Initial Environmental Examination

April 2017

Myanmar: Third GMS Corridor Town Development Project
“Kayin State”

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Abbreviations & Acronyms

3Rs	Reduce, Reuse, Recycle
ADB	Asian Development Bank
APCF	Asia Pacific Carbon Fund
C:N	Carbon-Nitrogen (ratio)
CBO	Community-Based Organization
CBP	Capacity Building Program
CC	Climate Change
CDIA	Cities Development Initiative for Asia
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon Dioxide
DFR	Draft Final Report
DUHD	Department of Urban Housing Development (MOC)
EA	Executing Agency
EA	Environmental Assessment
ECC	Environmental Compliance Certificate
ECD	Environmental Conservation Department
EIA	Environmental Impact Assessment
EHS	Environment, Health and Safety
EMP	Environmental Management Plan
FSR	Feasibility Study Report
GHG	Greenhouse Gas
GMS	Greater Mekong Sub-Region
GNP	Gross National Product
GoM	Government of Myanmar
HDPE	High Density Polyethylene

IA	Implementing Agency
IEE	Initial Environmental Examination
IFI	International Finance Institution
ISWM	Integrated Sustainable Waste Management
JICA	Japan International Cooperation Agency
m^3	cubic meter
MoECAF	Ministry of Environment Conservation and Forests
MoNREC	Ministry of Natural Resources and Conservation (ex-MoECAF)
MMK	Myanmar Kyat
MSW	Municipal Solid Waste
MW	Megawatt
NECC	National Environmental Conservation Committee
NGO	Non-Government Organization
NPK	Nitrogen, Phosphorous, And Potassium
PIU	Project Implementation Units
PPTA	Project Preparatory Technical Assistance
SPS	Safeguard Policy Statement
TA	Technical Assistance
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY (ENGLISH)

The Third GMS Corridor Town Development Project focuses on the towns of Hpa-An and Myawaddy in Kayin State. The Project intends to significantly improve the environmental conditions in the two cities and the quality of life of its population through the improvement of water supply and solid waste facilities.

Water supply is presently insufficient in terms of serviced areas, service duration, quantities supplied and water quality. The Project beneficial impacts are the followings:

In Hpa-An

- Improvement of the water supply efficiency by the mobilisation of new water intake in Thanlwin River;
- Improvement of water supply security by increasing the water supply storage capacity in Hpa-An through the construction (i) of a new 3,000 m^3 water storage on Bare Mae Hill in replacement of 3 old reservoirs and (ii) of a new 3,000 m3 reservoir on Kyar Inn Mountain;
- Improvement of public safety through the construction of a water treatment plant with a capacity of 10,000 m3/day (and a possibility to extend to 18,000 m^3/d in a second phase), based on rapid sand filtration process with disinfection by chlorine;
- Creation of transmission lines and distribution lines including 21.2 km of transmission lines and main networks (diameters from 200-400 mm) and 79.1 km of distribution system (including tertiary networks <= 200 mm). The project would also include a fund to finance over 10 000 new connections.

In Myawaddy

- Improvement of the water supply efficiency by the mobilisation of new water intake by infiltration gallery along Thaungyin (Moei) River;
- Improvement of water supply security by increasing the water supply storage capacity in Myawaddy through the construction of a new 4,500 m^3 water storage;
- Improvement of public safety in Hpa-An and Myawaddy through the construction of a water treatment plant, with a capacity of 9,000 m3/day, based on rapid sand filtration process with disinfection by chlorine;
- Rehabilitation and expansion of distribution network in wards 1,2,5 and a part of ward 4.

Solid waste management is a major environmental issue in Hpa-An and Myawaddy where only respectively 35% and 50% of the solid wastes are collected at present.

The remaining uncollected waste is dumped all over the cities where the waste either decays with unpleasant smells and proliferation of insects or is burnt by the residents with emission of unpleasant and dangerous smoke as materials like plastics are also burnt. The collected waste is disposed in Hpa-An in a dumping site where it is regularly burnt in the dry season and from where untreated leachates are discharged into the surface water bodies. In Myawaddy, collected wastes are dumped in three sites. Two of them located within the urban area on the Thaungyin River bank are now being closed at the time of this report and a new dump site has been recently created west of the city. Large quantities of

waste are dumped into the storm drainage networks, clogging the drains and creating localised flooding during the rainy season.

The solid waste component beneficial impacts in Hpa-An and Myawaddy include:

- Improvement of quality of life and public health by (i) increasing the collection rate of solid waste in the city and (ii) improving collection points facilities;
- Improvement of storm drainage efficiency by reducing the amount of waste dumped into the drains and clogging the system;
- Reduction of water pollution load by improved collection rate and construction of a sanitary landfill with leachate collection and treatment in each town;
- Reduction of air emissions and particularly GHG through (i) construction of a composting plant on the landfill site and (ii) collection of landfill gas and flaring;
- Improvement of waste recycling efficiency resulting in secondary beneficial environmental impacts through significant avoidance of GHG emission;

With the exception of Hpa-An new storage on Kyar-Inn mountain located on lands owned by monastery communities but presently unused and the WTP on floodable land privately owned, none of the other Project components requires land acquisition as they are all developed on Hpa-An or Myawaddy TDC land or on Kayin State Government land. Water distribution networks are located in public areas (roads and streets).

None of the Project components involves significant forest clearing or encroachment into valuable wetland or other conservation area. Only few urban trees may be cut depending on the detailed design of each component, but EMP shall limit the cutting and impose the plantation of 2 new trees per cut tree.

The project will support innovation with (i) the construction of the first composting plants in Myanmar, attached to the landfill of each city and (ii) the equipment of each proposed new landfill with a system of gas collection and flaring. When compared with the situation without project, the solid waste component of the Third GMS in Kayin State will reduce the annual emission of GHG from generated waste in 2020 by 13,500 tons CO2-eq/year for Hpa-An and by 18,500 tons CO2-eq/year for Myawaddy. GHG abatement shall reach in 2040 42,500 tons CO2-eq/year for Hpa-An and 66,700 tons CO2-eq/year for Myawaddy.

The IEE also considered climatic trends at the national, regional and local scale in Myanmar and more specifically in Hpa-An for which long term climatological data is available. Both temperature and rainfall show increasing trends in Hpa An along the last 50 years of observations, in line with the MONREC analysis for the Kayin State. Annual rainfall didn't change significantly over the last 50 years. Among the wet season months (May to October), only the months of June, July and September show an increasing trend, with July showing the highest raise during the 50 years period (about 120 mm, or 24 mm per decade).

Temperature rise was more significant during the same period. The average annual maximum temperature increased by 2,2°C over the last 48 years, or an increase of almost 0,5°C per decade, a value significantly higher than what is considered as an average increase in the Kayin State (0.32°C per decade). July and February increased by about 4°C during the period while the other dry season months increased by 2 to 3 °C. Wet season months increase was only about 1°C during the same period.

The results of AWARE model were considered in the preparation of the IEE Report. In this connection, climate change and natural hazards considerations had been incorporated in the IEE. AWARE was used by the ADB to undertake an initial climate risk screening exercise. The results had rated the project as MEDIUM RISK and have identified flooding and landslide as a high level risk factor as the project is located in a region which has experienced recurring flood events in the recent past. However, the effective risk level is dependent on local geographical factors. On this basis, due to the location of Hpa-An and Myawaddy in flat or smoothly undulating areas, the risk for landslide may be considered as low. Hpa-An experiences infrequent flooding mainly localized next to the Thanlwin River where the water intake is located and around the central lake (which level varies according to Thanlwin river level) near which the WTP is located. Both sub-components integrate flood level constraints into their design, including a safety board for climate change risk. Following such design principles, the Project components shall not be affected or put at risk by climate change.

A screening carried out during the Interim phase of the Project (based on Rapid Environmental Assessment –REA- checklists of the ADB) confirmed that environmental impacts raised by the project were either very beneficial or mainly related (i) to the risks of nuisances during the construction phase but easily controllable by appropriate construction site supervision and conventional mitigation measures and (ii) during operation, to typical risks in relation to WTP and landfill management but also easily avoidable considering the simple technology applied and the small size of the projects. Consequently, the proposed categorisation of the Project was B, involving the preparation of the present IEE. The conclusions of the present report confirm this initial categorization as category B Project.

Aside from the several and undisputable beneficial impacts of the Project in Hpa-An and Myawaddy, some potential but limited risks are still to be considered should the management program anticipated be deficient:

- Most of the anticipated environmental and social impacts are related to nuisances which may happen during the construction activities. Because of the project located in an urban environment, risk of nuisances is higher: traffic congestion, temporary alienation of access, temporary disruption of community facilities, noise and engine gas and dust release may temporarily disturb the nearby communities. However, recommendations formulated in the present EMP combined with a solid environmental contractual framework and an effective inspection and supervision of construction sites will definitely reduce these risks to acceptable levels.
- Impacts related to water treatment plant operation (pollution from sludge, contamination of water resource) can be also avoided by appropriate management measures already discussed in the IEE. Monitoring of rivers water quality and of treated water is considered to ensure compliance and reduce the risk of supplying contaminated water.
- Impacts related to landfill operation (gas emission and pollution by leachate) are unlikely to occur as design already consider gas collection and flaring and leachate collection and treatment. However, monitoring of gas emission, leachate and adjacent underground water table is considered to ensure compliance.

The EMP emphasises (i) the need for EHS capacity building for KSG, the PMO and the PIU staff, (ii) the need for very strict and detailed EHS specifications for the

tender documents and (iii) the need for strict EHS enforcement through monitoring of construction activities.

Conclusion. Assuming that the mitigation measures and monitoring requirements described in the Environmental Management Plan are effectively implemented, the Project is not expected to have a significant adverse environmental impact.

EXECUTIVE SUMMARY (MYANMAR)

- (i) (□) 3,000 m^3 (ii) 3,000 m^3
- Chlorine 10,000 m^3
- 35% □□ 50% 50%

- (i) Composting Plant (ii)
- Station
- (i) (ii)
- -

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□□□ □□□ □□□ □□□ (i) □□□ □□□ Composting Plant □□□ □□□ (ii) □□□ □□□ □□□ □□□ □□□ □□□ □□□ □□□ □□□ □□□ 13,500 □□□ CO2-eq/year □□□ □□□ 18,500 □□□ CO2-eq/year □□□ □□□ □□□ □□□ □□□ □□□ □□□ □□□ 425,000 CO2-eq/year □□□ □□□ 667,000 CO2-eq/year □□□

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□□□ □□□ □□□ 48 □□□ □□□ 2.2 □C □□□ □□□ 0.5 □C □□□ □□□ □□□ □□□ □□□ 0.32 □C □□□ □□□ □□□ □□□ □□□

(i)

(O&M activities)

(EMP)

(ii)

EMP OHS

EMP (i) MTDO , PMG PIO

(ii) EMS (iii) EHS

1 INTRODUCTION

1.1 Project Categorization

A preliminary screening exercise of the proposed Project components, based on the latest applicable Rapid Environmental Assessment (REA) Checklists proposed by the ADB (REA Urban Development, REA Water Supply, REA Sewage Treatment and REA Solid Waste Management), was initially carried out by the ADB in June 2014. The screening was updated in 2015 and presented in the Interim Report (August 2015) and led to the following conclusions:

The Project will provide major improvements regarding urban environment and quality of life of the residents;

- Projects components are not anticipated to significantly affect water, soil or air quality in the Project area;
- No detrimental impacts are anticipated on the long term. Most critical period will be the construction period, as many of the works will occur in densely urbanized areas. However, impacts can be strongly minimized, even avoided if good environmental practices are integrated in the Construction EMP and in the EHS specifications for construction contractors, and effectively enforced on sites through a solid and efficient monitoring. These requirements are described in the present IEE-EMP.
- The Project will have limited land acquisition and resettlement implications, as most of the project components have already been designed in order to avoid/minimize land acquisition and resettlement.

Considering (i) the major beneficial impacts on the urban environment of Hpa-An and Myawaddy, (ii) the anticipated limited environmental impacts from the Project components and (iii) the limited potential impacts on land acquisition and resettlement, the present Project was classified as an ADB category B. This categorization has been confirmed during the preparation of this IEE as discussed later. This IEE is complemented (i) by a Resettlement Plan (RP) to address in details land acquisition and resettlement issues and (ii) by a full EMP encompassing construction and operation period with a particular focus on the construction period, recognizing that many of the construction activities will be located within sensitive urbanized areas.

Considering the Myanmar environmental regulations, the study level also complies with the regulatory requirement of the draft EIA Procedures (6th edition).

1.2 Purpose of EIA/IEE

This report gives an account of the Environmental Assessment (EA) of the proposed Third GMS Corridor Towns Development Project. The IEE was conducted as part of the Project preparation with the following purposes:

- To ensure the environmental soundness and sustainability of the project;
- To support the integration of environmental as well as climate change and natural hazards considerations into the project decision-making process;
- To identify early potential impacts and risks arising from the proposed Project components on the physical, biological, socio-economic and cultural environment;

- To identify measures to avoid, minimize, mitigate or compensate for adverse impacts and enhance positive impacts, and
- To lead to overall environment improvements in the project area of influence.

The present EIA was carried out in compliance with the Safeguard Policy Statement (SPS, June 2009) of the Asian Development Bank (ADB) and with reference to the Draft Procedure for Environmental Assessment (6th edition) prepared by the Myanmar Government under the 2012 Environmental Conservation Law.

1.3 Report Organization

The Initial Environmental Examination follows a conventional layout for this type of report and integrates an Environmental Management Plan (EMP).In addition to this introduction the reader will find the following Sections in this report:

- The Executive Summary;
- This introduction with the project rationale (Section 1)
- The applicable Institutional and Regulatory Framework (Section 2);
- The description of the proposed Project components (Section 3);
- The Baseline Situation (Section 4);
- The Impact Analysis (Section 5);
- The Alternative Development options (Section 6);
- The Public Consultation activities (Section 7);
- The Grievance and Redress Mechanism proposed (Section 8)
- The Environmental and Social Management Plan (Section 9)
- Conclusions & Recommendations (Section 10)
- Appendices

2 POLICY, INSTITUTIONAL & LEGAL FRAMEWORK

2.1 Myanmar Environmental Laws, Regulations and Standards

2.1.1 HISTORICAL BACKGROUND

The National Commission on Environmental Affairs (NCEA) was formed in 1990 with the purposes of setting environmental standards and creating environmental policies for utilizing natural resources and controlling environmental pollutions. It was organized as a division under the Ministry of Foreign Affairs in April 1992. NCEA has adopted a National Environmental Policy (NEP) in 1994 to ensure the incorporation of environmental concerns in planning for economic development. The NEP emphasizes "the responsibility of the State and every citizen to preserve its natural resources in the interest of present and future generations". In 2005, NCEA was transferred under the Ministry of Forestry.

The Ministry of Forestry was upgraded in September 2011 as the Ministry of Environmental Conservation and Forestry (MOECAF) and then Ministry of Natural Resources and Conservation (MONREC) in 2016, the focal and coordinating agency for the overall environmental management in Myanmar.

The Environmental Conservation Department (ECD), one of the six departments under the MOECAF is responsible for implementing National Environmental Policy and to manage natural resources conservation and pollution control on water, air and land. The main ECD responsibilities include:

- Development of legislation related to environmental regulations, guidelines and procedures;
- Coordination of environmental conservation activities;
- Development of plans on climate change mitigation and adaptation, on desertification control and ozone layer protection;
- Preparation of national report in relation with international agreements.

When the MOECAF was created, the NCEA disappeared and its members were transferred to the ECD. The National Environmental Conservation Committee (NECC) was then established in April 2011 by ECD which selected representatives from most Ministries to participate to this committee.

On March 17th, 2016, the newly seated Pyihtaungsu Hluttaw announced an important reorganization of the Union Ministries, reducing the overall number from 36 ministries to 21. A total of 10 ministries have been merged. The Ministry of Environmental Conservation and Forestry (MOECAF) has been merged with the Ministry of Mines (MOM) to create the new **Ministry of Natural Resources and Environmental Conservation (MONREC).**

2.1.2 BACKGROUND OF LAWS AND REGULATIONS

Myanmar has already legislation and regulations which relate to natural environmental aspects dating prior to its independence. For instance, the Forest Act and the Burma Wildlife Protection Act have been enacted respectively in 1902 and 1936 for the sustainability of the forest products. Amended versions of such

earlier act and newly promulgated one give a perspective on the existing legal and administrative framework concerning the environmental affairs in Myanmar.

The Myanmar Agenda 21 was formulated in 1997 in response to the call of the Earth Summit to develop national strategies to implement the Global Agenda 21. The Myanmar Agenda 21 made recommendations for the drafting and promulgation of a framework law which can further promote the integration of environmental and developmental concerns in the decision making processes of the country.

Present major laws and regulations with relation to environmental management are summarized in following Table.

Table [1] APPLICABLE ENVIRONMENTAL, HEALTH AND SAFETY (EHS) LAWS & REGULATIONS IN MYANMAR

Laws and Regulations	Year	Purpose/Description
Environmental Conservation Law	2012	This law provides the basis for the conservation and protection of the natural environment of Myanmar including the marine environment. The ECL provides the common principles of environmental conservation and for other environmental laws and policy. The Environmental Conservation Committee (ECC) within the Ministry of the Natural Resources and Environmental Conservation (MONREC) was formed to oversee implementation, enforcement, and further development of the ECL including providing education and assistance to government agencies and proponents with the requirements of the ECL. The ECC also plays a lead role in managing environmental disputes.
Myanmar Environmental Conservation Rules	2014	These place responsibility on the Government to establish and adopt the necessary programs for the conservation and enhancement of environment, protection, control and reduction of pollution in environment, and conservation. Articles 52, 53 and 55 of the Rules states that all Projects and Project expansions undertaken by any ministry, government department, organization, corporation, board, development committee and organization, local government or authority, company, cooperative, institution, enterprise, firm, partnership or individual (and/or all Projects, field sites, factories and businesses including expansions of such Projects, field sites, factories and businesses identified by the Ministry, which may cause impact on environmental quality and are required to obtain Prior Permission in accordance with Article 62 of the Rules) having the potential to cause Adverse Impacts, are required to undertake IEE or EIA or to develop an EMP, and to obtain an ECC from MONREC.

Laws and Regulations	Year	Purpose/Description
Environmental Impact Assessment Procedures	2015	The EIA procedures states that all projects undertaken by a ministry, government department, organization, corporation, board, development committee, local government or authority, company, cooperative, institution, enterprise, firm, partnership or individual that could cause significant adverse environmental or social impacts are subjected to screening for either and IEE or EIA, and ultimately require an Environmental Compliance Certificate (ECC) from MONREC before being allowed to proceed. The EIA process involves (i) screening, (ii) scoping for EIA, (iii) EIA/IEE preparation and review, (iv) EIA/IEE approval, and (v) appeal. The procedures includes project categorization which helps determining whether such project or activity will be required to conduct an IEE, an EIA or an EMP. The article 13 of the procedures states that the appropriate public consultation is required through all phases of the IEE and EIA. Regarding the Resettlement and Indigenous People, in the article 7, chapter 2 of the procedures states that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples.
Conservation of Water Resources and Rivers Law	2006	To conserve and protect the water resources and rivers system for beneficial utilization by the public; to protect environmental impacts for the abuse use of water resources. Law strictly prohibits disposal of engine oil, chemical, poisonous material and other which may cause damage, or dispose of explosives from the bank or from a vessel.
Forest Law	1992	The Forest Law, 1992 highlights forest protection, environmental and biodiversity conservation, and extended set-up of the permanent forest estates (PFE) and protected areas system (PAS). It provides opportunities for the promotion of private sector involvement in reforestation and timber trade, and decentralizes management responsibilities. It encourages community participatory approach in managing forest resources, particularly to satisfy the basic needs of the rural people. It demonstrates a shift from the concept of revenue generation and restriction to motivation and share of management responsibility with people.

Laws and Regulations	Year	Purpose/Description
Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law	1994	To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological gardens and botanical gardens. The Law highlights habits maintenance and restoration, protection of endangered and rare species of both fauna and flora, establishment of new parks and protected areas, and buffer zone management.
National Environmental Policy	1994	To ensure sound environmental policies in the utilization of water, land, forest, mineral resources and other natural resources in order to conserve the environment and prevent its degradation.
Law of Mon State Development Affair	2012	It provides information on the policy, regulations on the solid waste management and drainage facilities management, and includes supervision of construction, renovation and extension of a building.
Law of Kayin State Development Affair	2013	It provides information on the policy, regulations on the solid waste management and drainage facilities management, and includes supervision of construction, renovation and extension of a building.
Protection and Preservation of Cultural Heritage Regions Laws	1998	To implement the protection and preservation policy with respect to perpetuation of cultural heritage that has existed for many years; to protect and preserve the cultural heritage regions and the cultural heritage. New project in such sensitive areas is required to get prior approval from the Culture
The Underground Water Act	1930	This Act provides the requirement for systematic use of ground water toward sustainable purpose.
Public Health Law	1972	For promoting and safeguarding public health and to take necessary measures in respect of environmental health.
Prevention and Control of Communicable Diseases Law	1995 Revised in 2011	The Law highlights the functions and responsibilities of health personnel and citizens in relation to prevention and control of communicable diseases. It also describes measures to be taken in relation to environmental sanitation, reporting and control of outbreaks of epidemics and penalties for those failing to comply. The law also authorizes the Ministry of Health to issue rules and procedures when necessary with approval of the government
Factory Act	1951	For effective management in every factory for disposal of waste and effluent, and matters on health, cleanliness and precaution against danger.
Agricultural Land Law	2012	To protect the rights of the people working on the farmland.
National Biodiversity Strategy and Action Plan	2012	The NBSAP acts as the major guiding document for planning biodiversity conservation in the country, following its goal to provide a strategic planning framework for the effective and efficient conservation and management of biodiversity and natural resources based on greater transparency, accountability and equity.

Laws and Regulations	Year	Purpose/Description
Myanmar Investment Law	2012	This Law makes sure not to cause environmental pollution or damage in accord with existing laws in respect of investment.
Myanmar Investment Rules	2013	The Myanmar foreign investment rules contain several elements dealing with environmental protection, including: Art. 33. Proposals for economic activities that are considered capital intensive by the Commission, and that are prescribed to undergo environmental impact assessment by the Ministry of Environmental Protection and Forestry have to be submitted along with Environmental and Social Impact Assessment. Art. 54. The promoter or investor shall: (a) comply with Environmental Protection Law in dealing with environmental protection matters related to the business; Art. 123. If it is scrutinized and found out that the investor has carried out business that causes environmental pollution or has not taken action to minimize environmental pollution at the land for which he is entitled to lease or use, or if it is scrutinized and found that the work carries out causes nuisance to the persons who reside around such place due to noise or by culture and if relevant persons officially object, the Commission may terminate the lease or tendering right to use after making necessary inquiry. Art. 125. The investor, for operating any business, does not have the right to lease and develop the following lands: (a) religious lands; (b) cultural heritage and natural heritage regions designated by relevant Ministries; (c) lands restricted for Union defence and security; (d) lands under litigation; (e) lands restricted by the State from time to time; (f) lands where exists place or building which may cause situations such as impact on public environment noise, pollution, impact on culture within urban residential area due to the business of the investor.
National Sustainable Development Strategy	2009	This strategy concerns the sustainable management of natural resources, integrated economic development, and sustainable social development.
Conservation of Water Resources and Rivers Law (2006)	2006	This Law aims to conserve and protect the water resources and river systems for beneficial utilization by the public, to smooth and enhance safety of waterways navigation along rivers and creeks, to contribute to the development of State economy through improving water resources and river systems, and to protect environmental impact.
Enacted Laws related to Labour and Safety	Mainly 2011-2016	Laws and Rules applicable for the construction and operation of the projects: Labour Organization Law & Rules (2011) Settlement of Labour Dispute Law & Rules(2012)

Laws and Regulations	Year	Purpose/Description
		Edited Settlement of Dispute Law(September, 2014) Social Security Law (2012) Social Security Rule (2012) Minimum Wages Law (2013) Minimum Wages Rule Employment and Skill Development Law Leave and Holiday Law (1951) Amended Law for Leave and Holiday Law 1951(July 2014) Payment of Wages Law (Jan 2016)

2.1.3 APPLICABLE ENVIRONMENTAL STANDARDS

In December 2015 MONREC released Myanmar Environmental Quality (Emission) Guidelines. The guidelines cover both water and atmosphere emissions related to a wide range of production industries. Most of the proposed standards refer to the Environmental, Health and Safety Guidelines of the IFC (2007). Concerning treated wastewater discharges (Section 1.2), proposed standards refer also to IFC EHS guidelines. Emission guidelines related to leachate discharges from municipal solid waste landfills and emissions from incinerators are presented in following Tables. With respect to drinking water standards the MONREC guidelines refer to the National Drinking Water Guidelines recently introduced by the National Water Council and based on WHO Guidelines and Standards for drinking water.

Table [2] EMISSION QUALITY STANDARDS APPLICABLE TO TREATED MUNICIPAL WASTEWATER EFFLUENTS

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

[a] MPN = Most Probable Number
[b] Not applicable to centralized, municipal wastewater treatment systems

Table [3] EMISSION QUALITY STANDARDS APPLICABLE TO LEACHATE FROM MUNICIPAL WASTE LANDFILLS

Parameter	Unit	Daily Maximum	Monthly Average
5-day Biochemical oxygen demand	mg/l	140	37
Ammonia	mg/l	10	4.9
Aniline		-	-
Arsenic	mg/l	-	-
alpha Terpineol	mg/l	0.033	0.016
Benzoic Acid	mg/l	0.12	0.071
Chromium (total)	mg/l	-	-
Naphthalene	mg/l	-	-
p-Cresol	mg/l	0.025	0.014
pH	S.U.	6-9	6-9
Phenols	mg/l	0.026	0.015

Parameter	Unit	Daily Maximum	Monthly Average
Pryridine	mg/l	-	-
Total suspended solids	mg/l	88	27
Zinc	mg/l	0.2	0.11

2.1.4 NATIONAL EIA REQUIREMENTS AND FRAMEWORK

In accordance with the recommendations of the 2012 Environmental Conservation Law, MONREC has prepared a procedure for the Environmental Assessment (EA) of development projects. This procedure is still in a draft form (version 42 latest) but is already virtually enforced by MONREC.

From the information gathered from the draft procedure, the PPTA Consultant has prepared a tentative flowchart depicting the various stages of the procedure and the formal review/approval steps by MONREC.

MONREC should be solicited 3 times during the preparation process of a local IEE/EIA:

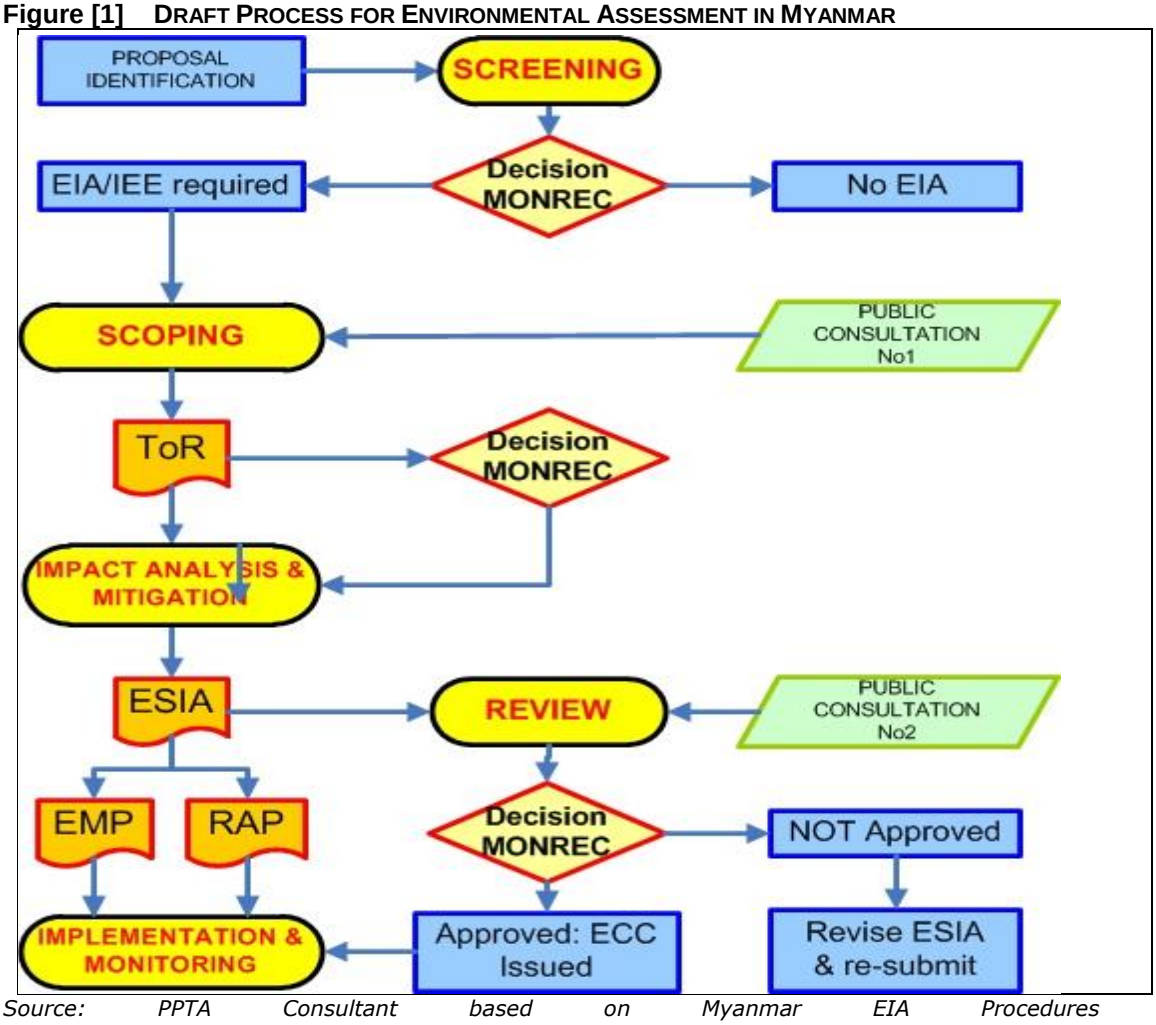
- at project proposal stage (screening), to decide if EIA or IEE is required or not
- before the start of the EIA study to approve (i) the Terms of Reference for the EIA and (ii) the qualification of the Consultant proposed for carrying out the EIA;
- at submission stage of the IEE/EIA draft report for comments and then issuance of the ECC.

Two public consultations are also considered. This process, as shown in following figure is quite comparable with ADB requirements regarding the EA main process stages.

In parallel to the preparation of the IEE documentation by the PPTA Consultant for ADB, it is required by the national procedure on EA that a local EIA report is submitted to MONREC. In order to avoid delay in the eventual implementation of the project, the required EA steps have been undertaken by the Executing Agency in parallel with the progress of the PPTA IEE, benefiting fully from the work done by the PPTA Consultant.

In terms of report content, the EIA requirement for Myanmar covers both environmental and social while for ADB SPS, these come separately in the EIA/IEE for environment and the RAP (and other types of documents) for the social aspects (baseline, resettlement, livelihood restoration). Compilation of information for reporting to MONREC relied on these documents from PPTA.

Figure [1] DRAFT PROCESS FOR ENVIRONMENTAL ASSESSMENT IN MYANMAR



Source: PPTA Consultant based on Myanmar EIA Procedures
Note: ECC=Environmental Compliance Certificate

Table [4] COORDINATION BETWEEN ADB AND MONREC REQUIREMENTS

Steps in Myanmar EA Procedure	Links with ADB PPTA EIA/IEE	Schedule
Submission of Project proposal	Project proposal to be submitted to MONREC by the Proponent (KSG) must be based on the final list of project components approved by proponent following PPTA Interim report and workshop	MONREC is required within 15 days of receiving a project proposal, to perform screening and determine the type of environmental assessment (EIA, IEE or none) required
Preparation of EIA Scoping and ToR	ToR may partly rely on the ADB ToR related to the Environmental and Social tasks of the PPTA, and be complemented as necessary by any issue identified during the public consultation activities. Project proponent must appoint a consultant registered/qualified to prepare scoping and ToR.	MONREC is required to provide decision on firm's qualification within 7 days, and to provide approval of scoping and EIA ToR within 15 days upon submission of documents by proponent

Steps in Myanmar EA Procedure	Links with ADB PPTA EIA/IEE	Schedule
Preparation of EIA report	Preparation of the EIA/IEE report will be based on the EIA/IEE and RAP reports prepared by the PPTA Consultant.	Report preparation to start when PPTA EIA/IEE is submitted to or approved by ADB
Public Consultations	Myanmar EA procedure requires 2 public consultations. ADB SPS requires minimum of 2 consultations for category A project (with full EIA) and minimum 1 for category B (with IEE)	Public consultation activities of PPTA Consultant to be fully considered in EIA report for MONREC

2.1.5 INTERNATIONAL TREATIES

Myanmar has also made commitments to the following international agreements and protocols on environmental, social, safety and occupational issues as shown in table below.

Table [5] INTERNATIONAL AGREEMENTS ON ENVIRONMENT, SOCIAL AND SAFETY

International Agreement	Date of Signature	Date of Ratification	Date of Membership	Cabinet Approval	Relevance to Project
United Nations Framework Convention on Climate Change, New York, 1992 (UNFCCC)	11/06/1992	25/11/1994 (Ratification)	-	41/94 (09/11/1994)	Yes (GHG reduction)
Convention on Biological Diversity, Rio de Janeiro, 1992	11/06/1992	25/11/1994 (Ratification)	-	41/94 (09/11/1994)	Yes but limited as urban environment
International Tropical Timber Agreement (ITTA), Geneva, 1994	06/07/1995	31/1/1996 (Ratification)	-	-	No
Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985	-	24/11/1993 (Ratification)	22/2/1994	46/93	No
Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987	-	24/11/1993 (Ratification)	22/2/1994	46/93	No

International Agreement	Date of Signature	Date of Ratification	Date of Membership	Cabinet Approval	Relevance to Project
London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London, 1990	-	24/11/1993 (Ratification)	22/2/1994	46/93	No
The Convention for the Protection of the World Culture and Natural Heritage, Paris, 1972	-	29/4/1994 (Acceptance)	-	6/94	Yes in Mawlamyine
United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and / or Desertification, Particularly in Africa, Paris, 1994 (UNCCD)	-	02/01/1997(Accession)	02/04/1997	40/96 (4-12-96)	No
Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, D.C., 1973; and this convention as amended in Bonn, Germany,1979 (CITES	-	13/6/1997 (Accession)	11/09/1997	17/97 (30-4-97)	No
ASEAN Agreement on the Conservation of Nature and Nature Resources, Kuala Lumpur, 1985	16/10/1997	-	-	-	No
Cartagena Protocol on Biosafety, Cartagena, 2000	11/5/2001	-	-	13/2001 (22-03-2001)	No

International Agreement	Date of Signature	Date of Ratification	Date of Membership	Cabinet Approval	Relevance to Project
ASEAN Agreement on Transboundary Haze Pollution	10/06/2002	13/3/2003 (Ratification)	-	7/2003 (27-02-2003)	No
Kyoto Protocol to the Convention on Climate Change, Kyoto, 1997	-	13/8/2003(Accession)	-	26/2003 (16-07-2003)	Yes
Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	-	18-4-2004 (Accession)	18/7/2004	14/2004 (01-04-2004)	No
Sendai Framework for Disaster Risk Reduction, UNISDR, 2015	-	-	2015	-	?

2.2 ADB Environmental Safeguards Policy

In 2005, the Asian Development Bank embarked on a review process of its three safeguard policies on the environment, involuntary resettlement and Indigenous Peoples. The 2009 Safeguard Policy Statement (SPS) is the result of this four-year process. NGO Forum on ADB's network members was heavily involved in monitoring and commenting the review process.

The new Safeguard Policy Statement (SPS) became effective in January 2010. It replaced the ADB's previous separate policies on each of these areas: Policy on Indigenous People (1998), Involuntary Resettlement Policy (1995) and Environment Policy (2002). Key documents related to the new Policy include:

- ADB, 2009. Safeguard Policy Statement, Manila.
- ADB, 2012. Environment Safeguards, a Good Practice Sourcebook, Draft Working Document, Manila.

The standards contained in the ADB's SPS have far-reaching impacts. They determine the ADB's environmental and social obligations for its annual and rising lending volume and influence emerging national legal frameworks in Asia. Due to the Bank's increasing support for private sector operations, the Safeguard Policy Statement also determines how private financing, supported by the ADB, operates in Asia.

The overarching statement on ADB's Commitment and Policy Principles (Chapter V) says that the ADB's safeguards have the following objectives (SPS, p 15): i) avoid adverse impacts of projects on the environment and affected people, where possible; ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

2.2.1 GENERAL REQUIREMENTS

The Policy Delivery section (Chapter V B, paras. 53–64) lists general requirements that the ADB is obliged to follow in regard to: project screening and classification, information disclosure, consultation and participation, due diligence, monitoring and reporting, local grievance redress mechanisms and the Bank's Accountability Mechanism.

- Project screening and classification: The Policy stipulates that the ADB will undertake project screening as early as possible to i) determine the significance of adverse impacts; ii) identify the level of assessment and institutional resources required; iii) determine disclosure requirements (para. 50).
- Information disclosure: In line with the ADB's Public Communications Policy, the Policy requires (para. 53) that for environment Category A projects, draft environmental impact assessments must be posted on the ADB's website 120 days before project approval. For draft environmental assessment and review frameworks, draft resettlement frameworks and/or plans and draft Indigenous Peoples planning frameworks and/or plans, the Policy only stipulates that these documents must be provided by the borrower/ client and posted on ADB's website before project appraisal, as follows: i) final or updated environmental impact assessments and/or initial environmental examinations, resettlement plans, and Indigenous Peoples plans upon receipt (by the ADB), and ii) environment, involuntary resettlement and Indigenous Peoples monitoring reports submitted by borrowers/clients during project implementation upon receipt (by the ADB).
- Consultation and participation: The general provisions on consultation and participation are mostly phrased as aspirations. The Policy states that the ADB "is committed to working with borrowers/ clients to put processes of meaningful consultation and participation in place." Meaningful participation is defined as: i) beginning early in the project preparation stage and being carried out on an ongoing basis throughout the project cycle; ii) providing timely disclosure of relevant and adequate information that is accessible to affected people; iii) being free of intimidation and coercion; iv) being gender inclusive and responsive; and v) enabling the incorporation of all relevant views of affected people and other stakeholders in decision-making (para. 54).
- Due diligence and review of safeguard assessments and plans: Due diligence refers to the ADB's process of assessing safeguard issues through field visits and desk reviews as well as through examining relevant safeguard documents (such as environmental impact assessments, resettlement plans, Indigenous Peoples' plans). Through its due diligence processes, the ADB confirms that all potential environmental and social risks are identified. If they cannot be avoided, it ensures that appropriate mitigation measures are identified (SPS, para. 56).
- Monitoring and reporting: The monitoring obligations are merely required to be "commensurate with the project's risks and impacts". For highly complex and sensitive projects, the ADB requires the borrower/client to "engage an independent advisory panel" (SPS, para. 57).
- Local grievance redress mechanisms: The Policy requires the borrower/client to set up and maintain a grievance redress mechanism at project level (SPS, para. 59). This mechanism does not replace the ADB's accountability mechanism, but is intended to solve grievances at the local level. Affected people can also take complaints to the ADB's Accountability Mechanism. The

Accountability Mechanism Policy merely requires complainants to demonstrate that they have sought to address their complaint with management.

2.2.2 ENVIRONMENTAL REQUIREMENTS

More precisely as environment aspects are concerned, the objective of the Policy is to "ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process" (SPS, p. 17). The main Environmental Safeguard requirements are the followings:

- **Categorization and information disclosure:** The Policy uses a categorization system to reflect the significance of a project's potential environmental impacts. "A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence" (SPS, para. 50). Final or updated EIAs and/or initial environmental examinations must be made available upon receipt on the ADB's website. The following categories exist:
  - **Category A**: significant adverse environmental impacts that are irreversible, diverse or unprecedented. Category A projects requires a full-scale Environmental Impact Assessment (EIA). A draft EIA, including the Environmental Management Plan, must be made available on the ADB's website at least 120 days prior to Board approval.
  - **Category B**: less adverse environmental impacts that are site specific, few of which are irreversible, and mitigation measures that can be designed more readily than for Category A projects. Category B projects require an initial environmental evaluation.
  - **Category C**: minimal or no adverse environmental impacts. Category C projects require further environmental assessment actions/documents.
  - **Category FI**: projects involving ADB funds to, or through, a financial intermediary. Category FI projects require an Environmental and Social Management System.
- **Assessment process:** Environmental impacts must be determined in consultation with affected people and concerned non-government organizations (NGOs). For category A projects, the borrower/client is required to undertake an assessment of options that looks at alternatives to the project's location, design, technology and components. The options assessment will also examine the "no project" alternative. The borrower/client must present the rationale for selecting the particular project details, including a cost-benefit analysis that takes into account environmental costs and benefits of the various alternatives considered (SPS, Appendix 1, para. 4).
- **Type of impacts:** The types of impacts related to the environment include physical, biological, cultural and socioeconomic impacts. These can relate to occupational health and safety; community health and safety; vulnerable groups; gender issues; and impacts on livelihoods and physical cultural resources (SPS, Appendix 1, para. 5).
- **Project site/scope:** The project site covered by the environmental safeguard provisions in the Policy is defined as: "the primary project site(s) and related facilities that the borrower/client (including its contractors) develops or controls, such as power transmission corridors, pipelines, canals, tunnels, access roads, borrow pits and disposal areas, and construction camps". This

definition also includes: associated facilities that are not funded as part of the project, but "whose viability and existence depends exclusively on the project"; "areas and communities potentially affected by cumulative impacts from further planned development of the project"; and predictable impacts caused by the project "that may occur later or at a different location" (SPS, Appendix 1, para. 6).

- **Transboundary impacts:** The environmental assessment process must identify potential transboundary effects, such as air pollution and increased use or contamination of international waterways. It must also identify global impacts, such as the impact of greenhouse gases and impacts on endangered species and habitats (SPS, Appendix 1, para. 7).
- **Environmental planning and management:** If environmental impacts are identified, the borrower/ client is required to prepare an environmental management plan describing how potential impacts and risks will be addressed (SPS, Appendix 1, para. 12).
- **Consultation and participation, grievance mechanism:** The consultation process and grievance mechanism process follows the same provisions as laid out in the general requirements (see above) (SPS, Appendix 1, paras. 19 and 20).
- **Reporting and monitoring:** The Policy states that "the extent of monitoring activities will be commensurate with the project's risks and impacts" (SPS, Appendix 1, para. 21). For Category A projects, the borrower/client is required to retain qualified external experts or qualified NGOs to verify its monitoring information. The minimum requirement is semi-annual report during construction for projects with significant impacts and which become annual during operation. For other projects, periodic reports are required.Monitoring reports must be posted in a location accessible to the public (SPS, Appendix 1, paras. 21 & 22).
- **Unanticipated environmental impacts:** If unanticipated impacts occur during project implementation, the borrower/client is required to update the environmental assessment and environmental management plan or prepare a new assessment and plan (SPS, Appendix 1, para. 23).
- **Biodiversity conservation and sustainable natural resource management:** This section (SPS, Appendix 1, paras. 24 – 49) contains requirements regarding the following issues: modified habitats; natural habitats; critical habitats; legally protected areas; invasive alien species; management and use of renewable resources;
- **Pollution prevention and abatement** (resource conservation, energy efficiency, waste, hazardous materials, pesticide use and management, greenhouse gas emissions);
- **Health and safety** (occupational health and safety and community health and safety); and
- **Physical cultural resources** (SPS, Appendix 1, para. 24).

3 PROJECT DESCRIPTION

3.1 Solid Waste Components

Solid waste management in Myanmar is in generally inadequate, with limited collection services and poor final disposal. Uncollected waste is usually burned or dumped into roadside drains and rivers, which is causing environmental pollution and urban floods. Such urban environment contaminates the productive capacity of a city making them less competitive and liveable.

3.1.1 REQUIREMENT

Solid waste disposal is presently a critical issue in the Project Towns. The existing dump sites in both towns are putting at risk surface and groundwater quality. Also smoke and toxic gasses from uncontrolled burning of the waste are a threat for public health.

Whatever the project components considered, mainly beneficial impacts will result from any improvement. Even if proposed new landfills do not include all the good practices measures and technologies observed in industrialized countries, for evident budget limitation reasons, potential detrimental impacts can be significantly avoided or minimized by appropriate location and design of the facility.

HPA AN

The population is expected to grow from 75 141 in 2015 to 143 936 in 2040. This is a growth rate of 2.5% per year.

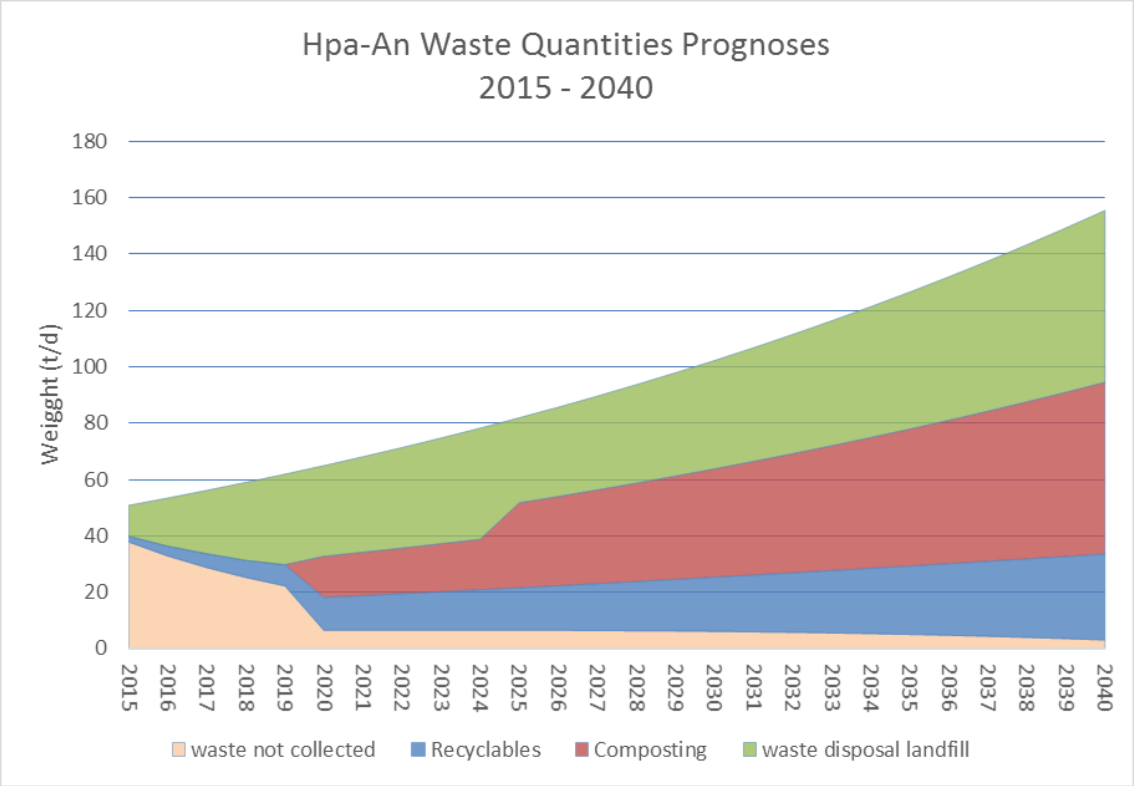
The more population, the more total waste is generated. Also due to higher income per household, more waste per capita is generated. Waste production per capita is anticipated to increase from 0.55 kg/cap/day in 2015 to 0.90 kg/cap/day in 2040. Waste generated at markets, small businesses and offices contribute to about 20% of household waste generation.

It is also anticipated a decrease of illegal dumping, with uncollected waste decreasing from 74% in 2015 to 8% in 2020 and 2% in 2040. Recyclable waste is estimated to represent at present about 20% of the collected waste.

As biodegradable waste represents about 58-60% of the generated waste, the project will consider the opportunity for composting, which will strongly increase the recycling level of the generated waste and extend the life of the landfill. A small composting plant is proposed for implementation in 2019, with experimentation and training in 2020 prior to start from 2021 till 2025 with the treatment of 25% of the waste generated to produce compost. From 2026, plant capacity will be increased to compost 40% of the waste generated.

After the recyclables are taken out (20% of waste collected), and after the biodegradable waste is converted to compost (25% first 5 years and 40% the following years), a relative small fraction remains for landfilling. The graph in the following Figure shows the quantities (in tonnes per day) with separation of recyclables and biodegradable waste from the total waste generated for the next 25 years.

Figure [2] CURRENT AND FUTURE WASTE GENERATION AND TREATMENT IN HPA-AN



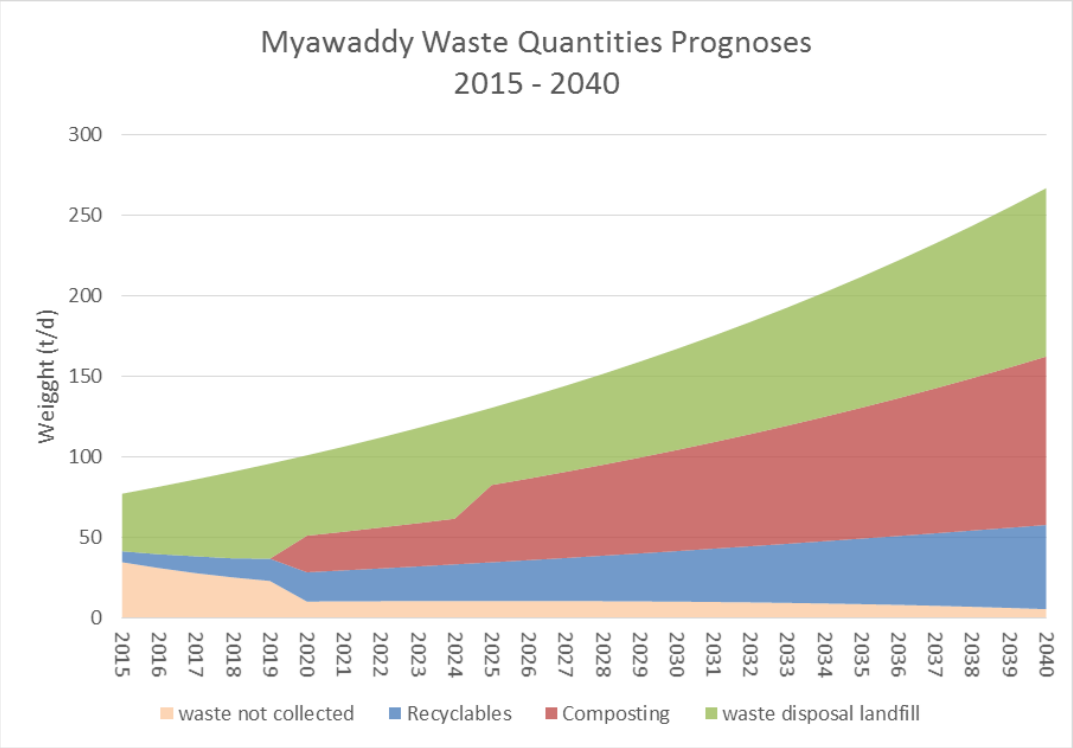
MYAWADDY

The population growth is anticipated from 113 155 in 2015 to 246 844 in 2040, or a growth rate of 3% per year.

The same assumption are used for Hpa-An and Myawaddy regarding evolution of waste generation per capita, evolution of markets wastes generation, evolution of recycling and composting. In this projection, a decrease of uncollected waste is anticipated from 45% in 2015 to 8% in 2020 and 2% in 2040.

The graph in following Figure shows the quantities (in tonnes per day) with separation of recyclables and biodegradable waste from the total waste generated for the next 25 years.

Figure [3] CURRENT AND FUTURE WASTE GENERATION AND TREATMENT IN MYAWADDY



3.1.2 PRELIMINARY DESIGN

The preliminary design consists of the following sections:

- Collection Strategy
- Recycling improvement
- Composting
- Controlled Landfill

3.1.2.1 Collection Strategy in Hpa An and Myawaddy

An economic analysis of options with or without transfer station carried out under the PPTA study leads to the conclusion that transfer station is not economically justified at least on a medium term. The project considers the acquisition of 2 small dumpers and 2 large dumpers in Hpa-An and acquisition of 2 small dumpers and one large dumper in Myawaddy, to cover the needs for the first phase until 2025. The number of trucks is based on the first phase implementation phase Short Term till 2025 and shall be increased according to needs on a longer term.

Improvement of the primary collection consists of the following elements:

Table [6] IMPROVEMENT PRIMARY COLLECTION

Item	Description	Subdivision	Hpa-An No. to purchase	Myawaddy No. to purchase
i)	Small containers 240 ltr in 3 different colours for the three different separation waste streams	a. Green colour containers for organics; b. Blue colour containers for recyclables c. Yellow colour containers for the reject waste	18 18 18	10 10 10
ii)	Aluminium containers 1100 ltr for siting at small size collection points. Two different containers for separating organics and rejected waste. It is assumed that most of the recyclables are already removed by the informal sector	a. Aluminium container with large text on site: ORGANICS b. Aluminium container with large text: ONLY REJECTS WASTE	15 15	13 13
iii)	Transport containers 3 m3 for collecting with hooklift trucks	a. Steel containers hook-lift system	9	5
iv)	Collection trucks for above containers	a. Small truck with lift system for 240 ltr and 1100 ltr containers b. Hook lift Truck for 3m3 steel containers	2 2	2 1

It is obvious when the new waste management systems will be fully implemented, more trucks are required. This is assumed to take place in the next Phase, Medium Term 2025 -2030.

3.1.2.2 Recycling

To improve the informal collection sector, awareness campaigns, information how to deal with recyclable collection in a safe and healthy manner through meetings and information leaflets will be provided to the concerned sector and the public.

To improve the recyclable collection rate from present 16% to about 20%, more involvement of the formal sector is required. More collection will be implemented throughout the following measures:

Table [7] IMPROVEMENT MEASURES FOR RECYCLING

Item	Description	Subdivision	Hpa-An	Myawaddy
i)	Formal sector: Introducing at schools, township offices and other official buildings separation and recovery of recyclables using 3 different colour containers	a) recyclables ("dry waste"): 240 ltr containers Blue	9	5
		b) compost ("wet waste"): 240 ltr containers Green	9	5
		c) reject waste: 240 ltr containers Yellow	9	5
ii)	Extra collection containers 1100 l dedicated to recycling	Recycling: 1100 l metallic container	9	5
iii)	Transport containers 3 m3 for collecting with hooklift trucks	Steel container hooklift system	5	3

3.1.2.3 Composting

Two proposed systems will be introduced in the cities:

- Backyard Composting;
- Construction of a Composting Plant.

BACKYARD COMPOSTING

Backyard composting will be only introduced in the suburban areas of the cities and for houses with large gardens. Training and information is required to assist the potential house owners with backyard composting. In this project it is estimated to implement "Instruction and Awareness Programs for Backyard composting"; this program may be executed in conjunction with the recyclables awareness programs.

CONSTRUCTION OF COMPOST PLANTS

The following assessment concerns only the first Phase for composting 25% of the generated waste till 2025. The following phase (composting 40% of the waste generated) is not analysed in terms of capex/opex, however, future land requirements are considered in the selection of sites. Compost plants will be located on the landfill sites. Composting Plants include the following facilities:

- Construction of Sorting Area: concrete pad with drainage
- Construction composting Pad, concrete pad with drainage system
- Construction of monsoon cover over composting area: hangar style roof
- Construction of maturing area, concrete pad
- Construction of storage area for ready compost: concrete based area with hangar style roof
- Office, sanitation building.
- Equipment to be purchased:
- Front-end loader: 1
- Trommel screen, capacity max.15 tons/hour: 1

- Conveyor belts different lengths and width: 5
- Magnetic Ferro remover: 1
- Mixer and Grinder, max capacity 15 tons/hour: 1
- Final automatic screens <10mm

The required area for each compost plant is 0.41 ha for Hpa-An and 0.61 ha for Myawaddy.

3.1.2.4 Controlled Landfills

WASTE QUANTITIES

Design criteria for the landfills in both cities are presented below and landfill requirements are presented in following table. Lifespan projections are 2040.

- Population growth from 2015 to 2040;
- Quantity per capita from 0.55 kg/c/day in 2015 to 0.9 kg/c/day in 2040;
- Separation rates for composting fractions of 25% of collected waste in 2020 to 40% of collected waste starting from 2026;
- Recyclables recovery rate from approx. 16% of collected waste in 2015 to 20% of collected waste in 2020;
- Collection of generated waste from 55% in 2015 to 95% in 2021 and finally to 98% in 2040.
- The total rejects waste to be landfilled after the separation of the recyclables and organics from the generated waste is 363,000 tonnes for Hpa-An and 616,900 tonnes for Myawaddy during the lifespan of the landfill in 2040.

LANDFILL AREA AND LANDFILL CELLS

Table [8] TOTAL LANDFILL DISPOSAL AREA AND LANDFILL CELL I AREA

Landfill Item	Unit	Hpa An	Myawaddy
Total Capacity LF 2040*	m^3	601770	996970
Average height	m	10	10
Area for landfill waste	m^2	60177	99697
Calculated area (trapezium shape)	m^2	65000	103500
Infrastructures (roads, offices etc.): 15%	m^2	9750	15525
Total m^2	m^2	74750	119025
Total ha. (/10,000m2)	ha	7.5	11.9
Total in acres (2.4691m2)	acres	18.5	29.4
First CELL I			
Total number of Cells	No.	3	4
Percentage landfilled in Cell I	%	33	25
Quantity waste in Cell I	m^3	200 000	247 500
Area required Cell I:	m^2	22 000	27 000
Cell I in ha.	ha	2.2	2.7

Landfill Item	Unit	Hpa An	Myawaddy
Cell I in acres	acres	5.4	6.7

Note: * Including cover material and provision for old waste of 100 000 m3 for Hpa An and 150 000 m3 for Myawaddy.

LOCATION OF LANDFILLS IN HPA-AN AND MYAWADDY WITH A 500 M BUFFER ZONE

The proposed area for the composting plant and sanitary landfill in Hpa-An is located at the Northern side of the future industrial zone extension. The wide area is recovering from recent vegetation clearing. Land is owned by the State Government, is presently unused and devoid of any built-up structures within a distance of 500 m around the site. Access road from the future IZ extension already exists.

Figure [4] HPA-AN PROPOSED LANDFILL LOCATION

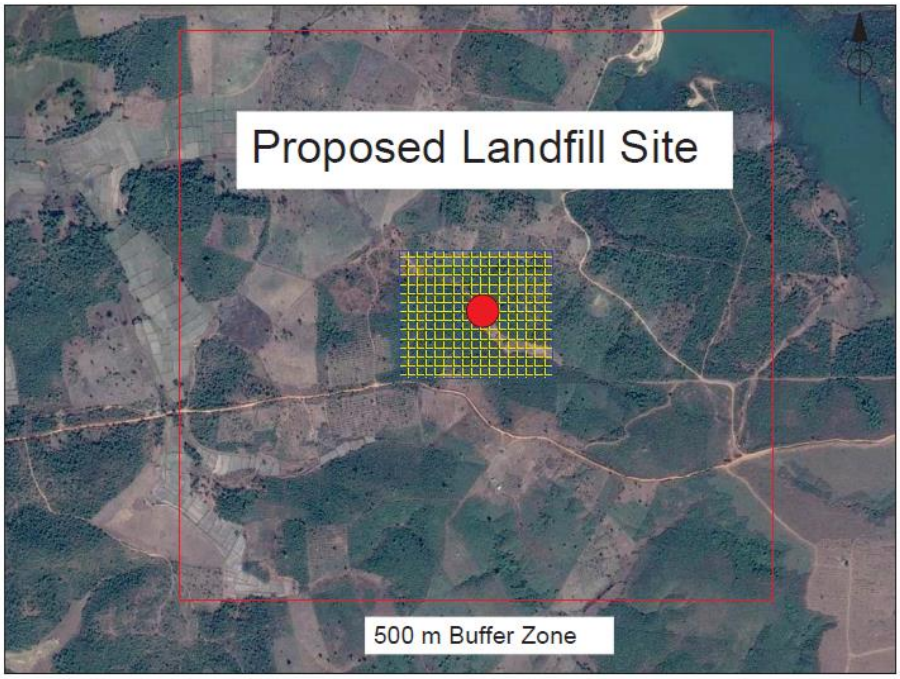
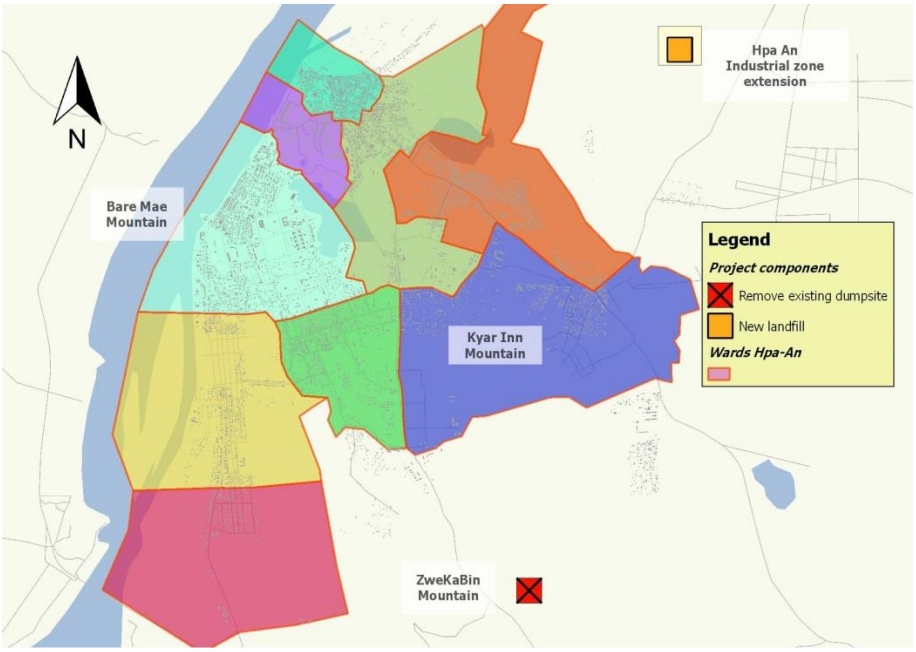


Figure [5] HPA-AN PROPOSED LANDFILL LOCATION AND DUMP SITE CLOSURE



The proposed site for Myawaddy landfill is presently owned by the Township Development Affairs within the Trade Zone. The total area secured for the long term development of the trade zone is 270 hectares (668 acres). The site presents scrub vegetation on its slopes and some common trees. With the exception of a warehouse located at 400 m from the site, no other buildings are located within 500 m around the site.

Figure [6] MYAWADDY PROPOSED LANDFILL LOCATION

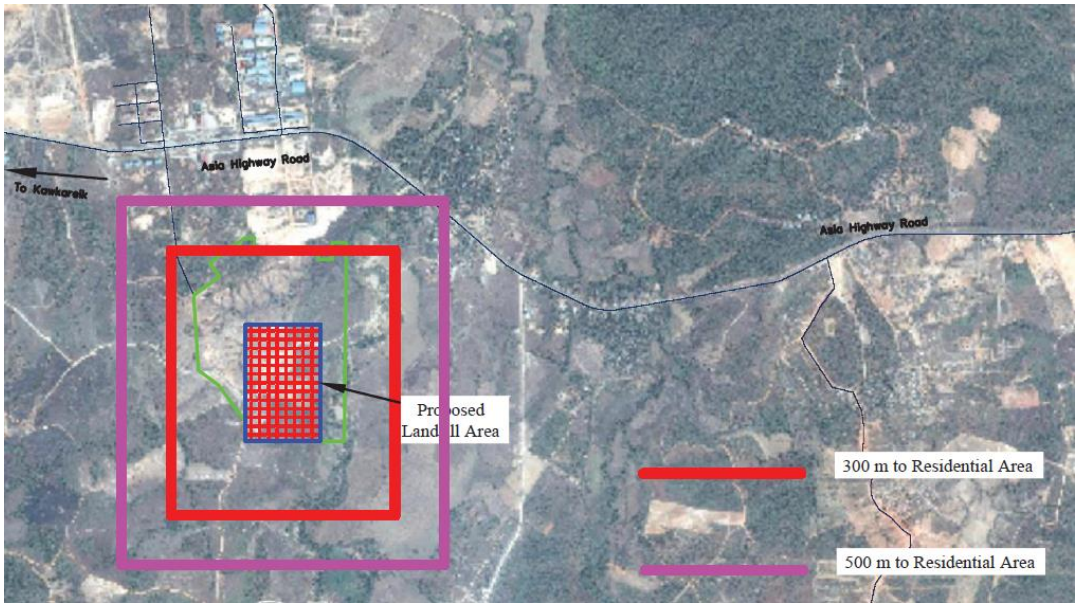
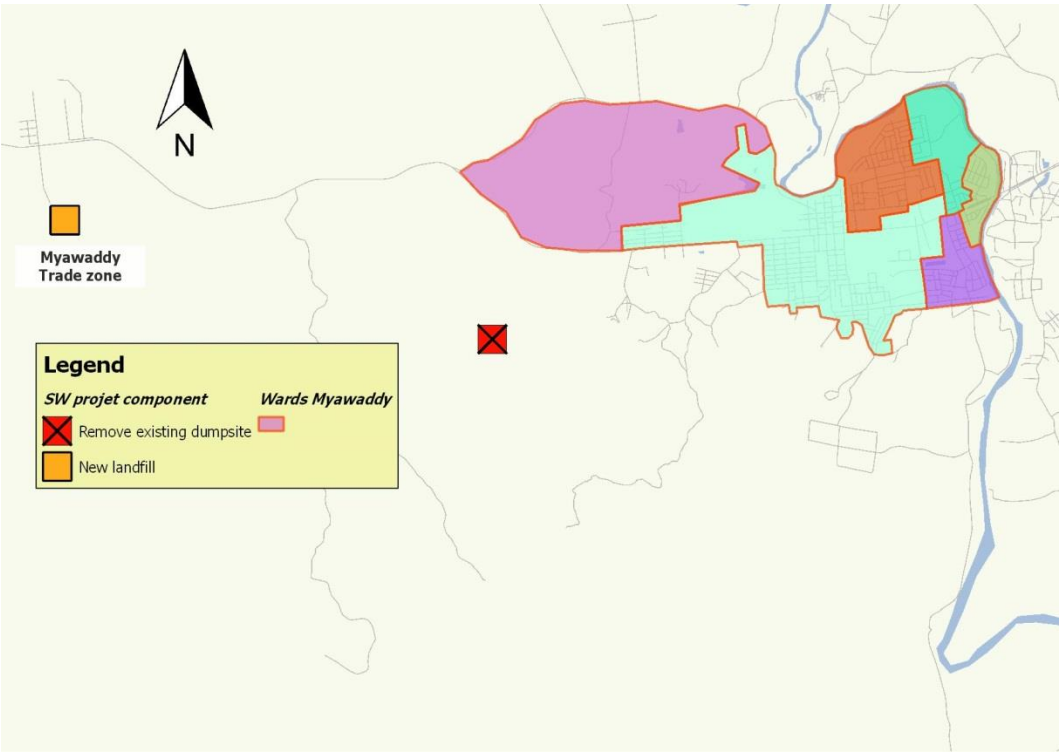


Figure [7] MYAWADDY PROPOSED LANDFILL LOCATION AND DUMP SITE CLOSURE



LEACHATE TREATMENT

Leachate treatment in this project is based on:

- Recirculation back into the landfill;
- Passive evaporation to the atmosphere (often through holding ponds or storage lagoons)
- On-site physical and biological treatment, a simple treatment unit with physical treatment (sedimentation, settling pond) and biological treatment (oxidation pond) is considered.

Hpa an: landfill cell area for waste landfilling in Cell 1 is 2.2 ha. Each cell will be split into hydraulically independent sub-cells to reduce the operated surface and then to reduce the leachates. A common practice is to operate with 6 months to 1 year lifespan sub-cell.

It would mean 5 000 m² of opened surface. As yearly rainfall in Hpa-An reaches 4,400 mm, there would be about 22,000 m^3 of leachate to be treated every year.

Simulation on a monthly basis leads to the conclusion that, for an annual rainfall of 4 400mm with 2 280 mm/year evaporation, 3 000 m² leachate pond by 3 m deep would allow for a simple evaporation process in dry season combined with a constant average treatment of 60 m^3/d.

Three landfill cells will be required for Hpa-An, respectively built in 2019/2020, 2027 and 2034. Only the first cell is considered for the present first phase of the project.

Myawaddy: landfill cell area for Cell 1 is 2.7 ha. Each cell should be split into hydraulically independent sub-cells to reduce the operated surface and then to reduce the leachates. It would mean 5,400 m² of opened surface. As yearly rainfall in Myawaddy reaches 1 800 mm, there would be about 9,800 m^3 of leachate to be

treated every year. About 4 300 m² basin with 2m depth (to store the peak flow in June/July/August) should be required to evaporate the leachate. The proposed option includes a series of 5 covered basins each of 1 000 m² and 2 m depth.

Four landfill cells will be required in Myawaddy, to be built respectively in 2019/2020, 2025, 2030 and 2035. Only the first cell is financed under the first phase of the project.

3.1.2.5 Closure of Old dumpsites

HPA-AN OLD DUMPSITE

When the new landfill site is active and as upgrading of the existing dumpsite is not possible as it too small for possible extension, the old dumpsite near ZweKabin Mountain must be rehabilitated. Two options have been considered:

- Coverage of the existing dumpsite with a HDPE liner, protection layer and top soil cover of 0.5 m with planting of grass and bushes;
- Removal of the existing dumped waste and transport to the new landfill, Restoring the area with topsoil and vegetation.

Coverage of the existing dumpsite has been considered as the best option for practical and mainly economic reasons considering the area of 25 000 m².

MYAWADDY OLD DUMPSITES

The two dumpsites in Myawaddy along the river side were closed in December 2015 and are presently under rehabilitation by Myawaddy Municipality. From December 2015 onwards, another temporary dumpsite has been created along HW1. As soon as the new controlled landfill starts operation, all the already dumped waste will be removed from this temporary dumpsite and transported to the new constructed landfill.

Proposed works will include (i) the removal of the disposed waste (estimated to be about 90,000 m3 by the end of 2020) and (ii) the restoration and revegetation of the area (20,000 m²).

3.2 Water Supply Components

3.2.1 PROJECT OBJECTIVES

The proposed project intends to improve the water supply system in Hpa-An and Myawaddy, with the following objectives:

Improve knowledge of the system by implementing monitoring and new practices:

Reduce and control level of NRW;

improve water production in both quantity and quality;

Increase water supply coverage to cope with future city development;

Improve water distribution achieving continuous water supply and enhancing pressure management;

Promote asset management and long term strategy of the system with assessment of long term requirements;

Secure the overall system, increasing its resilience and sustainability.

3.2.2 PROJECT STRATEGY

The water supply project of the two Kayin cities meets the following targets:

3.2.2.1 Increase water supply coverage and duration

In Hpa-An, the objective is to connect 70% of the urban population (9 urban wards) in the short term by the end of the project, and to reach 95% coverage in long term (2040). This means by 2020 nearly 75 000 inhabitants connected (increase of 68 000 persons from present situation) with 12 800 new connections, and by 2040 over 136 500 inhabitants connected.

In Myawaddy, the objective is to connect 70% of the urban population by the end of the project and to reach 95% coverage in long term (2040). By 2020 nearly 75 000 new inhabitants connected through 15 000 new connections, and by 2040 over 158 000 inhabitants connected.

In both cities, the level of service is unequal and some areas are supplied only few hours per day or do not have access to piped water at all. The target is to achieve a permanent water service, 24h/d and 7d/week together with an appropriate monitoring system.

3.2.2.2 Reduce Non-Revenue Water (NRW)

Reduction and control of NRW through the definition and application of an action plan for each city is also required to reach a suitable quality of services. It will also have an impact on the financial sustainability of the systems limiting expenditures (CAPEX and OPEX) and increasing incomes.

3.2.2.3 Improve Supplied Water Quality

The project aims also to ensure good water quality from production to consumer taps. Using existing assets and available resources, water will be treated before being distributed. Treated water will comply with WHO and national quality standards. The table below shows objectives on treated water quality.

Table [9] WATER QUALITY OBJECTIVES

Parameters	National drinking water standard	WHO drinking water standard	Treatment objectives
Turbidity	5 NFU	< 5 NFU**	1 NFU
pH	6.5 - 8.5	6.5 - 9.5	6.5 - 8.5
Iron	1 mg/l	0,3 mg/l**	0.2 mg/l
Aluminium	-	0.2 mg/l	0.2 mg/l
Ammonia	0.02 mg/l	-	0.1 mg/l
Chlorine	2 - 10 mg/l	-	1 - 2 mg/l
E. Coli	-	0 (99%)**	0 /100 ml
Parasites*	-	-	0 /100 ml

* Gardia and Cryptosporidium ** Expected

3.2.3 PROPOSED PROJECT FOR HPA-AN

In line with previous objectives and strategy the proposed project consists of four major elements as described below:

- Production and treatment
- Increase and secure storage
- Expand distribution system
- Reduce NRW, improved Operation & Management covering asset management, GIS, billing and customer management.

3.2.3.1 Water Intake

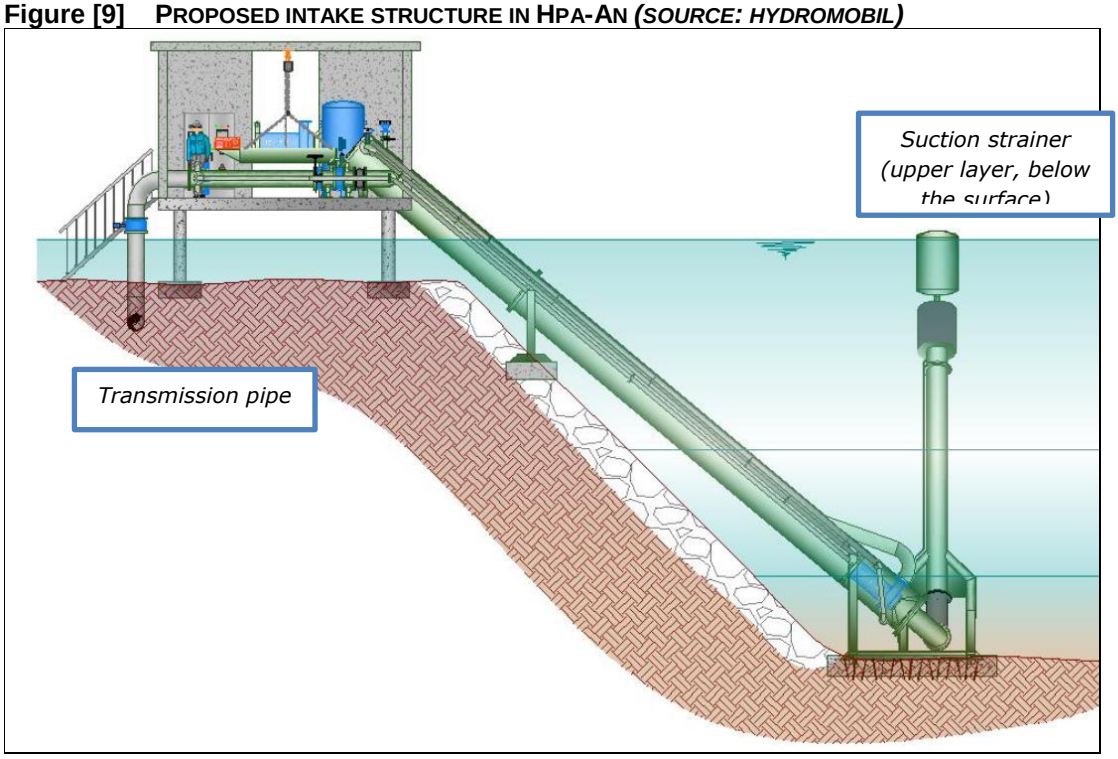
The project will create a new intake structure to abstract water from the Thanlwin River. The selected site is located on the river bank, north of the city and upstream the main waste water discharges to the river. The area belongs to HTDC and is currently used by an existing small floating pumping station (see figure below). Consequently, intake will be replaced with a new main system, using the existing building to be rehabilitated.

Proposed solution consists in a permanent structure with an anchored transfer mast equipped with a mobile pump inside together with a floating structure. . To adapt to water level variation, an oscillating and floating mast equipped with a suction strainer (ensuring a filtration of 500µm) is proposed to abstract water from the upper layer. This technique enables to abstract from the most appropriate water layer regardless the water level: just below the surface to avoid floating pollutants (oil…) and where turbidity is reduced compared to lower layers. Electrical and mechanical equipment are installed inside the existing building on the shore above high water mark.

Figure [8] WATER INTAKE SITE IN HPA-AN (KUSEIK INTAKE)

With an initial capacity of 650m3/h, this facility could be easily extended in future to cope with long term requirements, and will ensure a reliable water abstraction and transfer to the water treatment plant. Conceptual drawing of the intake structure is presented below.

Figure [9] PROPOSED INTAKE STRUCTURE IN HPA-AN *(SOURCE: HYDROMOBIL)*



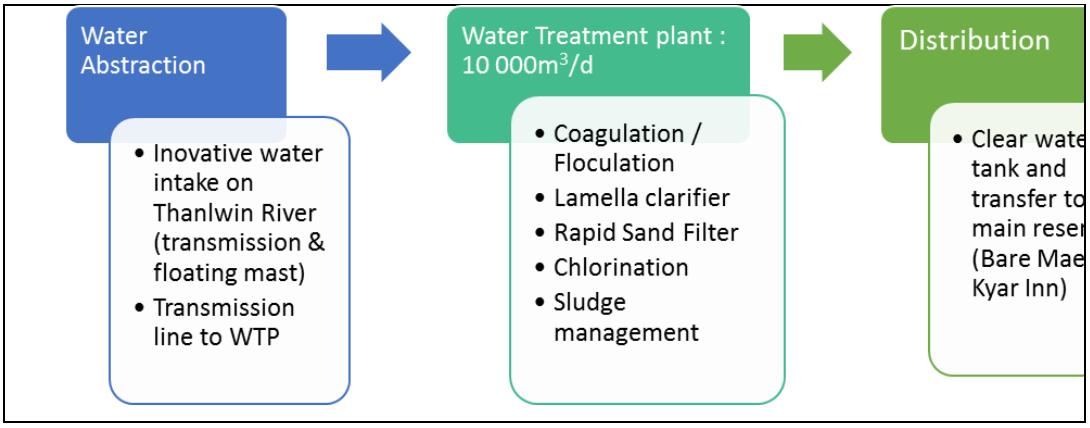
3.2.3.2 Treatment Plant

Land pressure is high in Hpa-An, and identification of suitable and available land for the treatment plant was very difficult. A land plot has been identified near KhanThaYar Urban Lake. Land requirement for the construction of the treatment plant together with future extension is estimated to be 1 acre (nearly 4 500 m²). The picture below shows the proposed area.

Figure [10] PROPOSED WTP AREA IN HPA-AN

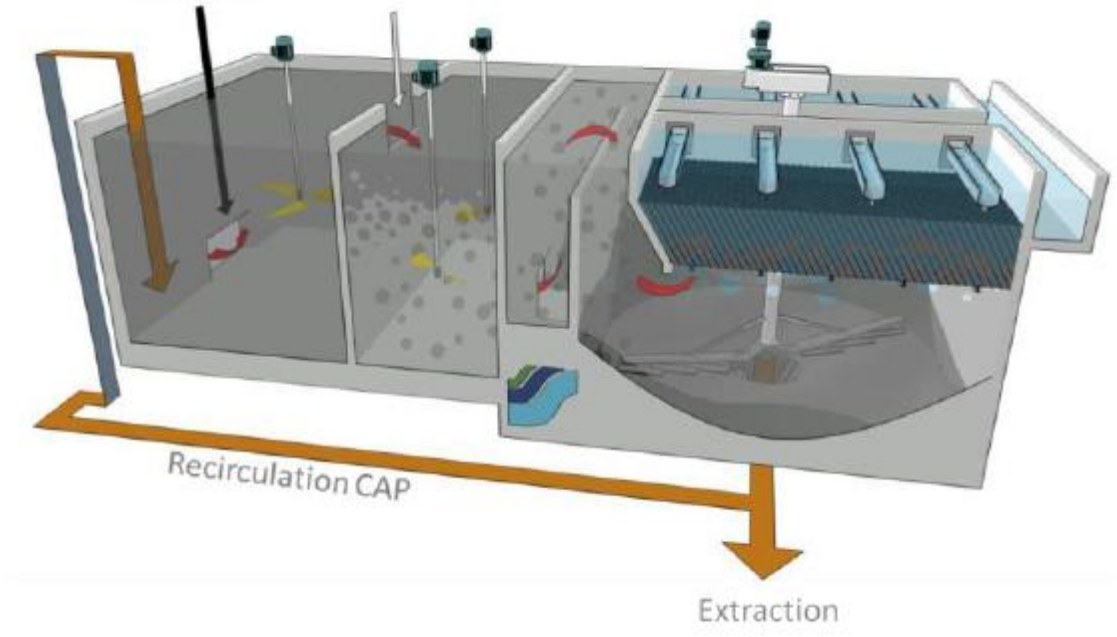
The new water treatment plant will have a nominal capacity of 10 000m^3/d (corresponding to 650m^3/h).This capacity will satisfy the needs on the basis of 15h/day operation. Daily capacity could be increased if necessary in order to supply the maximum daily need for the project horizon in 2025 of nearly 13 000 m^3/d under a 20h/d operation (maximum operation time considering regular washings).

Overall functioning is summarized below:



The first stage of the treatment is a clarification on lamella clarifiers where settling is increased by coagulation and flocculation. The clarification shall be split into 2 identical parallel lines. A first coagulation stage is required for which chemical would be added and mixed with the raw water in a specific tank ($12m^3$/line). Coagulant will be alum or PAC which can be supplied in powder or granular form. Then, flocculation is performed in an additional area ($60m^3$/line) by adding and mixing polymer. Settling will occur in clarifier ($25m^3$/line) for which standard clarifier with lamella is proposed to optimize the space. Particles will then settle and generate sludge at the bottom to be collected. Different variants of patented clarifiers exist and an example is presented in the figure below.

Figure [11] TYPICAL CLARIFIER



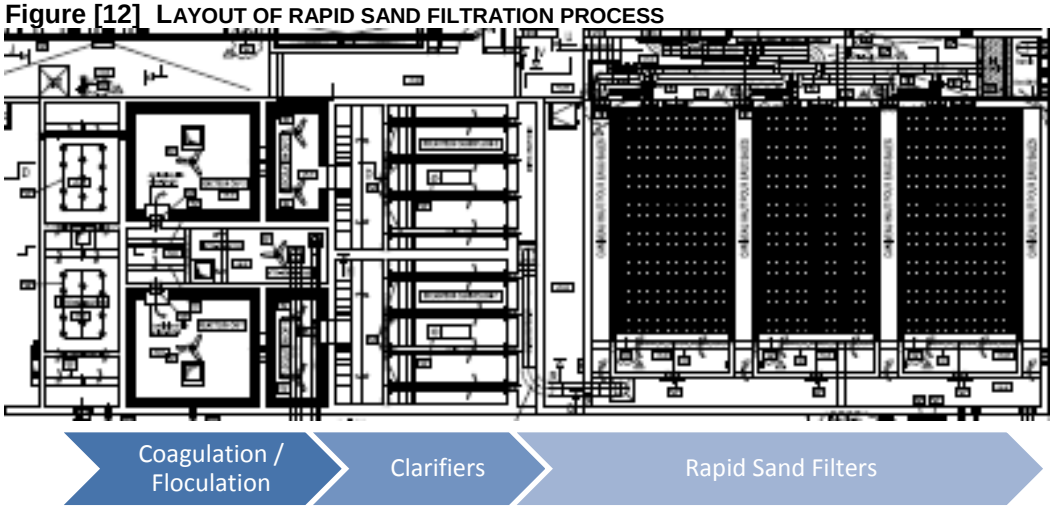
Filtration step includes a battery of 4 open type gravity sand filters, with the associated backwash, air scour and control facilities. Filters are upstream and constant level type and each of them will be equipped with one independent filter control system (easier operation). Using rapid sand filters, depth of sand shall not be less than 0.9 m (exclusive of all supporting layers). An overall filtration surface of nearly $80m^2$ would be necessary ($4 \times 20m^2$).

Chlorination for disinfection will be performed into a clear water tank prior to distribution. Treated water will be stored on site (1000m^3 storage tank) and supplied with transmission to the main storages of Bare Mae and Kyar Inn using a booster pumping station.

The new facility will also include: operation building, electricity building, chlorination plant, air production. A SCADA system shall also be installed to assist the operation of the plant and centralized the data and monitoring. In addition, sludge resulting from filters washing will have to be properly disposed. Due to the volume of sludge which is expected in connection with a seasonal high turbidity of the Thanlwyn, a thickener will be installed to reduce the volume prior to disposal.

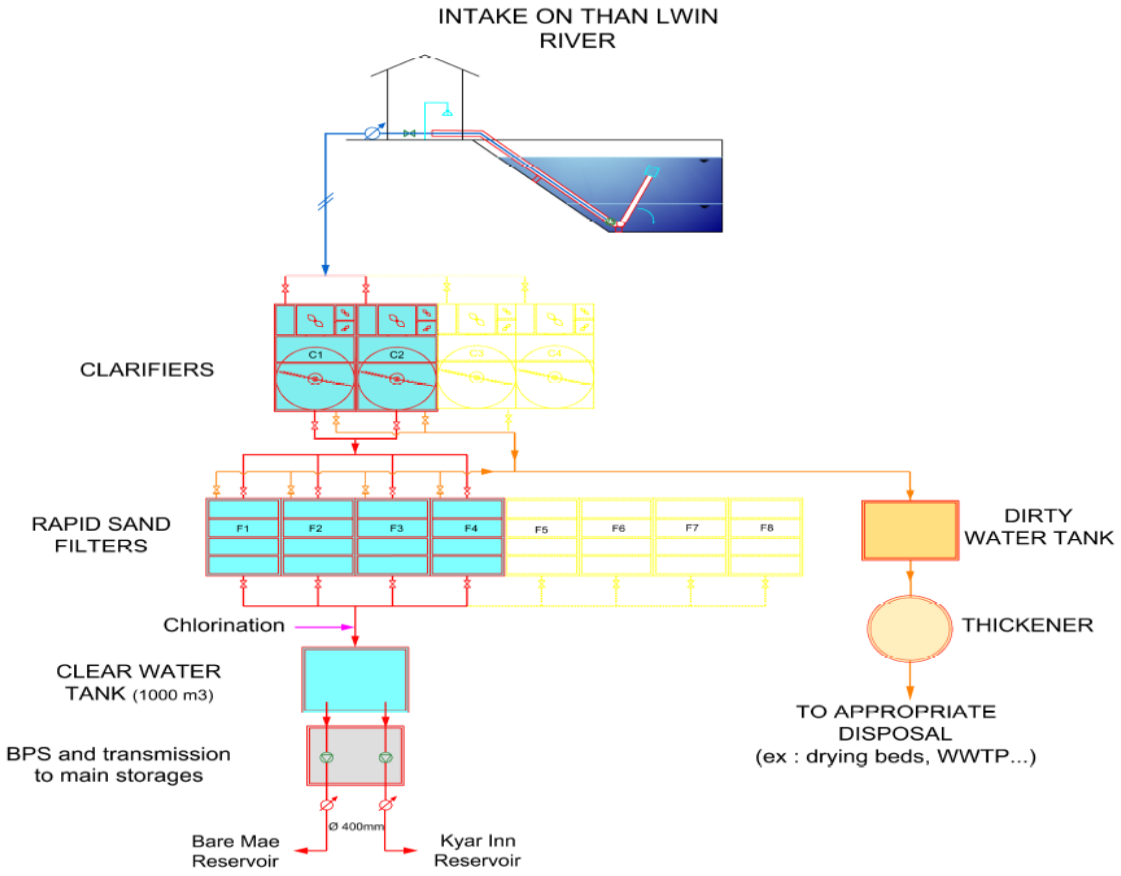
The figure below presents a general layout of the rapid sand filtration system representing the different steps of the treatment: chemical dosing, coagulation/flocculation, clarifier and rapid sand filters. This example presents 2 clarification lines and 3 filters.

Figure [12] LAYOUT OF RAPID SAND FILTRATION PROCESS



The treatment plant would have an initial capacity of 10,000 m3/day (to be financed under this project) with the possibility to expand to 18,000 m3/day in a second phase to cope with long term requirements. The system would include a permanent intake structure innovative and adapted to the site, followed by the treatment process: coagulation/flocculation/clarifier, rapid sand filtration, and disinfection as illustrated below.

Figure [13] DESCRIPTION OF HPA-AN WATER TREATMENT PLANT

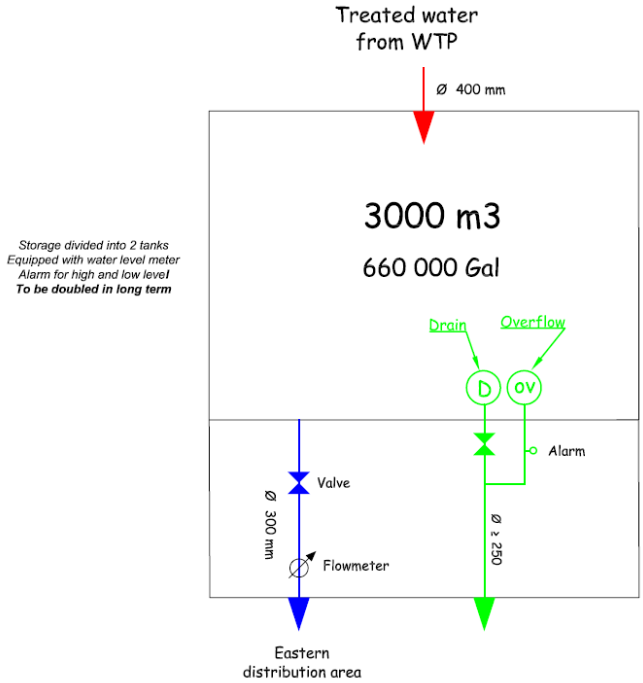


3.2.3.3 Storage

Treated water storage considers two main storages, in the eastern and western parts of the city, each with specific distribution areas.

Construction of a new reservoir for the Eastern area of the city with capacity of 3 000 m^3 (i.e. 0.66 Mgal), sufficient to cover half-day autonomy and ensure the good functioning of the system under gravity conditions and supply the peak demand. This facility is to be constructed on Kyar Inn Mountain where an area has been identified with a suitable elevation (nearly 50m) to enhance gravity flow. Site is a former earth reservoir developed by a nearby monastery and no more utilised. The figure below presents the proposed site and general scheme of the facility.

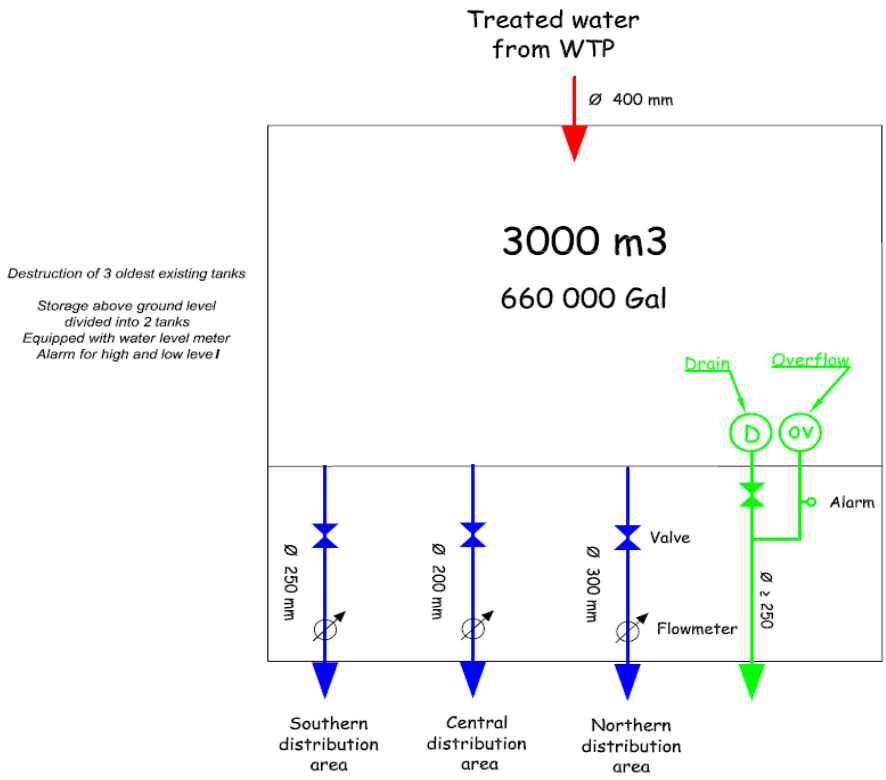
Figure [14] SITE IDENTIFICATION AND GENERAL SCHEME OF KYAR INN STORAGE



Rehabilitation and improvement of Bare Mae reservoir for the Western part of the city: Decommissioning of the 4 existing reservoirs and creation of a main infrastructure is suggested. Indeed, creation of key storage at this location with sufficient capacity (not less than 3 000m3) is highly strategic. Due to limited space, the demolition of the existing reservoirs is required to provide area for construction of the new reservoir.

Each reservoir will be equipped with overflow and drain system (for regular emptying and cleaning) as well as water level meter and sensors (low and high level). Measurements and data will be sent to the SCADA system and control room located at the treatment plant site.

Figure [15] EXISTING VIEW AND GENERAL SCHEME OF BARE MAE STORAGE



3.2.3.4 Distribution

Transmission and main distribution includes the new transmission line between water intake and treatment plant, the transmission lines between treatment plant and storages of Bare Mae and Kyar Inn Mountain (400 mm) and the main distribution lines (200-300 mm) from the two storages to the 9 wards.

Table [10] LENGTH OF TRANSMISSION AND MAIN DISTRIBUTION LINES FOR HPA-AN

	200 mm	250 mm	300 mm	400 mm	500mm	TOTAL
Length (m)	8 780	3 040	3 270	3 920	2 450	**21 460**

Internal distribution: The length of internal network to be installed by 2025 is estimated to be nearly 80km, in addition of existing distribution network (~32km) among which many pipes will need to be changed. Expected breakdown of pipe length per diameter for Hpa-An is detailed below:

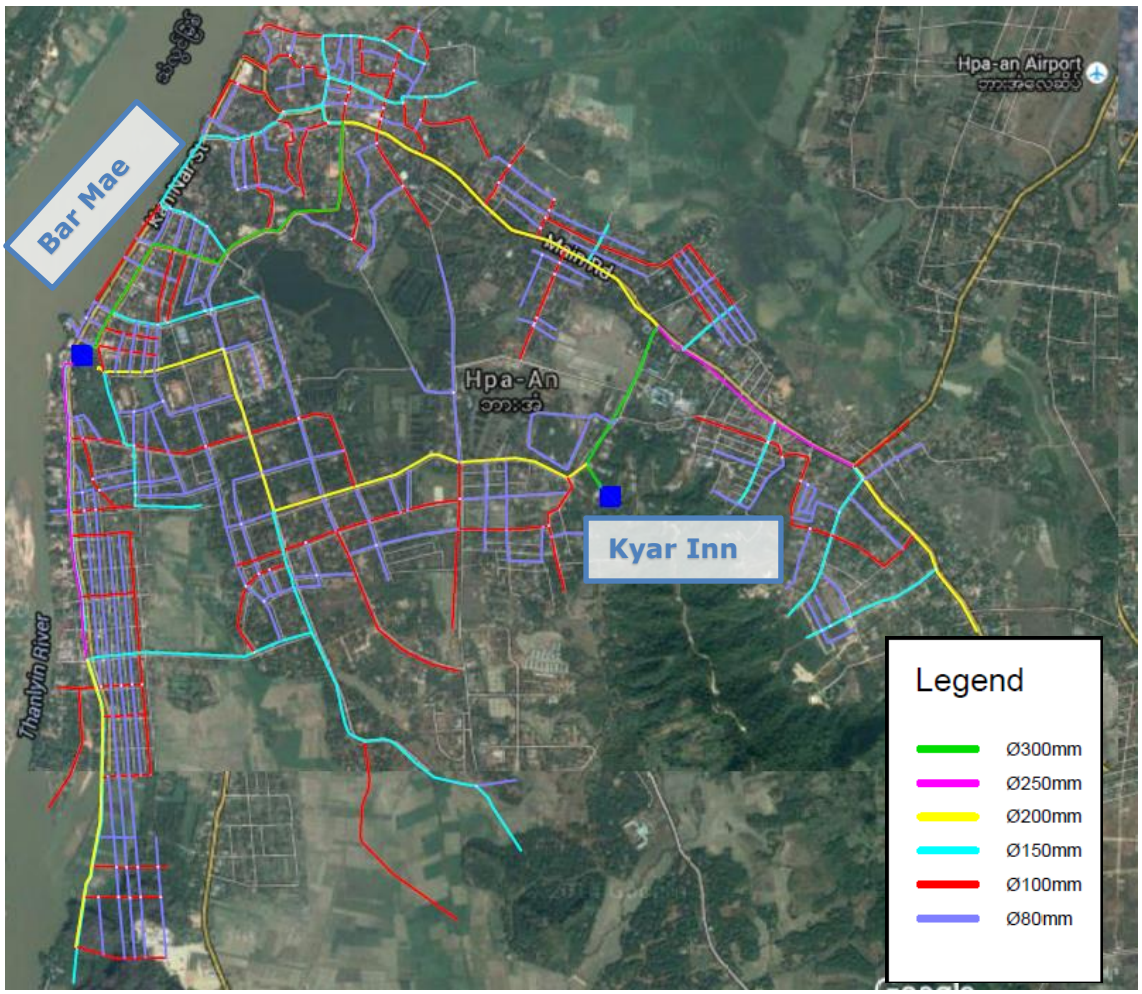
Table [11] LENGTH OF INTERNAL DISTRIBUTION LINES FOR HPA-AN

Diameter (mm)	≤ 80mm	100 mm	150 mm	TOTAL
Breakdown	45%	35%	20%	**100%**
Length (km)	35.6	27.7	15.8	**79.1**

At this stage, for durability and economic considerations, it is proposed to install ductile iron pipeline; alternatively HDPE could be considered for internal network.

Following map is a draft design of tentative future internal distribution network which shall be further detailed during the next steps of the Project:

Figure [16] TENTATIVE DRAWING OF HPA-AN FUTURE DISTRIBUTION NETWORK



The number of new connections is estimated to be nearly 12 800 by 2025 assuming that 14 000 households will be connected. New connections shall be implemented according to international standards with a defined procedure (material, maximal, length, registration…), and equipped with high quality water meters: certified class B or ideally class C.

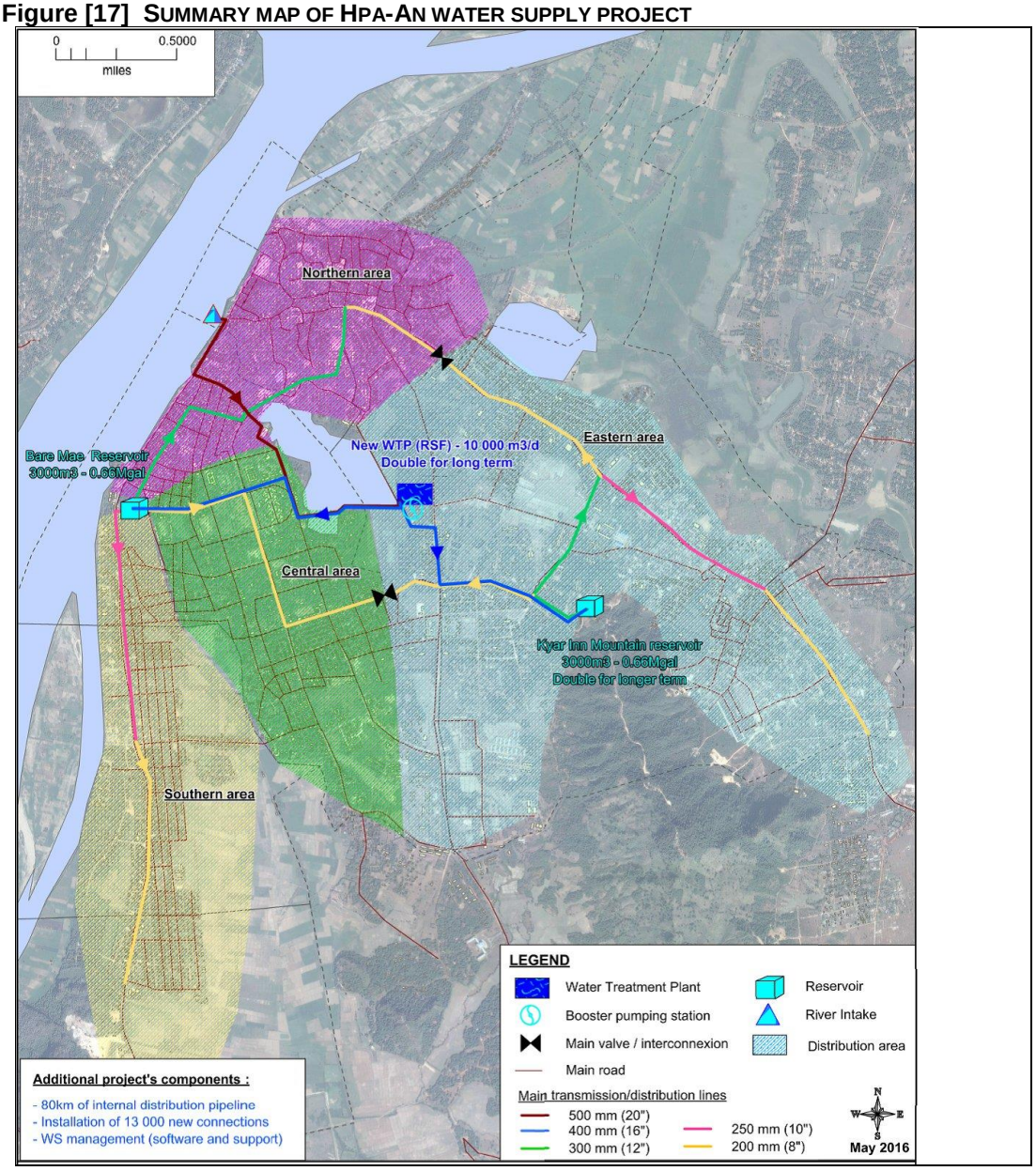
3.2.3.5 NRW Strategy

The project includes a full strategy to fight, control and reduce losses, from a macro scale to a household level, according to the objectives presented above. It is based on (i) quantification of losses, (ii) localisation of leakages and (iii) asset management plan.

3.2.3.6 Project Summary

The proposed water supply project and its components is summarized in the following summary map:

Figure [17] SUMMARY MAP OF HPA-AN WATER SUPPLY PROJECT



3.2.4 PROPOSED PROJECT FOR MYAWADDY

Water supply for Myawaddy covers the same sub-components as those described for Hpa-An, with required size and design adjustments. The proposed project includes a new water source from the Moei River aquifer, a treatment plant and a distribution system. This system will substitute existing public water supply using tubewells.

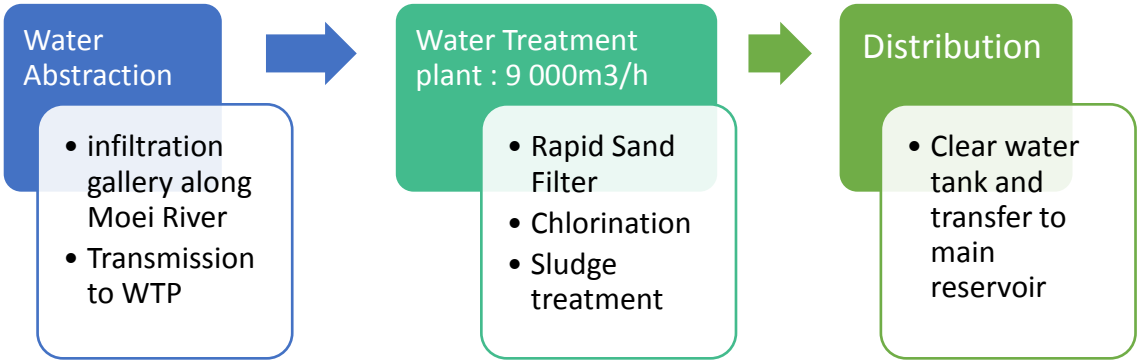
3.2.4.1 Water Intake

It is proposed an intake structure using infiltration gallery to pump water from the sub-surface flow of the Moei River and benefit from the bank filtration. A geological survey will be required to characterize the alluvial aquifer in order to design and size the intake structure. It consists in the installation of horizontal drains laid below the water table, surrounded by gravels to improve the flow. Number and size of drains depend on the soil characteristics and yields. Collected water from

the drains is taken to a collection well and then pumped to the water treatment plant through a transmission line equipped with flowmeter to control pumps and to display real-time information at the WTP site.

3.2.4.2 Treatment Plant

It is proposed the construction of a new water treatment plant with a nominal capacity of 9 000m^3/d (15h/day operation). Capacity has been set according to water demand for the project area (average daily need).



The proposed treatment process includes:

Clarification: Thanks to the natural filtration process at intake, it is assumed that clarification would not be necessary.

Filtration step consisting in a battery of 3 open type gravity sand filters, with the associated backwash, air scour and control facilities. Same design as for Hpa-An applies. An overall filtration surface of nearly 75m² is required (3 x 25m²).

Because of the expected very low turbidity of the raw water, it is considered that coagulation/flocculation step would not be required, hence limiting the use of chemicals.

Chlorination for disinfection will be performed into a clear water tank prior to distribution.

Treated water will be stored on site (1 000m^3 storage tank) and supplied through transmission pipe to the main water storage.

The new facility will also include operation building, electricity building, chlorination plant, air production. The amount of sludge produced is expected to be very limited due to the low turbidity of alluvial aquifer raw water. The proposed process is compact and able to treat a large quantity of water in a limited space. The process diagram below shows the global system proposed.

Figure [18] DESCRIPTION OF MYAWADDY WATER TREATMENT PLANT

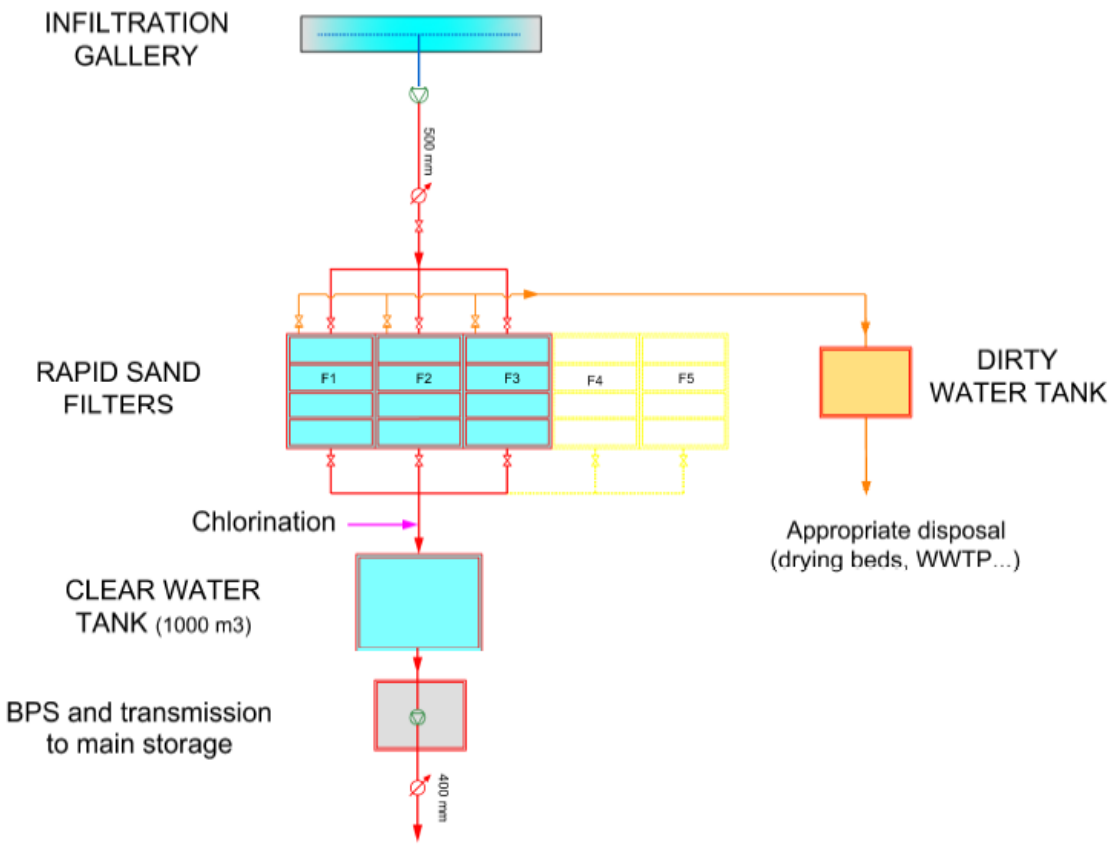


Figure [19] VIEW OF THE WATER TREATMENT PLANT SITE

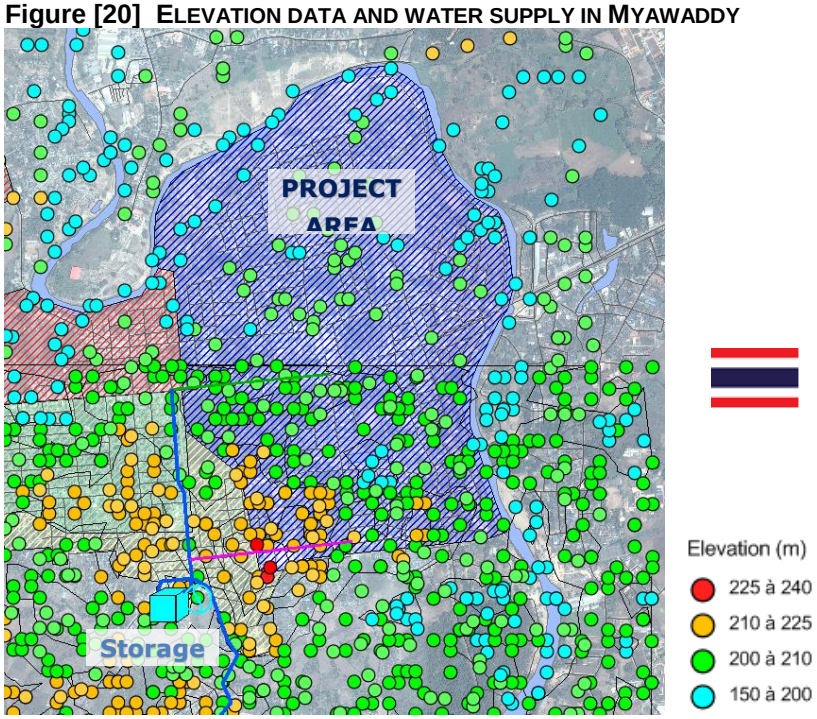
Design and area size include possibilities for extension on the long term from 9 000 m^3/d to 15 000 m^3/d (from 600 m^3/h to 1 000 m^3/h) by the addition of two more filters.

3.2.4.3 Storage

It is proposed the construction of a new above ground level reservoir within the city area with capacity of 4 500 m^3 (i.e. 1Mgal), which represents half of the daily production. According to available elevation data, most of the city can be supplied by gravity from the selected reservoir site. Only limited areas around the reservoir cannot be supplied with a suitable pressure and would require a booster pumping

station with pressure regulation. At this stage of the study, it is considered that a booster pumping station will be used and sized for the entire area to provide a sufficient pressure throughout the distribution system. The following figure details elevation data highlighting the problematic areas (yellow= insufficient pressure and red = no supply under gravity conditions).

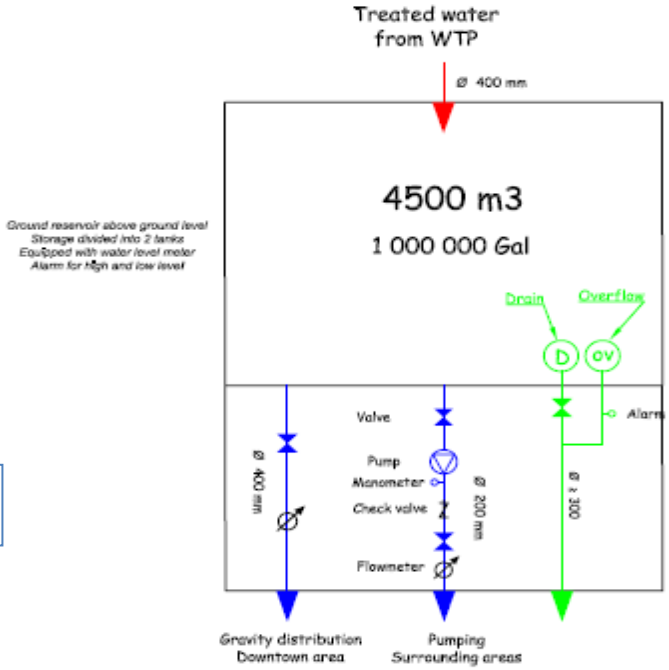
Figure [20] ELEVATION DATA AND WATER SUPPLY IN MYAWADDY



The reservoir will be equipped with overflow and drain system (for regular emptying and cleaning) as well as water level meter and sensors (low and high level). Measurements and data will be sent to the SCADA system and control room located at the treatment plant site.

Figure [21] SITE IDENTIFICATION AND GENERAL SCHEME OF MYAWADDY MAIN STORAGE

Location (0.5 acre) and view of existing site



3.2.4.4 DISTRIBUTION

Transmission and main distribution include the new transmission line between water intake and treatment plant, the transmission lines between treatment plant and storages of Bare Mae and Kyar Inn Mountain (400 mm), the main distribution lines (200-300 mm) from the two storages to the city wards.

Table [12] LENGTH OF TRANSMISSION AND MAIN DISTRIBUTION LINES FOR MYAWADDY

	200 mm	250 mm	300 mm	400 mm	500mm	TOTAL
Length (m)	800	750	780	6 550	100	**8 980**

In the absence of any existing internal distribution system, a fully new distribution network will be developed, sized on the population forecasts and future water demand, with the objective to cover 70% of the population by 2025 and 95% by 2040 (long term). Consequently, the length of internal network required by 2025 is estimated to be nearly 60km

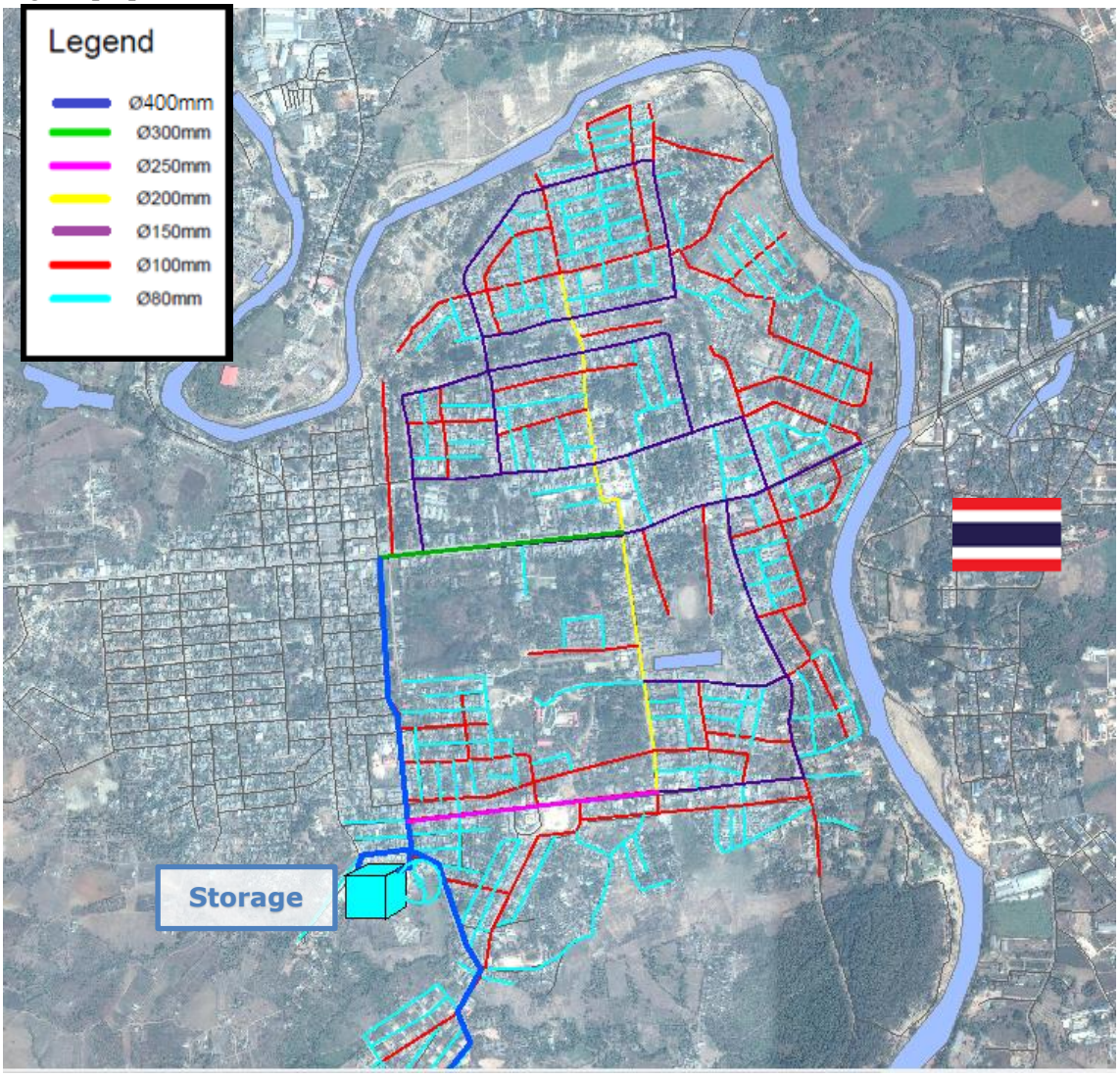
Table [13] LENGTH OF INTERNAL DISTRIBUTION LINES FOR MYAWADDY

Diameter (mm)	≤ 80mm	100 mm	150 mm	200 mm	TOTAL
Breakdown	40%	35%	20%	5%	**100%**
Length (km)	23.8	20.8	11.9	3.0	**59.5**

At this stage, for durability and economic considerations, it is proposed to install ductile iron pipeline; alternatively HDPE could be considered for internal network.

Following map is a draft design of tentative future internal distribution network which shall be further detailed during the next steps of the Project:

Figure [22] TENTATIVE DRAWING OF MYAWADDY FUTURE DISTRIBUTION NETWORK



The number of new connections is estimated to be nearly 14 900. New connections shall be implemented according to international standards with a defined procedure (material, maximal, length, registration…), and equipped with high quality water meters: certified class B or ideally class C.

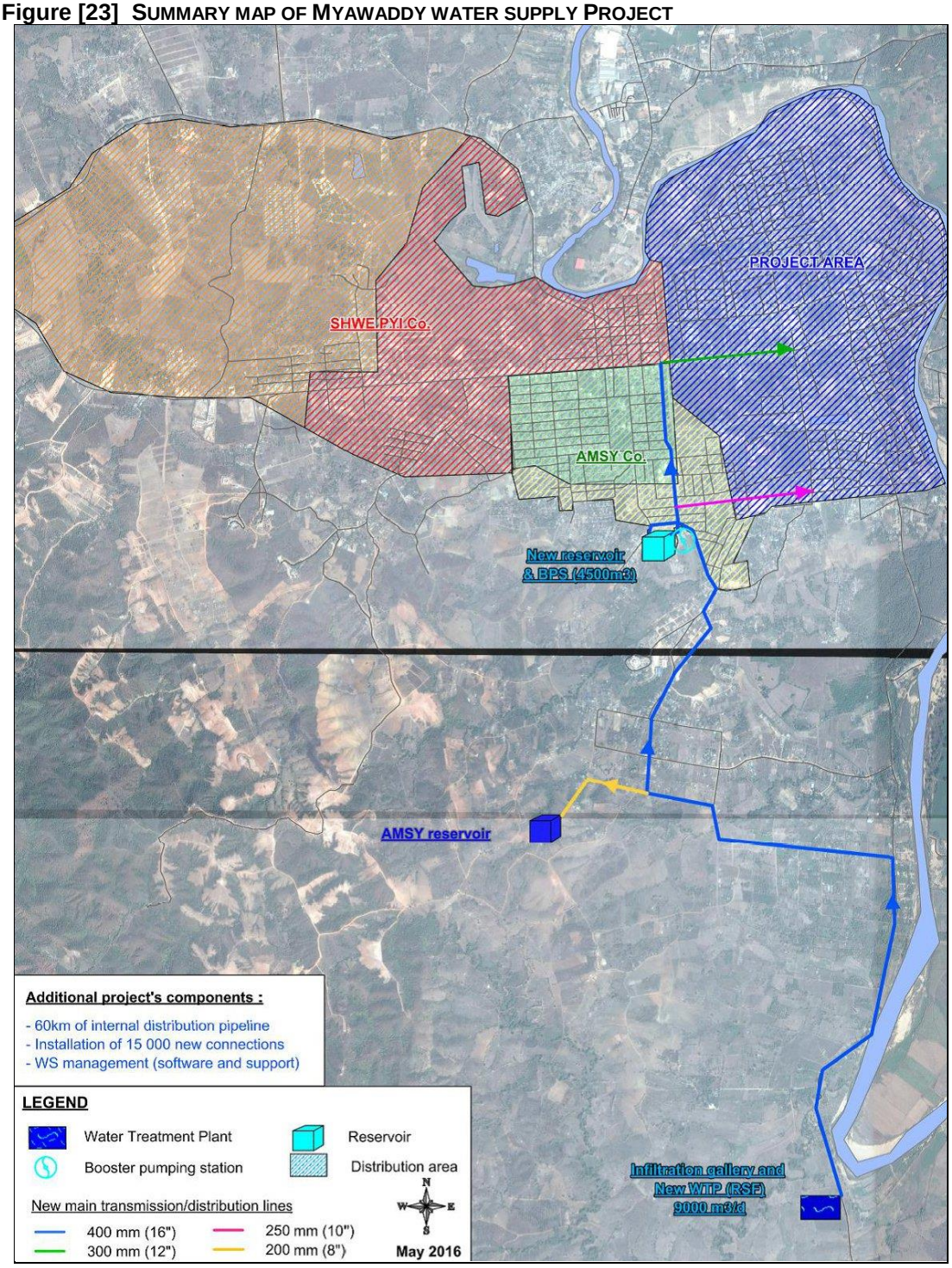
3.2.4.5 NRW Strategy

Same approach as Hpa-An is proposed in Myawaddy for NRW strategy to control and reduce losses, from a macro scale to a household level

3.2.4.6 Project Summary

The proposed water supply project and its components is summarized in the following summary map.

Figure [23] SUMMARY MAP OF MYAWADDY WATER SUPPLY PROJECT



3.3 Associated Facilities

Two water supply projects are currently under consideration in Hpa-An:

- JICA financed project: this project is part of an overall JICA grant to the Union of Myanmar covering several secondary towns.
- Water Supply Project for the Hpa An Industrial Zone (IZ) financed by the Union Government.

Regarding the Industrial Zone WS project, Kayin State Government confirmed during Interim Meeting his will to keep this project totally independent from the city water supply.

The other JICA project considers the construction of a new water intake in the Thanlwin River and a WTP slow sand filter type to supply water to the existing Bar Mae reservoirs.

The PPTA Consultant decided, given the relative small size of the JICA project, to ensure that the project proposed as part of the PPTA is a stand-alone project and not linked to the former. Nevertheless, a brief technical review of these 2 projects is provided in the FSR report. In both cases, the PPTA Consultant considers that the use of slow sand filters (SSFs), even with upstream pre-treatment facilities, is unsuited to the high levels of turbidity measured on the Thanlwin River and will most probably not be in position to provide high water quality to domestic and commercial or industrial customers.

No associated facilities or projects exist in Myawaddy.

4 BASELINE SITUATION

4.1 Topography, Regional Geology, Soils and Natural Hazards

4.1.1 REGIONAL GEOLOGY, SOILS AND SEISMICITY

Kayin State is a mountainous region with the Dawna Range running along the state in a NNW-SSE direction and the southern end of the Karen Hills in the northwest as shown in Figure [24] .

Hpa-An is the capital city of Kayin State located on the eastern bank of the Thanlwin river. The city is expected to grow as a logistics centre along the EWEC to support cross-border trade. The city also attracts tourists by its beautiful scenery of limestone hills and Buddhist heritages including pagodas and monasteries. Myawaddy is a border city located at the border with Thailand. It is separated from the Thai border town of Mae Sot by the Thaungyin (Moei) River, and the town is a major trading point between Myanmar and Thailand. The main rock types found in Kayin state are Soft Rocks, and Hpa-An area has soft rocks such as sandstone, shale, limestone and conglomerate. The rock types which found around the area of Myawaddy are hard rocks composed with limestone and dolomite, schist and granitic rock.

Regarding the soil type, red-brown forest soils, together with mountain red brown forest soils, primitive crushed stone soils are found in Kayin State. Lateritic soils and laterites are found at altitude below 100m above sea-level.

According to the seismic zone map of Myanmar shown in Figure [25] , the areas of the proposed projects in Hpa-An and Myawaddy are located in the low zone with less than 0.11 pga (peak ground acceleration).

Figure [24] GEOLOGY OF MYANMAR

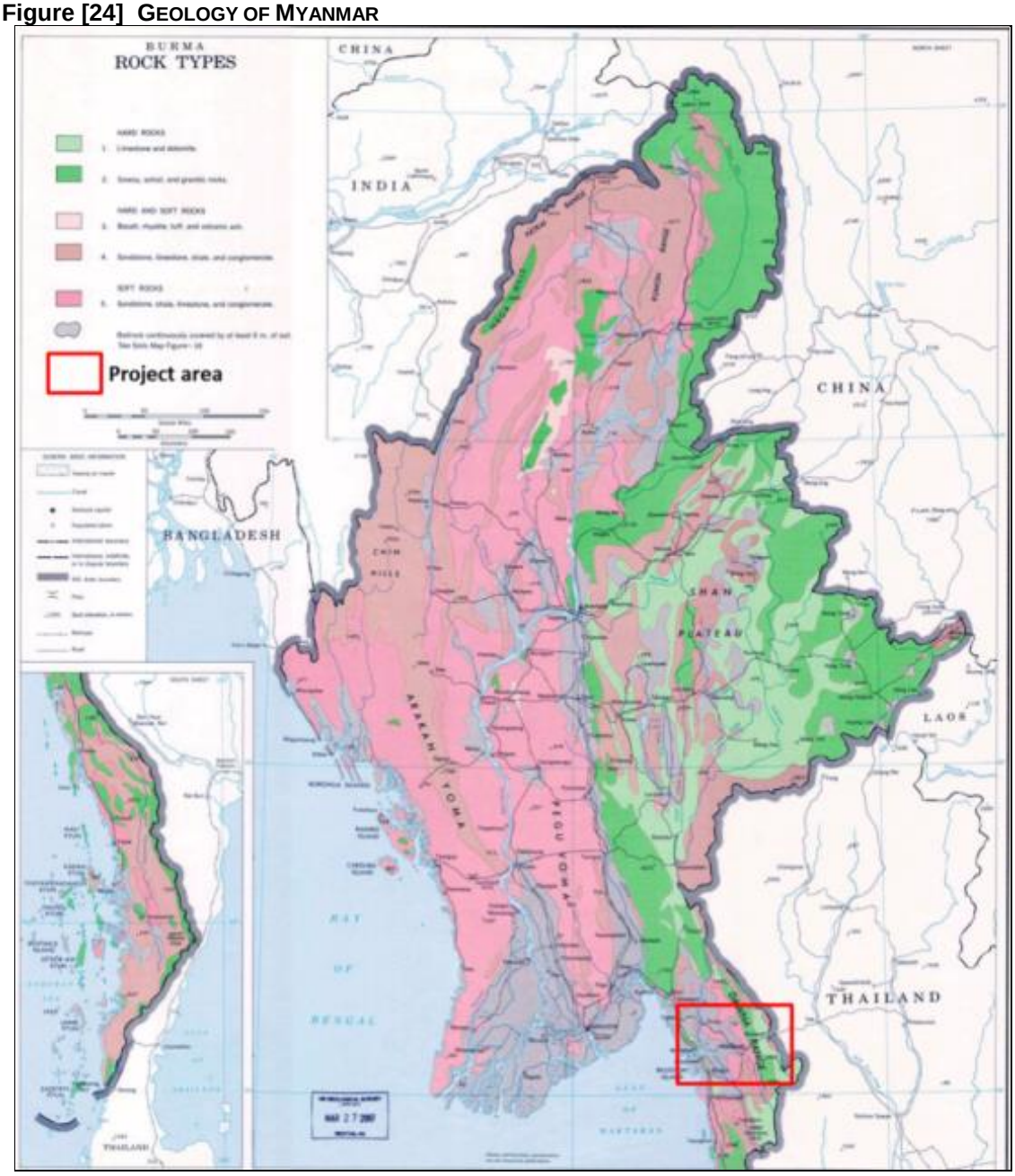
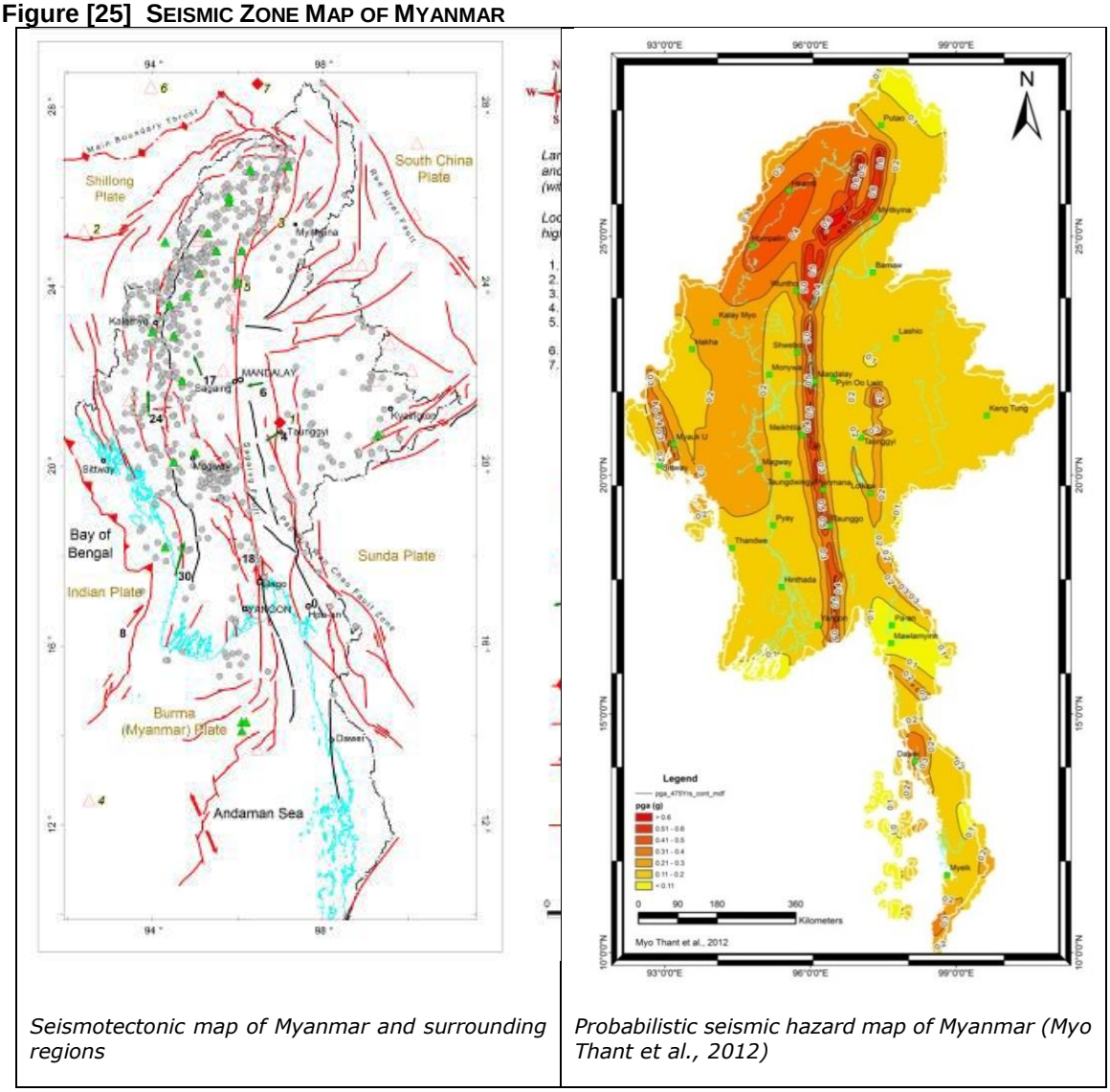


Figure [25] SEISMIC ZONE MAP OF MYANMAR



Seismotectonic map of Myanmar and surrounding regions

Probabilistic seismic hazard map of Myanmar (Myo Thant et al., 2012)

This means that the risk related to earthquake is considered as moderate and has been or will be fully integrated into the design standards applicable to the proposed facilities.

4.2 Climate

In the Andaman Sea, four seasons are distinguished:

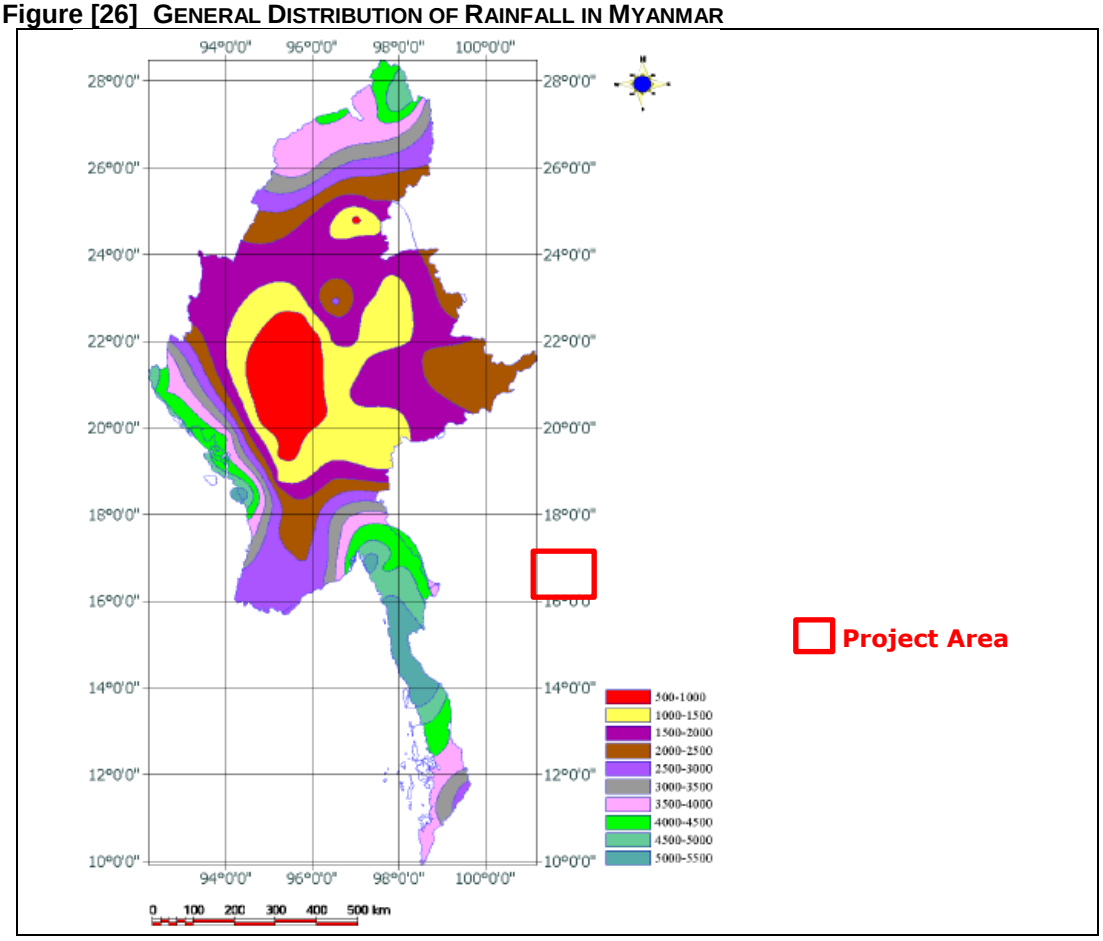
- The North-east Monsoon, from December to March, which brings fine cool weather and very little rainfall to the area.
- The Pre-monsoon transition period, from April to May, characterised by relatively weak and variable winds (prevailing land and sea breezes) and hot temperatures (37°C on the coast).
- The South-west Monsoon, from June to September, characterised by dense nebulosity, nearly daily drizzle interspersed with squalls, thunderstorms and heavy torrential rains along the East coast of the Andaman Sea.
- The Post-Monsoon Transition, from October to November, which is relatively similar to the Pre-monsoon transition with cooler temperatures.

Hpa-An and Myawaddy climatic conditions reflect these general characteristics. Regarding Myawaddy meteorological data, only rainfall data is available from 2006 to 2015.

4.2.1 RAINFALL

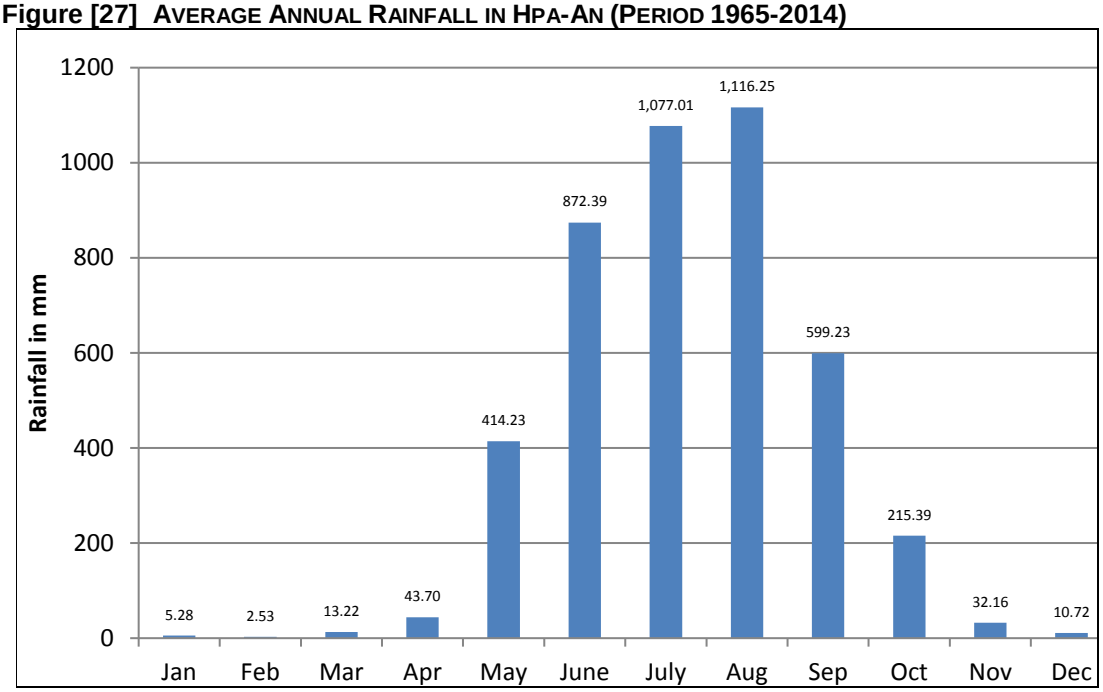
As presented on following figure, Hpa-An is located within the wettest part of Myanmar, receiving in average between 4500-5000 mm of rain every year.

Figure [26] GENERAL DISTRIBUTION OF RAINFALL IN MYANMAR



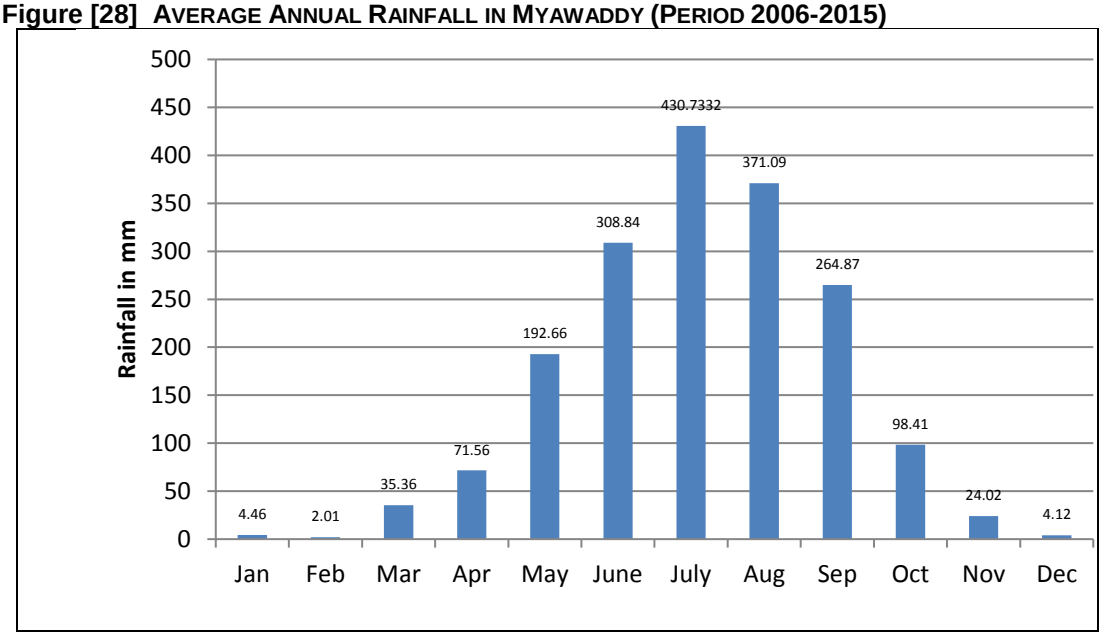
Annual rainfall average over the period 1965-2014 (50 years) in Hpa-An is provided in Figure [27] and the annual rainfall average over the period 2006-2015 (10 years) in Myawaddy is provided in Figure [28] . Average annual rainfall over the 50 years period in Hpa-An is 4 402 mm while the average annual rainfall over the 10 years period in Myawaddy is 1808 mm. About 83% (in Hpa-An) and 76% (in Myawaddy) of the annual rainfall falls from June to September, the 4 wettest months of the South-west monsoon.

Figure [27] AVERAGE ANNUAL RAINFALL IN HPA-AN (PERIOD 1965-2014)



Source: PPTA Consultant, 2015, data from Hpa-An hydro-meteorological station

Figure [28] AVERAGE ANNUAL RAINFALL IN MYAWADDY (PERIOD 2006-2015)

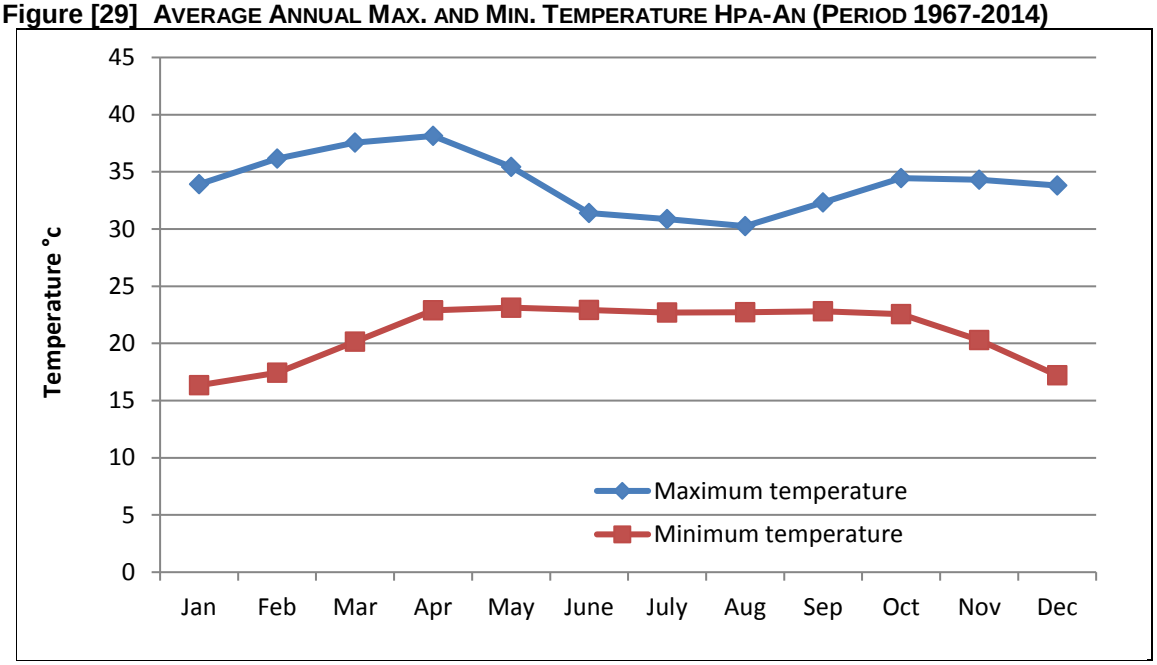


Source: PPTA Consultant, 2015, data from Myawaddy hydro-meteorological station

4.2.2 TEMPERATURE

Temperature in Hpa-An remains high all along the year as presented in following figure. February is the most contrasted month with about 19°C amplitude between maximum and minimum temperature while August presents the lowest difference with about 7.5°C. Average minimum monthly temperature never drops below 16°C.

Figure [29] AVERAGE ANNUAL MAX. AND MIN. TEMPERATURE HPA-AN (PERIOD 1967-2014)



Source: PPTA Consultant, 2015, data from Hpa-An hydro-meteorological station

4.2.3 WIND

In Hpa-An, the wind is predominantly from SE during the wet season as shown on Table [14]. In late afternoon, the wind speed is higher except January, September and December. The average maximum wind speed occurred in afternoon of April with 3.58 m/s.

Table [14] AVERAGE WIND SPEED AND DIRECTION IN HPA-AN (2011-2015)

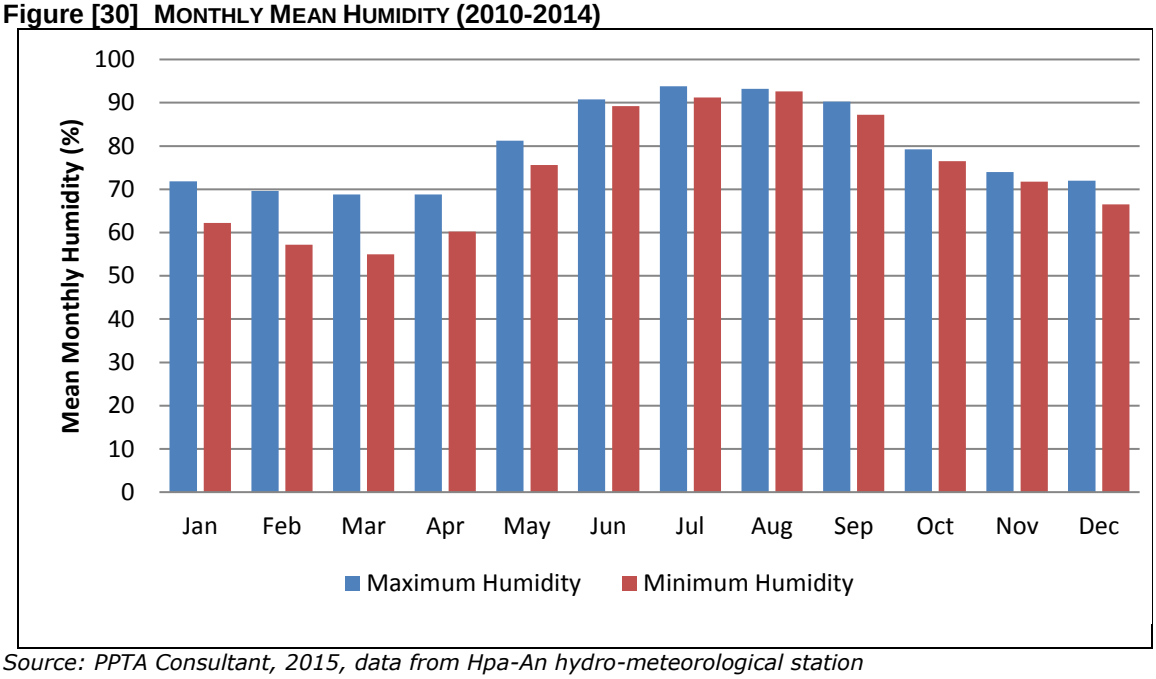
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Speed (mph) at 09:30	3.2	2.8	3.2	2.2	3.2	4.6	4.4	4.6	4.5	3	2	5.75
Speed (mph) at 18:30	1.8	3.2	5.4	8	5.4	5.6	4.8	6	4	3.75	2.25	2.5
Direction (Average)	NE	NE	SW	SW	SW	SE	SE	SE	SE	SE	NW	NE

Source: PPTA Consultant, 2015, data from Hpa-An hydro-meteorological station

4.2.4 HUMIDITY

Hpa-An has quite high humidity throughout the year by observing the 5 years data from 2011 to 2015, as shown on **Error! Reference source not found.**. It was o bserved that the minimum average humidity was 55% in March and the maximum humidity reaches 93.8% in July.

Figure [30] MONTHLY MEAN HUMIDITY (2010-2014)



Source: PPTA Consultant, 2015, data from Hpa-An hydro-meteorological station

4.3 Climate Change in Myanmar

Myanmar signed the UNFCC Convention on 11/06/1992 and ratified the convention on 25/11/1994. The country also ratified the Kyoto Protocol in 2003. Myanmar has recently submitted its Initial National Communication (INC) to UNFCCC. National Adaptation Programs of Actions (NAPA) have been prepared with the financial support of GEF/UNEP and are expected to be finalized in 2014.

4.3.1 THE NATIONAL TRENDS

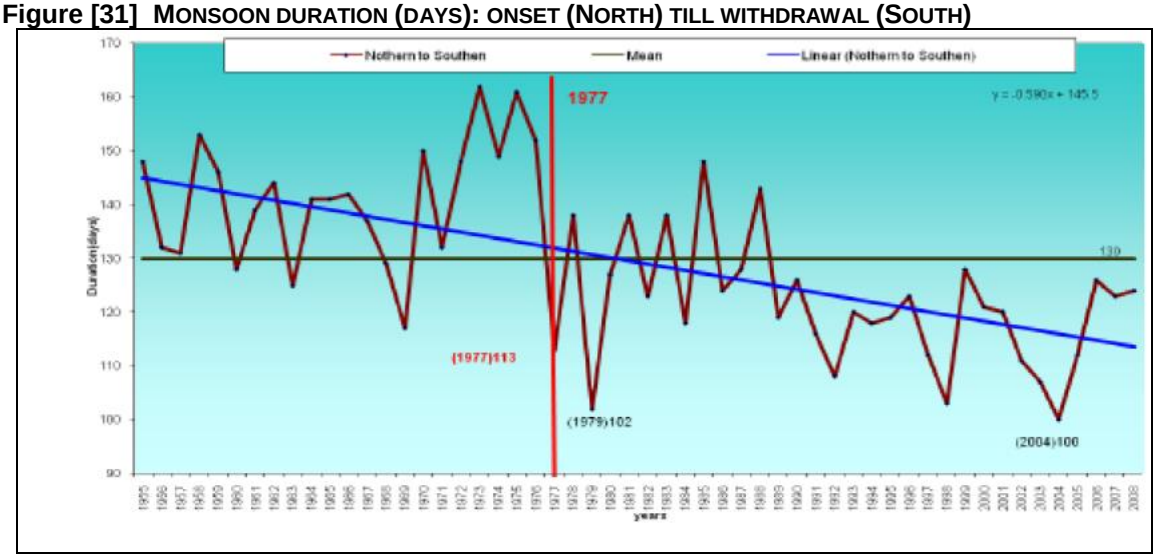
Due to its location in SE Asia and the length of its coastline, Climate Change (CC) is certainly a major concern for Myanmar. On the basis of the latest Climate Risk Index (period 1993-2012) ranking system (Global Climate Risk Index 2014, Germanwatch), Myanmar is reported as one of the most threatened country by climate change. The PPTA Consultant considers this ranking must be interpreted carefully as it is mainly based on the losses in assets and lives during major extreme events related to climate change (typhoons and floods). The high index attributed to Myanmar results in fact, for 95% of its value, from only one event: Typhoon Nargis which killed almost 150,000 peoples in 2008. If we except this unique event, Myanmar appear, for 2014, not more threaten than other neighboring countries by CC.

However, Myanmar is facing progressive climate changes which threat particularly water resources and food security: Change in rainfall distribution and quantity and raise in temperature.

Figure [31] depicts the observed change in southwest monsoon duration from 1955 to 2008. From the onset of the monsoon in Northern Myanmar until its withdrawal from the South, the monsoon duration over the last 50 years shows a significant reduction from 140-150 days in the mid-fifties to less than 120 days in 2008. Late arrival of the rain and early ending where particularly evident since the year 1977, when the duration of the rainy season dropped below 130 days, a critical limit for most cropping cycles.

According to regional information, the southwest monsoon duration has been shortened by about three weeks in northern Myanmar and one week in other parts of the country when compared to the situation observed in the fifties.

Figure [31] MONSOON DURATION (DAYS): ONSET (NORTH) TILL WITHDRAWAL (SOUTH)



Source: Some observed Climate Change Impacts in Myanmar, Dr Thin Nai Tham, Department of Meteorology and Hydrology, 2010.

Available information on climate change forecasts in Myanmar for period 2001 to 2020 anticipated:

- Slight warming of +0.5°c from June to November (rainy season) is anticipated in the whole country. During the dry season, warming will be more significant (+ 0.7 to +1.2°c) over the country, except in the delta area where temperature increase should not exceed +0.6°c.
- Only 5% increase of precipitation is forecasted for the period March-November in the whole country. During the dry season, which contributes to only 5-10% to the annual rainfall, the deficit may reach 45%, except in the delta region where dry season rain should remain normal.

4.3.2 THE SUB-NATIONAL TRENDS

Limited information has been collected so far by the PPTA Consultant at a local level. Observed temperature changes have affected some (though not all) regions to a significant degree thus far. Compared to the WMO's 1961–1990 average data, nine of the 17 state regions have observed an increase in annual temperature, two have seen decreases, and six have observed no appreciable change. Observed changes in Kayin and Mon States are provided in Table [15] presenting an analysis of records for the period 1951 to 2007 which identifies a more significant increase of temperature in Kayin State (+0.32 °C per decade) than in Mon state (+0.14°C per decade). Similarly, changes in rainfall over the same period show a decrease of 23.6 mm per decade for Kayin State while rainfall in Mon State increased by 71.57 mm per decade.

These figures have to be put into perspective with observations made in the other states of the country. Temperature increase rate in Kayin State is the highest observed in Myanmar, just followed by Lower Sagaing (0.30°c increase per decade) and Mandalay region (0.20°c increase per decade). For rainfall changes, the rainfall increase observed in Mon State is second after Upper Sagaing Region

(+215.2 mm per decade) and just before Kachin State (+64.71 mm per decade). Like Kayin State, two other places observed rainfall decrease over the observation period: Bago Region (-81.08 mm decrease per decade) and Lower Sagaing Region (-17.4 mm per decade).

Table [15] TEMPERATURE AND RAINFALL CHANGES IN KAYIN AND MON STATES

State	Station	Mean Annual Temperature (°c)	Temp. Increase per Decade (°c)	Mean Annual Rainfall (mm)	Rainfall Change per Decade (mm)
Kayin	Hpa An	27.2	0.32	4 346	-23.6
Mon	Mawlamyine	27.1	0.14	4 816	+71.57

MOECAF, 2012, Myanmar Initial National Communication to UNFCCC

4.3.3 OBSERVED TRENDS IN HPA-AN

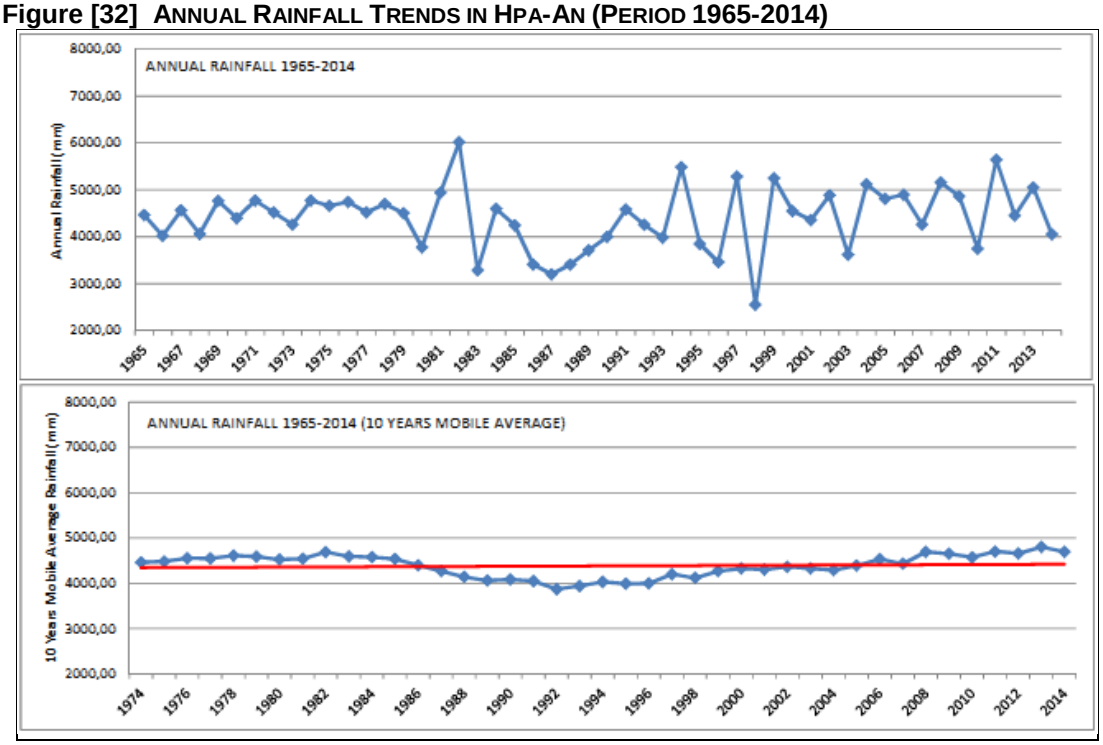
Rainfall Historical Trends

In addition to the general assessment of CC from GCM, the PPTA Consultant carried out an analysis of Hpa An hydro-meteorological station monthly data, available for the period 1965-2014 (50 years), in order (i) to confirm or infirm the general trends from the GCM and (ii) provide more specific conclusions for the Hpa-An area where the project is located. The trends over the 50 years period is identified based on the evolution of the 10 years mobile average: each point on the graph represents the average of the 10 precedent years; this approach provides a better clarity of the general trend through eliminating individual fluctuating values of each year, which reflects better the long term tendency. Figure [32] presents annual rainfall along the 50 years observation period (upper) and the same analysis but based on 10 years mobile average (lower). The 10 years mobile average does not display any particular trend except stability over the 50 years period.

Figure [33] presents a more detailed analysis for the 6 raining months (May to October) over the observation period and based on the 10 years mobile average. In red, the resulting linear trend curve. The results lead to the following observations:

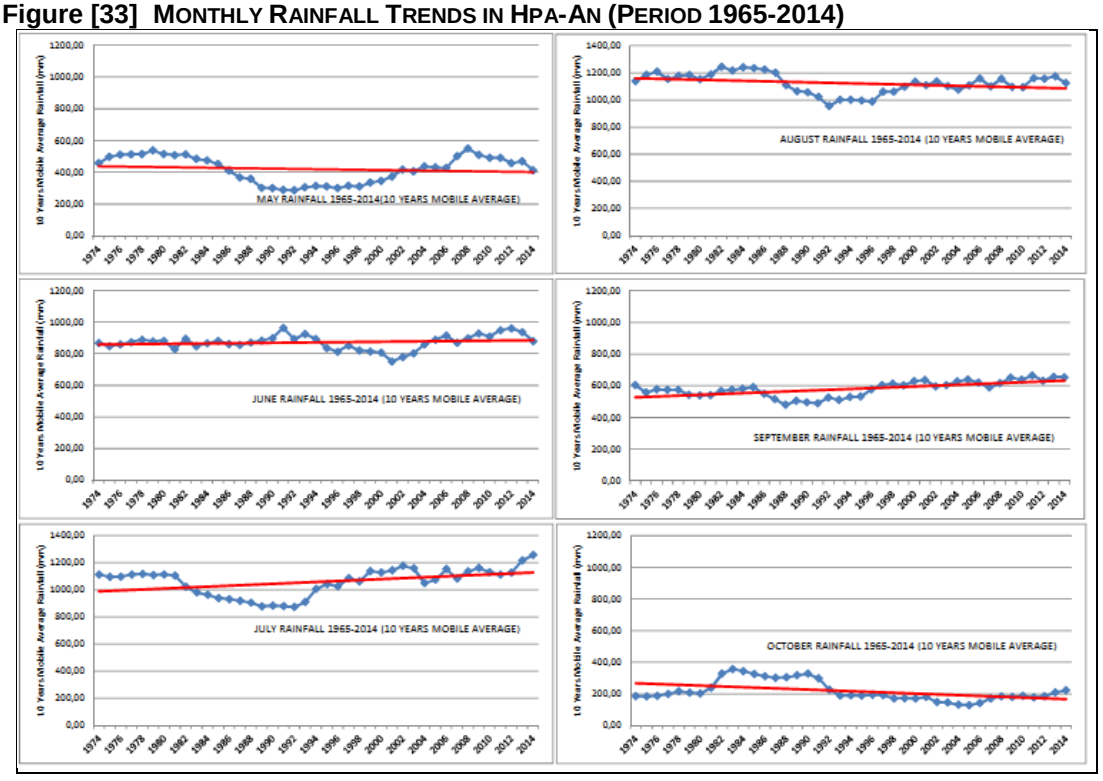
- Except July presenting a significant raising trend (about 70 mm over the whole period, or 14 mm/decade) all the other months show limited trends either raising or decreasing;
- Except August, the wettest months of the rainy season show a slight raising trend while May and October show decreasing trend.

Figure [32] ANNUAL RAINFALL TRENDS IN HPA-AN (PERIOD 1965-2014)



Source: PPTA Consultant, 2015.

Figure [33] MONTHLY RAINFALL TRENDS IN HPA-AN (PERIOD 1965-2014)

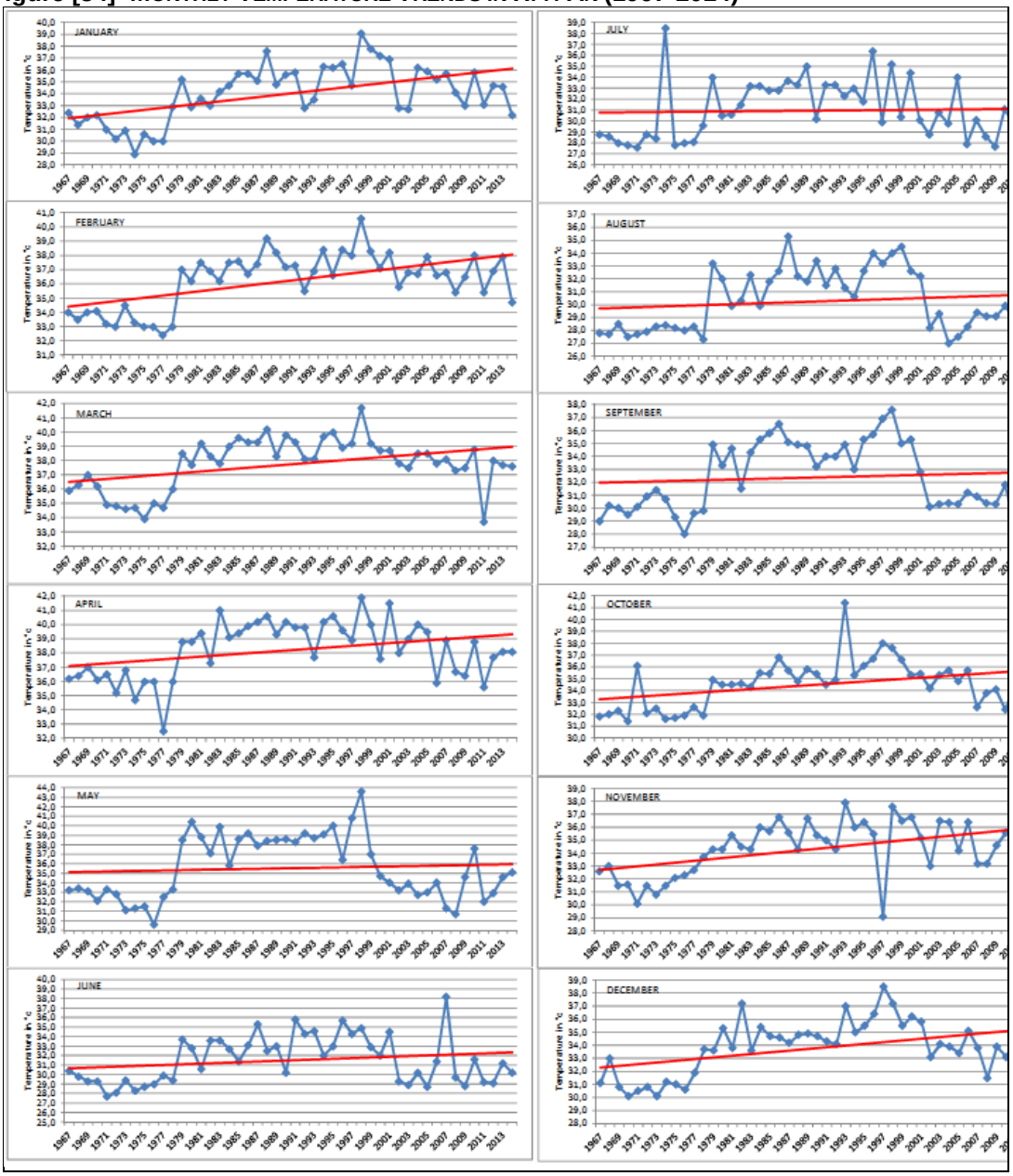


Source: PPTA Consultant, 2015.

Temperature Trends

Data on minimum and maximum monthly temperature observed in Hpa-An meteorological station were collected for the period 1967-2014 (48 years). Analysis performed on maximum monthly temperature is depicted in figure below showing the monthly maximum temperature distribution over the period and the linear trend curve (in red).

Figure [34] MONTHLY TEMPERATURE TRENDS IN HPA-AN (1967-2014)



Source: PPTA Consultant, 2015.

- All the months of the year show increasing maximum temperature trends;
- A very significant increase of temperature during the dry season: +3°C for October, November and December, +4°C for January and February, about +2°C for March and April;

- From May to September, corresponding to the wet season, temperature still increases but more modestly by about +1°C ;

The same analysis performed on the maximum annual average temperature shows an increase of about 2.2°C over the 48 years or about 0.46°C increase per decade. This value is two times higher than what is observed in Mawlamyine and significantly higher than the value of 0.32°C of increase by decade presented by MONREC as an average for the Kayin State.

Sea Level Trends

A rise in global sea levels has been observed in recent decades, and with continued global warming temperatures, the IPCC predicts this trend to continue throughout the century. There are two primary factors affecting sea level rise relating to global warming:

- First is thermal expansion: It is estimated that approximately 60 % of the global heat energy increases are stored in the upper ocean and 30 % in ocean waters at greater depths, resulting in total oceanic absorption of 90 % of heat energy increases. As ocean waters absorb heat energy, they naturally expand, contributing to rising ocean levels.
- The second primary factor is melting ice sheets and glaciers: As the Antarctic and Greenland ice sheets melt, runoff from melting glaciers empties into the world's oceans, resulting in sea level rise.
- The latest IPCC report also provides an assessment that it is very likely that mean sea levels rose worldwide by approximately 1.7 mm per year since 1901 (through 2010). Furthermore, the rate of rise has increased in recent decades, with an average of 2.0 mm per year since 1971 and 3.2 mm per year since 1993.

Table [16] IPCC PROJECTIONS: FUTURE TEMPERATURE AND SEA LEVEL CHANGES

		2046–2065		2081–2100	
	Scenario	Mean	*Likely* range[c]	Mean	*Likely* range[c]
Global Mean Surface Temperature Change (°C)[a]	RCP2.6	1.0	0.4 to 1.6	1.0	0.3 to 1.7
	RCP4.5	1.4	0.9 to 2.0	1.8	1.1 to 2.6
	RCP6.0	1.3	0.8 to 1.8	2.2	1.4 to 3.1
	RCP8.5	2.0	1.4 to 2.6	3.7	2.6 to 4.8
	Scenario	Mean	*Likely* range[d]	Mean	*Likely* range[d]
Global Mean Sea Level Rise (m)[b]	RCP2.6	0.24	0.17 to 0.32	0.40	0.26 to 0.55
	RCP4.5	0.26	0.19 to 0.33	0.47	0.32 to 0.63
	RCP6.0	0.25	0.18 to 0.32	0.48	0.33 to 0.63
	RCP8.5	0.30	0.22 to 0.38	0.63	0.45 to 0.82

IPCC, Climate Change 2013: The Physical Science Basis, 25.

- IPCC Projections for future temperatures and sea level rise are provided in table above according to various scenarios of CC. In order to be on the safe side, it is considered that a level rise of 0.5 m by 2065 and 1.0 m by 2100 is reasonable for planning projects in the coastal zone of Myanmar, including Mawlamyine and Hpa-An, both located along the lower reach of the Thanlwin river. This value does not integrate surge raise created by low pressure tropical storms (typhoons) which already occur but are anticipated to become more

frequent in the future. However, both cities are not facing directly the sea and are protected from such phenomenon, particularly for Hpa-An reasonably far from the estuary.

Conclusions

Both temperature and rainfall show increasing trends in Hpa-An along the last 50 years of observations, in line with the MONREC analysis for the Kayin State.

Annual rainfall didn't change significantly over the last 50 years. Among the wet season months (May to October), only the months of June, July and September show an increasing trend, with July showing the highest raise during the 50 years period (about 120 mm, or 24 mm per decade).

Temperature rose much more significantly during the same period. The average annual maximum temperature rose by 2,2°C over the last 48 years, or an increase of almost 0,5°C per decade, a value significantly higher than what is considered as an average increase in the Kayin State (0.32°C per decade). July and February increased by about 4°C during the period while the other dry season months increased by 2 to 3 °C. Wet season months increase was only about 1°C during the same period.

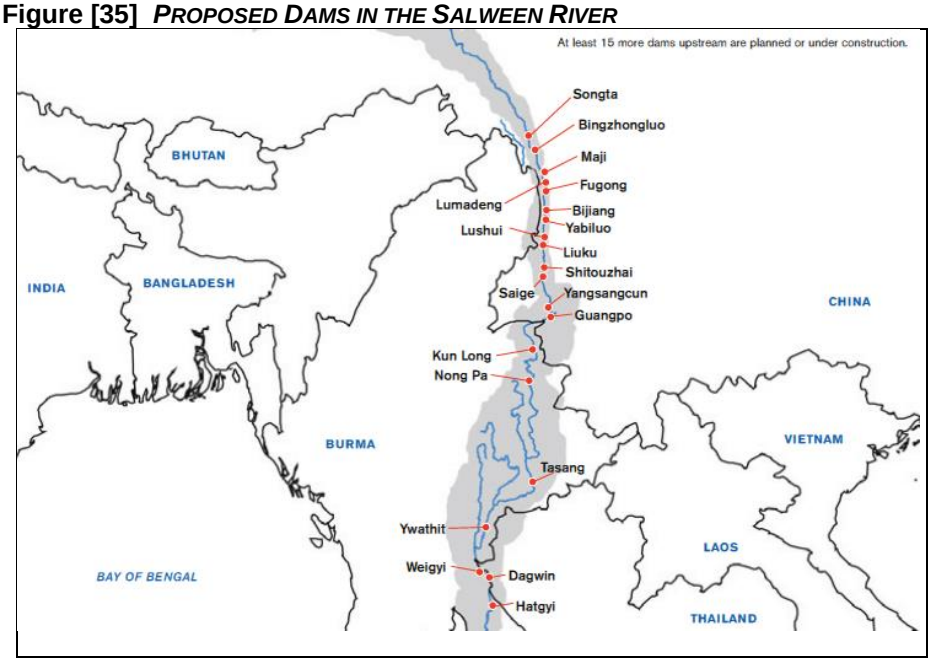
4.4 Surface Water

4.4.1 HYDROLOGY AND FLOODS

The Salween River (named Thanlwin in Myanmar) is about 2,815 km long which flows from the Tibetan Plateau into the Andaman Sea in Southeast Asia. It drains a narrow and mountainous watershed of 324,000 km² (125,000 sq. mi) that extends into the countries of China, Myanmar and Thailand. Steep canyon walls line the swift, powerful and undammed Salween, one of the longest free-flowing rivers in the world. Its extensive drainage basin supports a biodiversity comparable with the Mekong and is home to about 7 million people. In 2003, key parts of the mid-region watershed of the river were included within the "Three Parallel Rivers of Yunnan Protected Areas", a UNESCO World Heritage Site located in China, several hundreds of km upstream the project area.

In Hpa-An, where the unique gauge station is located, the Thanlwin river has an estimated discharge of 157 billion m^3/year, which means close to 5,000 m^3/s in average. Mean low flow at Hpa-An is about 2,000 m^3/s. Near the head of the delta, the mean low flow is 2 300 m^3/s and a flood discharge of 32,600 m^3/s has been reported. However, several hydroelectric projects are already identified all along the course of the river, both in China and in Myanmar, which may have drastic impact in the long term on the river hydrology. Figure [35] presents the location of sites where potential hydropower development is identified.

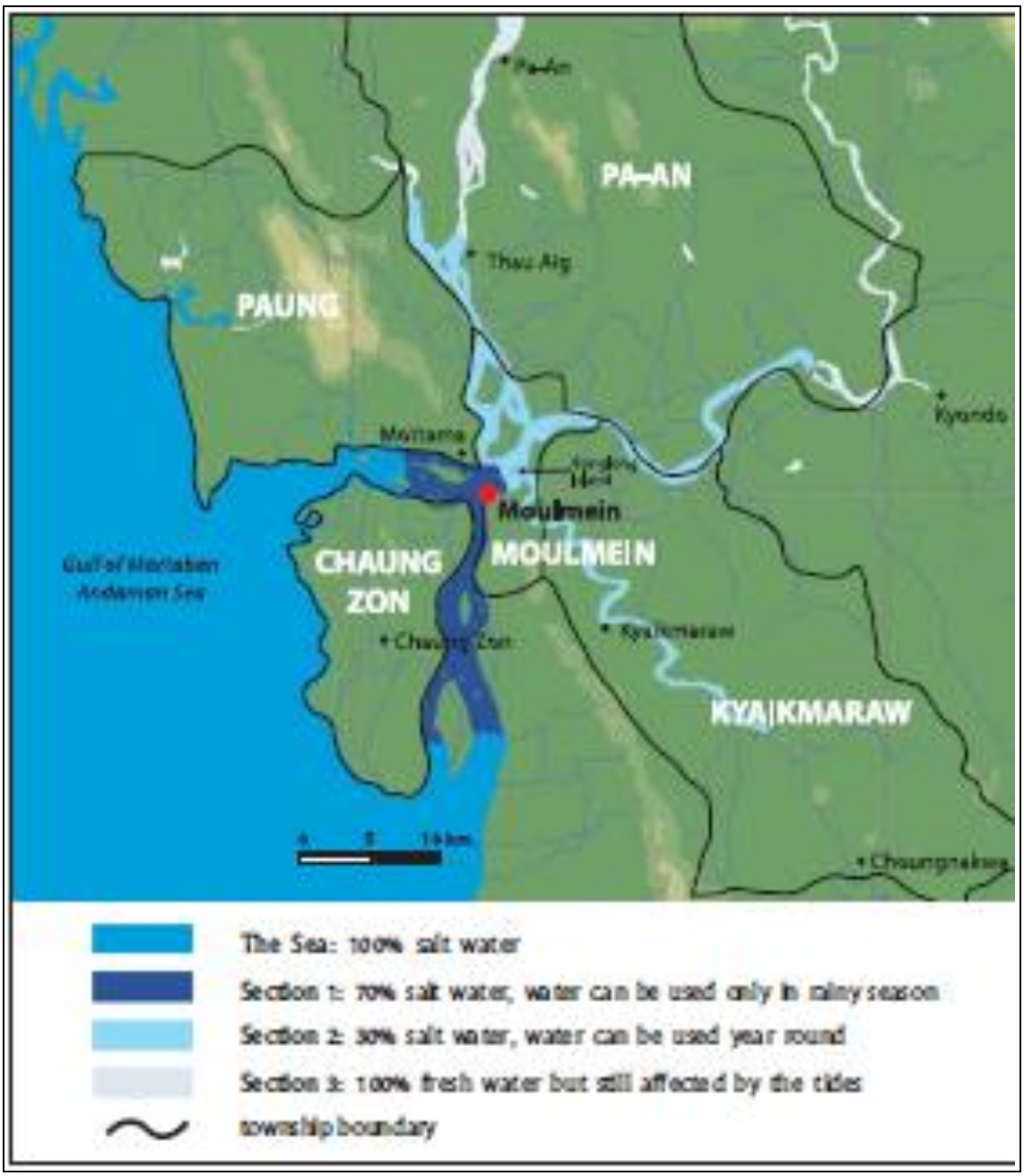
Figure [35] ***PROPOSED DAMS IN THE SALWEEN RIVER***



Source: Salween Watch, 13 March 2013

With rising sea levels and the impact of upstream reservoirs, there is a potential risk that the saline wedge of the estuary can encroach further upstream along the Thanlwin. At present there has been no attempt to simulate future saline conditions of the lower Thanlwin under different future scenarios; however, by analogy with nearby rivers the future risks can be appreciated. The risk for Hpa-An to see the salinity of river to rise up to levels endangering its water supply, shall directly depend on the modification of the river discharge resulting from damming and water use along its course (particularly irrigation). At present, and as shown in following figure, the Thanlwin river in front of Hpa An is still 100% fresh water year round. The most upstream point reached by a saline wedge with a low salinity of 30% (the water can still be used year round for water supply) is still more than 20 km downstream Hpa An.

Figure [36] EXISTING SALINITY CONDITIONS (ISOHALINES) OF SURFACE WATERS IN THE LOWER THANLWIN



Source: Salween Watch, 13 March 2013

The widespread floods mainly hit the lower and middle reaches of the large rivers such as Thanlwin, Attran and Gyaing Rivers, having a catchment area larger than few thousands of square kilometres. The water levels of the downstream/middle streams of these rivers tend to gradually rise. Because of such gradual rise of river water levels, the residents have time for evacuation from the flooded zones and therefore the human damages including the death seldom occur. However, once the river water levels exceed the river bank levels, extensive and prolonged flood inundation occur. As most major urban centres are located along the downstream reach of the large rivers and are inundated over a long period, economic damages

from flood tend to be huge. For this reason, most recorded major flood damages in the Southeast Myanmar result from the wide spread flood

In contrast to the widespread flood, flash-floods tend to occur along small rivers and creeks where the peak water level rises very rapidly immediately after the heavy rainfall event. Due to such features, flash flood results into potential risk of serious human damages including fatalities. However, since flash flood is limited to specific areas and residents being well aware of the risks, the flood damages are far smaller than those of the wide-spread flood described above (Ministry of Border Affairs & JICA, 2013).

Thanlwin River tends to be the main cause of serious flood damages in Hpa-An area. The critical level in Hpa-An above which flood start occurring in lowland areas is 7.50 m (staff gauge reading by the Department of Meteorology and Hydrology). According to the records of DMH, the river water levels in the Thanlwin River exceeded the critical level seven years out of ten (period 2003-2012) and water levels above the critical level lasted for 5 to 46 days.

However, flood is not a major issue in Hpa-An urban area as it protected by a dyke along the strand road. Flooding from the Thanlwin is more affecting the surrounding villages.

The Thaungyin (Moei) River, along which Myawaddy is located, is a tributary of the Salween River. It originates in Phop Phra district, Tak Province. Unlike most rivers in Thailand, the Thaungyin flows north. The river forms the natural border line between Thailand and Myanmar. The districts along the Thaungyin River bank of Thailand, from South to North are Mae Sot, Mae Ramat, Tha Song Yang and finally it enters the Salween River in Sop Moei district of Mae Hong Son Province. The river is about 327 km long (Hadden, 2008).

The Thaungyin (Moei) water level varies from 1 meter in dry season to 4 meters in rainy season. However an exceptional event occurred in 2013 with a peak up to 9 meters. Flood occurred then at the friendship bridge at the border crossing. The detailed design of the intake in Myawaddy should include a protection level in accordance with this flood occurrence.

4.5 Hydrogeology

In Kayin State, groundwater is abstracted by the following three kinds of wells: (i) hand-dug wells (9 to 12 meters in depth), shallow-wells (25 to 45 meters in depth), and tube wells (deeper than 50 meters) (Ministry of Border Affairs & JICA, 2013).There is not much detailed information about ground water in the regions of Hpa-An and Myawaddy.

In Hpa-An, the landfill site is proposed on a wide plateau unpopulated, covered by scrubland. Drainage around was observed dry at the time of the visits, with no underground drainage of superficial aquifer. No handwells or tubewells are observed in this area.

In Myawaddy, the proposed landfill site is also located on a plateau, nearby a deep dissection by a ravine, where no shallow aquifer seems to be drained.

4.6 Air Quality and Noise

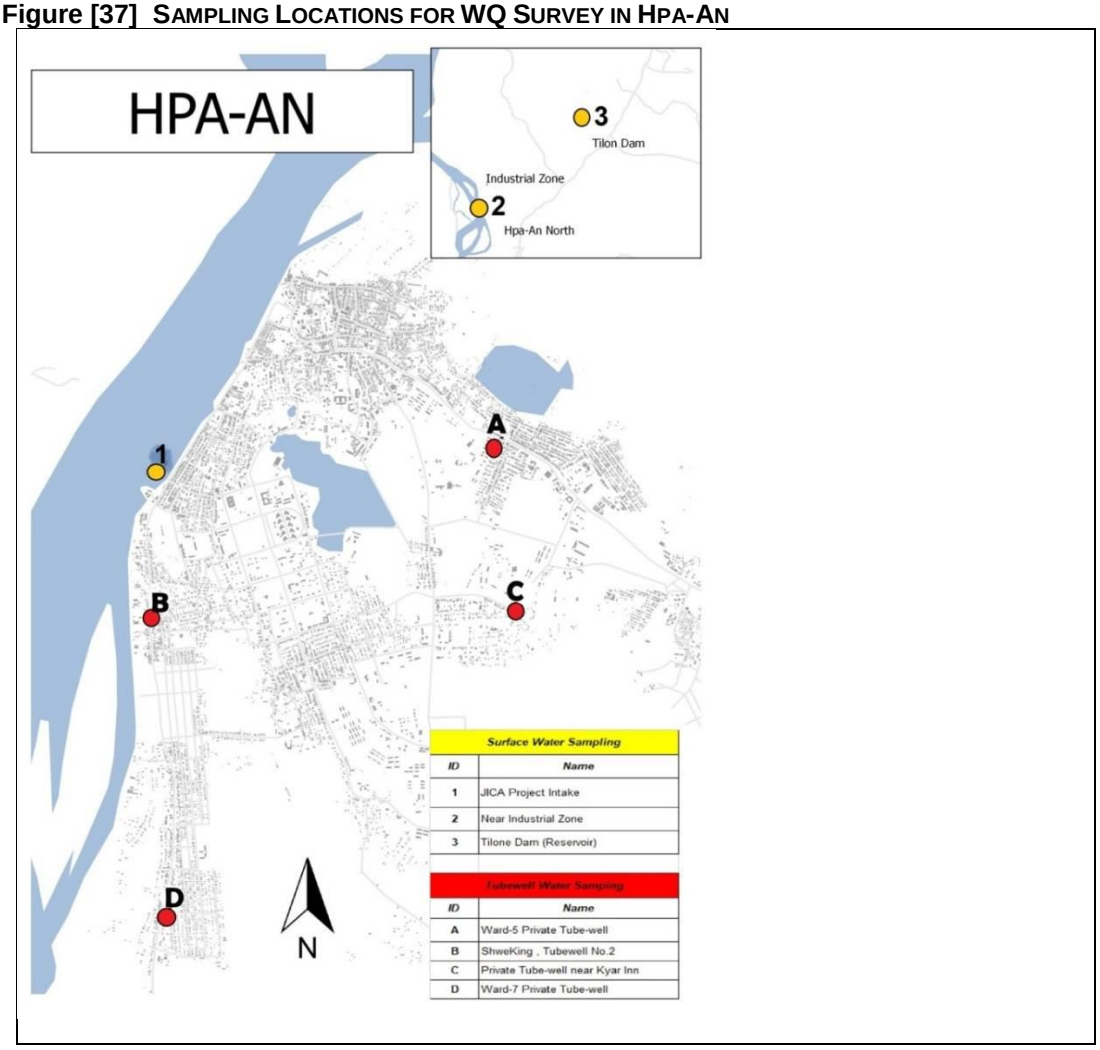
No data presently exist on air quality and noise in both concerned cities. However, considering the low industrialization of the cities, main air pollution comes from (i) dust from unpaved ways in dry season, (ii) smoke resulting from cooking and

from the burning of the solid waste dumped all over the urban areas and (iii) from road traffic, particularly in Myawaddy along the access road to the border post with Thailand, always presenting a heavy traffic.

4.7 Water Quality

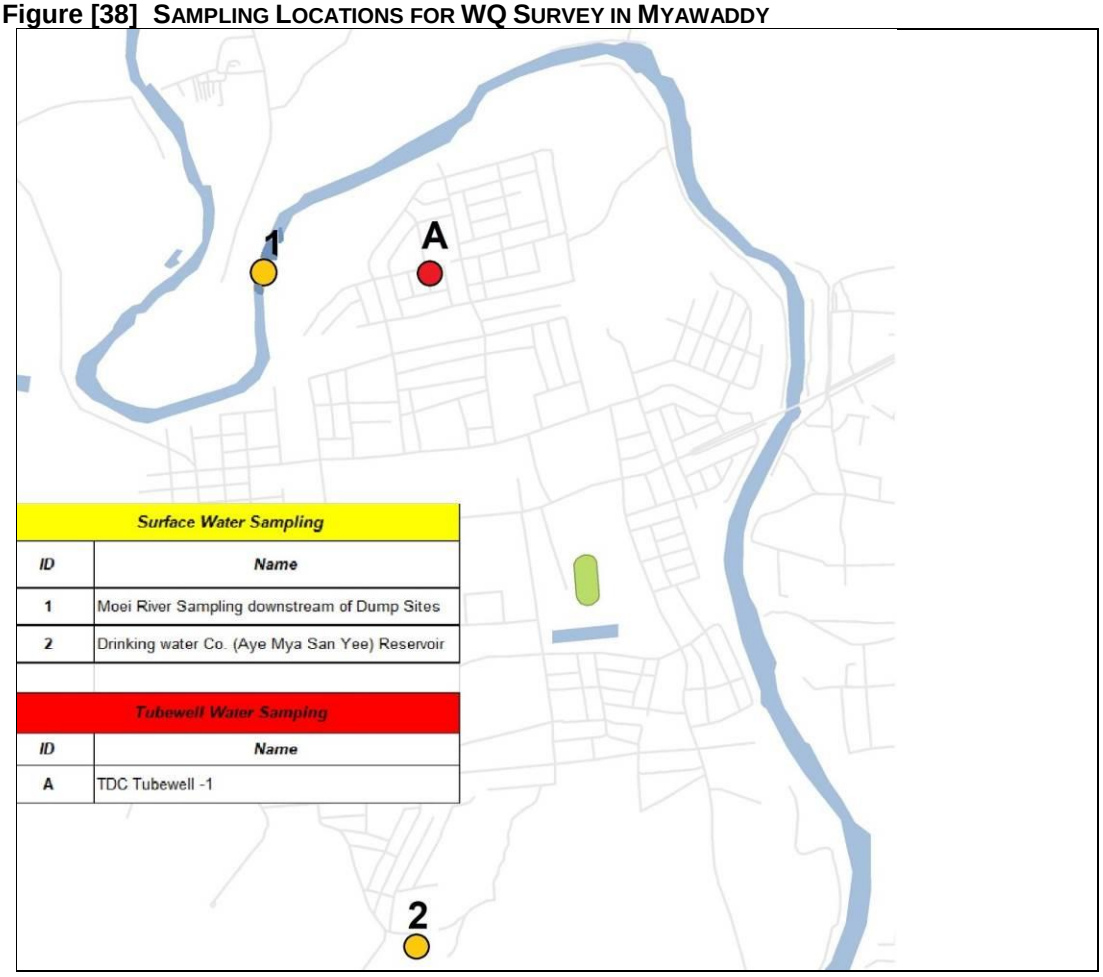
The PPTA Consultant appointed a Yangon laboratory (E-Guard) to undertake a water quality survey. Sampling was carried out in September 2015. Location of water quality samplings in Hpa-An and Myawaddy are presented in **Error! R eference source not found.** and **Error! Reference source not found.**.

Figure [37] SAMPLING LOCATIONS FOR WQ SURVEY IN HPA-AN



Source: PPTA Consultant, 2015

Figure [38] SAMPLING LOCATIONS FOR WQ SURVEY IN MYAWADDY



Source: PPTA Consultant, 2015

4.7.1 SURFACE WATER QUALITY

Surface water was sampled in 3 sites in Hpa-An and in 2 sites in Myawaddy in September 2015. Results of analysis are provided in table below.

Table [17] SURFACE WATER QUALITY ANALYSIS IN HPA-AN AND MYAWADDY

No.	Parameter	Unit	Hpa-An			Myawaddy	
			01	02	03	01	02
1	Temperature	°C	29	26.6	26.1	28.6	28.5
2	Electric conductivity	µS	49.1	223	222	233	540
3	Dissolved Oxygen	mg/l	7.96	7.78	7.88	7.26	7.63
4	pH	-	8.71	8.33	8.35	7.93	7.92
5	Turbidity	NTU	5	722	632	1338	4
6	BOD_5	mg/l	7	4	6	9	15
7	COD	mg/l	< 10	< 10	< 10	<10	31
8	TSS	mg/l	140.67	1683	1012	901.3	157.7
9	Total phosphorus	mg/l	< 0.01	0.08	0.07	0.08	0.02

No.	Parameter	Unit	Hpa-An			Myawaddy	
			01	02	03	01	02
10	Phosphate	mg/l	0.05	0.24	0.15	1.0	Nil
11	Total Nitrogen	mg/l	< 0.6	< 0.6	0.6	<0.6	<0.6
12	Nitrate	mg/l	0.12	0.58	0.05	0.56	0.43
13	Ammonia	mg/l	Nil	0.20	Nil	1.95	Nil
14	Ammonium	mg/l	Nil	0.21	Nil	Nil	2.06
15	Total Coliforms	Cfu /100ml	20	>50	Nil	5	35
16	Sulphate	ppm	48.13	154.21	171.19	13.61	114.89
17	Chloride	mg/l	1.42	5.32	1.4	4.25	5.67
18	Calcium	mg/l	7.09	46.06	47.83	52.43	147.15
19	Magnesium	mg/l	<0.5	8.60	6.45	8.21	7.18
20	Sodium	mg/l	0.79	3.76	4.15	4.84	1.98
21	Potassium	mg/l	< 0.5	1.4	1.4	2.08	0.5
22	Alkalinity	mg/l	12.5	47	47.5	47.5	110

4.7.2 UNDERGROUND WATER QUALITY

In Hpa-An 4 tubewells and in Myawaddy one tubewell were sampled in September 2015. All tubewells are located at more than 500 m from the proposed landfill site as no tubewell is observed within this range. Results of analysis are provided in table below.

Table [18] UNDERGROUND WATER ANALYSIS IN HPA-AN AND MYAWADDY

No.	Parameter	Unit	Hpa-An			Myawaddy	
			01	02	03	01	02
1	Temperature	°C	26.5	28.6	28.6	27.7	26.7
2	Electric conductivity	µS	166.5	479	719	470	1509
3	Dissolved Oxygen	mg/l	2.69	5.06	5.69	1.97	1.92
4	pH	-	5.47	7.76	7.27	7.40	6.35
5	Turbidity	NTU	2	225	2	27	2
6	BOD_5	mg/l	5	4	4	1	14
7	COD	mg/l	<10	<10	<10	<10	29
8	TSS	mg/l	29.67	145.33	98.67	51	152.3
9	Total phosphorus	mg/l	<0.01	0.47	< 0.01	< 0.01	0.05
10	Phosphate	mg/l	0.08	0.46	0.39	0.03	1.02
11	Total Nitrogen	mg/l	<0.6	0.6	0.7	1.4	1.47
12	Nitrate	mg/l	1.8	1.8	0.49	0.11	3.07
13	Ammonia	mg/l	Nil	0.39	0.38	1.32	2.68

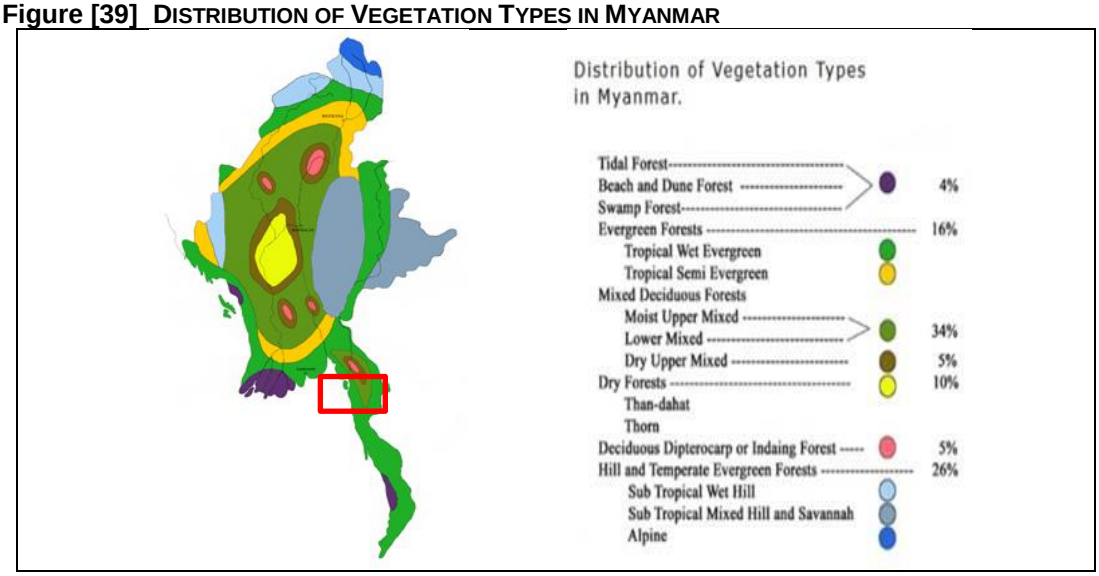
No.	Parameter	Unit	Hpa-An			Myawaddy	
			01	02	03	01	02
14	Ammonium	mg/l	Nil	0.41	0.40	1.39	2.82
15	Total Coliforms	Cfu /100ml	38	>50	>50	2	15
16	Sulphate	ppm	22.68	162.70	158.46	116.03	78.43
17	Chloride	mg/l	14.54	6.04	25.52	3.55	339.3
18	Calcium	mg/l	14.17	95.66	126.67	74.41	164.06
19	Magnesium	mg/l	1.07	5.37	9.14	17.20	2.05
20	Sodium	mg/l	19.78	6.92	27.68	17.8	169.9
21	Potassium	mg/l	5.39	0.5	1.4	< 0.5	7.22
22	Alkalinity	mg/l	20	125.5	168.5	125.5	65

4.8 Terrestrial & Aquatic Ecology

4.8.1 NATURAL AND URBAN VEGETATION

As shown on Figure [39] , there are various vegetative types ranging from Tropical Wet Evergreen, Moist Upper Mixed Deciduous forest, Lower Mixed Deciduous forest, Dry Upper Mixed Deciduous Forest, and Deciduous Dipterocarp or Indaing Forest. As Kayin State is located in the tropical climate zone with torrential rains, Evergreen forests (Tropical wet evergreen), Mixed Deciduous forests and Deciduous Dipterocarp or Indaing forests thrive naturally in the region. However, both in Hpa-An and Myawaddy areas, the vegetation cover has for long time been exploited and destroyed, leaving place mainly for scrub, secondary forest or rubber plantations, the latter two being mainly observed on the slopes of surrounding hills.

Figure [39] DISTRIBUTION OF VEGETATION TYPES IN MYANMAR



Source: A Checklist of the Trees, Shrub, Herbs, and Climbers of Myanmar. Contributions from the United States National Herbarium. Volume 45: 1-59

The most common tree and shrub species in Hpa-An and Myawaddy areas are listed in following table.

Table [19] SPECIES OF TREES FOUND IN PROJECT AREAS

Vernacular Name (Myanmar)	Scientific Name
Kyun	*Tectona grandis*
Pyin Ka Toe	*Xylia dolabriformis*
In	*Dipterocarpus tuberculatus*
Ka Nyin	*Dipterocarpus spp.*
Pyin Ma	*Legerstroemia speciosa*
Koako	*Alibizzia lebbek*
Gwe	*Spondias pinnata*
Gyo	*Schlicichera oleosa*
Kha Paung	*Stryohonos nux-blanda*
Kanaso	*Baccaurea sapida*
Padauk	*Pterocarpus macrocarpus*
Phat Than	*Heterophragma adenophyllum*
Phyuak Seik	*Holoptelea integrefollia*
Thit Saint	*Terminalia belerica*

Source: Hpa-An Township Forest Department and Myawaddy District Forest Department, Ministry of Environmental Conservation and Forestry.

Most of these trees are widely distributed in SE Asia and also widely used for community plantation in urban areas. None is registered as a protected species either at international (IUCN) or national levels.

4.8.2 AQUATIC FAUNA

Very limited information is available on the fish population in the project region. Only one study on fish composition of downstream Thanlwin River was carried out from May 2014 to October 2014 by the Department of Zoology, University of Mawlamyine (Than, Tun, & Htay, 2014). According to the study, 22 species were found in the Mottama area close to Hpa-An and the species observed are listed in **Error! Reference source not found.**table below. There are some small fish f arms around Myawaddy but no fishing activity is reported from Thaungyin (Moei) River. Most of the commercially consumed fish is imported from the places which are located around the downstream of Thanlwin. No subsistence fishery activities were observed along the river at the time of the visits by the PPTA consultant. The most consumed fish species observed in the market of Myawaddy are presented in the following photographs. None of these species is registered as protected either at international or national levels.

Table [20] MAIN FISH SPECIES IN MAWLAMYINE & HPA-AN REGION WATER BODIES

Vernacular Name (Myanmar)	Scientific Name
Nga hpe	*Notopterus notopterus* (Notopteridae)
Nga tha lauk	*Tenualosa ilisha* (Clupeidae)
Mee tan thwe	*Colia dussumieri* (Engraulididae)
Nga phan ma	*Osteobrama belangeri* (Cyprinidae)
Nga khone ma	*Puntius sophora* (Bagridae)
Nga zin yine	*Mystus vittatus* (Bagridae)
Nga nu than	*Ompok bimaculatus* (Siluridae)
Ka ka loung	*Eutropiichthys vacha* (Schilbeidae)
Nga yant gaung to	*Channa orientalis* (Channidae)
Nga yant	*Channa striatus* (Channidae)
Nga mway doh kyar	*Macrognathus zebrinus* (Mastacembelidae)
Nga mway don pyaung	*Macrognathus aral* (Mastacembelidae)
Moe nga yaung	*Arius caelatus* (Ariidae)
Pin lei nga khue	*Plotosus canius* (Plotosidae)
Nga khoo	*Clarias batrachus* (Centropomidae)
Nga si ooe	*Gerres filamentosus* (Gerrreidae)
Nga pyat khone	*Johnius coitor* (Sciaenidae)
Nga poke thin	*Otolithoides pama* (Sciaenidae)
Kabu lu	*Rhinomugil corsula* (Mugilidae)
Nga pon na	*Polynemus paradiseus* (Polynemidae)
Ka tha boe	*Glossogobius giuris* (Gobiidae)
Nga bee	*Scatophagus argus* (Scatophagidae)

Nga phan ma Osteobrama belangeri (Cyprinidae)

Ka tha boe Glossogobius giuris (Gobiidae)

NGA NU THAN OMPOK BIMACULATUS (SILURIDAE)

NGA THA LAUK TENUALOSA ILISHA (CLUPEIDAE)

NGA GYIN (CIRRHINUS MRIGALA)

NGA THA LAL HTOE (LEPIDOCEPHALICHTHYS SP.)

4.8.3 TERRESTRIAL FAUNA

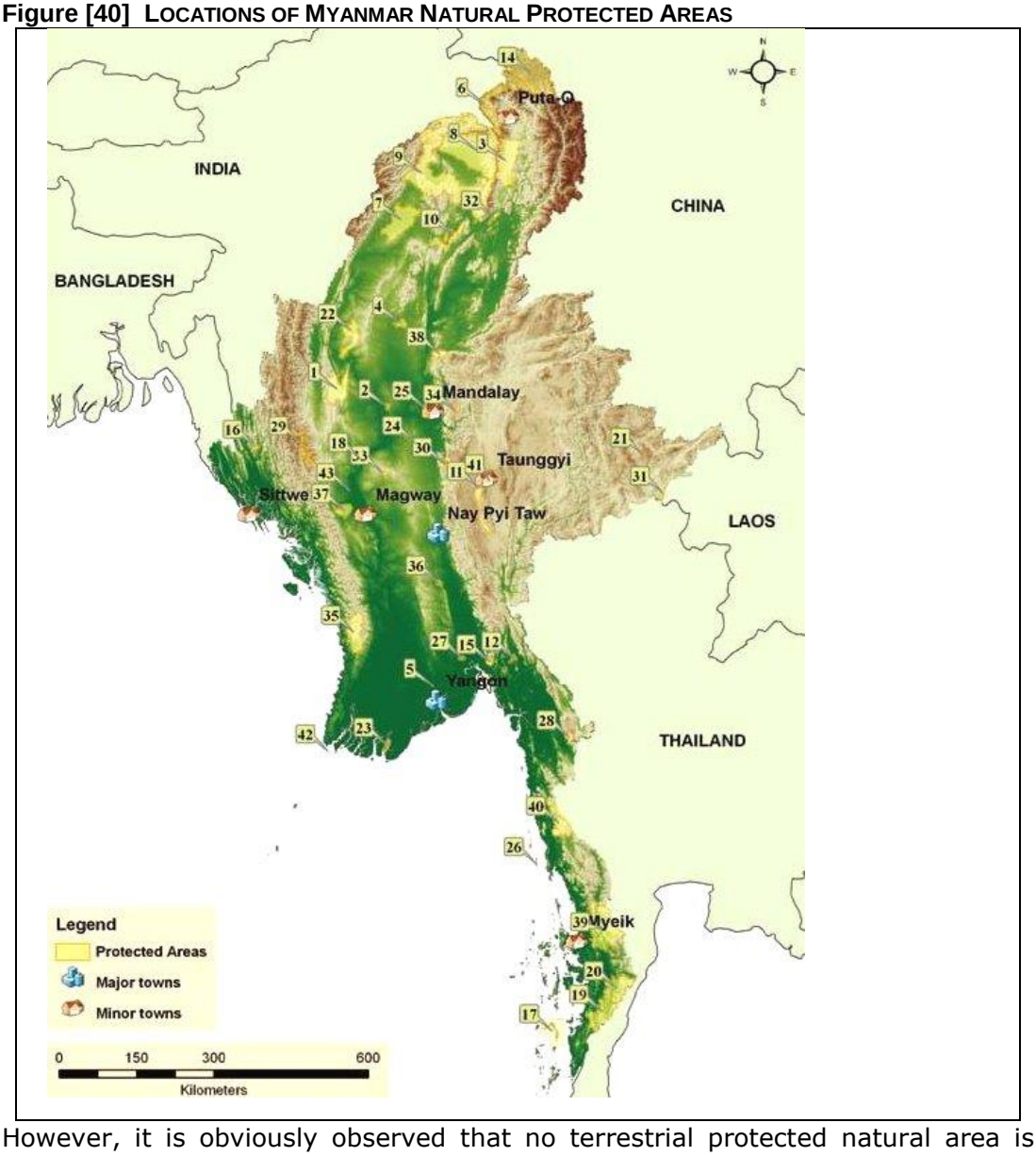
According to the world birds database (http://avibase.bsc-eoc.org) it is recorded in Kayin state a total of 602 avian species, 19 of them being identified as globally threatened and 1 as introduced species. However, project components are mainly developed in urbanized area where only few common species are observed and the project does not intend to alter or reduce any natural ecosystem of importance for the bird populations.

4.9 Protected Areas and Species

According to Forest Department (2009), 43 protected areas exist in Myanmar. Thirty-five sites were designated from 1918 to 2010. Eight additional sites proposed from 1997 to 2008 are still under examination. The 35 designated protected areas cover approximately 42,000 km² of land, representing 6.2% of the total country area. In case of establishment of eight additional protected areas, proposed from 2001 to 2008, the area would increase 7,400 km² (1.1%), and the total area would be 49,500 km², representing 7.3% of the total land area. Two protected areas were notified in the Mon State and one in Kayin State (Mitsui & Co., Ltd, 2015).

The protected area found within Kayin States is Mulayit wildlife sanctuary (Site ID 28 in Figure [40]) which is located in Kya-in Seik-kyi Township, Kayin State. This wildlife sanctuary is composed with variety of habitats including grassland, evergreen Forest (typical), mixed deciduous forest (moist upper), and hill forest (evergreen) (Myanmar Protected Areas, 2011). Mulayit wildlife sanctuary is founded since 1936 and it's IUCN status is IV. The observed animals are Barking Deer, Tiger, Leopard and avian species (Istituto Oikos and BANCA, 2011). It is 125 km away from Hpa-An, and 64 km away from Myawaddy.

Figure [40] LOCATIONS OF MYANMAR NATURAL PROTECTED AREAS



However, it is obviously observed that no terrestrial protected natural area is located within, in or near the vicinity of the Project zone. Locations of Protected Areas are presented in Table [21].

In Hpa-An Township, the existing 5 water supply reservoirs are located at the top of a small hill, Bar Mae Taung located inside the urban area which slopes are covered by a dense tree cover. Tree cutting is not allowed on this hill except if prior authorisation of Kayin State Forestry department in Hpa An. Preliminary

design of project intends to develop the new reservoir on the location of the 5 demobilised reservoirs, without need for extension of the area.

Table [21] NUMBERS OF PROTECTED AREAS IN KAYIN STATE

State	Item	Reserved Forest	Protected Area	Wildlife Sanctuary	Total
Kayin	No. of sites	55	31	2	88
	Area (ha)	454,625	39,467	44,514	538,060

Source: Statistical Yearbook 2011, Central Statistical Office, Ministry of National Planning and Economic Development, 2012

4.10 Social and Cultural baseline

4.10.1 ADMINISTRATIVE ORGANIZATION

The division of administrative areas in Kayin States follows the same dissecting arrangements as other states and regions. It starts with State which is divided down the line into Districts, Townships and Sub townships, Towns/Sub-towns, Wards/Village Tracts and Villages. The list in table below shows the division of administrative areas in Kayin States.

Administrative Officers are placed in each level of structure starting from State level down to village level. All of them are employees of General Administrative Department (GAD) under the Ministry of Home Affairs. Administrative Officer at State level has the official position of Director/Deputy Director in the department. Administrative Officer at ward or village level is however elected by constituents of wards or villages but paid monthly allowances by GAD.

Table [22] TABLE 4-1: DIVISION OF ADMINISTRATIVE AREAS IN KAYIN STATE

Township	Towns/sub-towns	No. of Ward	No. of Villages
Hpa-An	Hpa-An	9	476
Myawaddy	Myawaddy	5	42
	Su Ka Li	1	9
	Waw Lay Myaing	2	13

Source: UNDP Myanmar Information Management Unit

4.10.2 POPULATION

Population and Trends

According to the 2014 census result, Hpa-An has the urban population of 75,141 and Myawaddy has the urban population of 113,155 and they are expected to have the projected urban population of 143,936 and 246,844 respectively in 2040.

Ethnic Groups

Following table**Error! Reference source not found.** shows the ethnicity in Hpa-A n and Myawaddy, and in the wards where the project components are being proposed.

Table [23] ETHNICITY IN HPA-AN AND MYAWADDY TOWNSHIPS

Area	Ethnic Minorities in Hpa-An and Myawaddy (Kayin State)	

	Kachin	Kayah	Kayin	Chin	Mon	Rakhine	Shan Pao	Bamar	Total Ethnic Pop
Hpa-An	54	1	211718	73	54772	394	41683	46829	304695
Myawaddy	92	3	50576	145	3633	1275	10454	45904	112082
Total	146	4	262292	218	58405	1669	92733	92733	354284

Source: Township Administrative Department, 2015

4.10.3 PUBLIC HEALTH

Hospitals, dispensaries and health centres are being expanded to provide health care services in Kayin State. The numbers of hospitals, Rural Health Centres (RHC) and Sub Health Centres (SHC) are mentioned in table below.

Table [24] NUMBERS OF HEALTH FACILITIES AND STAFF IN HPA-AN AND MYAWADDY

Township	No. of Doctor	No. of Nurse	No. of Mid-wife	No. of Health Centers		
				Hospital	RHC	SHC
Hpa-An	11	200	100	6	17	75
Myawaddy	13	53	21	4	4	17

4.10.4 WATER SUPPLY IN HPA-AN

The public water supply system of Hpa-An comprises a central sub-system (the Bare Mae system) with one main storage facility and related distribution network (1 river intake, 2 tubewells and 5 tanks). Other facilities are small independent systems relying on river intakes or tubewells. With regard to these systems the following remarks have been made:

- Production & treatment: water resources are various with 3 small river intakes (among which one is supplying its own system) and several small tubewells (≤150mm) most of which are out of service. None of existing facilities include treatment (not even disinfection). Hence, only raw water is distributed with regular presence of bacteria and sometimes very high turbidity. The existing capacity is insufficient to cover future water demand. Implementation of a central production system able to treat raw water especially during the monsoon season and fulfil the water needs for the medium and long term is a clear requirement.
- Storage: Currently, main storage facilities consists of Bare Mae reservoirs, composed of 5 tanks for an overall capacity of 0.52 Mgal (i.e. 2,300m^3), since other smaller tanks remains secondary (≤ 220m^3). However, among the 5 tanks, 3 of them are in very poor condition with presence of leakages due to the age of the civil work (nearly 50 and 40 years old) and absence of maintenance. Furthermore, existing capacity appear to be insufficient looking at future water demand. Apart from this storage, a lack of main storage is noticeable in the Eastern part of the city, where urban development is undergoing. Rehabilitation of this facility has not been selected as an acceptable option by the PPTA consultant. Implementation of a new storage facility would appear necessary while increasing the coverage.

EXISTING RIVER WATER INTAKE FROM THAN LWIN RIVER

EXISTING TUBE WELL INTAKE

THE 3 RESERVOIRS ON BAR MAE HILL TO BE RECONSTRUCTED AS ONE LARGE RESERVOIR

ONE OF THE RECENT EXISTING RESERVOIRS ON BAR MAE HILL TO BE KEPT

- Distribution: Under existing conditions, the absence of a structural network or main distribution lines is noticeable since no distribution pipeline exceeds 150mm in the entire network. The existing distribution network represents a total length of nearly 30 km with the oldest pipes laid in the 60s-70s; the number of connections estimated to be around 1,150 mainly equipped with Chinese water-meters of which accuracy seem questionable. The coverage for the urban area is around 10.5%. Not only is there a need to increase the service coverage, but also to secure, strengthen and re-organize the distribution system according to the future water demand.
- Operation and Management: Hpa-An has limited human and technical resources at the township level with only 21 staff primarily involved in water supply (many of which appear to have other engineering functions). There is a lack of planning, poor overall maintenance of facilities and an equally poor or quasi inexistent commercial management. This is reflected in the high levels of NRW covering both commercial and physical losses probably in excess of 70%. Undoubtedly, capacity building and strengthening of the water supply utility is crucial

4.10.5 WATER SUPPLY IN MYAWADDY

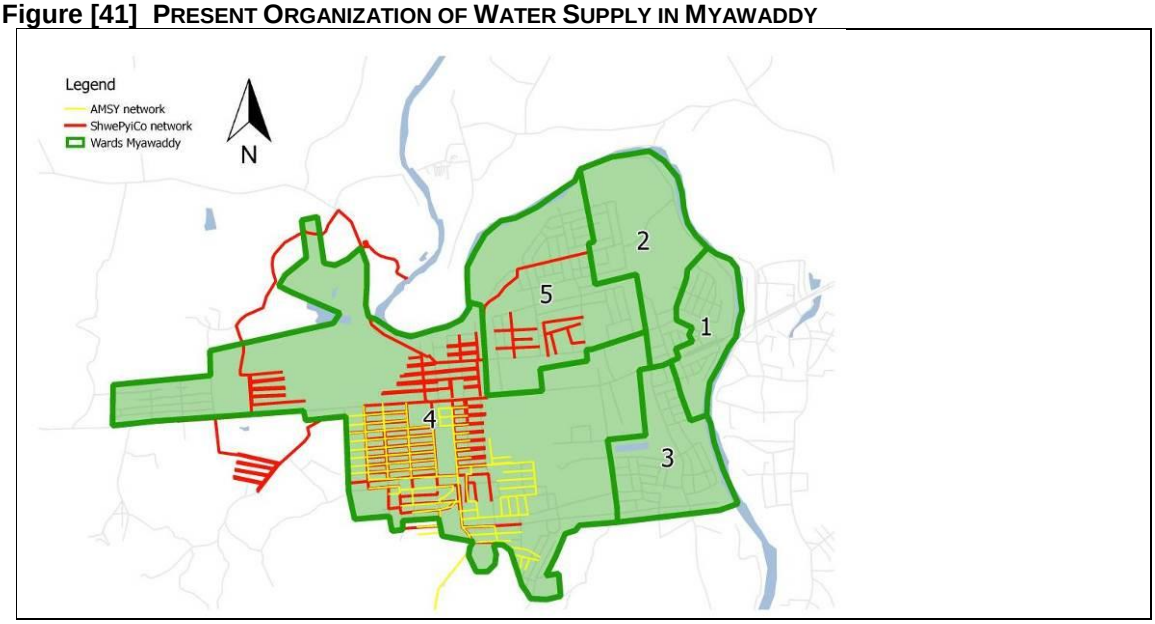
The provision of urban environmental services in Myawaddy Township is the responsibility of the Myawaddy District Development Committee (MDDC). Two private operators have been granted the right to distribute piped water to different wards in the township as shown on Figure [41] . These networks are extended on a rather ad hoc basis without any formal planning in response to customer demand for connections.

- ShwePyi Co., the "Northern Company", supplies ward #4 and recently extended to ward #5. They are extending their network out of the township boundaries on the western side. Myawaddy ShwePyi Company is managing a network of nearly 35 km, from 50 to 250mm diameter, with water pumped from the alluvial aquifer of the Thaungyin (Moei) River. Present total abstraction rate is 450 m^3/day.
- AyeMyaSanYae Company (AMSY) has a more modest network (17km) located in ward #4. AMSY Co. is a private company collecting the water from LatKhatTaung, a series of hills located 6 km in the South of Myawaddy. This company faces a lack of resources during the dry season limiting it expansion.
- The two networks are overlapping in ward #4 and some customers receive water from both companies, opening the tap depending on resource availability. None of the two systems is equipped with reliable treatment facility. Hence, there is no water supply system in the Eastern part of the city. In this area, people can get water from public tubewells managed by TDC (among the 26 existing tubewells, 9 are not currently functioning)

The requirements for future water supply provision are based upon the concept plans developed by DUHD and discussed in the overall FSR for Kayin State in which the population is set to grow at around 3% per annum reaching almost 150,000 by 2025 and 250,000 by 2040.

Taking into consideration the current situation and existence of private operators, it is proposed that water supply project focuses on the unserved area, that is to say the eastern part of the city.

Figure [41] PRESENT ORGANIZATION OF WATER SUPPLY IN MYAWADDY



Source: PPTA Consultant, 2015

4.10.6 SANITATION SYSTEM

Wastewater treatment consists entirely of septic tanks and discharges to the natural or storm drains crossing the city and discharging directly to the Thanlwin river for Hpa-An or to the Thaungyin river for Myawaddy. None of the cities disposes of a collective sewerage system.

4.10.7 SOLID WASTE MANAGEMENT (SWM)

SWM in Hpa-An

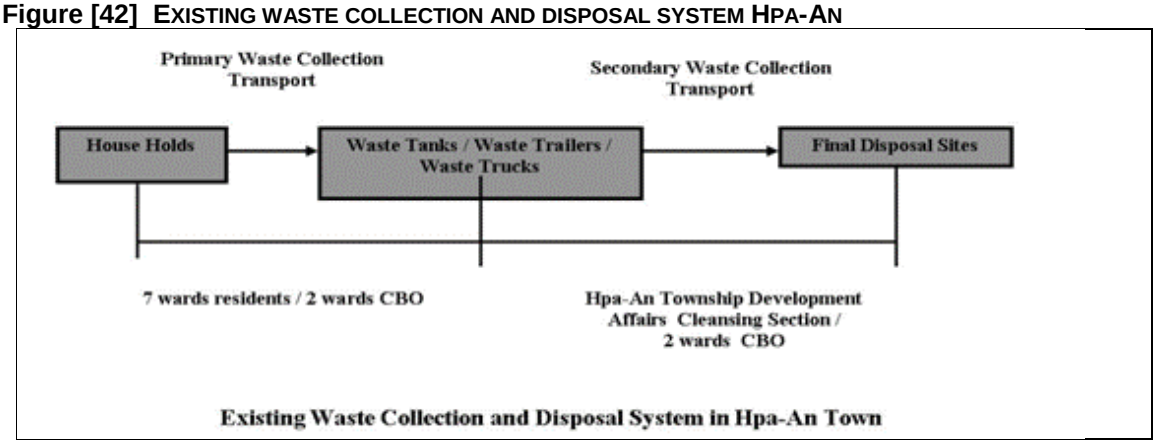
The Hpa-An Development Committee Cleansing Department has implemented a detailed cleansing program to collect solid waste from the 9 wards as shown on Figure [42] .

For this four garbage trucks are used operating 3 trips each per day and disposing their waste at the dumpsite. A number of wards are operating successful community based collection systems.

HTDA with only 4 vehicles cannot cover all the wards and streets. It can cover only the main streets. For the lanes with the bell ringing system the waste vehicle will stop at the corner of the streets and the people would come and disposed their household waste to the vehicle. Mostly they try every 2 days one trip per ward. See below photograph for collection vehicles in Hpa An.

Hpa-An Township Development Committee had implemented a cleansing program in the town area to clean up waste, to enhance the participation of the community to interest in the environmental protection programs such as collecting, transportation and disposal of the waste, recycling of the recyclable waste, composting of the waste etc.

Figure [42] EXISTING WASTE COLLECTION AND DISPOSAL SYSTEM HPA-AN



There are 9 wards in the town area; every day 4 Garbage trucks make 3 trips per truck per day and transport the waste to the dump site named Htan Koe Pin, which is about 11 km away from the town, near ZweKabin Hill.

SWM in Myawaddy

The 5 Ward Development Committees execute the collection, transport and disposal to the dump site by themselves. Private owned waste trucks are hired by the Ward Development Committees. The town generates about 64 tons of solid waste per day (estimation 2015: 0.55 kg/capita/day x 116,550 persons).

Half of the collected waste is dumped at two open dump sites located on the bank of the Thaungyin (Moei) River. The remaining is dumped illegally along streets and in water bodies such as the Thaungyin River. People living along the Thaungyin River in Ward no. 1 and Ward no. 2, next to the river simply throw their waste rubbish into this river. During the rainy season, when the river water is high, most of the waste from this dump site is taken away by the floods and flows into the Thaungyin river and finally into the Thanlwin river.

DUMPING SITE ALONG THAUNGYIN RIVER SEEN FROM THAILAND

SAME DUMPING SITE SEEN FROM MYANMAR SIDE

Medical waste is collected and transported by the TDC to the dumpsite near ward N°5. There is no soil covering at the dump site and the scavengers can easily come in contact with the hospital waste with all health and hygiene hazards. At the moment the hazardous waste is not separately collected but mixed with household waste.

MEDICAL WASTE IN THE DUMPING SITE

SCAVENGERS IN 2ND DUMPING SITE ALONG THAUNGYIN RIVER

It is worth to mention that the present intake for water supply in the Thaungyin River is located only 800 m downstream the two dumping sites, with evident sanitary risks. With the proposed project, landfill will be displaced inland far from river sides and the water intake shifted upstream the urban area.

4.10.8 UNEXPLODED ORDINANCES (UXO)

The PPTA Consultant was informed of the possibility of UXO in some areas of the region of Myawaddy, mainly remnant mines from past conflicts with rebel groups. However the risk is not reported from the immediate surroundings of the town where project components are located. A precautionary approach shall be considered before starting excavation works particularly for the proposed landfill.

5 IMPACT ANALYSIS

5.1 Methodology

The impacts were identified by confronting the environmental and social baseline situation of the area with the activities related to each component and stage of the project. For every interrelation between Project activities and each pertinent environmental component, all probable impacts have been identified.

This identification was mainly based on:

- The technical information related to project components design and operation as presented in Section 3 of this report;
- Field visits conducted in August-September and November 2014 by the Consultant in the Project area;
- The Consultant experience of environmental impacts of a variety of projects including urban development, water supply, sanitation and waste management;
- The checklists of potential impacts from various types of projects drawn up by international financial organizations (WB, ADB, AFD).

The result of this analysis is presented in the following sections covering 1) impacts connected with the location of the projected facilities, 2) impacts connected with

construction activities and 3) impacts connected with the actual operation of the facilities.

The potential impacts for each of these sections are presented in a summary table, followed by descriptions and analyses of the most probable significant impacts. These tables present, successively, the cause of the impact, the potential impact along with its risk level, the corrective measure along with the ease/difficulty of implementing it and the residual risk level after implementing the measure.

Table [25] IMPACT ASSESSMENT CRITERIA

Criterion	Level 1	Level 2	Level 3
Difficulty for implementing corrective measures	Easy, inexpensive and generally effective	Demands special attention (monitoring or training, for example)	Difficult due to complexity or cost
Probability of occurrence of the impact	Low: can be seen in cases of negligence or accident	Medium: generally seen a few times during construction or during the operation of the concerned facility	High: consistently seen if effective corrective measures are not put in place
Gravity of the impact	Generally limited impact in terms of intensity, duration or extent	Significant environmental impact but not endangering human or animal populations	Major environmental impacts with risks to people or special-status animals
Overall Risk	Low: subject of routine monitoring but impacts are minor and easily manageable	Significant: merits special attention	Major: merits close monitoring and the implementation of effective measures

Each summary table shows, for each identified impact, an assessment of the overall risk level, taking three criteria into a consideration: the probability of occurrence of the impact as part of the project, the expected gravity of such an impact given no special corrective measures, and the difficulty of implementing the proposed corrective measures.

- The probability of occurrence reflects how often the impacts are observed during construction and operation of similar projects: some impacts are inevitable (noise, dust, suspended sediment in surface water) whereas others occur only exceptionally (accident, explosion).
- The gravity of an impact incorporates various considerations of intensity of effects on the natural or human environment, its extent and its duration. All necessary efforts must be made to implement corrective and monitoring measures on impacts that are judged to be potentially serious.
- The overall risk relating to an impact, rated from 1 (low) to 3 (high) takes into account the abovementioned criteria as shown in Table 25.

5.2 Anticipated Benefits from the Project

The components of the Project are anticipated to significantly improve the environmental conditions and quality of life of the population in Hpa-An and Myawaddy through the following results:

In Hpa-An:

- Better quality of life and public health by the improvement of the water supply services and security through (i) increasing the water supply service in terms of satisfaction of the demand, 24/7 supply and good water pressure, storage capacity of the system by the construction of a new storage on Kyar Inn hill, (ii) reduction of non-revenue water and extension of serviced area, (iii) construction of a water treatment plant and (iv) improving and extending the distribution network;
- Better quality of life and public health by the improvement of solid waste management through better collection and safe disposal of waste: increased number of collection vehicles and collection points and new sanitary landfill and closure of existing dumping site;
- Better quality of life and public health by improving indirectly rainfall drainage: improvement of solid waste collection shall reduce the volume of waste presently dumped in the drains and clogging the system. This shall also reduce the temporary and localised flooding which occurs during heavy rainfall.
- Contribution towards Green City Principles through the implementation of a composting plant for solid waste. When compared to the "No Project" option, the Project solid waste component shall reduce the GHG emissions in Hpa-An by as much as 13,500 tons of CO2-eq per year in 2020 and 42,000 tons of CO2-eq per year in 2040;

In Myawaddy:

- Better quality of life and public health by the improvement of the water supply services and security through (i) increasing the water supply service in terms of satisfaction of the demand, 24/7 supply and good water pressure by the construction of a new water intake, storage capacity of the system by increasing the existing storage, (ii) reduction of non-revenue water and extension of serviced area, (iii) construction of a water treatment plant and (iv) improving and extending the distribution network;
- Better quality of life and public health by the improvement of solid waste management through better collection and safe disposal of waste: increased number of collection vehicles and collection points and new sanitary landfill to replace the existing dump site;
- Better quality of life and public health by improving indirectly rainfall drainage: improvement of solid waste collection shall reduce the volume of waste presently dumped in the drains and clogging the system.
- Contribution towards Green City Principles through the implementation of a composting plant for solid waste. When compared to the "No Project" option, the Project solid waste component shall reduce the GHG emissions Myawaddy by as much as 18,500 tons of CO2-eq per year in 2020 and 66,700 tons of CO2-eq per year in 2040;

Improvement of solid waste management shows that GHG emissions from solid waste in Hpa-An and Myawaddy could be reduced by 32,000 t CO2-eq/year in 2020 and even reach 108,000 t CO2-eq/year in 2040 when compared to a "No Project" option.

5.3 Impacts related to Project Location

5.3.1 IMPACTS FROM SITE LOCATIONS IN HPA-AN

Water Supply Components

Water Intake

The proposed river water intake is situated on the bank of the Thanlwin River. The land is owned by the Development Affairs. In the area of the proposed land, there are some medium sized trees such as Banda (*Terminalia catappa, Combretaceae*), Thayat *(Mangifera indica*) and Malaysia Padauk (*Acacia auriculiformis*). There is one small bricked building next to the premises owned by the Development Affairs. Land side of the site is used as a parking area for public transportation buses.

No land acquisition from private owner is necessary.

EXISTING SMALL PUMPING STATION AT PROPOSED SITEON THE THANLWIN RIVER

BUS PARKING NEXT TO PROPOSED SITE

Water Treatment Plant

The proposed land is a floodable area about three meters lower than the nearby road, under the influence of the Hpa-An lake, a large reservoir in the center of the city used for drainage of water and recreation,. Vegetation is mainly scrubs, grassland (Cyperus) with scattered water hyacinth *(Eichhornia crassipes*) in the remaining small water pockets at the time of the visit. Some trees, Pyin-ma (*Lagerstroemia reginae*) are observed along the road. The land is owned by a private and sale to KSG is currently under discussion. Land requirement is 5,000 m² (1.25 acre). No access road is required. The project design takes this situation into consideration and the facility will be raised to a safe level. As the facility requires only 5,000 m2 next to the dike, a small area compared to the srea of the floodable plain, no significant impact on future flood levels is anticipated.

VIEW OF PROPOSED SITE

ACCESS ROAD NEXT TO SITE WITH LAGERSTOEMIA TREES

Bar-Mae Hill Water Storage

Existing storages (5 units) are located on the Bar-Mae Hill, from which at least the 3 oldest shall be demolished and reconstructed as storage with increased capacity. Bar Mae Hill forest vegetation around the reservoirs consists of dense forest of large and old trees. The closest trees include Latpan (*Beaumontia grandiflora, Apocynaceae*), Sit (*Albizia procera, Mimosaceae*), Banda (*Terminalia catappa, Combretaceae*), Kyun (*Tectona grandis, Verbenaceae*), Ondon (*Litsea glutinosa, Lauraceae*), Thitsi (*Melanorrhoea glabra*), Tha Phan (*Ficus glomerata)*, Pinle-kabwe (*Casuarina equisetifolia*) and Letpan (*Salmalia malabarica)*. No extension of the existing storage site is anticipated, the new reservoir being built on the site of the demolished ones. No land acquisition required And access road already exists. The preliminary design of the proposed concrete storage takes full consideration of the area available for the construction and the fact that no tree can be cut without prior clearance from Kayin State Forestry Department.

Kyar Inn Montain water storage

A new water storage is proposed for the eastern part of the town, located on the Kyar Inn Mountain. The proposed site is an unused natural water storage belonging to a religious complex including a monastery, a school and a meditation centre. The pond is located outside the built up area, at least 200 m from the nearest building. The storage is not more used by the community for several years and its area is considered for the construction of a concrete storage. It is surrounded by planted trees of medium size, mainly Malaysia Padauk (*Acacia auriculiformis*) and some other local species such as Padauk (*Pterocarpus macrocarpus*).Only 1,600 m² of land need to be acquired. No impact on built-up properties or agricultural production. Presence of a tubewell station 50-80 m from the site, at a higher elevation.. Existing good road up to the site. No additional access road required.

Distribution System

Development of the water distribution system will follow roads and streets. No land acquisition anticipated.

BAR MAE HILL: 3 STORAGES TO BE DEMOLISHED (2 CONCRETE & 1 METALLIC)

VIEW OF THE AREA FROM A STORAGE

BAR MAE HILL: VIEW OF SURROUNDING VEGETATION...

...AND ACCESS ROAD TO THE SITE

VIEW OF PROPOSED SITE IN KYAR INN MOUNTAIN

ACCESS ROAD TO KYAR INN MOUNTAIN

Solid Waste Components

VIEW OF PROPOSED LANDFILL SITE

ACCESS ROAD TO LANDFILL FROM IZ EXTENSION

Landfill and Composting Plant

The proposed area for the composting plant and sanitary landfill is located at the Northern side of the future industrial zone extension. The wide area is recovering from recent vegetation clearing (3-4 years?) carried out over the whole Industrial Zone (IZ) (170 ha). Natural and dense regrowth of *Dipterocarpus tuberculatus* is observed over the whole area. Land is owned by the State Government, is presently unused and devoid of any built-up structures. Access road from the future IZ extension already exists.

Land requirement for the facilities is 10 ha (25 acres). No resettlement is required as the area is devoid of any building structure within a radius of more than 500 m.

The old site currently used by TDC near ZweKabin Mountain will be closed. The wastepickers currently living in the area will receive compensation according to the preconisation of the Resettlement Plan implemented under PPTA 8758. They will be proposed for recruitment on the future landfill.

5.3.2 IMPACTS FROM SITE LOCATIONS IN MYAWADDY

Water supply Components in Myawaddy

Water Intake

The proposed water intake by infiltration gallery is located on a TDC land along the Thaungyin (Moei) River South of Myawaddy.

Currently the site is used by a small intake and some dredging activities downstream. The access road to this site will belong to Myawaddy TDC. The land is covered by bushes.

ACCESS ROAD TO THE INFILTRATION GALLERY

BANKS OF THE MOEI RIVER NEAR THE PROPOSED SITE

Water Treatment Plant

The proposed water treatment plant is located in a wide opened grassland next to the proposed water intake by infiltration gallery. The total available area is 3.2 ha (8 acres) while space needed is 4,000 m² (1 acre). No built up properties nearby to be affected. No natural vegetation or trees in the proposed site. The area is located along the asphalted road.

AREA PROPOSED FOR THE WTP

ACCESS ROAD TO SITE

New water storage

A new water storage is proposed south of the city near the Myawaddy cemetery.

The proposed site is a vacant lot occasionally used for car parking. Myawaddy TDC planned to rearrange the facilities surrounding the cemetery and a specific area is dedicated to the future reservoir.

Only 2,000 m² of land need to be acquired. No impact on built-up properties or agricultural production. No access road required.

PROPOSED CADASTRAL MAP BY TDC

SATELLITE VIEW OF THE SITE

VIEW OF SITE FOR PROPOSED CONCRETE WATER STORAGE

Distribution network

Development of the water distribution system will follow roads and streets. No land acquisition is anticipated.

Solid Waste Components

Sanitary Landfill and Composting Plant

The land requirement will be 12.5 ha (31 acres) presently owned by the Township Development Affairs within the Trade Zone. The total area secured for the long term development of the trade zone is 270 hectares (668 acres).

The site presents scrub vegetation on its slopes and some common trees

The site development shall not involve resettlement or private land acquisition. 300 meters buffer zone is respected, the closest building being a storage warehouse. No residential buildings within 500 m radius.

The existing dumping site, currently used by TDC to transfer waste from the two closed dumpsites located on the river bank, will be closed. The wastepickers currently living in the area will receive compensation according to the preconisation of the Resettlement Plan and offer for recruitment to work on the new landfill.

CADASTRAL MAP LOCATING THE SITE IN THE TRADE ZONE

VIEW OF THE SITE

5.3.3 IMPACTS FROM OR TO CLIMATE CHANGE AND NATURAL HAZARDS

Climate Change (CC) or natural hazards are not anticipated to represent a significant risk in relation to project components location:

- Hpa-An water intake shall be located on the left bank of the Thanlwin River. The design of the facility takes into consideration the large amplitude of the water level depending the season (by the use of an oscillating and floating mast equipped with a suction strainer) and will also integrate a safety free board to avoid any risk of flooding of the electrical equipment in particular;
- Hpa-An water treatment site is located close to Hpa-An urban lake in a low lying area subject to flooding from the lake. The design takes into consideration a reclamation of the land up to a level at least 1 m above the highest recorded flood level (which corresponds to an estimated return period >500 years);
- Hpa-An storages are all located on small hills with smooth slopes and well forested. These areas are rocky and not landslide prone and not affected by CC. Design shall integrate the requirements related to earthquake (steelbars arrangements, subdivision of storage in cells to limit water oscillation, any other measures deemed necessary by the DD engineer), but taking into consideration that the region remains classified as low regarding seismic hazard.
- Myawaddy water intake (infiltration gallery) shall be located on a stable river bank in the upstream part of the town. Thaungyin (Moei) River has a large water level amplitude and the design take this in account to avoid any risk of flooding of the electrical equipment;
- The general topography is rather smooth, not prone to landslide.
- Seismic risk in Hpa-An and Myawaddy is considered as low ((low Peak Ground Acceleration of 0.11 only);

None of the Hpa-An and Myawaddy Third GMS Corridor Project component is anticipated to be eventually affected by CC or natural hazards.

5.3.4 IMPACTS ON CULTURAL HERITAGE

None of the Project sites considered in Hpa-An and Myawaddy are anticipated any known cultural heritage resource.

5.3.5 IMPACTS ON NATURAL RESOURCES

As presented in the previous sections, most of the proposed sites are either urban areas with no natural resources or already altered natural areas presenting a limited value regarding vegetation cover: grass or scrub vegetation, secondary or planted tree vegetation. Only in Hpa-An, the Bar-Mae Hill site where existing reservoirs will be demolished and a new reservoir will be constructed is surrounded by a valuable forest which will be protected against cutting of trees. Detailed design will adapt to the available area and Kayin State Forestry Department will provide regular inspection of the site during works. Recommendations for avoiding tree cutting through appropriate measures are presented in the EMP.

A Summary of Impacts and Mitigation Measures is shown on Table [26].

Table [26] SUMMARY OF IMPACTS RELATED TO PROJECT COMPONENTS LOCATION IN HPA-AN AND MYAWADDY

Component or activity	Potential risks	Potential impact	Impact assessment			Corrective or support measure		
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	Overall risk after correction
Improved Water Supply System								
New water intake in Hpa-An	Permanent and temporary land occupation	No private land acquisition required. Area owned by Development Affairs of Hpa-An TDC. Available area around site for the needs of the construction (area used as bus parking).	-	-	-	No particular measure required	-	-
Rehabilitation of Bar-Mae Hill reservoirs	Permanent and temporary land occupation	No land acquisition is required, no built-up property is affected. A new reservoir will be built on the site occupied by the 3 reservoirs to be demolished. Risk to have tree cutting around site.	2	1	2	Monitor during construction that no forest tree is cut without authorization from Department of forestry.	1	1
Construction of a new storage on Kyar-Inn hill	Permanent and temporary land occupation	Land belongs to a monastery, but site is presently an unused pond. No building nearby, except a tubewell house. Surrounding vegetation consists of planted Acacia auriculoformis. Access road available and large area for temporary use during construction. No nuisance risk.	-	-	-	No particular measure required	-	-
Construction of a Water Treatment Plant In Hpa An	Permanent and temporary land occupation	5 000 m² (1.25 acre) required of land belonging to private owner and discussion with KSG for purchasing at this stage; land acquisition is required. No built-up or crop production to compensate. Access road existing. Land available large enough to satisfy temporary needs during construction. Floodable area, involving preliminary land reclamation (or adapted foundation design). No nearby residences (>300 m)	3	2	2	Provide fair acquisition price. Monitoring during construction to ensure no encroachment happens outside dedicated area.	2	1
	Vegetation clearing	No forest or large trees concerned. Only open scrub and wet grassland	-	-	-	No specific measure required.	-	-

Component or activity	Potential risks	Potential impact	Impact assessment			Corrective or support measure		
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	Overall risk after correction
New intake by infiltration gallery in Myawaddy	Permanent and temporary land occupation	No private land acquisition required. Area owned by Myawaddy TDC. Available area around site for the needs of the construction. The detailed design must integrate water level variations of the river.	-	-	-	No specific measure required.	-	-
Construction of a Water Treatment Plant In Myawaddy	Permanent and temporary land occupation	4,000 m² (1 acre) required in a 3.2 ha area owned by TDC. . No built-up or crop production to compensate. Land available large enough to satisfy temporary needs during construction. Land located along the main asphalted road.	-	-	-	No specific measure required.		
	Vegetation clearing	No forest or large trees concerned. Only open scrub and wet grassland	-	-	-	No specific measure required.	-	-
Construction of a new storage near Myawaddy cemetery	Permanent and temporary land occupation	No land acquisition is required, No built-up property is affected as TDC secured a specific area for the reservoir.	-	-	-	No specific measure required.	-	-
Rehabilitation and extension of water supply network in both cities	Permanent and temporary land occupation	Short term land occupation required during works which may locally impact road traffic and access to house or business in urban area. Possible need for urban tree cutting. No land acquisition as works are in streets and along roads	2	2	1	Minimize as much as feasible tree cutting; Compensate by 2 trees planted for 1 tree cut;	1	1
Improved Solid Waste Management								
Construction of new Sanitary Landfill and closing of the existing one in Hpa-An	Permanent and temporary land occupation	Large land available at the northern limit of the IZ extension. Land belongs to Kayin State Government. No private land acquisition required. No built up property on land. Access road already available. Vegetation only regrowth from recent clearing. Risks of nuisances for the IZ in the long term	2	1	2	Ensure a minimum of 250 m buffer zone between landfill and nearest IZ building, densely planted by fast growing trees.	2	1

Component or activity	Potential risks	Potential impact	Impact assessment			Corrective or support measure		
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	Overall risk after correction
Creation of a Composting Plant for Hpa-An	Permanent or temporary occupation of land	Plant located on the premises of the landfill site. No further land required. No residents within a radius of >500 m at present and no resident in the future (industrial zone)	-	-	-	No particular measure required	-	-
Construction of new Sanitary Landfill and closing of the existing one in Myawaddy	Permanent and temporary land occupation	New landfill located in the Trade zone in a delimited area managed by Myawaddy TDC. No built-up or crop production to compensate. Access road existing. Land available large enough to satisfy temporary needs during construction. Risk of nuisance for the future trade zone.	2	1	2	Ensure a minimum of 50 m buffer zone between landfill and trade zone, densely planted by fast growing trees.	2	1
Creation of a Composting Plant for Myawaddy	Permanent or temporary occupation of land	Plant located on the premises of the landfill site. No further land required.	-	-	-	No particular measures required	-	-
Improved Waste Collection equipment	Need for garage & parking area	No land required as parking & maintenance area installed in Municipality compound	-	-	-	-	-	-
Closing the old dump site	Permanent land occupation	Disturbances regarding wastepickers available work.	-	-	-	Measures are included in resettlement plan.	-	-

5.4 Impacts & Mitigation during Construction stage

DISRUPTION TO COMMUNITY UTILITIES

Construction works in urban areas, particularly those involving ground excavation works, may involve a temporary disruption of utilities for individuals or groups of residents. The following components of the project may involve such impacts:

- Water supply network rehabilitation poses only a short term concern to residents affected by construction activities. Interruptions to power and communication, disruption of water supply, discoloration of water from re-located pipes can be anticipated but should not exceed periods of few consecutive days; Contamination of water during replacement of pipes along the network may happen, but with limited risks for public health as water distributed presently is not potable and not used directly by the population as drinking water.
- Water supply network extensions shall not create any significant disruption in existing water supply as population in concerned areas relies either on tube wells, shallow wells or small independent distribution systems.
- Some disruption related to electricity supply, to accesses to households and shops or to road traffic may be temporarily and locally observed when lying down the main pipes along the streets.

To minimize impacts, the contractor shall implement the following measures:

- Water supply pipelines, power supply, communication lines and other utilities shall be re-provisioned before construction works commence;
- Provisions shall be made to preserve the operation of current facilities in sufficient quantity and in agreement with the local community;
- Re-provisioning shall be undertaken in coordination with municipal services and other concerned utility companies;
- Affected households and establishments shall be notified at least 3 days in advance of such disruption if its duration is less than 24 hrs. Notification shall be given at least 1 week in advance if disruption is anticipated to last more than 24 hrs.

5.4.1 IMPACTS ON AIR QUALITY

Main Sources of Impacts

The main sources of air pollution are machines burning fuel for digging, transportation and loading. Dust and waste gas from these machines affect air quality in the surroundings of construction work places. Areas most affected are located in a range of around 50 m all around project sites, but also along the main access roads to sites which will be supporting heavy traffic of trucks. Carbon dioxide and other harmful pollutants may also be released through the burning of waste on construction sites, including plastics.

The production of dust is generally the most widely perceived nuisance generated by earthworks and transport on non-surfaced roads during dry season. Works carried out for water supply network rehabilitation may significantly generate dust if no preventive measure is applied during excavations.

Mitigation Measures

Best management practices will be adopted during construction to minimize dust and combustion exhaust emissions. Mitigation measures to be implemented by the Contractors to minimize impacts on air quality shall comply with IFC guidelines on construction, which shall be at a later stage detailed in the bidding specifications. Main mitigation measures include:

- Reduce pollutant emission at source: Wherever possible, use electrically-powered equipment rather than gas or diesel-powered equipment; Use only vehicles and equipment in good condition for works in densely urbanised areas; Construction equipment and vehicles shall be well-maintained and meet with applicable national emission standards (MONREC, 2015); Undertake immediate repairs of any malfunctioning construction vehicles and equipment, particularly regarding smoke emission and noise. Maintenance and control of equipment shall be done by the Contractor under the supervision of the PMO..
- Burning of wastes generated at the construction sites, work camps and other project-related activities shall be strictly prohibited.
- Position any stationary emission sources (e.g., portable diesel generator, compressor, etc.) as far as is practical from sensitive receptors and residents.
- Control the risk of dust release: Keep excavated soil moist and cover vehicles and stockpiles with tarpaulin sheets or other suitable materials to minimize dust emission and prevent spillage of materials (e.g. soil, cement, stone, sand, aggregates, etc.). In dense residential area, spoils shall be loaded and transported immediately; provide wheel cleaning for any truck/car leaving muddy construction site (as the future new landfill or the water treatment plant) and accessing to public road; clean daily road surfaces of debris/spills from construction equipment and vehicles in the vicinity of activities.
- Ensure availability of water spaying facility on site if the works area is not surfaced, or dry and dusty, near sensitive receptors (i.e. residential areas, roadside tea and food stalls, monasteries, schools, hospitals and other sensitive receptors). Spray water on the exposed surfaces to reduce dust emission.
- Impose compliance with speed limits of construction vehicles (generally 30 km/h) to minimize dust emission (as well as the risk of traffic accident).
- Provide prior notification to the community on schedule of construction activities which may generate some dust and implement 24 hour community grievance hotline.

5.4.2 IMPACTS FROM NOISE AND VIBRATION

Sources of Impacts

Works for the rehabilitation of the water supply network could be the most impacting activity in terms of noise nuisances due to the operation of equipment like backhoes or jackhammers in the immediate vicinity with residences. Along the hauling roads for material and equipment, the average noise level will probably rise because of increased truck traffic.

Table [27]**Error! Reference source not found.** provides some typical noise levels m easured at various distances from the emission point related to various construction machineries. . These values are indicative and already used since several years. More efficient systems of noise abatement are available on recent equipment.

Table [27] NOISE LEVEL OF VARIOUS CONSTRUCTION EQUIPMENT IN DBA

Equipment Type	15 m	30 m	50 m	100 m	200 m
Excavator / Backhoe	78	72	67	61	53
Bulldozer	78	72	67	61	53
Jackhammer	89(1)	83	78	72	66
Air compressor	75	69	64	58	52
Vibrator	76	70	65	59	53
Mixer	75	69	64	58	52
Truck	76	70	65	59	53

(1): According to IFC-EHS Guidelines, PPE (ear plugs) must be provided to staff working in noisy environment starting from 80dBA.

At night, construction noise would impose a severe nuisance on the residents in the vicinity, especially those located at less than 50 m from activities. Night working and especially the use of the noisiest equipment during the night should then be strictly prohibited.

The present draft of the National Environmental Quality (Emission) Standards of Myanmar (December 2014) imposes restrictions regarding noise levels which should not exceed the values presented in Table [28], or result in a maximum increase in background levels of 3 dBA at the nearest receptor location off-site.

Table [28] DRAFT NATIONAL STANDARDS FOR NOISE LEVELS

Receptor	One Hour LAeq (dBA)	
	Day time 07:00 – 22:00 (10:00 – 22:00 for Public holidays)	Night time 22:00 – 07:00 (22:00 – 10:00 for Public holidays)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: MOECAF, 2014 and IFC EHS, 2007

Mitigation Measures

- Before site works commence, a Noise Control Plan shall be prepared by the Contractor and shall be non-objected by the PMO. The plan shall provide details of mitigation measures, specific location and schedule where such measures shall be implemented to minimize impacts to sensitive receptors (residential areas, schools, hospitals, etc.) due to construction works, sourcing and transport of construction materials, and other project-related activities.
- Restriction of noisy construction activities as well as the transport of materials to day time from 7:00 AM (10:00 AM on public holidays) to 10:00 PM, and enforce in residential areas the suspension of the works during night time.
- Reduction of noise level for surrounding population through a set of measures: Select equipment with lower sound power levels, install silencers for fans, install suitable mufflers on engine exhausts and compressor components, install acoustic enclosures for equipment casing radiating noise, install acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier, position any stationary equipment that produce high noise levels (e.g., portable diesel generators,

compressors, etc.) as far as is practical from sensitive receptors. Whenever possible, completely enclose noisy equipment which can reduce noise level by 15-25 dB(A) and restrict duration of use of noisy equipment (e.g. 15 min for every consecutive 30 min period); erect temporary walls around the construction sites, as necessary, especially near sensitive areas such as schools, hospitals, administration buildings, monasteries, etc. All construction equipment and vehicles shall be well maintained, regularly inspected for noise emissions, and shall be fitted with appropriate noise suppression equipment consistent with applicable national regulations;

- Training of truck drivers: minimization of the use of horn, compliance with speed limitation particularly in residential zones.
- Provide prior notification to the community on schedule of noisy construction activities and implement 24 hour community complaint hotline.

5.4.3 OFF SITE PUBLIC SAFETY AND INCONVENIENCE

Source of Impacts

All activities involving work along public roads (as construction of solid waste collection, water supply network rehabilitation or extension) will definitely reduce the accessibility to certain streets, reduce the number of usable lanes and create traffic congestion. The presence of population including children next to construction activities where heavy machinery is operating and with the presence of excavations and construction equipment will create additional risks for public safety.

Also, the working area may temporary alienate access to work sites, schools and community facilities. In addition, retail merchants may suffer economic losses if access is denied to their establishments. The project will be required to take all the necessary measures in order to minimize the detrimental side effects of construction activities particularly regarding traffic and public safety.

Mitigation Measures

The following measures shall be implemented by the contractor to address impacts to traffic flow and access to properties:

- Before site works commence, a Traffic Management Plan for the construction phase shall be prepared by the concerned contractors and shall be approved by the PIC. The plan shall be designed to ensure that traffic congestion due to construction activities and movement of construction vehicles, haulage trucks, and equipment is minimized. The plan shall be prepared in consultation with local traffic police. The plan shall identify traffic diversion and management, define routes for construction traffic from materials storage/parking areas to construction site and from construction site to waste disposal locations, traffic schedules, traffic arrangements showing all detours/lane diversions, modifications to signals at intersections, necessary barricades, warning/advisory signs, road signs, lighting, and other provisions to ensure that adequate and safe access is provided to cars, motorists and pedestrians in the affected areas.
- Provide signs advising road users that construction is in progress and that the road narrows to one lane using cones.
- Employ flag persons to control traffic at sites for safety reasons when construction equipment is entering or leaving the work area.
- Lanes through the work site created by rope or flagging, shall be developed to minimize risks of injuries.

- Post traffic advisory signs (to minimize traffic build-up) in coordination with local authorities
- Provide road signs indicating the lane is closed 200 m before the worksite and signs to indicate the proposed detour road.
- Provide sufficient lighting at night within and in the vicinity of construction sites.
- Regularly monitor traffic conditions along access roads to ensure that project vehicles are not causing congestion.
- As much as possible, schedule delivery of construction materials and equipment as well as transport of spoils during non-peak hours.
- Implement suitable safety measures to minimize risk of adverse interactions between construction works and traffic flows through provision of temporary signals or flag controls, adequate lighting, fencing, signage and road diversions.
- Comply with traffic regulations and avoid, where possible, roads with the highest traffic volumes, high density of sensitive receivers or capacity constraints are not used as access to and from the construction areas and spoils disposal sites.
- Provide induction training on road safety to drivers and ensure they comply with regulations regarding speed and the ban of alcohol when on duty.
- Install temporary accesses to properties affected by disruption to their permanent accesses.
- Reinstate good quality permanent accesses following completion of construction.

5.4.4 IMPACTS FROM WASTE PRODUCTION

Source of Impacts

Quantities of solid waste will be generated by construction activities or by worker camps and canteens. A plan for managing all these types of waste needs to be put in place. There are three categories of waste to consider: domestic waste, inert construction waste and hazardous waste.

The quantity of domestic waste, mainly produced by temporary or permanent camps set up for the needs of the project, can be estimated at 0.5 to 0.7 kg/person/day. This waste mainly includes waste from canteens, packaging, plastic bottles, glass bottles, paper and cardboard. As the project is located in an urban area which may supply most of the manpower required, it is not anticipated large worker camps, but small camps on the sites to ensure a presence 24h and the protection of the equipment. Production of waste should be rather limited nevertheless it is worth being properly managed.

Inert construction waste is generated on the construction sites in variable quantities. It consists mainly of wood, packing boxes, scrap, plastics and concrete debris (the later coming from the few demolition required). This waste is generally disposed of, and landfilled in appropriated sites or in permanent inert materials sites. They represent no direct danger to health. Scrap metal is generally collected for recycling. Wood and cardboard waste if burnt on site will produce fumes and nuisance for the neighbourhood.

Hazardous waste such as vehicle batteries, oil filters, various containers that had held hazardous products (mainly paints, solvents, glue) and other alkaline/lithium ion batteries is generated by construction activities, but in specific places and in limited

quantities. This waste is harmful to the environment and public health and must receive appropriate treatment so as to ensure it is eliminated safely. The main risk comes from used engine and hydraulic oil resulting from the maintenance on site of heavy equipment (backhoe, bulldozer, levellers, etc.) and which may be produced in significant quantities. If released on the ground, these hydrocarbons will involve surface and underground water pollution. The present project does not anticipate the maintenance of trucks on site, as the project is developed in an urban area where garage facilities are available for trucks. Hazardous waste also includes sludge from temporary toilets to be installed on construction sites within urbanized areas.

Mitigation Measures

EHS specifications for bidding documents will follow and detail EHS guidelines from IFC (2007). Prior to the start of the works, the contractor shall be requested to prepare a Waste Management Plan addressing the management issues related to all types of waste and providing anticipated production and schedule, collection system proposed, disposal methods and location. The Plan shall reflect the following obligations:

For Non-hazardous Waste

- Provide garbage bins and facilities within the project sites for temporary storage of construction waste and domestic solid waste and ensure that wastes are regularly removed by the concerned department of Hpa-An or Myawaddy Township Development Committee and transferred to the existing landfill until new landfill is operational.
- Promote recycling on site and store material in appropriate storage areas before removal by/transport to recycling companies.
- Implement an employee awareness program in waste management and site cleanliness.

For Hazardous Waste

- Any waste engine oil and hydraulic lubricants from heavy machinery and the floating oily residue from oil separators will be collected and stored in tightly sealed containers to avoid contamination of soil and water resources. Transport and off-site storage of such wastes for recycling shall be presented in the Plan.
- Any container of such waste will be stored in a dedicated area with waterproof floor surrounded by a bund the height of which will ensure retention of a volume equal to at least 110% of that of the largest container stored in the area.
- Batteries, vehicle batteries, oil filters from the site will be sorted and deposited in separate containers. The contractor will identify a circuit for elimination/recycling of these products and will submit his choice to the PMO for non-objection.
- Any medical waste (in probably very small quantities) from the First Aid station on site shall be safely stored in a container before being delivered to the landfill area where the content will be burnt as none of the hospital or clinics is equipped with an incineration system.
- Metal or plastic containers that have contained hazardous or toxic chemical substances (mainly hydrocarbons, paints and glue) shall be collected with other hazardous waste for treatment and safe storage prior to recycling in a metal smelter facility).

As no facility does exist in Hpa-An and Myawaddy or even in Myanmar for the treatment and safe disposal of hazardous waste, it is proposed to implement, within

the premises of the landfill area a temporary disposal area for hazardous waste, where the contractors will deliver all hazardous waste produced on the construction sites. This disposal area shall be implemented in priority at the start of the landfill construction works in order to service all contractors involved in the project.

5.4.5 HAZARDOUS MATERIAL MANAGEMENT AND ACCIDENTAL SPILL

According to the type of construction activities anticipated for the present project components, it is not anticipated any significant storage of fuel on sites, as works are mainly implemented in urbanized areas with gasoline stations available. However, small quantities will probably be stored on site in jerry cans or 200 l drums to refill small equipment (compressor, generator) or heavy machinery (backhoe, bulldozer etc.) with related risks of accidental spillage. To avoid any leakage when refuelling on site, the contractor will be required:

- To store fuel or engine oil (as well as any other hazardous product as paint or solvent) in dedicated storage areas compliant with applicable good practice: storage bottom waterproof surrounded by a bund providing a safe retention capacity in case of accidental spillage or leakage of at least 110% of the largest container stored. The storage area shall be covered to be protected from the rain.
- To set-up a refuelling procedure for mobile equipment involving (1) the use of leakage-collection equipment, (2) a training program for the workers in charge of refuelling, (3) the availability of spill clean-up materials (e.g., absorbent pads, fine sand, etc.) specifically designed for petroleum products, and (4) the availability of an extinguisher.
- To train relevant construction personnel in handling of fuels and spill control procedures.

5.4.6 IMPACTS ON WATER RESOURCES QUALITY AND USE

Source of Impacts

A water intake in Hpa-An will be constructed respectively on the Thanlwin river. Works will involve some activities on the river banks, with potential water pollution risks. The receiving environment, both terrestrial and aquatic represented by the Thanlwin river bank in a densely populated urban area presents a low sensitivity regarding ecology: limited vegetation, mainly weeds, and limited aquatic ecology as the foot of the river bank is mainly muddy. However, the risk of accidental spill of chemical (diesel, oil, paint) as well as the increased turbidity of the water during works in the water or just nearby could happen and needs to be minimized if not avoided by appropriate preventive measure to be implemented by the contractor:

- Release of suspended sediments during excavation works on the bank of the river as required for the construction of the structure and the transmission pipe;
- Chemical contamination by leakages of engine oil, hydraulic fluids or fuel from the machinery during works;
- Biological contamination from the workers;
- Release of solid waste from the workers.

Works for the rehabilitation of the existing water supply network, particularly the change of the main pipes, may alter the quality of the water distributed by increasing temporarily sediment load or by creating contamination sources.

Mitigation Measures

The contractor shall be required the following prevention measures for works carried out adjacent to river body:

- Ensure equipment used for works is free of leaks and excess oil or grease
- Storage of fuel and chemicals and equipment refuelling operations shall be organized at least 50 m away from the water body on an efficient retention storage facility;
- The contractor shall submit an emergency plan in case of accidental spillage of hazardous product into the reservoir, describing the measures it intends to take in case of such event.
- Minimize disturbance of vegetation on surrounding areas. Cut brush off to ground height where needed but without disturbing the roots, to allow vegetation regrowth from root stocks and reduce risk of erosion and sediment transfer to the river.
- When muddy water is pumped from excavation works, it shall be transferred into a sediment trap or pond to collect as much as possible sediment before returning water in the river.;
- Equipment shall be washed in a dedicated area located at least 30 m from the river bank and the resulting wastewater (including grease, oil or cement) collected in a sediment pond.

For rehabilitation works on the main water supply network system, methods shall be selected to avoid risks of contamination of water supplied. Prevention of earth and wastewater or any contaminated water or chemicals from entering the distribution system shall be implemented. Training of workers shall be required to ensure the respect of the specific measures to be developed.

5.4.7 IMPACTS ON CULTURAL HERITAGE RESOURCES

Source of Impacts

Even if no valuable physical cultural resource has been identified from the project sites in Hpa-An and Myawaddy, impacts on archaeological relicts may still happen, particularly during earthwork excavation in the streets for the rehabilitation of the water supply network.

Mitigation Measures

The following measures shall be implemented by the Contractor:

- For any works carried in streets following religious and cultural heritage buildings, a protection of the surrounding walls shall be put in place in the areas the closest to the works. The protection shall consist of a mobile fence to ensure at least 1m safety distance between works and the preserved structure. This safety distance shall also be used for the passage of pedestrians.
- No activity generating vibrations shall be authorised next to a cultural heritage building to avoid any risk of degradation. Appropriate equipment and methods shall be implemented in such places.
- Any time, to dispose earth, materials, pipes, equipment etc. directly against a heritage structure (or its surrounding wall) shall be strictly forbidden.

- The owner of the building or the monk community and the government heritage staff concerned shall be informed of the measures imposed to the contractor and will ensure these are enforced 24/7 during the works. In case of breach with these obligations, the PMO shall be contacted for immediate corrective measure.

The contractor shall implement a "chance to find" procedure throughout the construction works to account for any undiscovered items identified during construction/excavation works. The procedure shall include the followings:

- Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance. This training shall be provided by an experienced professional in cultural heritage;
- Should any potential item be located, the site supervisor will be immediately contacted and work will be temporarily stopped in that site.
- If the site supervisor determines that the item is of potential significance, a representative from the Department of Archaeology and National Museum (DANM, Ministry of Culture) shall be invited to inspect the site and work will be stopped until he has responded to this invitation.
- Work will not resume in this location until agreement has been reached between Kayin State Government and DANM of Hpa-An as to any required mitigation measures, which may include excavation and recovery of the item.
- A precautionary approach shall be adopted in the application of this procedure.

5.4.8 HEALTH AND SAFETY OF WORKERS

Source of Impacts

The project will concentrate a number of workers, mostly recruited from Hpa-An or Myawaddy. Inappropriate accommodation or food quality may result in communicable diseases and outbreak of water, hygiene and mosquito related infections. Inappropriate safety conditions on construction sites may lead to accidents, muscular diseases and eventually fatalities. Issue of occupational health and safety (OHS) is a major one in Myanmar, where these aspects are hardly considered on most construction sites observed. It may also represent a risk for the surrounding community if construction sites are not sufficiently fenced.

Mitigation Measures

To ensure appropriate health and safety conditions for the workers, and in compliance with the requirements of the ADB or any other international lending Agency, a Health and Safety Management Plan shall be prepared by the concerned contractors and shall be apprnon-objectedoved by the PMO. The Plan shall be designed to ensure that Myanmar labour regulations and international good practices (ILO, IFC ESHS Guidelines) related to health and safety are complied with and measures efficiently implemented on site. This Plan shall also be considered as a pilot experience for the Hpa-An and Myawaddy municipalities to be systematically replicated for further construction projects.

The OHS Plan will address the following obligations:

- To identify health and safety hazards associated with construction activities (e.g., working at heights, work in confined space, permits to work, excavations and trenching, etc.), establishment and operation of construction/worker's camps, use of heavy equipment, transport and handling of materials and hazardous products (fuel);

- To ensure no UXO may remain on site prior to start excavation works (mine detection program);
- To propose for each potential risk appropriate and realistic prevention measures;
- To appoint an Environment, Health and Safety (EHS) Coordinator to look after implementation of required EHS measures, and to ensure the safety of the public in the vicinity of construction areas;
- To conduct awareness training for construction workers regarding occupational health and safety measures, hygiene, emergency response in case of accidents, fire, etc., and prevention of water related diseases;
- To provide first aid facilities in all working sites, particularly in those located outside the urban area: first aid kits in sufficient numbers with content complying with OSHA standard No. 1910.266 App.A, first aid officer present any time on site during working hours (at least 1 first aid officer per shift of 10-50 workers), first aid officer and stations clearly identifiable on sites;
- To provide fire-fighting equipment (extinguishers) on the work sites;
- To provide adequate accommodation for all workers living in a worker camp including building of acceptable quality, room size, sleeping equipment (bed, mattress, sets of bed sheets and blanket, mosquito net, storage area, light etc. ESHS specifications for bidding documents will elaborate in detail on all these requirements.. It is anticipated that the worker camps will accommodate only a limited number of workers as most of them should be resident either in Hpa-An or Myawaddy and should not require accommodation in camps;
- To provide reliable supply of potable water on work sites and in camps controlled at least on a weekly basis for residual chlorine and coliforms;
- To provide separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers.
- To establish clean canteen/rest area.
- To ensure proper collection and disposal of solid wastes produced within the construction and camp sites.
- To provide solid fencing on all areas of excavation greater than 1 m deep. For all worksite areas without excavation, provides movable barriers to prevent accident with surrounding residents.
- To provide personnel protection equipment (PPE) appropriate to the job: at least helmets and safety boots to all workers, and depending on job safety risk, to provide also gloves, protective clothes, goggles and ear protection where justified and ensure the equipment is effectively and adequately used.
- To ensure reversing signals are installed on all construction vehicles.
- To implement fall prevention and protection measures whenever a worker is exposed to the hazard of falling more than two meters, of falling into operating machinery or of falling through an opening in a work surface. Based on a case-specific basis, fall prevention/protection measures may include installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area, proper use of ladders and scaffolds by trained employees, use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard, fall protection devices such as full body harnesses, etc.
- To secure all construction sites inside urban areas from entering for the surrounding population and particularly for children.

5.4.9 SUMMARY OF IMPACTS AND MITIGATION MEASURES

Table [29] summarizes the impacts identified and the corrective measures proposed for the Third GMS Project Components during the construction period. For the meaning given to the evaluation of the impact, see Section 5.1 on Methodology for Impact Assessment.

Table [29] POTENTIAL IMPACTS AND MITIGATION MEASURES RELATED TO PROJECT CONSTRUCTION

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implemen-tation	Overall Risk after Correction
Land preparation	Excessive destruction of trees	Limited impact for the whole project. Most of the project sites proposed in Hpa-An and Myawaddy is in forested areas. Mainly individual trees may be affected in urban area when rehabilitating and expanding the water supply network. Demolition of the Bar-Mae Hill reservoirs in Hpa-An followed by construction of new reservoir may impact, surrounding dense forest,	3	1	1	Monitoring of tree cutting by PIC, and maximization of conservation	1	1
			3	1	1	Mitigation greening program considering at least 2 trees planted for 1 mature tree cut. Consider plantation of a greenbelt around the landfills, at least 50 m width using fast growing trees as Eucalyptus or other appropriate local species, to create a buffer zone with surrounding development areas. In Bar-Mae Hill, detailed design of reservoir to adapt to available area without tree cutting. Any request by Contractor for tree cutting shall be submitted to non-objection of PMO and Kayin State Forestry Dept. Monitoring by PMO & KSFD	1	1
	Destruction of protected tree species	Based on literature and direct observation, none of the species identified in Hpa-An or Myawaddy has a status of protected species (national or international)	1	2	1	Vigilance of the PIC during land preparation activities	1	1
	Interference with compensation & resettlement	Construction works start while land acquisition is not completed, raising conflicts with concerned owners. Risk limited but possible	1	3	2	Procedure with issuance of a land access certificate by PMO as a prerequisite for authorizing contractor to access the land.	2	1
						Monitoring by PIC of compensation progress and of issuance certificate	1	1

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implemen-tation	Overall Risk after Correction
Workers' camps	Pollution of surface water and groundwater	Wastewater discharged into the environment	3	2	2	Wastewater receives treatment before being released outside premises in compliance with MONREC domestic effluent standards	2	1
						Contractor to monitor the quality of effluents released outside the bounds of the camps	2	1
	Zones of stagnant water	Proliferation of water-borne disease vectors as dengue fever or malaria	2	3	2	Create and maintain ditches to ensure efficient drainage and drain all stagnant water zones in camp	2	1
						Regular treatment of living areas with pesticide in compliance with authorised pesticides in Myanmar and EHS IFC guidelines	2	1
	Health risks	Development of diseases among workers because insufficient hygiene in camps and construction sites	2	2	2	Systematic awareness sessions for all new arrivals at the camp: meetings, posters in circulation areas, monitored by the camp chief	1	1
		Risk of epidemics in the camps	2	2	2	Prevention by automatic medical check-up at hiring	1	1
						Monitoring of hygiene conditions at the camps	2	1
						Anti-malarial prophylaxis, including mosquito netting	1	1
	Workers' living conditions	The most serious impact would be the contractor not providing acceptable housing and subsistence for workers.	2	3	3	Include detailed specifications on camp equipment and management in the tender documents. Enforce contractor obligations on site by regular site inspections (PMO)	1	1

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implemen-tation	Overall Risk after Correction
	Non-potable water supplied to workers.	Impact on public health, risk of epidemic. Main risk at the WTP and landfill sites where worker camps may be installed. Other project components located within urban areas, where camp facilities may not be required. However, water supplied on construction sites may also be of bad quality with impacts on worker's health	1	3	2	Tender documents to define obligations of contractors regarding supply of potable water in camps and on construction sites.	1	1
						Contractor and PMO to regularly monitor coliforms or residual chlorine (if not industrial drinking water bottles supplied)) by reference to MONREC/WHO standards	2	1
Workshops and garages	Water and soil pollution	Such facilities should not be required in the urban area. One workshop may be installed near the landfill component considering extent of civil works. Storm water drainage contaminated by pollutants (mainly oil & grease)	3	2	2	Drains of workshops and garages equipped with oil separators	2	1
						Properly store hazardous products (including hydrocarbons). See activity "Use and storage of hazardous products"	1	1
						PMO to monitor and control used oil: Monitoring registers/logs and dedicated storage areas.	1	1
Excavations in urban area	Loss of cultural resources	Possible archaeological physical resource discovery during excavation work with the total loss of the relic if special measures are not taken.	1	2	2	Put in place a "Chance to Find" procedure aimed at halting work and warning the supervisors and the national authorities concerned for conservation measures to be taken to preserve the discovery and restart work as quickly as possible. Ensure personnel are aware of the procedure.	1	1
Hazardous waste management	Water and soil pollution	Located in urban area, most truck maintenance will be done in private garages. Only heavy machinery will	3	2	2	Require the contractor to prepare a hazardous waste management plan explaining where and how he will manage used oils	1	1

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implementation	Overall Risk after Correction
		receive basic maintenance and refuelling on site. Limited volumes of used engine oil and used hydraulic oil will be produced on site and will need appropriate storage to avoid soil and water pollution				Use storage sites that meet safety standards (with retention)	2	1
						Identify the existing used oil recycling facilities in Hpa-An and Myawaddy (none identified so far except re-use as paint for wood houses). Identify possibility of treatment in Thailand.	1	1
						Contractor to maintain a log of production/recycling of used oil	1	1
Production of non-hazardous solid waste	Water and soil pollution	By domestic waste: Possible impact if the waste is not managed in line with best practices in the worker camps and construction sites.	3	2	2	Contractor to submit a Solid Waste Management Plan including methods and procedures for (i) Awareness training of workers, (ii) collection and storage of waste on project sites, (iii) selective collection and recycling of waste (iv) eventual collection and disposal of waste, (v) coordination with Hpa-An and Myawaddy TDC/Development Affairs Committees/ Cleansing Departments	1	1
		By construction waste: Limited risk for inert products which may be associated to the fill required for other project components	2	1	2	Ensure recycling of metals, plastics and glass	2	1
Concrete production	Water pollution	Typical impact is water pollution by the alkaline wastewater from equipment and concrete trucks cleaning. This may concern the WTPs and the intakes in Hpa-An and Myawaddy.	2	2	2	Install a sedimentation pond with pH buffering before release of water in the natural drainage system	2	1
						Contractor (and PIC) to monitor the quality (SS, pH) of effluent released	1	1

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implemen-tation	Overall Risk after Correction
Spoil Disposal	Excessive use of productive land to dispose the spoil	Spoil expected particularly from the demolition of the Bar-Mae reservoirs and land excavation for WTP	3	1	1	Contractor to identify surrounding development projects involving land reclamation in low lying areas which could benefit the availability of spoil.	-	-
		Spoil from landfill construction to be disposed over productive land in Hpa-An and Myawaddy	2	2	2	Spoil could be stored on the landfill area for use as cover soil for waste during landfill operation or used as fill for extension of nearby IZ or TZ	1	1
Road Traffic	Public safety	Risk of road accidents related to truck traffic increase in urban zones for the transport of equipment and materials. Limited increase is anticipated as works will require limited quantities of materials/equipment (	2	3	2	Selected hauling routes and preventive/monitoring measures to be presented by the contractor in the Road Traffic and Access Plan	1	1
						Monitoring of driver behaviours in relation with Police Department	1	1
	Risk of traffic disruption in urban zones	Most sensitive areas in small streets concerned by rehabilitation of water supply network.	3	2	3	Road Traffic and Access Management Plan to be prepared by contractor shall detail procedures for traffic management: coordination with police, public information, signs and safety etc.	2	1
	Air pollution	Excessive exhaust gas emissions	3	2	2	Keep engines serviced	2	1
		Production of dust	3	2	2	Speed control, regular sprinkling of sensitive urban areas and on construction sites, cleaning of truck wheels when exiting muddy sites	2	1

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implemen-tation	Overall Risk after Correction
Handling of hazardous products	Fire risk	Related to the storage of flammable products: hydrocarbons, paints, solvents. Potential risk on most sites involving heavy machinery	1	3	2	Provide fire equipment (extinguishers, fine sand) and safety posters displayed at each site.	1	1
						Set up a safety procedure and awareness/training for personnel concerned.	1	1
	Risk of accidents to personnel	Skin burning during handling operations, but risks quite limited for such type of project (few hazardous products only)	1	3	2	Provide training for personnel plus personal protective equipment and onsite safety data sheets for the products concerned	1	1
	Water pollution	Potential risk of accidental spillage: Leak in a storage tank, accidental spillage when handling or refuelling engines, road accident when transporting hydrocarbons.	2	3	2	Contractor to prepare hazardous products management plan, in particular: Store using containment trays, measures for preventing and detecting leaks and accidental spills, register/log of hazardous products and their use, antipollution equipment.	2	1
		Works on water intakes more sensitive as in Hpa-An and Myawaddy existing water intakes operate downstream project works.				Emergency response procedure in the case of accidental spillage	2	1
						Special safety procedures for refuelling engines onsite	1	1

Component or activity	Potential risks	Description of Potential Impact	Impact assessment			Corrective or support measure		
			Probability	Gravity	Overall Risk	Description of Measure	Easiness of Implemen-tation	Overall Risk after Correction
All Components and Activities	Occupational Accident of workers	As observed at on-going construction sites in Hpa-An or Myawaddy, occupational safety of workers is almost inexistent, with high risks of injuries and accidents during construction activities	3	3	3	Contractor to prepare and enforce a Health and Safety Plan to describe organisation, prevention and measures in case of accident. Particular attention dedicated to measures in urban areas (rehabilitation/extension of water supply network)	2	1
						Obligation of Personal Protective Equipment (PPE) for all workers on project sites, minimum being helmet and safety shoes	2	1
						Main contractors to designate a HSE Coordinator to ensure safety measures are enforced on sites	2	1
						Regular construction site inspections of PIC	1	1

5.5 Impacts during Operation stage

5.5.1 IMPACTS ON/FROM FLOODING

In Hpa-An

The water intake in Hpa-An is implemented along the Thanlwin river bank. The design takes already into consideration the fluctuation of river water level between dry and wet season and includes an additional safety board which covers for the potential sea level rise which will subsequently impact the Thanlwin level. All sensitive electro-mechanical equipment shall all be located above the maximum anticipated water level.

Impact of abstraction on the river regime is insignificant. Indeed, the project will pump 10 000 m^3/day or 115 l/s. Other existing pumping systems on the river for the water supply of Hpa-An is estimated at 3 500 m^3/day, or 40 l/s. Total abstraction after project implementation will be about 150-200 l/s, or only 0.01% of the Thalnwin low flow discharge (2 000 m^3/s). There is no anticipated impact on other current river uses.

The water treatment plant site is located in an area located next to the city lake and regularly flooded when the water level of the lake rises during the wet season. The lake level can depends on the Thanlwin river level as a sluice gate is installed at its outlet. The dike road next to the site is reported by the authority as having never been flooded. This level, which is about 3.5 m above the site bottom level shall be considered as the minimum safety level for the plant and is already considered in the design.

In Myawaddy

In Myawaddy, the project does not intend to pum directly in the river but to pump from a draining gallery developed in the alluvial aquifer. There is no direct impact on the Thaungyin River. The design of the facility follows the same flood safety principles than anticipated for Hpa-An, in particular all sensitive electro-mechanical equipment shall be secured in a building well above the maximum anticipated water level.

The water treatment plant located in a wide agricultural area shall not be subject to flooding.

None of the project components in Hpa-An and Myawaddy is in a position to generate flooding or to increase flooding conditions. The improvement of solid waste collection in both towns will have direct beneficial impacts on urban drainage which is presently severely clogged by dumped waste, resulting in localised flooding during heavy rainfall events.

5.5.2 IMPACTS ON UNDERGROUND WATER RESOURCES

The water supply components of the project in Hpa-An relies on surface water sources and does not exploit underground resources. The proposed infiltration gallery in Myawaddy will exploit sub-surface water from the Moei River baseflow. Extraction rate will be 9 000 m^3/day (or 100 l/s) in addition to present water pumping in the alluvial aquifer of about 2 000 m^3/day (or 23 l/s). With a total abstraction rate of about 125 l/s in the alluvial aquifer, it represents only around 2.5% of the river low flow estimated about 5 m^3/s.

Iin the long term, the Project may have indirect beneficial impacts on the underground water resources:

- The water supply component will significantly increase the water supply of the population both in terms of duration of service, volumes and quality of water. Considering that presently people rely partly on low quality underground water (from shallow wells) and on septic tanks for their sanitation, the project will increase the volume of water released to the soil by septic tanks and eventually reduce the dependency on shallow wells, thus improving aquifer recharge;
- The solid waste component will drastically increase the quantity of waste collected and safely disposed in the landfill. At landfill site, leachates will be collected and treated. This component will definitely reduce the pollution load from solid waste which presently percolate into the soil and affects the underground water quality.

However, if leachates from waste piles is not appropriately collected and treated before being released in the environment it may have significant impacts on underground water quality with health threats for the surrounding population relying on shallow wells.

The project design as presented in the Project description Section of this report fully considers this risk and provide for a full collect, treatment and disposal process for the leachate:

- The landfill cell bottom and side slopes will be fully covered by an impervious liner made of high density polyethylene (HDPE) minimum 1.5 mm thick with sheets welted together by a specialized company;
- A drainage system will cover the bottom of the cell including layers of gravels of various grain size with a network of drainage pipes to collect the leachate;
- The leachate will be transferred into an on-site treatment process including physical treatment (sedimentation, settling pond) and biological treatment (oxidation pond);
- Environmental monitoring includes 6 groundwater monitoring wells, 1 well up-gradient of the groundwater flow and 5 wells along the sides in down gradient direction, all wells 30 m away from landfill;

The organic load of the leachate shall be reduced as a part of the biodegradable waste will be diverted to the composting plant to be developed on the landfill site. The composting plant will have a design capacity of 65 t/day, for the treatment of 25% of the generated waste till 2025. In a second stage, the target is to compost 40% of the generated waste with a capacity of 120 t/day. Composting pad, maturing pad and storage pad will be covered, reducing the volume of leachate produced. Leachate produced by the composting plant will be drained and transferred to the leachate treatment facility.

Compost production is intended to be used for agriculture or green urban areas. To maximize the usability of end products (compost), waste should not be accepted that contains organics that are contaminated by potentially hazardous chemicals (e.g., PCBs, chlordane and other pesticides, heavy metals and metalloids) and/or pathogenic substances and micro-organisms (e.g., prions, viruses, bacteria, and parasites) that will not be rendered harmless by the process or may constitute a health or environmental risk. This may include certain clinical waste and other related wastes of clinical origin, and diseased carcasses, or contaminants classified as hazardous or industrial wastes.

5.5.3 IMPACTS ON SURFACE WATER QUALITY

The solid waste component of the Project will have major impact on surface water which is, presently the main receiving body for most of the solid waste generated in Hpa-An or Myawaddy. At the existing dumping site in Hpa-An, leachates are presently released into surface water without any treatment. In Myawaddy, dumpsites are located on the banks of the Moei River, with direct discharge of leachate into the river during dry season and flooding of the dumpsites in wet season. The drastic improvement of solid waste collection and disposal will remove these present sources of pollution but also reduce the pollution load to the drains which eventually flow to the Thanlwin and the Moei rivers.

Waste will be weighted at entrance on the landfill site, then discharged on a platform for sorting and segregating the waste: organic waste to be directed to the compost plant, recyclable waste, hazardous waste (including infectious waste from hospital and clinics) and other dangerous items (gas containers, explosive products, etc.).

Water treatment plant will generate sludge from the treatment process, with potential but limited risk of pollution for water resources. The volume produced may be significant during the rainy season, when turbidity of the Thanlwin River is high. The project anticipates the installation of a thickener to reduce the volume of sludge on site before disposal. It may be considered the use of the thickened sludge as daily soil cover for the landfill. The sludge will consist mainly of mineral material and chemicals used for flocculation is not anticipated to concentrate harmful pollutants.

Treatment of water at WTP level will rely on liquid chlorine.Liquid chlorine may involve a risk of accidental spill. This risk shall be mitigated by a dedicated storage area with an active retention capacity of at least 110% of the largest container capacity stored on site. Dedicated safety training shall be organised for the workers in charge. No residents at risk in the immediate vicinity of the plant.

Measures for the protection of the resource shall also be implemented.

- Ensure no harmful industry discharge untreated and toxic effluents at short distance upstream the water intake/pumpage;
- Ensure that treatment capacity is adequate to meet anticipated demand;
- Construct, operate and maintain the water treatment facility in accordance with national requirements and internationally accepted standards to meet national water quality standards (equivalent to WHO Guidelines for Drinking Water Quality;
- Evaluate the vulnerability of the treatment and storage systems and implement appropriate security measures, such as background checks of employees, perimeter fencing and video surveillance, improve the electrical power feeds to the facilities by secondary stand-by equipment to reduce the vulnerability risk to essential operations.

5.5.4 IMPACTS ON URBAN ENVIRONMENT AND QUALITY OF LIFE

The Project components will eventually contribute to a healthier and cleaner urban environment. Improvement of water supply capacity, rehabilitation/extension of networks and supply of treated water will reduce the population dependency to private or public shallow wells, most being significantly contaminated, and reduce

population expenses related to the purchase of drinking water bottles. Improved collection of waste will contribute to reduce the risk for waterborne diseases among the population and will contribute to improve public health conditions of diseases transmitted through insects or rodents. Improvement of waste collection shall drastically improve the cleanliness of the city.

5.5.5 IMPACTS IN TERMS OF GHG EMISSIONS

Methodology

Green House Gas (GHG) will be produced during construction and operation of the project components, water supply and solid waste management improvement. GHG production shall be limited during construction for both components, mainly related to exhaust fumes from trucks and other thermal machinery relying on diesel. During operation, the water supply component shall also release some quantities of GHG, mainly related to the use of electricity for pumps and treatment plant operation and to the transport of residual treatment sludge to the landfill. The amount released by such activities will be very limited.

However, GHG emissions from conventional solid waste management in Asian countries are considered to contribute significantly to global climate change: methane (CH_4) emission from open dumping and landfilling is considered the third highest anthropogenic methane emission source (IPCC, 2006). These two processes are currently the most common waste treatment methods in Asian countries. In addition, GHG emissions (e.g. CO_2, N_2O) from waste handling, transportation and operation of machinery contribute also in GHG emission, but at a much modest level. Depending on the treatment processes considered, there is a possibility for important indirect GHG savings through materials and energy recovery from waste management which may even result in global GHG emission avoidance.

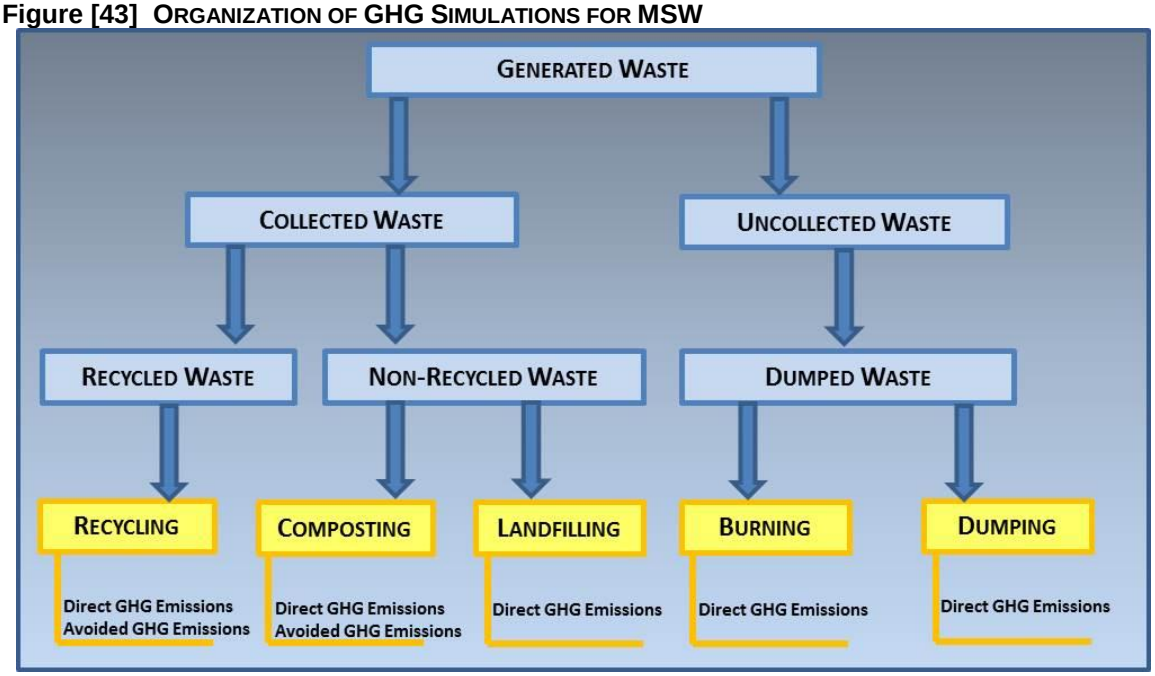
Thus, this section focuses mainly on GHG emissions from waste management components, as they shall provide most of the future emissions from Project components.

Simulations carried out by the PPTA Consultant to quantify GHG emissions from various waste management technologies rely on the IPCC 2006 guidelines from which the Institute for Global Environmental Strategies (IGES) simulation model was developed. The simulation calculates both the total GHG emissions and total GHG avoidance potentials of individual technologies. Based on the total GHG emissions and avoidance values, net GHG emissions are calculated from all the individual technologies considered in the Project.

The net GHG emission value reflects the overall climate impact/benefit of a particular technology taking into account the impact of all the possible resource and material recovery from the waste.

The simulation performed relies on the type of waste distribution in the municipal solid waste (MSW) and on the eventual treatment or disposal of the waste. The general waste processing organisation considered for simulations is presented in Figure 43.

Figure [43] ORGANIZATION OF GHG SIMULATIONS FOR MSW



Source: PPTA Consultant, 2015

In addition to these various processes for which GHG emissions and/or savings are estimated, an additional estimate is performed for waste collection and transport, mainly represented by the combustion of fossil fuel (diesel).

The main assumptions used for the estimate of waste types and quantities are those established by the PPTA Consultant in charge the waste management component and presented in the related Feasibility Study report. Assumptions regarding GHG production per unit of fossil fuel consumption and per unit of specific waste are those recommended by IPCC (2006) for the estimate of national GHG emissions. Decay equations are those recommended by IPCC (2006) and presented by the Institute for Global Environmental Strategies (IGES) from Japan in their Estimation Tool for Greenhouse Gas Emissions from Municipal Solid Waste Management in a Life Cycle perspective[1].

Table [30] MAIN SOURCES AND VALUES OF REFERENCES

Topic	Source or Values of Reference
Waste Collection and Transportation	Diesel consumption estimated in FSR Diesel Energy content: 36,42 MJ/l diesel Diesel GHG emission factor: 0,074 kg CO2/MJ Uncollected waste is 53,17% of generated waste in 2015, 10% in 2020, 2% in 2040

[1]Tool developed by Nirmala Menikpura and Janya Sang-Arun under project « Measurement, Reporting and Verification for Low Carbon development in Asia » (2013)

Topic	Source or Values of Reference
Recycling	GHG emission based on recycling emissions from fossil fuel and electricity consumption from Thailand; Avoided emissions also based on energy required from related material production in Thailand (paper, aluminium, plastic, glass, metal) Recycling is 16% of generated waste in 2015 and 20% from 2020
Managed Landfill	Landfill gas: 60% methane and 40% CO2 Equations regarding decay according to IPCC 2006 Waste Model Model considers emission without/with gas collection & flaring Waste disposed to landfill is equal to collected waste minus recycled and minus composted fractions
Composting	IPCC default emission factors: 4kg CH4and 0,3 kg N2O/ton organic waste (wet basis) Electricity: basis is Thailand grid emissions of 566 kg CO2eq/MWh Composted waste is 25% of generated waste in 2020 and 40% from 2025. 90% of the compost produced is re-used for agriculture or urban gardening as fertilizer substitute
Dumping	Similar to managed landfill but it considers more shallow deposits (<5m) and no collection of landfill gas. Fraction dumped in various locations of the city equivalent to uncollected waste, with 70% decaying as in shallow landfill (<5m)
Burning	Model considers only emission of CO2 Quantity burnt is estimated as 30% of uncollected waste.

Results

Results from the assessment are provided for Hpa-An and Myawaddy for years 2015, 2020 and 2040 in following table.

Table [31] GHG EMISSIONS FROM MSW FOR HPA-AN AND MYAWADDY

GHG Emissions (in tons CO2-eq/year)	Hpa-An			Myawaddy		
	2015	2020	2040	2015	2020	2040
Emissions from Collection & Transport of waste						
Direct Emissions from fossil fuel consumption	9	29	58	19	39	91
Net GHG Impact/Benefit	9	29	58	19	39	91
Emissions from Recycling of waste						
Direct Emissions from recycling	1725	7329	17364	4336	11334	29716
Avoided emissions from material production	-3194	-13567	-32144	-8028	-20982	-55011
Net GHG Impact/Benefit	-1468	-6238	-14780	-3691	-9648	-25295
Emissions from Composting of waste						
Direct Emissions from Plant Operation	N.A.	32	49	N.A.	36	97
Direct Emissions from waste degradation	N.A.	1050	3980	N.A.	1624	6811
Avoided emissions from fertilizer production	N.A.	-5231	-20918	N.A.	-7554	-36008
Avoided emissions from organic waste landfilling	N.A.	-2758	-10457	N.A.	-4266	-17896
Net GHG Impact/Benefit	N.A.	-6907	-27347	N.A.	-10161	-46996
Emissions from Landfilling of waste						

GHG Emissions (in tons CO2-eq/year)	Hpa-An			Myawaddy		
	2015	2020	2040	2015	2020	2040
Emissions of Methane Gas	64	345	592	225	534	1013
Emissions of Methane with gas flaring	N.A.	69	118	N.A.	107	203
Direct GHG emissions without gas flaring	1353	7264	12461	4726	11234	21326
Direct GHG emissions with gas flaring	N.A.	1451	2513	N.A.	2243	4300
Net GHG Impact/Benefit with flaring	N.A.	1451	2513	N.A.	2243	4300
Net Total GHG Emissions from Collected waste	-106	-11666	-39556	1054	-17527	-67900
Emissions from Uncollected Waste	-106	-11666	-39556			
Emissions from uncontrolled dumping	3640	801	413	3307	1239	708
Emissions from waste burning	796	45	4	723	70	7
Net GHG Impact/Benefit	4435	847	418	4030	1309	715
Net GHG Emissions from Generated Waste	4329	-10819	-39138	5084	-16217	-67185

Source: PPTA Consultant, 2015

At present (situation 2015), the highest contribution to GHG for Hpa-An is coming from uncontrolled dumping of waste (3 640 tons CO2eq in 2015) while in Myawaddy it is coming from collected waste disposed in the two dumpsites (4 726 t CO_2eq/year). These figures are buffered in 2015 by the avoided emissions from the recycled waste, totalling 11 200 t CO_2eq/year for the two cities. Present uncollected waste GHG emission is in a similar range for both towns, with about 4 400 t CO_2eq/year for Hpa-An and 4 000 t CO_2eq/year for Myawaddy in 2015. The annual net balance in 2015 is a GHG net emission of 9 410 t CO_2eq/year for both cities.

With the project components, which intend to strongly reinforce waste collection, promote recycling and composting and develop a sanitary landfill with gas collection and flaring, the yearly balance shall be strongly beneficial, **with a GHG net benefit in 2020 of about 27 000 t CO_2eq/year for both cities. In 2040, the net benefit expected shall reach106 300 t CO_2eq/year for both cities**. This beneficial situation results from major emissions avoidance related to recycling and mainly to composting. **Flaring of landfill gas (60% methane) provides also a major reduction of GHG emissions from the managed landfill with 80% abatement.**

5.5.6 IMPACTS ON AIR QUALITY AND NOISE

The project shall have beneficial impacts on Hpa-An and Myawaddy air quality. Indeed, the large volume of rotting organic solid waste dumped in any possible place around the urban area contributes to release unpleasant gas. The several collection points with only degraded containers (or without container) are also places generating smell nuisances to the surrounding population. The several points in the city, where such dumped waste is burnt, release smoke and unpleasant smells. The solid waste component will improve this situation: improving the waste collection will reduce the volume of waste dumped into the drains and open spaces of the city where it either rot or is burnt. The new transfer points proposed will be equipped and managed to reduce gas emission: shorter transit time for the waste, closed containers, closed trucks.

However, handling of solid waste during the collection and disposal process may generate nuisance dust but also bioaerosols (i.e., particles in the air consisting wholly

or partially of microorganisms). Bioaerosols are of particular concern to the health of waste workers and have been shown to be the source of reduced pulmonary function and increased respiratory disease for those in immediate proximity to waste sweeping and collection activities. Recommended management strategies to minimize dust, bio-aerosols, and odours include:

- Establishing frequent waste collection schedules;
- Instituting a washing program for waste collection vehicles and for company-owned waste collection and transfer containers;
- Promoting the use of bags to reduce the odours from soiling of waste collection and transport equipment.
- Cover collection and transfer vehicles along the entire route of transport to avoid windblown litter;
- Clean vehicles used for waste hauling before transportation of any goods, including compost;
- Encourage residents to put waste out at designated times and locations;
- Where possible, blocking off access to dumping sites and fining illegal dumpers.

Specific measures to prevent, minimize and control vehicle air emissions during waste collection and transport include the following:

Optimize waste collection routes to minimize distance travelled and overall fuel use and emissions

Waste collection and transport vehicle owners and operators should implement the equipment manufacturers' recommended engine maintenance, along with the mechanical maintenance for the safe operation of the vehicle, including proper tire pressure.;

Drivers should also be instructed on the benefits of driving practices which reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits (working with garbage truck drivers can save as much as 25% on fuel use and reduce maintenance by 15%).

Additional fleet management recommendations are presented in the General EHS Guidelines (IFC).

The following measures are recommended to prevent, minimize, and control vehicle emissions and emissions of dust, odours, and bioaerosols during waste receipt, unloading, processing, and storage:

- Select vehicles and containers that minimize air emissions during waste loading and unloading;
- Design drop-off points to minimize queuing of vehicles;
- Sweep waste management areas and roads frequently and use water spray for dust control where needed;
- Pre-treat wastes as needed (e.g., solidification, encapsulation, or wetting sufficient to reduce dust but without forming leachate);
- Use enclosed waste handling and storage areas for malodorous wastes or wastes that generate hazardous dust (e.g., asbestos). Enclosed waste storage and handling areas are preferred for all wastes;

- Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions (e.g., bag filter);
- Remove, treat, or dispose of all biological/malodorous wastes in an expeditious manner;
- Use odour-neutralizing sprays where necessary;
- Use negative pressure in processing buildings and appropriate air filtration (e.g., bio filter) to remove odour

In addition, annual medical check-up shall be organized for all waste workers involved in waste collection and in activities on the landfill.Principal sources of noise and vibration include truck traffic, loading equipment (e.g., cranes, wheeled loaders), stationary compactors, balers, grinders, and other treatment and conveyance systems.

Recommended noise management strategies include:

- Construct a buffer zone between the facility and the external environment or locate facilities away from sensitive receptors;
- Include noise and vibration considerations during design, including use of models to predict noise levels at specified noise-sensitive locations, using standardized sound power levels for construction plant;
- Maintain site roads in good condition to reduce noise and vibration from vehicle movements;
- Use acoustic screens around fixed/mobile plant and equipment;
- Select equipment that has low noise emission levels;
- Fit silencing equipment to plant, e.g. baffles/mufflers;
- Use buildings to contain inherently noisy fixed plant equipment (e.g., locate waste shredder in the tipping hall, and enclose tipping hall on all sides) and consider use of sound-insulating materials in construction.

Noise shall not be an issue when compared to the present situation. For waste, only the noise related to the carts and trucks transporting waste is expected. For the water supply component, no noise nuisance is expected as the distribution of water is by gravity and does not include the construction of any pumping station within the urbanized area. All facilities (WTP and landfill) both in Hpa-An and Myawaddy are located reasonably far from residential area (200 to 500m) and shall not create any noise nuisance at night for residents.

5.5.7 SUMMARY OF IMPACTS AND MITIGATION MEASURES

Table 32 summarizes the potential operation impacts of the project components in Hpa-An and Myawaddy with proposed corrective measures.

Table [32] SUMMARY OF IMPACTS AND MITIGATION MEASURES DURING OPERATION PHASE

Component or activity	Potential Effect	Potential impact	Impact assessment			Corrective or support measure		
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	Overall risk after correction
Improved Water Supply Systems								
Operation of two WTP with disinfection stage	Quality of life and public health	Improved water supply security in Hpa-An and Myawaddy with improved public health	-	-	-	-	-	-
		Benefits from disinfection may be erased if disinfection not permanent or not strong enough to reach far points of network	2	3	3	Regular monitoring of residual chlorine and coliforms in the network, to confirm residual chlorine >0.5 mg/l. Operation ensures permanent and appropriate level of disinfection Monthly monitoring of general drinking water parameters	2	2
	Surface water pollution	Risk of pollution or accident for workers by accidental spill of chlorine if chlorine solution is used	1	2	2	Storage area of liquid chlorine to ensure retention capacity of 110% of the capacity of the largest container on site; Regular monitoring of storage and container conditions Training of workers in charge of handling chlorine on safety	1	1
		Pollution of surface water by inappropriate management of grid residues and sludge:	2	1	2	Ensure thickening and drying up of sludge and regular delivery with grid removals to the solid waste landfill	1	1
Operation new urban water storages	Quality of life and public health	Storages provide better water supply safety during peak demand hours; no particular impact or risk anticipated except the fast reduction of residual chlorine in water because of the high temperature in the region	2	3	2	Due to high temperature in the two cities, and 1 day capacity of storage, control of residual chlorine recommended at storage level with possibility of additional chlorination if required	2	1
		Risk of deliberate contamination of water before distribution	1	3	3	To avoid criminal action, ensure access to storage is restricted and sites guarded 24/7	1	1
Operation of 2 new storages in Hpa An	Impact on landscape	New storage implemented on Kyar Inn Mountain in a former pond surrounded by	-	-	-	No particular measure required	-	-

Component or activity	Potential Effect	Potential impact	Impact assessment			Corrective or support measure		
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	Overall risk after correction
		woody vegetation will not be visible from outside. New storage built on the existing 3 storages of Bar Mae hill is also surrounded by dense forest and shall not be visible from outside						
New water intake in Thanlwin river in upstream section of Hpa-An city	Nuisance for surrounding population	Area isolated next to parking area for bus and next to an electric post. No residential property next to it. Limited noise from the pumps.	-	-	-	No particular measure required	-	-
New water pumping in Moei river aquifer to supply Myawaddy	Nuisance for surrounding population	Selected zone is upstream of the city far from residential zone. No nuisance expected.	-	-	-	No particular measure required	-	-
Network Rehabilitation and Extension in both towns	Quality of life and public health	Increase of population serviced will decrease number relying on polluted shallow wells; supply of potable water will reduce dependency to expensive water bottles	-	-	-	-	-	-
Climate Change	Affect water resources mobilised by the project	In Hpa-An, salinity of Thanlwin is anticipated to increase because of sea level rise and penetration of saline water. However, Hpa-An is located enough upstream to avoid salinity increase on the long term.	3	1	1	Long term monitoring of river salinity	-	-
		In Myawaddy, no risk of salinity. The river being of medium size, dry season discharge may follow a decreasing trend on the long term, as a consequence of dry season rainfall reduction	3	1	1	Implementation of a river gauge station and monitoring of river discharge; Identification of alternative water supply resources at medium term	2	1

Component or activity	Potential Effect	Potential impact	Impact assessment			Corrective or support measure		Overall risk after correction
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	
	Increase of flooding risk	Water intakes in Hpa-An and Myawaddy and WTP in Hpa-An integrate CC forecast in their respective designs.	-	-	-	-	-	-
Improved Solid Waste Management								
Improving waste collection	Impact on Water Quality and Drainage	Reduced quantity of waste discharged into the local drainage system and in the surface water bodies Improvement of drainage discharge capacities and reduction of localised flood risk, but risk of solid waste dumping continues by surrounding population, wasting efforts	2	2	2	The achievement of all these positive impacts depends on a major awareness campaign and capacity building on waste management among population of Hpa-An and Myawaddy.	3	1
	Impacts on Quality of life and Public Health	General improvement of city image and quality of life of residents as a result of better waste collection rate	-	-	-			
		Risk of air nuisance if collection points not regularly cleaned	2	1	2	Cleaning procedure for collection and transfers points	2	1
	Impacts on Air quality	Reduction of waste presently dumped in the city shall reduce air pollution from gas, unpleasant smells and smoke from burnt waste	-	-	-	The achievement of all these positive impacts depends on a major awareness campaign and capacity building on waste management among population of Hpa-An and Myawaddy	-	-
	Reduction of pollution load	Collection point will improve waste segregation and management of hazardous waste	-	-	-	Organise and facilitate segregation on sites through public awareness campaigns	2	1

Component or activity	Potential Effect	Potential impact	Impact assessment			Corrective or support measure		
		Description of impact	Probability	Gravity	Overall Risk	Description of measure	Easiness of implementation	Overall risk after correction
Creation of a sanitary landfill with composting plant	Impacts from smells and insects on surrounding population	In Hpa-An, large area of scrub vegetation is available for landfill near industrial zone. Risk of nuisance does exist for the future building of the IZ located the nearest to the landfill In Myawaddy, proposed landfill site is located next to the Trade Zone, with potential nuisances to nearest buildings in the future.	2	2	2	Ensure the presence of a buffer zone of at 250 m width between landfill and IZ or TZ, to be densely planted with trees (if natural vegetation is not sufficient) Daily coverage of fresh waste by soil or WTP sludge to limit smells/insects/rodents Daily cleaning of platforms and equipment	2	1
	Release of GHG by the landfill and composting plant	Landfill and composting process release methane gas. However, when compared with conditions of the present situation, the No project alternative releases much more GHG than with the proposed project.	-	-	-	No specific measure required	-	-

6 PROJECT ALTERNATIVES

6.1 "No Project" Alternative

For water supply, the "No Project" alternative shall maintain the urban population in a situation of the delivery of insufficient and unsafe domestic water. A significant number of wards shall continue to rely on underground water resources, more and more polluted and contaminated by the septic tanks servicing an increasing population, and oblige the population to rely on expensive water bottles for drinking purposes.

For the solid waste component, should no action being implemented and the present 2015 situation for MSW management being maintained on the long term, the cleanliness of the city shall continue to degrade with more solid waste dumped in the urban area creating unhealthy conditions and increasing the clogging of the drainage network, resulting in more frequent conditions of localised flooding during the wet season, with secondary impacts on the city activities and economy.

Furthermore, the "No Project" alternative should have much more detrimental impacts on GHG emissions as presented in following table.

Table [33] COMPARISON OF GHG EMISSIONS WITH AND WITHOUT PROJECT

Situation	Year	Collected Waste				Uncollected	Total
		Collection	Recycling	Composting	Landfilling		
Hpa-An							
No Project	2020	11	-1 872	0	1 725	5 653	5 517
	2040	20	-4 434	0	4 087	13 392	13 064
With Project	2020	29	-6 238	-4 148	1 451	847	-8 060
	2040	58	-14 780	-16 890	2 513	418	-28 681
Difference	2020	18	-4 367	-4 148	-274	-4 806	-13 578
	2040	39	-10 346	-16 890	-1 574	-12 975	-41 746
Myawaddy							
No Project	2020	25	-4 824	0	6 176	5 266	6 644
	2040	66	-12 647	0	16 193	13 808	17 419
With Project	2020	39	-9 648	-5 895	2 243	1 309	-11 951
	2040	91	-25 295	-29 100	4 300	715	-49 289
Difference	2020	14	-4 824	-5 895	-3 933	-3 957	-18 595
	2040	24	-12 647	-29 100	-11 892	-13 093	-66 708
Total Kayin State							
No Project	2020	37	-6695	0	7901	10919	12161
	2040	86	-17081	0	20279	27200	30484
With Project	2020	68	-15886	-10044	3694	2156	-20012
	2040	149	-40075	-45990	6813	1133	-77970
Difference	2020	31	-9191	-10044	-4207	-8763	-32173
	2040	63	-22994	-45990	-13466	-26067	-108454

The results of the comparison shows that GHG emissions from solid waste in Hpa-An and Myawaddy could be reduced by 32,000 t CO2-eq/year in 2020 and even reach 108,000 t CO2-eq/year in 2040.

6.2 Intake Location & Design Hpa An

As part of the interim report, two options were studied consisting of providing water supply from a unique source for both the urban area and the HIZ and secondly from two different sources. As a result of the different technico-economic analysis undertaken it was shown that separate systems for each service area was the most economic option, given the large distance of the IZ from the urban area itself. In addition development trend of the Industrial zone, related water needs and time frame remain uncertain.

During the Interim and Final phases of the assignment further details of the other water supply projects, land availability in Hpa-An have been obtained, allowing to refine and adapt the Project consequently.

Given the latter project, the conclusion to consider separately the urban area and the HIZ was confirmed by the KSG during presentation of the Interim Report. It is understood that an independent water supply project for the Hpa-An Industrial Zone will be financed by the Union Government. However, no details have been obtained as of yet for this project. It was also decided given the relative small size of the JICA project, to ensure that the project proposed as part of the PPTA could be stand-alone and not linked to the former.

Further analysis of the proposed project during the final phase of this assignment focused on the identification of an appropriate site for the intake and treatment plant and the preliminary design of the network facilities (including storage). Three scenarios were considered for the location of the intake and treatment plant site:

Scenario 1: Intake and WTP near /on Bare Mae Hill (or replacing JICA project)

Scenario 2A: Intake to the south of the city with a WTP near Thanlwin bridge;

Scenario 2B: Intake located to the north of the city with a WTP near KanTharYar Lake (several locations have been proposed).

Of these different options, **Scenario 2B** was selected so as to enhance technical functioning, minimize land acquisition and resettlement costs, to be as far upstream as possible to avoid near bank pollutant discharges (existing and future) and finally to be completely separate from the proposed JICA project.

It is firstly proposed to create a new sustainable and robust intake structure to abstract water from the Thanlwin River in the best conditions. A site has been identified along the shore, north of the city and before the main waste water discharges to the river. The area belongs to HTDC and is currently used for water supply purpose with an existing small floating barge (see figure below). Consequently, intake will be replaced with a new main system, using existing building to be rehabilitated.

7 INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

7.1 Consultation and Public Participation Process

Information disclosure and stakeholder consultations were conducted as part of the environmental assessment process. The consultations involved in-depth key informant interviews with relevant Government agencies and focus grouped discussions.

The consultations aimed on environmental issues and concerns affecting the community. Specifically, the objectives of the consultation meetings are the following:

- To present the proposed projects to the stakeholders;
- To solicit views of the stakeholders relative to the proposed project;
- To identify the most important project components for the locals;
- To identify possible environmental issues inherent on the proposed project and to identify mitigation measures to address these issues in the project design.

Preliminary consultations with relevant Government agencies were conducted as part of the IEE of the proposed project. The focus grouped consultations primarily focused on presenting the project components, identifying the most important issue for the locals, receiving inputs and suggestions from the participants regarding environmental concerns arising out of the project, obtain baseline environmental and cultural information for project sites as well as Government clearance requirements and discuss their opinions on the perceived environmental impacts of the project. Suggestions were sought on measures to consider to properly implementing the project and in avoiding any potential adverse impact.

The principles of information dissemination, information solicitation, integration, coordination, and engagement into dialogue were incorporated during the preliminary consultations.

7.2 Consultation Meetings

7.2.1 SCHEDULE AND PARTICIPATION

Main consultation activities held during the PPTA are summarized below.

Table [34] CONSULTATION ACTIVITIES FOR ENVIRONMENT COMPONENT

Date	Activity	Persons met	Location	Purpose
Throughout the project since 27 April 2015	Meetings and interviews	Department heads of township and state Development Affairs	Township Development Affairs offices	To get better understanding of the project and the existing situations, and the requirements for the projects; to obtain perspectives and suggestions from the officers and representatives on the

Date	Activity	Persons met	Location	Purpose
				project
16 October 2015	In-depth key informant interviews	Deputy Director	Forest Department, Myawaddy, Ministry of Environmental Conservation and Forestry.	To gather the common flora and fauna species found in the region, and to discuss the concerns and suggestions regarding the existing environmental situation
30 September 2015, 14-17 October 2015	Public consultation with the ward administrators, stakeholders, solid waste contractor, and NGOs	Ward administrators, Regional officer, International Organization of Migration (Myawaddy), Regional officers of NGOs	Hpa-An, Myawaddy	To disclose the proposed project and gather information on the critical environmental problem in the society, and their concerns and suggestions on the proposed project.
18-20 October 2015	Focus Grouped discussions	Township and wards Development Committee members, Women household leaders, Local organizations	Myawaddy	To disclose the proposed project and gather information on the critical environmental problem in the society, and their concerns and suggestions on the proposed project.

7.2.2 SUMMARY OF FEEDBACK FROM PARTICIPANTS

From discussing with the public and the stakeholders, it was summarized that the necessity of good quality water supply, and the good solid waste management are important for both in Hpa-An and Myawaddy. Some main feedbacks from the discussions are as follow:

- Current water sources especially the private wells have very high concentration of calcium and effect on health negatively. The local people want to have the treated water access.
- In Myawaddy, the most important issue is the landfill site as the locals do not have specifically defined place to throw the solid waste. The existing landfills are along the River Thaungyin and all the rubbish reached into the city after flooding.
- There should be a proper facility to handle the medical wastes.
- There should be a monitoring body during project implementation.
- Public awareness and individual awareness are very crucial to keep the environment clean. More training programs on raising public awareness should be encouraged.
- To bring up the successful project and to avoid unwanted negative impacts on natural and social Environment, proper management along the whole project cycle are very crucial.

7.3 Future Consultations

Information dissemination to, consultation with and participation of affected people and involved agencies reduce the potential for future conflicts and minimize the risk of project delays. Further information and consultations will be carried out before construction starts (during the first year of the project) and during the construction period.

Prior to the start of the construction, consultation will be carried out in all the areas where the proposed project activities area anticipated. The objective will be to provide the local population with accurate information on activities to be undertaken, on the schedule of these activities and on the potential nuisances for them during construction. This information stage, which concerns all the project sites, will be carried out jointly with the team in charge of RP preparation in those areas concerned by compensation and/or resettlement.

During construction stage, consultation will be carried out with local population in specific area where construction activities are expected to start within 1 month. This will be carried out through focus group discussion with residents and key stakeholders (police station, ward heads) on possible nuisances (noise, dust, traffic/access constraint, temporary suspension of public utility, etc.), on safety measures they will have to respect (regarding engines under activity, risks of fall in excavations, risks specific to children etc.) and on the detailed schedule of activities.

At the end of the construction activities in a dedicated site, inspection of site to ensure cleaning and rehabilitation has been done by the Contractor will include interview of residents to possibly identify non-compliance in the rehabilitation of the site.

7.4 Disclosure

The Draft Final IEE will be submitted to the ADB for review and approval. It will then be transferred to the Hpa-An and Myawaddy Town Development Affairs for endorsement. Upon finalization, the final IEE will be disclosed on the ADB's website before the Board Approval, in compliance with ADB Public Communication Policy (2011).

8 GRIEVANCE AND REDRESS MECHANISM

A grievance redress mechanism (GRM) will be established in compliance with ADB's SPS (2009) requirement to prevent and address community concerns and assist the project to maximize environmental and social benefits. The grievance mechanism proposed for the environmental issues follows the same process than the one proposed for the compensation and resettlement issues.

The GRM will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available. Opportunities for confidentiality and privacy for complainants will be honoured where this is seen as important.

8.1 Types of Grievance Expected and Eligibility Assessment

Public grievances addressed by the GRM will most likely relate to environmental issues during the construction phase, as consultations with potentially affected people conducted during project preparation confirmed their basic support to the project. Grievances will most likely include damage to public roads due to heavy vehicle operation and transportation of heavy equipment and materials; disturbance of traffic and increased traffic congestion; dust emissions; construction noise; inappropriate disposal of waste materials; damage to private houses; safety measures for the protection of the general public and construction workers; water quality deterioration, disruption of services (water supply, electricity), loss of access, etc.

During operation, grievances will most likely include nuisances related to unpleasant odours around waste collection points or around the landfill site. Possible grievances may also concern quality of distributed water during maintenance works on the network or pressure problems in some areas.

8.2 Proposed Mechanism

The overall purpose of the grievance redress mechanism (GRM) will be to reduce risk for the project, offer communities an effective platform for expressing concerns, and achieving solutions that will promote a constructive relationship between the government, project staff, and communities.

Specifically, the project GRM will be established to allow all persons affected by the urban infrastructure and services project to appeal any disagreeable decision, practice, or activity arising from the implementation of the Third Greater Mekong Subregion Corridor Town Development Project.

The design of the GRM should enable the mechanism to provide:

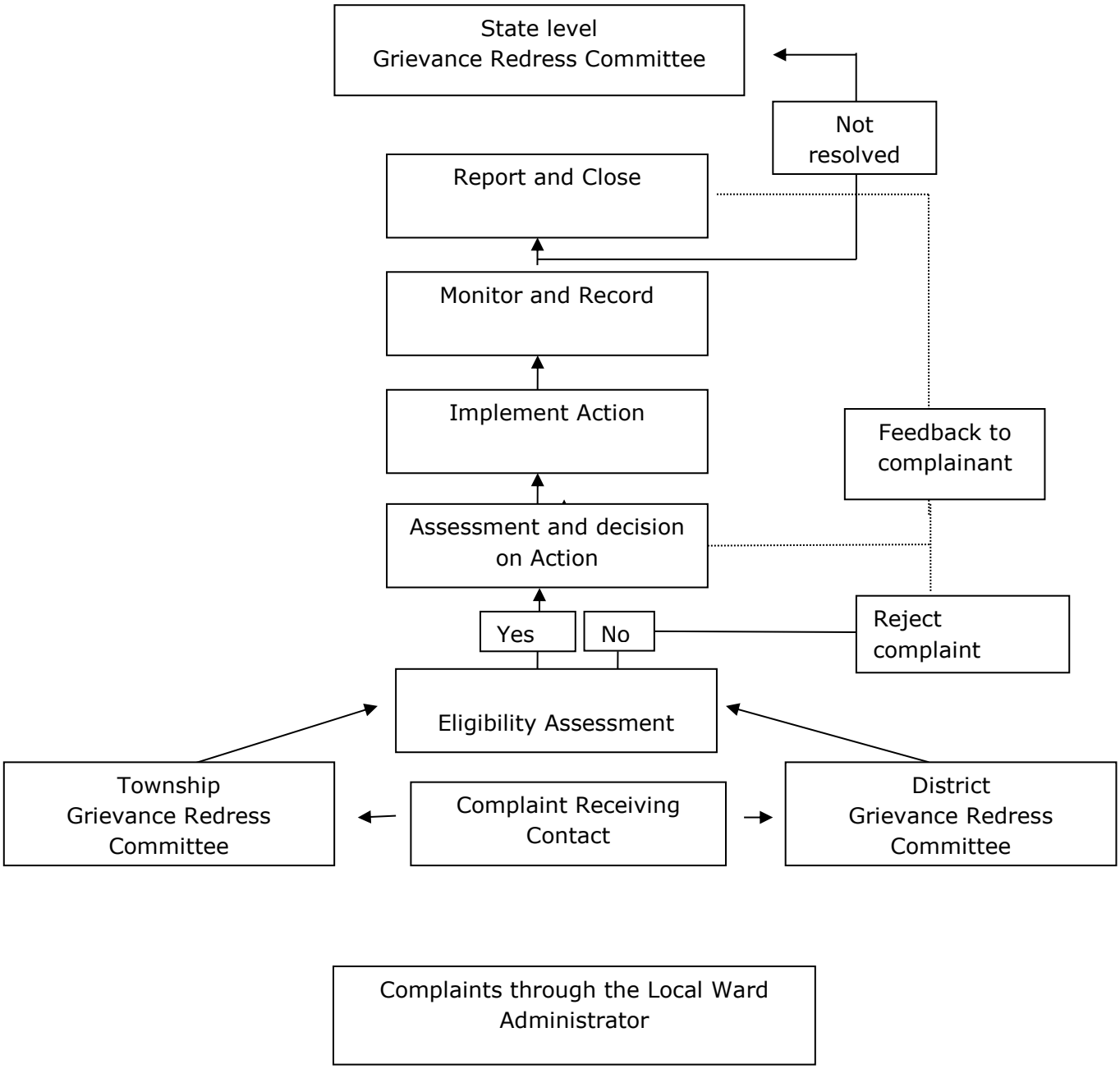
- a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen as fair, effective, and lasting;
- builds trust as an integral component of broader community relations activities; and
- enables more systematic identification of issues or problems, facilitating corrective action, and pre-emptive engagement.

The GRM will include the following elements:

- a transparent grievance receipt and registration system to provide ways for community members to register complaints and confirm they have been received;
- grievance eligibility assessment to determine if the issues raised in the complaint fall within the mandate of the grievance mechanism and if the complainants are legitimate;
- grievance assessment and investigation to clarify concerns raised in the complaint, to gather information on the situation, and to identify how the issues might be resolved;
- several choices for solving problems are as follows:
    1. Internal decision-making processes, whereby issues are handled by designated members of the GRM, using set criteria to develop a response to the grievance and to allow for tracking complaints, monitoring and evaluation of the resolution and an appeals process.
    2. Joint problem-solving, in which the project and the complainant engage in a dialogue and action planning to resolve the problem.
    3. Third-party mediation to facilitate a solution when a voluntary agreement is not possible.
- grievance tracking, including maintenance of written records of grievances, monitoring, public information disclosure and reporting to the community; and
- grievance closure, including community feedback and confirmation of resolution of the problem.

All project stakeholders (Ministry of Construction [MOC], Project Management Office [PMO] and Project Implementation Unit [PIU] staff of the Kayin and Mon State Governments [M/KSG], district/township/ward officials, communities, civil society organizations (CSOs), and ADB staff) were involved in the design of the GRM—to outline the purpose, structure, and specifics about how the grievance mechanism will function.

Below is the structure of the GRM and its operational arrangements.



The GRM will be established in Hpa-An and Myawaddy. It involves the following process:

- Stage 1: Access to the GRM. If a concern arises, the complainant will make his/her complaint known to the Local Ward Administrator (LWA) of the concerned ward through verbal, phone, email, or written submission. CSOs may file complaints on behalf of affected persons through the LWA or directly to the Complaint Receiving Contact (CRC) with a copy to the LWA.

- Stage 2: Submission and Registration. The LWA or CSO will submit a written complaint to the Complaint Receiving Contact (CRC). The CRC will register the complaint and forward it to the township grievance redress committee (GRC) or district GRC depending on the nature of the complaint. The CRC will issue an acknowledgement of receipt of the complaint with information of which GRC will handle the complaint to the LWA. The LWA will inform the complainant and CSO if appropriate, and deliver the acknowledgement of receipt. The township level GRC will handle complaints or queries pertaining to construction activities (including road safety, and environmental issues), information about project activities, give general feedback. The district level GRC will handle complaints regarding environment and construction-related impacts, resettlement, compensation and livelihood improvement issues.
- Stage 3: Determine Eligibility. The township or district GRC will determine whether the complaint requires further action to address. A screening procedure based on simple eligibility criteria will be established for the GRCs. If the complaint is deemed ineligible, the complainant is informed of the decision and the reasons for ineligibility. Where appropriate, the GRC may refer the complainant to alternative options for resolution of the complaint.
- Stage 4: Assessment and Decision on Action. If the complaint is eligible, the appropriate GRC will conduct an assessment and gather information about the complaint and key issues and concerns to determine how the complaint might be resolved. The LWA and community members will participate in the assessment as necessary. If outside experts or technical information is needed, the GRC may seek such guidance and may request all parties concerned to participate in the GRM process. The GRM may offer a variety of grievance resolution approaches. The decision on the solution will be by the GRC. The GRC will develop an action plan and identifies responsibilities for the plan. This action plan will be reported to the complainant through the LWA.
- Stage 5: Implementation of Actions. Implementation of the action plan commences with close collaboration of relevant project stakeholders depending on the type of complaint.
- Stage 6: Monitoring and Reporting on Implementation. The GRC will monitor the implementation of actions and record findings which will be filed through the CRC. As part of the monitoring process, the GRC will consult the relevant project stakeholders, as needed. The monitoring time frame will be project-specific depending on the implementation of the actions.
- Stage 7: Closure of the Complaint. When the monitoring has been completed, the GRC will prepare a final report which is shared with the LWA and complainant, and filed with the CRC. The complainant will confirm completion of the actions and agree to the closure of the complaint. The grievance dossier is closed and filed in the project archive.
- Stage 8: Appeal to the State GRC. If the complainant is not satisfied with the solution suggested by the GRC during the assessment stage or after the implementation of actions, an appeal can be lodged at the state GRC through the LWA in writing, with a copy sent to the PMO/PIU of the M/KSG. The state GRC will serve as the second level authority for addressing grievances that were not resolved satisfactorily. It will also look into grievances regarding inconsistencies of grievance handling by the township and district GRCs. It may assign a second investigation of the grievance case to another expert or group of experts, depending on the required expertise for analysis and reporting, with final decision-making remaining with the State GRC.

If efforts to resolve complaints or disputes are still unresolved and unsatisfactory, the complainants have the right to send their concerns or problems directly to ADB's Southeast Asia Department (SERD) through ADB Myanmar Resident Mission. If the households are still not satisfied with the responses of SERD, they can directly contact the ADB's Office of the Special Project Facilitator as outlined in the Information Guide to the Consultation Phase of the ADB Accountability Mechanism.

GRM proceedings will entail one or more meetings for each complaint and may require field investigations by specific technical or valuation experts. Grievance cases shared by more than one complainant will be treated as a single case.

The GRC and the procedures for resolving complaints and grievances will be made public through an effective public information campaign. During the RP updating process when the detailed engineering design is available, the grievance redress procedure shall also be explained in the project's Public Information Booklet.

The mechanism proposed relies on the creation of a Grievance Redress Committee (GRC) integrated into the Department of Public Relations and Information (DPRI) of KSG and basically dealing with grievances related to resettlement and compensation. The GRC will additionally address those complaints related to construction activities when the grievance cannot be closed at the level of the contractor. The GRC, as defined in the RAP, will be headed by the Senior Officer of DPRI and would include representatives from townships, from civil society (Woman Association, Elder groups, Social Welfare groups) and Community representatives from the complainant's ward.

When construction starts, a sign will be erected at each construction site providing the public with updated project information and summarizing the grievance redress mechanism process including details of the GRM entry points. The contact persons for different GRM entry points, such as PMO, community leaders, contractors, and operators of project facilities, will be identified prior to construction. The contact details for the entry points (e.g. phone numbers, addresses, e-mail addresses, etc.) will be publicly disseminated on information boards at construction sites and on the website of the local government.

The GRC will establish a GRM tracking and documentation system. The system will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyse information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 Purpose and Objectives

The role of the Environmental Assessment process is to identify the impacts which may be caused by the project and to develop a series of attenuating or mitigating measures which will be technically appropriate, financially acceptable and easily applicable in the context of the project. These measures are identified in Section 6 of the present IEE.

The role of the EMP is to complement this analysis by defining the operational context in which these measures will be implemented. The present Section therefore sets out the principles, the approach, the procedures and methods which will be applied to monitor and reduce the environmental and social impacts resulting from the construction works and subsequent operation of the components projected in Hpa-An and Myawaddy.

All the measures proposed in this EMP are based on the results of the analysis of impacts and corrective measures outlined in previous Section 5 of the present EIA. These aspects will not therefore be repeated here.

9.2 Summary of Key Impacts

The key impacts described in Chapter 5. Table 26 summarizes the key impacts related to project location. Table 29 summarizes the impacts during construction and Table 32 summarizes the key impacts during operation.

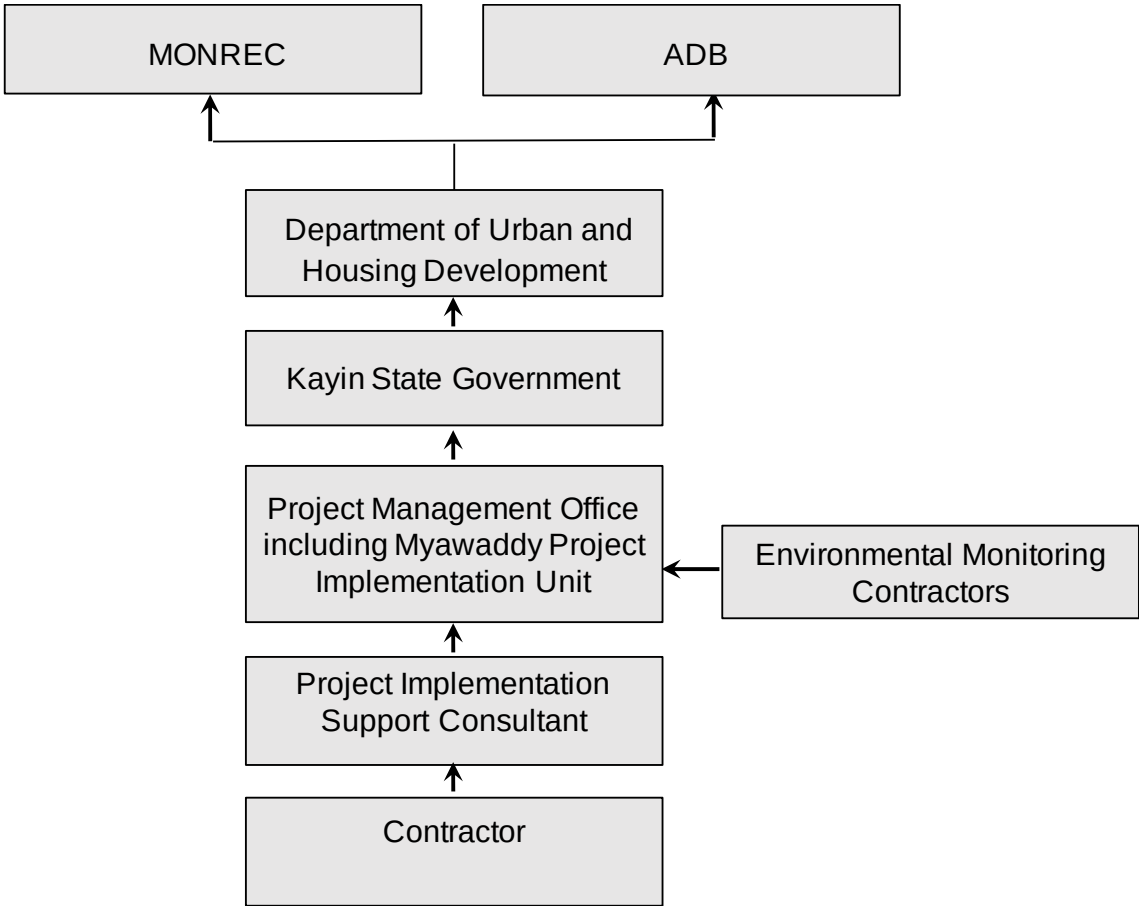
9.3 EMP Organisation and Responsibilities

9.3.1 OVERALL ORGANIZATION

The Ministry of Construction and its Department of Urban and Housing Development do not have environmental and social management systems to guide project preparation, project construction, operation, and maintenance of roads. Overall responsibility for implementation of the environmental management plan falls to the Project Management Office (PMO) and Kayin State for this project.

There are eight agencies that are involved in the implementation, supervision, and monitoring of the environmental management plan: (i) the Department of Urban and Housing Development, (ii) the Kayin State Government, (iv) the Kayin State Government Project Management Office (including the Myawaddy Project Implementation Unit), (iv) the Project Implementation Support Consultant, (v) the Contractor; (vi) the Ministry of Natural Resources, and Environmental Conservation, (vii) ADB, and viii) independent, third party Environmental Monitoring Contractors (see reporting relationships Figure 44).

Figure 44: Proposed Organization for EMP Implementation



Department of Housing and Urban Development. Department of Housing and Urban Development is the Project Executing Agency.

Kayin State Government. The Kayin State Government is the Project Implementation Agency. The Kayin State Government PMO is to establish the Kayin State Government Project Management Office including the hiring of environmental management staff. A Project Implementation Unit will be established the Myawaddy.

Kayin State Government Project Management Office (KSG PMO) and Myawaddy Projection Implementation Unit (MPIU). The KSG PMO and MPIU will have overall responsibility for:

- ensuring implementation of all mitigation measures;
- ensuring implementation of all monitoring programs;
- supervision and monitoring of the implementation of the environmental management plan (EMP);
- establishment and operation of the Grievance Redress Mechanism;
- training and capacity development of environmental staff of PMO

- meeting all the conditions of the Environmental Compliance Certificate (as issued by MONREC); and
- submitting semi-annual Monitoring Reports through the Kayin State Government and DUHD to the MONREC and to ADB.

Construction Contractor. The Construction Contractor will be responsible for:

- implementation of the environmental management plan mitigation measures; and
- frequent monitoring and reporting of environmental management plan implementation

Project Implementation Support Consultant(PISC). The PISC will be responsible for

- supervision and monitoring of and reporting the contractor implementation of the EMP on behalf of KSG PMO;
- supervision of third party environmental monitoring contractors;
- assisting KSG PMO in preparing of the environmental safeguard monitoring reports; and
- assisting KSG PMO in organization of training and capacity development

Ministry of Natural Resources and Environmental Conservation (MONREC). MONREC is responsible for:

- review of the periodic environmental safeguard monitoring reports submitted by KSG to ensure that adverse impacts and risks are mitigated as planned;
- as necessary, conduct monitoring and inspection of projects to determine compliance with all environmental and social requirements;
- as necessary, impose penalties and /or require Project Proponent to undertaken corrective action; and
- where Projects are not in compliance or not likely to comply with its environmental and social requirements, take appropriate enforcement actions including: (i) suspension of project operation; and (ii) employing third parties to correct non-compliance.

ADB. ADB is responsible for:

- conducting periodic site visits for projects with adverse environmental impacts;
- conducting supervision missions for detailed review for projects with significant adverse environmental impacts; and
- reviewing the periodic environmental safeguard monitoring reports submitted to ensure that adverse impacts and risks are mitigated as planned

Independent Third Party Environmental Monitoring Contractors. Environmental Monitoring Contractors will be responsible for conducting air quality, water quality, noise, and biological environmental monitoring programs on behalf of the KSG PMO.

9.3.2 ENVIRONMENTAL STAFFING REQUIREMENTS

Environmental staff are needed by the (i) Construction Contractor, (ii) Project Implementation Support Consultant, and (iii) the KSG PMO. It is the Kayin State Government's responsibility to ensure that qualified and trained staff are hired by all three agencies (Table 36).

Independent Third Party Environmental Monitoring Contractors need to retained to conduct ambient environmental monitoring of air quality, water quality and noise.

Table 36: Indicative Staffing and Outside Consultants

Staff	Position	Level of Effort
Contractor	Environmental Engineer	Full time during construction
Project Implementation Support Consultants	Environmental Supervision Engineer	Half time during construction
	Environmental Safeguard Specialist	Full time during construction
KSG PMO	Environmental Safeguard Officer	Full time during Project
Outside Consultants to KSG PMO or through the Project Implementation Support Consultant	Environmental Management Capacity Development	$40,000 Lump Sum Contract
	Independent Third Party Environmental Monitoring Contractors	To be estimated based on proposed environmental monitoring programs.

9.3.3 TRAINING AND CAPACITY DEVELOPMENT

The Kayin State Government needs to provide capacity development and/or training programs to ensure staff in all three agencies (i) fully understand the environmental management plan; (ii) understand their responsibilities; and (iii) are capable to undertake their responsibilities. As it does not have environmental and social management staff, Kayin State Government needs to hire a qualified contractor through the PMO or the PISC to conduct necessary training and capacity development programs.

9.4 Recommended Reporting Requirements.

Monitoring of the environmental management plan will have weekly reporting by the Contractor; and monthly reporting by the PISC.

The Kayin State Government is required prepare and submit, to the DUHD, MONREC, and ADB, semi-annual environmental monitoring reports. The reports will cover environment performance based on the implementation of the EMP and the environmental monitoring plan. The PISC will draft semi-annual environmental monitoring reports. The PMO will finalize the environmental monitoring reports and Kayin State Government will submit the reports to DUHD, ECD and ADB (see Table 37)

Table 37: Recommending Reporting Requirements

Responsibility	Reporting Requirement	Reporting to
Contractor	Weekly inspection and monitoring reports	PISC
Project Implementation Support Consultant (PISC)	Monthly inspection and monitoring reports	KSG PMO
	Draft semi-annual environmental monitoring reports	KSG PMO
Kayin State PMO	Final semi-annual environmental monitoring reports	Kayin State Government
Kayin State Government	Submission of Final semi-annual environmental monitoring reports	DUHD, ECD, ADB

9.5 Environmental Management Planning Prior to Construction

The main recommended actions for this pre-construction period are detailed in the following paragraphs. Revision of measures proposed during this pre-construction and construction periods will be considered as soon as the PISC will be recruited. Indeed, detailed design will start at this stage (for components not developed under DBO) and it is required (i) that design fully integrate mitigation measures identified in this IEE and (ii) that monitoring activities are adjusted in accordance with the selected design (particularly sampling points and parameters).

9.5.1 APPOINTMENT OF THE PMO- ENVIRONMENTAL AND SOCIAL OFFICERS

The PMO will appoint its environmental and social officers before construction works start. The environment and social officers will be assisted at the beginning of his mandate by the Project Implementation Support Consultant (PISC) who will deliver training and assist with (i) the preparation of tenders regarding monitoring surveys, (ii) the selection of the Consultants, (iii) for the follow-up of the studies.

9.5.2 ENVIRONMENTAL CAPACITY BUILDING OF PMO

The PISC will carry out training of the environmental and social officers and other PMO staff. Purpose is to have the staff fully operational at the start of the project construction activities. Training will focus on:

- Detailed review of impact analysis and mitigation from the Third GMS IEE
- Detailed review of EMP Program of Action
- Organization of KSG PMO for EMP implementation
- Basics for site inspection practices: organization of visits, frequency, control checklist;
- Basics for non-compliance procedures: reporting procedure and form, organization of follow-up, procedure for resolution approval;
- Data management for PMO: key information to be stored, data base organization, registers;
- Structure and content of weekly, monthly reports.

9.5.3 CAPACITY BUILDING ON HEALTH AND SAFETY

When observing construction sites in Kayin State, the conclusion comes easily that health and safety considerations are still strongly ignored. Project construction sites must be compliant with international good practices regarding health and safety of workers on sites. This project may even be considered as a pilot project for introducing good EHS practices and for the concerned contractors.

The PISC shall organise safety training courses not only for the staff of PMO but also for all technical departments. The aim is to provide the basics of safety rules and organization of constructions sites and for the PMO staff, to clearly understand what must be required from the contractors on the sites.

9.5.4 PUBLIC CONSULTATION AND NOTIFICATION

In support and follow up to the public consultations carried out within this PPTA, it is important to prepare the appropriate communication material rapidly, allowing KSG to present, before starting the works, clear information on the design of the project, on the phasing of construction work, on the recruitment procedures and on the environmental and social measures which will be implemented.

Preparation of proactive communication is essential to ensure the widest possible circulation of information at the most critical time, since it is during this period prior to the start of works, when important decisions and negotiations are in progress, that information on the Project must be available in a completely transparent manner. The communication tools to be developed include:

- Colour flyers and posters to be posted all along the various sub-components sites;
- Articles in the press and radio or TV messages;
- The technical EIA documentation available for consultation by any person, at KSG.

9.5.5 PREPARATION OF CONTRACTOR EHS SPECIFICATIONS FOR THE ENVIRONMENTAL MANAGEMENT PLAN

Effective consideration of the EHS during construction activities pre-supposes the production of a clear, complete and detailed contractual document at the time the contract is awarded. This means including the specifications which will lay down all the EHS obligations to be imposed on contractors by PMO in the Tender Documents. These requirements dictated by the Project Owner will be presented in a document entitled "Environmental and Social Obligations of the Contractors", which will be prepared together with the Technical Specifications (General and Particular) of the Project. The PISC will assist PMO for the preparation of the Tenders.

The document will set out all the EHS obligations imposed to the contractors and the principles and measures required for complying with. These obligations will be articulated around the key fields of environmental and social management for all construction activities related to the Third GMS project components, including:

- general specifications for good environmental management which will be applicable to the contractor at any point within the work site and at all times, covering areas such as: training/awareness of employees on protection of the environment and safety, management of hazardous substances and waste, protection of biodiversity, prevention of water and air pollution, preservation of soils, rehabilitation of sites;
- minimum conditions to be established in the contractors' camps and installations, covering aspects related to housing, catering, waste management, drinking water, sewerage and conditions of public hygiene;
- minimum conditions to be observed by the contractor in the field of employees' health and safety;
- minimum conditions to be observed by the contractor with a view to protecting the environment of the sites as well as that of the areas contiguous, most densely urbanized;
- minimum conditions to be observed by the contractor in managing the social aspects of construction activity including applicable procedures for temporary land occupation or in case of damage to any private property.

9.6 Contractor Environmental Management Plan

A Contractor Environmental Management Plan will be prepared for the undertaking of the mitigation measures described in Chapter 5 and summarized in Tables 26, 29, and 32.

Contractor Management Plans. Before the construction starts each Contractor will prepare a Contractor Environmental Management Plan (CEMP) consistent with the EMP. The CEMP is to include all mitigation measures and monitoring requirements

to be carried by the Contractor. The CEMP will be submitted to the CSC for review and approval. Approval will be required one month prior to the start of construction

Contract documents shall explicitly indicate the requirement for the CEMP. Construction cannot start until the CEMP is prepared. To ensure that the Contractor allocates sufficient funds to prepare and implement the CEMP, the Tender and Bid documents will require that the cost of implementing the EMP is included in the Contractor Bid price.

9.6.1 WASTE MANAGEMENT

The CEMP include measure for domestic waste and hazardous waste. The first relates to domestic waste (mainly generated in worker camps) and other non-hazardous waste generated on the construction sites, while the second is related to hazardous wastes. Mitigation measures are designed:

- to minimize the generation of wastes by carefully considered use of raw materials;
- to sort and treat the wastes in order to limit their environmental impact;
- to raise awareness and train personnel in good waste management practices.

Measures include procedures, in accordance with local regulations or with international best practice, concerning the handling, transport, storage, treatment and elimination of wastes depending on their category:

- Non-hazardous wastes (Group A): putrescible wastes from the camps and canteens, paper, cardboard, plastics, wood and vegetation, inert wastes from construction or demolition (concrete, scrap iron, bricks, etc.);
- Hazardous wastes (Group B): wastes that are corrosive, explosive, toxic, representing a degree of danger for humans or for the ecosystem. In the context of the present project components considered, this will mainly include engine oils and used hydraulic fluids, the residues of paints, solvents and resins, first aid medical wastes, sludge from septic tanks and mobile toilets, various concrete additives (but with a lesser degree of danger for the latter).

Non-hazardous Waste Management

A system of waste segregation at source, ensuring separation of metal products (including drink cans or food cans), plastic products (bottles, cartons, wrapping, etc.), glass bottles, paper and cardboard, will be set up on the construction sites and in the camps. All these products will, as far as possible, be made available for collection by outside contractors responsible for recycling.

The workers' camp will be provided with two types of covered bins for selective collection of the various products listed above: putrescible in one, for recycling in the other. The contractor will carry out systematic awareness campaigns among residents of the camps to promote efficient use of these refuse bins.

On the construction sites, metal wastes that have not been polluted by hazardous substances (oils, acids, paints, etc.) will be collected in containers for recycling. The same applies to wood and cardboard and plastic packaging. It will be absolutely forbidden to burn plastic or lubricants.

Concrete and plaster debris that is not reused will be collected and dumped with other materials which may be usable for land filling or reclamation.

The Contractor will estimate the anticipated volumes of non-hazardous waste to be produced, the procedures for management, collection and disposal, the technical means implemented, the location and dimensions of the controlled landfill, the contact details of the companies involved in waste recycling, as well as the training programs to raise awareness among workers on this subject.

Hazardous Waste Management

Should maintenance of heavy equipment happen on site, used engine lubricants from maintenance activities or floating oily residue from oil separators will be collected in 200 litre drums with a view to recycling. The drums will be stored in a dry and covered area, surrounded by a bund the height of which will ensure retention of a volume equal to at least 110% of that of the largest container stored in the area, and equipped with an oil separation system at its outlet. The contractor will identify an acceptable solution where the waste can be burned or recycled. A register will be maintained to record all handling of used lubricants, for the purpose of monitoring wastes. Machine and plant maintenance operations will be centralised in appropriate area allowing collection of the used oils and hydraulic liquids.

Should the use of chemical substances happen on sites, the following rules shall be followed: (i) give preference to substances with low toxicity values and minimize quantities to use, (ii) used chemical substances will be stored in containers or drums in the same storage areas as used oils, as long as these substances are compatible; (iii) otherwise, they will be stored in a safe area protected from inclement weather. The possibility of reuse in situ will be evaluated; failing this, the materials will be returned to the supplier or to appropriate waste treatment installations.

9.6.2 HAZARDOUS SUBSTANCES MANAGEMENT

Mitigation measures will be applicable to all project activities involving the handling, storage and use of substances catalogued as hazardous. Measures will include:

- procedure for registering and monitoring any substance of a hazardous nature including in particular the drafting of a safety data sheet per substance;
- procedure for identification of alternative and less hazardous substances;
- handling and storage conditions, including details on compatibility of the substances;
- emergency procedures in case of a spill;
- condition for final treatment of residues or recycling.

Chemical substances will be stored in a locked container located on a watertight floor surrounded by a bund, capable of storing at least 110% of the volume of the largest receptacle placed there. Each storage site will be provided with a substance collection pit, absorbent products and extinguishers. Standard signs will warn of the presence of toxic substances.

The substances' safety data sheets will be available on the site and from the CC-EHSC of the contractor concerned. All chemical substances stores will be regularly inspected in order to detect any possible leakage or damage to the containers.

The largest volume of chemical substances anticipated under a project of this type may concern hydrocarbons (diesel, oil and grease). The programme will lay down the conditions to be respected for storage and refuelling of machinery.

Pollution control equipment to be installed by contractors at the storage sites (i.e., anti-pollution kits, extinguishers, substance description sheets) will be described

At each site, the employees in charge of handling chemical substances will be given special training relative to best practice and emergency measures in case of an incident.

9.6.3 ACCIDENTAL SPILL PREPAREDNESS AND RESPONSE PLAN

An anti-pollution plan will be established to define the intervention procedures in case of leaks or accidental spills of liquid hazardous substances. This plan will include a description of the organisation planned for such situations and the work stations of key people. Specific training will be given for the activities to be performed in case of emergency intervention, for all staff and workers involved in any stage of the procedure. This plan will be required even if the Project doesn't imply the necessity for handling and storage of large quantities of hazardous material.

9.6.4 EROSION AND SEDIMENT CONTROL

Erosion control measures will be applied to all land that is stripped or excavated, all embankments and temporary or permanent deposits of materials in order to minimise and control the resulting sediment loads before they reach surface water bodies. This protection will involve, on one hand, the implementation of methods for stabilising slopes where justified and, on the other, collection of surface water runoff.

Erosion control will include methods that are incorporated into construction practices, as the provision of temporary protection of a mechanical nature (geotextile covering sheets, sediment barriers).

Drainage of the entire area of any construction operations will be provided prior to the start of any other activity. Drained water will be channelled towards one or several sedimentation basins designed following accepted best practice and sized to contain the rainwater falling in 24 hours with a return period of two years.

For each site to be opened for construction activities, measures for drainage and anti-erosion measures will be prepared by the contractor and submitted to the PISC for non-objection at least three weeks before starting works on the site. The drainage channel and sedimentation basins will be built as a priority before any other activity is carried out.

9.6.5 MANAGEMENT OF CAMPS

The following obligation will apply for any site sheltering workers on a 24 hrs. basis, including both permanent camps only dedicated for the residence of the workers and the temporary camps implemented on the construction sites where few workers may stay permanently (also to guard equipment and material at night).

A permanent and temporary camp management program will be prepared by each concerned contractor. The various aspects covered by such a program will include:

- choice of location for the camp, proposed organization, controlled entry;
- installations proposed for water supply and sewerage, waste management and drainage of storm water;

- equipment chosen for the sanitary facilities, collective equipment, bedrooms and dormitories;
- anticipated catering and food supply services, particularly canteens; means for monitoring the quality of foodstuffs stored and distributed in the camp;
- the policies implemented with regard to prevention of drug and alcohol abuse.

The specifications of the Tender Documents will lay down the requirements regarding water supply and sewerage. In order to eliminate the risks of development of disease vectors, rainwater drainage will be provided. The ratios to be respected in terms of sanitation (number of toilets, showers and wash-basins) will also be defined. The standards applicable to bedrooms and their furnishing and fittings will also be detailed in the Tender Documents. In particular, the minimum floor space per person, the supply of impregnated mosquito nets and mattresses, will be stipulated.

The procedures to ensure hygiene in all common facilities and in particular food hygiene procedures for storing and monitoring fresh products used by the canteens will be detailed by the contractor responsible.

In order to prevent possible abuse of drugs and alcohol, measures to raise the awareness of employees and specific control measures will be set up by the contractor responsible.

9.6.6 PUBLIC HEALTH MANAGEMENT PROGRAM

The program requirements will be described in detail in the Tender Documents and will cover the following main areas of action:

- First aid facilities established on the construction or camp site; hospital facilities available;
- emergency intervention procedures in case of an accident;
- employee surveillance measures: medical check-up on recruitment, annual medical check-up;
- regular cleaning of the sanitary facilities provided, in particular toilets and septic tanks;
- waste management and regular cleaning of refuse bins;
- systematic program to keep employees aware of good hygienic practices;
- monitoring hygiene in canteens

9.6.7 MANAGEMENT OF AIR QUALITY, DUST AND NOISE

Mitigation Measure to limit atmospheric and noise emissions will be put in place in all areas likely to be affected by construction of the Project. Emissions of exhaust gases and fumes will be limited by appropriate maintenance of equipment and trucks, and by banning the burning of waste on the sites.

Dust caused by road traffic on unpaved surfaces will be subject to reduction measures in residential areas, by requiring the contractor to water spray the ground at regular intervals, i.e. at least two to four times per day during periods without daily rainfall. All loads of fine materials potentially causing dust to be spread during transport will be covered by a tarpaulin. In storage areas, watering will be recommended for all materials likely to generate dust. Wheels of trucks will be washed every time before

leaving sites for dredging, to avoid deposition of sludge on public road and later production of dust.

Noise will be the subject of regular monitoring to ensure that the limits imposed for the site are respected or that the employees exposed to higher noise levels are appropriately equipped with PPE. Measures will be taken to reduce noise levels and the corresponding disturbance on the site and along the access roads: maintenance of plant and vehicles, use of soundproofed equipment, reduction of the hours of use of certain noisy activities.

9.6.8 MANAGEMENT OF ROAD TRAFFIC AND ACCESS

Road traffic is a prime cause of accidents during the construction phase of infrastructure projects. It is therefore essential to regulate traffic both on site and outside. This is particularly important for the present project as (i) components are located in (or close to) dense urban area and (ii) the project shall involve the transport of significant quantities of materials and equipment which may generate heavy truck traffic. Various measures will be considered and adopted by the contractors:

- Awareness raising and training of drivers of trucks on elementary traffic safety rules and on the legal risks: driving under the influence of alcohol or drugs, excess speed, monitoring of tyre condition, load stability, etc.;
- visual acuity of all recruited drivers and their ability to drive;
- provision for parking trucks not encroaching on the roadway;
- respect of speed limitations;

Access to the construction sites will be indicated by appropriate road signals.

The Tender Documents will set out all these obligations as well as the penalties that will be applied to contractors and their sub-contractors in case of infringement.

9.6.9 PROTECTION OF CULTURAL RESOURCES

The IEE confirms that the project components are not affecting any cultural site or building. However, as some components involve significant excavation (particularly for the rehabilitation of the water supply network, the chance to find any physical cultural resource does exist.

A chance to find procedure will adopted in case a discovery is made or an interaction is observed during the works. This procedure will include aspects such as:

- immediate measures to stop work at the site concerned and mark out the area to be protected;
- information procedure involving the contractor, PISC, and PMO
- approval of the measures decided by the PMO;
- organization of removal of the resource (if physical);
- closure of the incident and resumption of work.

9.6.10 EHS TRAINING

The objective of this training is to ensure effective implementation of the measures proposed under the EMP on the construction sites. General training programs

(awareness training) are to be delivered to all personnel and the specialized training programs intended for the employees involved in particularly sensitive activities from the environmental standpoint (management and distribution of hydrocarbons, hazardous waste management, etc.). Each new recruit must participate in the awareness-raising program within 15 days following his recruitment. Each employee in charge of sensitive activities will follow a catch-up session every 6 months.

This training will be delivered by the CC-EHSC of the main Contractors or by a specialized consultant appointed by the contractors. All personnel shall be trained. The sessions shall be recorded in a register where the names and attendance signatures of all participants will be noted.

The environmental management awareness program on the sites will cover at least the following priority subjects:

- rules for waste management within the sites;
- rules for management of hazardous substances and wastes, particularly their storage authorized exclusively in specially adapted areas;
- pollution control, in particular the response required in case of an accidental pollutant spill;
- protection of sites against fire;
- protection of sites against erosion and sedimentation;
- procedure to follow in case of discovery of a physical cultural resource;
- rules for traffic safety on public roads and within the sites;
- principles for saving energy and other resources;
- applicable penalties in case of infringement against the established rules.

Complementary training sessions will be made relating to hygiene, health and safety including:

- Hygiene and basic public health issues;
- Safety rules on-site and off-site;
- Emergency response in case of accident;
- Personal and collective protective equipment and measures;
- Safety measures in public areas;
- Electricity hazards;
- Fire control and fire protection;
- Works in elevation and scaffolding safety.

9.6.11 SITE CLEANING AND REHABILITATION PROGRAM

By the end of the construction activities, each contractor has to decommission the sites where its activities for Project needs have been performed, which includes:

- The demolishing of all temporary structures/buildings developed for the purpose of Project construction.

- The removal from the sites of all equipment and remaining material and waste, the safe disposal or recycling of construction and demolition waste and of construction material;
- The restoration of the land in order to return it as close as possible from its initial state
- The official handover of the site to its owner, signed by parties.

In order to ensure that this Site Cleaning and Rehabilitation (SCR) operation is successfully implemented, the Contractor will be required to prepare a Site Cleaning and Rehabilitation Plan (SCRP) which provides operational methods for (i) site assessment and (ii) cleaning and rehabilitation in compliance with Contractual obligation and international good practices. The Plan will respect the following:

Cleaning Stage

- All construction materials, equipment, buildings, facilities and residual waste will be removed from all sites, except if a site-specific decision modifies this principle. This decision shall be commonly agreed on by the CC and the PMO.
- All waste collected on site will be treated in compliance with the requirements of the Tender Documents Environmental Obligations and the Waste Management Plan prepared by the CC at the start of the construction, depending on the classification of the waste product considered.
- Recycling of waste will be maximized.

The Plan will be submitted to the PISC not later than 1 month before the start of decommissioning and include the methods for carrying out the following activities:

- Evaluation of quantities regarding each group of materials/waste identified;
- Identification of registered companies for the recycling of materials and waste;
- Procedures for treatment and disposal of non-recycled material and waste;
- Schedule for cleaning operations;

Rehabilitation Stage

Rehabilitation will be carried out in immediate continuation or even in parallel with the cleaning stage, taking advantage of the presence of the manpower and the equipment. Consultation with concerned stakeholders will be carried out where necessary. The following principles will apply:

- Sites shall be rehabilitated in a way to restore, as much as feasible and reasonably possible, the original use of the land;
- All sites must be returned free of any buildings or infrastructures developed for the purpose of Project construction, except if specific request is made;
- All sites where structures were temporary removed (market stalls, shops, other) will be reinstalled at the end of the works, excepts if special request from the owner.
- All spoil disposal areas shall be rehabilitated according to the obligations of the Tender Documentation and the obligations of the Plan on Sediment and Spoil Management.
- Rehabilitation option will eventually be selected through consultation between CC, PISC, PMO and any private party if the land is privately owned.

After completion of SCR works, the CC will inform the PISC regarding the final site status. After acceptance by PISC of the site conditions, the PMO will be notified. To finalize the SCR process, a joint site visit with all concerned parties will be organized by the PISC to sign SCR Completion Certificates as follows:

- For public land, the SCR Completion Certificate will be signed by PISC, PMO and by the Town Development Committtee Land Services as witness; and
- For private land, the SCR Completion Certificate will be signed by the land owner, CC, PISC and PMO.

9.7 Environmental Supervision during Construction

The Project Implementation Support Consultant (PISC), through its Environment Health and Safety staff, is responsible for ensuring the Contractor complies with its CEMP. The PISC is the one that certifies payments to the contractor and as such, he can therefore 'negotiate' the deployment by the contractor of equipment or labour initially allocated to the works in favour of specific environmental measures.

9.7.1 MONITORING OF CONSTRUCTION ACTIVITIES

Contractors' compliance with their environmental and social obligations will be the subject of a specific monitoring process, coordinated by the PISC. In order to ensure compliance with E&S requirements and efficient implementation of corrective measures an environmental monitoring program will be set up, including:

- EHS supervision of the contractors: Through regular site inspections the objective is to ensure that all EHS measures, set out in the obligations for Contractors and in the CEMP, are effectively and efficiently implemented;
- Environmental quality monitoring: monitoring of changes in the quality of the environment in order to evaluate the efficiency of the mitigation measures applied and, if necessary, to modify acceptability thresholds or methods;
- Environmental compliance control monitoring: ensuring that all discharges from all project sites are compliant with environmental legislation or with related specifications in the Tender Documents (under the responsibility of the Contractor. This monitoring will also confirm or not the validity of information supplied by the CCs on a monthly basis. Analysis will be performed on a limited number of parameters indicators of pollution from construction activities.

Weekly Inspections

Weekly inspection of the different work sites will be organised by the PISC and will be the subject of a report using a standard inspection sheet. This information sheet will cover all the environmental specifications imposed to the contractor, item by item, giving an immediate overview during each inspection, of potential situations of non-conformity.

Each environmental event (EE) will be the subject of a standard record sheet to be filled in by the observer (Inspector) and submitted to the PISC for action. The record sheet signed by the PISC is handed over to the Contractor who then completes the document by explaining the proposed corrective measure. If the solution is acceptable, the EE is closed after checking that the corrective measure has been effectively and successfully implemented.

Coordination Meeting

Regular (weekly or semi-monthly) coordination meetings will be held between the Contractors. (and their inspectors) and the PISC (and his inspectors), during which they discuss the EE in progress, the remedial measures taken and any other subject of current concern such as the Action Plans presented by the CC-EHSCs.

9.7.2 WATER QUALITY MONITORING

A water quality monitoring plan to appreciate the performance of the environmental management implemented on the sites. This monitoring will control the quality of liquid effluents (waste water, drainage water) leaving the limits of the work site concerned and their compliance with applicable norms or standards provided in the tender Documents.

Under the supervision of the PISC, a third party independent environmental monitoring consultant will be contracted for monitoring the quality of all discharges leaving its sites or subcontracting a competent consultant or local agency to do so. The parameters to monitor will be defined according to the type of discharge (grey water, storm water) and detailed in the Tender Documents.

Sampling sites and parameters may change in the course of construction in order to adapt to the areas of activity and the types of activity observed, some components being linear. The monitoring will be carried out on a monthly frequency.

Compliance monitoring will concern at least the following water quality indicators:

- organic pollution: BOD5, COD, nitrates, phosphates, coliforms, (particularly related to the camps areas);
- oils and grease, relating to drainage water from the areas used for mechanical activities, storage of hazardous substances (hydrocarbons) and wastewater from canteens;
- suspended solids in drainage water and used also as performance criteria for the dredging activities and for sedimentation basins.

9.7.3 AIR QUALITY AND NOISE MONITORING

The main anticipated impact will be caused by dust near the construction sites. No significant problem is seriously anticipated with exhaust emissions, except very locally along hauling routes.

Two types of sampling monitoring are under the responsibility of the PMO:

- ad-hoc controls for dust at the boundaries of construction sites near residential areas and along hauling routes used between the dredging sites and WWTP site to be filled. Action will be taken as soon as few complaints from residents have been collected for a particular location, or where visual inspection confirms that excessive dust is being generated. The PISC will make spot checks of noise levels on the various work sites and in certain residential areas during daytime and night, in order to check that applicable references at the boundaries of the work sites or in the surrounding residential areas are complied with.
- regular monitoring for air quality and noise carried out by an external registered laboratory on a semi-annual basis. Locations may vary according to progressive transfer of activities, particularly for the road works.

Proposed Monitoring Plan is detailed in **Table**.

Table 38: Environmental Monitoring for Air and Noise

Reference	Parameters	Locations	Frequency
Ambient air quality standards: Ministry of Health	CO, SO_2, NO_x, TSP, O_3, lead dust (Pb), (PM10), (PM2.5),	Hpa-An • WTP • Bar-Mae storage • Kyar-Inn storage • Water Intake • WS distribution network • SW Landfill/Compost plant Myawaddy WTP Water storage Water Intake WS distribution network	Quarterly
Noise level standards: Ministry of Health	Day time and night time noise levels dB(A)		

Monitoring will be conducted by a third party independent environmental monitoring contractors.

All results will be checked against MONREC Environmental Quality (Emissions) Standards, 2015. Any non-compliance detected will require immediate correction from the Contractor.

9.8 Environmental Management for Operation Stage

The implementation of environmental monitoring is necessary from the time the works are completed and commissioned, in order to ensure impacts and mitigation measures proposed have been efficiently implemented during the construction stage and show positive results as expected.

The start of the operation stage will vary depending on the project components considered. The total project construction is anticipated to last 5 years. Due to the type of sub-components concerned, only a water quality monitoring of the resources used to supply Hpa-An and Myawaddy is anticipated.

9.8.1 WATER QUALITY MONITORING OF RIVERS

Monitoring of Thanlwin and Thaungyin (Moei) rivers in order to ensure water quality remains stable on the long term and fully compatible for domestic water supply purpose.

Sampling will be carried out on a semi-annual basis (one sampling in wet and one in dry seasons) in 2 locations: in Hpa-An, close to water intake in Thanlwin River and in Myawaddy close to the intake in the Thaungyin (Moei) River.

- On site measurement: Temperature, EC, dissolved oxygen, pH, turbidity;
- Physical and chemical analysis: BOD, COD, Total Suspended Solids, Total Phosphorus, Phosphate, Total Nitrogen, Nitrates, Ammoniacal Nitrogen,

Ammonium, Sulphates, Chloride, Calcium, Magnesium, Sodium, Potassium, Alkalinity (Bicarbonate HCO_3^- and Carbonate CO_3^{2-});

- Total and faecal coliforms;
- Heavy metals (during dry season sampling only): Iron, Lead, Cadmium, Chromium, Zinc, Copper.

PMO shall appoint a certified laboratory in Myanmar to carry out the monitoring program. Exact location of sampling sites shall be determined after the completion of the detailed design. Sampling of water resource will be complemented by the daily/monthly monitoring of distributed water carried out by the operator of the WTP.

9.8.2 MONITORING OF TREATED WATER SUPPLY QUALITY

The Operators of the WTP in Hpa-An and in Myawaddy shall be requested to monitor on a daily basis the safety of the water supplied to the system. Sampling shall be done at the WTP reservoirs and at the main storages (Kyar Inn and Bare Mae reservoirs in Hpa-An and main storage in Myawaddy) before water enters the network and at tap level (4 random sites every day). Parameters controlled daily include residual chlorine for all sites and coliforms for any sample measured with residual chlorine lower than 0.5 mg/l.

9.8.3 MONITORING OF WTP SLUDGE

The Operators of the WTP in Hpa-An and in Myawaddy shall be requested to monitor twice a year the quality of the sludge delivered to the landfill. Parameters to control include: pH, EC, N, NH_4, P_2O_5, K_2O, Ca, Mg, Al, Cu, Fe, Mn, Zn, Cd, Cu, NI, Hg, Pb, Helminth eggs, salmonella, odour.

9.8.4 MONITORING OF TUBEWELLS AROUND THE LANDFILL

5 monitoring tube wells to control any contamination of underground water around the two landfills have been implemented at the start of the construction. These tube wells will continue to be monitored by the operators of each landfill during the operation and even during at least 5 years after its eventual closing.

Sampling shall be organized on a semi-annual basis including the control of the following parameters: pH, EC, BOD5, COD, TDS, Chlorides, Sulphates, Phosphates, Total N, Ammonia-N, Nitrate-N, Mn, Fe, Cu, Cd, Ni.

Should the results prove that no contamination is observed, sampling on an annual basis shall be sufficient.

9.8.5 MONITORING OF GAS EMISSION AT LANDFILL

The owner/operator of each landfill will also be required, for health and safety concerns, to regularly monitor landfill gas (LFG). Monitoring is intended to detect unacceptable gas emissions resulting from landfill operations. Methane (CH_4) and carbon dioxide (CO_2) are the major constituents of landfill decomposition gas; other gases present in trace quantities include non-methane organic compounds (NMOCs), hydrogen sulfide (H_2S), nitrogen (N_2), hydrogen (H_2) and oxygen (O_2).

Gas will be controlled on a monthly basis the first year of operation, then reduced to quarterly control if results are below applicable limits. Any control detecting above standard value will re-activate monthly controls for at least 3 months.

Measures will concern the concentration and migration of methane, CO_2, H_2S, O_2 and percent lower explosive limit (%LEL, a concentration of 5% methane in the air). Hazardous conditions are not considered to be present on a landfill when methane concentrations are less than 25% of LEL in facility structures, and when the concentration of methane gas does not exceed the LEL (5% by volume) at the property boundary. Air sampling and analysis shall be carried out by a registered laboratory in Myanmar. Cost of monitoring will be supported by the owner/operator.

9.8.6 MONITORING DISCHARGES FROM LEACHATE TREATMENT PLANT

Monitoring of Leachate Treatment Plant discharge water quality to ensure water quality remains in compliance with the national emissions standards of MONREC

Sampling will be carried out on a daily basis tracking the parameters included in the standard and including the following general parameters on at least a monthly basis. In addition, specific parameters related to new standards for municipal solid waste emissions will be monitored as agreed with MONREC prior to construction.

- On site measurement: Temperature, EC, dissolved oxygen, pH, turbidity;
- Physical and chemical analysis: BOD, COD, Total Suspended Solids, Total Phosphorus, Phosphate, Total Nitrogen, Nitrates, Ammoniacal Nitrogen, Ammonium, Sulphates, Chloride, Calcium, Magnesium, Sodium, Potassium,
- Total and faecal coliforms;
- Heavy metals (during dry season sampling only): Iron, Lead, Cadmium, Chromium, Zinc, Copper, Mercury.

This monitoring part of the conventional follow-up and maintenance to be carried out for this type of plant. The cost is not a part of the EMP budget.

9.9 Cost of Environmental Impact Prevention, Mitigation and Monitoring

Table 39 sets out the estimated budgets required for implementation of the corrective measures and monitoring activities for implementation of the environmental management plan.

Table 39: Tentative Budget for EMP Implementation in Kayin State

Item	Cost ($)	Comment
Mitigation Measures		Normally included in construction contracts. Indicative cost only.
Implementation of the CEMP	200,000	
Monitoring Programs		Contracted out by PMU to qualified environmental monitoring agencies.
Noise Monitoring	20,000	
Water Quality Monitoring	42,000	
Air Quality Monitoring	20,000	
Environmental Staff		
Contractor	72,000	36 person months
Project Implementation Support Consultant	150,000	Assumes 50% of PISC effort will be devoted to Kayin State subprojects 6 person months (International) 36 person months (national)
PMO Environmental and GRM Staff	36,000	72 person months
Capacity Development and Training	40,000	
Vehicles	30,000	
Subtotal	610,000	
Contingency (10% of subtotal cost)	61000	
TOTAL COSTS	**671,000**	

10 CONCLUSIONS

The Third GMS Corridor Town Development Project focuses on the towns of Hpa-An and Myawaddy in Kayin State. The Project intends to significantly improve the environmental conditions in the two cities and the quality of life of its population through the improvement of water supply and solid waste facilities.

Water supply is presently insufficient in terms of serviced areas, service duration, quantities supplied and water quality. The Project beneficial impacts are the followings:

In Hpa-An:

- Improvement of the water supply efficiency by the mobilisation of new water intake in Thanlwin River;
- Improvement of water supply security by increasing the water supply storage capacity in Hpa-An through the construction (i) of a new 3,000 m^3 water storage on Bare Mae Hill in replacement of 3 old reservoirs and (ii) of a new 3,000 m^3 reservoir on Kyar Inn Mountain;
- Improvement of public safety through the construction of a water treatment plant with a capacity of 10,000 m3/day (and a possibility to extend to 18,000 m^3/d in a second phase), based on rapid sand filtration process with disinfection by chlorine;
- Creation of transmission lines and distribution lines including 21.2 km of transmission lines and main networks (diameters from 200-400 mm) and 79.1 km of distribution system (including tertiary networks <= 200 mm). The project would also include a fund to finance over 10 000 new connections.

In Myawaddy:

- Improvement of the water supply efficiency by the mobilisation of new water intake by infiltration gallery along Thaungyin (Moei) River;
- Improvement of water supply security by increasing the water supply storage capacity in Myawaddy through the construction of a new 4,500 m^3 water storage;
- Improvement of public safety in Myawaddy through the construction of a water treatment plant, with a capacity of 9,000 m3/day, based on rapid sand filtration process with disinfection by chlorine;
- Rehabilitation and expansion of distribution network in wards 1,2,5 and a part of ward 4.

Solid waste management is a major environmental issue in Hpa-An and Myawaddy where only respectively 35% and 50% of the solid wastes are collected at present.

The remaining uncollected waste is dumped all over the cities where the waste either decays with unpleasant smells and proliferation of insects or is burnt by the residents with emission of unpleasant and dangerous smoke as materials like plastics are also burnt. The collected waste is disposed in Hpa-An in a dumping site where it is regularly burnt in the dry season and from where untreated leachates are discharged into the surface water bodies. In Myawaddy, collected waste is dumped in 3 sites. Two of them are located within the urban area on the Thaungyin River bank and a new dump site has been recently created west of the city. Large quantities of waste are dumped into the storm drainage networks, clogging the drains and creating localised flooding during the rainy season.

The solid waste component beneficial impacts in Hpa-An and Myawaddy include:

- Improvement of quality of life and public health by (i) increasing the collection rate of solid waste in the city and (ii) improving collection points facilities;
- Improvement of storm drainage efficiency by reducing the amount of waste dumped into the drains and clogging the system;
- Reduction of water pollution load by improved collection rate and construction of sanitary landfills with leachate collection and treatment in each town;
- Reduction of air emissions and particularly GHG through (i) construction of a composting plant on the landfill site and (ii) collection of landfill gas and flaring;
- Improvement of waste recycling efficiency resulting in secondary beneficial environmental impacts through significant avoidance of GHG emission;

With the exception of Hpa-An new storage on Kyar-Inn mountain located on lands owned by monastery communities but presently unused and the WTP on floodable land privately owned, none of the other Project components requires land acquisition as they are all developed on Hpa-An or Myawaddy TDC land or on Kayin State Government land. Water distribution networks are located in public areas (roads and streets).

None of the Project components involves significant forest clearing or encroachment into valuable wetland or other conservation area. Only few urban trees may be cut depending on the detailed design of each component, but EMP shall limit the cutting and impose the plantation of 2 new trees per cut tree.

Following the principles of Green Cities, the project will support innovation with (i) the construction of the first composting plants in Myanmar, attached to the landfill of each city and (ii) the equipment of each proposed new landfill with a system of gas collection and flaring. When compared with the situation without project, the solid waste component of the Third GMS in Kayin State will reduce the annual emission of GHG from generated waste in 2020 by 13,500 tons CO2-eq/year for Hpa-An and by 18,500 tons CO2-eq/year for Myawaddy. GHG abatement shall reach in 2040 42,500 tons CO2-eq/year for Hpa-An and 66,700 tons CO2-eq/year for Myawaddy.

The IEE also considered climatic trends at the national, regional and local scale in Myanmar and more specifically in Hpa-An for which long term climatological data is available. Both temperature and rainfall show increasing trends in Hpa An along the last 50 years of observations, in line with the MONREC analysis for the Kayin State. Annual rainfall didn't change significantly over the last 50 years. Among the wet season months (May to October), only the months of June, July and September show an increasing trend, with July showing the highest raise during the 50 year period (about 120 mm, or 24 mm per decade).

Temperature rise was more significant during the same period. The average annual maximum temperature increased by 2,2°C over the last 48 years, or an increase of almost 0,5°C per decade, a value significantly higher than what is considered as an average increase in the Kayin State (0.32°C per decade). July and February increased by about 4°C during the period while the other dry season months increased by 2 to 3 °C. Wet season months increase was only about 1°C during the same period.

The results of AWARE model were considered in the preparation of the IEE Report. In this connection, climate change and natural hazards considerations had been incorporated in the IEE. AWARE was used by the ADB to undertake an initial climate risk screening exercise. The results had rated the project as MEDIUM RISK and have

identified flooding and landslide as a high level risk factor as the project is located in a region which has experienced recurring flood events in the recent past. However, the effective risk level is dependent on local geographical factors. On this basis, due to the location of Hpa-An and Myawaddy in flat or smoothly undulating areas, the risk for landslide may be considered as low. Hpa-An experiences infrequent flooding mainly localized next to the Thanlwin River where the water intake is located and around the central lake (which level varies according to Thanlwin river level) near which the WTP is located. Both sub-components integrate flood level constraints into their design, including a safety board for climate change risk. Following such design principles, the Project components shall not be affected or put at risk by climate change.

A screening carried out during the Interim phase of the Project confirmed that environmental impacts raised by the project were either very beneficial or mainly related (i) to the risks of nuisances during the construction phase but easily controllable by appropriate construction site supervision and conventional mitigation measures and (ii) during operation, to typical risks in relation to WTP and landfill management but also easily avoidable considering the simple technology applied and the small size of the projects. Consequently, the proposed categorisation of the Project was B, involving the preparation of the present IEE. The conclusions of the present report confirm this initial categorization as category B Project.

Aside from the several and undisputable beneficial impacts of the Project in Hpa-An and Myawaddy, some potential but limited risks are still to be considered should the management program anticipated be deficient:

- Most of the anticipated environmental and social impacts are related to nuisances which may happen during the construction activities. Because of the project located in an urban environment, risk of nuisances is higher: traffic congestion, temporary alienation of access, temporary disruption of community facilities, noise and engine gas and dust release may temporarily disturb the nearby communities. However, recommendations formulated in the present EMP combined with a solid environmental contractual framework and an effective inspection and supervision of construction sites will definitely reduce these risks to acceptable levels.
- Impacts related to water treatment plant operation (pollution from sludge, contamination of water resource) can be also avoided by appropriate management measures already discussed in the IEE. Monitoring of rivers water quality and of treated water is considered to ensure compliance and reduce the risk of supplying contaminated water.
- Impacts related to landfill operation (gas emission and pollution by leachate) are unlikely to occur as design already consider gas collection and flaring and leachate collection and treatment. However, monitoring of gas emission, leachate and adjacent underground water table is considered to ensure compliance.

The EMP emphasizes (i) the need for EHS capacity building for Hpa-An and Myawaddy TDCs, the PMO and the PIU staff, (ii) the need for very strict and detailed EHS specifications for the tender documents and (iii) the need for strict EHS enforcement through monitoring of construction activities.

Conclusion. Assuming that the mitigation measures and monitoring requirements described in the Environmental Management Plan are effectively implemented, the Project is not expected to have a significant adverse environmental impact

11 APPENDICES

Appendix 1 Bibliography

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