CHAPTER 5: IMPACT ASSESSMENT AND MITIGATION MEASURES

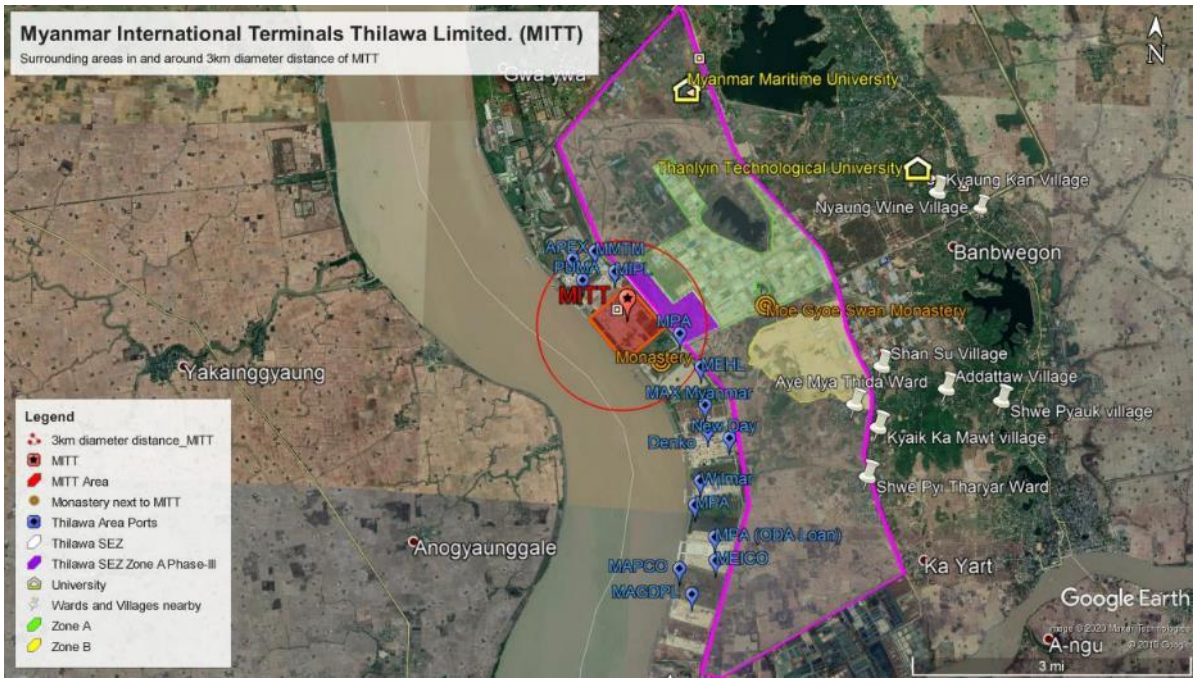
5.1 Impact Assessment Methodology and Approach

5.1.1 Scope of Assessment

In order to access likely significant environmental, social and health impacts, the conceivable adverse environmental, social and health impacts by the project were initially identified based on the project descriptions and overall environmental and social conditions in the surrounding area.

5.1.2 Setting Potential Impact Area of Interest (AOI)

In order to cover potential environmental and social impacts that can be caused by the project, the potential impact area boundary was set up to 3km diameter distance which is sufficient for the main potential impacts such as noise and dust impacts. The following satellite image shows the project area, Thilawa SEZ, oil and gas terminals located within 3km diameter of distance from the project. Sensitive receptors such as community areas, natural reserved areas, public areas and religious areas are not existed within 3km potential impact area boundary while only port terminals and Thilawa SEZ are existed.



Source: Google Earth (Prepared by EMP Study Team)

Figure 5.1-1 Project area and its surroundings within 3km diameter distance

5.1.3 Impact Assessment Methodology

The following assessment methodology is used to assess the impacts of pollution, natural environment, social environment, health and safety and emergency concerned issues that can be caused by the project. The methodology is composed of two metrics: severity and likelihood or frequency. Each can be given a numeric value from 1-5 with increasing severity and likelihood respectively and displayed in a risk matrix as shown in Table 5.1-1.

Table 5.1-1 Impact Assessment Matrix

		Likelihood				
		Improbable / Rare (1)	**Remote / Unlikely (2)**	**Occasional (3)**	**Probable / Likely (4)**	**Almost Certain / Frequent (5)**
Severity	**Very High (5)**	5	10	15	20	25
	High (4)	4	8	12	16	20
	Moderate (3)	3	6	9	12	15
	Minor (2)	2	4	6	8	10
	Negligible (1)	1	2	3	4	5

Source: EMP Study Team

The impacts of pollution, natural environment, social environment, health and safety and emergency risks will be assessed and evaluated in a accordance with above matrix table and from the respective calculations, and will be classified as A (±), B (±), C (±), D & E with colour code and criteria as below.

A-:	**(20-25)**	**Very Significant Negative Impact**	**A+:**	**Very Significant Positive Impact**
B-:	(15-19)	Significant Negative Impact	B+:	Significant Positive Impact
C-:	(9-12)	Moderately Significant Negative Impact	C+:	Moderately Significant Positive Impact
D:	(5-8)	Generally Acceptable Risks		
E:	(1-4)	Minimal to Insignificant		

The EMP Study Team have employed the principles and hierarchy in the same Draft Myanmar EIA Guidelines (2017) in addressing the impacts identified. These principles and hierarchy are provided below.

1) Avoidance and prevention – choosing technologies or materials that will not generate the impact,

2) Minimization and reduction – lowering the effect of the impact by lessening the use of impact-producing equipment or performance of the activity,

3) Rehabilitation – ameliorate the affected environment,

4) Offset or compensation – compensate or offset impacts which are deemed unavoidable to achieve no net loss.

5.2 Summary of Environmental, Social and Health Impact Assessments and Emergecny Risk Assessment

The environmental, social and health impact assessments and emergency risk assessment were examined and evaluated in accordance with above-mentioned assessment matrix. According to EIA Procedures (2015) issued by MONREC (formerly MOECAF), the project is divided into two stages: i) Operation stage (OS) and ii) Closure Stage (CLS).

In order to access likely significant environmental, health and social impacts, the conceivable adverse environmental, health and social impacts were identified based on the operating activities of project, demolishing activities of the project and overall environmental and social conditions in the surrounding area.

Table 5.2-1 Preliminary Assessment Results of Environmental, Social and Health Impacts and Emergency Risks

Category	Assessment Item	Source of Impact / Causes	Assessment Evaluation		Reason for Preliminary Assessment
			OS	CLS	
Pollution	Air Quality	Emission of dust and exhaust gases	B-	C-	**OS: D**ust and particulate matters' emission from cargo handling operations, exhaust gas emission from backup generators, operation- related machineries, vehicles and engines are expected. Emission of exhaust gas (SO_x, NO_x, CO, etc.) from berthing ships' engines is also anticipated. Likelihood is **"Likely (4)"** and Severity is **"High (4)",** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS: D**ust and particulate matters' emission from material transportation and demolition works, and exhaust gas emission from demolition-related vehicles and engines are anticipated. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)",** thus Impact Rating is **"Moderately significant (12)".**
	Water Quality	Effluents from surface runoff, utilities and activities	B-	C-	**OS:** Water quality deterioration of receiving water body and surrounding environment due to the wastewater generation from surface runoff, domestic activities, and effluent from utilities are expected. Also, accidental leakage of oil and chemical substances during loading and unloading of berthing ships and wastewater generated from maintenance dredging works can be occurred. Likelihood is **"Likely (4)"** and Severity is **"High (4)",** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS:** Water quality deterioration of receiving water body and surrounding environment due to the wastewater generation from surface runoff and demolition activities is expected. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)",** thus Impact Rating is **"Moderately Significant (12)".**
	Wastes	Hazardous and non-hazardous waste generation	C-	C-	**OS:** Non-hazardous wastes such as domestic wastes, food wastes, and garbage and bulk cargo residues can be generated from port activities, cargo operations and berthing ships. Hazardous wastes such as leftover paints, oily wastes, dredged materials, etc. are also anticipated to generate. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (12)".** **CLS:** Both hazardous and non-hazardous wastes from land excavation, domestic activities and demolition of building structures can be generated. Likelihood is **"Occasional (3)"** and Severity is **"Moderate (3)"** thus Impact Rating is **""Moderately Significant (9)".**
	Hazardous Chemicals and Materials	Fuel and other hazardous chemicals and materials usage	B-	C-	**OS:** Oil and fuels used for generators, machineries and engines, and dangerous containers, toxic and harmful cargoes may impact on surrounding environment and living beings more or less if not properly stored, handled in case of spillage, leakage or damage. Likelihood is **"Likely (4)"** and Severity is **"High (4)"** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS:** Spillage and leakage of fuel used for backup generators, oils, lubricants, etc. used for demolition works may impact on surrounding environment and living beings. But this impact may be very limited and impact duration will also be very short. Likelihood is **"Occasional (3)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (9)".**
	Offensive Odor	Odor emission from domestic activities and port operation activities	C-	C-	**OS:** Domestic wastes, sewage treatment plant, toilets, and temporary container washing area would generate offensive odor to the surrounding nearby and make nuisance to the workers, staffs and the surrounding environment. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (12)".** **CLS:** Bad smell from temporary toilets, domestic wastes and wastewater from construction/ demolition activities would

Category	Assessment Item	Source of Impact / Causes	Assessment Evaluation		Reason for Preliminary Assessment
			OS	CLS	
					generate offensive odor more or less and make nuisance to people nearby and surrounding environment. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (12)".**
	Soil Contamination	Spill/ leakage of fuel, hazardous materials and hazardous waste	B-	C-	**OS:** Dredged materials, wastes and wastewater from domestic activities, spillage and leakage of oil and fuels, runoff from quay, container washing area and storage areas, spills from bulk cargo operations and wind-blown dust would cause soil contamination when contacted with sub soil and bottom soil of the river. Likelihood is **"Likely (4)"** and Severity is **"High (4)"** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS:** Spillage and leakage of fuel used for generators and engines, domestic wastes and wastewater may cause soil contamination when contacted with the sub soil. Likelihood is **"Occasional (3)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (9)".**
	Noise and Vibration	Noise and vibration generation from operation and demolition activities	B-	C-	**OS:** Operation and movement of cranes, pumps, vehicles, heavy machineries, cargo handling equipment, generators, cargo operations, ship traffic and other port activities may increase noise and vibration level and cause nuisances to surrounding area. Likelihood is **"Likely (4)"** and Severity is **"High (4)"** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS:** Operation and movement of demolition-related vehicles, temporary power supply generators, machineries, equipment and other demolition activities may generate noise and vibration in and around the site. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (12)".**
	Ground Subsidence	Ground water usage and other activities that can happened ground subsidence	E	E	**OS/ CLS:** Ground water will not be extracted and used for water supply and thus, ground subsidence due to the project at both operation and closure stages is not expected. Likelihood is **"Unlikely (2)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (4)".**
	Bottom Sediment	Activities that can cause bottom sediment	C-	E	**OS:** Dredged materials generated from regular maintenance dredging can cause bottom sediment if not properly disposed to the designated disposal area. Likelihood is **"Occasional (3)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (9)".** **CLS:** There are no activities that can cause impact on bottom sediment to the nearest water bodies during closure stage.
Natural Environment	Protected area	Natural reserved areas, public parks & other protected areas	E	E	**OS/ CLS:** Although Banbwegon reserved forest area is located over 3km east side from MITT, there are no project activities which can cause any impacts on that reserved forest. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2)".**
	Marine Ecology	Activities that can impact on marine ecology	C-	E	**OS:** Leakage of oils, oily wastes and mixtures from berthing ships may directly cause damage to fishery resources, aquatic biota and coastal habitat. Besides, runoff, spills or leakage of toxic or harmful materials or oily compounds from cargo handling and storage may cause deterioration of aquatic biota and fishery resources. Likelihood is **"Occasional (3)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (9)".** **CLS:** No impact on hydrology is anticipated as there are no project activities that can cause impact on it. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2)".**
	Hydrology	Activities that can impact on hydrology	E	E	**OS/ CLS:** No impact on hydrology is anticipated as there are no project activities that can cause impact on it.

Category	Assessment Item	Source of Impact / Causes	Assessment Evaluation		Reason for Preliminary Assessment
			OS	CLS	
					Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2)".**
	Topography and Geography	Land acquisition, site cleaning and factory operation	E	E	**OS/ CLS:** No impact on topography and geography is anticipated as there are no project activities such as large-scale excavation works that can cause impact on it. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2)".**
Social Environment	Involuntary Resettlement and Land Acquisition	Land acquisition, site cleaning and factory operation	E	E	**OS/ CLS:** The project is located inside 37 plots in Thilawa Port Area and has been operating since from 1997. Thus, no resettlement or land acquisition issues are necessary to consider for operation and closure stages. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2)".**
	Local Economy (e.g. employment and livelihood)	Job opportunities for local people	B+	E	**OS:** There will be positive impacts on local economy in terms of increment of job opportunities for surrounding communities and creating some businesses for local people to get more income during operation stage. Likelihood is **"Likely (4)"** and Severity is **"High (4)"** thus Impact Rating is **"Significant Positive Impact (16)".** **CLS:** During closure stage, temporary job opportunities for local workers in demolition activities will be provided. After that, the local economy will revert back to the original condition same as the time before construction of the port. Likelihood is **"Unlikely (2)"** and Severity is **"Minor (2)"**, and Impact Rating is **"Insignificant (4)"**.
	Indigenous and Ethnic People	Activities that can impact on indigenous and ethnic people	E	E	**OS/ CLS:** No indigenous and minority people are around the project site as the factory is located in urban and industrial area. Likelihood is **"Rare (1)"** and Severity is **"Negligible (1)**" thus Impact Rating is **"Insignificant (1).**
	Land Use and Local Resources	Activities that can impact on land use and local resources	E	E	**OS/ CLS:** No impact on land use and local resources as the project is already located in Thilawa Port Area and has been operating since 1997. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2).**
	Greening and Landscape	Activities that can impact on greening and landscape	D	E	**OS:** Impact on visual landscape can be caused by physical appearance of QC, RTG, berthing ships and container yards, etc. Development of greening area inside the port area can create better visual appearance. Likelihood is **"Occasional (3)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Generally Acceptable (6).** **CLS:** No impacts on landscape is expected during closure stage as the landscape of the project area will revert back to the original condition as same as the time before construction of the port. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"**, thus Impact Rating is **"Insignificant (2).**
	Existing Social Infrastructures and Social Services	Activities that can impact on Existing Social Infrastructures and Social Services	E	E	**OS/ CLS:** No impact on existing social infrastructures and services is anticipated as the project is already located in Thilawa Port Area. Likelihood is **"Unlikely (2)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (4).**
	Conflict of interests within the region	Activities that can impact on conflict of interests within the region	E	E	**OP/ CLS:** No impact on social institutions is expected as the project is already located in Thilawa Port Area. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (1).**
	Cultural Heritage	Activities that can impact on cultural heritage	E	E	**OS/ CLS:** No impact on cultural heritage is anticipated as the project is located in Thilawa Port Area since 1997 and there is no cultural and archaeological structures and sites within study area boundary. Likelihood is **"Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2).**

Category	Assessment Item	Source of Impact / Causes	Assessment Evaluation		Reason for Preliminary Assessment
			OS	CLS	
	Gender Discrimination	Activities that can impact on gender discrimination	E	E	**OS/ CLS:** The project will not make any impact on gender discrimination. Likelihood is **""Rare (1)"** and Severity is **"Minor (2)"** thus Impact Rating is **"Insignificant (2)".**
	Children's Right	Working in construction/ operation/ demolition works	E	E	**OS/ CLS:** The project will not make any impact on children's right as the project will not employ child workers under age of 18 years. Likelihood is **""Rare (1)"** and Severity is **"Negligible (1)"** thus Impact Rating is **"Insignificant (1).**
Health and Safety	Occupational Health and Safety	Occupational health and safety risks to worker during operation and closure stages	B-	C-	**OS:** During operation stage of the project, physical hazards due to movement of vehicles, equipment and cargo handling operations, exposure to heat and noise, asphyxiation or drowning, working at height, exposure to infectious diseases, etc. would be occurred in port workers. Likelihood is **"Likely (4)"** and Severity is **"High (4)"** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS:** During closure stage of the project, air pollution, noise and vibration, exposure to heat, workplace injuries, movement of demolition-related vehicles, and other communicable diseases would be occurred in demolition workers. Likelihood is **"Likely (4)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (12)".**
	Community Health and Safety	Community health and safety risks to worker during operation and closure stages	B-	C-	**OS:** During operation stage of the project, traffic accidents, port safety and security and public nuisance due to the operation of heavy machineries and vehicles would be occurred. Likelihood is **"Likely (4)"** and Severity is **"High (4)"** thus Impact Rating is **"Significant Negative Impact (16)".** **CLS:** During construction/ closing stage, communicable diseases may occur due to the influx of workers and other migrant workers such as HIV/ AIDS. Also, other common communicable diseases such as diarrhea due to materials, chemicals, working environment, stagnant water and unsanitary facilities can occur. Likelihood is **"Occasional (3)"** and Severity is **"Moderate (3)"** thus Impact Rating is **"Moderately Significant (9)".**
Emergency Risks	Fire	Fire explosion due to fuel and harmful chemicals and materials usage and storage	B-	B-	**OS:** Improper storage and handling of flammable materials, fuel and oil, dangerous containers, improper waste management and careless behavior of workers and operators may cause fire risk during the operation stage. Likelihood is **"Occasional (3)"** and Severity is **"Very High (5)"** thus Impact Rating is **"Significant (15)".** **OS:** Behavior of workers, improper storage and handling of oil and fuel, improper waste management, etc. may cause fire risk during closure stage of the project. Likelihood is **"Occasional (3)"** and Severity is **"Very High (5)"** thus Impact Rating is **"Significant (15)".**
	Flood	Flood occurrence due to heavy rain, and drainage system	C-	C-	**OS/CLS:** Flood can occur due to the heavy rains, overflowing of canals, moats and drainage systems, etc. during heavy storms, cyclones, rainfall and unexpected weather conditions, etc. Likelihood is **"Occasional (3)"** and Severity is **"High (4)"** thus Impact Rating is **"Moderately Significant (12)".**
	Earthquake	Earthquake occurrence	C-	C-	**OS/ CLS:** Earthquakes are possible to happen as the Yangon area is near earthquake faults and is prone to earthquake. Also, there is possibility that structures for operation and demolition works may collapse if an earthquake occurs. Likelihood is **"Occasional (3)"** and Severity is **"High (4)"** thus Impact Rating is **"Moderately Significant (12)".**

Source: EMP Study Team

Note: OP= Operation Stage and CLS= Closure Stage

Evaluation Classification

A+-: (20-25) Very Significant Negative Impact A-+: Very Significant Positive Impact

B+:	(15-19)	Significant Negative Impact	B-:	Significant Positive Impact
C+:	(9-14)	Moderately Significant Negative Impact	C-:	Moderately Significant Positive Impact
D:	(5-8)	Generally Acceptable Risks		
E:	(1-4)	Minimal to Insignificant		

5.3 Environmental Impact Assessment

5.3.1 Air Quality

(1) Air Quality Assessment during Operation Stage (OP)

1) Impact

During operation stage, the major air pollutants by ports are dust, soot, particulate matter and exhaust gas emissions.

Backup generators, transportation vehicles and railway traffic, heavy machineries and cargo handling equipment using diesel engines such as quay cranes (QC), RTG cranes, mobile harbor cranes, empty handlers, reach stackers, forklifts, etc. can emit exhaust gases (NO_x, So_x, CO, $PM_{2.5}$ and PM_{10}). The berthing ships can also emit exhaust gases (NO_x, SO_x and CO, etc.) from the main engine used as propulsion and diesel engine used as generators for electricity supply due to the usage of heavy fuel oil (bunker fuel) which contains higher Sulphur levels than diesel. NO_2 and SO_2 are typical air pollutants generated by berthing ships while both maneuvering and berthing and may impact on air quality in the hinterland.

Dust and particulate matter emissions can also be occurred from loading and unloading of dry bulk cargoes and road traffic, especially dry and windy conditions. Other soot, fumes and vapours can also be emitted from storage areas, berthing ships and cargo handling activities.

2) Mitigation Measures

According to summary of air quality survey results conducted at AQ1 on 29 and 30 November 2019 (peak day), shown in Figure 5.3-1 and Table 5.3-1, SO_2, $PM_{2.5}$ and PM_{10} levels are exceeded NEQG guideline values while NO_2 level is under NEQG guideline value on daily average.

However, on hourly average shown in Figure 5.3-2, $PM_{2.5}$ and PM_{10} levels exceeded the target values especially in mid night and early morning (roughly from 22:00hr to 7:00hr), and wind directions blew during that times are mainly from NNW, WSW, SW, E, SSE, ESE, in where container yards, berthing area, road side from community, car yard, open land area, labour housing and canteen, traffic lanes, temporary container washing area are located. SO_2 levels exceeded in the afternoon (roughly between 11:00hr to 17:00hr) and win directions blew during that times are ESE, SE, SSE, E and SSW in where open land area, traffic lanes, berthing area, car yard and road side from community are located. NO_2 levels also exceeded target values in early morning time (roughly from 1:00hr to 6:00hr) and wind directions blew during that times are SW, NNW, WSW, SE and NNE in where berthing area, container yards, traffic lanes, road side from community are located. Ozone levels also excedded target values in afternoon time (roughly between 10:00hr to 15:00) and wind directions come from during that times are ESE, NNE, E and SSW, in where labour housing, open land area, main office and canteen and traffic lanes. Based on above information, mainly air pollution sources may be from ship berthing area, container yards, open land area, traffic lanes and cumulative air emission from community road next to the project area

But this air quality monitoring survey was conducted during peak day (especially Wednesday, Thursday and Friday) and total vehicles ‘gate in/ out numbers is over 1000. The monitoring results might be impacted from emissions of these vehicles and the results can be decreased during non-peak days.

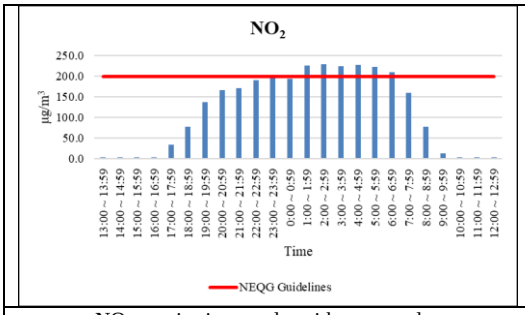
Table 5.3-1 Air Quality Survey Result (Daily Average)

Date	NO_2[3)4)]	$PM_{2.5}$	PM_{10}	SO_2[3)]	Ozone[5)]
	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
29 ~ 30 Nov, 2019	115.651	52.024	75.021	67.205	35.764
1 Day Average Value	115.651	52.024	67.205	75.021	35.764
NEQG Guideline Value[2)]	200 (1-hour)	25 (24-hours)	50 (24-hours)	20 (24-hours)	100 (8-hours)

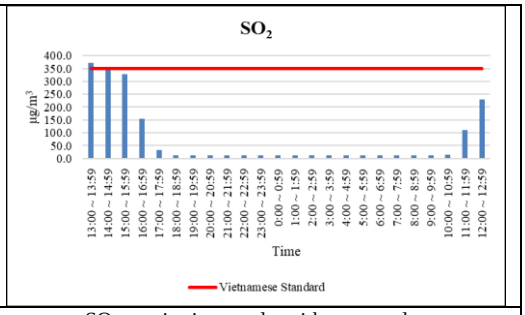
Note: 1) The value in red color shows the value which is higher than NEQG
2) NEQG- National Environmental Quality Emission Guideline, Myanmar (Dec, 2015)
3) The value of NO2 and SO2 were converted to µg/m3 units from ppb per day at 1 atm condition.
4) The value of NO2 is 24 hours average. 1- hour average (1:00 to 7:00) is higher than the Guideline value.
5) The value of Ozone is 8 hours average. 1- hour average (10:00 to 15:00) is higher than the Guideline value.
Source: EMP Study Team

Source: Google Earth (prepared by MKI)

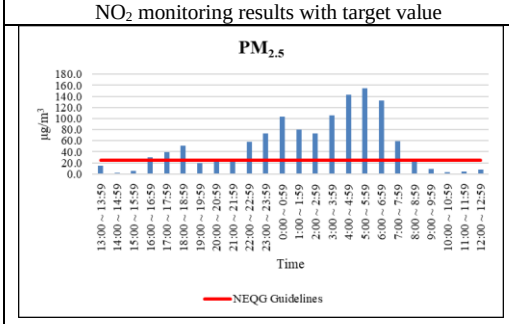
Figure 5.3-1 Location of Air Quality Monitoring Point and Wind Direction



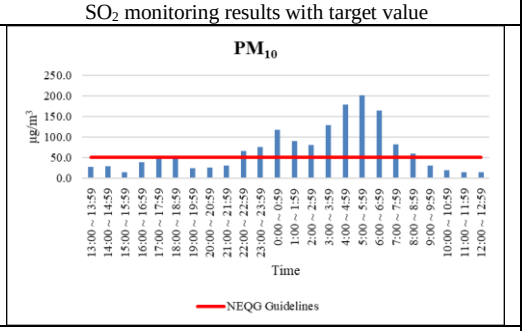
NO_2 monitoring results with target value



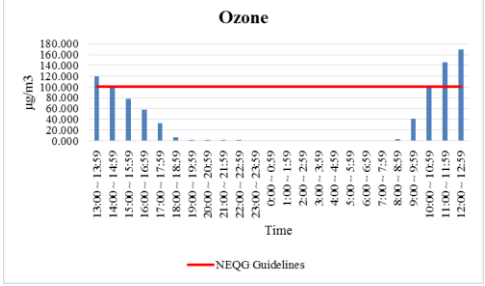
SO_2 monitoring results with target value



$PM_{2.5}$ monitoring results with target value



PM_{10} monitoring results with target value



Ozone monitoring results with target value

Source: EMP Study Team

Figure 5.3-2 Air Quality Monitoring Results with Target Values

Table 5.3-2 Vehicle Usage Record during Noise and Vibration Survey Period

Date	General Cargo Truck		Container Trucks	
	Gate In	Gate Out	Gate In	Gate Out
29/11/2019 30/11/2019	27	313	378	475

Gate in Total	405
Gate out Total	788
Grand Total	1193

Source: MITT

It was confirmed that the project proponent is currently undertaking the following mitigation measures to reduce air pollutants' emissions:

For exhaust gas emissions

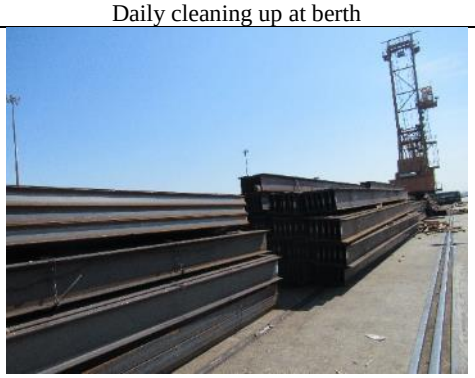
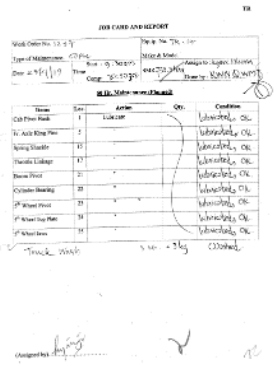
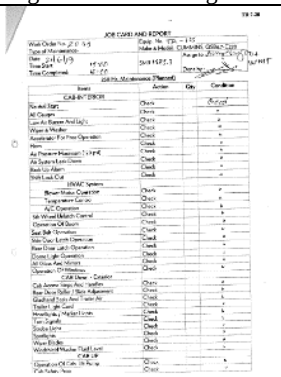
- Using modernized and eco-friendly backup generators and vehicles.
- Keeping generators, cargo handling equipment and vehicles in a good and effective working order.
- Regular inspection, repair and maintenance of generators, vehicles, machineries and cargo handling equipment as per maintenance plan for each type. (Some maintenance record sheets are attached in Appendix-5)
- Stopping the generators and engines when not in use.
- Provision of adequate ventilation system for staff and stevedores.
- It is recommended to consider to supply electricity for berthing ships, a reliable solution to cutting shipping emissions, to turn off their engines and plug into an electrical grid while at berth.

For dust and particulate matter emissions

- Proper transfer, storage and handling of dry bulk cargo in enclosed system to reduce soot, particulate matters and dust dispersions.
- Reduction of dust and soot emission by covers, screens and sprinkling water or other similar methods on dry bulk cargo except anti-humid materials like grains or cement.
- Taking care of each step during the transfer of dry bulk cargo from ship to transportation vehicles and vice versa to reduce and prevent splashes and spills.

- Cleaning any bulk materials spilled as expeditiously as possible, but not later than the end of the daily work shift.

Some representative photos of above-mentioned mitigation measures undertaken by the project proponent are shown in Figure 5.3-3.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Keeping generators, cargo handling equipment and vehicles in a good working manner</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Proper storage area inside workshop</td><td>Daily cleaning up at berth</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Stack for emissions from kitchen</td><td>Temporary storage area of bulk cargo handling facilities</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Record Sheets of maintenance of TR on hour basis</td></tr>
</table>

Source: MITT

Figure 5.3-3 Photos of current mitigation measures for air pollutant emission

Proposed mitigation measures for berthing ships

- To use low-Sulphur fuels (e.g. premium diesel which contains 500ppm Sulphur content) which is one of the easiest measures to reduce ship pollution. Normally, Heavy Fuel Oil used for ship's engines includes Sulphur content of up to 35,000 ppm which is almost 35 times that of low Sulphur alternatives such as Marine Gas Oil (MGO), which contains up to 1,000 ppm).

- To conduct internal engine modifications using the techniques such as water injection and exhaust gas reticulation to reduce NO_x from combustion processes.

- To use scrubbers which can cut SO_2 emissions by 99% and emissions of other polluting particles. The scrubbers can be able to continue use of cheap bunker fuel than expensive low-Sulphur fuel. However, the scrubbing process only transfers the unwanted pollutant from the exhaust gas form into liquid or solid form. This material requires further disposal.

- To conduct internal engine modifications to reduce NO_x production during the combustion processes by using the techniques such as water injection & exhaust gas reticulation that can reduce NO_x emissions by as much as 50%.

- To use Selective Catalytic Reduction (SCR), an active management system to treat exhaust gases after formation before emission into the atmosphere. It uses a chemical reaction to convert NO_x into nitrogen, water and tiny amounts of CO_2 and reduce NO_x emissions by up to 90%.

3) Evaluation

According to above assessment results and mitigation measures, the project proponent is already undertaking necessary countermeasures and mitigation measures properly to reduce air pollutant emissions. Based on EMP study, regular air quality monitoring, checking and monitoring the mitigation measures are recommended to ensure the acceptable air pollutant emissions throughout the operation stage.

(2) Assessment on Air Quality during Closure Stage

1) Impacts

During closure stage of the project, dispersion of dust and particulate matters can be occurred from demolition activities such as land excavation, demolition of building structures, drainages and roads, etc. and from transportation vehicles carrying demolished materials if not properly covered. Moreover, movement of demolition-related vehicles, power supplied generators, heavy machineries and equipment can emit exhaust gases. But, it is expected that the impact on air quality during closure stage will be temporary within demolition period and will be no longer.

2) Mitigation Measures

In order to minimize the air pollutants' emissions, the following mitigation measures are proposed to be undertaken during closure stage:

[For dust and Particulate matters' emissions]

- Regular Spraying water to bare land and site access roads.
- Proper treatment for exposed earth by compaction or covering with bitumen within six months after last construction activity on the site or part of the site where there is exposed earth.
- Conducting demolition works under well-ventilated areas.
- Keeping all dusty and demolished materials under covers to prevent dust dispersion.
- Preparing temporary green belt zone or open space between the site and local community during closure stage.
- Proper movement of vehicles for the transportation of demolished materials with covers.

[For exhaust gases' emissions]

- Using modernized and eco-friendly generators and vehicles, and avoiding usage of old machineries and vehicles that can emit more exhaust gases.

- Keeping generators, equipment and vehicles temporarily used in the site in a good and effective working order.
- Regular inspection, repair and maintenance of generators, vehicles and machineries.
- Turning off the generators and engines when not in use.

3) Evaluation

Based on above impact assessment and proposed mitigation measures, the contractor can be able to reduce properly air pollutant emissions due to demolition work under the supervision of the project proponent. It is also recommended to monitor air quality and their mitigation measures for air pollution during closure stage.

5.3.2 Water Quality

(1) Water Quality Assessment during Operation Stage

1) Impact

During operation stage of the project, the wastewater generated from domestic activities (e.g. canteens, workers' living areas, canteens, washing areas and toilets, etc.) and operation activities (e.g. container washing process, workshop activities, handling of harmful and toxic liquid cargo, etc.) can impact on water quality of receiving water body, the Yangon River. Moreover, accidental spillage and leakage of fuels and oils from storage area, bulk cargo handling and loading and unloading of harmful and toxic chemical substances and the runoff which includes organic compounds, fine particulates, heavy metals such as phosphates, nitrogenous manure, coal, metal ores, mercury, cadmium, lead, and pesticides, etc. can also impact on water quality. Maintenance dredging activity can re-suspend the contaminated materials and pollutants which can result to temporary increase in water turbidity and concentration of suspended matter and sedimentation rates.

Regarding container washing process, containers are washed with detergent and water according to the request of customers and the process is not conducted always. 'WIN'detergent is used as cleaning agent and it is a surfactant detergent. Detergents can have poisonous effects in all types of aquatic life if they are present in sufficient quantities. Most fish will die when detergent concentrations approach 15 parts per million and detergent concentration as low as 5ppm can kill fish eggs. Surfactant detergents are implicated in decreasing the breeding ability of aquatic organisms. Surfactant detergents are more toxic than phosphate detergents.

Domestic wastewater and harmful and toxic wastewater (e.g. bilge water, ballast water with the transfer of harmful aquatic organisms including dormant stages of microscopic toxic aquatic organisms such as dinoflagellates, pathogens such as the bacterium vibrio cholera) generated from berthing ships, accidental spills and discharges of oils, wastes and other residues from ships can also impact on river water quality if discharged accidently or intentionally into the river.

2) Mitigation Measures

According to water quality monitoring survey results conducted at low tide time on 2 December 2019, the total monitoring results of 28 parameters stated in NEQG (2015) general application guidelines for runoff and 8 specific parameters for ports and harbors under NEQG (2015) are fully described in Chapter- 4 and only those which exceeded NEQG guideline values are highlighted here in Table 5.3-3. The excess levels of total suspended solids at all points might be due to the original high level of turbidity in the river and maintenance dredging activity which was conducting at that time. The excess levels in Ammonia and Iron at the drainage/ main outlet, might be due to the runoff from harmful and toxic bulk cargo handling, and spills of harmful chemicals from storage area. The excess level of Total Nitrogen and Total Coliform at the drainage and downstream area of Jetty might be due to insufficient domestic wastewater treatment system and/ or natural excess of bacteria from existed in the river by tidal effect.

Table 5.3-3 Parameters exceeded NEQG guideline values during water quality monitoring

No.	Parameters	Unit	SW-1	SW-2	DW-1	NEQG Guideline Value (Reference Value for Self-Monitoring)
4	Suspended Solids	mg/L	264.00	2240.00	98.00	50
8	Total Nitrogen	mg/L	2.4	11.1	13.9	10
10	Ammonia	mg/L	-	-	15.800	10
23	Iron	mg/L	-	-	4.770	3.5
26	Total Coliform	MPN/100ml	350	1600	>160000	400

Source:EMP Study Team

In order to minimize the above-mentioned possible impacts on water quality due to port activities and ship discharges, the project proponent has been implementing the following mitigation measures:

[For Port Terminal]

- Not allowing any wastewater to discharge directly to the river prior to the treatment system.
- Recording monthly water consumption amount for port operation activities and ship water supply.
- Sewage Treatment Plant (STP) has been installed and used for domestic wastewater treatment before discharging into the river. The effluent water from this STP is in the range of 10-30 mg/L for BOD, 40-80mg/L for COD and 6.5-8.5 for pH level which are much lower than NEQG guideline values. The detailed description, flow chart and figures of STP can be seen in Sub-section (2) under Section 3.3.4.
- TJQ Flotation Water Purifier has been installed and used for wastewater treatment to treat wastewater from container washing and other operation activities. The detailed description, flow chart and figures of TJQ Flotation Water Purifier can be seen in sub-section (3) under Section 3.3.4.
- Temporary filtration tank has been installed at temporary container washing area for container washing wastewater. But adequate treatment system for container washing wastewater should be considered to reduce the increase of phosphorus from the washing detergent in the receiving water body. The detailed description, flow chart and figures of temporary filtration tank can be seen in Section 3.4.5.
- Drinking water treatment plant using Ro System has been installed for domestic water treatment and the purified water quality is met with WHO drinking water standard. The detailed description, flow chart and figures of drinking water treatment system can be seen in sub-section (3) under Section 3.3.4.
- Proper storage and handling of oils and fuels not to spill or leak into the drainage.
- Installation of oil separating facility at the workshop and catch basins with oil trap in fuel storage area and workshop.
- Installation of adequate drainage system for storm water runoff and effluent water from treatment facilities.
- Keeping mangroves behind the jetty to indirectly recover water quality and provide habitat for terrestrial and aquatic biota.
- Regular checking, repair and maintenance of STP, WWTP and Drinking WTP are highly recommended.
- Proper treatment for temporary container washing area and better control of the quality of run off are recommended.

[For Berthing Ships]

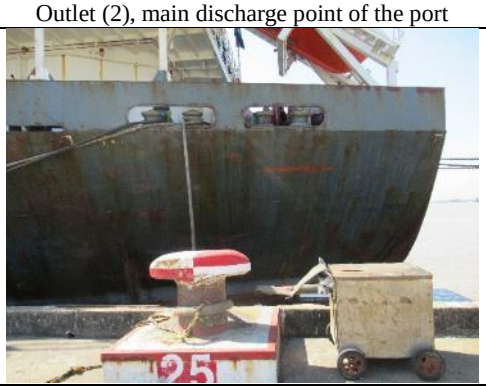
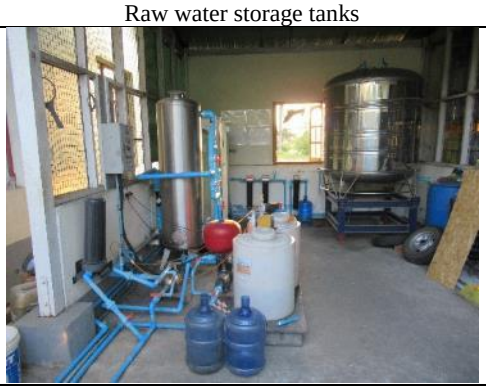
- Prohibition of the berthing ships to discharge any domestic wastewater, bilge water, ballast water, oily wastes, sewage, garbage and other residues in the berthing ships into the river in accordance with rules and regulations issued by Department of Marine Administration (DMA) under Ministry of Transport and Communications (MOTC).
- Connecting between local service-provider and berthing ships for disposal of domestic wastewater.
- Compliance with rules and regulations issued by MPA and DWIR for ship discharges.
- In case of accidental spills from ships, it is recommended to prepare recovery vessels, oil fences, and treatment chemicals with a view to minimizing dispersal.
- Having proper contingency plans and prompt reporting system for prevention of oil dispersal.
- Periodic clean-up of floating wastes around jetty is recommended for preservation of port water quality.

Some representative photos of above-mentioned mitigation measures undertaken by the project proponent are shown in Figure 5.3-4.

Oil trenches at fuel storage area and workshop

Oil separator at workshop

Oil trench under vehicle repair area

Storm water drainage	Outlet (2), main discharge point of the port
	
Raw water storage tanks	Ship water supply
	
Drinking water treatment facility	Toilet facility for stevedores
	
Filtration tank at temporary container washing area	Sewage treatment facility
	
Installation area of TJQ Flotation Water Purifier (wastewater treatment facility)	Storm water Drainage along the terminal gate

Source: MITT

Figure 5.3-4 Photos of mitigation measures for water pollution

3) Evaluation

Based on the possible impacts on water quality due to port activities and berthing ships and current mitigation measures, the impacts on receiving river quality can be minimized by regular implementation

of current mitigation measures and proposed consideration measures and monitoring effluent water qualities, river water quality in front of the jetty are recommended to conduct for ensuring acceptable water pollutants' generation during operation stage.

(2) Water Quality Assessment during Closure Stage

1) Impacts

During closure stage of the project, surface runoff from demolition site, spillage and leakage of oil and fuel storage area and workshop, wastewater generated from domestic activities such as temporary toilets, washing areas, canteens, temporary office areas and muddy water and turbid wastewater generated from demolition activities and direct flushing of solid wastes can deteriorate the receiving water quality if not properly treated, stored and managed.

2) Mitigation Measures

In order to minimize the above-mentioned possible impacts, the following mitigation measures are proposed to be undertaken by the contractor under the supervision of the project proponent during the closure stage.

- Prohibition of direct discharges of any kinds of wastes and wastewater into the drainage.
- Developing proper temporary drainage system around the whole boundary of the site.
- Installation of temporary septic tanks for the collection of sewage and domestic wastewater.
- Setting temporary settling ponds for turbid water generated from demolition activities.
- Collection and Disposal of domestic wastewater by licensed contractor.
- Monthly recording the collection amount of domestic wastewater by contractor.

3) Evaluation

It can be evaluated that the impacts on water quality during closure stage can be very limited by implementing the proposed mitigation measures well throughout the closure stage.

5.3.3 Wastes

(1) Assessment on Waste Management during Operation Stage

1) Impacts

During operation stage of the project, non-hazardous wastes from domestic activities such as office rooms, living areas of stevedores, canteens, rest areas, toilets, etc. can generated solid and liquid wastes. Maintenance dredging activity will generate contaminated dredged materials which include pollutants. Hazardous and oily wastes can be generated from fuel deposits, and wastes such as the residues of bulk cargo storage, rubbish from unpacking, wood bark from log handling generated from cargo operations. These wastes can cause water pollution and offensive odor emission and nuisance to the surroundings.

Berthing ships can generate garbage, sewage and oily wastes such as bilge water, ballast water, lubricant oil and other residues in machinery space and cargo residues. Accidental spills of these wastes into the river may happen floating garbage and deterioration of river water quality.

2) Mitigation Measures

In order to minimize the above impacts due to the hazardous and non-hazardous waste generations from port activities and berthing ships, the following mitigation measures are undertaking by the project proponent and some are proposed after EMP study:

[Non-hazardous Waste Control]

- Segregation of garbage, food wastes, and other non-hazardous wastes.
- Promoting and practicing 3R (Reduce, Reuse, Recycle) for solid waste control.
- Proper storage of non-hazardous wastes and cargo residues at designated waste storage area and disposal by Kyauktan Municipal regularly.
- Connecting between local service-provider and berthing ships for the disposal of all kinds of wastes generated from ships.
- Provision of adequate reception facilities for ship discharges can be considered as an alternative.

[Hazardous Waste Control]

- Prohibition of direct discharge of any kind of hazardous wastes into the drainage.
- Proper disposal of dredged materials from maintenance dredging work into designated disposal area by the full service of MPA.
- Hazardous oily wastes such as lubricant, batteries, oily residues, etc. will be stored separately and sold for recycle as much as possible.
- Prohibition of discharges of oily wastes, toxic residues and other hazardous wastes from berthing ships.

Some representative photos of above-mentioned mitigation measures undertaken by the project proponent are shown in Figure 5.3-5.

Washing basin and dustbin at workshop

Housekeeping at berth

Providing dustbins along the berth

Providing dustbin at labour canteen

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Providing dustbin at the office area</td><td>Waste segregation at workshop</td></tr>
<tr><td>
<table>
<tr><th>2018</th><th>Lubricant (Tons)</th><th>Battery (Tons)</th><th>Total Hazardous waste produced</th></tr>
<tr><td>January</td><td>1.087</td><td>0.173</td><td>1.26</td></tr>
<tr><td>February</td><td>0.596</td><td>0.164</td><td>0.76</td></tr>
<tr><td>March</td><td>0.524</td><td>0.146</td><td>0.67</td></tr>
<tr><td>April</td><td>0.676</td><td>0.114</td><td>0.79</td></tr>
<tr><td>May</td><td>0.991</td><td>0.199</td><td>1.19</td></tr>
<tr><td>June</td><td>0.9695</td><td>0.2505</td><td>1.22</td></tr>
<tr><td>July</td><td>1.169</td><td>0.131</td><td>1.3</td></tr>
<tr><td>August</td><td>3.097</td><td>0.403</td><td>3.5</td></tr>
<tr><td>September</td><td>3.412</td><td>0.088</td><td>3.5</td></tr>
<tr><td>October</td><td>2.19</td><td>0.31</td><td>2.5</td></tr>
<tr><td>November</td><td>1.817</td><td>0.183</td><td>2</td></tr>
<tr><td>December</td><td>1.7</td><td>0.3</td><td>2</td></tr>
</table>
<table>
<tr><th>2019</th><th>Lubricant (Tons)</th><th>Battery (Tons)</th><th>Total Hazardous waste produced</th></tr>
<tr><td>January</td><td>2.25</td><td>0.06</td><td>2.31</td></tr>
<tr><td>February</td><td>1.93</td><td>0.13</td><td>2.06</td></tr>
<tr><td>March</td><td>1.74</td><td>0.20</td><td>1.93</td></tr>
<tr><td>April</td><td>3.51</td><td>0.20</td><td>3.70</td></tr>
<tr><td>May</td><td>2.86</td><td>0.40</td><td>3.26</td></tr>
<tr><td>June</td><td>3.11</td><td>0.46</td><td>3.57</td></tr>
<tr><td>July</td><td>1.37</td><td>0.40</td><td>1.77</td></tr>
</table>
</td><td>  </td></tr>
<tr><td>Records of recycled wastes</td><td>Providing dustbins at kitchen</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Disposal of dredged materials by MPA Service</td><td>Waste Storage area including three chambers</td></tr>
</table>

Source: MITT

Figure 5.3-5 Photos of waste management at the port

3) Evaluation

According to the assessment on waste management of port and shipping berths, the impacts due to the generation of non-hazardous and hazardous wastes from port activities and berthing ships will be very minimum as the project proponent is currently undertaking proper waste management not only for ports but also for ships in accordance with national rules, regulations and international best practices.

(2) Assessment on Waste Management during Closure Stage

1) Impacts

During closure stage of the project, the demolition activities can generate domestic wastes such as garbage, unsanitary wastes, plastics, unpackaging rubbish, cans, glasses, etc. and demolished wastes (hazardous and non-hazardous) such as excavated soils, used reinforced bars, concrete tiles and many debris from buildings and structures. Hazardous wastes such as leftover paints, batteries, residues from cargo operations, etc. can also be generated.

2) Mitigation Measures

The following mitigation measures are proposed to be undertaken by the contractor under the supervision of the project proponent for proper waste management:

[Non-hazardous Waste Control]

- Segregation of domestic wastes, demolished wastes and debris.
- Recycling demolished wastes and debris as much as possible.
- Practicing 3R (Reduce, Reuse and Recycle) for waste control.
- Proper storage of different types of non-hazardous in designated temporary storage area.
- Record of amount of wastes and regular disposal of wastes by entrusting Kyauktan Township Development Committee.

[Hazardous Waste Control]

- Proper collection and storage of oily wastes, leftover paints, batteries, lubricants, and packaging materials etc. from demolition activities at temporary storage area with proper labels and signs.
- Proper disposal of hazardous wastes and materials by licensed contractor.

3) Evaluation

According to assessment on waste management and proposed mitigation measures for closure stage, the impacts on the surrounding environment due to the wastes generated by demolition activities can be reduced and minimized by implementing proper waste management for both hazardous and non-hazardous wastes throughout the closure stage.

5.3.4 Hazardous Materials and Chemicals

(1) Assessment on Hazardous Material Management during Operation Stage

1) Impacts

During operation stage of the project, oils and fuels stored in both ground and underground tanks, oil and fuel usage of generators, vehicles and engines and accidental spillage and leakage of oils and fuels, lubricants, and paints can be very harmful and explosive if not properly stored and handled. Improper storage and handling of dangerous containers and cargoes in accordance with IMO Classes (see in Table 3.4-1) and dispersal of harmful and toxic dry bulk cargoes can lead to fire risks and harmful to the workers.

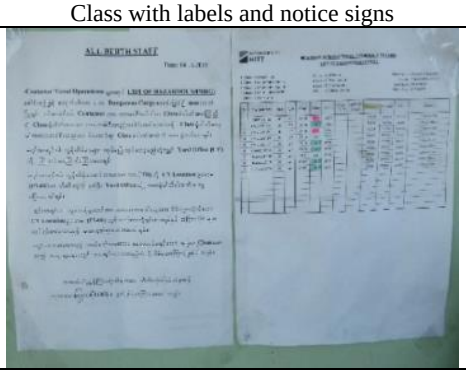
2) Mitigation Measures

In order to minimize the above possible impacts due to hazardous materials and chemicals, the following mitigation measures are currently implemented by the project proponent and some mitigation measures are recommended after EMP study.

- Recording the usage and amount of oil and fuels, lubricant, paints monthly.
- Getting the license issued by Department of Mines under MONREC (formerly MOECAF) to store dangerous and non-dangerous petroleum in tanks in connection with a pump outfit for fueling motor conveyances.
- Proper storage and handling of oils and fuels in accordance with the instruction of relevant government organization.
- Installation of trench and catch basin and secondary containment at the underground and on ground fuel storage areas and at the whole boundaries in case of spillage and leakage.

- Filling the diesel fuel for engines of heavy equipment with handling equipment such as forklift or pallet track or trolley.
- Segregation of dangerous cargoes and other types of cargoes in accordance with IMO classes.
- Careful storage and handling of inbound and outbound dangerous cargoes in accordance with respective handling procedures. The detailed description for container and cargo handling processes can be seen in Section 3.4.1 and 3.4.2 under Chapter-3.
- Development of Inbound and Outbound Container Handling Procedures, Damaged Container Handling Procedure, etc. as necessary (see these procedures in Appendix-3).
- Consideration of emergency response plan for spillage and leakage of hazardous chemicals and materials is recommended.

Some representative photos of above-mentioned mitigation measures undertaken by the project proponent are shown in Figure 5.3-6.

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Underground fuel storage tanks with label and notice signs</td><td>On ground fuel storage tanks with label and notice signs</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Portable mobile tank for fueling of heavy engines</td><td>Designated DG container yard in accordance with IMO Class with labels and notice signs</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>PPE and fire-fighting facilities at DG container yard</td><td>Warning notice for all berth staff for hazardous DG cargo handling</td></tr>
</table>

	
Proper transportation of harmful cargo with full labels and signs	Installation of concrete containments under generators

Source: MITT

Figure 5.3-6 Photos of mitigation measures for hazardous materials and chemicals

3) Evaluation

According to the assessment results and current mitigation measures undertaken by the project proponent, the impacts due to hazardous materials and chemicals can be minimized and the dangerous cargoes and containers, oils and fuels are under proper storage, handling and management. Monitoring the current mitigation measures is recommended to conduct regularly to ensure the safe and effective management of hazardous materials and chemicals.

(2) Assessment on Hazardous Material Management during Closure Stage

1) Impacts

During closure stage of the project, oils and fuel used for power supply generators and heavy machineries, lubricants, and paints, etc. used for demolition work can be harmful and explosive if not properly stored and handled. But this impact would happen temporarily.

2) Mitigation Measures

In order to minimize the impacts due to hazardous materials and chemicals, the following mitigation measures are proposed to be undertaken by the contractor under the supervision of the project proponent.

- Fuels used for generators and engines will be stored properly with fire extinguishers and notice board.
- Secondary containment such as steel trays filling with sand, concrete foundation with oil pit will be installed under generators and fuel storage areas in case of spillage or leakage.

3) Evaluation

Based on impact assessment and mitigation measures, the impacts would happen only in a short time and impact will be very limited if the contractor undertake proposed measures very well.

5.3.5 Offensive Odour

(1) Assessment on Offensive Odour during Operation Stage

1) Impacts

During operation stage of the project, offensive odour can be generated from liquid cargo handling, bulk cargo storage and handling, waste disposal areas, and dredged materials from maintenance dredging

activity. Moreover, toilets, container washing areas, sewage treatment plant and wastewater treatment plant can also generate offensive odour and make nuisance to the surroundings.

2) Mitigation Measures

In order to minimize the impacts on the surroundings due to offensive odour emission, the mitigation measures are currently undertaken by project proponent and recommended measures based on the study are described as follows:

- Regular check of waste storage area, toilets, kitchens, etc.
- Proper waste storage and disposal of domestic wastes by Kyauktan Township Development Committee.
- Smell checking in and around sources that can generate offensive odor.
- Prohibiting direct discharge of any kinds of wastes into the drainage or the river.
- Regular checking the operation of sewage treatment plant, wastewater treatment plant and temporary container washing area.
- Consideration for prevention of offensive odor generation from temporary container washing area (e.g. covering the filtration tank or treatment system) is highly recommended.

3) Evaluation

According to impact assessment and mitigation measures, the offensive odour emission can be reduced by implementing proper mitigation measures and monitoring these measures regularly throughout the operation stage of the project.

(2) Assessment on Offensive Odor during Closure Stage

1) Impacts

During closure stage of the project, offensive odour can be generated from temporary toilets, canteens, temporary waste storage areas and settling ponds.

2) Mitigation Measures

In order to minimize offensive odor emission, the following mitigation measures are proposed to be undertaken by the contractor during closure stage:

- Regular checking of temporary waste storage area, temporary septic tanks installation area and other possible sources of offensive odor within the site.
- Proper waste management system for domestic wastes and disposal by Kyauktan Municipal.

(3) Evaluation

According to impact assessment and mitigation measures for offensive odour emission, it can be reduced by implementing proper mitigation measures and monitoring these measures regularly throughout the closure stage of the project.

5.3.6 Soil Contamination

(1) Assessment on Soil Contamination during Operation Stage

1) Impacts

During operation stage of the project, improper storage and disposal of wastes and runoff from berth, warehouse and container yards, dredged materials from maintenance dredging activity, spills of dry bulk

cargoes and ship discharges can cause soil contamination to contacted sub soil or bottom soil of the river resulting in deterioration of river water quality. Besides, spillage and leakage of oils and fuels from fuel station, generators, engines and cracking of fuel storage tanks can cause soil contamination.

2) Mitigation Measures

According to the site visit to the port and current status, it was confirmed that the project proponent is conducting the following mitigation measures to minimize soil contamination.

- Conducting necessary waste management (see the full description in section 5.3.3 and photos in Figure 5.3-5).
- Proper storage and handling of oils and fuels in accordance with the instruction of relevant government organization.
- Installation of trench and catch basins and secondary containment under generators, underground and on ground fuel storage areas, inside and boundary of workshop and at the whole boundaries of the port in case of spillage and leakage.
- Filling the diesel fuel for engines of heavy equipment by mobile fuel tank with handling equipment such as forklift or pallet track or trolley.
- Checking leakage and ground cracking in oil and fuel storage areas.
- Taking care of runoff from quay and cargo storage area, spills from bulk cargo operations not to cause soil contamination.
- Consideration of Emergency response plan for spillage and leakage of fuel and hazardous materials and cargoes to prevent soil contamination.

Some representative photos of above-mentioned mitigation measures undertaken by the project proponent are shown in Figure 5.3-6.

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Underground fuel storage tanks with concrete foundation</td><td>On ground fuel storage tanks with concrete containment</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Daily Housekeeping at berth for dust dispersion</td><td>Installation of concrete containments under generators</td></tr>
</table>

Source: MITT

Figure 5.3-7 Photos of mitigation measures for soil contamination

3) Evaluation

Based on the impact assessment results, the soil contamination due to possible impacts from port activities and ship discharges will be very minimum by proper implementation of mitigation measures and recommended ones. Moreover, regular inspection and checking of mitigation measures should be required.

(2) Assessment on Soil Contamination during Closure Stage

1) Impacts

During closure stage, soil contamination can cause due to the spillage and leakage of fuel storage area, workshop, power supply generators, engines and vehicles etc. if not properly stored and handled. Besides, runoff from improper storage and discharges of hazardous and non-hazardous wastes and wastewater from demolition site can also cause soil contamination and lead to deteriorate water quality of river.

2) Mitigation Measures

In order not to cause soil contamination, the following mitigation measures are proposed to be undertake by the contractor within closure stage:

- Proper storage of fuels, lubricants and paints with secondary containments such as steel trays, concrete foundation including oil trap not to direct contact with soil in case of spillage and leakage.
- Proper waste and wastewater management not to direct contact with soil to prevent soil contamination.

3) Evaluation

Based on assessment result, soil contamination will be rarely caused and impact will be very minimum if the contractor implement the proposed mitigation measures to prevent soil contamination during closure stage.

5.3.7 Noise & Vibration

(1) Assessment on Noise & Vibration during Operation Stage

1) Impacts

During operation stage, noise and vibration can be generated from main propulsion engines, auxiliary engines, propeller and transverse propulsion unit, heating, ventilation and air conditioning systems of berthing ships during port stay.

Container handling equipment and transportation vehicles will be main sources of noise and vibration generation. Operations of container handling equipment such as quay cranes (QC), RTG cranes, Reach Stackers, Mobile Harbour Cranes, yard operations, cargo operations, road traffic from heavy transportation vehicles (e.g. trucks, lorries, etc.) and passenger cars and repair and maintenance activities at workshop will generate noise and vibration levels and make nuisance to the port workers and the surroundings. Though rail traffic can generate noise level, the rail movement in port and surrounding areas are prevalent to low speed and of consequence, the noise level will not be so high.

1) Mitigation Measures

According to noise and vibration monitoring survey results conducted on 29th December 2019 at the NV1 shown in Figure 5.3-8, the noise and vibration monitoring levels are lower than target values of

nosie and vibration during operation stage described in Table 5.3-4 and Table 5.3-5, eventhough the survey was conducted on the peak day with total gate in/ out vehicle numbers of 1193 vehicles (see in Table 5.3-6).

Source: Google Earth

Figure 5.3-8 Location of Noise and Vibration Level Survey Point

Table 5.3-4 Results of Noise Levels (LA_{eq}) Survey at NV-1

Date	(Industrial, Commercial) Equivalent Noise Level (LA_{eq}, dB)	
	Day Time (7:00 AM – 10:00 PM)	Night Time (10:00 PM – 7:00 AM)
29 – 30 November, 2019	62	59
NEQG Guideline value	70	70

Note: Target value is applied to the noise level in the NEQG Guideline (Dec, 2015), Myanmar
Source: EMP Study Team

Table 5.3-5 Results of Vibration Levels (L_{v10}) Survey at NV-1

Date	(Commercial and Industrial areas) Equivalent Vibration Level (L_{v10}, dB)		
	Day Time (7:00 AM – 7:00 PM)	Evening Time (7:00 PM – 10:00 PM)	Night Time (10:00 PM – 7:00 AM)
29 – 30 November, 2019	53	52	49
Target Value	70	65	65

Note: Target value is applied to the vibration level during the operation stage in the EIA Report for Thilawa SEZ Development Project (Industrial Area of Zone B).
Source: EMP Study Team

Table 5.3-6 Vehicle Usage Record during Noise and Vibration Survey Period

Date	General Cargo Truck		Container Trucks	
	Gate In	Gate Out	Gate In	Gate Out
29/11/2019 30/11/2019	27	313	378	475

Gate in Total	405
Gate out Total	788
Grand Total	1193

Source: MITT

Moreover, it was also confirmed that the proponent is implementing the following mitigation measures to minimize noise and vibration levels from possible sources:

- Installation of backup generators in roofed area to minimize noise contribution.
- Regular checking of backup generators, cranes, cargo handling equipment, heavy machineries and vehicles as necessary.
- Using high-efficiency and eco-friendly generators, heavy machineries and vehicles to minimize noise and vibration.
- Planting of trees, fences in and around port boundary can be served as effective noise barriers.
- Setting speed limit for transportation vehicles inside the port area.
- Turning off the engines when not in use.
- Noise and vibration check by equipment in and around the factory periodically.
- Complying with NEQG guideline values and other international guideline values for noise and vibration.

Some representative photos of above-mentioned mitigation measures undertaken by the project proponent are shown in Figure 5.3-6.

Conducting repair & maintenance works under roofed workshop compound

Installation of backup generators inside noise proof room

	
Setting speed limit for vehicle movement	Sound proof Front Loader with insulated mounting to the chassis
	
Reach Stacker with noise and vibration insulation at operator's cab	Ergonomically designed forklift
	
Planting trees along the boundary fencing as barriers	Planting trees along the road traffic inside the port

Source: MITT

Figure 5.3-9 Photos of mitigation measures for noise and vibration generation

2) Evaluation

Based on the assessment results, the noise and vibration level within port area is under target values and acceptable for receptors even in the peak day. Moreover, the impact due to noise and vibration will be very limited as the project proponent is undertaking the above mitigation measures to minimize noise and vibration generation. However, noise and vibration monitoring at the port area should be conducted yearly to ensure acceptable Nosie and vibration levels.

(2) Assessment on Noise and Vibration during Closure Stage

1) Impacts

During closure stage, noise and vibration can be generated from temporary power supply generators, heavy machineries and equipment used for demolition works and transportation vehicles can generate noise and vibration into some extent and make nuisance to the workers and surroundings. But this impact will occur only within closure period and will not be longer.

2) Mitigation Measures

In order to minimize noise and vibration generation due to above possible sources, the following mitigation measures are proposed to be undertaken by the contractor throughout closure period:

- Regular repair and maintenance of demolition-related vehicles, vessels and machineries in a good and effective working order to minimize noise generation to the surroundings.
- Installation of generators and engines under roofed areas to minimize noise contribution.
- Turning off the generators and engines when not in use.
- Setting the speed limit for vehicle movement within the site.
- Preparation of green belt of plants to serve as a barrier.
- Limitation of working hours to mitigate the nuisances of demolition activities.
- Temporary installation of noise insulation walls around demolition site as necessary.

3) Evaluation

According to the assessment results on possible impacts and proposed mitigation measures, the noise and vibration that can be generated from demolition activities may not be very significant and the impact duration will also be very limited if the contractor implement proper mitigation measures for noise and vibration.

5.3.8 Bottom Sediment

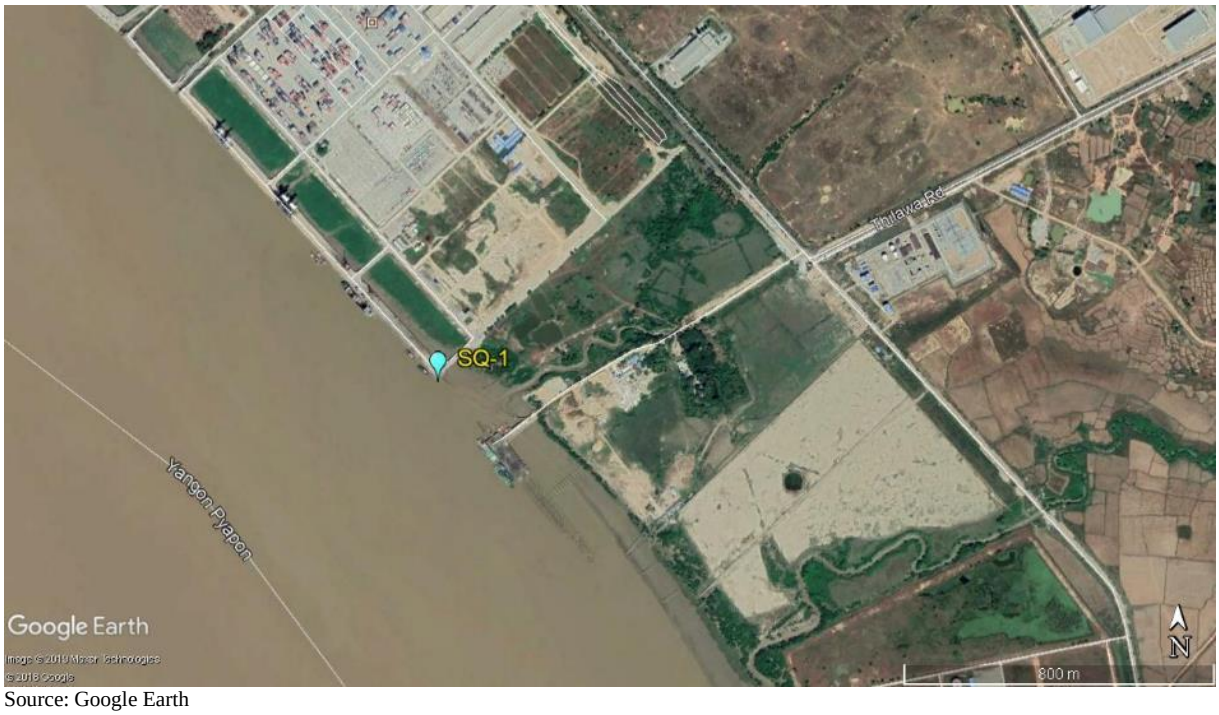
(1) Assessment on Bottom Sediment during Operation Stage

1) Impacts

During operation stage, the runoff from quay berth and storage areas, spills from dry bulk cargo operations, etc. can result contamination of bottom sediments. Toxic and harmful substances, oils and fuels, oily mixtures, organic materials and hazardous materials can cause contamination of bottom sediments. Dredged materials from maintenance dredging and ship discharges and spills can contaminate bottom sediments of the river.

2) Mitigation Measures

According to sediment quality monitoring results conducted on 2nd December 2019 at the downstream area near the jetty (see in Figure 5.3-10 and Table 5.3-7), all soil parameters are lower than target Japanese standard (as there are no standard for soil quality in Myanmar) and there are no significant soil quality deterioration due to the project activities.



Source: Google Earth

Figure 5.3-10 Location of Sampling Points of Soil and Sediment Quality Survey

Table 5.3-7 Results of Sediment Quality Survey at SQ-1

No.	Parameter	Unit	SQ-1	Reference Value
				Environmental Standard in Japan[1]
	Date	-	2-December-19	
	Time	-	10:55	
	Weather	-	Sunny	
1	Water Content	%	54.35	
2	Arsenic	mg/kg	≤0.34	150
3	Cadmium	mg/kg	≤0.034	150
4	Lead	mg/kg	10.438	150
5	Chromium	mg/kg	32.6	250
6	Copper	mg/kg	24.0	-
7	Zinc	ppm	1.76	-

Note 1): Ministry of Environment, Government of Japan (2002) "Regulation for implementing the Law on Soil Contamination Countermeasures"
Source: EMP Study Team

It was also confirmed the following mitigation measures are being implemented by the project proponent in order to minimize the contamination of bottom sediments due to port operation activities and berthing ships:

- Undertaking mitigation measures to prevent water pollution and soil contamination (see the details in Sections 5.3.2 and 5.3.6).
- Using low pollution type grab bucket which generates which is designed to be water-tight and avoid scattering dredged sediments while pulling up in the water during grab dredging process.
- Proper disposal of dredged materials into designated area defined by MPA.

3) Evaluation

According to assessment results and current mitigation measures, the impact on bottom sediment due to port operation activities and berthing ships cannot be very significant as the project proponent is implementing necessary mitigation measures very well. However, yearly monitoring of sediment soil quality at the downstream of the river should be conducted to ensure acceptable sediment soil quality.

5.3.9 Marine Ecology

(1) Assessment on Marine Ecology during Operation Stage

1) Impacts

During operation stage, spillage and leakage of oils and fuels, oily mixtures and wastes from berthing ships can impact on fishery resources, coastal habitat and aquatic biota. Biodegradation of oils can indirectly cause damages to bottom biota and habitat. This all lead to damage marine ecology.

Similarly as water pollution and soil contamination, run off from cargo storage and handling, spills or leakage of dry bulk cargo, oils and fuels can include toxic and harmful materials, oily compounds and organic materials and can cause damage to marine ecology and water quality deterioration as well. Poor dissolved oxygen concentration due to biodegradation of oils and eutrophication can also lead to damage to fishery resources and marine ecology.

2) Mitigation Measures

According to on-site monitoring results during the survey on 2 December 2019, the dissolved oxygen (DO) levels and, are 5.6mg/L at the upstream, 5.09mg/L at the downstream of the jetty and 5.42 mg/ L at the discharge point of drainage outlet (2) respectively resulting to no or very rare biodegradation of oils and enough DO level for fishes and aquatic organisms in the river.

It was also confirmed that the project proponent, MITT has been implementing the following mitigation measures and consideration measures to protect marine ecology:

- Implementing mitigation measures same as for water pollution control (see in Section 5.3.2),
- Implementing mitigation measures same as for soil contamination control (see in Section 5.3),
- Using low pollution type grab bucket which is designed to be water-tight and avoid scattering dredged sediments while pulling up in the water during grab dredging process,
- Proper disposal of dredged materials into designated area defined by MPA.

3) Evaluation

According to impact assessment results, the project proponent MITT has been implementing cargo storage and handling activities and other port operation activities and berthing activities in accordance with national laws and regulations and international best practices and international regulations not to make impact on the surrounding natural and social environments as much as possible. Thus, it can be evaluated that the impact on marine ecology due to the port activities would be occurred as minimum during operation stage as the project proponent is undertaking necessary mitigation measures not to cause any damage to marine ecology.

5.4 Social Impact Assessment

5.4.1 Local Economy and Livelihood

1) Impact

The impact on the local economy and livelihood conditions were assessed by Job Opportunities and Local Economy in the Project area (Thanlyin & Kyauktan Townships) and CSR activities of the Project Proponent.

The main sources of livelihood in the two townships are agriculture, fishing and official employment in the government sector as shown in below Table.

Table 5.4-1 Existing Status of Local Livelihoods in Thanlyin and Kyauktan Townships (2018)

Township	Type of Workers (Person)								
	Government Staff	Service Staff	Agriculture	Livestock	Trade	Industry	Odd Job	Others	Total
Thanlyin	3,947 (2.7%)	18,530 (12.6%)	11,980 (8.2%)	670 (0.5%)	32,337 (22%)	25,128 (17.1%)	35,000 (23.8%)	19,225 (13.1%)	146,817 (100.0%)
Kyauktan	2274 (2.2%)	11,130 (10.7%)	11,290 (10.9%)	9,638 (9.3%)	8,593 (8.29%)	5,543 (5.3%)	20,307 (19.6%)	34,115 (32.9%)	103,632 (100.0%)

Source: Thanlyin Township Administrative Office Data (2018) & Kyauktan Township Administrative Office Data (2018)

According to the above statistical data of Thanlyin and Kyauktan townships, most of the people are earning their livelihood in odd jobs (23.8 % in Thanlyin Township & 19.6 % in Kyauktan Township) and others (13.1 % in Thanlyin Township & 32.9 % in Kyauktan Township). The implementation of the Project is a good opportunity for these people to improve their and their families' social and economic situation. The Project is giving importance to employ local people to work in the Port Terminal.

2) Mitigation Measures

Recruitment of Work-force from nearby communities

The Project is currently employing around 124 permanent employees (planning, administration, terminal operation) and around 495 employees casual employees (stevedore, general cargo workers, etc.) recruited from the neighboring villages near the Project area. Sometimes due to demand of operation, there may be work for around 1000 ordinary worker. The Project is implementing the following trainings and programs to improve the livelihood of the employees.

Capacity Building & Training

Staff appraisal system is conducted on a yearly basis and the necessary training programs are designed & scheduled by the Human Resources (HR) department. Furthermore, on-line learning programs are also provided by the Hutchison Ports for building up of staff capacity.

Social Welfare Program

A social welfare program is implemented to provide staff with Life Insurance, Social Security Board (SSB) benefits and other in-house programs such as recreation trips are arranged on a yearly basis.

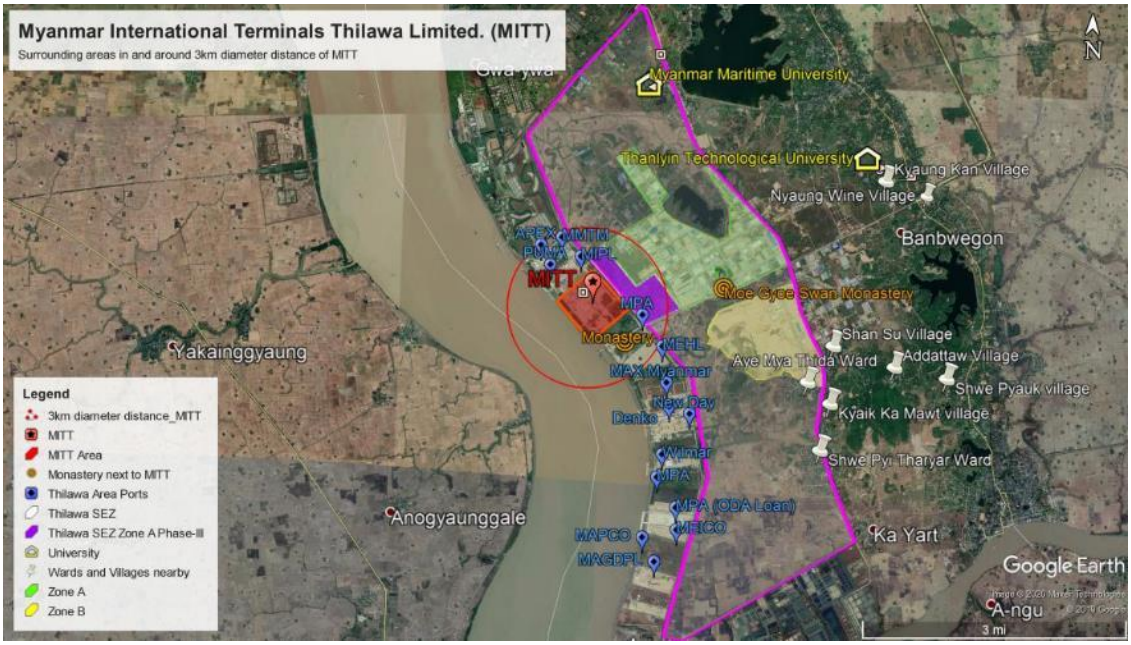
Health Surveillance

A health surveillance program is implemented to provide staff with a regular health care & check program via a private clinic.

Corporate Social Responsibilities (CSR) of the Project Proponent

CSR is defined as the voluntary activities undertaken by a company to operate in an economic, social and environmentally sustainable manner. CSR policy functions as a self-regulatory mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards and international norms.

The satellite photo in below figure shows the location of the schools, universities, monasteries and villages in the nearby surrounding area of MITT. These places will be the areas supported by the Project Proponent's CSR program. The distances of the villages and institutions are listed in below Table.



Source: EMP Study Team

Figure 5.4-1 Satellite Image of Places nearby the Project Area

Table 5.4-2 Distances of Affected Areas in the Project Area

Sr.	Village / Institution	Direction	Distance from Project Site
1.	Adda Taw Village	SE	1.53 km
2.	Aye Mya Thida Village	S	1.73 km
3.	Thanlyin Technological University	NE	2.9 km
4.	Shan Su Village	E	1.37 km
5.	Kyaik Ka Mawt Village	SE	2.42 km
6.	Shwe Pyauk Village	SE	2.77 km
7.	Kyaung Kan Village	NE	2.98 km
8.	Shwe Pyi Thayar Village	S	2.92 km
9.	Ah Lun Soke Village	NW	3.13 Km

Source: EMP Study Team

The Project Proponent is investing in CSR activities by planning, recording, future activities, and donations, etc. Donations to primary schools in the nearby community, providing scholarships for outstanding students from the Myanmar Maritime University (MMU) is conducted on a yearly basis by the Project Proponent. Furthermore, the Project Proponent also actively participates in charitable activities in the local community.

Table 5.4-3 Monetary Support to MMU by Project Proponent

Year	HPH Gold Medal Award (USD)	Scholarship Award (USD)	Dock School Assistance (USD)		Fun Fair (Kyats)	Internship (USD)	Miscellaneous (USD)	
2002			English Language Lab	6,000				
2003			Teaching Aid & Computer purchase	10,000				
2004			Teaching Aid	3,000				
2005			Reference Books & Teaching Aid	8,000			Ceremony Expenses & Others	240
2006	1,500	1,000	Bench / Chart Table / Lecture Stage / White Board	8,000			"	465
2007	1,500	1,000	GMDSS Training Station	20,000			"	200
2008	1,500	1,000	Reference Books / Teaching Aids / Survey Instrument	12,540			"	526
2009	1,500	1,000	MMU Monument Pile Erecting	782			"	208
2010	1,500	1,000					"	200
2011	1,500	1,000					"	200
2012	1,500	2,000					"	200
2013	1,500	2,000					"	200
2014	1,500	2,000	Project Researches	6,500			"	200
2015	1,500	2,000	Project Assistance	5,500	500,000		"	200
2016	1,500	2,000	Furniture & Equipment for Multi-media Room	6,000	500,000		"	200
2017	1,500	2,000	Computer Sets / Desks	4,500	500,000	3,300	"	200
2018	1,500	2,000	TV / Air Conditioner & Computer Sets for GIS Labs	6,000	500,000		"	200
2019	1,500	2,000	Computer Sets / Desks	6,000	500,000		"	200
Total	**21,000**	**22,000**		**102,822**	**2,500,000**	**3,300**		**3,639**
Grand Total	**2,652,761**							

Source: MITT

Table 5.4-4 Summary of Donations to Local Schools

Sr.	Year	Month	Name of School	Items	Amount (MMK)
1.	2010	August	Phan Chat	Playground, Equipment & Stationery	3,003,685.00
2.	2011	May	Addutaw	Stationery, Water Purification System, Toilet	6,300,000.00
3.	2011	December	Kyeik Kamawt	Stationery, Electricity Installation, School Fence, Water Tank	8,000,000.00
4.	2012	June	San Chain Mhe	Stationery, School Building, Water Supply System, Desks	8,000,000.00
5.	2013	January	Thida Myaing	School Building, Water Supply System, Ground Water Tank	9,000,000.00
6.	2013	August	Shan Su	Stationery, Renovation of School Building, Ground Water Tank & School Gate	6,500,000.00

Sr.	Year	Month	Name of School	Items	Amount (MMK)
7.	2015	July	Shwe Pyi Tharyar 1	Stationery, Desks & Tables	1,948,370.00
8.	2015	July	Shwe Pyi Tharyar 2	Stationery, Desks, Tables, Ground Water Tank	2,884,070.00
9.	2015	July	Shwe Pyi Tharyar 3	Stationery, Desks, Tables, Tube Well & Ground Water Tank	5,188,570.00
10.	2016	October	Nyaung Waing	Stationery, Water Purification System, Classroom Partitioning, Laminated Floor	6,300,000.00
11.	2016	October	Gway Pin	KG Room Flooring, Water Purification & Storage, Sanitation System	5,700,000.00
12.	2017	November	Banbwe Kone	Stationery, Water System, KG Room Flooring, and Sanitation System	4,845,341.00
13.	2017	November	Thayet Kone	Stationery, Water System, KG Room Flooring, and Sanitation System	8,735,159.00
14.	2018	October	Aung Thukha	KG Room Flooring & Class Room Repair	2,185,966.00
15.	2018	October	Banbwe 2	Stationery, Water System, KG Room Flooring, and Sanitation System	12,731,117.00
16.	2019	September	Kyar Kan Hteik	Stationery, Class Room Partitioning, Ground Water Tanks, KG Room Flooring, & Library Room	11,312,200.00
17.	2019	September	Kone Tan	KG Room Flooring, Tube Well & Basin	2,631,800.00
18.	2019	September	Gway Pin	KG Room Flooring	1,056,000.00
					106,322,278.00

Source: MITT

Increase of Business, Opportunities and Income for Local Businesses

Moreover, commercial opportunities targeted to the Port work-force has increased, such as vendors selling food, sundries, merchandise or supplying drinks, water, providing ferry and other services such as waste removal, collection of recyclable waste, etc.

3) Evaluation

The investment and continuing business of MITT will have a wider social impact in the area of operation. By not only creating a significant number of direct and indirect employment, the workforce will have skill development through various trainings as mentioned above and safety trainings which are mentioned in detail in following section 5.5.1. The implementation of welfare programs will also significantly benefit the workforce. Moreover, local businesses will have the opportunity to improve in the long-term as well.

5.4.2 Greening and Landscape

1) Impact

The Project has many buildings and facilities laid out on a large area of land. Some viewers may have some negative opinion on the project (e.g. crane derricks, RTG cranes, quay cranes, etc.) as well as concern on the environmental effect on the surrounding areas and the safety of occupants and passers-by.

The buildings and facilities in the project are designed for the nature and work of the project and its operations. The safety of the occupants and passers-by are taken into account during the design and operation. The maintenance of the buildings and facilities during the operation are conducted regularly to keep a clean and new impression. The greening areas are properly maintained by cultivating and watering of plants and grass, trimming of overgrown plants, trees, grass, etc. as well as conducting housekeeping activities regularly around the premises of the project area.

2) Mitigation Measures

The total greening area of the project area is around 57,100 m^2. Tree plantation is one of the most effective measures to control air pollution and noise pollution. The project has many trees planted around the fencing (boundary), canteen area, administration office area, car parking area. A full-time gardener living on the premises in a suitable housing quarters is employed to maintain the greening.

There are many benefits of planting trees especially such as natural shade and shelter from the elements. Urban heat island effect is reduced through evaporative cooling and reducing the amount of sunlight that penetrates to parking lots and bare concrete areas. Air quality is further improved by filtering harmful dust and pollutants such as ozone, carbon monoxide and Sulphur dioxide from the air. Moreover, trees reduce the amount of storm water runoff, and reduces erosion and effect of flooding.

Furthermore, there are some mangrove areas between the yard and jetty which have allowed to grow naturally which stabilizes the river coast line, helps against soil erosion from waves and storms and conserve mangrove places by protecting seagrass meadows from being smothered in sediment.

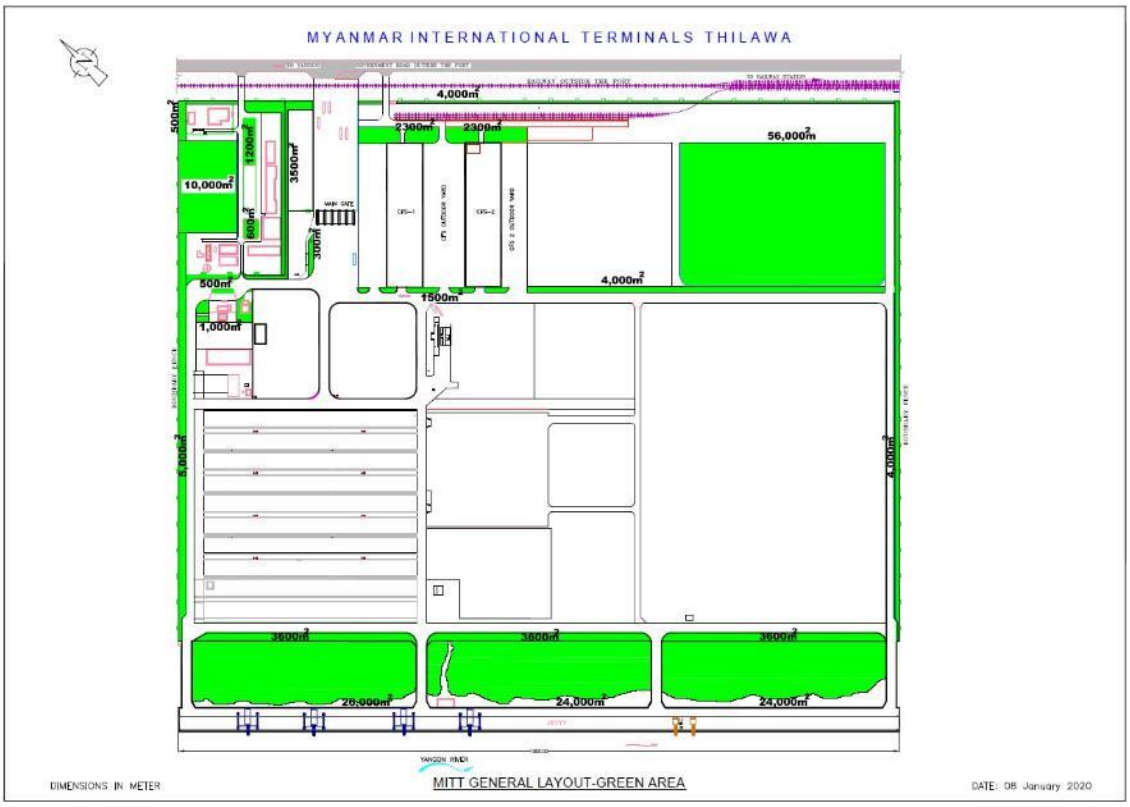
Source: MITT

Figure 5.4-2 Drone Photo of Port Showing Mangrove Area between Jetty & Yard Operation Area

		
Water tower	Trees along fencing	Greening
		
Mangrove area	Mangrove area	Trees & greening

Source: EMP Study Team

Figure 5.4-3 Photos of Greening in the Port Area



Source: MITT

Figure 5.4-4 Greening Layout Plan of the Port Area

3) Evaluation

Due to the above discussion, it is evaluated that impact from landscape and greenery in the Operation of Port to the surrounding environment is well controlled by the mitigation measures of the Project and would not be significant impact. However, it is suggested to continue the regular maintenance in the green areas of the Port to be constantly clean and aesthetically pleasing condition throughout the duration of the project.

5.5 Health Impact Assessment

5.5.1 Occupational Health & Safety

1) Impacts

Seaports and docks are challenging places to work and docking is considered as a high-risk industry. Port and dock workers must work throughout the day and night, sometimes under extreme weather conditions. The job is done with and around heavy equipment and machinery, amidst lots of traffic and alongside international workers which creates a language barrier.

Some of the duties and responsibilities of the normal worker and crane operators are described below.

<u>Port Workers</u>

The duties of port/dock workers (also known as stevedores, longshoreman, etc.) include the following:

- Preparing docks for incoming ships & securing ships to moorings
- Transferring vessel cargo (containers, bulk [grains, liquid, iron ore, etc.]) from the ship to the dock safely & efficiently by using suitable material handling equipment such as ramps, forklifts, hand trucks, pallet jacks, cranes, power winches & grain trimmers among others
- Securing ships & handling unloading set-up, such as preparing the gangway

- Communicating with other dock workers by using handheld radios to ensure safe loading & unloading of cargo
- Inspection of cargo & maintaining records, marking down any damaged, irregular or lost items
- Securing cargo before departure using rigging & lashings
- Ensuring dock areas are clean & free of debris in order to prevent accidents & injuries

Port terminal workers conduct potentially hazardous operations in an unfamiliar environment and are often exposed to a regular & significant risk for personal injuries.
Some of the occupation impacts can be:

- Slips, trips & falls
- Risk of falling objects
- Suspended loads
- Lashing & unlashing containers
- Ship holds (Asphyxiation in confined spaces due to lack of oxygen, toxic gases or vapors, etc.)
- Types of cargo
- Poor lighting
- Noise & vibration

Quay Crane and Rubber-tired Gantry (RTG) Crane Operators

Quay cranes use spreader for unloading shipping containers from sea-going vessels onto the external trucks or in-land shipping barges for delivery and for loading cargoes from trucks or barges onto the vessels. QC spreader is put on the container, fixed by twist locks and lifted by a hoist for unloading. The trolley of crane moves the container to the quay where spreader is lowered and then the container is placed on the ground (wharf) or transport vehicle either. QCs can be able to realize about 24-30 moves per hour. The responsibilities of the operators are described below:

- To operate for loading/ unloading of containers from container ship to other (chasis, automated guided vehicle), and vice versa.

The RTG is a straddle style gantry crane with rubber tires that swivel 90 degrees so that the gantry can move forwards or backwards, or side to side. The operators use the RTG to load or unload containers between dock and railcars, street trucks, etc. Their responsibilities are described below:

- To operate the travelling or stationary overhead crane to lift, move & position loads, such as machinery, equipment, products & solid or bulk materials by using hoisting attachments

Quay Crane or RTG Crane operators are at risk from:

- Electrical hazards (coming into contact with power source, inadvertent contact of any metal part of a crane with a high-voltage power line)
- Overloading (structural failure attributed to exceeding the crane's operational capacity, swinging or sudden dropping of load, using defective components, hoisting a load beyond capacity, dragging a load, etc.)
- Materials slipping/falling from overhead hoists (visual impairment, mechanical failure, operator incompetency, materials not properly secured), pinch or crush workers.

2) Mitigation Measures

Physical Hazards

Impacts
The workers working on port operations are exposed to various safety impacts during the course of their duties. Loading or unloading of cargo from ship to quay is a high-risk activity with potential of accidents both to human as well as property. Human fault, equipment, machines, and environment causes injuries from impacts such as slips, trips & falls; truck struck by quay crane, worker struck by truck, worker struck by falling materials (e.g. container, cargo, hatch cover, etc.) & being trapped between containers. The following are some of the injuries which could happen to anyone and at any time.

- On the job violent acts (fighting among workers)
- Ergonomics (repetitive motion, manual handling, lifting of heavy items, etc.)
- Machine entanglement or struck by rotating/moving equipment

- Vehicle accidents
- Walking into injuries
- Falling object injuries
- Falling from height
- Slipping, tripping
- Overexertion
- Electrocution
- Asphyxiation in confined spaces

Mitigation
Workers should be provided with the proper PPEs (safety hard helmet, gloves, boots, ear plugs/muffs, goggles, reflective vests, etc. Not only is it the employer's responsibility to ensure a safe working environment, each employee also has a responsibility to themselves to exercise caution when on the job.

From moving vehicles and equipment

- Segregating vehicle movement and pedestrians, as much as reasonably possible
- Implement safe driving within the premises, post speed limit signs
- Provision of appropriate road signs & markings
- Restricting access to operational areas for members of the public, private vehicles and delivery vehicles
- Ensure that all operational areas and access routes are sufficiently lit, especially at night or in reduced visibility conditions
- Ensure all drivers, operators are licensed
- Training all vehicle drivers and equipment operators so that they are fit and competent to carry out their respective job tasks (e.g. forklifts must be operated by a qualified person, and follow the operation practices, e.g. parking in designated place, fully lowering forks, avoid lifting with one fork, avoid overloading, ensure stable load, drive at safe speed, check surroundings, conduct regular inspection & maintenance, etc.)

From lifting operations

- Avoiding lifts over areas where people are likely to be working or passing
- Ensure that workers are trained, competent and experienced in safe lifting procedures
- Regular inspection and checking of all lifting equipment and accessories
- Restriction of access to lifting area
- Discontinue operations if wind conditions make it unsafe (high winds, ice or unduly cold or hot weather, performance of lifting equipment, etc.)

From manual handling

- Using mechanical handling equipment, such as vehicle mounted hydraulic hoists, portable roller conveyors and pallet trucks, handheld carts, etc. to minimize manual workload of the worker
- Encourage workers to adopt safe lifting techniques
- Avoiding manual handling of loads, where possible

From electrical shock

- All electrical works must be conducted by a certified and competent electrical worker who will conduct all electrical works, such as c hacking and inspection, ensure safe usage of approved electrical equipment, prohibit usage of un-safe & faulty electrical devices
- Layout drawings must be readily available in order to identify electrical wiring such as underground or hidden cables

From workplace violence

- To implement workforce violence employee training & employee diligence in watching out for suspicious, abnormal behavior and activities

From slips, trips & falls

- Good housekeeping (remove debris, store equipment material adequately)
- Ensure slopes & ramps have suitable ribbed surfaces to prevent slipping

Exposure to Heat

Impacts
Conducting physical work outdoors in the hot weather climate may result in extremely high body temperatures, nausea, vomiting, weakness, fainting, thirst & other health problems such as heat stroke, heat exhaustion, heat cramps or heat rashes. Heat also increases the risk of injuries as it may result in sweaty palms, fogged-up safety glasses. High temperature humidity, radiant heat sources, contact with hot objects, direct sun exposure, no breeze nor wind are also causes for heat-related illnesses.

Mitigation
The following should be done to prevent the impact of heat to the workers.

- Job acclimatization & job rotation
- Buddy system to check one another
- Use of machine/equipment to reduce physical work
- Provision of adequate PPE (thick gloves to prevent burns, scalds, to prevent sweaty hands)
- Wear appropriate clothing for the hot climate (light & loose clothing) but wearing of PPE must be mandatory (hard hats, gloves, boots etc.
- Provision of adequate drinking water, rest areas with shade and cover from the elements
- Monitoring of weather forecasts
- Wearing of "thanaka" (a Myanmar traditional cosmetic product) on face & skin as a form of sunscreen and natural alternative to sunblock

Exposure to Noise

Impacts
During operation of port terminal works, noise levels may exceed the required limits of noise level for workers (85 dB), as guided by EHS Guidelines of IFC. Workers exposed continuously to excessive noise may have possible health problems such as NID (noise induced deafness), tinnitus, fatigue, headaches, loss of balance, etc. The sources of the noise may be from the following:

- Ships' engines
- Port machinery & equipment (quay cranes, mobile harbor cranes, RTGs, front loader, forklifts, tractors, bagging units, generators, transporters, trucks, etc.)
- Pumps, compressors, etc.
- Loading/unloading of cargo, conveyors, etc.

Mitigation
Mitigation measures should be implemented as below:

- Provision of adequate and proper PPE such as ear plugs/muffs and gloves
- Rotation and scheduling of work near source of noise to limit time of exposure
- Keep in enclosure & on good foundation, machine/equipment which emit loud noise
- Conduction of noise monitoring
- Conduct hearing checks for workers

Asphyxiation or Drowning

Asphyxiation
Impacts
Port workers as part of their duties may be required to inspect and prepare cargo holds. It is to ensure that the compartment intended to be loaded with cargo is clean, dry & ready in all aspects to receive the cargo being loaded. However, this exposes the workers to a hazard of confined space.
A confined space is determined by the following:

- Limited openings for entry and exit
- The space is not intended for human occupancy
- The space is large enough to enter and conduct work

The hazards of confined space is mentioned below:

- Flammable gases or vapours that can ignite, causing an explosion or fire
- Toxic atmosphere (it may cause various acute effects, including impairment of judgement, unconsciousness and death)

- Oxygen deficiency
- Oxygen enrichment
- Flowing liquid or free flowing solids
- Excessive heat

Mitigation

- Permit-to-work procedure
- Gas purging and ventilation
- Testing and monitoring of the atmosphere inside confined space (Acceptable levels of oxygen are between 19.5% & 23.5% as per OHSA)
- Mechanical, electrical and process isolation
- Respiratory protective equipment
- Competence, training, supervision & suitability
- Stand-by of rescue equipment and emergency rescue procedures

Drowning

Impacts

Working in ports/docks, means that working near a water body exposes the person to a risk of falling in the water and danger of drowning.

- Falls from open side of ships, quayside ladders, gangways
- Working adjacent to unfenced open edges of docks, wharves, etc.
- Maintenance and unplanned work

Mitigation

- Provision of suitable PPE (e.g. lifejackets or buoyancy aids) if work involves being within 1 m of unprotected quay edge over water
- Competence, training, supervision & suitability
- Stand-by of rescue equipment and emergency rescue procedures (safety harnesses, life-lines, life-buoys, throwing lines, rescue poles, etc.)
- Ensuring edge protection at areas at risk of falling (e.g. handrails, railings, barricades, danger signages, etc.)
- Ladders at quay walls (if required)

Working at Height

Impacts

Working at height is one of the causes of work-related fatalities and major injuries. Many of the activities carried out in ports/docks could lead to a fall from height. These activities may be during routine operations, maintenance activities, or unexpected or unplanned activities. In ports/docks, the added hazard of working near water means a fall may lead to the risk of drowning.

The following are the typical height hazards in ports and docks.

- Access to and from vessels by quayside ladders, gangways, etc.
- Container working (lashing & unlashing)
- Loading & loading (some types of cargo, such as pipework, timber packs, etc. can result in open edges from ships' decks and from cargo itself)
- Access to and from places of work on board vessels (holds, hatches, decks, etc.)
- Falls from vehicles and trailers during loading/unloading & sheeting
- Maintenance and unplanned work
- Working adjacent to open edges of docks, wharves, etc.
- Falls from plant and machinery
- Moorings

Mitigation

Before any work is carried out at height, the risk should be determined and appropriate control measures should be put in place.

- Conduct risk assessment for any work carried out at height

- Proper planning and organizing work at heights
- Selecting and using suitable work equipment, such as guardrails & mobile elevated work platforms (ensure proper rigging & maintenance)
- Regular inspection and maintenance of equipment and accessories
- Ensuring edge protection at open edges where there is a risk of falling from height
- Ensure holds/hatches are not left open for longer than required

Exposure to Infectious Diseases

The risk for transmission of diseases among employees is likely, including sexually-transmitted diseases (e.g. AIDS/HIV), influenza, tuberculosis (TB), measles, rubella (German measles), pertussis (whopping cough), meningitis, etc. Such risk may be minimize by regular medical checks, education on prevention of diseases. Vector control measures should be in place to prevent vector breeding & spreading of diseases. Health checks such as body temperature monitoring should be carried out during outbreaks of seasonal diseases such as flu, H1N1, SARS, etc. When a worker is suspected of being sick, he/she should be placed in quarantine or sent back for rest and if required, sent to clinic for adequate treatment by professionals.
Some diseases are as follows:

- HIV (a blood borne infection that may progress to AIDS)
- Hepatitis (a disease of the liver, that can occur in several types and is caused by exposure to viruses and chemicals)
- SARS (a respiratory illness, a form of acute pneumonia and is spread through sneezing or coughing although there is a possibility of airborne or contact transmission)
- Malaria, Dengue (are mosquito borne diseases, with symptoms that typically include fever, tiredness, vomiting, headaches, etc.)
- Diarrhea (one of the most common health complaints, it can range from mild, temporary condition to potentially life-threatening one, and is caused by bacteria, viruses, and parasites, consumption of undercooked, unclean, spoilt, rotten food and drinks, etc.)
- Tuberculosis (caused by bacteria attacking the lung and damaging other parts of the body, is spread through the air when a person infected with TB of the lungs or throat coughs, sneezes or talks)

The sources of the diseases are persons infected with the diseases, unclean environment, water ponding and stagnant water (which propagate breeding ground for mosquitoes), uncovered or spoilt food, dirty canteen, kitchens, eating areas, unsanitary toilets, etc. Some of the items to consider for the prevention and mitigation of communicable disease are as below:

- Provide health surveillance for workers
- Implement health awareness and education briefings on the risks, prevention and available treatment for the potential disease
- Encourage personal hygiene, cleanliness and good habits
- Take precautionary measures during occasions of outbreaks of communicable diseases in the surrounding and immediate area (take & record body temperature, segregate from healthy workers, allow rest at home, consult with health professionals, treat at clinic, hospital, etc.)
- Provide clean and sanitary facilities (canteen, kitchen, eating area, adequate and clean toilets, etc.)
- Ensure proper housekeeping is conducted daily
- Ensure proper covering of food, proper disposal of food & leftovers (to prevent propagation of vector, i.e. rats, mice which can carry disease)
- Ensure no consumption of food & drinks outside of designated place (prohibit eating/drinking in labs, chemicals rooms/storage, toilets, etc.)
- Ensure no water ponding or stagnant water in and around port premises to prevent vector (mosquito) breeding

Mitigation Measures by the Project Proponent

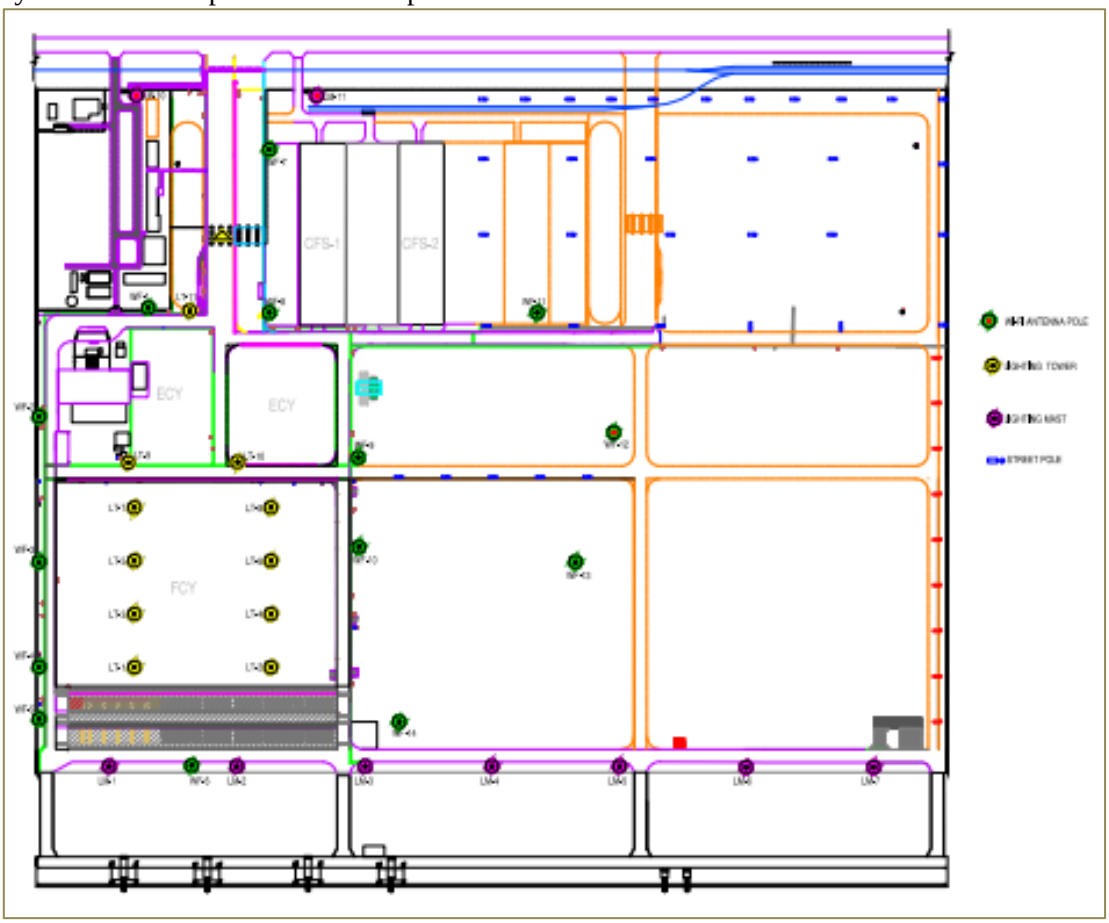
Provision of Adequate Lighting
The quality of lighting in a workplace can have a significant effect on productivity. With adequate lighting, workers can get work done with fewer mistakes. It can prevent workplace incidents by

increasing the visibility of moving machinery and other safety hazards. The port area has installed high poles with lighting intensity adequate for the good visibility and safe working conditions of workers and employees. Buildings are provided with natural and artificial lighting to allow workers to work in good illumination and therefore avoid injuries and accidents due to poor lighting conditions.

Symbol indicates positions of Lighting Tower

Symbol indicates positions of Lighting Masts

Symbol indicates positions of Lamp Posts



Source: MITT

Figure 5.5-1 Lighting Layout Plan of the Port Area

		
Illuminated storage area	Natural illumination	Light towers

		
Lamp posts in the port premises	Light Towers	Light Masts

Source: MITT

Figure 5.5-2 Photos of Adequate Lighting in the Port Area & Buildings

Provision of First Aid, Health Check-up, Snake Bite Response Plan

First aid is the first and immediate assistance given to any person suffering from either a minor or serious illness or injury, with care provided to preserve life, prevent the condition from worsening, or to promote recovery.

First Aid Station

The Port facility has a first aid station to:

- Deal with cuts, scrapes, bruises, burns & other minor injuries
- Manage eye injuries
- Treat fractures, sprains
- Prevent choking
- Stopping excessive bleeding
- Assist unconscious persons

		
First Aid Building	First Aid Room	First Aid Drill

Source: MITT

Figure 5.5-3 Photos of First Aid Measures

Snakebite Response Plan

Snake bites are possible to occur as the project area is near to vegetative areas where there is source of food for snakes. Most snakebites occur to those who have to work in the outside environment, such as nearby grassy areas. It often happens when a person steps on a snake or approaches it too closely.
Prevention of snake bites include wearing of protective footwear, avoiding habitats where snakes may reside and not handling snakes as well as proper training and response.


Source: MITT

Figure 5.5-4 Snakebite Emergency Preparedness Training & Drill

Provision of Rest Area, Canteen, Portable Drinking Water & Sanitary Facilities

Rest Area and Canteen

Rest areas with adequate protection against the weather elements (hot sun & rain) are placed at places where it is far from the buildings. This will ensure that workers are provided with a safe place for rest breaks.

A canteen is provided for workers to have their daily meals in a designated area. Food is also prepared and cooked in the kitchen and the meals are provided to the employees as part of services.

Portable Drinking Water

Drinking water is provided for the employees by means of a filtration system (as shown below in Figure) and the quality is tested regulary to ensure water provided is safe for consumption. The water examination report tested at the National Health Laboratory is shown in the following Figure.


Temporary rest area near jetty


Drinking water purification Facility


Drinking water purification System


Canteen building


Canteen for workers


Canteen and rest area for labours

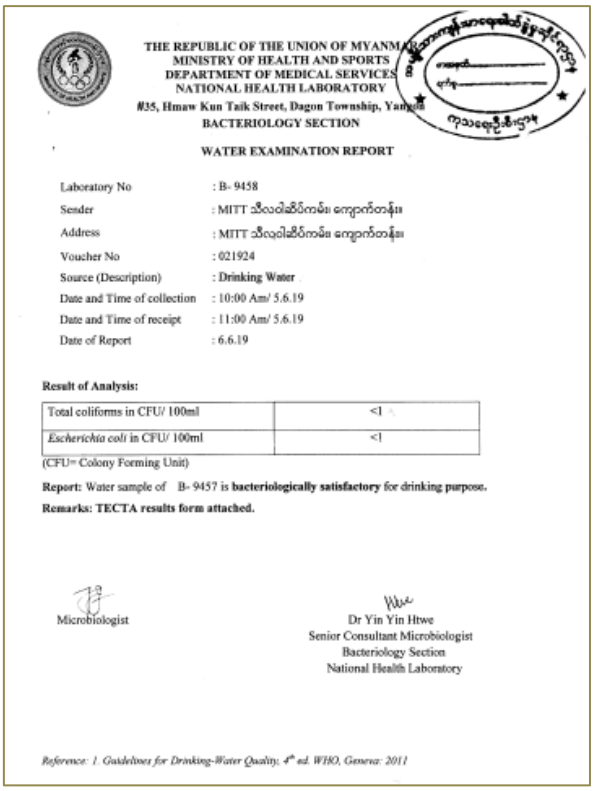

Kitchen for preparing & cooking meals


Electronic appliance for catching mosquitoes, flies, etc.


Push-cart for manual work on berth

Source: MITT

Figure 5.5-5 Photos of Measures for Health Protection



THE REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF HEALTH AND SPORTS
DEPARTMENT OF MEDICAL SERVICES
NATIONAL HEALTH LABORATORY
#35, Hmaw Kun Taik Street, Dagon Township, Yangon
BACTERIOLOGY SECTION

WATER EXAMINATION REPORT

Laboratory No	: B- 9458
Sender	: MITT သီလဝါဆိပ်ကမ်း ကျောက်တန်း
Address	: MITT သီလဝါဆိပ်ကမ်း ကျောက်တန်း
Voucher No	: 021924
Source (Description)	: Drinking Water
Date and Time of collection	: 10:00 Am/ 5.6.19
Date and Time of receipt	: 11:00 Am/ 5.6.19
Date of Report	: 6.6.19

Result of Analysis:

Total coliforms in CFU/ 100ml	<1
Escherichia coli in CFU/ 100ml	<1

(CFU= Colony Forming Unit)

Report: Water sample of B- 9457 is **bacteriologically satisfactory** for drinking purpose.
Remarks: TECTA results form attached.

Microbiologist

Dr Yin Yin Htwe
Senior Consultant Microbiologist
Bacteriology Section
National Health Laboratory

Reference: 1. Guidelines for Drinking-Water Quality, 4th ed. WHO, Geneva: 2011

Source; MITT

Figure 5.5-6 Drinking Water Examination Report

Sanitary Facilities (Toilets, Washroom, Showers, etc.)

The toilets, washrooms showers are the facilities adequately provided for the workers and employee. They provide workers for cleaning and showering and clean sanitary conditions can help prevent the spread of communicable diseases between workers. Daily housekeeping and cleaning of the provided facilities are also required to have the sanitary condition.

Housekeeping

Hand washing facilities

Sanitary facilities

Bins in building areas

Bins at the jetty

Bathing area for stevedores

Source: EMP Study Team

Figure 5.5-7 Photos of Sanitary Facilities

Provision of Training (OHS, others, etc.)

Safety trainings of various kinds are conducted regularly by the Project Proponent as below mentioned. These trainings ensure that the workers are properly trained to work in the port environment in a safe manner without causing hazard to oneself and others.

- Safety Refreshment Training for Foremen (In-house)
- Emergency Response Team Table Top Training for Security Staff (In-house)
- Fire Fighting Training for Class-2 (Reagent) by Kyauktan Fire Brigade (In-house)
- Safety Induction Training for Office Staff (In-house)
- Safety Induction Training for Engineering Workshop (In-house)
- IMDG Code General Awareness Course (In-house)
- Safety Refreshment Training for Stevedore (In-house)
- Safety Refreshment Training for Security Staff
- Safety Refreshment Training for Container Labor
- Electrical Safety Course (NFPA 70E) for Committee Member (Out-source)
- Health & Safety Management System Course (ISO 45001) (Out-source)
- Safety Management System (ISO 45001)
- First Aider Training (Refreshment) (In-house)
- Traffic Safety Awareness Training for TTS Driver (In-house)
- Traffic Safety Awareness Training for Internal TTS

Source: MITT

Figure 5.5-8 Photos of Safety Training

<u>General Safety Rules for Hatch Foremen</u>

Safety rules for Hatch Foremen to follow are posted and some of the rules are mentioned below:

Before Start of Work

- Warn workers to follow the safe working practices before cargo operation
- Provide necessary PPE and ensure workers are wearing the issued PPE properly
- Check the safe working loads of derrick and cranes
- Ensure to check the correct securing of fixed topping lifts
- Look aloft to see that all appear to be in order
- Check the hatch covers and beams are safely stacked when removed and proper gear is used for such handling operation
- Check cargo handling gears are in good order and issue appropriate cargo handling gears to stevedores depending on different types of cargo

During Work

- Leave a clear walkway around hatch coverings
- Ensure that hatch covers and beams are safely secured during operation against displacement
- Ensure that hatch covers and beams are replaced in their proper positions
- Prohibit overweight loading and improper slinging
- Prohibit load lifting & suspension without proper drivers at the controls
- Prohibit makeshift extensions to winch controls

General Safety Rules for Stevedores

A general safety rules for stevedores are posted with instructions to follow the safety and some are mentioned below:

- Know the details of the job
- Carry out instruction of foremen and hatch signalmen
- Ensure to wear the issued PPE (helmets, shoes, gloves, safety belt for fall protection, etc.)
- Check cargo is stable and steady
- Observe safety regulations (e.g. "No Smoking" signs, etc.)
- Report all injuries and sickness to foremen
- Use both hands when ascending and decendng ladders
- Attention to gaps when working in hatches
- Do not operate machinery without permission
- Do not jump from ship to wharf (use gangway)
- Do not walk across hatchways, walk around them
- Do not stand under a suspended load
- Do not use drugs or consume alcohol during work

General Safety Rules for Winch and Crane Operators

A general safety rules for winch and crane operators are posted in both English and Myanmar language with instructions for operators to follow the safety rules and some are mentioned below:

- Ensure wires are properly secured
- Ensure running both ways of winch or crane and testing of brakes before start work
- Switch off winch or crane and place controls in neutral position before stop work
- Check the position of emergency stop switch on the machine
- Pay attention to signalman
- Report faults in timely manner to supervisor
- Do not leave loads suspended

General Safety Rules for Signalmen

Some of the rules for signalmen are mentioned below:

- Ensure hand signal codes are agreed and understood by all parties
- Stand in appropriate place to observe progress of work clearly and where the operator can see you
- Give clear and efficient signals
- Ensure slings are fully hooked or unhooked before giving signal to hoist/unhoist
- Give warning to stevedores working in hatch/on truck to vacate away from hoisting or lowering until it is completely out of the hatch or lowered properly on truck/in hatch
- Endeavor to protect the safety of all persons working in the immediate vicinity

	
Instructions for Hatch Foremen	Instructions for Stevedores

Instructions for Crane Operators

Instructions for Signalmen

Source: MITT

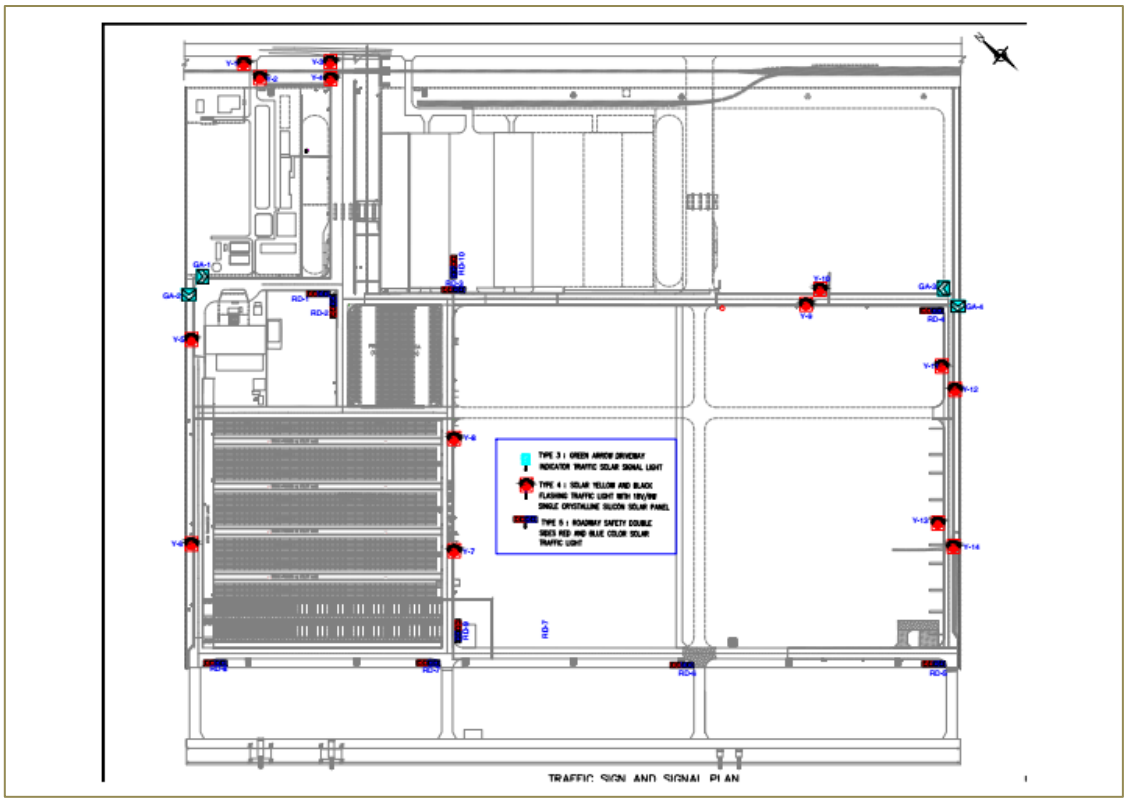
Figure 5.5-9 Photos of Posted Safety Instructions for Port Workers

Provision of Traffic Control

Managing traffic in workplace is an important part of ensuring the workplace is without risks to the health and safety of its employees. Vehicles including powered machineries move in and around a workplace, reversing, loading and unloading and they are often linked with death and injuries to workers and members of the public.

The following should be ensured:

- Safe movement of vehicles in the workplace
- Traffic movement and management plan
- Workplace speed limits
- Designated walkways



Source: MITT

Figure 5.5-10 Traffic Control Plan (Traffic Sign & Signal)

This symbol indicates the locations of Green Arrow Driveway Indicator and is powered by a solar signal lamp.

This symbol indicates the locations of Yellow and Black Flashing Lights with 18V/9W Single Crystalline Silicon Power Panel.

 This symbol indicates the locations of Roadway Safety Double Sided Red & Blue Color solar traffic lights.

No overtaking signage

Stop & Give-way sign

Speed limit sign

Roadway Safety Traffic Light

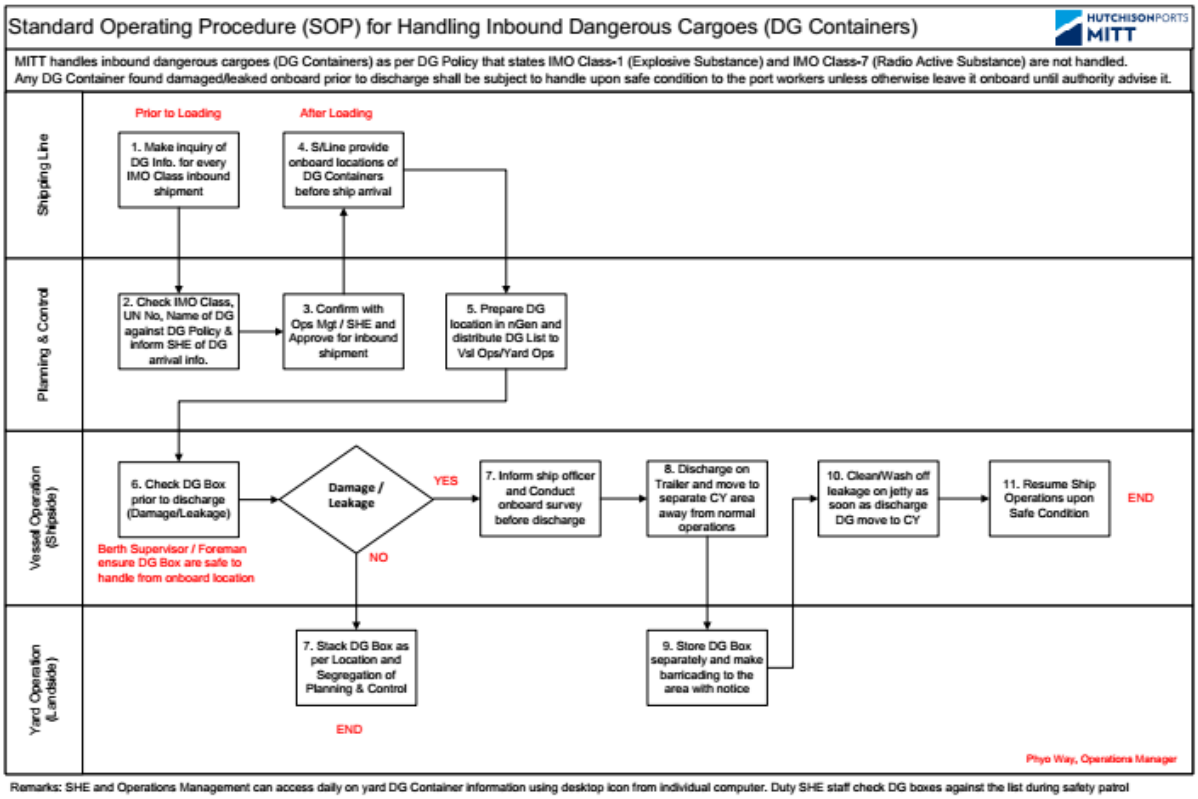
Yellow & Black Flashing Light

Source: EMP Study Team

Figure 5.5-11 Photos of Traffic Control

Provision of Dangerous Cargo Handling

The project is implementing a standard operating procedure (SOP) for the handling of dangerous cargo for both incoming and outgoing cargo. The SOP for incoming cargo handling is shown in below Figure.



Source: MITT

Figure 5.5-12 Standard Operating Procedure for Handling Dangerous Cargo (Inbound)

		
PPE for dangerous cargo handling	Area designated for dangerous cargo	Firefighting facilities at DG cargo yard

Source: EMP Study Team

Figure 5.5-13 Photos of Provision for Handling Dangerous Cargo

Provision of Measures for Other Items

Measures to prevent drowning

The project is implementing many measures to prevent accidental fall into water body and subsequent drowning hazard and some of the measures are:

- Provision of railing to prevent fall into waterbody
- Provision of life buoy for rescue operation

Measures to prevent machine accidents

Many measures are being implemented to prevent accidents such as traffic collision, struck by lifting loads, stuck in machine (entanglement with moving part), etc. and some of the measures being implemented by the Project was observed as below:

- Provision of warning signs to prevent accidents during lifting of heavy loads and items
- Emergency stop switched to stop machine in case of emergencies
- Warning signs to prevent entanglement hazards

Measures to prevent slips, trips and falls

Some of the measures being implemented by the Project was observed and they are:

- Railings are provided to prevent falls from high rise cranes
- Safety cones are provided around openings to prevent falls
- Handrails and step ladders are provided for safe access to and from RTGs, quay cranes, etc.

Other measures to enhance safety in port operations

- Information on PPE is posted at strategic points in the port area
- Signs are also translated into Myanmar for local workers to understand
- First aid station is provided

Measures to prevent drowning		
		
Railings to prevent falling into water	Life Buoy location information	Life buoy & railings
Measures to prevent machine accidents		
		
Warning sign for lifting operation at QC	Emergency stop switch	Machine entanglement warning

Measures to prevent slips, trips and falls		
		
Railings to prevent falls on Quay crane	Safety cones around opening	Handrails provided
Miscellaneous		
		
Information of PPE wearing	Safety sign in Myanmar language	First aid station at berth office

Source: MITT

Figure 5.5-14 Photos of Mitigation Measures for OHS by Project Proponent in the Port Terminal

Safety Risks Assessments

The Project has conducted Safety Risk Assessments to identify and analyze potential impacts that may negatively affect individuals, assets, and the environment. A sample of the risk assessment is attached in Appendix.

3) Evaluation

The Project is taking appropriate measures as mentioned above to mitigate the risks and injuries to employees of MITT and is summarized below:

- Control of vehicle movement
- Provision of adequate PPE
- Provision of trainings
- Warning signages
- Provision of sanitary facilities

The above mitigation measures will ensure that the risks, hazards of OHS in Port Terminal activities are adequately controlled and mitigated and therefore impact on OHS will not be significant.

5.5.2 Community Health & Safety

1) Impacts

The operation activities of a port terminal such as air, water and noise may impact on the surrounding environment and community. Public safety is also of concern as there may be occurrences of accidents due to movement of vehicle traffic of the port terminal. Public security may be impacted due to the influx of labor which may result in petty crime, nuisance such as indiscriminate throwing of rubbish, etc. to the general public. Similarly, the general public may enter the premises of the port and endanger themselves and others due to the dangerous conditions of the port. Un-authorized persons may enter the port area and come into contact with dangerous machinery, equipment, materials, etc.

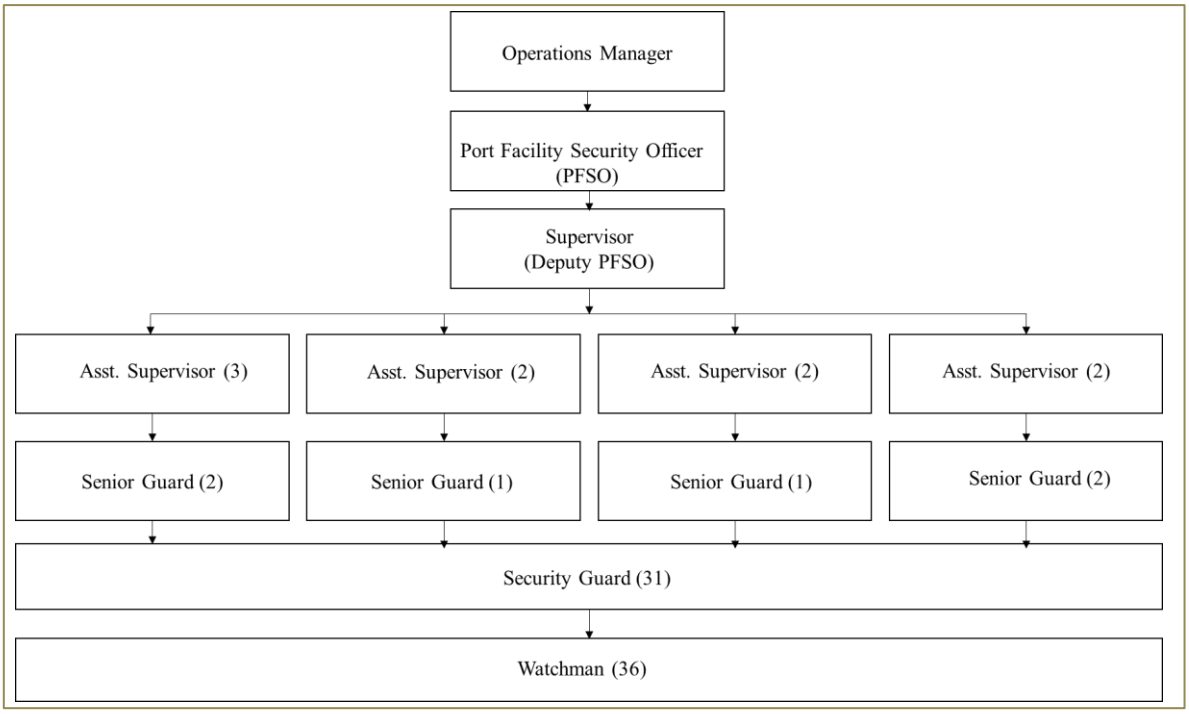
2) Mitigation Measures

Mitigation for Traffic Accidents

- Implement best transport practices to prevent traffic accidents
- Emphasize safe driving aspects among drivers (e.g. to follow traffic rules & regulations, avoid dangerous routes, to consider rush-hour traffic, be aware of school areas and school hours, etc.)
- Training, certification of vehicle drivers & machine operators
- Regular inspection, servicing & maintenance of vehicles, cranes, machineries, etc.
- Safe loading and unloading of goods, securing loads, ensure vehicles are road-worthy, etc.
- Providing commute buses to prevent traffic

Mitigation for Public Safety & Security

- Provision of security gate and system (see Figures below) to prevent un-authorized entry
- Provision of CCTV system (see below Figure)
- Provide adequate vehicle parking for employees, visitors, vendors
- Provide safety information of the port
- Provide necessary PPE and escort for visitors



Source: MITT

Figure 5.5-15 Security Organization Chart of the Project Proponent

Card Issue	Gate - In	Gate - Out
- Entry Form issued by Doc Section - Temporary Retain Port User ID - Issue Security Pass (Bar Code) - Input information into System 1. SPP (Security Pass Permanent) 2. SPT 1 (Cargo Truck Driver) 3. SPT 2 (Yard Pass) 4. SPT 3 (Jetty Pass) 5. SPT 4 (Boarding Pass) 6. SPV (Security Pass Visitor)	- Physical Security Check - Walk-Through Detector Check - Facial Photo Taken into System - Bar Code access through System	- Return Port User ID - Retain Security Pass - Bar Code access through System - Facial Photo Check through System

Source: MITT

Figure 5.5-16 Gate Access Control System

Source: MITT

Figure 5.5-17 CCTV System of the Project

Mitigation for Public Nuisance

- Enclosure of noisy machinery & equipment (e.g. pumps, compressors, etc.) inside buildings to prevent noise pollution to surrounding environment and community
- Provision of water treatment system to prevent water pollution to surrounding environment and community.

		
Unauthorized access prevention	Traffic lights	Boundary fencing
		
Fencingg for Fuel storage area	Commute buses for staff	Waste bins provided
		
Port Security guards	Security fencing	Noisy machineries kept in building
		
Setting speed limit	Regular safety meeting	Certification of operators

Source: MITT

Figure 5.5-18 Photos of Mitigation Measures for CHS by Project Proponent in the Port Terminal

3) Evaluation

The project is implementing many measures to prevent safety hazards to the nearby community such as security system (security gate, guards, pass system, CCTV monitoring, etc.), is following local traffic rules and regulations to prevent traffic accidents (driver training, providing commute means for employees, etc.), is implementing measures to prevent public nuisance for noise, water, waste, etc.

The above-mentioned measures will ensure that CHS impacts are well controlled and mitigated and therefore, the impact will not be significant.

5.6 Emergency Risk Assessment

Catastrophic and disastrous events brings huge impacts to human beings and the environment. Therefore, it is necessary to evaluate emergency risk assessment for any project as there are various risks in operation as in any other large-scale infrastructure and factory operation. The following main emergency risks are taken into consideration as emergency risk assessment.

5.6.1 Fire

1) Impacts

The risk of fire, which can be impacted on the port by its operations may increase the vulnerability of the port from fire hazards. If proper and adequate measures to prevent the disaster are not implemented, it could lead to loss of human lives, widespread damage and destruction of port property, infrastructure and facilities and could mean the ceasing of port operations.

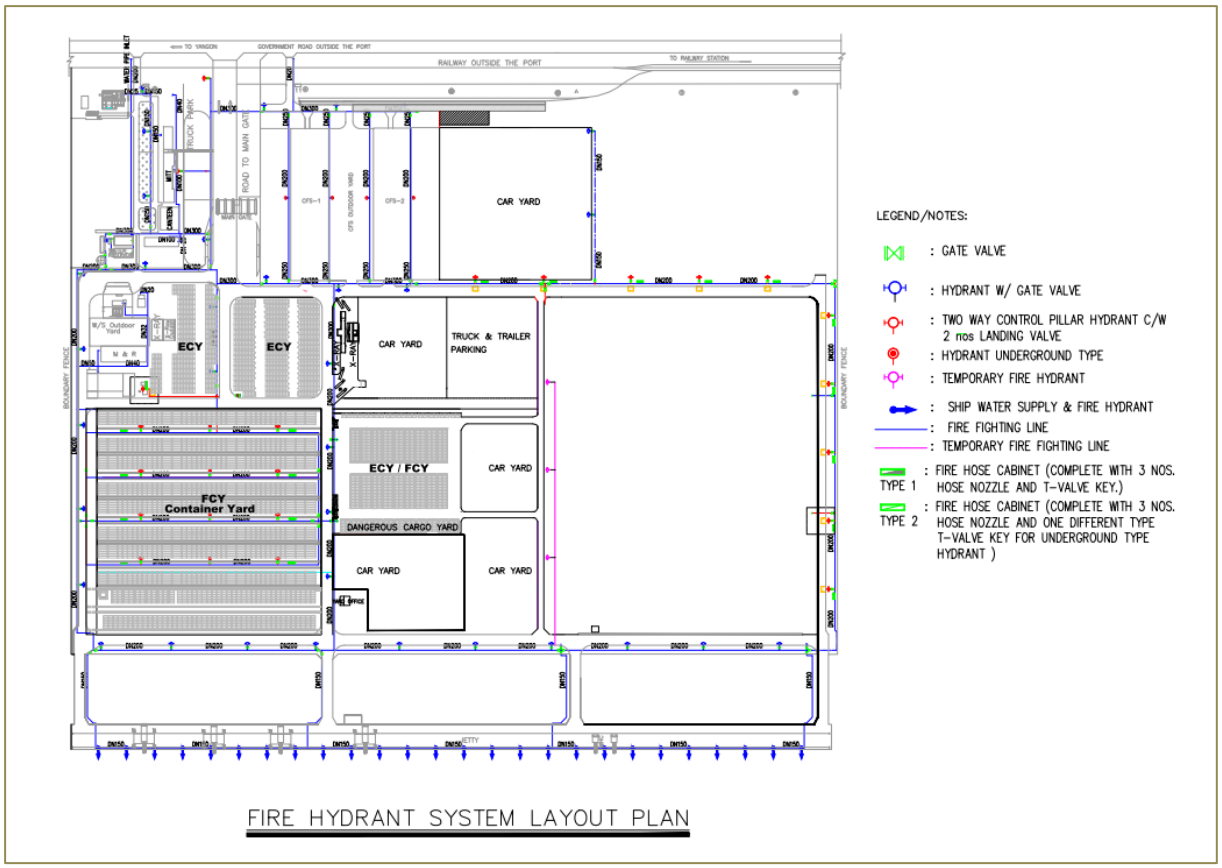
The sources of fire can be from the following:

- Behavior of workers (e.g. smoking, cooking, etc.)
- The storage of hazardous materials (e.g. diesel/petrol, chemical, etc.)
- Insufficient protection for combustible materials storage area
- Build-up of waste (e.g. paper, cardboard, etc.)
- Poorly maintained or defective electrical systems
- Non-provision of fire-fighting facilities (e.g. fire extinguishers, fire alarms, water supply, etc.)

2) Mitigation Measures

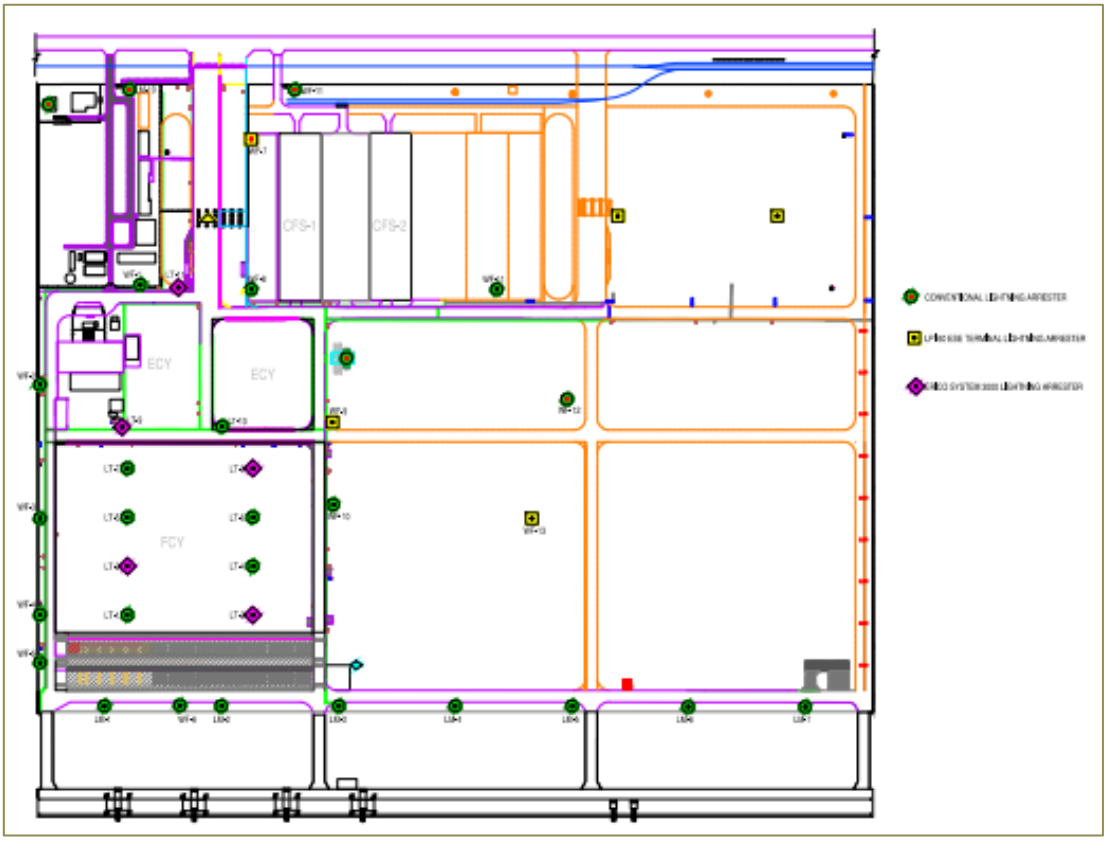
Some of the mitigation measures to consider for the prevention of fire is mentioned below:

- Provision of fire-fighting facilities (e.g. emergency exits, fire extinguishers, fire alarms, dedicated water tank & supply system for fire-fighting, assembly points, etc.)
- Regular fire-drills, exercises, training for port staff & employees (e.g. demonstration on use of fire-extinguisher, etc.)
- Lightning strike prevent (Lightning Arrestor Plan)
- Emergency preparedness & response plans



Source: MITT

Figure 5.6-1 Fire Hydrant System Layout Plan



Source: MITT

Figure 5.6-2 Lightning Arrestor Layout Plan

Emergency Response Plan of the Project Proponent

In the case of emergency situation, the port is implementing an Emergency Response Plan and the plan is summarized below and the action plan is attached in Appendix.

Action Plan #1
Safeguarding of Access Points

During any emergency, all roadside access points to be safeguarded by security and checking of manpower to facilitate the evacuation process. Some points may be closed temporarily (if necessary) to prevent unauthorized access and looting.

Action Plan #2
Shuffling Security Staff

The shuffling of security staff, mustering public to respective assembly points, making announcements, will be handled by the responsible PFSO/Security Supervisor.

There are altogether 4 Assembly points as below:

- Point No. 1 (in front of MITT Main Office Building) for office staff, canteen staff, port users, visitors, etc.
- Point No. 2 (in front of MITT CFS Office) for CFS staff, CFS canteen staff, customs officers, port users, visitors, etc.
- Point No. 3 (in front of MITT Berth Office on Jetty) for berth staff, stevedores, shipping lines staff, port users, truckers, etc.
- Point No. 4 (in front of MITT Yard Office) for operators, checkers, shipping lines staff, port users, truckers, etc.

Action Plan #3
Communication

The emergency is to be communized with external security authorities such as Thanlyin & Kyauktan townships GAD offices, Police Stations & Fire Brigades.

Additionally the emergency occurrence must also be relayed immediately to the Myanmar Port Authority (MPA) and Department of Marine Administration (DMA) respectively.

The detailed telephone emergency numbers will be available in the PFSO room & CCTV rooms.

The emergency equipment & resources are as below mentioned.

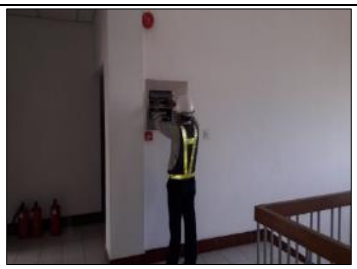
- Siren (to alert staff and public)
- Radios & walkie-talkies (to communicate among ERT members & offices, etc.)
- Fire extinguishers, fire hoses & pipes (for fire-fighting if required)
- Terminal pick-up trucks (for movement of ERT, resources, equipment)
- MITT ferry buses and cars (to assist in evacuation of personnel)
- Low-bed trailer (for massive movement of resources, personnel)
- Megaphones (for public announcements)

Source: MITT

Figure 5.6-3 Assembly Points and Evacuation Routes

Fire-fighting Drills

Drills are regularly conducted by the Project and involve all related personnel. Photos of fire drills conducted by the Project Proponent is shown in below Figure.

Fire-fighting drill in office 28/04/2019		
		
Sounding of fire-alarm	Fire extinguisher demonstration	Roll call at assembly point
Fire-fighting drill in Container Yard 29/03/2019		
		
Quick evacaution	Fire fighting demonstration	Roll call at assembly point

Source: MITT

Figure 5.6-4 Fire Fighting Drills

Fire Stations

In the project area, there are 2 fire brigades stationed in Aung Chantha in Thanlyin Township and in Kyauktan in Kyauktan Township. The estimated distance and trip duration between the project area and the 2 fire stations are described in below Table and locations are shown in below Figure.

Table 5.6-1Fire Stations in Thanlyin and Kyauktan Townships

From	To	Distance	Trip Duration (minutes)
Aung Chantha Fire Brigade	MITT	Approx. 14.2km	around 15-20 minutes

From	To	Distance	Trip Duration (minutes)
Kyauktan Fire Station	MITT	Approx. 13km	

Source: EMP Study Team

Source: Google Earth (Prepared by EMP Study Team)

Figure 5.6-5 Location of Fire Stations near the Project

3) Evaluation

In conclusion, the following points are evaluated to be adequate for controlling fire hazards.

- Provision of adequate fire-fighting facilities (fire extinguishers, fire hose, dedicated water tank, etc.) situated adequately in strategic points in the Project area
- Designated areas for storage of chemicals or hazardous materials, waste (rubbish), etc.
- Drills, trainings, exercises and Emergency Plan

The above measures will ensure that:

- Any occurrence of fire will be well controlled and impact will be minimal
- Damages to buildings, structures and facilities in the port will be minimal
- The possibilities of casualties and injuries to staff will be minimal as the project is well prepared to respond to any emergencies.

5.6.2 Flood

1) Impacts

Flood risk triggered by heavy rain, cyclone, high tide water or tsunami which might increase flood vulnerability with the operation of port. If proper and adequate measures to prevent and minimize the disaster is not implemented, it would lead to loss of human lives and destruction of property, facilities and impact greatly on the operation of the port.

The occurrences of heavy rain, uncommon weather, etc. may cause flooding to nearby canals, moats, rivers, waterways, etc. and thereby to the premises of the port area. The lack of main drainage system in and around the port area will increase the time for flooding to recede.

The history of flood occurrence are as follows:

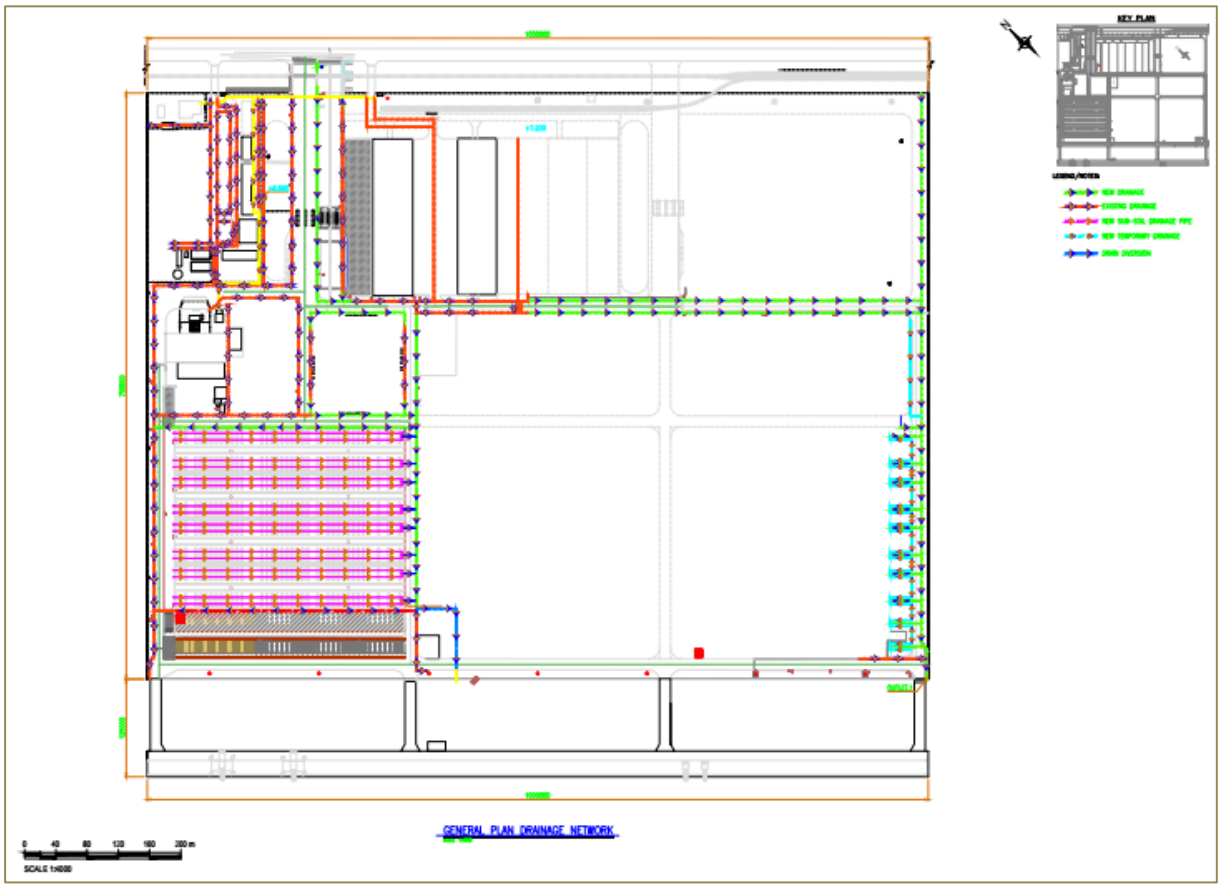
- Hearing survey of flood disaster (MSL +5.5m)
- 100 years flood analysis of return rainfall (MSL +4.9m)
- Storm surge simulation in Yangon River during Cyclone Nargis (MSL +6.5m)

The flooding will contaminate drinking water, cause health condition to deteriorate due to outbreak of waterborne diseases. Electrical systems, appliances, gas systems will be affected raising the possibility of electrocution and explosion. Ceilings and structures will be weakened and may collapse.

2) Mitigation Measures

The following mitigation measures can be implemented to lessen the impact of flooding during a disaster impact.

- Provision of drainage system with adequate capacity for rainwater
- Consideration of history and accepted flood level risks of the project area
- Construction and design of port taking into consideration the above
- Conduct regular flood drills, exercises, training for port personnel
- Provision of emergency exits, alarm systems, safe routes, assembly points
- Emergency plan (including rescue and rehabilitation)



Source: MITT

Figure 5.6-6 Drainage Layout Plan of the Project

Flood Preparedness Checklist

MITT has prepared a guide to prepare for a flood emergency, keep staff and important documents safe. Some of the guides are mentioned below and the full details will be attached in Appendix.

Guide #1 Watch for Flood Emergency Alerts
A flash flood warning will be issued by the authorities concerned and MITT Safety Committee (and/or) SHE officer shall communicate such information to all.

Guide #2 Purchase an Emergency Weather Radio
The flooding event may disrupt normal communication channels, knock out power supply, therefore, an emergency weather radio (portable size powered by AA batteries) would be helpful in such case. It can be active for up-to-date flood news. Handy torch lights are also essential for ready se when necessary.

Guide #3 Secure Important Documents in Emergency Bag
Every department will make available Emergency Bags and each individual department will organize their vital important papers in a fireproof lockbox or any other means to survive severe weather conditions and keep them safe from destruction. Important documents will be proactively digitized and uploaded to a cloud-based storage at secure off-site location.

Guide #4 Vital Supplies for Emergency Flood Kits
Emergency go-to kits will be provided filled with medicines, asthma inhalers, non-perishable foods such as biscuits & cookies, a multi-purpose knife, flashlight with extra batteries, bottled water, first aid kit, etc.

Guide #5 Use Landscaping to Improve Drainage
Design techniques such as effective drainage implementation will offer adequate protection against flooding whenever possible. The MITT Engineering Department will ensure that drainage systems are properly maintained causing slope away to river side in all directions.

Guide #6 Evacuation Route
MITT has implemented an effective evacuation route for the staff and personnel once a flood warning alert has been issued by the authorities.

Guide #7 Communication Network with Local Authorities
A communication network is established with local authorities for better assistance during any flood or other emergency.

Quay Crane Tie-Down Systems

Sever wind loads have caused the collapse of many cranes due to initial failure in the wharf hardware. The Project has prepared a Quay Crane Tie-Down System to mitigate and control the failures or collapse of cranes during high intensity wind speed occurrence. The system is described in detail in the document which is attached in Appendix. Drills are often conducted as preparedness and the summary of the steps of the drill taken for the event is described below:

- Drill explanation by the SHE Officer
- Tie-down step explanation by Berth Supervisor
- Drill announcement
- Collection of lashing materials
- Moving QC to lashing place
- Lashing and tie-down QC
- Inspection conducted by Berth Supervisor
- Review and Discussion

Storm Protection Plan

Due to previous disastrous experience of Cyclone Nargis with wind speeds of 120 miles per hour which highlighted the threat of storms during rainy seasons, MITT has prepared a plan for protection from storms. Furthermore, all MITT's civil structures were designed and constructed based on historical data

of maximum wind speed of 33 m/s. The full details of the Storm Protection Plan is attached in Appendix and some measures for protection, evacuation and resettlement are summarily mentioned below.

Before Storm
- Getting Storm Warning in Advance
- Confirmation of Warning and Taking Action
- Evacuation
- Protection
- Operation
- Security Arrangement

During Storm
- Duty and Responsibilities of Duty Officers
- Electric Power

After Storm
- Inspection
- Reporting
- Remedy

3) Evaluation

In conclusion, the following points are evaluated to be adequate for controlling flood hazards.
- Elevation level of the Project area is 7.5m on quay deck & 8m on landside CY storage yard & warehouses able to withstand flooding history
- Quay crane collapse prevention (tie-down systems and designed to withstand 33 m/s wind force)
- Drainage system of the port area
- Drills, trainings, exercises and Emergency Plan

The above measures will ensure that:
- Any occurrence of flooding will be well controlled and impact will be minimal
- Damages to buildings, structures and facilities in the port will be minimal
- The possibilities of casualties and injuries to staff will be minimal as the project is well prepared to respond to any emergencies.

5.6.3 Earthquake

1) Impacts

Earthquakes in Myanmar

Myanmar is a geologically active country, 6 earthquakes of magnitude 7 or more since 1930 and other smaller quakes occurring regularly in many parts of the country. Most are caused by the Indian tectonic plate diving beneath the country and the rest mainly from the Sagaing Fault and puts more than 17 million people at risk throughout the country.

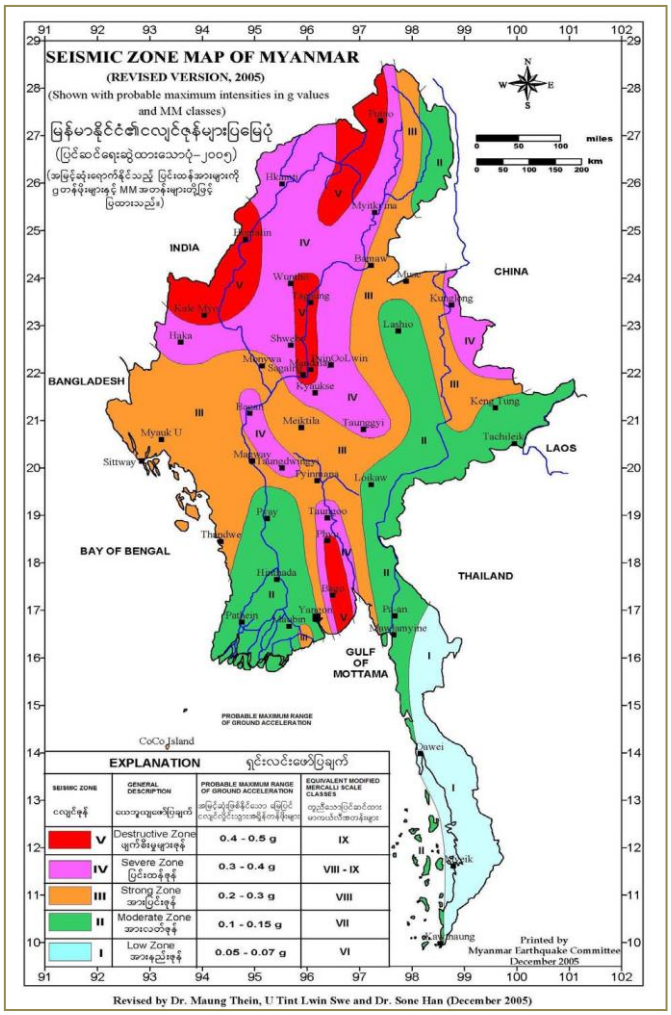
Table 5.6-2History of High Magnitude Earthquakes in Myanmar

No.	Date	Location	Epicenter	Magnitude	Damage	Casualties
1	02-04-1762	Arakan	Coast of Chittagong	8.8 with Tsunami		200
2	04-12-1930	Pyu (Nyaunglebin & Taungoo)	North of Bago	7.3	Buildings, local railway, freight cars & locomotive	36
3	28-01-1931	Myikyina	Northern Myanmar	7.6		
4	16-07-1956	Sagaing	Central Myanmar	7.1	Damage to Mingun pagoda	38
5	08-07-1975	Bagan	Central Myanmar	7.0	94 major Stupas & temples extensively damaged	2

6	24-03-2011	Shan State Region bordering Thailand	Eastern Myanmar	6.9	Roads & houses damaged by landslides	151
7	11-11-2012	Shwebo	Male town, 52 km NNE from Shwebo	6.8	Bridge collapse into river, mine collapse	26
8	24-08-2016	Chauk	25 km west of Chauk	6.8	Several temples damaged in Bagan	4

Source: www.earthquaketrack.com

Moreover, as shown in below Figure, Myanmar is divided into 5 zones related to potential earthquake intensity.



Source: Myanmar Earthquake Committee

Figure 5.6-7 Seismic Zone Map of Myanmar

The seismic areas are highlighted as Red as Destructive Zone, the Pink as Severe Zone, the Orange as Strong Zone, the Green as Moderate and Blue as Low Zone.

Earthquakes in the Yangon Region

The 1200 km long Sagaing Fault is running from north to south in the central area of Myanmar. M-7 class earthquakes have been occurring around the fault since 1990s. Major cities such as Yangon, Nay Pyi Taw and Mandalay are adjacent to the fault and have a high probability and risk of earthquakes.

During the last 10 years, a total of 48 earthquakes have occurred in Myanmar and some of them struck near the Yangon Region. The earthquakes are described in the following Table with detailed information and illustrated in Figure below.

Table 5.6-3 List of Occurrences of Earthquakes near the Yangon Region

No.	Date	Place	Magnitude	Epicenter	Depth
1	Thursday, August 16, 2018	Thongwa, Yangon, Myanmar	4.3	73km S of Thongwa	10.0 km
2	Thursday, August 16, 2018	Thanlyin, Yangon, Myanmar	4.3	39km SSE of Yangon	68.1 km
3	Wednesday, April 18, 2018	Twante, Yangon, Myanmar	4.2	12km WNW of Twante	10.0 km
4	Sunday, February 4, 2018	Thongwa, Yangon, Myanmar	4.1	60km S of Thongwa	10.0 km
5	Saturday, January 13, 2018	Twante, Yangon, Myanmar	3.5	14km SSW of Twante	10.0 km
6	Wednesday, January 30, 2013	Yangon, Yangon, Myanmar	3.4	Near the South Coast of Myanmar	10.0 km
7	Tuesday, October 20, 2009	Twante, Yangon, Myanmar	4.2	Near the South Coast of Myanmar	10.0 km
8	Monday, November 29, 2004	Kayan, Yangon, Myanmar	4.3	Near the South Coast of Myanmar	85.0 km
9	Thursday, October 28, 1999	Kanbe, Yangon, Myanmar	4.6	Near the South Coast of Myanmar	97.6 km
10	Monday, November 30, 1998	Yangon, Yangon, Myanmar	4.5	Yangon, Myanmar	10.0 km
11	Sunday, March 17, 1996	Kanbe, Yangon, Myanmar	4.1	Near the South Coast of Myanmar	22.7 km
12	Thursday, December 26, 1991	Thongwa, Yangon, Myanmar	3.6	Near the South Coast of Myanmar	33.0 km

Source: www.earthquaketrack.com

Source: www.earthquaketrack.com

Figure 5.6-8 Illustration of Occurrences of Earthquakes near Yangon Region

2) Mitigation Measures

Preparation for an Earthquake

From the above recorded history of earthquakes in Myanmar and in Yangon, it is inferred that an earthquake of high magnitude is occurring with regularity throughout Myanmar. On average, there are less than 15 earthquakes of 7 to 7.4 magnitude per year, however most of them occurred in sparsely populated regions, therefore major causalities and injuries were relatively rare. The Bago Earthquake in 1930 was the highest magnitude recorded to occur near a major populated area. An earthquake of such intensity takes a long time to develop. Based on an expert's calculations and opinions, the chances of

another 7 or higher magnitude happening near Yangon is about 1% in any given year and estimates a recurrence period between 200 or 300 years for that particular part of the Sagaing Fault.

However, preparations must be made to be well-equipped for the event when and should it occurs, as it can happen with appalling suddenness.

Considerations in the design and construction of an earthquake resistant structures & facilities

A building, structure, or facility is more likely to perform better in an earthquake when its structural system is properly designed to resist lateral loads and detailed to absorb energy.

Fire protection systems

Fires following earthquakes can result in loss of life and damage to buildings, structures and facilities which impact may be higher than from the earthquake itself. Possible causes include broken gas & power lines, spilling and ignition of flammable liquids and chemical hazards, damaged equipment or appliances becoming electrically charges, etc.

Collapse of Structure and Cranes

In the event of high magnitude earthquake, the collapse of high structures and cranes may occur and could result in deaths, injuries and damages.

3) Evaluation

In conclusion, the following points are evaluated to be adequate for controlling earthquake hazards.

- Good design and construction (piling, foundation, etc.) using of good building materials and implementing good construction methods, most buildings and structures are adequate to resist seismic impacts.
- Other safety considerations of facilities (e.g. firefighting facilities and plans)
- Drills, trainings, exercises and Emergency Plan

The above measures will ensure that:

- Any occurrence of earthquake will be well controlled and impact will be minimal
- Damages to buildings, structures and facilities in the port will be minimal
- The possibilities of casualties and injuries to staff will be minimal as the project is well prepared to respond to any emergencies.

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