ ECL Section 15

⁵ ECL Section 16(a)

⁶ ECL Section 16(b)

⁷ ECL Section 16(c)

⁸ ECL Section 26

⁹ ECL Section 28

¹⁰ ECL Section 31

No one shall violate any prohibition contained in the rules, notifications, orders, directives and procedures issued under the ECL¹¹. The violation of this prohibition constitutes an offence punishable by imprisonment with a term not exceeding 1 year, a monetary fine, or both¹².

No one shall, without permission of the MOECAP, import, export, produce, store, carry or trade any material which can have an adverse impact on the environment¹³. Any violation of this prohibition will attract a prison term of minimum 3 years and maximum 5 years, a monetary fine of minimum Kyats 100,000 and maximum Kyats 2,000,000, or both¹⁴.

3.3 FOREIGN INVESTMENT LAW 2012 (FIL)

The FIL, in its Basic Principles, states that the investment shall be allowed based upon principles including “protection and conservation of the environment”¹⁵.

The duties of the investor requires the carrying out of business in a manner not to cause environmental pollution or damage in accord with existing laws in respect of investment business¹⁶.

3.4 RULES OF THE FIL

3.4.1 Notification No 1 of 2013.

The list of Economic Activities under Prohibition includes:

- Installation of Factory in Myanmar utilizing of the imported wastes
- Manufacturing of hazardous material which are not in compliance with the environmental and conservation Law, Rules and Procedures promulgated from time to time.
- Activities which may emit hazardous chemicals, minerals, rays, noise, particles etc., and may cause earth/water/air pollution which affect public health.
- Exploitation of minerals including gold in the revering and water way.

The list of Economic Activities Permitted with Specific Conditions includes at No (3) includes Economics activities which required Environmental Impact Assessment.

¹¹ ECL Section 29

¹² ECL Section 32

¹³ ECL Section 30

¹⁴ ECL Section 34

¹⁵ Fill Clause 8(I)

¹⁶ Fill Clause 17(h)

Exploration and production of minerals, manufacturing of iron, steel and minerals and operation in cultural heritage, archaeological and prominent geographical symbolical sites, etc., all require that it will allowed subject to the need for Environmental Impact and Social Impact or Environmental Impact and less Social Impact carried out for initial study of environment.

3.5 MINES LAW (1994) (MML) AND ASSOCIATED MINES RULES

The Mines Law (1994) aims to protect the environment from mining operations that may be detrimental to conservation of environmental quality.

Section (3) of the Mine Law states the objectives as follows:

- To carry out for the development of conservation, utilisation and research works of mineral resources;
- To protect the environmental conservation works that may have detrimental effects due to mining operations.

Under duties of the holder of Permit, it is stated that the holder of permit shall comply with the rules prescribed under this Law in respect of the following matters:

- Making provisions for safety and the prevention of accidents in a mine and their implementation;
- Making and implementation of plans relating to the welfare, health, sanitation and discipline of personnel and workers in a mine;
- Making provisions for the environmental conservation works that may have detrimental effects due to mining operation;
- Reporting of accidents, loss of life and bodily injury received due to such accidents in the mine; and
- Submission to the inspection of the Chief Inspector and inspectors¹⁷.

Rules 69 to 73 govern the rights of utilisation of land and water for mineral production which includes the provisions of the responsibility of the mineral permit holder so that there is no pollution of the environment due to the use of land and water.

The holder of a mineral exploration permit or a mineral production permit must backfill or otherwise make safe bore holes, excavations, surface of land damaged during the course of underground mining operations to the satisfaction of the Ministry or the Department. The holder must also establish forest plantations or pay compensation to the Ministry of Forestry, if trees were cut and cleared for mineral exploration or mineral production within a forest land or in a land area covered with forests.

¹⁷ MML Section 13

In disposing of liquids, wastes, tailings and fumes which have resulted from mineral production, the holder of a mineral production permit must undertake laboratory tests as may be necessary for the prevention of pollution of water, air and land in the environment and for the safety of living beings. If toxic materials are found in the waste products, which are harmful to living beings, degradation shall be made by chemical means and systematic disposal shall be made only when it is assured that there is no danger.

The holder of a permit for mineral production within an area under the Ministry's administrative control or which does not lie within the Mineral Reserve Area or Gemstone Tract, shall carry out such production only after co-ordinating and receiving agreement from the individual or organisation having the right of cultivation, right of possession, right of use and occupancy, beneficial enjoyment, right of succession or transfer of the said land¹⁸.

If the holder of a mineral production permit requires the use of public water for mineral production he shall first and foremost inform the Department of such requirement in accordance with the prescribed manner¹⁹.

If the Department, after scrutinising the requirement submitted under Section 16 finds that the use of public water is necessary for the holder of a mineral production permit, it shall co-ordinate with the relevant government department(s) and organisation(s) to obtain permission to use water in accordance with the existing law²⁰.

Chapter XXI of the Myanmar Mining Rules (MMR) describes "making provisions to prevent detrimental effects due to mining operations on the environmental conservation works". The requirements include:

- Backfilling or making safe bore holes, excavations or surface of the land damaged during the course of underground mining²¹; and
- Undertaking laboratory tests, as necessary, to prevent pollution of water, air and land²².

3.6 NATIONAL COMMISSION FOR ENVIRONMENTAL AFFAIRS

Environmental protection in Myanmar previously came under the authority of the National Commission for Environmental Affairs (NCEA), formed in 1990. Until 2005, the

¹⁸ MML Section 14

¹⁹ MML Section 16

²⁰ MML Section 17

²¹ MML Section 105

²² MML Section 106

Minister of Foreign Affairs was the chair of NCEA. In 2005, however, the NCEA was transferred under the Ministry of Forestry (MoF), and the Minister of Forestry assumed the role of the NCEA chairperson.

The stated objectives of the NCEA were to set environmental standards, create environmental policies for using natural resources, issue rules and regulations to control pollution, and to create short- and long-term environmental policies which balance environmental needs and development requirements.

The NCEA has drafted the Environmental Impact Assessment Rules, which are pending approval by the government, to complement the ECL 2012.

3.6 ENVIRONMENTAL POLICIES

A national environmental policy was drafted by the NCEA in 1994. The National Environment Policy is as follows:

“To establish sound environment policies, utilisation of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy: The wealth of the nation is its people, its cultural heritage, its environment and its natural resources.”

The objective of Myanmar’s environmental 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 the life of all its citizens. Every nation has the sovereign right to utilise 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 interests of present and future generations.

The development of the environmental policy was followed by the drafting of ‘Myanmar Agenda 21’ in 1997, which follows a UN framework for a multi-pronged approach to sustainable development. The Myanmar Agenda 21 recognises the need for Environmental Impact Assessments. Myanmar, in its Agenda 21, calls for integrated management of natural resources and provides a blueprint for achieving sustainable development.

The ECL provides more institutional space to regulate environmental quality and conduct EIA’s and SIA’s for infrastructure and investment projects funded by the government and private sector.

3.7 MYANMAR INVESTMENT COMMISSION (MIC)

The MIC issued a Notification on 30 June 1994 on Protection of Environment stating that:

1. The Myanmar Investment Commission, at its meeting 8/94 held on 17 June 1994 has resolved that all projects established with the permission of the Commission shall be responsible for the preservation of the environment at and around the area of the project site. The enterprises are entirely responsible that they shall be able to control pollution or air, water and land, and other environmental degradation, and that they can keep the project site environmentally friendly.
2. Consequently, it is hereby notified that treatment plant, industrial waste water treatment plant and other pollution control procedures should be promptly implemented and abide with the sanitary and hygienic rules and regulations set by the authorities concerned.
3. In the future proposals that are to be submitted to the Commission, either under the Union of Myanmar Foreign Investment Law or the Myanmar Citizens Investment Law, shall incorporate the provision in their contracts that they shall undertake proper sewage and industrial wastewater treatment systems and other environmental control systems. The system so used shall be in accordance with the rules and regulations specified by the respective development committees and local authorities.

3.8 IMPACT ASSESSMENTS IN MYANMAR

One of the most important internationally-accepted environmental protection methods is to conduct an environmental and social impact assessment (ESIA) prior to implementing development projects. An ESIA identifies, predicts, evaluates, and mitigates the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. The ESIA is supposed to provide appropriate opportunities to inform and involve stakeholders in a project. In the absence of formal regulations and guidelines in Myanmar regarding the scope and content for ESIA, the International Association for Impact Assessment has guidelines on the objectives and principles of an ESIA which should be used to inform this ESIA process²³.

Social impact assessment (SIA) should cover 'all social and cultural consequences to human populations of any public or private actions that alter the ways in which people

²³ http://www.iaia.org/publicdocuments/special-publications/Principles%20of%20IA_web.pdf

live, work, play, relate to one another, organise to meet their needs, and generally cope as members of society' and 'cultural impacts involve changes to the norms, values, and beliefs of individuals that guide and rationalise their cognition of themselves and their societies' (Burge and Vanclay, 1996).

3.9 NATIONAL SUSTAINABLE DEVELOPMENT STRATEGY

The National Sustainable Development Strategy (NSDS) is part of a broader programme of the UN Sustainable Development Commission set up after the World Summit on Sustainable Development in 2002. Every country, including Myanmar, that signed Agenda 21 at the Earth Summit in Rio de Janeiro in 1992, agreed to develop an NSDS by 2010 in line with the Millennium Development Goals (MDGs). UNEP provided funding for Myanmar to develop an NSDS. The main aim of the process was to develop an NSDS in line with international standards by meeting the MDGs and ensure that environmental and social impacts are mitigated when implementing development projects. The NCEA took a lead in developing the strategy in consultation with the government and a small number of NGOs. Myanmar's NSDS was published in August 2009.

The three goals described in Myanmar's NSDS are sustainable management of natural resources, integrated economic development and sustainable social development. 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 utilisation, and so on.

The NSDS was officially accepted by the Ministry of Planning. In theory, it is a guiding document for government ministries, departments and local authorities, UN organisations, and international and local NGOs. Implementation of the strategy will be assisted by adoption of the ECL and its accompanying regulations and guidelines and the development of sectoral-specific regulations that seek to enhance environmental protection and efficiency of resource use.

The United Nations Environment Program (UNEP) (BEWG, 2011) has stated that there are opportunities to review and further develop the strategy in the future.

3.10 INTERNATIONAL COMMITMENTS

Myanmar has signed a number international treaties related to the environment which may have implications for the Project. These include:

- Plant Protection Agreement for the Asia and Pacific Region; Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer;
- London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer;
- United Nations Framework Convention on Climate Change (UNFCCC); United Nations Convention to Combat Desertification;
- International Civil Aviation Organisation: ANNEX 16 Annex to the Convention on International Civil Aviation Environmental Protection Vol. I, II, Aircraft Noise;
- Vienna Convention for the Protection of Ozone Layer;
- Montreal Protocol on Substances that Deplete the Ozone Layer;
- Convention Concerning the Protection of the World Cultural and Natural Heritage;
- Convention on Biological Diversity (CBD); International Tropical Timber Agreement (ITTA);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- ASEAN Agreement on the Conservation of Nature and Natural Resources; Cartagena Protocol on Biosafety;
- Kyoto Protocol to the United Nations Framework Convention on Climate Change;
- Ramsar Convention on Wetlands; and
- Copenhagen Amendment to Montreal Protocol on Substances that deplete the Ozone Layer.

3.10.1 United Nations Declaration on the Rights of Indigenous Peoples

Myanmar was one of 144 states that endorsed the United Nations Declaration on the Rights of Indigenous Peoples in September 2007. Article 32 discusses indigenous peoples' right to free and prior informed consent (FPIC):

"States shall consult and co-operate in good faith with the Indigenous Peoples concerned through their own representative institutions in order to obtain Free and Prior Informed Consent prior to approval of any project affecting their land or territories".

Article 10 discusses forcible relocation of indigenous people, and the need for FPIC and Article 26 about land rights are also relevant articles for indigenous peoples in relation to this project. It is good practice to ensure that relocation takes place following the free, prior and informed consent of the indigenous peoples concerned and after agreement on just and fair compensation and, where possible, with the option of return if that is possible following mining.

3.10.2 Environmental Conservation Department (ECD)

Environmental Conservation Department (ECD) was established on 11 October, 2012.

The Objectives of ECD are as follows:

1. to implement the National Environment policy
2. to develop short, medium and long term strategy, policy and planning for the integration of environmental consideration into the sustainable development process.
3. to manage natural resources conservation and sustainable utilization
4. to manage the pollution control on water, air and land for environmental sustainability
5. to cooperate with government organization, civil societies, private and international organizations for the environmental affairs.

The ESIA should conform to all relevant international environmental and social conventions ratified by Myanmar.

Where no appropriate Myanmar standards are available, standards or guidelines based on IFC guidelines or other international best practice will be applied to the project and existing environmental conditions.

4. CURRENT DESCRIPTION OF THE PROJECT

4.1 RESOURCE OVERVIEW

The Project is situated along the Inner Volcanic Arc which lies within the Central Myanmar Subsidence Belt and occurs in Late Tertiary pyroclastics and late stage andesite dacite on the west bank of the Chindwin River. The deposits are high sulphidation copper deposits formed by weathering, leaching and supergene enrichment of porphyry copper ores. There are four copper deposits distributed in a north-west direction among which Sabetaung, Sabetaung South and Kyisintaung are neighbouring deposits. Letpadaung deposit is 7 km to the south-east of Sabetaung deposit, the largest one of the four. Please refer to Figure 1.2 for the relative location of the Sabetaung and Kyisintaung (S&K) Mine.

Letpadaung deposit is a concealed deposit beneath two mountains and their valley. The deposit is gold-ingot-shaped with a flat top, trending north-west and approximately 2,200 m long and 1,400 m wide and the occurrence is basically horizontal. The ore body has an average thickness of about 140 m, and an average copper grade of 0.37%.

There is a 10-200 m thick leaching zone between the ore body and surface. Under the leaching zone is a layer of secondary enrichment zone at the thickness of several metres to dozens of metres which is the high grade ore section and concentrated in the valley between two hill tops. Beneath the secondary enrichment zone is a mixed belt composed of primary and secondary sulphide, silicate and sulphate minerals. Further downward is a primary zone consisting of andesite porphyry and dacite porphyry. There is no clear boundary between each pair of zones.

Due to secondary leaching of the deposit, part of the secondary ores under the leaching cap contains mud. Categorization is made based on clay content:

- High clay ores (clay content >15%) account for 3%;
- Medium clay ores (clay content between 10% and 15%) 4%; and
- Low clay ores (clay content 0%-10%) 93%.

Generally speaking, clay content is not high and far lower than that of the Sabetaung deposit.

North-west and north-east trending hydrothermal breccias are developed in the district close to north-west and north-east trending faults in the form of an echelon swarm or veinlet-disseminated structure with local several-centimetre to several-metre thick dykes, pinching to various directions. Hydrothermal breccia are closely related to high grade copper ores.

Major minerals in primary ores include chalcite, covellite, enargite, chalcopyrite and bornite. Major minerals in secondary ores include chalcite, covellite, alpha chalcocite and sulphurous copper ores. Major gangue minerals include, but are not limited to, feldspar, quartz, sericite, chlorite and clay minerals.

A series of geological exploration and prospecting programmes have been carried out at the Letpadaung deposit. One hundred and forty three straight holes were drilled to an average depth of 219 m for a total metreage of 31,286 m before 1994. From November 1994 to December 1996, IMHL conducted further exploration programmes on the Letpadaung deposit including 533 drill holes, of which there are 304 core sampling holes, 19 hydrogeological holes, 12 metallurgical test holes and 198 confirmation holes.

In March 1997, Mineral Resource Development Incorporation (MRDI) developed a geological model of the deposit using Medsystem (MineSight) based on 204 drill holes completed until September 1996. The MRDI model follows Canadian NI43-101 standard, estimating measured and indicated resources with a 70 m grid and inferred resources within a 70 m to 140 m grid, upon which the Feasibility Study was based. The current design is based on inferred resources in view of subsequent drilling.

In August 1997, Minproc built a geological model of the deposit using Datamine based on 304 drill holes completed up to December 1996. The Minproc model follows the Australian JORC standard, estimating measured resources with a 70 m grid, indicated resources with a 140 m grid and inferred resources where the grid exceeds 140 m. The development plan of Letpadaung Mine is prepared based on the Datamine model.

In December 2008, Wanbao Mining Ltd. organised a group of experts for a field survey of the Project and a report “Monywa Copper Project (formerly MICCL) Field Survey Report before Production is Resumed” was prepared.

In March 2009, based on geological data provided by Wanbao Mining Ltd, China Non-ferrous Metals Resource Geological Survey Centre and Sinotech Mineral Exploration Co., Ltd. prepared the report “Myanmar Sagaing Monywa Copper Mine Resource Reserve Verification Report” which was submitted in April 2009.

Based on the Chinese geological exploration code, DZT/ 0214-2002, the Letpadaung deposit is categorised into exploration Category I with a 200~240 m × 100~200 m grid used to estimate indicated resources and a 100~120 m × 50~100 m grid used to estimate measured resources.

The resources calculated in this design at the cut-off grade of Cu 0.1% are summarised in Table 4.1.

Table 4.1: Summary of resources calculated in the design

Resource Category	Ore Quantity (kt)	Copper Grade (%)	Metal Quantity (t)
Measured	611,068	0.43	2,621,301
Indicated	528,952	0.35	1,866,164
Inferred	448,142	0.31	1,394,405
Total	1,588,162,000	0.37	5,881,870

4.2 HYDROGEOLOGY

The strata of the Letpadaung deposit are divided from the top down as follows:

- The upper unit is a clay-rich alluvial and slope deposit aquifuge;
- The middle unit is a Quaternary formation sandy gravel aquifer containing silt and clay; and
- The lower unit is a Tertiary sediments and volcanic fissure aquifer.

Factors that will influence the water levels in the Letpadaung open pit are mainly atmospheric precipitation and water from the Quaternary aquifer and bedrock fissure aquifer. Studies on the hydrogeological conditions of the deposit are insufficient and as yet unclear. MWMCL has conducted supplementary hydrogeological survey programmes which indicate that there will be no major impact on mining of the Letpadaung open pit by groundwater and the Chindwin River if preventative measures are taken.

4.3 SLOPE DESIGN

Outcropping lithology in the mine area includes Magyigon formation pyroclastics, andesite porphyry, a dacite porphyry intrusive body (mineralisation parent rock) and extensively outcropped Quaternary clay, alluvial and slope deposits. The recommended final slope parameters for the Letpadaung Mine presented in the Slope Engineering Geologic Study Report prepared by Golder Associates in 1996 are as follows:

- Ultimate bench height 30 m;
- Ultimate batter angle 60° (upper leaching cap), 65° (lower rocks);
- Ultimate overall slope angle 45-50°.

Preliminary studies suggest that the rock is quite competent.

4.4 SEISMICITY

The project area is located in an earthquake active area and many earthquakes greater than magnitude 7 are known to have occurred through history. A magnitude 7.2 earthquake occurred in 1938 whilst the largest recorded earthquake (magnitude 8.0) took place in 1912. Based on the latest seismic zone map of Myanmar (revised version, 2005) provided by MWMCL, the project area lies in seismic zone 3 (strong seismic intensity zone) and the range of probable ground accelerations is 0.2 g-0.3 g. The design basis seismic acceleration value is 0.2 g, equivalent to a seismic intensity of 8 according to the Chinese standard.

4.5 GENERAL LAYOUT

The Project will comprise a complex of mining, process and metallurgical functions to produce 100 kt/a of cathode copper. The Project will consist of an open pit, mining area, crushing area, SX-EW plant, heap leaching area, waste dump, waste dump flood pond, wastewater conditioning pond, ammonium nitrate and explosive initiator magazine, general warehouse, administration area, step-down sub-station, accommodation village, water source and other accessory facilities.

4.5.1 Open Pit

The main access elevation into the pit will be located at RL120 m with the top bench elevation at RL315 m. The upper surface of the pit is approximately 2,700 m long and 1,900 m wide with an east-west orientation along its length. The base of the pit will be about 600 m long and 120 m wide with an elevation at the base of RL –345 m.

It is planned to mine the open pit in two sections. Section I has a mine life of 19 years and Section II will be mined for an additional 13 years. Total excavation area of the open pit will be 325.0 ha, with Section I being 207.0 ha and Section II 118.0 ha. A series of figures depicting the staged development of the pit are shown as Figures 4.1 to 4.5.

4.5.2 Mining Service Area

The mining operation will be serviced from an area comprising office buildings (including dispatching office, management and technical staff office, canteen and bathroom), parking lot and switchyard, oiling station, mining dispatching building, open pit high-voltage sub-station and draining facilities. The mining service area occupies 22.5 ha.

4.5.3 Crushing Area

The crushing area will comprise a semi-portable crushing station, primary crushing product stockpile, secondary crushing plant, screening plant, qualified crushed ore

stockyard, sub-station, in-pit crushing station and transfer station. The crushing area will occupy 13.5 ha.

Semi-portable crushing stations are to be located within the open pit to reduce truck haulage distance.

The crushing system of primary crushing products stockpile, secondary crushing plant, screening plant and qualified crushing product stockpile will be arranged along the existing passage between the two hills in the shape of an “L” so as to optimise land and earthworks volume.

4.5.4 Heap Leaching Area

This area will be located to the south-west and south of the open pit, and will comprise a belt conveyor, tripper trailer, bridge-type stacker, heap leaching pad, pregnant liquor stream (PLS) pond, intermediate liquor stream (ILS) pond and raffinate pond. The area will occupy 1,169 ha at elevations ranging between RL77.8 m and RL154.8 m.

The heap leaching area will be divided into Nos. 1, 2 and 3 heap leaching pads. No. 1 and No. 2 pads are to be operated during the first 13 years whilst No. 3 pad is to be used after the 13th year. No. 1 and No. 2 pads occupy an area of about 845 ha and the active area for ore stacking is 693 ha. No. 3 pad will have an area of 322 ha and the active area for ore stacking will be 266 ha. Nos. 1 and 2 pads have an outline dimension of 770 m × 4,500 m, with 15 cells each sized 770 m × 300 m. Due to the proximity of the regional arterial highway, the area of No. 2 pad will be reduced slightly at the south-west corner.

The general solution flow of the 3 pads will be from north to south. The pregnant solution, intermediate solution and raffinate ponds will be located south of the pads. No. 1 heap leaching pad will be situated at elevations of between RL112.5 m and RL76 m, and No. 2 pad at between RL115.5 m and RL77 m.

4.5.5 Temporary Pads for Low-Grade Ore

During the whole production period, the amount of low-grade ore that will be produced is approximately 31,053 kt. This material will be stacked separately, to be treated depending upon the market price of copper.

No. 3 pad will be started in the 13th year, and therefore part of this pad near to the mining area can be used as a temporary storage for low-grade ore. At a height of 30 m this stockpile will have a capacity $700 \times 10^4 \text{ m}^3$. If insufficient, the pad could be expanded to the south to meet additional storage requirements.

4.5.6 Heap Leaching Test Area for Low-Grade Ore

A triangular parcel of land, separated from the mining area, will be designated for heap leach testing of low-grade ore.

4.5.7 Waste Dumps

In order to minimise haulage distances, 3 waste dumps will be located around the mining area. Waste Dump No. 1 (WD1) will be located north of the open pit and will extend to the east gradually. Counter dumping will be adopted to form a stockpile height of 150 m to 225 m, with a capacity of $17,795.6 \times 10^4 \text{ m}^3$. Waste Dump 2 (WD2) will be located to the west of the pit and will have a capacity of $9,585.3 \times 10^4 \text{ m}^3$. Waste from early-stage works will be dumped from RL250 m elevation. After the 180 m bench is developed, all waste will be dumped from this elevation. Downward dumping will be used for benches below the elevation of 180 m, whilst upward dumping to elevation RL230 m will be used for those above 180 m. Waste Dump 3 (WD3) will be located south of the pit, where counter dumping will be used to form a stockpile height of 200 m with nominal capacity of $8,133.5 \times 10^4 \text{ m}^3$. The total capacity of the 3 dumps is $35,514.4 \times 10^4 \text{ m}^3$ versus the expected quantity of waste rock of 689,375 kt (equivalent to about $34,000 \times 10^4 \text{ m}^3$). Approximately 99,375 kt of waste rock is expected to bear copper, so a separate area is proposed to the west of No. 1 pad and to the south of No. 2 pad for stacking this waste rock, awaiting future processing.

Waste stockpiles will be configured as follows:

- single bench height 25 m;
- berm width 25 m;
- bench slope 1V:1.75H; and
- final overall slope of 20°.

At the toe of each waste dump, bulk waste will be placed to a height of 5 m to 10 m for the purpose of managing drainage from the waste dumps.

A retention bund is proposed to be constructed along the eastern perimeter of the plant area to prevent pollution of the Chindwin River. The bund will be constructed with earth fill to an elevation of RL76 m. Flood protection for the operation will also be provided by the bund wall.

4.5.8 SX-EW Area

This area will be located on the east side of the heap leach pad approximately 180 m from the ore stockpile. The SX-EW plant will consist of a solvent extraction (SX) plant, flux oil warehouse, electro-winning (EW) plant, final product preparation and stockyard,

compressed air station, boiler house, emergency diesel power generator station and sub-station. The footprint area is approximately 19 ha.

4.5.9 Comprehensive Maintenance Workshop

This workshop will be located to the north of the heap leaching pads, and to the south of the mining and crushing area. The proposed workshop incorporates mechanical repair, vehicle repair and electrical repair workshops, and will occupy an area of approximately 12 ha.

4.5.10 Flood Pond and Wastewater Conditioning Pond for Heap Leaching Pads

The flood pond will be located at the south-east corner of the plant area and occupies an area of 64 ha. It will serve to accommodate the acidic copper bearing water collected during storm events in Nos. 1 and 2 heap leaching pads and their accessory areas. The pond will be expanded after No. 3 pad is put into operation in the 13th year of production. The pond embankment will be constructed with earth fill to a crest elevation of RL78.5 m and crest width of 3.0 m. The embankment will be approximately 3,171 m long. The embankment crest will be highest at the north-east corner, approximately 4.6 m above surrounding ground level. Both upstream and downstream batter slopes will be constructed slopes of 1V:2H. The capacity of the pond at RL78.0 m is 2,224 million litres, which is sufficient to store run-off arising from a 1 in 50 year, 24-hour rainfall event occurring over a catchment of 194.6 ha from No. 1 and No. 2 heap leaching pads, and including the flood pond itself (69.64 ha).

The wastewater conditioning pond will be located to the east of the flood pond, and occupies an area of 149 ha. The embankments will be constructed with earth fill, to a crest elevation of RL64.5 m along the north, west and south sides, and to RL76.15 m along the eastern side. It will be connected with the water retention bund, forming a total capacity of 4,645 ML, capable of storing the maximum expected rainfall arising from a 1 in 20 year event.

4.5.11 Ammonium Nitrate and Explosion Initiator Magazine

The magazine is proposed to be located north-east of the heap leaching pads and west of WD3, and comprises an area enclosed by the southern perimeter of the open pit. The area will incorporate a production division and magazine division, located 200 m from each other. The magazine facility will occupy an area of about 5 ha.

The production division will incorporate 4 ammonium nitrate warehouses which belong to the hazardous building. Each warehouse stores 500 t of explosive, for a total storage of 2,000 t.

The hazardous building includes No. 1 and No. 2 explosive initiator magazine. No. 1 magazine is class 1.1 in hazard rating, with a calculated explosive amount of 14 t; No. 2 magazine is class 1.1 in hazard rating, with a calculated explosive amount of 0.02 t.

4.5.12 Water Supply System

The water supply system includes the water source, fresh water supply system, mining water supply system, fire water supply system, domestic water supply system, cooling water circulation system and wastewater collection and utilisation facility. Fresh water will be taken from the Chindwin River and pumped to a 2,500 m³ header tank located in the metallurgical plant. The header tank will be located on the western slope of the hill where the crushing station is located. The tank base elevation is at approximately RL155 m.

4.5.13 Power Supply System

The power supply system is mainly composed of a 230 kV step-down sub-station connected to the national electricity grid, a 35 kV sub-station and other various sub-stations. The 230 kV step-down sub-station will be located to the east of the SX-EW plant, and to the south of the administration area. The 35 kV sub-station will be located on the southern slope of the crushing area. The facility occupies an area of 1.1 ha.

4.5.14 Warehouse and Supply Store

The warehouse is proposed to be located to the west of the crushing area, and to the south of the mining area, and mainly comprises the comprehensive warehouse, metal warehouse and material shed. The comprehensive warehouse is mainly composed of a spare parts store and miscellaneous store. The metallic material warehouse is for storing steel, and the material shed is to be used for storing metal, plastic pipe and other construction consumables. The facility occupies an area of 1.1 ha.

4.5.15 Administration Area

The administration area is located to the south of the flood pond and waste water conditioning pond. It is mainly composed of office buildings, canteen, parking lot, sub-station, clinic, firehouse, laboratory and weigh house. The buildings in the administration area are proposed to be founded at an elevation of approximately RL78.0 m. The facility will occupy an area of 4.9 ha.

The arterial road towards the south of the administration area is the main access from the highway into the plant area and will be constructed along the alignment of the existing road formation in order to avoid damaging the existing village infrastructure.

The weighbridge and control room will be located south of the arterial road and close to the main access.

4.5.16 Accommodation Village

The accommodation village will be located in the reserved area of S&K mine to the north-west of the mine area, near to the local arterial highway and mine access. It incorporates 3 parts, the long-term employee dormitory area, Chinese management staff dormitory area, and Myanmar management staff dormitory area, arranged from east to west. The camp will occupy an area of 35 ha.

4.6 WATER SUPPLY AND DRAINAGE SYSTEM

The forecast total industrial water consumption is 30,340 m³/d including 16,500 m³/d of fresh water (mining 1,200 m³/d, crushing and heap leaching 12,505 m³/d, electro-winning and extraction 814 m³/d, boiler house and compressed air station 114 m³/d, contingency 1,867 m³/d, and 13,840 m³/d of cooling circulation water). In addition, 81,295 m³/d of raffinate will be circulated. The forecast utilisation rate of return water to the SX-EW plant is 86.2% and the expected domestic water consumption is 300 m³/d.

The Chindwin River is east of the project area at a distance of approximately 3 km. Perennial flow of the river is 3,860 m³/s, water depth is 1.5 to 10.25 m (5 m on average) depending on the season, the pH value is between 7.3 and 8.0, being slightly alkaline, and the total dissolved solids are from 49 to 123 mg/l. Water quality and quantity can meet production and domestic water requirements of the project. The Chindwin River will be used as the fresh water source for the mine, and both the quality and flow rate are sufficient for the requirements of the project.

The water supply system includes fresh water supply, mining water supply, fire water supply, domestic water supply, and the cooling circulation water supply system, as well as the wastewater collection and utilisation facility.

4.6.1 Fresh Water Supply

An 18 m by 6.6 m steel barge will be installed on the Chindwin River, incorporating five (5) units of self-priming water pumps (one for work and one standby). These pumps will pump water via a 7.2 km-long 477 mm welded steel pipeline to the fresh water purifying station. At the purifying station, the water passes through two (2) fully hydraulic automatically control integrated high turbidity purifiers before flowing by gravity to the 2,500 m³ header tank (Φ30 m×4 m, bottom elevation RL155 m) in the SX-EW plant to supply fresh water to the circulation water system of the SX-EW plant, (make-up water for heap leaching does not need treatment).

4.6.2 Mining Water Supply

The water from the 2,500 m³ header tank will be delivered by tanker to the mining area for spraying water on roads and dust suppression of the blasting muck pile.

4.6.3 Fire Water Supply

Fire water supply along with other fire suppression measures are provided throughout the SX-EW plant, flux oil house, light oil house, explosives magazine, diesel power plant and 230 kV step-down station.

4.6.4 Domestic Water Supply

The domestic water consumption of the project is 300 m³/d, which will be taken from the water source by means of a booster pump before entering a domestic water treatment plant, which will disinfect water for domestic use by chlorine dioxide dosing. Disinfected water will be stored in a 100 m³ stainless steel water tank and flow by gravity to domestic users.

4.6.5 Cooling Circulation Water Supply

The total amount of cooling water for the project is 13,198 m³/d, including the rectifier cooling water demand of 12,600 m³/d, EW cooling water requirements of 48 m³/d, and the compressed air station cooling water requirement of 1,920 m³/d.

4.6.6 Wastewater Collection and Utilisation Facility

The rainfall from WD1 catchment and the groundwater inflow into the open pit below the 90 m bench may possibly be weakly acidic (pH=5~6), and consequently this water will be collected and transferred to the wastewater conditioning pond before being pumped to the heap leaching pads as make-up water. As wastewater quality information is not available, any treatment considered is temporary as it will be amended according to the quality of water presented for treatment. The water in the wastewater conditioning pond will be used as much as possible and stored for the least time possible. The wastewater in the plant area shall be drained only when required to provide a safe working condition. It is calculated that the wastewater conditioning pond needs a balancing storage of 382.98 ha. Water from the wastewater conditioning pond will be conveyed via a 6.3 km-long pipe to the heap leach ILS pond or raffinate pond.

Domestic sewerage will be treated by one WSZ15 underground domestic sewage treatment facility before being drained to the wastewater conditioning pond.

4.7 POWER, AUTOMATION SYSTEM AND TELECOMMUNICATIONS

4.7.1 Electric Power

The Project is located in the relatively developed industrial area in middle and western Myanmar. The power source of its electricity system is mainly hydro-power stations. Yeywa power station, one of the national main hydro-power stations of Myanmar, is approximately 133 km from the mine in linear distance and 184 km by road. Yeywa power station consists of four 197.5 MW power generator sets with a total installed capacity of 790 MW. The annual low flow period is 3 months in duration and in this

period only 1 or 2 generator sets can operate normally, depending on the water level. There are two outgoing powerlines from Yeywa station, the Yeywa-Belin 230 kV double-circuit single-tower line and the Yeywa-Meiktila 230 kV double-circuit single-tower line. Belin sub-station is one of the national pivot sub-stations of Myanmar, with voltage class 230/132/11 kV, through which Yeywa station is connected with the Whweli hydro-power station developed jointly by Myanmar and China. Whweli station is composed of six 100 MW generator sets with a total installed capacity of 600 MW. From the Belin sub-station westward there are the Ohntaw sub-station and the Nyaungbingyi sub-station. The Nyaungbingyi sub-station is approximately 5 km from the mine. These sub-stations are connected through 230 kV double-circuit overhead lines.

Presently the national power network in middle and western Myanmar is being upgraded. When the upgrade is completed, a double-bus ring power network with 230 kV sub-station will be formed, and the power supply capability and reliability will be greatly increased. It is intended to supply the Project through the Nyaungbingyi 230 kV sub-station.

Due to the reduced generation capacity at the Yeywa hydro-power station, and the hydro-power station network generally, during the three-month low water flow period, supply of the year-round power requirement to the Project cannot be met through hydro-power supply alone until the Myitkyina hydro-power station is constructed, and at present no construction schedule for this hydro-power station has been finalised. To compensate for this periodic shortfall, diesel powered equipment is to be used as much as possible at the mine site to reduce the power draw from the national electricity grid during low flow conditions. A diesel generator set will also be provided as the emergency power source at the mining site so the power requirements for the open pit drainage system are in continuous supply.

No power use limits in high and low water periods are provided by the national grid of Myanmar and, therefore, the ultimate external power supply plan is to be confirmed after negotiation with the national grid of Myanmar.

An estimated 596 items of equipment are expected to consume a total of 163.3 MW of electricity on the Project. It is estimated that at any one time there will be 520 loaded items of equipment that will draw 148.4 MW of power.

4.7.1.1 On-Site Sub-Stations

Eleven 10 kV sub-stations will be installed to support the power needs of the open pit primary crushing, open pit drainage, heap leach pads and SX-EW plant.

To ensure power supply, a 2 MW diesel power generator will be located in the open pit. If the external power supply fails, the diesel power generator will start and supply power to meet the open pit drainage requirements. The open pit power supply system is independent of the normal power supply source.

4.7.2 Automation System

The project will adopt integrated electrical and instrumentation systems well proven in the production process. Operators will be able to monitor the process parameters and running of electrical equipment in the production control room. The running condition will be recorded automatically to allow monitoring of the whole production process in an integrated and centralised manner. The control system will maintain an interface with the computerised production control management network, which serves the purpose of logging the main parameters from the process flow sheet and equipment status to the real-time database server. This control system will establish the basis for integration of the computerised management and control of the whole mine.

The control room for the crushing and screening area will monitor the process parameters of the crushing plant, screening plant and relative auxiliary facilities.

The control room for the heap leaching pads will monitor the process parameters from the various solution ponds, leaching system pump house and relative accessory facilities. Heap leaching is fundamental to the metallurgical process as it is the source of feed solution delivered to the SX-EW plant.

Control of the SX-EW Plant will be achieved through a control room located in the accessory span of the EW plant, which is the general control room of the project. It will not only operate and control the local plant, but also monitor the production status of the whole mine.

4.7.3 Telecommunications

The project design adopts modern information, digital communication and electronic technologies to establish three centres in the plant:

1. An information centre located in the laboratory building of the administration area, including telephone communications, computer network and CATV for the purpose of broadcasting CATV programmes, communications, management and office automation;
2. A CATV centre located in the activity room of the Chinese living area, which serves the purpose of broadcasting CATV programmes in the living area; and

3. A fire alarm centre located in the firehouse of the administration area, in charge of monitoring and commanding the fire systems for the whole mine area.

Three relatively independent industrial TV monitoring systems will be established to monitor the status of the SX-EW plant and explosives magazine.

To improve the production capacity and efficiency of excavators, haul trucks and other mechanical haulage equipment, one computerised automatic dispatching system for trucks has been designed for the mine production area to provide real-time monitoring of production and the running status of the excavating and haulage equipment. The dispatch tower and centralised computer system will be located in a dispatch building in the mining area.

4.8 TRANSPORTATION

The project site is approximately 5 km (26 km by road) from Monywa. Monywa is 110 km west of Mandalay, the economic centre of central Myanmar, and 722 km north of Yangon. The mine site is connected with the town of Monywa by road and water. Beyond Monywa Town, transportation is available by road, railway (metre gauge) or through a small airport.

Transportation to the Project site will be by truck. The transportation requirement is mainly for cathode copper, production material and spare parts, of which the total volume is 173.96 kt/a including an imported quantity of 73.96 kt/a and exported quantity of 100 kt/a (cathode copper).

4.9 MATERIAL SUPPLY

Supply of wood, sandstone, POLs, etc. required in capital construction and production will be sourced from local manufacturers whilst other materials, such as steel, cement, reagent, explosive materials (detonators, explosives), etc. will be imported. An existing local 15 kt/a sulphuric acid plant will provide the acid supply to the Project.

4.10 OUTSIDE SERVICES

The Salingyi District in Myanmar, where the Project is located, has developed around the agricultural industry. Industry and processing are not well developed and there is little capacity to maintain large earthmoving equipment in the area. There are existing mechanical, truck and electrical repair workshops at the Sabetaung Mine with some maintenance capability. However, it will be necessary to build some repair facilities to ensure daily maintenance of production equipment and assembly exchange can be undertaken. Equipment manufacturers will be encouraged to set up a local technical service centre to provide all-around maintenance and support service.

4.11 VENTILATION, DUST REMOVAL AND THERMAL POWER

4.11.1 Dust Collection

During the crushing, screening and haulage of coarse ore, a significant amount of dust will be produced which has potential effects on the environment and occupational health. Therefore dust created from crushing, screening and belt conveying must be suppressed, collected and cleaned to reduce the potential for pollution. Dust collection systems will be provided within the primary and secondary crushing circuits, screening circuit and vibrating feeders and material fall points of all belt conveyors feeding the product stockpiles.

4.11.2 Ventilation and Air Conditioning

The SX-EW plant will be naturally ventilated. The SX plant will be located outdoors whilst the EW plant will be located in an open-walled shed. Mobile axial fans will be located in each of the plants. A centrifugal fan will be used to remove steam produced by cathode copper scrubbing in the EW plant. Each of the 8 high voltage and low voltage sub-stations proposed for the project will have four steel axial fans. The EW Rectifier Rooms 1 to 3 will have 4 steel axial fans in each room. Other electrical facility buildings will be equipped with mechanical ventilation facilities.

In addition, office buildings, various living buildings, the canteen, activity room and control room will be installed with a split-type air conditioner to maintain indoor temperatures between 24 and 26 °C.

4.12 COMPREHENSIVE MAINTENANCE AND OIL STORAGE

4.12.1 Comprehensive Maintenance Workshop

The comprehensive maintenance workshop will incorporate mechanical repair, vehicle repair and electrical repair areas. The mechanical and vehicle repair areas will share one building, and the electrical repair facility will be located in a nearby independent building so that some mechanical equipment can be shared.

The mechanical repair area will include mechanical machining, plate work and welding sections. The machining section will serve to machine small parts, repair old parts, assemble components, and carry out technical renovation. The plate work and welding section will manufacture pure metal members, as well as welding and repairing plate work and welding members.

The vehicle repair section will carry out maintenance and light repairs to construction machinery and other vehicles (e.g. dump trucks). Vehicle overhaul will be contracted to other companies.

Electrical repair will carry out overhaul, medium repairs and light repairs of some AC motors and transformers, as well as the physical regeneration of transformer oil. High-voltage AC motors and larger transformers will be contracted back to the manufacturers to guarantee the quality of workmanship and ongoing warranty.

The mechanical and vehicle repair workshop design comprises a main span of 18 m and width 117 m long, occupying a land area of 2106 m². The vehicle repair section will have 8 repair posts.

4.12.2 Flux Oil Storage

The flux oil storage holds No. 260 flux oil (III A, kerosene-type special flux, leuco transparent liquid) used for ore extraction. The oil storage has two 200 m³ arc-roof oil tanks for a total capacity of 400 m³. The design flux oil consumption is about 4,488 t/a and the storage period is 25 days. The storage is classified as a Class-V petroleum storage.

4.12.3 Oil Filling Station

The oil filling station holds light diesel (II B), stored in two 300 m³ arc-roof oil tanks for a total capacity of 600 m³. It will be classified as a Class-V oil storage. The design light diesel consumption is about 19,110 t/a and storage for 10 days will be provided.

The oil filling station will have an oil house for storing drummed lubricants, such as machine oil, yellow grease and turbine oil, of which the total design consumption is 1,277 t/a.

4.13 CIVIL CONSTRUCTION

The Project requires a number of new constructions including semi-portable crushing station, secondary crushing plant, screening plant, primary crushing product stockpile, qualified crushing product stockpile, SX-EW plant, electric step-down substation, emergent diesel power generator station, industrial and domestic water supply system, comprehensive warehouse, comprehensive maintenance workshop and living welfare facilities.

The design service life of the project facilities is 50 years.

The seismic magnitude is 8 and the design basis seismic acceleration is 0.2 g. As the project is located in a high seismic zone, most of the construction will consist of steel structures with high seismic-resistant performance.

Building and working platforms will adopt a cast-in-place concrete single foundation under columns. Foundations will be buried no less than 1.2 m. The equipment foundation is made of C25 concrete. If there is any corrosive medium, the concrete strength shall be compliant with Chapter 4.2.3 of the Chinese "Industrial building anti-

corrosion design rule” (GB 50046-2008). Environmental Protection and Water & Soil Conservation.

4.13.1 Environment Protection

Environmental protection on this project shall strictly comply with relevant environmental protection laws, regulations and policies issued by the Chinese Government and the Myanmar Government. In the absence of Myanmar laws, the environmental protection laws, regulations and policies which represent good practice shall apply. Pollutant sources, such as waste rock, wastewater, noise and dust produced during mining, material processing and metallurgy shall be subjected to management measures for environmental protection and treatment to mitigate the impact on the local environment.

4.13.1.1 Water Management

A clean water and waste water separation system will be established across the site to maximise water re-use on the site. For drainage of the open pit, the surface water catchment above 90 m elevation will be drained by gravity through a flood trench on the 90 m bench. Water below the 90 m elevation in the open pit will be lifted and collected in a flood pond for use as make-up water for heap leaching.

The foundations of the 3 waste dumps will be compacted after removal of the topsoil, and a channel will be constructed at the toe of the waste dumps to collect the rainfall run-off from the dumps. WD2 and WD3 will mainly store waste rock from higher elevations of the pit, which are less sulphur-bearing, and the run-off from these two dumps may be able to be discharged directly to the environment as clean water, depending upon the results of on-going water monitoring. WD1 contains materials with a high sulphur content and rainwater run-off from this dump will be collected in a lined channel and drain to a wastewater pond as make-up water for heap leaching.

A two (2) millimetre thick high density polyethylene (HDPE) membrane will be installed as liner to the base of the heap leachpads, and to the leach solution trench, PLS pond, ILS pond, raffinate pond and stormwater pond to mitigate seepage from the leaching operation. An embankment will be constructed around the perimeter of the leach pad to prevent the stormwater catchment contaminating surrounding waters and to separate the catchment outside of the leaching area. The run-off collected on the pad during a storm period shall be collected by solution channels and led to the stormwater pond in the pad, then used in the leaching process after settling to reduce sediments. This water will not be discharged to minimise the wastewater amount within pad.

The cleaning and washing water for SX extractant, and washing water for EW electrolytic copper and ground wash water from these facilities shall be de-oiled in an

oil-water separation unit and then returned to the stormwater pond for re-use in the heap leaching process.

The ground wash water from the crushing and screening facilities and the air compression station, and the treated wastewater from the domestic sewage treatment system shall be collected in the wastewater pond and then returned to the heap leaching process.

4.13.1.2 Noise

The principle of “use of acoustic damping and supplementary noise elimination” will be applied for noise reduction of high noise equipment to reduce the impact of noise on surrounding areas. A sound-proof cover will be placed over crushers and vibration screens. Separate pump rooms will be set aside for high noise pumps, with sound absorbing material lined on the inside walls and ceiling and a sound proof door installed. Vibration reducing devices shall be installed on the foundations of high noise equipment such as crushers, vibration screens, air compressors and water pumps. To improve occupational health protection, the operators at the open pit, crushing and screening sections will work in noise controlled cabs and operations rooms. Where workers are exposed to high noise levels for extended periods, the hours of work will be reduced and the wearing of protective devices, such as ear plugs, protective cotton and ear muffs, will be a workplace requirement.

4.13.1.3 General Environmental Management

Management and monitoring of the mine environment will be undertaken in accordance with environmental standards developed through consideration of relevant Myanmar and international standards. These will be established to guide and co-ordinate the performance of the environmental monitoring plan and ensure that the monitoring is undertaken as part of normal operating protocols and that the operations are strictly carried out to the agreed pollutant discharge and environmental control standards.

4.13.2 Water and Soil Conservation

No local prevention standards for water loss and soil erosion are available in Myanmar. The Chinese Technical Code on Soil and Water Conservation of Development and Construction Projects (GB50433-2008), the Standard on Soil Erosion and Water Loss Prevention in Project Construction (GB50434-2008), and the Standard On Comprehensive Water & Soil Conservation Treatment (GB/T16453.1~16453.6-2008) have been applied in developing the basic design.

The Class I standard for soil erosion and water loss prevention has been applied to this Project. As such, the detailed targets are:

- Remediation rate of land disturbance - 96%,

- Treatment rate of water loss and soil erosion - 91%;
- Control rate of water loss and soil erosion - 100%;
- Slag interception rate - 98%;
- Restoration ratio of vegetation cover - 98%;
- Vegetation cover ratio - 26%.

The main production construction site includes the open pit, mining support services, processing and metallurgy, waste dump, heap leach pad, storm pond, flood control pond, internal service roads, administrative office and auxiliary facilities, and accommodation village. The project general layout will be as compact as possible and is designed to minimise the interruption of the water and soil holding capacity of other land. The scope of water loss and soil conservation prevention for the Project is divided into the project construction area and direct influence area.

4.13.2.1 Project Construction Area

During the life of the Project, construction of the open pit, waste dump and industrial site for processing and metallurgy will need to occupy land which will change the current hydrology and water conservation structures, change the landscape and topography, and increase water run-off and potential for soil erosion. Therefore, the scope of prevention and control responsibility is the same as the scope of land disturbance.

4.13.2.2 Direct Impact Zone

In the construction period, the direct impact zone is mainly the area affected by construction works, stripping of the open pit, site levelling, and development of drainage structures and roads.

During production, the direct impact zone includes the surrounding and downstream area which is impacted by the open pit, processing and metallurgy site, waste dumps and heap leach pads.

The area of disturbance during construction is estimated to be 3,273 ha and the area subject to soil erosion after disturbance at completion of construction is estimated to be 1,100 ha. Without mitigation measures, soil loss due to erosion could amount to 130 kt/a. Waste dumps are the main source of soil erosion during production and the soil loss due to erosion could amount to about 3,000 kt/a without taking measures.

4.13.3 Waste Dump

4.13.3.1 Waste rock

The amount of waste rock within the mining boundary is about $94,604.4 \times 10^4$ t, of which $25,666.9 \times 10^4$ t will be mined from the 20th year of production and disposed of through

in-pit dumping. The balance of the waste rock will be dumped outside the open pit and amounts to $68,537.9 \times 10^4$ t, or $34,000 \times 10^4$ m³ assuming an in situ density of 2.55 t/m³ for the waste, a bulking coefficient of 1.36 and a sedimentation coefficient of approximately 1.05 to 1.1. The three waste dumps are located around the pit, WD1 to the north-east, WD2 to the west and WD3 to the south. The total capacity of the 3 dumps is about 355 Mm³ which meets the demand for disposing of all waste rock produced within the mine life. Heap leach slag will be fully stockpiled on the heap leach pad. When heap leaching is completed, the stockpile will not be removed. Topsoil from each site, stripped prior to construction and stored centrally, will be used for site reclamation after pit closure and pad closure to aid rehabilitation of disturbed areas.

4.13.3.2 Amount of waste rock and properties

The top soil to be stripped from the open pit and waste dumps is expected to yield 122.5×10^4 m³ of material. It shall be stacked separately for use in rehabilitation of disturbed areas.

4.13.3.3 Site selection and capacity

The mining sequence is to mine the north part of the pit during capital construction and the initial production stage, WD1 will be located north of the open pit and will extend to the east. WD1 will have a height of 150 m to 225 m and a capacity $17,795.6 \times 10^4$ m³ of waste rock.

WD2 will be located west of the pit. It will have a capacity of $9,585.3 \times 10^4$ m³ of waste rock. Early-stage development will result in waste rock being dumped from the 250 m bench level. After the 180 m bench is developed, all waste will be dumped from that bench level. End dumping will be used for benches below elevation 180 m while paddock dumping will be used for those above 180 m and upward dumping elevation 230 m.

WD3 will be located to the south of the open pit and will be constructed using layered dumping to build the dump to a height of 200 m and capacity $8,133.5 \times 10^4$ m³.

The total placement required for waste rock outside the open pit within the three (3) dumps will be $35,514.4 \times 10^4$ m³.

4.13.3.4 Waste Dumping Method

Multi-bench dumping is proposed for WD1. Each bench will be a maximum height of 25 m with a berm of 25 m between benches. The number of benches will range from 3 to 6 depending on the initial ground level.

Single-bench dumping will be used in the initial stage of WD2. The bench will be 180 m in maximum height. When 180 m bench is completed, a further two raises of 25 m are

planned. Each bench will have a maximum height of 25 m with a berm of 25 m width being placed between raises.

Multi-bench dumping is proposed to the east of the open pit on WD3. Each bench will have a maximum height of 25 m with a berm of 25 m width being placed between raises. The total number of benches is likely to be five (5) if the waste dump is constructed according to plan.

According to local climatic and geological conditions, the slope parameters of the waste dumps are temporarily recommended as single bench height of 25 m with a safety berm of 25 m width and the slope on the face of each raise being 1:1.75 to produce a final overall slope gradient of 20°. These parameters will allow the waste dumps to meet the safety requirements of slope stability.

Waste rock will be hauled by dump truck from the open pit to the respective waste dump before being end dumped. It will then be spread by bulldozer when necessary. During the waste dumping process, a reverse slope of 3 to 5% will be formed at the unloading place of the waste dump and a safety berm will be provided at the edge of the truck unloading platform to ensure the safe unloading of trucks away from the unstable edge. When the truck is unloaded, the waste remaining on the working platform will be then pushed to the edge of the platform by a bulldozer. When placing the waste rock, the transportation route of waste dump truck hauling the waste will be selected according to the shape and stability of the slope crest and communicated by radio from the bulldozer operator to the truck driver.

During the night, lighting will be utilised in the operational area of the waste dump. The distance from the lighting tower to the operation edge of the dump will be 15 to 25 m.

4.13.4 Low Grade Ore

Copper-containing low grade ore will be 99,375 kt. Depending on market conditions at the time, the low grade ore may be processed, so the copper-containing low grade ore will be segregated from the waste rock and stored in a separate stockpile. Two blocks are nominated west of WD1 and south of WD2 for storing low grade ore. The stockpile west of WD1 is expected to contain 30,000 kt of low grade and 20,000 kt is planned for the stockpile west of WD2. Excess quantities of low grade ore will be placed so that stockpiles will expand east and north if necessary. Sediment control ponds will be located at the downstream of these proposed waste dumps. The water from the low grade ore stockpiles will be collected for utilisation or treatment.

The volumes of waste to be moved for Y0 to Y5 of mine life are provided in Table 4.2.

Table 4.2: Waste dumping plan of each dump (in m³)

Bench	Capital construction year		Production Y1		Production Y2		Production Y3		Production Y4		Production Y5	
	WD1	WD2	WD1	WD2	WD1	WD2	WD1	WD2	WD1	WD2	WD1	WD2
315				121								
300				620								
285				1548								
270	11			2858								
255	114	5		2466		31						
240	97	114		2314		151		1861				
225	3	213		1884		229		3049				
210	412	199		2097		140		1884		3850		
195	76	191		1884		929		1358		1571		3504
180	180	515		1652		1279		1509		3257		2246
165	639	751		2030		1358		2327		4126		2474
150	1824	1117		1321		1995		2638		3456		2736
135	3859			1586		3062		2138		2644		3138
120	6323		2518		3365		3077		2577		3058	
105	11438		2262		4214		3663		2535		3232	
90	14364		2281		4619		4311		3401		3337	
75	583		4774		6189		3203		3300		3634	
60			4578		4840		2342		2485		3709	
45			1691		1300		802		1861		2429	
30			869		1993		539		1342		1524	
15			57		1722		97		326		479	
0					1109		858		237		604	
-15					126		1697		102		543	
-30							1121		619		377	
-45							177		911		257	
-60									50		770	
-75											601	
Sub-total	44135	3105	19029	22381	29476	9174	21886	16764	19746	18904	24552	14098
Total	47240		41410		38650		38650		38650		38650	

Note: The part in bold type is the waste outlet elevation.

4.13.5 Flood Control and Discharge Controls on the Mine Site

The main area for control is located south of the open pit. Due to the influence of rainfall runoff around the open pit, an interception trench will be set at the upper part of each area to convey rainwater out of the area. The rainwater of each area will be discharged centrally after being collected.

Since the waste dumps are adjacent to the open pit, the upstream catchment will be taken away by the runoff interception trench. Only the rainwater of the waste dump itself will be considered, thus the flood interception trench may be built at the slope

corner of each waste dump to intercept rainwater within the waste dump. Rainfall runoff from WD1 will be discharged centrally to the wastewater conditioning pond in the south-east. The clean water component will be discharged into the surface catchment trench to the east of the mine site.

4.13.5.1 Structures for Flood Control and Discharge

Flood structures will consist of four (4) types:

- i. Interception trenches around each main area, open pit and waste dump;
- ii. Seepage control at the base of each waste dump;
- iii. Flood protection berm at the east edge of the mine site to prevent the flooding of Chindwin River from eroding the mine site; and
- iv. A clay dam with a water-stop ridge is proposed. The inside of the dam will be protected with rock rubble.

4.13.6 Public Safety Measures

The following safety measures are proposed:

- The waste dumps will be located to define the boundary of the mine
- The main area of the plant will be enclosed by a fence. An access control system will be used for people and freight entering and leaving the site.
- All major roads will include road signs and markings for the safety of people and vehicles.

4.13.7 Generation of Solid Waste

4.13.7.1 Waste rock

The stockpiled volume of waste rock is estimated to be $33,162.4 \times 10^4 \text{ m}^3$. The key components of the waste rock are SiO_2 , CaO , MgO , Fe_2O_3 , K_2O and Na_2O .

4.13.7.2 Heap leach slag

Heap leach slag shall be generated in the heap leaching process. Within the production service life (32 years), the heap leach slag generated shall have a stockpiled volume of $59,636.6 \times 10^4 \text{ m}^3$. The heap leach slag will be less than 50 mm in diameter and will have a pH of 1.5 to 2.5. It will mainly be composed of SiO_2 , CaO , MgO , Fe_2O_3 , K_2O , Na_2O and residual amounts of Cu, Zn, As and S. Corrosivity and toxicity tests conducted on the heap leach slag generated by similar copper mines suggest that the heap leach slag from the Project can be classified as a Category II general industrial solid waste.

4.13.7.3 Clay-mixing slag

The SX plant will generate a small amount (420 t/a) of three-phase substances and active clay-mixing slag, the components of which are silica gel and iron hydroxide. According to the composition of the slag, it has been classed as a Category I general industrial solid waste.

5. THE EXISTING ENVIRONMENT

5.1 CLIMATE

Myanmar is characterised by a tropical monsoon climate. Annual average temperature is 27°C and there are distinct cool-dry, hot-dry and wet seasons. From October to February is the cool-dry season, when there is plenty of sunshine, crops are harvested and the monthly average temperature at Monywa is about 25°C. From March to May is the hot-dry season when monthly average temperature is over 30°C and day time temperatures can reach over 42°C. From June to September is the wet season when the south-west monsoon is common. The most intense rains fall in July and August. Annual precipitation is approximately 720 mm, annual evaporation is 1,876 mm and annual average relative humidity is 78.8%.

5.1.1 Rainfall

Records received from MEHL in Table 5.1 represent the monthly precipitation recorded in Monywa for the 40 years from 1970 to 2009 inclusive.

Table 5.1: Average monthly precipitation in the project area (1970 to 2009)

Year	Monthly rainfall (mm)												Annual rainfall (mm)
	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	
1970	0.0	0.0	0.0	0.0	96.3	76.2	16.3	68.1	81.3	168.7	89.4	22.4	618.5
1971	0.0	0.0	0.0	54.4	263.4	136.1	119.1	228.1	93.0	114.3	14.7	0.0	1023.1
1972	0.0	0.0	0.0	61.0	49.0	51.6	23.1	357.1	91.2	28.2	49.0	0.0	710.2
1973	0.0	6.1	2.0	19.1	77.7	234.7	134.6	308.4	191.0	219.2	186.4	0.0	1379.2
1974	0.0	0.0	9.1	8.1	194.3	64.0	34.0	151.6	198.9	21.1	44.5	0.0	725.7
1975	31.2	0.0	0.0	2.0	176.3	126.0	55.1	187.5	232.4	179.6	76.5	3.0	1069.6
1976	0.0	4.1	4.1	8.1	178.6	91.4	56.4	122.7	118.6	182.9	84.3	0.0	851.2
1977	0.0	0.0	0.0	29.5	35.6	53.3	43.2	197.4	294.1	173.5	71.1	0.0	897.6
1978	0.0	0.0	0.0	16.3	114.6	116.8	183.1	141.0	165.1	178.6	0.0	0.0	915.4
1979	0.0	0.0	0.0	2.0	15.0	56.1	158.8	70.9	70.4	28.2	0.0	39.4	440.7
1980	0.0	0.0	2.0	38.4	61.5	24.6	124.0	84.3	151.9	118.1	0.0	0.0	604.8
1981	0.0	0.0	13.2	45.5	151.4	246.6	31.2	93.0	47.5	82.3	118.6	0.0	829.3
1982	0.0	0.0	0.0	2.0	106.9	77.7	11.2	117.6	60.7	33.0	1.0	0.0	410.2
1983	0.0	0.0	1.0	5.8	20.8	36.8	78.5	33.0	86.9	264.9	98.0	18.0	643.9
1984	0.0	0.0	0.0	81.0	70.6	227.1	11.2	105.9	134.1	78.5	0.0	2.0	710.4
1985	1.0	0.0	0.0	6.1	64.0	54.1	137.9	49.0	121.9	64.0	41.9	0.0	540.0
1986	0.0	0.0	0.0	31.0	17.0	77.0	85.1	184.9	198.1	89.9	34.5	0.0	717.6
1987	0.0	22.9	57.9	26.7	73.9	15.5	395.5	138.7	118.9	26.2	0.0	0.0	876.0
1988	0.0	0.8	0.0	4.8	111.0	204.5	136.7	65.3	79.5	149.1	126.0	0.0	877.6
1989	0.0	0.0	1.3	25.1	56.1	53.3	65.5	164.6	170.9	159.3	0.8	0.0	697.0
1990	0.0	0.0	6.6	3.8	98.3	49.0	1.3	49.0	172.0	632.5	48.3	0.0	1060.7
1991	0.0	0.0	0.0	27.4	21.1	88.9	24.6	68.1	129.0	68.1	98.6	0.0	525.8

Table 5.1 (cont'd): Average monthly precipitation in the project area (1970 to 2009)

Year	Monthly rainfall (mm)												Annual rainfall (mm)
	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	
1992	1.3	5.1	0.0	0.0	77.0	23.6	29.0	113.0	151.6	150.4	52.8	23.4	627.1
1993	0.0	2.3	5.1	2.5	114.6	98.6	13.5	11.7	276.4	127.5	0.0	0.0	652.0
1994	0.0	9.4	16.5	0.8	60.2	133.6	60.7	163.3	120.4	11.9	25.9	0.8	603.5
1995	0.0	0.0	0.0	0.0	10.2	22.6	51.1	100.1	271.3	54.6	26.2	0.0	535.9
1996	0.0	2.5	59.9	61.7	8.6	112.8	54.9	138.4	48.0	55.6	63.5	0.0	606.0
1997	0.0	0.0	2.8	30.0	63.0	28.2	122.2	77.2	54.6	122.9	3.3	7.4	511.6
1998	0.0	0.0	9.4	2.5	48.3	9.4	9.7	79.8	148.8	41.7	0.0	0.0	349.5
1999	0.0	0.0	0.0	14.7	57.4	36.6	58.9	46.5	93.5	149.9	58.4	0.0	515.9
2000	0.0	7.1	14.0	47.2	80.5	68.8	31.2	68.3	212.9	174.2	0.0	0.0	704.3
2001	0.0	0.0	0.0	6.1	124.2	33.0	52.3	105.4	66.3	151.9	21.1	0.0	560.3
2002	2.0	0.0	2.0	3.0	70.4	43.2	56.9	326.1	252.0	49.3	53.1	1.0	859.0
2003	0.0	2.0	9.1	40.9	153.9	91.9	67.1	65.0	212.9	167.1	0.0	4.1	814.1
2004	0.0	0.0	0.0	54.9	118.1	195.1	62.0	9.9	327.2	54.9	0.0	2.0	824.0
2005	0.0	0.0	4.1	25.9	15.0	121.2	17.8	124.0	236.2	85.9	8.1	30.0	668.0
2006	0.0	0.0	0.0	140.0	71.1	109.0	47.0	237.0	302.0	128.0	35.8	0.0	1069.8
2007	0.0	5.1	0.0	6.9	337.1	85.9	17.0	57.9	116.8	135.9	20.1	0.0	782.6
2008	27.9	0.0	11.9	8.1	147.1	45.0	47.0	20.1	83.8	122.2	0.0	0.0	513.1
2009	0.0	0.0	2.0	23.9	121.2	51.8	4.1	45.0	84.1	166.1	0.0	0.0	498.1
Ave. rainfall	1.6	1.7	5.9	24.2	93.3	86.8	68.2	119.4	151.7	125.2	38.8	3.8	720.5

5.1.2 Winds

The prevailing winds during March to October are south-westerly and south-easterly respectively, and during November to February are northerly. The average wind velocity is between 0.5 and 1.4 m/s and the observed maximum wind velocity is 3.66 m/s.

5.2 LANDFORMS

The terrain in the project area comprises a very flat plain which varies less than ten (10) metres in elevation, with a number of steeply sided hills rising up to 300 metres above the surrounding plain. Letpadaung Hill is the highest of these hills at 300 m above the plain. Nearby Nachitaung Hill, which also lies within the project area, rises to 130 m above the plain.

5.3 SURFACE WATER

5.3.1 Water Source

The Chindwin River lies approximately 3 km east of the Letpadaung deposit, with a maximum flow rate of 24,850 m³/s and an average flow rate of 3,860 m³/s. The river depth ranges from 1.5 to 10.25 m with an average depth over the year of 5 m. The 20-year flood water level is RL75.1 m and 100-year flood water level is RL75.65 m. The freshwater supply from this source can easily meet the mine requirements.

5.3.2 Water Quality

Water quality in the Chindwin River changes over the course of the year. Table 5.2 presents a series of water quality indicators monitored during various months over the year 2000.

Table 5.2: Water quality monitoring data – Chindwin River (Muir, 1997)

Month	Temp (°C)	Total Dissolved Solids (mg/l)	Total Suspended Solids (mg/l)	Total Hardness (mg/l)	Dissolved Oxygen (mg/l)	CaCO ₃ (mg/l)	Sulphate (mg/l)	Ca (mg/l)	Mg (mg/l)
Feb	22.6	146.7	70	90	3.8	107.4	9.2	18.5	10.7
May	34.5	186	11.9	93	-	113	4.8	18.5	11.3
Jun	29	399	1,438	-	4.2	51.6	6.0	21	-
Aug	30.6	98	404	58	3.5	43	2.0	11.6	7
Nov	28.4	79	528	43	3.3	57	10	10.3	4.2
Dec	21	117	190	85	4.6	90	2.4	19.1	9

The table indicates that the indices are generally stable (except water turbidity which increases markedly in the rainy season) and meet the surface water standard of class IV water (GHZB1-1999) (NERIN, 2011), and as such can be used for common industrial purposes.

5.4 ROCK MINERALISATION

The principal ore minerals include chalcocite, covellite, alpha chalcocite, enargite, chalcopyrite, bornite, sulphurous copper ore, pyrite, etc., among which, chalcocite, covellite, enargite, chalcopyrite and bornite dominate the primary ores. Chalcocite, covellite, alpha chalcocite and sulphurous copper ore constitute secondary ores. Principal gangue minerals include feldspar, quartz, sericite, chlorite, clay minerals, etc.

5.4.1 Mineral Composition of Rock

Metal mineral includes chalcocite, covellite, alpha chalcocite, enargite, chalcopyrite, bornite, pyrite and a small amount of blende. Gangue mineral covers sericite, feldspar,

kaolinite, quartz, alunite, chlorite, clay mineral, etc.

Pyrite is the foremost primary sulphide mineral with an average content of about 7% and general variation scope of 5 to 10%. The proportion increases in some dykes and breccia.

Sulphide minerals of primary (plutonic) copper covers chalcocite, covellite, enargite, chalcopyrite and bornite in descending order of proportion. Sulphide minerals of secondary (hypabyssal) copper covers chalcocite, covellite, alpha chalcocite and copper sulphite ore in descending order of proportion. Chalcocite - covellite - alpha chalcocite is the foremost copper paragenetic mineral which is filled among pyrite particles.

5.4.2 Embedding Features of Major Minerals

5.4.2.1 Chalcocite

Chalcocite is the major copper-contained mineral and distributed along the surface of pyrite. About 23~46% pyrite is wrapped by chalcocite. The particle size of the chalcocite minerals ranges from as large as 0.01~0.02 mm to as small as 0.001 mm.

5.4.2.2 Pyrite

Pyrite is the foremost primary sulphide mineral with an average content of about 7% and general variation of 5 to 10%. The proportion increases in some dykes and breccia. Coarse pyrite is wrapped by fine chalcocite.

5.4.2.3 Gangue minerals

Gangue minerals comprise primarily sericite (about 60 to 70%) in andesite porphyry and pyroclastic rock, and secondarily alunite, quartz, feldspar, kaolinite, chlorite and clay mineral, etc. In hydrothermal breccia rock, the gangue mineral is primarily quartz (about 50%), and secondary alunite, sericite, feldspar, kaolinite, chlorite and clay mineral, etc.

5.4.3 Chemical Composition

Chemical element analysis results from andesite porphyry, hydrothermal breccia rock, pyroclastic rock and composite ore are shown in Table 5.3, among which composite ore, mainly composed of andesite porphyry and hydrothermal breccia rock, is chalcocite with high grade of copper.

5.5 GEOCHEMISTRY

Two high level geochemical studies have been conducted for the Letpadaung Project and neighbouring S&K project. These studies have been reviewed and are summarised in the following section.

Table 5.3: Chemical elements analysis results of ROM (NERIN, 2011)

Element	Andesite porphyry		Hydrothermal breccia rock		Pyroclastic rock		Composite Ore
	Low grade	High grade	Low grade	High grade	Low grade	High grade	
Ag	1.8	3.1	2.7	4.1	1.9	2.7	3.9
Ai	0.61%	0.42%	0.48%	0.34%	0.54%	0.46%	0.50%
As	61	80	99	116	41	56	207
B	524	574	920	1123	599	606	993
Ba	24	26	23	24	28	43	24
Be	<0.1	<0.1	<0.1	<0.1	0.5	0.2	<0.1
Bi	<3	<3	6	10	<3	<3	6
Ca	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%
Cd	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5
Co	12	13	17	21	9	10	18
Cr	58	54	74	54	68	51	62
Cu	0.59%	0.89%	0.63%	1.28%	0.43%	0.83%	1.35%
Fe	5.76%	6.46%	9.93%	11.80%	7.05%	7.11%	10.59%
K	0.37%	0.31%	0.29%	0.22%	0.39%	0.35%	0.33%
La	<1	1	<1	<1	<1	<1	<1
Mg	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%
Mn	20	27	38	29	43	44	38
Mo	2	2	2	2	3	3	3
Na	0.01%	0.01%	0.01%	0.01%	0.02%	<0.01%	0.02%
Ni	15	16	17	20	16	16	17
P	37	36	31	28	43	44	34
Pb	31	34	29	44	21	25	50
Sb	<2	4	<2	4	<2	<2	6
Sr	27	21	26	21	20	20	31
Ti	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
V	13	12	13	13	11	10	16
W	<2	<2	<2	2	<2	4	3
Zn	16	19	19	25	26	19	24

Note: The unit unspecified is g/t.

Overall there is a very limited amount of geochemical data (twenty one relevant samples) considering the size of the deposit and the clear risk of acid rock drainage that exists from the high sulphidation systems. Furthermore, the methods employed in the two studies have not been tailored to suit the mineralogy of the deposit. Therefore, the results and subsequent conclusions are of limited use.

The testing to date has not differentiated between the individual lithologies or between the various grades of material within the ore body (Coffey, 1997). The analysis included determination of total sulphur, pyritic sulphur, sulphate sulphur and “unidentified sulphur”. The total sulphur content in nine out of ten samples was high to extremely high (0.68 to 9.12%) with only a single sample of leach cap lapilli tuff exhibiting a low total sulphur content (<0.01%).

Total sulphur content was used to calculate the maximum potential acidity which resulted in nine of the ten samples being classified as potentially acid generating. This approach appears to be overly conservative as the majority of the sulphur in the leach cap sample was unidentified sulphur, and a large proportion of the sulphur in the internal waste was also present as unidentified sulphur. The leach cap samples were essentially devoid of pyritic sulphur.

The acid neutralising capacity (ANC) of the samples was highly variable ranging from material which was essentially devoid of ANC (<0.01 kg CaCO₃/t) up to a sample with a very high ANC (141 kg CaCO₃/t). However, the majority of samples exhibited very low to moderate ANC (0.2 to 10 kg CaCO₃/t).

The assessment conducted by Coffey (1997) concluded that six out of ten samples were Acid Producing (i.e. had positive net acid producing potential) with a further three samples classified as Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) and only a single sample classified as Non Acid Producing (i.e. had negative net acid producing potential with MPA/ANC ratio of greater than 2). However, as noted earlier, the presence of unidentified sulphur in the samples could have significantly impacted the acid producing classifications.

The unidentified sulphur could be present in mineral forms which may not be acid generating, such as barite or alunite, but as no mineralogical analysis was conducted on the samples it is not possible to determine definitively the nature of the unidentified sulphur. However, previous geological assessments of the deposit do list alunite as being present (MRD (1997); Coffey (1997); Mason Geoscience (2004)) and, therefore, it is reasonable to assume that some of the unidentified sulphur is present as alunite, which is not acid forming. If the results of the assessment are re-calculated using just the pyritic sulphur to calculate the maximum potential acidity, only 50% of the samples would be classified as potentially acid forming, rather than the 90% which was suggested by this study, which in turn would have a large impact on the ARD mitigation measures which may be required at the project.

The location of the acid generating material has been modelled based on extrapolation of results from the testing undertaken at S&K and the results are shown in Figure 5.1

below. This model suggests that significant volumes of material are potentially acid producing. As such, this material volume will require confirmation and specialised handling and dumping procedures to ensure that no environmental harm arises from their mining and storage.

5.6 SOIL

The description of soils in the area included here is taken from Muir (1997). The soils are described in two (2) parts – Letpadaung Hills and the plains surrounding the Letpadaung Hills.

5.6.1 Letpadaung Hills

All soils examined in the area comprised deeply weathered profiles, with only minor bedrock being encountered, mainly along the hill crests. Soil sections observed indicated a general soil profile comprising:

- A few centimetres of humus at the surface;
- A deep gradational profile of pink to red-loamy clays with increasing boulder content with depth;
- An underlay of moderately dense weathered rock; and
- Water seepage at the soil rock interface.

Soil surfaces tend to be rough and rocky due to the abundance of large particles (greater than 75 mm in size) in the surface soils. This results in limited evidence of soil erosion and suggests run-off in the area tends to be a sheet flow rather than concentrated in gullies.

Soils on the hills exhibited:

- Uniform structure laterally;
- Good moisture retention characteristics;
- Slow drying when exposed to heat from the sun;
- Low to moderate permeability; and
- High dispersion.

It is expected that the combination of slope and permeability would encourage run-off rather than percolation into the soil. It is also expected that the dispersive nature of the soil would lead to a turbid run-off containing fine soil particles.

Muir (1997) estimated that 10 cm of soil had been lost from the surface of the hills through historic disturbances of fire and firewood collection.

5.6.2 Plains Around The Letpadaung Hills

The soils around the Letpadaung Hills grade from sandy materials close to the hills to fine grained soils near creeks and the Yama Stream and Chindwin Rivers. Sections of the plains are subject to periodic inundation which influences the consistency of gradation and soil productivity. These soils are frequently loamy and silty in nature. The heavy clays are most often found within 1 km of the Yama Stream and Chindwin River and represent the best soils for paddy fields.

The undisturbed soils on the plains are near-neutral to slightly alkaline, non-saline and very low in organic matter (based on Muir (1997) results). They are also nutrient and zinc deficient but contain normal levels of copper and manganese.

5.7 GROUNDWATER

5.7.1 Regional Groundwater Conditions (NERIN, 2011)

The Project is located in the long and narrow plain flanked by the mountainous region in the west and the highland watershed in the east of Myanmar. The area lies within the Myanmar Class I hydrological geology unit.

The Monywa basin where the mining area is located is an inland basin in the plain, with flat topography, and scattered low mountains and hills whose watersheds are taken as boundaries of the basin, forming the Class II hydrological geology unit.

In the Class I hydrological geology unit, there are large amounts of Quaternary pore water from loose rock formed by alluvial – proluvial deposits of the Irrawaddy River and Chindwin River, and bedrock fissure water formed in Triassic period ~ Mio-Pliocene sedimentary rock and volcanic rock weathered zone. Quaternary pore water from loose rock includes eluvial – slope deposit pore water distributed at the piedmont and slope edge, and the alluvial - proluvial pore water distributed on the river banks and their alluvial – proluvial plain. The bedrock fissure water is developed at the upper weathered zone on the bedrock, and the deeper part is weakly developed.

5.7.2 Mine Groundwater Conditions

5.7.2.1 Aquifers in the mining area

The main outcrop rocks of the mining area include Quaternary stratum and andesite – dacite rock mass. Considering the water yield property, they are divided into Quaternary loose pore aquifer (I), andesite – dacite rock mass (π) fissure weak aquifer (II).

Quaternary Loose Pore Aquifer (I)

According to the difference of cause of formation, permeability and water yield property, this aquifer can be further divided into two sub-group aquifers, i.e. Quaternary

eluvial – slope, slope – diluvial deposits loose pore weak aquifer (IA), and Quaternary alluvial – diluvial loose pore strong aquifer (Ib).

Quaternary eluvial – slope deposits loose pore weak aquifer (IA)

The lithology of this aquifer mainly comprises silty clay containing (mixing with) gravel breccia and gravelly soil, with a thickness of 0.8~22.6 m (6.6 m in average). This aquifer mainly distributes around the isolated island manner peak, in the river valley and anterior margin in the mining area, and generally stretches to between 100 and 800 m (300 m on average) out of the piedmont of Letpadaung Mountain. This aquifer has large pores and strong permeability. According to the water injection test, its permeability coefficient is 0.104~7.52 m/d, with an average of 3.41 m/d.

Quaternary alluvial – diluvial deposits loose pore strong aquifer/ permeable layer (IB)

This aquifer is composed of modern river alluvial and diluvial deposits, and the lithology mainly consists of medium – fine sand, sand gravel and clay with poor sorting. The upper part is clay, with a thickness of 4 to 6 m; the lower part is medium – fine sand, sand gravel and cobble gravel, with a thickness of 12.07 to 50.09 m (25.72 m on average). Massively distributed in the depression (between the Chindwin River and the mining area) of Chindwin River and its branch, riverbed and the alluvial plain in between, it belongs to a strong aquifer outside the mining area, and has direct contact with IA aquifer. The distribution scope may extend to Quaternary eluvium and diluvium, about 300 to 800 m to the foot of Letpadaung Mountain. This aquifer is exposed in the east outcropped part of Section II. It has large pores, strong water yield properties and permeability. The buried depth of the groundwater in the dry season is 0.65 to 19.12 m, with an average of 4.86 m; the permeability coefficient is 18.45 to 43.62 m/d, with an average of 23.64 m/d.

Andesite – dacite rock mass (π) fissure weak aquifer (II)

This aquifer is andesite – dacite rock mass, with the lithology mainly comprising dacite, andesite, andesite porphyry, ignimbrite rhyolite, etc. The thickness is about 600 to 650 m, so this aquifer was not totally exposed during prospecting. This aquifer is massively distributed in the Letpadaung mining area, and is in the direct wall rock of ledge and ore body. Based on the weathering degree, permeability and water yield properties, this aquifer is divided into intensely weathered fissure weak aquifer (IIA), and moderately weathered fissure weak aquifer (IIB).

The intensely weathered fissure weak aquifer (IIA) is mostly covered by Quaternary slope eluvium and diluvium. The thickness ranges between 25.43 m and 138.05 m, with the average thickness of 66.78 m. The permeability coefficient is 2.9×10^{-4} m/d to

6.7×10^{-2} m/d, with an average of 1.60×10^{-2} m/d. The unit water inflow is about 0.002 L/s/m to 0.41 L/s/m, with an average of 0.080 L/sm.

The thickness of the moderately weathered fissure weak aquifer (IIB) is 17.71 m to 620.36 m, with an average of 251.51 m. The permeability coefficient is 2.8×10^{-4} to 2.4×10^{-3} m/d, with an average of 1.80×10^{-3} m/d; the unit water inflow is about 0.002 L/s/m to 0.052 L/s/m, with an average of 0.032 L/sm.

5.7.3 Hydraulic Connection of The Aquifers

At the massif surroundings, in the river valley and anterior margin of the mining area, Quaternary eluvial – slope deposits of the loose pore weak aquifer overlie the bedrock, receiving rainfall recharge. The groundwater of this aquifer has direct hydraulic connection with the groundwater of the underlying andesite – dacite rock mass fissure weak aquifer.

To the east of the mining area, the Quaternary alluvial – diluvial loose pore strong aquifer overlies the andesite – dacite rock mass fissure weak aquifer. The groundwater of IB aquifer has direct hydraulic connection with the bedrock water.

5.7.3.1 Recharge, run-off and drainage conditions of groundwater in the mining area

The main recharge source for groundwater in the mining area is rainfall. In the recharge area, the aquifer outcrops at ground surface, directly receiving rainfall and lateral recharge from the Chindwin River. Quaternary loose pore aquifer (I) recharges the andesite – dacite rock mass fissure weak aquifer (II) vertically.

Generally, the underground run-off is controlled by the landform – it moves from the higher altitude mountainous area to the lower lying and flat plain below. The overall direction of run-off in this aquifer is from the west to the east, and from the south to the north, before entering the Chindwin River and Yama River. The underground run-off is primarily drained through the outcropped area of the aquifer which, together with evaporation, is one of its forms of drainage.

As the mining in the pit expands and deepens, the groundwater level will gradually drop. The groundwater in the aquifer around the mining pit will be drawn down continuously by the pit dewatering, providing a water yielding source in the mining pit. In the early stages of open-pit development, the water inflow in the mining pit will be drawn down from the groundwater contained within the orebody. In the mid- to late stages of mining it will be mainly drawn from the regional aquifers.

5.7.3.2 Hydrogeological characteristics of structural fracture zone in the mining area

The structural setting in the mining area is understood. The faults that may possibly be affected after the deposit is filled with water are f2 fault, f1 fault, f2 fault, f3 fault and f4 fault. According to the prospecting results, these faults are mainly compressional

fractures, and the fault zones compress tightly, with poor water yield properties and water conductivity, basically due to the confining nature of the narrow fractures.

5.7.3.3 Impact of surface water body on deposit water filling

The elevation (lowest erosion base) of the Chindwin river bed in the mining area is about RL 64 m whilst that of the open mining pit is RL345 m. The elevation difference between the river bed and the bottom of the open pit is therefore about 409 m. Thus it can be inferred that most of the ore body is below the elevation of the lowest erosion base. From the geological report it can be inferred that the elevation of the 100-year return flood (P=1%) of the Chindwin River is RL75.65 mASL, and that of the 20-year return flood is RL75.1 mASL. The elevation of the topography around the eastern boundary of the final open pit is about RL72 m, and there is therefore the possibility that the open pit could be affected by flooding of the Chindwin River. Accordingly, it will be necessary to construct flood prevention measures in this area. The elevations of other locations around the pit perimeter are higher than the elevation of the 100-year return flood so would not be affected by flooding of the Chindwin River.

Quaternary alluvial – diluvial loose pore strong aquifer outcrops at the east boundary of the final open pit. The average permeability coefficient of this aquifer is 43.62 m/d, with a water level of RL69.85 m; the elevation of the base slab of the aquifer is RL45.77 m, with an average, thickness of 13.61 m. It can be inferred that the cone of influence is 1590 m. The shortest distance between the open pit and the Chindwin River is around 2 km, so the Chindwin River is not within the radius affected by the drawdown, and it is impossible therefore to form a constant head recharging the boundary.

According to the analysis based on S&K mine Copper Mine, this Mine belongs to the deposit with medium hydrogeological conditions dominated by fissure water filling.

5.8 TERRESTRIAL VEGETATION

The Letpadaung hills themselves have modified semi-natural vegetation. Remnants of natural woodland occur on Nachitaung Hill. Remnant natural vegetation also exists on the surrounding plains, which are mostly cultivated with agricultural crops farmed by the local people. Than (*Tectonia hamiltoniana*), Dahat (*Terminalia olivieri*), and Sha (*Acacia catechu*) are dominant species in the project area. A bamboo species *Dendrocalamus strictus*, and two shrub species, *Limonia acidissima* and *Harrisonia benettii*, also exist in the project area. Natural vegetation of the flatlands is almost entirely cleared.

A map of the existing vegetation at Letpadaung is provided below at Figure 5.2.

In the past, there was a proposal to set aside the Letpadaung Hills as a “Protected Forest” for the purpose of protecting the area for its value as a firewood supply. Earlier mining proposals have recognised the need for a firewood supply for the surrounding communities given the coincidence of areas where vegetation suitable for firewood and the mineral resources exist within the Salingyi Township.

The modified vegetation of the Letpadaung hills is structurally heath to shrub land and is further divisible into:

1. Low heath in the broad saddle between the hills;
2. Low shrub land on the lower slopes;
3. Tall shrub land in more steeply-sided and cooler valleys; and
4. Stunted woodland on the hill crests.

5.9 FLORA

A baseline flora study undertaken by the Botany Department of Yangon University in 2003 identified 80 species of flora in the vicinity of the Project. Shrubs, which comprised 39 of the species identified, are the most predominant vegetation community in this area and the trees greater than 5-10 cm diameter are used as a source of wood by local villagers. The second largest community is trees of which 19 species were identified. The remaining groups differentially encompass 13 species of herbs, 6 species of grass, 2 species of bamboo and one Acacia species. Most of the plants found in this area are xerophytes which are totally adapted to the arid conditions of the project area.

A total of 134 species representing 107 genera and 49 families were listed in the Letpadaung taung area during the fieldwork associated with the 1997 field studies. The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. (with the highest incident vegetation index (IVI) of 91.93%), the second most dominant species is *Dalbergia paniculata* Roxb. (IVI = 38.29%), and *Atalantia monophylla* A. DC. (IVI= 37.87%) is third. The number of species greater than 10% IVI value was seven species. Those species could be considered as ecological indicator species of the Letpadaung taung area.

The distribution of scrub and tree species by frequency class in the study area showed that a high percentage of the total number of species was in the lower frequency classes, A and B, whilst a low percentage only was observed for the higher frequency class C, D, and E. This indicates that the forest in the study area is floristically heterogeneous. The value of diversity indices and evenness indices for scrubs and tree species were very low in the study area.

Stem density of $\geq 10\text{cm}$ was 1,247 m^2/ha and basal area was 3.17 m^2/ha in the study area. Among the 15 sample plot studies, 27 tree species were recorded, and 10 species with only one individual were found and these were considered as unique species. The 3 most abundant species in terms of basal area occupied 71.45% of the total area, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 37.08%, followed by *Dalbergia paniculata* Roxb. 22.04%, and *Atalantia monophylla* A. DC. with 12.32% of the total basal area. The plant species that were listed and recorded in the recent study were checked against the IUCN red list of threatened species but are not found on the IUCN red list.

5.10 FAUNA

A number of fauna surveys were undertaken in the mid-1990's (Muir, 1997) when the proposal to mine Letpadaung was mooted by MICCL. The results of those fauna surveys are described below.

5.10.1 Birds of the Letpadaung Project Area

A total of 18 bird species were recorded during the studies in the 1990s (Table 5.4) (Muir, 1997). The recorded species belong to 11 Families of the Order Passeriformes.

The broad saddles between the hills are inhabited by 7 bird species of 6 Families; 16 bird species were recorded on the lower slopes, 11 species in the steeply sided valley of Letpadaung hill, and 4 species at the hill crest.

Table 5.4: Bird species of the Letpadaung Copper Mine project area

Sr.No.	Family	Scientific name	Common name	Location
1	Ploceidae	<i>Passer montanus</i>	Tree sparrow	I,II
2		<i>Streptopelia chinensis</i>	Spotted dove	I,II,III,IV
3	Pycnonotidae	<i>Pycnonotus cafer</i>	Red vented bulbul	II,III
4		<i>P.blanfordi</i>	Streak eared bulbul	I,II,III
5	Coraciidae	<i>Coracias benghalensis</i>	Indian roller	II
6	Meropidae	<i>Merops orientalis</i>	Green bee-eater	I,II,III
7	Timaliidae	<i>Turdoides gularis</i>	White throated babblers	II
8		<i>Lanius collurio</i>	Burmese shrike	II,III
9		<i>Accipiter badius</i>	Shikra	III,IV
10	Sturnidae	<i>Acridotheres tristis</i>	Common mynah	II,III
11		<i>Sturnus burmanicus</i>	Vinous breasted starling	II
12	Upupidae	<i>Upupa epops</i>	Hoopoe	II
13		<i>Coracias benghalensis</i>	Indian roller	II,III
14	Turnicidae	<i>Turnix tanki</i>	Yellow-legged buttonquail	II
15	Sylviidae	<i>Orthotomus sutorius</i>	Common tailorbird	I,II,III,IV
16		<i>Orthotomus cuculatus</i>	Mountain tailor bird	I,II,III,IV
17	Falconidae	<i>Francolinus pintadeanus</i>	Chinese francolin	I,III,
18	Turdidae	<i>Saxicola caprata</i>	Pied bush chat	II,III

Note:

- I = the broad saddle between the hills
- II = the lower slopes
- III = the steeply-sided valleys
- IV = the hill crests

5.10.2 Mammals of the Project Area

The Myanmar hare *Lepus peguensis* was recorded during the survey period and were observed on the flatlands. They have a large movement range between the shrublands and cultivated areas at the base of Letpadaung Hill. According to the interview survey, Eld's deer (Shwethamin) *Cervus eldi thamin* was listed as a frequent visitor to the project area.

5.10.3 Reptilian and Amphibian Species

A total of three reptile species and one amphibian species were recorded during the survey period (Table 5.5). The most common species among them was observed as garden fence lizard *Calotes versicolor*.

Table 5.5: Reptile and amphibian species recorded during the survey period

Sr. No.	Species	Common name	Family	Taxonomic group
1	<i>Calotes versicolor</i>	Garden Fence Lizard	Agamidae	Reptile
2	<i>Mabuya multifasciata</i>	Many-lined Sun Skink	Scincidae	Reptile
3	<i>Ptyas korros</i>	Rat Snake	Colubridae	Reptile
4	<i>Bufo melanostatus</i>	Common Toad	Bufo	Amphibian

5.10.4 Butterfly and Odonate Species

Twelve butterfly species were recorded during the survey period (Table 5.6) (Muir, 1997). The most common species among them were *Eurema andersoni* and *Cethosia cyane* species. Most of the butterfly species and higher population size were observed in the lower slope habitat.

Three odonate species, namely *Tholymis tillarga*, *Orthetrum Sabina*, and *Macrodiplax cora*, were recorded. Damsal fly species were not observed in the project area during the survey period.

Table 5.6: Butterfly species recorded during the survey period

Sr. No.	Family	Species	Habitat
1	Papilionidae	<i>Papilio demoleus mylayanus</i>	I,II,III
2	Papilionidae	<i>P.castor</i>	II,III
3	Papilionidae	<i>P.memnon</i>	I,II
4	Papilionidae	<i>C.clydia</i>	II,III
5	Peridae	<i>Hebomoia glaucippe</i>	III,IV
7	Peridae	<i>Eurema andersoni</i>	I,II,III,IV
7	Peridae	<i>Eurema andersoni</i>	I,II,III,IV
8	Peridae	<i>Hyarotis adrastus</i>	I,II,III
9	Peridae	<i>Pareronia valeria lutescens</i>	II
10	Peridae	<i>Catopsilia pomona</i>	I,II,III,IV
11	Nymphalidae	<i>Cethosia cyane</i>	I,II,III
12	Nymphalidae	<i>Junonia hierta</i>	I,II,III

6. SOCIO-ECONOMIC ENVIRONMENT

6.1 THE PROJECT AREA

The Project site lies within the jurisdiction of the Salingyi Township of Monywa district. Monywa is approximately 7 km north-east of the project site. Salingyi is approximately 13 km south of the site. Within 5 km of the S&K and Letpadaung project sites, 26 villages account for a population of approximately 25,000 people. Amongst them, Nyaunbingyi is the largest village with approximately 3,500 people, and Mine Town, the second largest one, has a population of 3,100 and is continuing to grow (MICCL, 2003).

6.2 NATIONAL DEMOGRAPHIC AND ECONOMIC FEATURES

The estimated population of Myanmar in 2000/2001 was 50.13 million, with 2.02 per cent growth over the preceding year. Myanmar shares borders with Bangladesh and India to the north-west, the People's Republic of China to the north-east, the Lao People's Democratic Republic to the east, and Thailand to the south-east.

In Myanmar there are 135 recognised ethnic groups. The major ethnic groups are Bamar, Shan, Kayin, Rakhine, Mon, Chin, Kachin and Kayah. The majority of the Myanmar nationals are Bamar, which constitutes about 70% of the total population, the second largest majority is the Shan which constitutes about 9% of population, and the third largest majority is Kayin which constitutes about 6% of the population.

In view of the topography and natural resources, Myanmar is dependent on agriculture for its economic base. It is the leading sector in Myanmar's economy, provides about 60% of GDP as well 66% of employment, and brings in more than 60% of export profits. GDP increased by 7.3% per annum between 1997 and 2003. During that time mining only contributed 0.5% of GDP.

6.3 LOCAL SOCIAL, ECONOMIC AND ETHNIC FEATURES²⁴

The population of the Salingyi Township is 190,000 of which 46.9% are males and 44.5% are under the age of 18 years. The majority (92.6%) live outside urban areas. About 4,000 new identity cards were issued in the Township in 2012.

Salingyi Township is made up of 3 Quarters, 39 Village Tracts and 152 Villages. There are 939 houses occupied by 1,027 families with a total population of 14,000 in the Quarters (or about 15 persons per household). In the Village Tracts and Villages there are a total of 20,543 houses occupied by 21,550 families with a total population of

²⁴ Based on data provided by MEHL

176,000 (or about 8.5 persons per household). Thus the majority of people in the Township area are considered to have a rural lifestyle.

Of the 84,467 persons under the age of 18 years, 22,037 (or 26%) attend school at any level. Of the 22,037 students, 58% attend primary school (Y1 – Y5), 31% attend middle school (Y6 – Y9) and 11% attend high school (Y10 – Y11). In 2011-12 a total of 92 students matriculated to attend university in the Salingyi Township. Overall the ratio of teachers to students is 1:24.

Within the Salingyi Township there are:

- Ten (10) high schools;
- Eighteen (18) middle schools;
- Seventy six (76) primary schools; and
- Eleven extended primary schools.

In 2012-13 the Salingyi Township had the following medical facilities:

- Two (2) hospitals with a total capacity of 41 beds;
- Twenty six (26) health care centres; and
- Six (6) clinics.

The Township had 81 medical staff appointed and were seeking to fill a further 38 approved appointments. The ratio of doctors to population was 1:72,439 and for nurses was 1:22,472. In total 5,522 people were treated as in- or outpatients at the hospitals during 2012-13 and health care centres treated a further 12,026.

Cultivation of crops and trade in farming goods play an important role in the economy of Monywa District and its adjacent areas. Contributions also come from manufacturing industries such as textiles, cotton mills, saw mills, rice-noodle mills, wood and wood products, and construction materials and small home industries. There is no dedicated industrial area within the Township.

The staple crops of the region are peas and beans, corn, oil crops, vegetables and millet. Very little cotton is produced.

In the 2012-13 year, 44,500 ha of cultivatable land was utilised in the Salingyi Township. Over 89% of that land was used for dryland crop production, about 5.5% was used as paddy, and the balance for seasonal farming on riverbanks or gardens.

The area is a net importer of rice as the local production provides only 45-50% of the total demand. In contrast, the area produces about 4.5 times the local requirement of vegetable oils and exports about 5,000 tonnes annually.

The average income in the Salingyi Township is less than \$500/annum.

The majority of the nationals in Monywa District, Mine Town and neighbouring villages are of Bamar ethnic origin. A small fraction of the population in the region comprises Chin, Shan and Kayin ethnic groups. Likewise, the majority of inhabitants near the Letpadaung project site are expected to be from the Bamar ethnic group.

6.4 THE AREAS NEIGHBOURING THE LETPADAUNG PROJECT SITE

Mine Town and 10 villages, namely, South, North and Central Phaunga, South, North and Central Mogyopyin, Kyawywa, Wet Hmay, Kon Daw and Taungpalu, are located within 8 km of the Letpadaung project site as shown in Figure 6.1.

6.4.1 Mine Town

Mine Town has a total population of 3,100 people and its infrastructure is significantly more advanced than other places that are near the mine. Housing includes 145 separate houses, 256 semi-detached houses and a 60-person male dormitory for semi-contract workers. The bulk of the workforce of MYTCL comes from Mine Town as well as the nearby rural communities.

The existing facilities in Mine Town include a high school, a hospital, a recreation centre, a fire station with 2 fire engines and 10 fire brigade personnel, a police station, a number of small stores, and a telecommunications centre. Electricity is supplied to all houses and other facilities in Mine Town from the Nyaungbingyi Power Station. The sanitary water is provided as running water to all houses and other buildings of Mine Town from Pump Station No 3.

6.4.2 South Phaunga Village

This village is located three (3) kilometres from the Project site. It has a population of 421 persons occupying 65 houses. The majority of inhabitants are farmers and they principally grow wheat, peas and beans, sesame, and a small amount of paddy. A main water source for the village is Phaunga Dam, which was recently renovated by MWMCL, and supplies about 300 acres of farmed land.

Aside from crop cultivation, the villagers have established sheep and goat farms for trade as well as breeding a few pigs and cows for domestic consumption. Approximately 4 villagers work in MYTCL, with one permanent employee and the remainder as contract labourers.

6.4.3 North Phaunga Village

This village is located also 4 km from the Project site. It has a larger population than South and Central Phaunga with 1,224 inhabitants occupying 211 houses. The traditional economy is the same as that of the other Phaungas. Sesame and a variety

of peas and beans are staple crops for most villagers, while some farmers adopt paddy cultivation as water can be drawn off from Phaunga Dam.

In addition, a number of village women consistently trade items of groceries and vegetables to Mine Town. It has a primary school and 2 monasteries. Approximately 8 permanent staff and about 50 contract employees are engaged as MYTCL workforce from this village.

6.4.4 Central Phaunga Village

This village is 3.25 km from the project site and comprises 799 residents and 142 houses. Differing from other Phaungas, the central village owns a library. The way of life and focal business are similar to the North and South villages. Paddy farming, however, is more utilised in Central Village owing to its closer proximity to the Phaunga Dam than the other Phaungas.

A scattered toddy plantation exists around Central Phaunga up to the periphery of Phaunga Dam (located ½ mile to the west of the Central village). These toddy palms are just used as a source of feedstock for animals, and leaves are used as covering materials for houses. One monastery is set up, but for primary education children depend on a school in the adjoining North Village. The number of MYTCL recruits from this village includes 2 permanent employees as well as 60 contract labourers.

6.4.5 South Mogyopyin Village

South Mogyopyin Village is approximately 5 km south-west of the Project. It has a resident population of 734 occupying 142 houses. The major crops are sesame, maize, peas and beans, and wheat. Paddy cannot be grown due to the scarcity of water in this area. Animal farms cannot be differentiated in the vicinity of the village. This village has a primary school, a Sub Health Centre and a midwife.

A small dam of approximately 35 hectares area is located near the village, providing the sole source of water for the purpose of drinking, irrigation and domestic uses. The dam dries up during the dry season, which results in a shortage of available water, not only in this village but also in other adjoining villages.

The south-west part of the village is of interest to archaeologists. Figures of archaeological interest were unearthed by staff from the Department of Archaeology (MICCL, 2004) in locations only about 0.5 km south-west of the village. These findings are of interest to the expatriates and authorities from the Department of Archaeology as it is believed the items have existed at the site since the antediluvian period. Another point of interest for archaeologists, also located in this area, is an ancient graveyard from the Pyu civilisation.

6.4.6 North Mogyopyin Village

North Mogyopyin Village has the second largest population among the neighbouring villages with 951 people occupying 172 houses. The village is located approximately 5 km from the project site. A primary school is established in the village and the economy and living standards are similar to those of the nearby villages. The number of MYTCL employees originating from the village is 15 contract labourers which appears to be rather higher than other surrounding villages.

6.4.7 Central Mogyopyin Village

Similarly to the North and South Villages, the local population relies heavily on cultivation of a variety of crops. It has a population of 511 and 90 houses sited 5 km away from the project site. Children from this village usually go to a school in the Southern village.

6.4.8 Kyawywa Village

Kyawywa Village is positioned at the side of Yinmapin Road and 1.5 km from the project site. The total population is 645 with 56 houses. The farmers predominantly grow wheat, peas and beans, garlic, onion, maize and sesame. However, there is no paddy cultivation as most farm areas are located on moorland and underground water is considerably salty.

Since this village is quite close to Nyaungbingyi village and Monywa Town, a number of villagers have taken up employment as oddjobbers according to the work offered. Eight (8) people are civil servants and about 6 are MICCL permanent employees. The village has a primary school, a monastery and two stupas. Majority of village wells are somewhat salty and cannot be utilised as a drinking water source. Support from MYTCL has been provided to enable construction of a fresh water well near Aungchansi for villagers.

6.4.9 Taungpalu Village

Although the village has only 864 dwellers and a total of 145 houses, the infrastructure of the village appears to be better equipped than other nearby villages. Taungpalu village lies next to Yinmarbin road and just 2 km away from Letpadaung work site. It has a primary school, a Rural Health Centre and two monasteries. Approximately 14 people are MYTCL workforce and the majority cultivate crops.

6.4.10 Wet Hmay Village

Wet Hmay is located 2 km from the Letpadaung work site. Its residential population is approximately 457 and 110 houses are owned by the villagers. Unlike other neighbouring villages, their prime source of income is derived from the Toddy Palm which has been planted and cultivated by ancestors and existing villagers keep them

for manufacturing jaggery (Toddy Sweet). Further cultivated crops are wheat and a variety of peas and beans. A small brook runs around the village and provides a supply of water which allows the cultivation of paddy in the vicinity of the village.

However, no breeding of farm animals, except domestic ones can be supported, due to the lack of pasture in this area. A primary school is established in the west corner of the village. In terms of topographical setting, Wet Hmay is situated closer to Nyaungbingyi village than Mine Town. In order to pursue a high school education and for other services, locals usually rely on the accessible amenities of Nyaungbingyi village. No villagers are employees of MICCL.

7. IMPACTS ON THE NATURAL ENVIRONMENT

An environmental risk matrix was prepared to identify those issues that require consideration in the ESIA as area/process specific assessment or assessment on a site-wide basis where they result from broadly applied activities.

The matrix is provided as Appendix A.

Based on the findings that have arisen from the matrix, a number of site wide management plans and numerous work process specific plans will be required to address both natural and social environmental issues. The key issues are addressed in the following sections.

7.1 AIR EMISSIONS

Dust is a site-wide issue and also an issue for project vehicles that use the local and regional road system. Emissions from the power generation facilities and SX-EW plant are also potential risks to the natural and social environments.

Dust and waste gas produced in open pit mining are mainly reduced by:

- Fixed and mobile water suppression systems;
- The drills being equipped with a bag filter;
- Water sprays and sprinklers used in loading areas and on haul roads respectively;
- Applying emulsion dust suppressant when necessary; and
- Nozzle spraying of stockpiles with water containing 0.005% to 0.1% humectants to enhance the wettability.

Dust from the crushed ore stockpile, secondary crushing, screening, competent ore pile and all belts in the heap leaching pad will be collected by a combination of dust collection hood, pulse dust collector, ventilator and exhaust drum cleaning process.

Floating balls will be used as cover on the EW cells to inhibit waste gas produced, and the extraction plant will be set up outdoors and a tank house will be provided with no enclosed wall to intensify the natural ventilation and acid mist suppression.

The waste gas, derived from energy produced by burning light diesel oil as boiler fuel, can be discharged directly via a 15 m stack. This will generate dust and SO₂ concentrate respectively below 50 mg/Nm³ and 125 mg/Nm³ which satisfy the Type II and Time II demands (dust 100 mg/Nm³, SO₂ 500 mg/Nm³) in Chinese “Emission Standards Of Air Pollutant Produced By Boiler”.

During the next phase of study, modelling will be undertaken to confirm the design criteria described above will be achievable.

7.1.1 Greenhouse Gas Reduction

Chinese laws and regulations that address energy conservation include:

- Energy Conservation Law of the People's Republic of China;
- Provisional Regulations on the Control of Energy Conservation; and
- Energy Savings Design and Technology Rules of Nonferrous Metals Industry.

These will be applied by MWMCL to this project.

Energy saving measures already identified to reduce production of Greenhouse Gases include:

- Optimised design to confirm the final boundary of open pit and reduce the stripping ratio and save energy. The open pit mining will utilise modern mining and haulage equipment which will reduce unit energy consumption.
- The mining on steep slope angles is utilised to minimise stripping ratio. In the mining, the trench excavating mode and direction can be decided flexibly for the purpose of reducing mining depletion and improving resource recoveries.
- The open pit will be mined by areas and achieve internal disposal of waste in the 20th year of production, which reduces the haul distance of waste and lowers the energy consumption. In addition, the mine transportation will use the pattern of truck-semi-mobile crush station-belt conveyor, which saves the truck haul distance and lowers energy consumption.
- Deep-hole blasting will be used in open pit mining and stripping. The pre-split blasting will be used near slope, which will improve slope stability and reduce or eliminate the need for slope cleaning. The intermediate depth hole blasting will utilise short delay blasting which will improve blasting quality and minimise the volume of oversized material requiring secondary blasting, re-handling and crushing. The secondary crushing will be minimised and power consumption will be reduced.
- The water discharge from the open pit will utilise the combination of interception and discharge with interception such that main, clear and sewage water are separated, to reduce pollution to water and accordingly reduce the power consumption in water treatment.
- The processing plant will be configured to be as compact as possible. The slope of the belt conveyor will be minimised to save power.

- The variable speed electric motors used are controlled by variable voltage and variable frequency to improve the efficiency and reduce energy consumption.
- The ore slurry flow by gravity will be used as much as possible to save lifting power.
- The simultaneous operation of the double circuits used in the line from step-down sub-station to 10 kV sub-station will reduce line losses.
- Low-loss energy saving power transformers and process equipment are proposed.
- The power factor of the processing plant and SX-EW plant is over 0.9.
- The general layout arrangement has considered the land condition to shorten the haulage distance and lifting height. The centralised arrangement reduces the investment and production cost as well as energy consumption.

Wastewater in the pit and waste dump will be returned for use, and the average return water amount will be 11,000 Ml/d thus reducing the need for pumping water overland from the Chindwin River.

7.2 NOISE

7.2.1 Generation of Noise

The noise intensity of major high noise producing equipment is indicated in Table 7.1.

There are two key elements to the noise emitted from each source – wind conditions and location. The significance of wind conditions relates to the change in prevailing wind between the dry seasons and the wet season.

The second element – location – consists of two aspects. These are:

- Proximity to a home or village; and
- Elevation with respect to the receiver.

Without modelling the noise generation from the mine, the impact of noise from the mine on local communities is not yet fully understood. The collection of baseline noise data and modelling of the effect of the noise on the environment surrounding the mine is proposed in the next phase of mine development.

Table 7.1: List of major high noise producing equipment and intensity of noise source

Production System	Noise Source	Quantity (Set)	Noise intensity [dB(A)]
Open mining	Φ250 rotary drill	5	78~95
	Hydraulic excavator, with bucket capacity of 22m ³	5	88~98
	Dump truck, with load capacity of 186t	24	75~95
	890HP bulldozer	1	85~100
	449HP bulldozer	5	85~100
	5m ³ front loader	2	85~100
	Sprinkler	2	75~95
	Water pump	52 (19 under normal conditions and 52 at the maximum)	85~95
Ore processing	Vibrating feeder	20	90~100
	Gyratory crusher (in the pit)	2	90~100
	Vibrating screen	12 (10 on duty and 2 standby)	90~110
	Cone crusher	4	92~98
	Draught fan	15	80~95
	Water pump	20	80~90
Metallurgical process	Solution delivery pump	25	85~90
Return water and water in take system	Water pump	3	85~90
Air compression station	Air compressor	3 (2 on duty and 1 standby)	90
Boiler house	Air blower	1	85

7.3 RAINFALL

Based on an analysis of rainfall data from 1970 to 2012, two trends appear to be developing.

The average rainfall over the 40 year period appears to be declining, given that the cumulative rainfall curve over the period of recording has a decreasing slope. This suggests that rainfall considerations in design will likely accommodate lower levels of water availability than the rainfall record.

The second trend is the development of more intense rainfall events, as shown by the higher rainfall recorded in any one month. This suggests that any structures which are expected to contain the run-off from distinct rainfall events should have additional capacity provided to account for changes in the rainfall pattern that appear to be developing.

7.4 WATER CONSUMPTION

The total industrial water consumption of this project is 30,340 m³/d including fresh water 16,500 m³/d (mining 1200 m³/d, crushing and heap leaching 12,505 m³/d, electro-winning and extraction 814 m³/d, boiler house and compressed air station 114 m³/d, contingency 1,867 m³/d) and recirculated cooling water 13,840 m³/d. In addition, the internally circulated raffinate volume for metallurgy is 81,294.5 m³/d. The domestic water consumption is 300 m³/d.

The current water consumption estimates are based on current average rainfall and rainfall intensity. Given the assessment of the rainfall trending to a lower average and high intensity, the water demand from off-site sources should be reviewed to establish scenarios that occur in years of below average rainfall and when storm intensities in excess of those that currently occur are required to be captured and managed on-site.

A site water balance is required to enable the demand for off-site water supply to be determined over the life of the mine. It is also required to enable an assessment of the volume of water to be released from the site and a prediction of the water quality to be made.

The next stage of the project should also consider the impact of the site water demand on the overall water demand from the supply source at the Chindwin River. These considerations should review the impact under a drought scenario to establish the sustainability of that level of demand and its impact on other water users and river resources (such as aquatic fauna).

The current site water balance includes about 7,000 m³/day of water being derived from inflow into the open pit. It is understood that this amount has not been validated by pump testing of water bores within the mining area. Such a volume needs to be confirmed as it represents about 25% of the total water supply for the site.

The effect of groundwater extraction on areas outside the site, through interception of flow paths within the open pit, is not well understood. As part of the next phase of the project, a hydrogeological assessment should be undertaken to determine the zone of influence of extraction from the open pit and the effects extraction has on adjacent

users of the resource and also its source, given the cone of influence has an estimated radius of almost 1,600 m.

The next phase of work should also describe in detail the means by which surface and ground water quality will be maintained and address such issues as leaching of solutions in heap leach, management of potentially acid generating materials, acid rock drainage, sediment control and separation of contaminants such as petroleum compounds, drilling muds and sanitary waste water.

7.5 WASTEWATER POLLUTION

7.5.1 Source, Generation and Discharge of Pollutants

Total water consumption of this project is 30,340 m³/d as described in Section 7.4. The recycling rate of production water is 85.22% and 86.2% for the processing plant and metallurgical plant.

7.5.2 Wastewater From Mining

As the production service life of the mine is 32 years, open pit block mining method shall be adopted, with the service life of Section I being 19 years and that of Section II being 13 years. The total excavation area of open mining is 3.25 km², including 2.07 km² for Section I and 1.18 km² for Section II. The elevation of the closed loop for the open pit boundary is 75 m, with the minimum pit bottom elevation of RL345 m. The mining wastewater results from rainfall and groundwater inflow to the open pits (elevation of RL90 m to RL345 m). The average production of mine water is 14,500 m³/d (4,784,709 m³/a), including average production for Section I of 4,800.5 m³/d (1,584,157 m³/a) and for Section II of 9,700 m³/d (3,200,052 m³/a). According to the analysis data of Sabetaung deposit nearby, the waste water in the open pit is likely to be acidic (pH5~6) and it is also likely to contain relatively high content of heavy metals. Because there is no specific monitoring data from the Letpadaung deposit, the actual water quality is not yet known. Further testing of the groundwater in the Letpadaung pit area is required to confirm the expectation developed from experience of operating the Sabetaung Pit and to confirm the yield anticipated in the water modelling completed for the site.

7.5.3 Wastewater in Waste Dumps

Run-off from waste dumps results from water produced by rainfall percolating through the waste rock, so wastewater is produced only when there is rainfall, and the amount of waste water generated is related to the factors of catchment area, amount of rainfall, surface run-off co-efficient and infiltration rate. The three waste dumps cover an area of 501 ha and the total catchment cross-section is 509 ha. Allowing for the local annual

average rainfall of 720 mm, rainfall run-off coefficient of 0.7 and coefficient of modulus of 1.56:

- The catchment area of WD1 in the north-east is 252 ha and the amount of run-off generated from the waste dump will be $203.38 \times 10^4 \text{ m}^3/\text{a}$;
- The catchment area of WD2 in the west is 143 ha and the amount of run-off generated will be $117.28 \times 10^4 \text{ m}^3/\text{a}$; and
- The catchment area of WD3 in the south is 114 ha and the amount of run-off generated will be $96.77 \times 10^4 \text{ m}^3/\text{a}$.

Since WD2 and WD3 will store waste rock from a high position of the pit that is less likely to be sulphur-bearing, the run-off from these two dumps could be discharged directly as clean water. However, the run-off from WD1 is expected to be high sulphur-containing and the water quality of its rainfall run-off similar to that of the mine water in the open pit. In addition, the run-off from WD1 will contain heavy metal ions released into solution due to the acidity of the water.

The quality of the run-off from the waste dumps will be highly dependent on the composition of the waste materials and their placement in the waste dumps. The quantity of run-off will also be dependent on the rainfall characteristics used to calculate the estimated volume. It is proposed that the next phase of study include a waste characterisation program which not only investigates the potential to generate acidic run-off but also addresses the character of the material in the leach zone and the physical behaviour of all the materials when exposed to rainfall.

It is expected that the next phase of work will delineate and quantify the areas of acid generating material and also define the acid neutralisation potential of other materials as well their physical stability and suitability as cover materials on the external surfaces of waste dumps and pit walls. Once these properties have been established, they can then be applied to the run-off model to generate estimates of run-off quality and quantity for the purposes of determination of water recycling capacity and water treatment requirements.

7.5.4 Wastewater From Ore Processing

Wastewater from ore processing is produced by the ground flushing water for the crushing plant, screening plant and heap leach pad. The amount of wastewater produced is $25 \text{ m}^3/\text{d}$ and the main pollutant is suspended solids (SS). It is predicted that the concentration of SS shall be 500 mg/L. If the crushed ores contain sulphur bearing rock there is also potential for the waste water to be acidic, depending on the amount of contained and available sulphur. The wastewater will be collected and conveyed to the wastewater conditioning pond. The amount of make-up water required

for the heap leaching process is 12,480 m³/d (coming from fresh water or return water in the waste water conditioning pond), 1,440 m³/d of which will be sent to the SX-EW plant and the rest, 11,040 m³/d, will be retained in the heap leach slag or lost in evaporation. Therefore, there will be no discharge of wastewater from the heap leaching process.

Wastewater from metallurgical process includes the purifying and washing water for the extracting agent of the SX plant, washing water for electrolytic copper in electro-winning (EW) plant and ground flushing water for the SX-EW plant. The amount of wastewater produced will be approximately 182 m³/d and the main pollutants in the waste water will be the acidity, petroleum, and metals. The waste water shall be sent to the heap leach pad for re-use after treatment to remove oil.

7.5.5 Waste Water From Smelting Plant, Air Compression Station

Waste water from the smelting plant, air compression station mainly includes ground flushing water. The amount of waste water produced is 2 m³/d and the main pollutant is SS. It is predicted that the concentration of SS shall be 200 mg/L. The waste water will be collected and then gathered in the waste water conditioning pond.

7.5.6 Domestic Waste Water

The amount of domestic waste water produced at the mine is 240 m³/d. This waste water is derived from the accommodation village and the main pollutants are COD_{cr}, BOD₅ and SS, the initial concentrations of which are respectively 150 to 250 mg/L, 50 to 150 mg/L and 100 to 200 mg/L. The domestic waste water will be discharged into the wastewater conditioning pond after being processed by a waste water treatment plant designed to process sewage effluent.

7.6 ACID ROCK DRAINAGE

Current mine planning has utilised a relationship model developed from the geochemistry the S&K operation to determine the potential for acid rock drainage (ARD); for waste rock to generate acidic run-off or seepage when stockpiled.

Currently the design of the waste dump and low grade ore stockpiles do not address the differential placement of acid generating materials to allow encapsulation with other waste materials to provide seepage pathways which avoid water percolating through the acid generating material and producing low pH water which subsequently leaks from lower levels in the waste dump or infiltrates through the soil profile into the shallow groundwater aquifer.

In Section 7.5.3, a waste characterisation program has been described for the purpose of managing the quality of run-off from the waste dumps and low grade stockpiles. The

findings of this program and that described in Section 7.7 below shall also be applied to the design of waste dumps and low grade stockpiles in the next phase of work. This design effort will identify the strategy for construction of waste dumps in such a way that the potential for generation of acidic water within the waste dump or in the soil, through seepage, is minimised. It will also describe the structures to be used to prevent infiltration into the groundwater or to collect and treat seepage from the waste dumps.

7.7 GEOCHEMISTRY

High sulphidation systems present a risk of acid generation due to the high concentrations of reactive sulphide minerals which are deposited within the systems, but also due to depletion of acid neutralising capacity during hydrothermal alteration. They also pose one of the most challenging systems to gain a full understanding of the geochemical risk profile due to the presence of non-acid generating sulphide minerals, which render standard laboratory analysis inappropriate.

The scale of the Letpadaung project and the lack of good baseline geochemical data are such that a phased approach to a geochemical investigation is warranted to improve the quality of the data which can be obtained from the investigation. It is therefore recommended that the geochemical investigation be split into three phases as detailed in the following sections.

7.7.1 Desktop Assessment and Sample Selection

A desktop study will be conducted to review the geology of the deposit and the core samples which are currently available on site. This study will be aimed at identifying recent core samples located within the waste zones which can be tested without the need for additional drilling to collect new samples. Older historical drilling samples can also be used, providing that they have not been exposed to rainfall which could have washed out sulphide oxidization products. However, recent samples are preferred.

The study will aim to identify approximately 150 samples for testing, with the assessment designed to provide initial estimates of the magnitude of the ARD risk at the project, together with the risk associated with leaching of environmentally significant elements which may be present within the deposit.

To conduct this study the following data sources will be required:

- Cross sections of pits showing waste / ore zones, geology, alteration and the boreholes from which core samples are available;
- Estimated waste volumes by lithology and alteration type;
- Geological logs of boreholes from which core samples are available;

- Dates the boreholes were drilled and the samples collected / available; and
- Any existing assay / multi-element data for the boreholes from which core samples are available.

A preliminary test program will be defined for all 150 samples, which will include geochemical testing tailored to the mineralogy of the deposit. This is considered to be a low number of samples, with international guidelines (BCMEM (1997); DMEQ (1995)) generally recommending a much higher number of samples per geological unit to enable a complete definition of the geochemical characteristics of geological units, as summarised in Table 7.2. Therefore, this phase of testing should be considered as providing preliminary data on which to start building an understanding of the deposit.

Table 7.2: Recommended number of samples

Tonnage of Geological Unit (tonnes)	Minimum Number of Samples
<10,000	3
<100,000	8
<1,000,000	26
<1,000,000	26

7.7.2 Laboratory Testing and Interpretation

The samples selected during the desktop assessment will be sent to a National Association of Testing Authorities of Australia (NATA) or similarly accredited laboratory. The test work will be staged to minimise unnecessary testing, with the initial stage of testing including the following tests on all samples:

- Total sulphur, sulfate sulphur and chromium reducible sulphur;
- Acid neutralizing capacity (ANC);
- Paste pH; and
- Multi-element analysis of the solids.

A review of the results will then be conducted to determine which samples will require additional testing. All samples will have either single addition NAG testing or multiple addition NAG testing, depending on their acid neutralising capacity, paste pH and chromium reducible sulphur content. Only those samples with high acid neutralising capacity and high chromium reducible sulphur content will be subjected to the multi-stage NAG testing. A limited number of samples will also have carbonate carbon analysis, specifically those samples which indicate some acid neutralising capacity and based on the preliminary static test results would be classified as having an uncertain acid forming potential.

Based on the results of the multi-element analysis and preliminary static test results, approximately 25% of the samples will be selected for distilled water extract testing. This test provides an indication of readily soluble metals which are contained within the samples and is particularly useful when assessing whether material is suitable as a cover or capping material, as it determines which metals will leach at unacceptable levels if placed on the outer facing of the dumps.

A limited number of samples (approximately 10%) will have quantitative mineralogical XRF analysis conducted so that a better understanding of the mineralogy of the deposit can be gained. These samples will be selected based on both the lithological descriptions provided in the borehole logs and from the preliminary static test results.

The staged approach will result in a longer testing duration, but will save significant costs and allow for the testing to be better tailored to the actual samples selected. It is estimated that the testing will take a total of ten weeks from receipt of samples. A comprehensive interpretative geochemical report will be compiled once all the test work is complete.

7.7.3 Mine Waste Management Strategy

The geochemical analyses will provide initial indications of the likely extent of geochemical risk and should allow for a mine waste management strategy to be developed for the project.

To minimise the geochemical risk during operations, it will be essential to characterise the waste material prior to mining so that high risk geochemical material can be selectively handled. Therefore, a plan will need be developed for the project which will include recommended test methods to be applied to grade control / blast hole samples ahead of mining. It should be noted that correct placement of material in the dumps, effective dump design and ongoing encapsulation of high risk geochemical material with inert waste provides both the lowest cost and most robust long term solution to acid rock drainage.

The key objectives of WRD design is that the facility is safe, physically and chemically stable, and aesthetically acceptable during construction and following closure.

A mine waste management strategy will be produced in consultation with MWMCL. The mine waste management strategy will allow MWMCL to effectively manage the waste materials to reduce both operational and long term risk, without placing an unnecessary burden on the project. The mine waste management strategy will include the following:

- Recommendations for ongoing testing during operations;

- Recommendations for waste dump designs and waste handling practices;
- Recommendation for encapsulation and capping of high risk geochemical material;
- Recommendations for water management around the waste dumps; and
- Recommendations for monitoring and instrumentation to assess the effectiveness of waste management practices / controls.

Once a mine waste management strategy has been agreed, a detailed design of the dumps or detailed waste storage plans should be developed. These plans should be used as the basis for waste dump/stockpile design and refined as the detailed mine planning is completed and follow the test method proposed for characterisation of waste, as described to minimise the geotechnical risk. These plans will also satisfy the requirements described in Section 7.5.3 regarding the management of the quality of run-off from waste rock dumps.

This work should be undertaken in the next phase of the project as it is information that will be required for completion of the ESIA, as acid rock drainage is potentially the highest environmental risk associated with the project.

Current waste dumping procedures being used on site are the top down construction (TDC) method. The TDC method results in segregation of materials. Larger, bulky, particles roll to the foot of the slope and fines stay near the dump crest. TDC dumps are not suitable for encapsulation of acid generating materials as:

- They do not provide any control on the final destination of materials after they are dumped;
- It is difficult to achieve the compaction required to create a low permeability barrier within the encapsulation layers; and
- The fines at the surface will likely crack and destroy the reduced permeability of compacted encapsulation layers.

The bottom up construction (BUC) method of construction is more suited to waste dumps that must cater for the dumping of acid generating materials. It achieves much higher densities due to the compactive effort produced as each layer is spread. Compaction can be achieved through use of compaction equipment using other waste dumping techniques. BUC storages are suited for encapsulation (Spitz and Trudinger, 2009).

7.8 LAND DISTURBANCE AND CLEARING

7.8.1 Prevention and Control Object of Water and Soil Conservation

This project shall comply with the relevant requirements in the Chinese *Control Standards for Soil and Water Loss on Development and Construction Projects* (GB50434-2008), with the project implementing Class I standard. Proposed performance criteria are:

- Control percentage of 96% for the disturbed land;
- Treatment percentage of 91% for the soil and water erosion;
- Control ratio of 1.0 for soil and water erosion;
- Percentage of slag or ashes of 98%;
- Recovery percentage of 98% for vegetation; and
- Coverage rate of 26% for the forest and grassland.

7.8.2 Extent of Disturbance

7.8.2.1 Disturbance in construction period

During the construction period, general earthworks will be required for field levelling and road construction. The volumes of material required for excavation and fill are respectively $59.2 \times 10^4 \text{ m}^3$ and $17.9 \times 10^4 \text{ m}^3$.

Foundation development and improvement will require excavation and filling for the heap leach pad totalling volumes of $616.5 \times 10^4 \text{ m}^3$ and $50.8 \times 10^4 \text{ m}^3$ respectively.

Topsoil stripping from the surface of areas to be excavated or filled will produce a stockpiled volume of $175.6 \times 10^4 \text{ m}^3$.

The overall areas to be disturbed to accommodate all facilities including the mine, service areas, leach pads and all metallurgical facilities totals 3,273 ha.

In the next phase of work, the sources of fill materials will need to be defined and procedures developed to rehabilitate those areas as an activity in construction of the Project. An erosion and sediment control plan will need to be developed specifically for the construction phase to minimise the potential for erosion and describe structures required to contain eroded materials and prevent pollution of land and waterways off-site.

7.8.2.2 Dumped residue in production period

The total amount of waste earth (rock) dumped from open pit during the service life is $94,604.4 \times 10^4 \text{ t}$, of which $68,937.5 \times 10^4 \text{ t}$ will go into the waste dumps, and the rest $25,666.9 \times 10^4 \text{ t}$ will be dumped in the open pit after 19 years of operation.

The heap leaching slag is $95,418.6 \times 10^4 \text{ t}$. Since the heap leach pad will not be removed, the heap leach slag will be stored in the heap leach pad.

Given the area of disturbed land is estimated to be 3,273 ha of which 1,091 ha will be disturbed during construction, without any measures to control erosion, it is estimated 130.9 kt/a of soil will be lost from the disturbed areas.

Waste dumps are the main area for potential soil erosion in the production phase. The estimate for the rate of soil erosion is 2,963.4 kt/a would be lost without remediation/rehabilitation of exposed surfaces.

The use of BUC in the development of waste rock dumps (WRD) enables for progressive topsoil placement and revegetation development of the WRD. It avoids the storage of large volumes of topsoil and loss of the soil structure, nutrients and micro-biological elements of topsoil. It also reduces the exposed area of WRD face which, in turn, provides for easier management of dust and turbidity in run-off from the exposed areas. BUC also enables WRD to be integrated into existing landforms so that batter slope angles are consistent with those of the surrounding hills. It provides for the construction of valleys to carry water off the WRD. The final surface can then be developed into a form that is congruent with the surrounding land uses. The form of the WRD will be reflected in the final objectives for the WRD. For example, if a WRD contains PAF materials it is desirable to have them shaped to encourage water to run-off the structure. This requires a designed drainage system to carry water down rock lined valleys on the external surface of the structure to avoid seepage into the encapsulating materials (Lindbeck and Hannan, 1998).

The final land use of the structure is important. Where the slopes of the waste dump are proposed for agriculture, grazing or forestry, slopes in excess of 14° are not desirable for such uses if machinery is to be used on the slopes. However, such activities using manual methods can be undertaken on slopes up to 24° if constructed accesses are provided (Spitz and Trudinger, 2009).

Selection of slope angles will lead to trade-offs with other factors, such as:

- Increase in overall footprint as slope angle decreases;
- Increased constructive effort with lower slope angles leading to increased construction cost (which may be offset by lower rehabilitation maintenance costs and the overall productive worth of the area after mining ceases);
- Increased area to be revegetated (a cost if the revegetation is not productive); and
- Increased catchment areas on longer slopes which may require specific erosion control effort (but which could have benefits for productive use of the land through use of low cost water harvesting methods on the slopes).

The next phase of work needs to describe the design of the waste dumps in detail and include:

- Proposed final land use for each WRD (or areas within the WRD);
- Differential placement of waste rock in each WRD;
- Removal and storage of topsoil ahead of placement of the waste rock;
- The progressive development and rehabilitation of each waste dump;
- Strategies for control of erosion on/from the waste dumps; and
- Use/reuse of run-off derived from waste dumps.

Thus the design of the WRD needs to consider a range of issues in their development, not just the cost of dumping the waste, and identify the overall costs and benefits in the long term for definition of a sustainable outcome in the waste rock design. Such a design process will be undertaken in the next phase of the project.

7.8.3 Clearing

Prior to removal/placement of materials associated with construction, it is anticipated vegetation that is presently growing in the area of disturbance will be removed. The effect of the removal of vegetation is two-fold.

The existing vegetation provides stability for soils on existing slopes and cover for soils on the plain that are subjected to agricultural activities. Where vegetation remains, procedures need to be developed to ensure ground disturbance envelopes are defined and adhered to and that the vegetation resource is conserved and put to use as ground protection in areas where ground is no longer required or on batter slopes of waste dumps and topsoil stockpiles.

The second effect is a social consequence that arises from use of the Letpadaung Hills as a source of firewood for local communities.

The next phase of work on the project will describe the clearing zones and their location on the project site, develop a work method for control of clearing and develop a reuse strategy for cleared material. It will also describe how it is proposed to supplement the local firewood supply to compensate for the loss resulting from clearing.

7.9 VEGETATION AND FLORA

Vegetation and flora can be delineated into two separate zones – the hills and the plains.

The hills are principally Letpadaung Hills and Nachituang Hill within the project site. The differentiating factor between the two hill areas is principally their level of

disturbance. The Letpadaung Hills are covered with a remnant vegetation, that is a naturally occurring vegetation that is not a crop. In reality, the vegetation on these hills has been highly modified and manipulated as a result of the harvesting of the *Tectonia* shrubland for firewood (Muir, 1997). In the current mining plan, much of this vegetation will be removed as the mine advances and only patches of the current remnant will remain, albeit a representative of the current vegetation.

The ecological value of the Nachituang Hill is considered of greater worth in its representation of local flora as it supports a greater diversity of vegetation and does not appear to have suffered the same degree of disturbance as the Letpadaung Hills (Muir, 1997).

The vegetation on the plains is primarily associated with crop production and is represented by introduced species. The most significant loss is likely to be the Toddy Palm (*Borassus flabelliformis*) which is used for beer production and thatching for houses. Other plants, some natural, also occur in hedgerows constructed around fields (Muir, 1997).

It is not believed that any plants considered rare or threatened species occur in the area.

The next phase of the project will see detailed vegetation and flora surveys completed across each season to document the abundance and diversity of vegetation and to confirm there are no species that could be considered as rare or threatened within the project site. Attention will also be given to understanding the use of 'naturally occurring' species for traditional use, such as medicine or for use in timber products. The study will also recommend the suitability of specific species for rehabilitation works. Further to that work, it is proposed some revegetation trials should be commenced to ensure a method of rehabilitation is refined before the rehabilitation works are required at a large scale.

It is considered that some trials should be undertaken to establish a method for transplanting Toddy Palm, given its social value and rate of growth, to ensure the areas removed do not cause a shortage of product locally.

7.10 TERRESTRIAL FAUNA AND HABITAT

Work undertaken by AATA (1996) and Muir (1997) identified the presence of:

- Amphibians and reptiles;
- Frogs;
- Lizards and snakes;

- Birds; and
- Mammals.

In the populations of fauna investigated, the number of each type and species within each animal type was quite low, although a rare mammal, the Dhole (*Cuon alpinus*), has been reported locally as occurring within the region. Generally, the observations made suggested the number of species and their abundance is low, which may be a reflection on the percentage of the area which is subject to agriculture, and hence reduce habitat for fauna.

A full survey of fauna and their habitats will be undertaken in the next phase of work. This work will address seasonal changes throughout the year to establish changes that occur with food availability. Consideration must be given to how habitat development in rehabilitated areas will influence improvement of species diversity and numbers as the mine develops and the further work that may be undertaken to gather a sound database of fauna that inhabits the area permanently or seasonally.

The study will also examine the potential for loss of wildlife through mortality associated with ponds containing water of poor quality being established in the landscape. The death of animals, particularly avifauna, on ponds and dams in mining environments is not uncommon. Given the number and size of ponds/dams proposed in this project, the next phase should include consideration of the likely impact of poor quality water bodies on fauna and its potential for fatalities when fauna use these facilities.

7.11 AQUATIC FLORA AND FAUNA

Work reported by Muir (1997) highlighted some inconsistencies in information relating to aquatic flora and fauna which could be influenced by a range of issues including seasonality, water quality, metal content in the water or habitat condition in relation to level of disturbance by other industrial activity (including agriculture along the banks).

The next phase of the project will seek to investigate the inconsistencies highlighted by Muir, including the range of species and diversity of species within the aquatic flora and invertebrate and vertebrate fauna within the Yama Stream and Chindwin River, both upstream and downstream of the mining areas and outlets. The study will also consider abundance of fish in the rivers and how the local fishery is influenced by fishing activity in the river. Fish from above and below the mining areas will also be examined for conditions which may suggest their habitat is being adversely affected within the river catchment.

7.12 HAZARDOUS MATERIALS

The mining and processing associated with the Project will utilise a range of hazardous materials including petroleum products, acid, explosives and a number of chemicals used within the processing systems. Each of these will be manufactured remote from the site and transported to the site, stored, prepared for use and used within the site. Each step in handling and use of hazardous chemicals has risks associated with it.

The next phase of the project will need to assess the risks associated with the hazardous materials proposed for use on the site. This phase will need to assess:

- The types and amount of each material on site;
- Transport risks;
- Storage requirements and security;
- Materials handling;
- Spill and release scenarios;
- Potential for uncontrolled reactions;
- Use within the site and controls required for maintenance of community and occupational health; and
- Disposal of waste products and packaging.

Management options need to consider:

- Release prevention and control planning;
- Occupational health and safety;
- Process knowledge and documentation;
- Overfill protection;
- Hazardous materials transfer;
- Reaction, fire and explosion prevention;
- Secondary containment;
- Leak detection;
- Storage options;
- Management actions;
- Preventative measures; and
- Community involvement and awareness.

7.13 WASTE

Aside from waste rock, which is discussed in Section 7.5.3 and 7.7.3 above, leach pad waste is another significant waste product of the proposed type of mining and mineral

processing. This type of operation does not require a tailings storage facility (TSF). Treatment of heap leach slag will be considered in the site rehabilitation, described in Section 7.15 below.

The other waste products that are significant are the hazardous wastes generated during this process. These include acids, waste oils and greases, some plastics, tyres, medical waste and e-waste.

General waste, whilst not necessarily requiring specific treatments, requires assessment for its potential for reduction, reuse, recycling, recovery or removal.

If a landfill is proposed for construction on the site, the next phase of the project should estimate the classes of waste to be generated, and their volumes, to allow for the design of an on- or off-site landfill to be included in the ESIA. It is likely that a landfill for general waste can be constructed within a waste rock dump that is free of acid generating materials.

Hazardous wastes should be assessed for their risk associated with disposal. Some of the waste may be able to be shipped off-site to disposal facilities as backloads in containers used to deliver goods to site. In other instances, on-site disposal may be an option. For example, waste oils may be able to be added to light diesel and used for power generation. Classification of waste should include hazardous waste and describe a disposal strategy for hazardous wastes produced on-site.

Any removal of waste to an off-site facility should be accompanied by a waste tracking record to enable the destination of waste to be known and for monitoring of the performance of any contractor charged with disposal. Such a system should be described in the next phase of work.

7.14 ENERGY USE

Energy use is one of the major costs to an operation but also one where effective cost savings can be made. Energy use also reflects the quantity of greenhouse gas emissions generated by the project. The Basic Design (NERIN, 2011) describes options which have been considered, including the use of high efficiency electric drives to power pumps and conveyors, to reduce power consumption. In preparation of the ESIA, in the next project phase, the energy efficiency options developed should be optimised to ensure lowest energy demand occurs in the processing phase with the aim of reducing energy load.

Traditionally, fuel consumption in the mining fleet and energy used in processing are the largest producers of greenhouse gas emissions in a mining and processing operation. They may account for up to 95% of all emissions produced. In assessing

the energy efficiency, consideration should be given to overall energy use in the next phase of project development to investigate how fuel consumption can be reduced and what options to use alternative fuels, such as Liquefied Natural Gas, biogas or biofuels, are available.

7.15 REHABILITATION

During construction, and then when operations commence, land will be disturbed to acquire ore for processing and to make way for facilities on the site. This disturbance will lead to destabilisation of existing surfaces and expose them to erosion when it rains and a source of dust when it is dry. Creation of new surfaces through the stockpiling of materials will also occur and these surfaces, often at angles steeper than the local angle of repose of such materials, are also prone to erosion and dust generation.

As part of the ESIA, the capacity to progressively rehabilitate areas which have been disturbed and waste dumps and stockpiles created must be demonstrated. As a minimum the following topics will be addressed:

- A dynamic rehabilitation plan will be developed which has the flexibility to evolve as results from investigations, research, on-site trials and detailed mine planning become available;
- Early characterisation of materials to be rehabilitated to identify potential issues sufficiently early for them to be resolved prior to removal from their source location;
- Understand the environmental externalities which have potential to constrain rehabilitation success, for example, the availability of a local firewood source;
- Set realistic rehabilitation objectives;
- Manage site water to minimise erosion and restrict the potential for off-site pollution;
- Design landforms which are stable, safe and blend in to the surrounding landforms;
- Establish cover materials which enhance stability and isolate potentially hazardous materials within the landform, such as acid generating waste rock and heap leach slag;
- Remove, store and manage topsoil to conserve valuable nutrients and enhance the viability of native seed and micro-organisms;
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);

- Develop success criteria for rehabilitation which are consistent with overall site closure objectives;
- Establish a rehabilitation monitoring program which measures key functional parameters of an evolving landscape (for example, ecosystem function analysis program); and
- Demonstrate through long-term monitoring that the development of rehabilitated areas is consistent with completion criteria (DITR, 2006a).

A site rehabilitation plan will be prepared as part of the ESIA. The plan will make recommendations on the treatment of specific types of disturbance and take into account the range of issues that will influence the final landform required and identified in the Decommissioning and Closure Plan described in Section 7.16.

7.16 DECOMMISSIONING AND CLOSURE

Current good mining practice suggests that mine planning should be undertaken with mine closure at the forefront of consideration. Some key principles and elements related to mine closure include:

- Integrate sustainable development considerations within the corporate decision-making process,
 - Plan, design, operate and close operations that enhance sustainable development;
- Implement risk management strategies based on valid data and sound science,
- Consult with interested and affected parties in the identification, assessment and management of all social, health, safety, environmental and economic impacts associated with closure activities, and
- Inform potentially affected parties of significant risks from mining, minerals and metals operations and of the measures that will be taken to manage potential closure risks effectively;
- Seek continual improvement in environmental performance,
 - Assess the positive, negative, indirect and cumulative impacts of new projects from exploration through closure,
 - Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses, and
 - Design and plan all operations so that adequate resources are available to meet closure requirements of operations;

- Contribute to the social, economic and institutional development of the communities in which we operate,
- Contribute to community development from project development through closure in collaboration with host communities and their representatives; and
- Implement effective and transparent engagement, communications and independently verified reporting arrangements with stakeholders (www.minerals.org.au/enduringvalue).

Sustainable development issues for closure include:

- Environmental issues
 - The post-mined landscape is safe and stable from physical, geochemical and ecological perspectives;
 - The quality of the water resources is protected;
 - The agreed sustainable post-mining land use is established and clearly defined to the satisfaction of the community and government; and
 - Success criteria are agreed with relevant stakeholders and monitored and reported to those stakeholders;
- Socio-economic issues
 - Future public health and safety of the community is not compromised;
 - An early and effective communication strategy should be established and the community engaged throughout the life of the operation, including through decommissioning and closure;
 - Community development should include strategies for sustaining the socio-economic state of the community without the support of the mine;
 - Develop capacity to maintain certain infrastructure services and facilities for future community or local government ownership or as part of arising business development opportunities;
 - Provide appropriate skills transfer and employment opportunities through the development of local business enterprises;
 - Community development should be driven by the needs of the community with the aim of contributing to the building of the long-term strength of community viability; and
 - Develop the formal and informal processes, systems, structures and relationships within the community that actively supports the capacity of

current and future generations to create a range of healthy and liveable communities (DITR, 2006b).

A Mine Decommissioning and Closure Plan should be developed as part of the ESIA which addresses the issues and key principles and their elements as described above. The plan should be prepared recognising that mine closure is a dynamic process and that the detail in the plan will be developed as construction and operations progress and continual improvement allows the mining industry to advance its knowledge and skill associated with closure as well as MWMCL implementing its community development program and identifying the aspirations of the community in future generations.

8. SOCIAL IMPACTS

8.1 LAND ACQUISITION

The following describes the process that has been undertaken to enable the land on which the Project is located to be used for mining purposes.

The Ministry of Mines received La Na (39) for utilization of farm lands for the purpose of mining. The document was submitted by ME-1 on 18th January 2001 with reference No. 5/41-5(130)/Oo 6 from Sagaing Division Peace and Development Council. ME-1 handed over La Na (39) to the Myanmar Economic Holdings Limited (MEHL) on 5th March 2010. According to La Na (39), the total area of 7,867.78 acres (3,191 ha) includes the following-

- Registered permanent farm land - 4,826.70 acres
- Temporary farm land - 230.80 acres
- Other land (Including mountain area, road and etc..) 2,810.28 acres

Before carrying out the compensation work, MEHL studied the ground conditions of the farm land with the help of local authorities and the local Settlement and Land Record Department. Then MEHL submitted a letter to the regional authorities to organise a committee for compensation work with the letter of Ref No. 2/3/AhKhYa/Paing(3200/2012), dated on 12th October 2010.

Regional authorities organised a committee for compensation associated with the Project. It comprised two parts. Firstly, the Leading Committee comprised Regional Level officials and, secondly, the Acting Committee was formed from district and township level officials including village heads of respective areas.

The Salingyi Township authority set up three (3) teams for the field work to check, confirm and record the ground conditions on farm lands. According to the records of the three (3) teams, the registered farm lands had increased to 5,487.27 acres over the ten years from 2001 to 2010 when records were last updated.

8.1.1 Land Compensation Strategy

For land compensation, 12 to 20 times of revenue is consistent with the existing provision in Myanmar law for compensation. However, that amount is very little compensation (only 5 to 20 kyats (Ks)/acre). As a result, the compensation committee considered two methods of land compensation. One method is to give the compensation according to the local average current price of land. The approximate cost of land is about 200,000 Ks/acre to 400,000 Ks/acre. The second method is to give the additional compensation depending on the type and selling price of the crops

for (3) times (or) three years' profit. This amounts to about 525,000 Ks to 550,000 Ks for one acre.

In the areas where the new villages were established, the compensation procedures are the same as in the mine lease area, but utilised a different rate of compensation for two reasons. Firstly, the areas are outside of the mine lease. Secondly, the areas have better fertility than most areas in the mine lease area. However, the rates of compensation used for trees are the same for all areas.

After defining the rate of compensation, the compensation committee reported to the regional authority to get the confirmation of the authority. The Regional Authority confirmed the rates of compensation as summarised below in Table 8.1.

Table 8.1: Approved rate of farm land compensation in Letpadaung Copper Mine (based on (1) acre)

Name of Crop	Production Rate (Myanmar Unit)				Annual Local Currency Price (Ks)				Cost per Acre (Ks)	Compensation Paid per Acre (Ks)
	Max	Fair	Poor	Average	Max	Fair	Min	Average		
Sesame	11	8	5	8	26,000	23,000	20,000	23,000	184,000	552,000
Sunflower	33	25	17	25	9,000	7,000	5,000	7,000	175,000	525,000
Pigeon Pea	15	10	5	10	23,000	18,000	13,000	18,000	180,000	5,400

Note

- 1 acre = 0.4056 ha
- Production Rate is based on the local average production rate
- Current Price is based on the average annual price of local market current price based on the average annual price of local market

The approved compensation rate for trees in the Project area is:

- Toddy tree 5,000 Ks
- Mango tree 8,000 Ks

Toddy trees are compensated when they have reached a minimum height of 9 ft (2.8 m) and mango trees are compensated once they bear fruit. For this project the compensation rates paid were actually two (2) times the specified rate i.e. 10,000 Ks and 16,000 Ks respectively.

8.1.2 Application of Compensation Strategy

Four villages were located inside the mine lease area and they needed to be resettled outside the lease area. Two locations were selected as new village sites and land compensation was also completed in the period 19th February 2011 to 18th December 2012 for those areas as follows:

- New Taungyar Monastery Area of 6.55 acres for which 4,387,322.25 Ks was paid;
- Wet Hmay – Kan Daw Village area of 54.67 acres for which 37,095,410.55 Ks was paid; and
- Sete – Ze Daw Village area of 58.25 acres for which 39,493,045.05 Ks was paid.

Thus, for the total area of 119.97 acres (48.66 ha), a sum of 80,975,777.85 Ks was paid to landholders.

Kan Daw village is already relocated into the new village area with 97 houses and one monastery being relocated. Wet Hmay village has relocated 67 houses and one monastery and 43 houses remain to be moved. Ze Daw village has relocated 29 houses and 37 houses and one monastery remain to be moved. Sete Village has relocated 28 houses and 140 houses and one monastery remain to be moved.

Tree compensation has already been completed for the new village area as follows:

- New Taungyar Monastery area had 10 Toddy trees for which 100,000 Ks was paid;
- Wet Hmay – Kan Daw village area had 2,722 toddy trees for which 13,610,000 Ks was paid; and
- Sete – Ze Daw village area had 1,542 toddy trees for which 7,710,000 Ks was paid and 2 mango trees for which compensation amounting to 16,000 Ks was paid.

In total for the loss of 4,274 toddy trees and 2 Mango trees, compensation of 21,436,000 Ks was paid. Some farmers had not received the additional compensation for toddy trees (5,000 Ks/tree) at the time this report was prepared. Therefore some toddy trees in Wet Hmay-Kan Daw village area were compensated at the rate of 5,000 Ks/tree. The additional compensation will be paid in the future.

Total compensation for the new village areas is 21,436,000 Ks up until 18th December 2012.

In addition, for all houses that have been relocated, MWMCL has guaranteed one member of each household will be trained to fill a functional position on the mine and receive the normal wages for undertaking that function.

8.1.3 Compensation for Land on Mine Lease

For land on the mining lease the following areas were compensated:

- Permanent registered farm land of 4,826.70 acres compensated according to approved land compensation rates;

- Temporary registered farm land of 230.86 acres;
- Unlawful farmed land of 1,725.37 acres to be compensated according to instructions from Divisional authorities; and
- Remaining other land of 1084.85 acres which was occupied by monasteries, villages, roads, canals and similar infrastructure.

Although land was cultivated unlawfully within the mining lease area between 2001 and 2010, the Chairman of MEHL and local authorities instructed that compensation for this land should be paid at the same rate as for other farm-land.

The first compensation for farm-lands in the mining lease was carried out between 5th April 2011 and 19th August 2011 for an area of 5,487.27 acres (2226 ha) which attracted compensation of 3,000,153,745 Ks. After the first compensation, some farmers complained to the Government wanting compensation for their unregistered farm-lands. The Regional Government then requested the Regional Land Record Department to investigate the complaint and confirm that the land was actually farmed. The Department confirmed that 1,298.81 acres should be compensated.

A second round of compensation was completed between 30th January 2012 and 6th November 2012 during which the unregistered area of 1,298.81 acres was compensated to the value of 707,775,034 Ks. All compensation was completed on 6th November 2012 with a total of 6,786.08 acres (2,752.4 ha) being compensated for a total of 3,707,928,779 Ks (i.e. 3.7 Billion Ks). Only 1,081.7 acres remains to be compensated. These are lands where the landholders are absent and may be required to re-register lands and pay land taxes owed to the Government.

Tree compensation for the mine lease area has been completed as follows:

- A total of 35,815 Toddy trees for 385,150,000 Ks;
- Mango trees totaling 188 in number for 3,008,000 Ks; and
- One garden of Thanakhar trees for 1,900,000 Ks.

Before the land compensation finished, auxiliary or additional compensation was paid for the survey works, exploratory drilling works for the initial mine development period and minor construction works. The following compensation of 4,047,842 Ks was paid associated with those works:

- Compensation for the geological survey works - 1,572,125 Ks
- Compensation for the electrical power line construction - 355,142 Ks
- Compensation for the construction of a workshop - 2,120,575 Ks

8.1.4 Summary of Compensation

Total compensation paid for the Letpadaung Project to date is:

- Farm land compensation for mine lease area (6786.80 acre) of 3,707,928,779.00 Ks;
- Tree compensation of mine lease area of 363,058,000.00 Ks;
- Land compensation of new village areas (119.97 acre) of 80,975,777.85 Ks;
- Tree compensation of new village areas of 21,436,000.00 Ks;
- Auxiliary compensation for mine development works of 4,047,842.00 Ks; and
- Total compensation for the project of 4,177,446,398.85 Ks.

Samples of the acknowledgement of compensation received are included at Appendix B.

After all compensation to date was paid, a submission was made for the long term land grant from the Ministry of Home Affairs. A 60 year land grant for the Letpadaung Copper Mine was issued to MEHL by Ministry of Home Affairs on 3rd August 2012.

8.1.5 Resettlement

As described in Section 8.1.2, some resettlement of landholders who have signed compensation agreements has taken place. However, some of the land compensation agreements are yet to be finalised and, in some instances, landholders who have been offered compensation have not accepted the compensation offer and have not yet been relocated. Others who have been compensated are also still awaiting resettlement.

At present there is no formal resettlement action plan. Already 221 houses have been relocated into two resettlement villages together with monasteries, schools and village infrastructure.

In the next phase of work, a Resettlement Action Plan (RAP) will be prepared which is consistent with the International Finance Corporation (IFC) and World Bank Operational Directive 4.30 regarding Involuntary Resettlement. The RAP will be prepared consistent with the IFC Handbook for Preparing a Resettlement Action Plan and observe the requirements of Annexure B – Sample TOR for a Resettlement Action Plan.

The following basic principles will be observed in relation to resettlement at Letpadaung:

- Wherever possible, involuntary resettlement will be avoided;

- Where involuntary resettlement is unavoidable, all people affected by it should be compensated fully and fairly for lost assets;
- Involuntary resettlement should be conceived as an opportunity for improving the livelihoods of the affected people and undertaken accordingly; and
- All people affected by involuntary resettlement should be consulted and involved in resettlement planning to ensure that adverse effects are avoided/minimised and the benefits of resettlement are appropriate and sustainable.

In addition, to assist in the transition from working the land and deriving an income from the land, MWMCL will engage a member of each resettled family in meaningful work on the project site, including provision of paid training in a specific role if required.

8.2 LOSS OF PRODUCTION

Given that nearly 7,000 acres of land has been occupied by the mine and its associated processing plant and other facilities, it is expected that the change of production base will lead to a reduced production of some commodities in the local area.

Based on data provided by MEHL, the area acquired through compensation constitutes about 6% of the total cultivatable land area in 2010-11. The actual production off that land cannot be specifically determined, this loss of production is likely to require further importation of grain, such as rice, for which a local sufficiency of less than 100% currently exists.

During the collection of data for the ESIA, in the next project phase, an assessment of the loss of production and its impact on local supply will be undertaken.

8.3 EMPLOYMENT

The workforce estimates suggest a total workforce of 2,000 persons will be required for the construction phase of the project and about 2,500 persons during the operational phase. Of the total workforce it is planned that 90% of the workforce will be sourced from Myanmar with a preference for engagement from within the Salingyi Township area if numbers and skills permit. About 10% of the workforce will be Chinese nationals or other expatriate staff to provide the high level management of the project.

The next phase of the project will develop a workforce engagement plan to identify what sequence of engagement and skills is required for individual roles. This will enable identification of local employees who are trained to fill the roles.

The wages proposed for the various grades of employee are enclosed at Appendix C. These wages are consistent with those paid at the adjoining S&K mine and more broadly within the mining industry within South East Asia.

8.4 LOCAL GOODS AND SERVICES

Projects of this nature create new job opportunities within local economies. Examples cited by the IFC suggest that in developing countries up to 28 indirect jobs are created with local suppliers and distributors for every direct hire on the project (IFC, 2013). Similar studies in the developed economy in Australia indicate the industry multiplier is at least 3.3 (AWU, 2012).

Through provision of training to employees and members of the local community, small and medium enterprises can be established and operated locally to support the mining and processing operation and provide a level of flexibility in delivery that cannot be achieved by direct employees engaged to perform the role.

In preparation of the ESIA in the next phase of the project, MWMCL should investigate the range of goods and services that can be provided by local suppliers and distributors. It should then develop a management plan to describe those goods and services that are currently available and those, not available, that would be preferred should they be made available locally. A strategy should be developed for development of enterprises so that local supply can be provided for all goods and services for which MWMCL would seek local supply and distribution. The strategy should also include the provision of a system of micro-finance to enable individuals to set up the enterprises to deliver the goods and services required.

8.5 EDUCATION AND TRAINING

Currently a training facility is operated to service the requirements of MWMCL and the adjoining S&K mine. The training facility was set up by IMHL to train locally engaged employees in a range of skills from office administration to plant operation and maintenance that are required by mining operations of the type undertaken in the Monywa area.

To meet commitments made to the resettled population, MWMCL will need to address the education requirements of the family members seeking employment. Given the overall level of education received in the areas of the Project, this education will include upgrading the standard of education received as well as training specifically focussed on development of skills which will enable individuals to fulfil a role on the project.

The training program should also include training of individuals who seek to set up small and medium enterprises (SME) to enable them to have the skills to provide the

services and level of service required, as well as providing training in the skills required to manage an SME.

Given the long life of the mine, the education and training program should demonstrate how it is integrated with the workforce plan to move MWMCL toward achievement of its goal of 90% local employment and, having achieved that goal, how the training program will link to the career development plan on the Project.

Further, the education and training program should be linked to the decommissioning and closure plan to describe how both direct and indirect employees, who become redundant through the completion of mining and processing, can transfer their skills to other roles within the community to maintain the sustainability of the community and continuity of employment after site closure.

This program should be described within the ESIA and linked to plans for employment, local engagement of suppliers, resettlement as well as decommissioning and closure.

8.6 ACCESS CONTROLS

Control of access to the Project area is important for ensuring community safety, as well as reducing disruption to the Project operation.

The current mode of operation is to expand the operation out from a centroid located around the area proposed for open cut mining. Currently there is no physical delineation of the boundary of the Project area using a fence or other physical barrier to identify the extent of the overall operation.

The lack of access control to the site creates the following scenarios:

- People continue to use access across the site as they have done prior to the site being established as a mine site;
- People who have traditionally used the land, prior to land compensation being completed, continue to use the land unhindered and when works commence they will feel they are being encroached upon, particularly if there is interaction between construction and mining activities and their normal activities or they have crops or pasture in the areas where work commences; and
- Access to resources traditionally used is terminated and they have no alternative resource (firewood and water are typical examples).

The ESIA will describe how access control will be established and how affected individuals and communities will be informed of the control of access being put in place.

8.7 IN-MIGRATION

Rapid and sustained growth of an in-migrant population can cause significant environmental, economic, and social impacts in the project area of influence. Individually and collectively, in-migrants' presence and their activities can directly or indirectly affect the local environment, the 'host' communities, and project operations. Over time, in-migrants may cause a fundamental change in the project area of influence and thereby change the project context.

In-migrants may be categorised as either "true" migrants, who are genuinely mobile in their search for economic opportunities, or extended family members, who rely on ties of kinship as a basis for claiming rights to reside within the project area (and thereby claim project benefits). Kinship-based migration and residence present significant problems in distinguishing migrants from locals.

The major drivers for increased project costs and risks (both operational and reputational) include:

- The creation of new migrant stakeholder groups;
- Unmet promises of local participation, benefit, and development; and
- Deterioration in the social context in which the project is operating (IFC, 2009).

In-migration brings with it a range of issues that reflect on the project, but may not necessarily be the responsibility of the project proponent. These include pressures on local goods, services and infrastructure, accommodation shortages, over-crowding in houses, entrepreneurial activities (such as banks, guesthouses, bars and restaurants) as well as illegal activities such as prostitution, alcohol and drug sales, gambling, smuggling and loan sharking.

An examination of existing police records suggests that many of these illegal activities are not currently an issue in the project area.

In-migration also introduces and spreads contagious diseases including sexually transmitted diseases and HIV. From a social perspective, in-migration can also lead to a cultural shift in the community which ultimately can create tensions regarding heritage and ethnic traditions.

In-migration can also occur where the expatriate staff integrates into the local community and position themselves to become permanent residents of the area. Such residual habitation can lead to economic and cultural tensions which have effects that often outlast the project which initiated them.

During the next phase of the project, an assessment of the risk of in-migration will be undertaken and an Influx Management Strategy and Implementation Plan developed in consultation with the local community and Government.

8.8 COMPETITION FOR RESOURCES

A project of this size requires significant infrastructure and services to operate and maintain its effectiveness. The basic infrastructure in the area is recognised as having some limitations in regard to capacity and availability. For example, the capacity of the local electricity supply is recognised in the Basic Design as having insufficient capacity to provide the existing electricity needs and the needs of the Project.

Natural resources, such as firewood supply, will be reduced through the clearing of Letpadaung Hill, which supports the bulk of the source materials for firewood in the locality. Reduction of this scale will mean local residents will either have no access to firewood or the relationship between demand and supply will mean they will have to pay more for firewood that is available. It is also likely to impact the charcoal industry and the supply of charcoal.

Water supply from seasonal run-off may well be affected by the collection of run-off on-site instead of being accessible to local landholders to harvest and use for paddy or watering of crops or irrigation of fish farms. While no cost is put on water, such change in local stream flows often leads to disputation between landholders, who feel aggrieved, and the Project.

Competition for resources also leads to competition in local markets for food, or simply a rise in the price of food when local producers become aware of the price paid by the Project for supplies (even when the supplies are obtained more remotely from the site). This can lead to the local cost of living increasing, to the detriment of local people without access to the wages paid by the Project. This competition can also arise from the in-migration that could accompany the Project through a simple increase in local population.

Competition for human resources may also be a significant issue for the local community, particularly for trained personnel such as tradespeople, administrators, machinery operators and para-professionals. Often people who fill these roles in local businesses and government are attracted to work on large-scale projects due to the incentives offered and the longevity of the operation. These resources are then not available to the former areas of employment and this drain requires appointment and training of replacement personnel by the depleted agency or industry sector. A similar situation exists with current SME. If they gain contracts on the Project they will place

their equipment onto the Project to complete the contracted task, thus removing that equipment and its operators from access by the local market.

In the next study phase an assessment of the capacity of the local labour supply, SME and resources chain will be undertaken to identify the impact it is likely to have on the local community and a management plan prepared to establish the mitigation activities to accompany development of the mine.

8.9 ACCOMMODATION

While the Project will establish an accommodation village to provide living quarters for 300 staff, it is anticipated that additional accommodation for up to 10,000 employed persons may be generated by the project (based on an indirect employment multiplier of 4). Although some of these persons may come from within the Salingyi Township, the pattern of projects similar to this project suggests there will be an influx of people into the local area with, or seeking, work.

Many of the people coming into the area will enter as “single” adults as they will leave their families in their existing homes, at least until they become established in employment or business.

Based on the size of families in Myanmar, the overall requirement for accommodation could expand to 30,000 persons (assuming 50% of indirectly employed persons bringing their families to live in Salingyi Township and close to the Project). Such a rise in residents could require an additional 5,000 homes for families and accommodation for 5,000 single persons.

Such an increase could see a significant rise in the cost of rental accommodation in the area with a consequent displacement of persons who cannot afford the increased rental costs. It could also see a rise in the cost of local house construction which would impact those existing residents wanting to build or extend their homes as well as increase the cost of housing for new residents.

As part of the plan to manage in-migration to the Project area, a strategy to address the accommodation requirements, associated with the increase in direct and indirect employment arising from the project, should be prepared in the next phase of the Project. The strategy should address not only the provision of housing but also the supply of materials and labour to build any additional accommodation and its impact on local and regional costs of housing provided for rental or purchase.

8.10 HEALTH

The objective in relation to community health is 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.

Community health can be strongly influenced by changes in the local environment (changes in traffic patterns, in-migration, transient employees such as drivers delivering goods and services to the project, specialist tradespersons), loss of buffering environmental elements (such as wetlands, river foreshores, vegetation cover), introduction of new vectors for disease (water bodies, waste facilities) and infection of water supplies through contamination.

MWMCL currently undertakes visits to villages as part of its community development program. As part of these visits it records the illnesses that are presented at the clinics it provides in each village during these visits. As part of the visits, MWMCL has commenced recording the illnesses presented to develop a database of common illnesses and differentiating those which are associated with common transmitted diseases, such as colds and influenza, to those which may be associated with environmental change. This database is unlikely to be of value to management of health impacts until it has at least a full round of yearly data to allow seasonal trends to be identified.

During the next phase of the project a community health plan will be prepared which will address the common ailments identified in the community. It will also address the facilities available in the community and the pressure additional population generated by the Project will place on those resources. The plan should make proposals regarding how shortcomings in the current facilities will be addressed by MWMCL and how the company proposes to make those facilities available to the broader community.

8.10.1 Prostitution, STDs and HIV

Current records held by the Salingyi Township indicate that no prosecutions have occurred related to prostitution. Historically, large mining projects have attracted prostitutes due to the large concentration of single male employees associated with these projects (Laite, 2009). This trend is evidenced in Australia, North America, Africa, Central and South-East Asia.

Associated with prostitution is the trend for the spread of sexually transmitted diseases (STD) and HIV AIDS. The spread of HIV AIDS by transport drivers has been documented in Africa, Asia and northern Europe where the spread of HIV AIDS was

tracked along major national and continental transport routes. The spread was linked to the use of prostitutes by transport drivers UNAIDS/ESCAP (nd).

As part of the community health plan, the control of the spread of HIV/AIDS and STDs should be addressed in the training of employees, as well as the risks associated with the use of prostitutes. The concept of “safe sex” should be introduced as part of the employee induction package as well as any controls the company may wish to place on staff accessing these services should they become available in the community.

8.10.2 Traffic

The current level of heavy vehicles using the local road network appears quite low. It is envisaged that during construction and operation up to 20 heavy vehicle movements may occur on a daily basis to carry loads from barge landings on the Yama Stream during the wet season and the Chindwin River at Pakokku during the dry seasons.

It is also proposed that convoys of vehicles will bring supplies of explosives to site from China at least twice yearly.

During the next phase of the Project it is proposed to collect data on the level and type of traffic using the roads that will serve as haulage routes. This data will then be used to assess the level of expected impact on local communities and the risk associated with the increased traffic and the present traffic generated by the nearby S&K mine. Based on that assessment, a traffic management plan will be prepared which will identify the need for any road/intersection improvements to improve the safety generally and specifically.

8.10.3 Noise

From a community health perspective, noise associated with mining operations (as with other noise sources) is known to disturb areas around the source of noise generation. It is particularly significant where noise disturbance is associated with schools, hospitals, places of worship and nearby households. Noise disturbance is most intrusive at night when people are sleeping and background noise levels are low.

A common standard is that any increase in noise levels which is 3dB(A) above the existing background level is likely to disturb people at the receptor point whilst the background noise level varies dependent on the time of day that it occurs. Typically noise levels in town areas are likely to be 60-65 dB(A) during the day and 45-50 dB(A) during the night. In rural settings the levels may be 5-10 dB(A) less depending on season.

There is no current background noise data available to determine how significant the noise generated by the mining, crushing, stacking and processing is likely to be and

what management actions will be necessary to make it acceptable. In the next phase of the project, background noise levels will be determined by field sampling and modelling will be conducted to determine the areas where noise disturbance levels will exceed accepted levels based on a range of global guidelines.

A noise management plan will then be incorporated into the ESIA if required.

8.10.4 Dust

Dust influences community health, as well as social well-being, as it is a cause of respiratory problems for individuals and a nuisance, respectively. The current levels of dust experienced at the border of the mine site are not currently known.

Field sampling around the Project area and beyond will be undertaken in the next phase of the project. The results of the field sampling will then provide the basis for modelling of potential dust generation on the site and enable both the nuisance and respiratory irritants to be determined for areas around the site.

Based on the results of the modelling, exceedences of health and nuisance levels will be established and a control program developed. This plan will be included in the ESIA.

8.10.5 Light

Light is a night-time issue where working lights used by the mine spill over into adjacent areas. Ill-directed lighting can lead to light being cast into areas outside the work area with subsequent disturbance of both people and animals in the area.

The resolution of this issue can be addressed by equipment selection and use of directional beams on the lights. Through correct placement of the lights in the work area, light shed can be managed such that minimal light is dispersed into areas outside the site boundary.

A lighting management plan will be developed, as the forerunner of an operational procedure to be used when operations commence, and included in the ESIA.

8.11 OCCUPATIONAL HEALTH, SAFETY (OHS) AND FIRE FIGHTING

8.11.1 Applicable Legislation

MWMCL propose to follow Myanmar Mining Law and Myanmar Mining Rules where they apply. If an issue relating to OHS is not addressed in the Myanmar legislation, MWMCL propose to use relevant Chinese legislation to address the specific issue. Such legislation and guidelines include, but are not limited to:

- Production Safety Law of the People's Republic of China;
- Mine Safety Law of the People's Republic of China;

- Regulation on the Implementation of the Mine Safety Law of the People's Republic of China;
- Regulations on Labour Safety and Hygiene Supervisory of Construction Projects (Engineering);
- Mandatory Regulation on Engineering and Construction of the People's Republic of China (for Mine Project);
- Safety Codes on Metal and Non-metal Mines;
- Safety Regulations on Blasting Practices;
- Safety Regulations on Mineral Processing;
- Safety Regulations on Mechanical Protections;
- Code for Seismic Design of Buildings; and
- Code for Fire Fighting Design of Buildings and Safety Identifications.

8.11.2 Industrial Hygiene

Relative Chinese laws, codes and technical specifications, regulations and standards that shall be adhered to include but are not limited to:

- Labour Safety and Hygiene Supervisory Regulations for Construction Projects;
- Management Methods for Occupational Disease Harm Classifications of Construction Projects;
- Occupational Disease Prevention Law of the People's Republic of China;
- Hygienic Standard for Design of Industrial Enterprises; and
- Hazard Classification of Operations in Productive Dust Environment, Design Code for Noise Control in Industrial Enterprises,

for example.

8.11.3 Firefighting

A fire fighting system has been designed within the processing areas of the Project. A firefighting plan will be prepared and submitted to local authority for approval based on the fire-fighting regulations and requirements promulgated by the local fire authority for buildings, industrial facilities, material storage, warehouse, explosive storage. Site specific fire control measures have been discussed in Section 4.7.3.

8.11.4 Hazardous Materials

All hazardous materials used on the site will be accompanied by a Material Safety Data Sheet (MSDS) that specifies requirements for the design use of the material, its transport, storage, handling and the personal protective equipment (PPE) required

when handling the material. The MSDS also describes the emergency response requirements should the material spill or leak from its container.

All staff handling hazardous materials will be trained in all aspects of its safe handling, use and management. Drivers transporting the material to site will be required to have specific training in relation to the materials they transport.

All materials transported will be accompanied by a chain of custody document to ensure the movement of materials is tracked and that all material supplied is delivered to site.

Training will be provided to regional emergency response personnel to ensure those located along transport routes are familiar with the response requirements in relation to spills or accidents involving vehicles transporting hazardous materials.

A hazardous materials management plan will be prepared during the next phase of the project to enable the materials to be used to be specifically defined and the design parameters for management of the storage and handling of hazardous materials to be specified. The plan should also describe the spill management procedures and the methods of disposal of contaminated materials.

8.12 VISUAL AMENITY

A significant impact on the surrounding community is the change on Letpadaung Hill that is visually evident. These visual images, together with the noise of machinery operating in the area, are a constant reminder of the change which is occurring as a result of the Project. Given the significance of hills in the area on the overall landscape and their cultural values, this visual image is a constant reminder of other changes, environmental and social, and fears regarding the future that exist within the community.

The sensitivity of the visual impact warrants consideration of specific landscape treatments to progressively blend in the operations with the surrounding hills vegetation. As part of the next project phase, a landscape management plan will be integrated into the construction and operations plan to address the visual impact of the project on residents living immediately adjacent to the project site.

8.13 CULTURAL HERITAGE

Traditional values in an area play a significant part of the lives of people who traditionally reside in the area. From work already undertaken, it is known that structures of religious significance are highly valued by the community. In addition, there are reports of archaeological excavations having taken place in areas surrounding the Project site (MICCL, 2004).

At this time, it is not apparent that minority indigenous groups exist in the area that may require special consideration from a cultural heritage perspective or, more broadly, as a group that may be disadvantaged by the Project.

It was also observed that the transport route between the site and Pakokku passed through an area identified as having heritage values. Any work proposed on the transport route, as a result of the traffic management plan, will need to consider these values if it is planned within the heritage area.

A cultural heritage survey will be undertaken to consider the archaeological and ethnographic significance of the Project site and areas in its surroundings. This work and any management plan required as a result of the survey will be included in the ESIA.

8.14 COMMUNITY DEVELOPMENT

In 2011/2012 MWMCL invested over USD1 Million in their Society and Community Assistance and Development (SCAD) Plan. The activities which were focussed on in SCAD included:

- Basic living;
- Medical treatment and health care;
- Education; and
- Religion and culture.

The projects associated with improving the basic living conditions included:

- Constructing wells, repairing a water dam and purchase of water purifying facilities; and
- Repairing damaged roads and bridges within the local community.

In addition 20 Million Ks were donated to the relief fund for the Sagaing earthquake. Cash and commodities were also given to local community members who suffered flooding and damage associated with the earthquake. Assistance was provided to aged villagers without support from their families and to villagers who were poor and unable to support themselves.

Over 13,000 villagers received treatment from the mobile clinic operated by MWMCL which also provided a free of charge medical service to 28 nearby villages.

Donations were made to schools to enable repairs to be undertaken and funds were provided for books and uniforms.

Electricity and water supply facilities were connected to the Myaypyinthar monastery and donations were made to other monasteries for repairs to their monastery and pagodas.

MWMCL has committed to provide USD500,000 per annum over the life of the mine for community development. It proposes to set up a SCAD committee which will include local representation at village and government levels. The committee will oversee planning, implementation and monitoring of progress of projects to which funds are allocated in the future.

A clear objective of the SCAD Plan going forward is to build capacity within the community to take advantage of the mine's presence. Currently the project employs 880 local staff. The salary structure proposed will enable staff to progress within the structure based on performance and training, thus engendering a work ethic as well as skills development. The MWMCL purchasing policy will see USD70 million of local purchasing over the 3 year construction period which will then lead into USD86 million per year during the 30 year operating life in purchase of local services excluding electricity and diesel. It is expected these purchases will encourage the development of local manufacturing, logistics, rental and service industries to support the mine.

In preparation of the ESIA, a SCAD plan will be prepared in detail to ensure that it addresses the good practice principles for strategic community investment – strategic, aligned, multi-stakeholder driven, sustainable and measurable. To this end, MWMCL has already engaged a Myanmar national to lead the MWMCL community development team that will facilitate the development of this plan.

9. CONCLUSION AND RECOMMENDATIONS

A project of the size proposed for the extraction of copper from ore mined from the Letpadaung Hills cannot be achieved without some effect on the natural, social and economic environments. During this scoping study a total of 87 environmental risks were identified that require specific management to minimise the harm that they would induce if not considered. A number of others, 62 in all, require management plans that should be applied across the whole site. Many of these risks apply to a number of aspects of the project and will require careful consideration in the detailed project design. Others could well be considered lower risks when additional baseline information is available.

The natural environment within the Project site is largely disturbed. The area has been the subject of farming and grazing on the plains. The foothills and hills areas comprise a stony soil that is not suitable for cultivation but has been used for grazing and harvesting for firewood. As a result, the biological diversity in the area is poor and the abundance is considered to be low.

Surface water flow within the Project site is seasonal due to the distinct wet and dry seasons experienced in the region. The nearest major water course is the Chindwin River which is some three (3) km to the east of the site at its nearest point. The mining operation is expected to encounter groundwater during the operation of the open pit. Initially the groundwater will be drawn from a local aquifer but deeper parts of the pit will encounter a more regional aquifer. The detailed hydrogeology of either aquifer is not well understood. It is likely both aquifers may have some use by villagers within the region.

The key risks to the natural environment are the clearing of the Letpadaung Hills and the mining of low grade ores and waste that have a high risk of generating acidic run-off and seepage if they are not handled and stored correctly. If these materials are placed incorrectly in storage areas, they will react with the atmosphere and the resultant water and surface solids will be deleterious to surface water and groundwater quality as well as rendering the surface of the storage area (waste dump) unsuitable as a growth medium.

The social environment is quite complex as the current population is quite agrarian in nature, although the population of at least one village, Mine Town, is specifically engaged in mining at the S&K operation which has been operating intermittently since its start in the 1980's. Some local staff at this operation have over 30 years mining experience and hold supervisory roles on that operation. There are legacy mining sites

adjacent to the existing S&K operations which do not form part of the S&K operation or the proposed Letpadaung operation.

To allow mining to occur at Letpadaung, four (4) villages will need to be moved from within the Project site, along with some monasteries and temples. Land compensation has been paid to those villagers who accepted the compensation package proposed. Two resettlement villages have been established to accommodate the persons requiring resettlement. About 50% of the households have been relocated. The new homes have electricity connected and assured supplies of water. To date 4,177 million Ks has been paid in compensation.

One member of each household is guaranteed employment on the new project.

Overall 26 villages will be affected by the Project. The MWMCL community development plan and current community activities involve all 26 villages. To date MWMCL has spent over USD1 million in community aid.

Development of the Project will result in in-migration and its accompanying challenges – shortages of accommodation, demands on public services, competition for local resources, increased traffic, changes in demographic balance, for example. Minimising the risks associated with these challenges will require planning and stakeholder engagement. A key risk in this process is the level of community consultation that has occurred to date and the willingness of the community to see the opportunity presented in addressing these challenges.

Arising from this study, a number of recommendations for the natural and socio-economic environment are proposed.

The presently available baseline data regarding the Project area was collected in the mid-1990's. In addition, the data were collected at a point in time and provides a snapshot rather than identifying trends. It is recommended that data collection for the natural environment occur for at least the following parameters over the three (3) seasons to identify seasonal changes and allow comparison with the 1990's data to identify both seasonal and longer term trends that are evident:

- Climate – temperature, wind, humidity, rainfall and evaporation for the localised site area;
- Flora and fauna including vegetation and habitat types and their locations;
- Geochemistry of the open pit mining area;
- Air quality including dust, noise and GHG;
- Surface and groundwater quality including but not limited to analysis for pesticides, metals, acidity, turbidity, nutrients, total and suspended solids;

- Local hydrology and hydrogeology, particularly in relation to the water to be removed from the open pit and the flood behaviour of the Chindwin River;
- Soil characteristics, quality and waste rock geochemistry as a baseline for identification of current contaminants and knowledge of the soil type and nutritional status for site rehabilitation; and
- Geotechnical conditions in the foundation areas for waste dumps, stockpiles and leach pads.

In dealing with socio-economic aspects of the project, the single biggest issue to be addressed is obtaining free, prior and informed consent (FPIC), if the ESIA process is to have legitimacy with the affected community. Given the stage to which the project has been developed and the legislative regime surrounding the project, it is unlikely this can ever be achieved. But it is clearly an issue with some people who are antagonistic to the project proceeding. However, moving forward there is a need to address how IC can be incorporated in the future progression of the ESIA and the project.

The socio-economic impacts associated with this project outweigh those associated with the natural environment. They include the primary issues of land compensation and resettlement, an issue that must be addressed and concluded before the project progresses much further. If this issue is not addressed, and resolved, it will colour discussion on any other issue that arises during the course of the project. The examples of projects in other countries where resettlement has been poorly implemented and subsequently influenced the success of the project are too numerous to mention.

In areas outside the Salingyi Township, the biggest single effect is likely to be the traffic associated with movement of goods and product to and from the Project site, particularly in the dry season when barge services cannot reach the landing on the Yama Stream. Baseline traffic data should be compiled to establish the existing load on the road network and the risks associated with increased vehicle numbers on the regional road network.

An overall philosophy for the Project should be to “design for closure” so that the project delivers community development that will be sustainable when the mine life is reached and that there are no residual legacies left as a result of the mining. This includes not only managing the environmental outcomes on the natural environment but also building a local economy that will continue to thrive after mining ceases. As such, a decommissioning and closure plan should be developed and agreed as part of the next phase of the project.

A number of management plans have been recommended within this study for preparation in the next phase of the project. These are:

- Dust Management Plan;
- Noise Management Plan;
- Water and Waste Water Management Plan;

- Erosion and Sediment Control Plan;
- Waste Rock Management Plan;
- Flora Management Plan;
- Fauna Management Plan;
- Hazardous Materials Management Plan;
- General Waste Management Plan;
- Site Rehabilitation Plan;
- Mine Decommissioning and Closure Plan;
- Resettlement Action Plan;
- Education, Training and Employment Programme;
- In-Migration Management Strategy and Implementation Plan;
- Community Health Plan;
- Lighting Management Plan;
- Landscape Management Plan; and
- Society and Community Assistance and Development Plan.

The final recommendation is that during development of the ESIA the Community Social Development Team of MWMCL should maintain good communications with the local communities and advise them of study findings as soon as practicable. After the ESIA is submitted to the Government for approval the ESIA should be made available for public comment.

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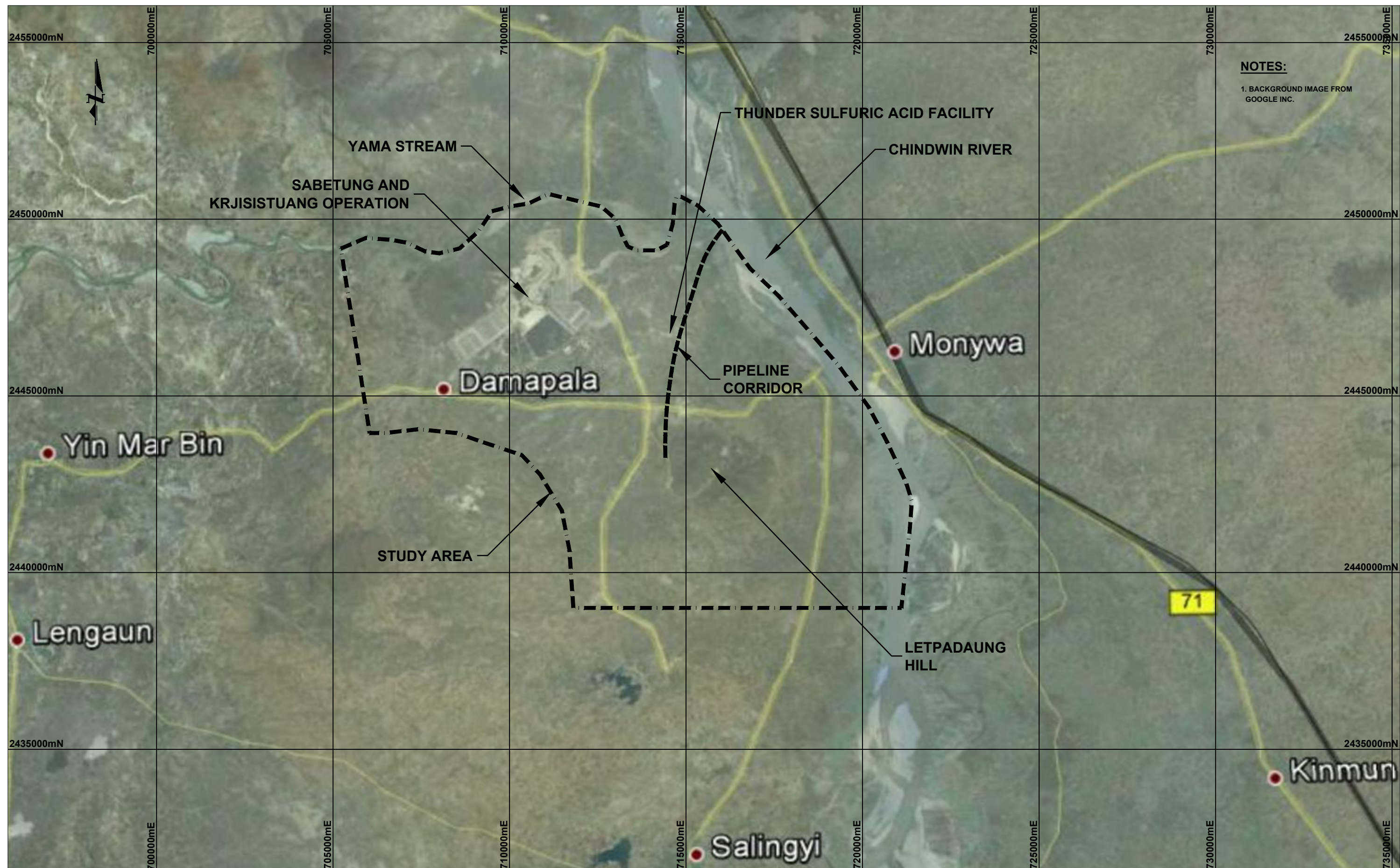
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FIGURES



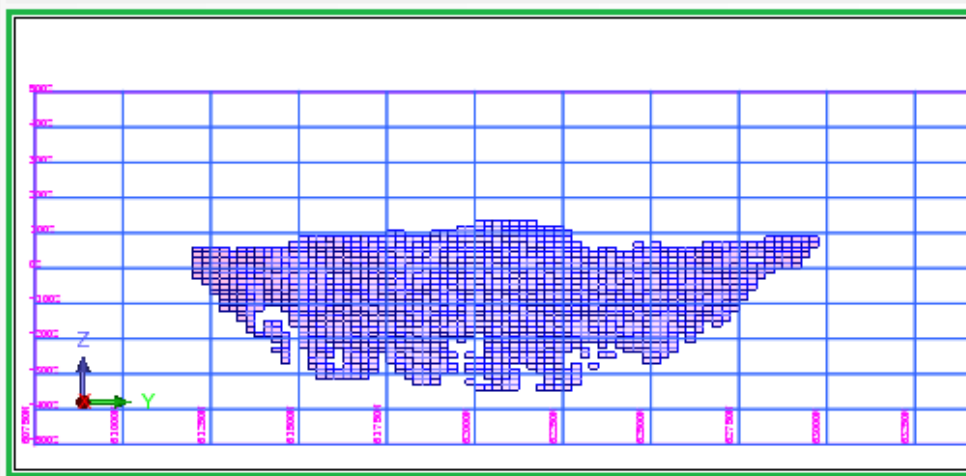
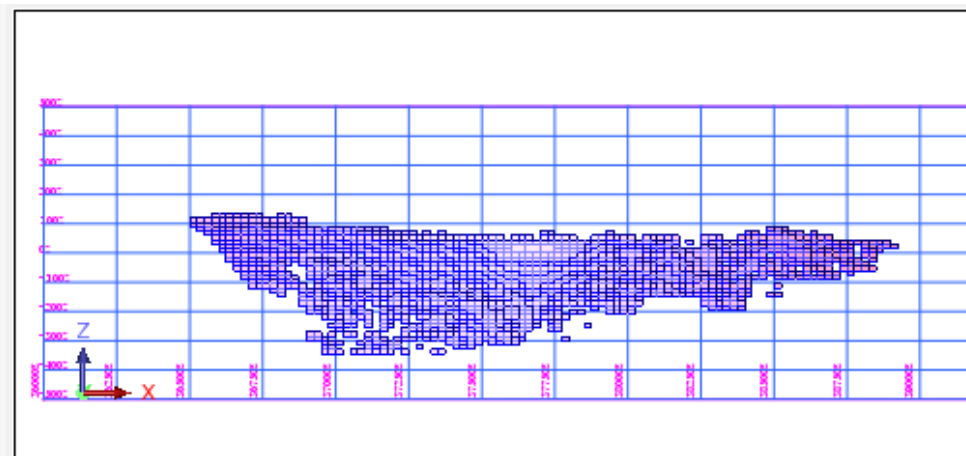
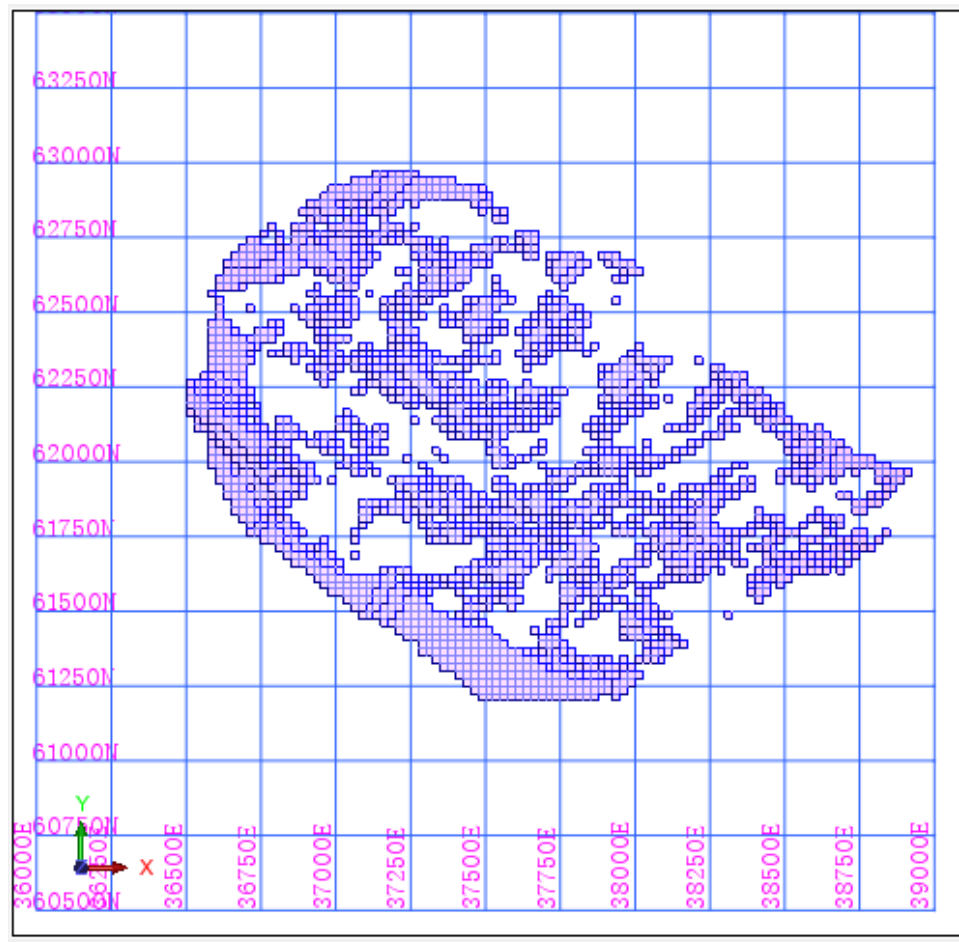


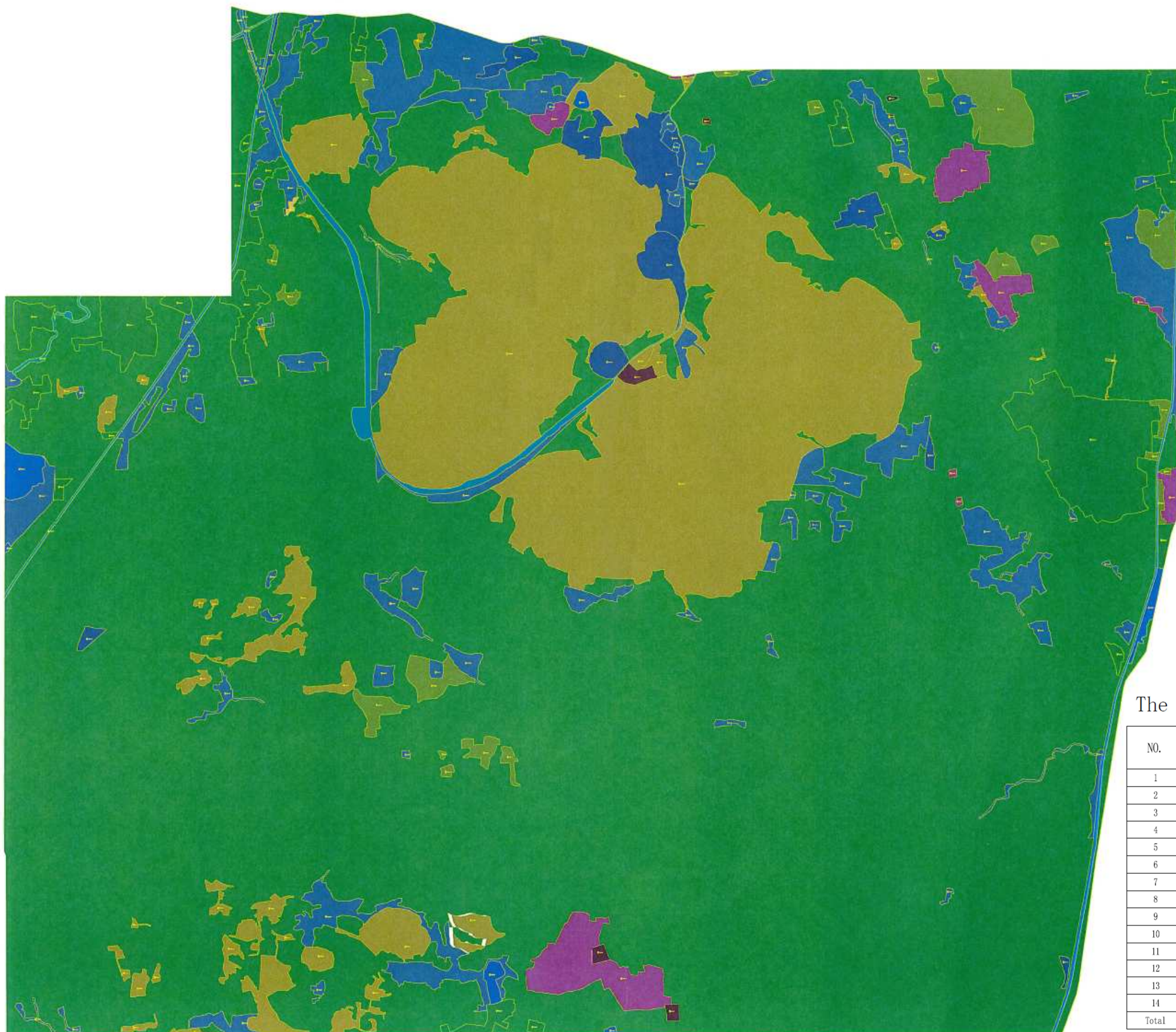












The Data of Land Use in Letpataung Project

N0.	Land types	Land identifier	Area(m ²)	Proportion	Legend
1	Paddy Field	111	940668.75	2.88 (%)	
2	Dry Land	114	23029490.18	70.42 (%)	
3	Grove	121	2812.16	0.01 (%)	
4	Woods	131	431538.76	1.32 (%)	
5	Bush	132	5433127.78	16.61 (%)	
6	Rural Road	153	176327.56	0.54 (%)	
7	Pond	154	104791.22	0.32 (%)	
8	Rural Homestead	253	379774.12	1.16 (%)	
9	Hydraulic Structure	272	69016.00	0.21 (%)	
10	Religious Site	283	31640.56	0.10 (%)	
11	Grave	285	2292.56	0.01 (%)	
12	Grassland	311	1714826.40	5.24 (%)	
13	Bare Surface	315	375654.36	1.15 (%)	
14	River Surface	321	12809.05	0.04 (%)	
Total			32704769.45		



APPENDIX A

Environmental Risk Matrix

LETPADAUNG COPPER PROJECT
PRELIMINARY ENVIRONMENTAL AND SOCIAL RISK ASSESSMENT
SCOPING STUDY
7 February 2013

Aspect	Activity	Category	Impact	Scope	Likelihood	Consequence	Unmitigated Risk	Action
Project Start-up	Camp	Environmental	Land clearing for camp/lay-down	Local	P	M	A	
			Water supply	Local	L	L	N	
		Social	Waste water	Local	L	L	N	
			Basic raw materials	Regional	L	M	T	
			Land acquisition	Regional	L	H	A	
			Traffic	Regional	L	L	N	
			Noise	Regional	L	L	N	
			Infrastructure demand - electricity, health	Regional	L	L	N	
			Cultural	Local	L	M	T	
			Labour competition	Regional	P	L	T	
			Cost of goods and services	Local	U	M	T	
			Local transport	Local	U	L	N	
			Resettlement	Regional	L	M	T	
Exploration	Drill pads	Environmental	Drill pad preparation	Local	L	L	N	
			Access	Local	L	L	N	
		Social	Erosion and sediment	Local	L	M	T	
			Water demand	Local	U	L	N	
			Clearing	Local	L	M	T	
			Land compensation	Local	P	H	A	
			Employment	Local	U	L	N	
			Loss of production	Local	P	H	A	
			Dust	Local	L	L	N	
			Noise	Local	L	L	N	
	Drilling	Environmental	Drilling mud pollution	Local	L	M	T	
			Erosion and sediment control	Local	L	M	T	
		Social	Access	Local	L	M	T	
			Hazardous materials	Local	L	L	N	
			Litter	Local	L	L	N	
			ARD	Local	L	M	T	
			Employment	Local	U	L	N	
			Loss of production	Local	L	M	T	
			Noise	Local	L	L	N	
			Dust	Local	L	L	N	
Land clearing		Environmental	Loss of habitat	Regional	L	M	T	
			Loss of topsoil	Local	L	M	T	
			Reduced air quality (dust)	Local	P	M	A	
			Erosion and sediment	Local	P	M	A	
			Water quality	Local	L	M	T	
			Loss of timber resource	Local	P	H	A	
			Loss of productive land	Local	P	H	A	
			Loss of protected land	Regional	P	H	A	
		Social	Noise	Local	L	M	T	
			Loss of firewood resource	Local	P	H	A	
			Disturbance of heritage sites	Local	P	H	A	
			Loss of arable land	Regional	P	H	A	
			Dust	Local	L	M	T	
			Visual amenity	Local	P	M	A	
Construction		Environmental	Material stockpiles	Local	P	M	A	
			Basic raw materials	Regional	P	M	A	
			Water demand	Regional	P	L	T	
			Solid waste generation	Local	P	L	T	

Aspect	Activity	Category	Impact	Scope	Likelihood	Consequence	Unmitigated Risk	Action
Operations		Social	Creation of water bodies	Local	L	L	N	
			GHG generation	National	L	M	T	
			Vegetation loss	Regional	P	H	A	
			Noise	Local	L	M	T	
			Dust	Local	P	M	A	
			Cultural	Regional	L	H	A	
			Disease	Regional	L	H	A	
			Access controls	Local	L	H	A	
			Accomodation	Local	L	H	A	
			Loss of amenity	Local	L	M	T	
			Cultural heritage	Regional	L	H	A	
			Employment	Regional	L	M	T	
		Environmental	Solid waste generation	Local	P	M	A	
			Waste water	Regional	P	M	A	
			Air emissions	Regional	L	M	T	
			GHG generation	National	L	M	T	
			Land contamination	Regional	U	M	N	
			Water quality	Local	L	M	T	
			Hazardous materials	Regional	L	M	T	
			Acid vapours	Local	U	H	T	
			ARD generation	Local	P	H	A	
		Social	Noise	Local	L	M	T	
			Light shed	Local	L	L	N	
			Health	Regional	U	H	T	
			Water	Regional	U	M	N	
			Electricity	Regional	L	H	T	
			Traffic	Regional	P	H	A	
			Employment	Regional	L	H	A	
			Cost of services	Local	L	H	A	
			Education	Local	U	H	T	
			Loss of arable land	Local	P	H	A	
			Cultural heritage	Local	L	H	A	
			Accomodation	Local	U	M	N	
Removal of overburden		Environmental	Cultural heritage	Regional	U	H	T	
			Erosion and sediment	Local	P	H	A	
			Topsoil conservation	Local	P	H	A	
		Social	Visual impact	Local	L	M	T	
			Dust	Local	P	H	A	
			Noise	Local	L	M	T	
Drill and blast		Environmental	Loss of productive land	Local	L	H	A	
			Dust	Local	L	M	T	
			Hazardous goods	Regional	U	H	T	
			Diesel spill	Regional	U	H	T	
		Social	AN spill	Regional	U	H	T	
			Noise	Local	L	H	A	
			Vibration	Local	L	H	A	
			Access controls	Regional	L	H	A	
Waste removal		Environmental	Fly rock	Local	U	H	T	
			ARD	Local	P	H	A	
			Erosion and sediment control	Local	P	H	A	
			Water quality	Local	P	H	A	
		Social	Slope stability	Local	L	M	T	
			Groundwater pollution	Local	L	M	T	
			Visual amenity	Local	L	M	T	
			Loss of productive land	Local	P	H	A	
Low grade ore		Environmental	ARD	Local	P	H	A	
			Water quality	Local	P	H	A	
			Erosion and sediment control	Local	P	H	A	

Aspect	Activity	Category	Impact	Scope	Likelihood	Consequence	Unmitigated Risk	Action
Heap leach pads		Social	Groundwater pollution	Local	L	M	T	
			Visual amenity	Local	L	H	A	
			Loss of productive land	Local	P	H	A	
		Environmental	Slag	Local	P	M	T	
			Leachate pollution	Local	L	H	T	
			Fauna deaths	Local	L	H	T	
			Hazardous materials	Regional	P	H	A	
			Dust	Local	L	M	T	
			Water management	Local	P	H	A	
			Land contamination	Local	L	M	T	
SW-EX		Social	Raffinate management	Local	L	H	A	
			Noise	Local	L	M	T	
			Visual amenity	Local	P	M	A	
		Environmental	Flooding	Local	P	H	A	
			Hazardous materials	Regional	P	H	A	
			Acid mist	Local	L	M	T	
			Solid waste	Local	P	M	A	
			Liquid waste	Local	P	H	A	
			Land contamination	Local	L	M	T	
		Social	Health	Local	P	H	A	
			OHS	Local	L	H	A	
			Public safety	Local	P	H	A	
			Noise	Local	L	L	N	
			Light	Local	L	L	N	
Flood protection		Environmental	Traffic	Local	P	M	T	
			Constrained floodwaters	Regional	P	H	A	
			Site runoff	Local	P	H	A	
			Loss of productive land	Local	P	H	A	
			Material supply	Regional	P	M	A	
Water processing		Social	Property loss during flooding	Regional	L	H	T	
			Visual amenity	Local	P	M	A	
		Environmental	Contamination of surface water	Local	L	H	T	
			Groundwater quality	Local	L	M	N	
			Containment failure	Local	L	H	T	
			Land contamination	Local	L	M	N	
		Social	Pipe bursts	Local	P	H	A	
			Noise	Local	L	M	T	
Waste water disposal		Environmental	Surface water quality	Local	L	H	A	
			Groundwater quality	Local	L	M	T	
			Waste water use	Local	P	L	T	
		Social	Disease	Local	L	H	A	
			OHS	Local	L	H	A	
Reagents		Environmental	Odour	Local	P	H	A	
			Spill	Local	P	H	A	
			Land contamination	Local	L	M	T	
			Storage	Local	L	L	N	
			Transport spills	Regional	L	H	A	
Hazardous materials		Environmental	Explosion	Regional	L	H	A	
			Storage	Local	L	M	T	
			Spills	Regional	P	H	A	
		Social	Traffic	Regional	L	H	T	
			Explosion	Regional	I	H	T	
Rehabilitation		Environmental	Erosion and sediment control	Local	P	H	A	
			Species selection	Local	P	M	A	
			Weed	Local	P	M	A	
			Proposed land use	Local	P	H	A	
			Landform	Local	P	H	A	
			Surface finish	Local	P	H	A	

Aspect	Activity	Category	Impact	Scope	Likelihood	Consequence	Unmitigated Risk	Action
Decommissioning and Closure		Social	Proposed land use	Local	P	H	A	
			Firewood supply	Local	P	H	A	
			Heritage	Regional	L	H	T	
		Environmental	Erosion and sediment control	Local	P	M	A	
			Weeds	Local	P	H	A	
			Void water quality	Local	L	H	T	
			Slope stability	Local	P	H	A	
		Social	Loss of employment	Regional	L	L	N	
			Land claims	Regional	L	H	T	
			Safety of site	Local	P	L	T	
Community Development		Environmental	Final land use	Regional	P	M	A	
			Land tenure post-mining	Regional	L	M	T	
			Social forestry	Regional	P	H	A	
			Land use practices	Regional	L	M	T	
		Environmental	Waste management	Regional	L	L	N	
			Water use	Regional	L	H	T	
		Social	Health	Regional	P	H	A	
			Education	Regional	P	H	A	
			Housing	Regional	L	M	T	
			Employment	Local	P	M	A	
			Business development	Local	P	L	T	

Note:

Likelihood

U = Unlikely

L = Possible

P = Probable

Consequence

L = Low

M = Medium

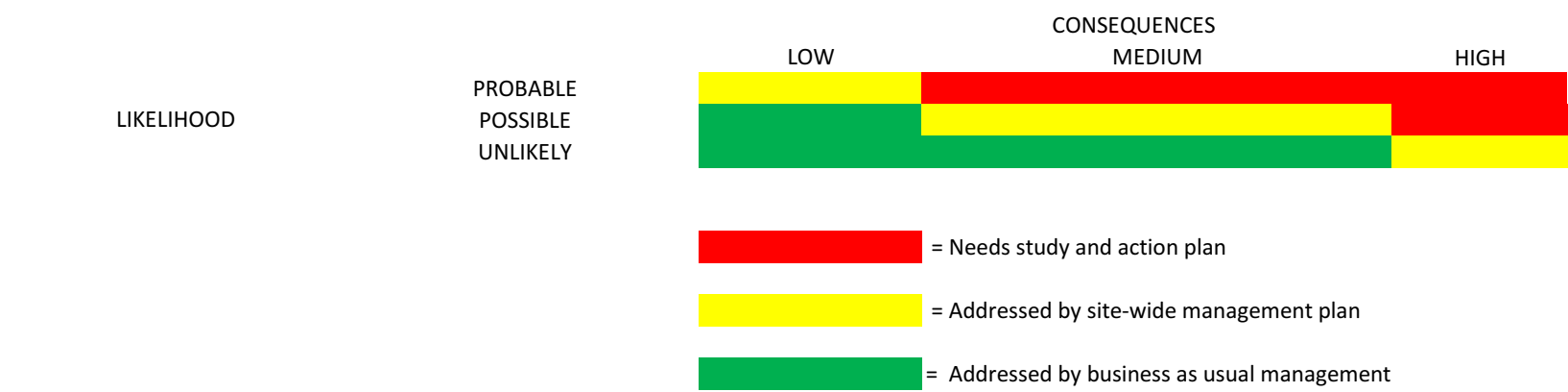
H = High

Unmitigated Risk

N = None need for action

T = Tolerable (addressed by overall management plan for site)

A = Action (requires specific management plan for activity)



APPENDIX B

Sample Land Compensation Documents

(SAMPLE)

Acknowledgement of receiving the compensation fee and giving up the farm land

Date: . . .20--

Hereby, I ----- sign and acknowledge that I give up my farm land to utilize as copper mine situated in the Letpadaung Taung Copper Mine Project Area at ----- group of village, -----village and I receive the compensation as follows-

- (a) Field No. -----
- (b) Land Mark No. -----
- (c) Area (Acre) -----
- (d) Type of Land -----
- (e) Additional compensation of crops -----Ks
- Including (20) times of land revenue ()

Payer (signature)
 Name -----
 Rank -----
 Dept. -----

(Finger Print)
 Payee (signature)
 Name -----
 Father's name -----
 NRC No. -----

In The Presence of

(SAMPLE)

Acknowledgement of receiving the compensation fee and giving up the Trees

Date: . .20--

Hereby, I ----- sign and acknowledge that I give up my trees for copper mine situated in the Letpadaung Taung Copper Mine Project Area at ----- group of village, ----- village and I receive the compensation as follows-

- | | |
|--------------------------|---------------|
| (a) Type of Trees | ----- |
| (b) Number of Trees. | ----- |
| (c) Rate of Compensation | ----- |
| (d) Total Compensation | -----kyats |
| | (-----)kyats |

(Finger Print)

Payer (signature)

Name -----

Rank -----

Dept. -----

Payee (signature)

Name -----

Father's name -----

NRC No. -----

In The Presence of

(SAMPLE)
Acknowledgement of receiving the compensation

Date: . . .20--

I am ----- who is living in ----- group village,-----village, Letpadaung Taung Copper Mine Project had done ----- work on my farm land. For that purposes, Letpadaung Copper Mine project gave and I received ----- Kyats as compensation.

Payer (signature)

Name -----

Rank -----

Dept. -----

(Finger Print)

Payee (signature)

Name -----

Father's name -----

NRC No. -----

Date. -----

In The Presence of

APPENDIX C

Workforce Grades

myanmar employee numbers in construction period for all departments

	leader	AD	HR	FD	PR	ED	MD	TD	BD	PR	SE	LD-logistics	yangon	naypyitaw	mandalay	total
G0	2															2
G1	6															6
G2			1	1	1	1	3	1	1	1	1					11
G3		1	1	1	1	3	5		1	1	1	1	1	1	1	19
G4		2	2	3	2	5	24	1	2	2	2	1	1			47
G5		1	1	3	1	9	18	3	2	2	4	2	2			48
G6		4	2	5	3	17	10	2	5	4	10	8	1			71
G7		5	2	6	2	27	40	4	6	10	8	12	4	1	1	128
G8		16	6	3	2	35	70	2	7	5	25	26	5	1	1	204
G9		48	6	4	1	44	140	1	6	40	17	25	12	1		345
G10		5	2	2	10	120	200	1	2	280	120	330	14	1	1	1088
合计	8	82	23	28	23	261	510	15	32	345	188	405	40	5	4	1969

Note: AD=Administration Department; BD=Business Department; ED=Engineer Department; MD=Mining Department; SE=Safety and Environment department; CSD Team=Community and Social Development Team; HR=Human Resource Department; MEHL=Myanmar Economy Holding Limited; FD=Financial Department; PRD=Public Relation Department; GM=General Manager; LG=Local Government;

myanmar employee numbers in production period for all departments

	leader	AD	HR	FD	PR	ED	MD	TD	BD	production-operation dept				Motor energy dept			SE	LD-logistics	yangon	nay pyi taw	mandalay	total
										PR	CS	L-EX-EW	LAB	ME	PH	MP						
G0	2																					2
G1	6									1				1								8
G2			1	1	1	1	3	1	1	1	1	1	1		1	1	1					16
G3		1	1	1	1	3	5		1		2	2	1		1	1	1	1	1	1	1	25
G4		2	2	3	2	5	24	1	2		2	2	1	3	1	1	2	1	1			55
G5		2	1	3	2	8	18	3	2	2	4	4	1		2	2	4	6	2	1		67
G6		5	3	6	3	15	15	2	5	3	10	16	1	1	1	5	14	10	2	1	1	119
G7		10	4	7	2	4	40	6	7	4	55	44	6	4	19	18	10	14	4	1	1	260
G8		19	6	5	4	12	70	2	8	2	52	76	18	2	48	25	27	42	7	1	1	427
G9		50	6	4	1	14	150	2	6		58	83	14		34	24	25	38	15	2	1	527
G10		8	2	2	20	40	200	1	3	2	21	24	8	2	14	12	166	380	18	2	1	926
total	8	97	26	32	36	102	525	18	35	15	205	252	51	13	121	89	250	492	50	9	6	2432

Note: AD=Administration Department; BD=Business Department; ED=Engineer Department; MD=Mining Department; SE=Safety and Environment department; CSD Team=Community and Social Development Team; HR=Human Resource Department; MEHL=Myanmar Economy Holding Limited; FD=Financial Department; PRD=Public Relation Department; GM=General Manager; LG=Local Government;