13 WASTE

13.1 INTRODUCTION

During the construction and operation phases, there are a range of activities which have the potential to generate a range of liquid and solid hazardous and non-hazardous waste streams. This Chapter identifies in detail the various types of waste that will be generated, potential impacts associated with their generation and disposal, and identifies appropriate mitigation, management and monitoring measures required to reduce residual impacts to an acceptable level.

Based on the outcomes of the IFC Scoping Study (outlined in ***Chapter 5***), all liquid waste streams during both construction and operations phase have been identified.

Impacts associated to all liquid waste streams (both planned and unplanned) were noted as occurring to a range of receptors such as surface water, groundwater and soils. Due to this, the impact screening undertaken has meant that all impacts associated with the generation, storage and disposal of all liquid hazardous and non-hazardous waste streams are assessed elsewhere. Specifically:

- Wastewater discharges from on-site sanitary facilities during construction are assessed within ***Chapter 9***;
- Surface water containing unconsolidated sediment generated during construction is assessed within ***Chapter 9***;
- Waste water generated from washing of equipment on-site, as well from the concrete batching plant is assessed within ***Chapter 9***;
- Contaminated surface water discharged due to inappropriate waste storage and disposal is assessed within ***Chapter 9*** for construction and operations; and
- Wastewater generated during the operations phase is treated within the Industrial Wastewater Treatment System (IWTS), the Sanitary Wastewater Treatment System (SWTS), Storm water Drainage System and Oily Water Treatment System. All impacts associated with the management and discharge of these liquid waste streams are identified and assessed within ***Chapter 9***.

This Chapter is exclusively focused upon impacts associated with the generation and management of solid waste.

13.2 ASSUMPTIONS AND LIMITATIONS

The assessment of potential impacts related to waste in this section is based on the environmental baseline data (presented within ***Chapter 5***), socio-economic baseline data (presented within ***Chapter 6***) and the information available from the Sponsor at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. Should there be significant changes in factors such as assumed input data, engineering design of waste management and treatment components of the Project, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

As stated within ***Section 13.1***, this Chapter does not focus on waste in the context where it impacts upon soil, surface water, or groundwater as the receptors.

13.3 SCOPE OF ASSESSMENT

Based on the IFC Scoping Study and the Project Description, the key potential impacts due to solid waste generation identified arise from the following activities.

Construction Phase

- Power Plant
  - Solid waste generation (primarily steel pipes, steel plates, structural steel, and wooden crates), storage & disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of;
  - Biomass from clearance activities is also required to be stored and disposed of.
- 230kV Overhead Transmission Line
  - Solid waste generation (primarily steel, excess cables etc.) storage and disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
- Gas Supply Pipeline
  - Solid waste generation (primarily steel and other metal scraps), storage and disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - 20,000m^3 of excess soil requiring to be disturbed and relocated within the site;
  - Solid waste generation (primarily steel and other metal scraps), storage and disposal;
  - Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.

Operation Phase

- Power Plant
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste materials such as steel, excess cables etc associated with routine and non-routine maintenance.
- 230kV Overhead Transmission Line
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste materials such as steel, excess cables etc associated with routine and non-routine maintenance.

- Gas Supply Pipeline
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste materials such as steel, excess cables etc associated with routine and non-routine maintenance.
- Water Supply Pipeline and Wastewater Discharge Pipeline
  - Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of.
  - Waste material such as steel, excess cables etc associated with routine and non-routine maintenance.

13.4 LEGISLATION REQUIREMENTS

This waste impact assessment is based upon the international guidelines which have been reviewed, discussed and presented in detail within Chapter 3. In particular, IFC PS3 Pollution Prevention and Abatement and ADB SPS which adopts the WBG Environment Health and Safety Guidelines are of relevance to this assessment. This standard requires an assessment of the waste generated and avoidance and minimisation measures proposed to be utilised as part of the basic project description. This includes an assessment of the measures on how to best avoid or minimise all waste stream, put in place resource recovery, recycling and/or reuse measures where avoidance is not feasible, and as a final resort how remaining waste will be treated and disposed of in an environmentally sound manner.

13.5 SUMMARY OF BASELINE CONDITIONS

13.5.1 *Existing Waste Generators*

The existing baseline information is based upon the amounts of waste generated. The overall generation of waste within the area of influence is a mixture of domestic, agricultural and industrial waste.

Waste generated within the villages of Sa Khar, Hnan Ywa, Hpet Taw, Nyaung Kan and Gyoke Pin and surrounding agricultural areas consists primarily of domestic solid waste and some liquid sanitary waste. Based on observations of the area, littering and waste dumping are prevalent, with burning of waste piles being undertaken regularly.

The Mandalay City Development Committee is the agency responsible for waste management in the Mandalay region. Issues with the existing Municipal Waste Management system include a lack of equipment and personnel, improper collection and management of disposal sites and a complete lack of recycling facilities within Myanmar. Formal, centralised waste management within the Project Study Area (including the aforementioned villages) is extremely limited.

13.6 ASSESSMENT METHODOLOGY

Potential impacts associated with the generation and management of solid waste during the construction and operation phase have been reviewed in ***Chapter 5***. Based upon this review, potential sources of impacts associated with solid waste that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined considering the factors of the nature and magnitude of impacts. The temporal and spatial spread of activities will mean that the actual volumes and types of solid waste generated will be dependent on the specific activities being undertaken at the time. Accordingly, to identify clearer identification of impacts and development of management and mitigation measures specific to each activity, the potential soil impacts are described on an activity basis.

13.7 RESOURCES AND RECEPTORS

The resources (physical, biological, human or cultural environment) and receptors) that may be impacts in relation to solid waste generation and management are detailed within ***Table 13.1*** below.

Table 13.1 Resources and Receptors for Waste Management

Resources	Receptors
• Physical environment including land, air quality and water resources (addressed elsewhere). • Biological environment, primarily being the terrestrial environment. • Human environment including subsistence resources, community health, welfare, amenity and safety, employment and incomes, business and economic activity, existing government services, land use and traffic	• Construction workers • Full time and temporary workers during operation • Contractors and visitors to the site • Residents within the area of influence • Adjoining industrial facilities • Workers in or near waste disposal locations • Residents near waste disposal locations • Government bodies/businesses providing waste management services

13.8 ASSESSMENT OF IMPACTS

13.8.1 Construction Phase

Construction of the Power Plant will be carried out by the construction contractor appointed by the Sponsor. The construction phase for the Project will comprise of primarily two distinct phases: (a) civil construction work that would require a minimum of one year for completion; and (b) mechanical and electrical work for Plant commissioning. The entire construction phase is expected to continue for approximately 22.5 months. The approximate number of workers for both civil and mechanical works is expected to be around 600 - 900. During the construction phase, potential impacts will likely arise associated with the generation, storage and disposal of solid waste. Based on the outcomes of the IFC Scoping Study (***Chapter 5***) and the above sections, the following impacts are anticipated during the construction phase:

- Impacts due to improper storage and disposal;

- Impacts associated with the removal of potentially contaminated soils from the site; and
- Impact associated with the generation, storage and disposal of solid hazardous and non-hazardous waste.

Impacts due to Improper Biomass Storage and Disposal

Whilst the site can be described as generally sparsely vegetated, there are small trees, shrubs and groundcover scattered throughout the site which will need to be removed prior to soil disturbing works commencing. Impacts direct to terrestrial biodiversity are addressed within ***Chapter 14***, however the removed vegetation represents a solid waste stream which needs to be disposed of. Presently, it is estimated that up to 800m^3 of biomass such as trees, shrubs and grass will be removed. In cases where there are limited municipal waste options, often the removed vegetation is gathered into piles and burnt. The generation of smoke, when combined with the already degraded air-shed due to the Steel Mill, can lead to human health impacts.

The significance of potential impacts to improper disposal of biomass during the construction phase is assessed in the following table, and mitigation measures are presented.

Table 13.2 Potential Impacts Due to Improper Disposal of Removed Biomass

Impact	Potential impacts due to improper disposal of removed biomass				
Nature	**Negative**	Positive	Neutral		
	Potential impacts associated with improper disposal of biomass (i.e. burning) are considered to be negative				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts would be direct				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	The construction phase will last approximately 22.5 months, however any impacts associated with biomass management would be experienced within the initial phases and possibly only for 1 to 2 days.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be limited to the location where biomass is stored and disposed of				
Scale	• The anticipated volume of biomass to be removed and requiring management is in the order of 800m^3. • The impact would initially be limited to the footprint of where the biomass is stored, with any smoke from burning likely to be very locally restricted.				
Frequency	It is likely that this impact will occur only once.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Improper disposal of biomass, particularly through vegetation, can result in a small change in air quality when measured at nearby receptors.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	The receptors in the event that the vegetation is burnt will be the local communities situated within 1km of the site.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- No vegetation is to be disposed of by burning under any circumstances
- Generally biomass such as trees, shrubs and grass are utilised by the local community for a variety of purposes. The Sponsor will engage with the local community to ensure that they are provided with priority access to all of the biomass. In order to ensure public safety and limit access to the site (given its proximity to the steel mill), the Sponsor will first clear of the biomass and store it in a designated area (most likely the north-east corner of the site closest to the village of Sa Khar) where the local community are easily able to access it.
- Any biomass not taken by the local community biomass is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

Impacts of Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network

During the construction phase, a range of waste materials will be generated either due to the daily activities of the construction workforce (e.g. generation of putrescible waste) as well as a range of general construction waste such as concrete, steel pipes, plastic pipes, steel plates, structural steel and wooden crates during the civil works phase of construction. Whilst most of these are likely to be non-hazardous, some of these may be hazardous include used paint, engine oils, hydraulic fluids, spent solvents, spent batteries etc. As detailed within ***Chapter 12*** based on similar projects the total approximate quantities of hazardous and non-hazardous waste during construction (assuming an average of 600 workers per day) include:

- 600kg/day of solid (non-hazardous waste); and
- 135kg/month hazardous waste.

Based on data gathered and presented within the environmental and social baseline chapters, the municipal waste management network within the area is exceptionally limited. Therefore, any additional waste streams generated by the Project are likely to place additional stress on this already struggling waste management network. Whilst the Project plans to put in place contracts with local service providers to collect the waste, this may simply be exporting impacts off site. These impacts could include soil and groundwater impacts (depending on the nature of the final disposal site), human health impacts, impacts to surface water and indirect impacts to community health and safety due to contamination of drinking water or food.

Additionally, it is noted that the improper storage of waste on-site can also give rise to a number of impacts. These include:

- Indirect impacts to community and work health and safety due to contamination of drinking water or food; accidental leaks or spills of oil, fuel or other hazardous materials could potentially pollute surface waters; and
- Soil may be contaminated by pollution from spills or leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored.

As discussed within ***Section 13.1***, these impacts associated with improper storage are related directly to management of impacts to soils, groundwater and surface water and are therefore addressed separately and in an integrated manner within these chapters.

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous and non-hazardous waste streams from the project construction phase are assessed in the following table, and mitigation measures are presented.

Table 13.3 Potential Impacts Due to Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network

Impact	Impacts of Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to the existing waste management network would be direct				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 22.5 months. Impacts from the Project could potentially last longer than the duration of the construction phase. The duration of impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area				
Scale	Construction activities will take place within the Project area. Based on experience with similar projects, the total approximate quantities of waste that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include: • 600 kg/day of solid waste • 135 kg/month hazardous waste The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area				
Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to soil quality in Project area due to inappropriate waste disposal is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	Medium	**High**		
	The existing waste network in the area is almost non-existent and is therefore very sensitive with regards to accepting additional waste streams.				
Significance	Negligible	**Minor**	**Moderate**	Major	
	The combination of a High Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- All waste collection and storage measures as detailed within ***Chapter 9*** and ***Chapter 12*** (Surface Water, Soil and Groundwater) will be implemented;
- Prior to construction commencing, the Sponsor is to engage with local authorities and other stakeholders (such as the Steel Mill) to determine the capacity of the local waste management network to absorb the new waste streams during construction;
- A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;
- Education of all workers on site shall be undertaken to avoid, reduce and reuse wastes generated;
- Waste disposal facilities shall be sited and signposted throughout the construction site;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site. All waste collected should be managed and disposed of in accordance with the accepted best practice for waste collection and disposal;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing IFC and ADB requirements;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis on any cross-boundary transport of waste.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be Negligible.

13.9 OPERATION AND MAINTENANCE PHASE

The operation phase is expected to continue for approximately 22 years. The average number of permanent workers present during operation is expected to be approximately 80. The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the Power Plant. During the operation phase, the plant is expected to produce limited additional waste streams than those anticipated within the construction phase. These waste streams would be mainly materials generated either due to the daily activities of the workforce (e.g. generation of putrescible waste) or a range of general construction waste such as paper from offices and scraps of steel/plastic during maintenance activities. Whilst most of these are likely to be non-hazardous, some of these may be hazardous, for example, used paint, engine oils, hydraulic fluids, spent solvents, spent batteries etc. Whilst these volumes are anticipated to be lower than the

construction phase, there is still the matter of the capacity of the existing waste management network in the region to absorb the additional waste being generated. An additional waste stream during operation is the generation of sludge from process operations. Myingyan municipality will be engaged for appropriate disposal of the dried sludge from process wastewater, and disposal will be by a licensed waste contractor.

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous and non-hazardous waste streams from the project operation and maintenance phase are assessed in the following table, and mitigation measures are presented.

Table 13.4 Potential Impacts of Solid Waste Generation, Storage and Disposal during Operations

Impact	Impacts of Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network during Operation and Maintenance				
Nature	**Negative**	Positive	Neutral		
	Potential impacts would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to the existing waste management network would be direct				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 22 years. The duration of impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Scale	Operation activities will take place within the Project area. The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area.				
Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the operation phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to soil quality in Project area due to inappropriate waste disposal is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	Medium	**High**		
	The existing waste network in the area is almost non-existent and is therefore very sensitive with regards to accepting additional waste streams.				
Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a High Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- All waste collection and storage measures as detailed within ***Chapter 9*** and ***Chapter* 12** (Surface Water and Soil and Groundwater) will be implemented;
- Prior to construction commencing, the Sponsor is to engage with local authorities and other stakeholders (such as the Steel Mill) to determine the capacity of the local waste management network to absorb the new waste streams during construction;
- A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;

- Education of all workers on site shall be undertaken to avoid, reduce and reuse wastes generated;
- Waste disposal facilities shall be sited and signposted throughout the site;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis on any cross-boundary transport of waste.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.